TRANSIT DESIGN MANUAL

Prepared for the

El Dorado County Transit Authority

Prepared by

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El Dorado County Transit Authority Transit Design Manual

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November 9, 2007
LSC #077100

The preparation of this report has been financed with Federal Transit Administration (FTA) 5313 (b) and Transportation Development Act (TDA) funds as claimed by the El Dorado County Transit Authority (EDCTA) for fiscal year 2006/2007.

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Section 1 • Introduction

The El Dorado County Transportation Authority (EDCTA) fulfills several important roles in western El Dorado County, focusing on the following:

- Providing local public transit services along the US 50 corridor stretching from El Dorado Hills through Placerville to Pollock Pines.

- Providing commuter services from El Dorado County to Sacramento that helps address congestion and air pollution issues.

- Providing dial-a-ride services that benefit the quality of life of El Dorado County seniors and persons with disabilities.

These services are provided in an area experiencing significant urban development, which in turn will result in many new developments and roadway improvements affecting the transit service. A key element in the EDCTA's ability to effectively fill these roles is the provision of transit facilities that enhance passenger's transit experience, ensure access by persons with disabilities, allow for effective transit operations, provide a safe environment for passengers, transit operators, and the public. Effective transit facilities are an important element in the region's efforts to provide a quality multimodal transportation system.

The purpose of this handbook is to provide the EDCTA with transit improvement standards appropriate to the specific conditions of the transit organization and its area. The focus of this handbook is the specific standards for bus stop improvements and roadways along transit routes. These standards are intended to guide government agencies, commercial and residential developers, employers, and others in their efforts to provide useful, attractive, and safe transit facilities for the region's transit patrons. The handbook is not intended to supersede the authority of the local jurisdictions, but rather to offer criteria, complementary to existing standards, for the design of a more pedestrian-oriented, bike-oriented, and transit-friendly environment. It is important for individual jurisdictions and business leaders to consider how best to incorporate land uses and road networks that support public transportation, while providing transportation infrastructure that supports overall community goals.

The transit improvement standards included in the handbook are organized by section for quick reference. Sections include:

– Vehicle characteristics,
– Site design and pedestrian accessway,
– Bus stop placement,
– Bus stop spacing,
– Bus pullouts,
– Passenger amenities,
– Park-and-ride/multi-modal facilities, and
– Vehicle turning radii.

In addition, this handbook includes a glossary of terms used in the standards, as well as a checklist that transit staff or others can use to review development and roadway improvement proposals. The handbook concludes with a list of resources used in the preparation of the handbook and other references for further information on transit improvement standards.

Section 2 • Vehicle Characteristics

The types of vehicles used for transit are the cornerstone to designing facilities to support transit. This section is a compilation of critical specifications of the transit vehicles currently in operation, as well as those planned for future purchase. It is important to consider these specifications when designing roadway features and other transit improvements. For example, the size of the transit vehicle impacts the required turning radius, and the weight of the vehicle impacts pavement design. This section provides vehicle characteristics for large buses, small buses, and paratransit vans, including drawings of each.

COMMUTER BUS

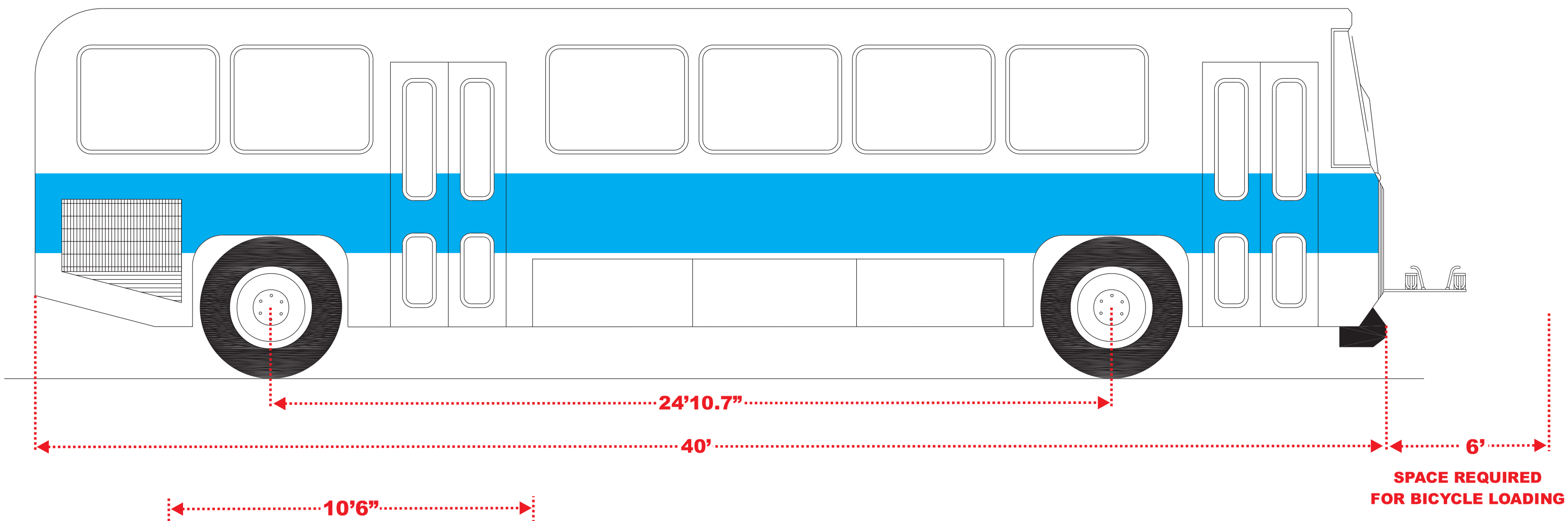
Specifications of the largest vehicles (40-foot coaches) in the current or planned EDCTA fleet are shown in Table 1. A drawing of a typical 40-foot coach is provided in Figure 1. Larger single-unit or articulated buses are not currently used, nor is the use of such vehicles planned for the future.

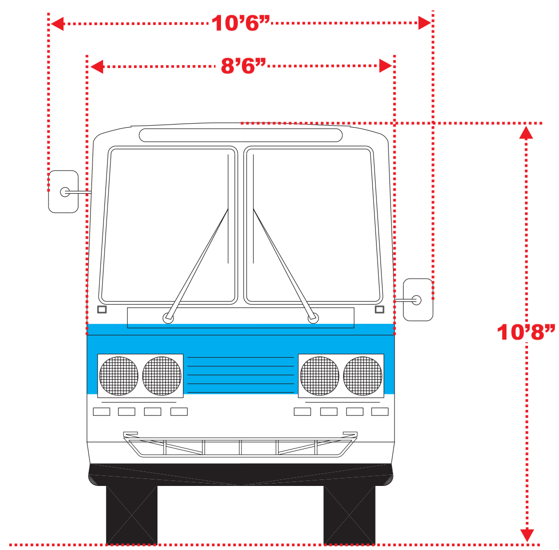
TABLE 1: Specifications for a Commuter Service Bus

Line Item	Specification
Vehicle Length (Maximum)[1]	40 feet
Vehicle Height (Maximum)	10 feet, 8 inches
Wheel Base	24 feet, 11 inches
Vehicle Width	
Without Mirrors	8 feet, 6 inches
With Mirrors	10 feet, 6 inches
Vehicle Curb Weight	
Gross Vehicle Weight Rating	36,200 lbs
Front Gross Axle Weight Rating	13,200 lbs
Rear Gross Axle Weight Rating	23,000 lbs
Turning Radius	
Front Outer Tire	40.9 feet
Front Body Corner	45.75 feet
Maximum Break Over Angle	11.6 degrees
Note 1: Excludes front bicycle rack.	

FIGURE 1

DRAWING AND SPECIFICATIONS OF COMMUTER BUS





<u>GROSS VEHICLE CURB WEIGHT</u>

GROSS VEHICLE WEIGHT RATING = 36,200 LBS

FRONT GROSS AXLE WEIGHT RATING = 13,200 LBS

REAR GROSS AXLE WEIGHT RATING = 23,000 LBS

<u>TURNING RADIUS</u>

FRONT OUTER TIRE = 40.9 FEET

FRONT BODY CORNER = 45.75 FEET

MAXIMUM BREAKOVER ANGLE = 11.6 DEGREES

EL40COMMUTERSPECS

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SMALL BUS

Specifications of a typical small bus (32-foot coach) are listed in Table 2. Figure 2 presents a drawing of a typical small bus. Vehicles of this size (or smaller) are used on the local bus routes serving Placerville, Diamond Springs, El Dorado, Cameron Park, Shingle Springs, Pollock Pines, and Camino.

TABLE 2: Specifications for a Local Service Bus

Line Item	Specification
Vehicle Length (Maximum)[1]	29 feet
Vehicle Height (Maximum)	10 feet, 1 inch
Wheel Base	17 feet, 9 inches
Vehicle Width	8 feet, 3.5 inches
Vehicle Curb Weight	
Gross Vehicle Weight Rating	23,500 lbs
Rear Gross Axle Weight Rating	15,000 lbs
Turning Radius (Front Outer Tire)	31 feet

Note 1: Excludes front bicycle rack.

It should be noted that EDCTA's local routes (with the exception of the Placerville Express Route) operate as "route deviation" service, whereby buses will deviate up to three-quarters of a mile from the designated route to serve individual ride requests by persons with disabilities. The specifications identified in Table 2 (and elsewhere in the handbook) should be considered in the design of facilities within this three-quarter-mile service area that have the potential to generate deviation requests, regardless of whether they are located on the route or not.

PARATRANSIT VAN

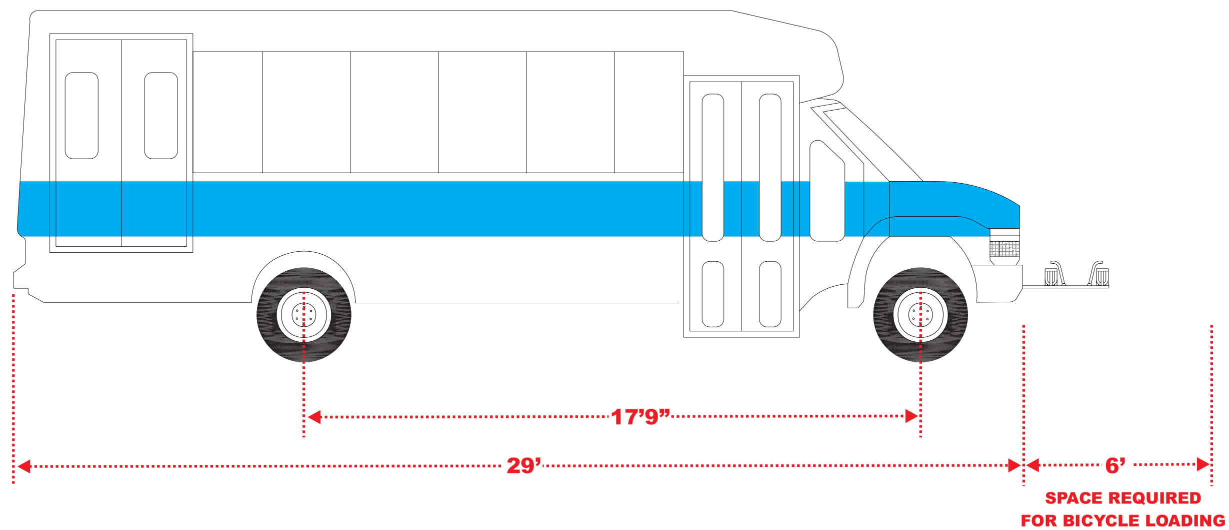
The specifications of a typical paratransit van are shown in Table 3, and a drawing of a typical paratransit van is presented if Figure 3. The fleets currently include vehicles of this type, and new and replacement vehicles are planned for future purchase.

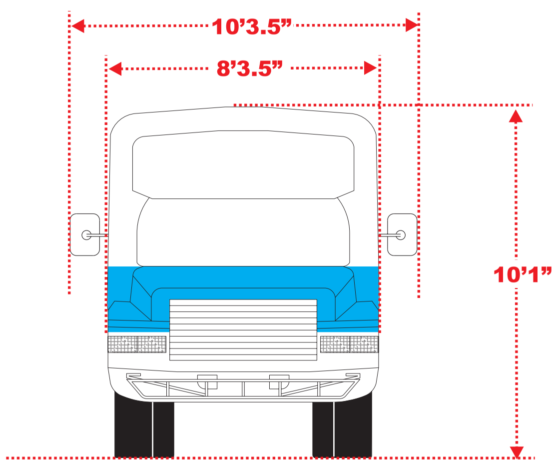
TABLE 3: Specifications for a Paratransit Van

Line Item	Specification
Vehicle Length (Maximum)	16 feet
Vehicle Height (Maximum)	5 feet, 10 inches
Wheel Base	9 feet, 5 inches
Vehicle Width	6 feet
Gross Vehicle Weight Rating	4,300 lbs

FIGURE 2

DRAWING AND SPECIFICATIONS OF LOCAL SERVICE BUS





GROSS VEHICLE CURB WEIGHT

GROSS VEHICLE WEIGHT RATING = 25,500 LBS

REAR GROSS AXLE WEIGHT RATING = 15,000 LBS

TURNING RADIUS

FRONT OUTER TIRE = 31 FEET

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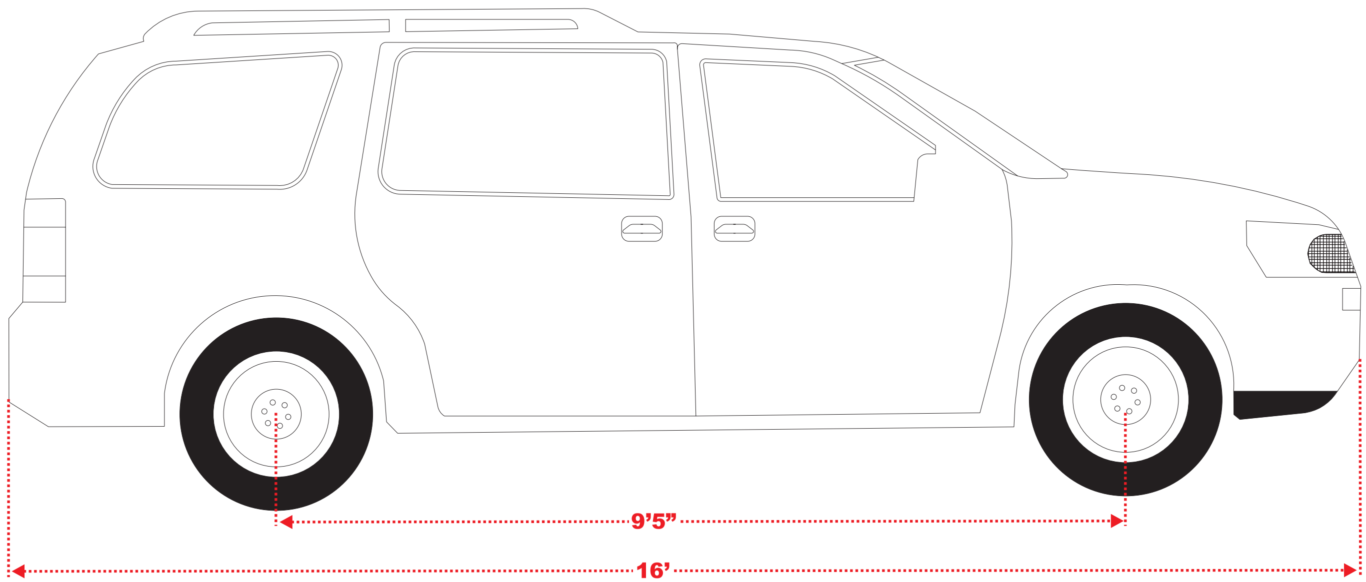
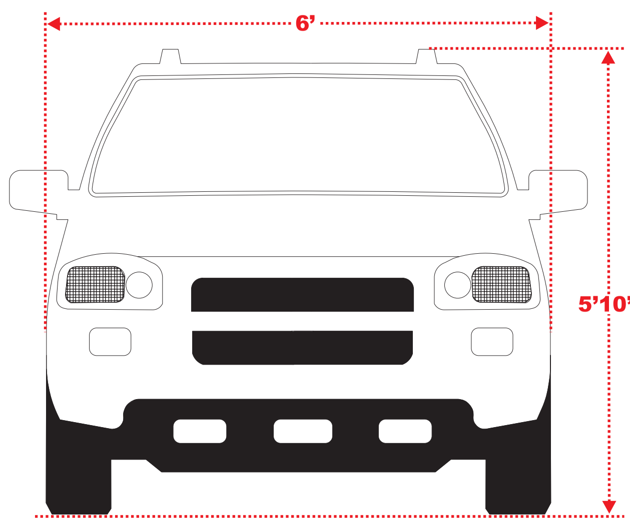
FIGURE 3

DRAWING AND SPECIFICATIONS OF PARATRANSIT VAN





GROSS VEHICLE CURB WEIGHT

GROSS VEHICLE WEIGHT RATING = 4,300 LBS

TURNING RADIUS

FRONT OUTER TIRE = 16.5 FEET

Section 3 • Site Design and Pedestrian Access

The configuration of communities, neighborhoods, and individual development sites can greatly affect transit service operations and effectiveness, both positively and negatively. For larger areas that will be served internally by transit routes, providing a street network that allows for effective through transit service is an important consideration. For all site designs (including smaller areas and individual project sites), the strategic siting of transit stops and pedestrian/bicycle facilities are vital issues that affect the transit program. While not the primary focus of this handbook, it is appropriate to review overall site design strategies that benefit transit services. The Resources and References section of this document provides some prime examples of the extensive literature on this subject.

Key site design strategies that can benefit EDCTA's operations and ridership consist of the following.

- In new developments, the site design process should strive to reduce the length and inconvenience of pedestrian accessway between destinations and transit stops. For the majority of commercial and institutional developments, it is not feasible for the transit stop to be nearer than along an adjacent arterial or collector street. A site design that places buildings near the on-street transit stop, as shown in Figure 4, can provide a pedestrian connection that is dramatically more attractive than a design that requires a long walk across a potentially hot parking lot. Given the sensitivity of potential transit passengers to walk distances, identifying the most direct access routes possible can benefit ridership.

- Developments can also be designed to provide an attractive transit passenger/pedestrian environment, through such strategies as varying building facades, incorporating weather protection such as canopies, and providing clear sight lines to enhance security. Where the most direct walking path is through a large parking lot, providing a sidewalk with landscaping through the islands can significantly improve the quality of the pedestrian environment while breaking up the monotony of the overall lot.

- Locating higher land use densities adjacent to bus stops can enhance ridership. For instance, in residential developments with a mix of single family and multifamily units, locating the multifamily elements closest to the transit stop is beneficial.

- Improve the pedestrian environment. Typical auto-oriented development (such as "big box" retailers) often results in a pedestrian path between the activity center and transit stop across an unattractive and potentially hazardous large parking lot.

In particular, site design plays a large role in providing pedestrian access to and from transit service stops. At one end if not both ends of their trip, virtually every transit passenger walks (or uses a mobility device) to complete their transit trip. In planning for transit riders and services, therefore, it is important to consider rider's entire trip from portal to portal, including the elements outside of the transit bus.

Appendix A provides a "Development Review Checklist" that can be used by EDCTA staff or others to assess a project's impact on transit services and to identify issues that merit consideration in the approval process. It is useful for transit agency staff to be involved early in

FIGURE 4

TRANSIT FRIENDLY COMMERCIAL SITE PLAN

the development approval process to ensure that consideration is given to providing access that is as direct as possible from residences and work places to bus stops.

SIDEWALKS AND CURBS

Clearly-defined sidewalk access to and from bus stops should be as direct as possible. Sidewalks should be constructed of impervious material, such as concrete. Surfaces should be non-slip, stable, firm, and well-drained. Abrupt changes in grade should be avoided, and those that cannot be eliminated should be beveled. Any drop greater than one-half inch and any surface steeper than 1:20 (5 percent) requires a ramp. To accommodate wheelchairs, sidewalks should be a minimum of 5 feet wide, and should be equipped with wheelchair ramps (curb-cuts) at all intersections. Sidewalks (except in rural areas) and bus stops should be well-lit to provide an acceptable level of safety and security. When possible, the construction or major repair of sidewalks should be coordinated with roadway improvements to minimize the inconvenience to bus patrons and other users.

It is important to examine all paths from the bus stop to major destinations to determine whether there are obstacles, such as a phone or kiosk, which may interfere with access to or from the stop. Obstacles that protrude into the access path might restrict wheelchair movements. Obstacles that are higher than 27 inches or lower than 80 inches may cause problems for a person with a vision impairment, who may not be able to detect an obstacle with a cane. A guide dog may lead a person with vision impairment off of the path in order to get around the obstacle. Even though it may not be the responsibility of the transit agency to address accessibility problems along the entire access path, the agency staff should keep in mind that an obstacle may make a path inaccessible for potential patrons who have disabilities.

WALLED RESIDENTIAL AREAS

Walled communities and circuitous sidewalks, common features of modern developments, can create barriers to bus stop access and increase the time required to walk to a bus stop. Coordination of sidewalk design and placement between developers and the transit agency is necessary to ensure that residents have direct access to a bus stop. Without such coordination, the length of pedestrian paths to a transit stop can often be increased by a quarter-mile or more. As research consistently indicates that the proportion of potential passengers willing to walk to a local bus stop drops significantly beyond a quarter-mile distance, poor coordination of bus stop location with pedestrian access pathways in walled residential areas can all but eliminate any potential for fixed-route transit use.

With careful planning, however, the provision of sidewalks and of gates in the walls of residential communities can be coordinated with developers to reduce walking time from the residential area to the nearest bus stop. Figure 5 presents examples of recommended and not recommended methods of providing bus stop access from a walled residential area.

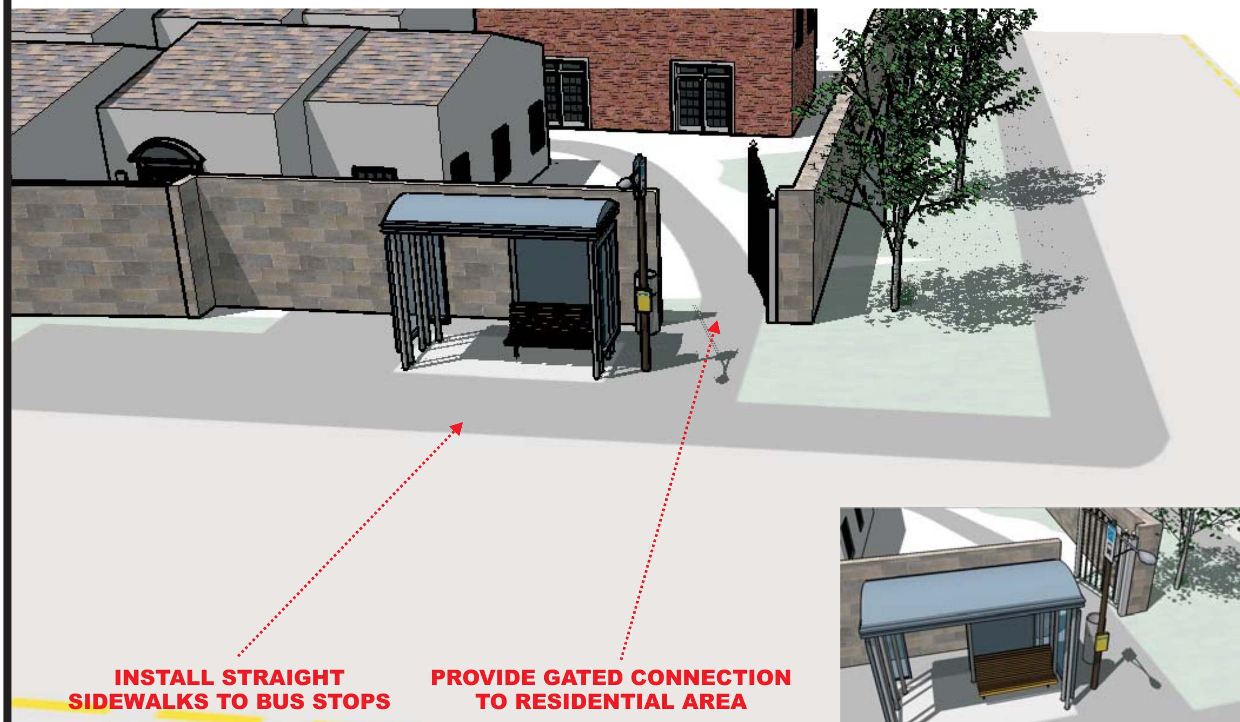
RURAL AREAS

Undeveloped rural areas typically do not have existing sidewalks. Installation of a sidewalk segment from the nearest intersection to the bus stop is recommended to provide a minimum level of patron access to the bus stop in such areas. Although the sidewalk segment may not provide access to bordering land uses, it will provide at least one access route that does not

FIGURE 5

EXAMPLES OF BUS STOP ACCESS FROM A WALLED RESIDENTIAL AREA

RECOMMENDED



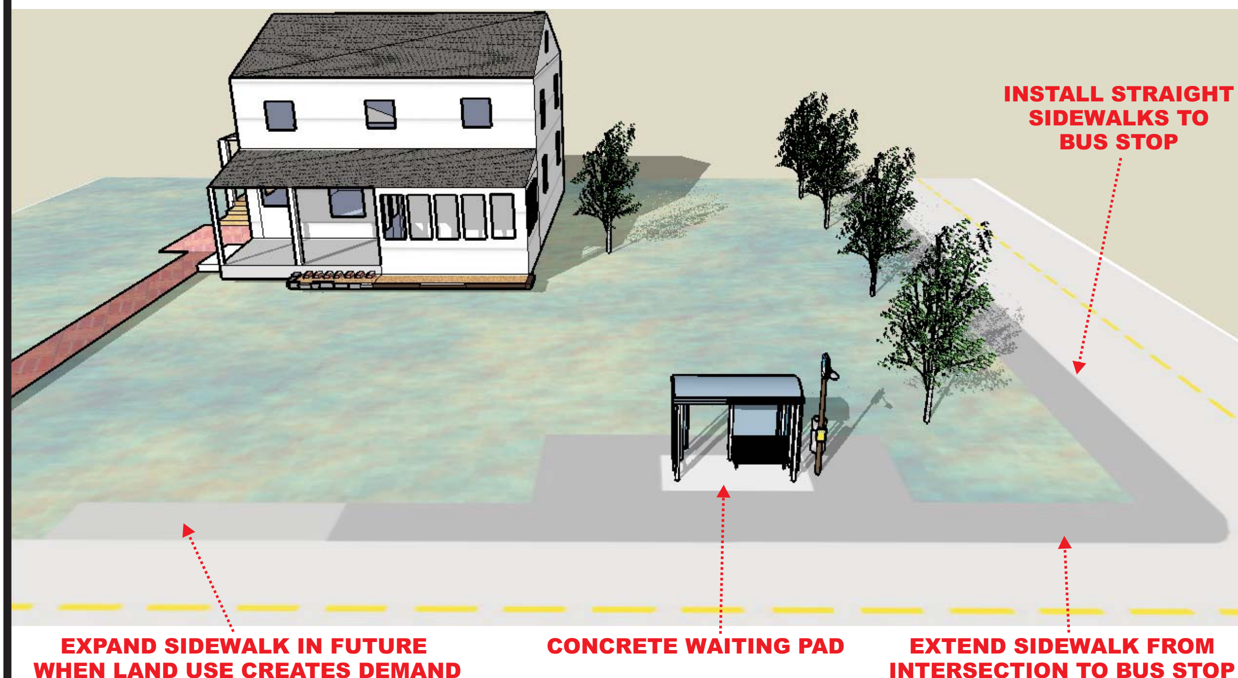
NOT RECOMMENDED

require walking along the roadway shoulder, and can serve as a first step toward providing complete access to the bus stop. The sidewalk segment will ensure that access to the bus stop does not require the patron to traverse uneven grass or exposed soil, problems which can be exacerbated by poor drainage and by surface changes during inclement weather. Conditions such as these are particularly difficult for persons who are elderly or disabled. Figure 6 shows examples of recommended and not recommended bus stop access in rural areas.

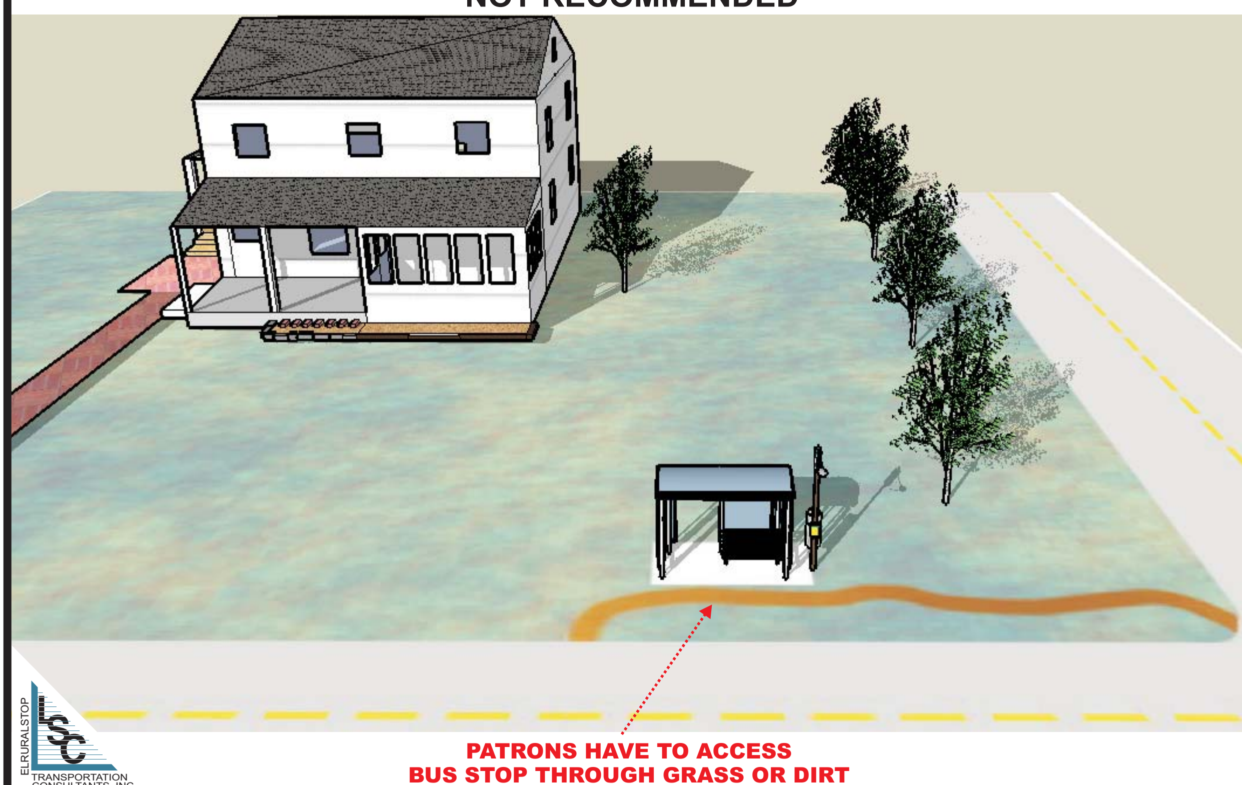
FIGURE 6

EXAMPLES OF BUS STOP ACCESS IN A RURAL AREA

RECOMMENDED



NOT RECOMMENDED



Section 4 • Bus Stop Placement

Properly located, adequately designed, and effectively enforced bus stops can improve public transportation service and expedite general traffic flow. Decisions regarding bus stop spacing, locations, and length require careful analysis of passenger requirements, bus service type provided (local, express, or shuttle), and the interaction of stopped buses with general traffic flow.

TRAFFIC ENGINEERING AND INDUSTRY STANDARDS

Standards for bus stops include the following:

- Figure 7 presents specifications for new passenger loading pads and shelters at stops served by buses equipped with front- or back-mounted wheelchair lifts. These specifications meet Americans with Disabilities Act (ADA) requirements, though larger dimensions are desirable. The bus stop design installation and passenger loading pad should align with the wheelchair lift located at the rear of the bus (as is the case with the current EDCTA fleet). Optimally, a pad should be provided at both the front and rear door locations. A front pad should always be provided to ensure adequate landing space for non-wheelchair users.

- Bus parking pads should be a minimum of 10 feet in width and preferably 12 feet in width. Stops that are typically served by four or more buses per hour should be made of concrete.

- Asphalt bus parking pads should be a minimum of 3 inches of asphalt over a minimum of 5 inches of base materials; concrete bus pads should be a minimum of 8 inches of reinforced concrete, with base requirements dependent upon soil conditions.

- Curb heights should be no less than 4 inches and no more than 8 inches to minimize passenger falls when alighting from a bus.

- A minimum horizontal clearance of 2 feet should be provided between the curb and any obstruction (such as a bus stop sign).

- Trees should be trimmed at least 11.5 feet above the roadway pavement for the length of the bus stop. In the case of new development, plantings should be slow-growing or high-canopy to reduce trimming maintenance costs to the affected jurisdiction or development.

BUS STOP CONFIGURATIONS

A number of roadway configurations can be utilized for bus stops, as described below.

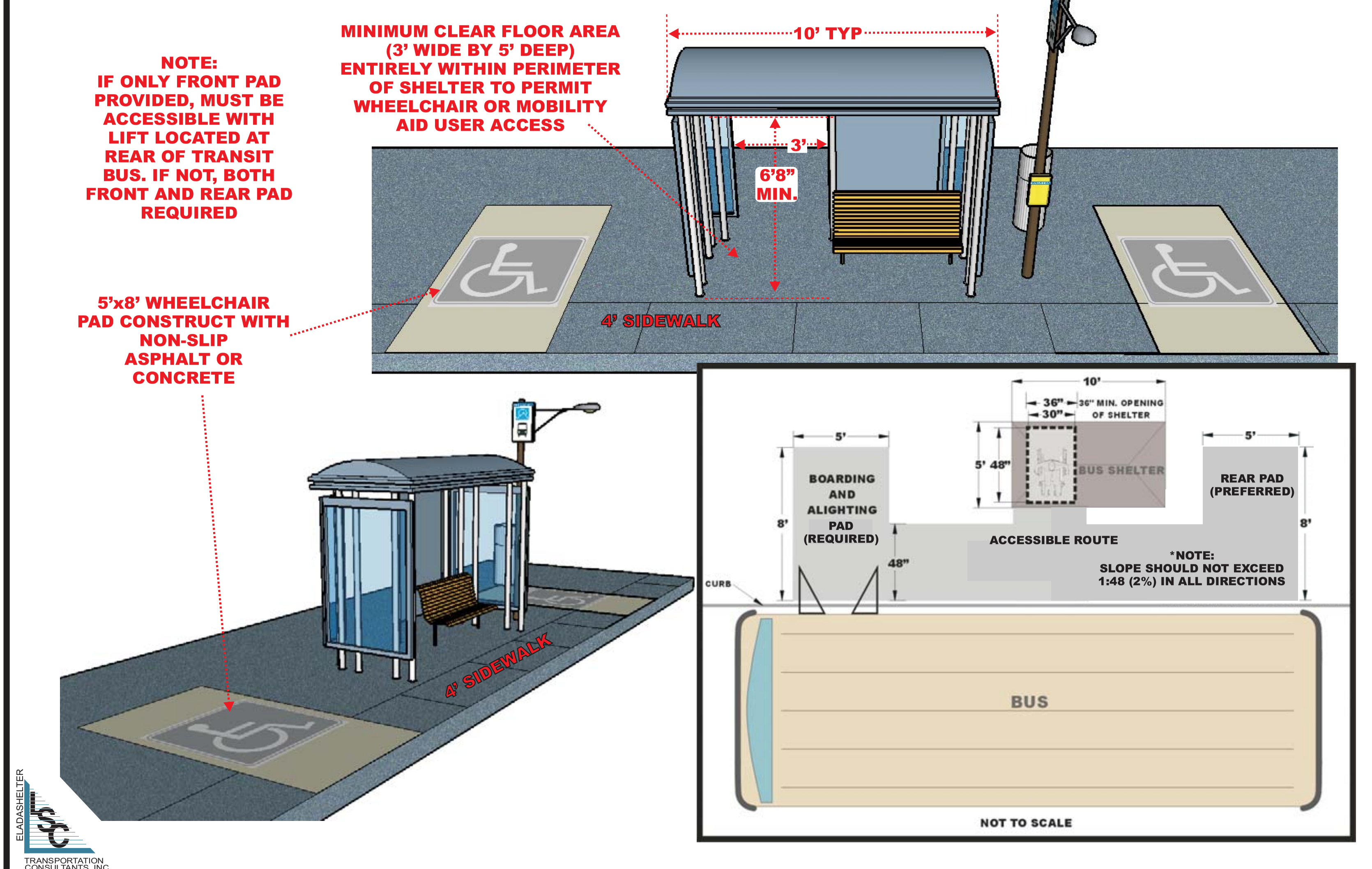
- ***Curb-Side Stop*** – A curb-side stop is a bus stop without any alterations to the curb to especially accommodate the bus.

- ***Bus Bay*** – A bus bay is a stop which is especially designed to allow the bus to pull out of the traffic lane. An acceleration and deceleration lane is included.

- ***Open Bus Bay*** – A Bus Bay that utilizes adjacent cross streets for one or both acceleration/deceleration lanes.

FIGURE 7

ADA MINIMUM DIMENSIONS OF A PASSENGER LOADING PAD AND SHELTER



- ***Queue-Jumper Bus Bay*** – An Open Bus Bay located on the far side of intersection beyond the terminus of a right-turn lane, allowing buses to use the right-turn lane to bypass through-traffic queues.

- ***Bulbout or Nub*** – A curb extension the length of a bus built into a parking lane, especially designed for buses to stop without having to pull out of and into travel lanes.

Each of these configurations is illustrated in Figure 8. The advantages and disadvantages of each are discussed in Table 4.

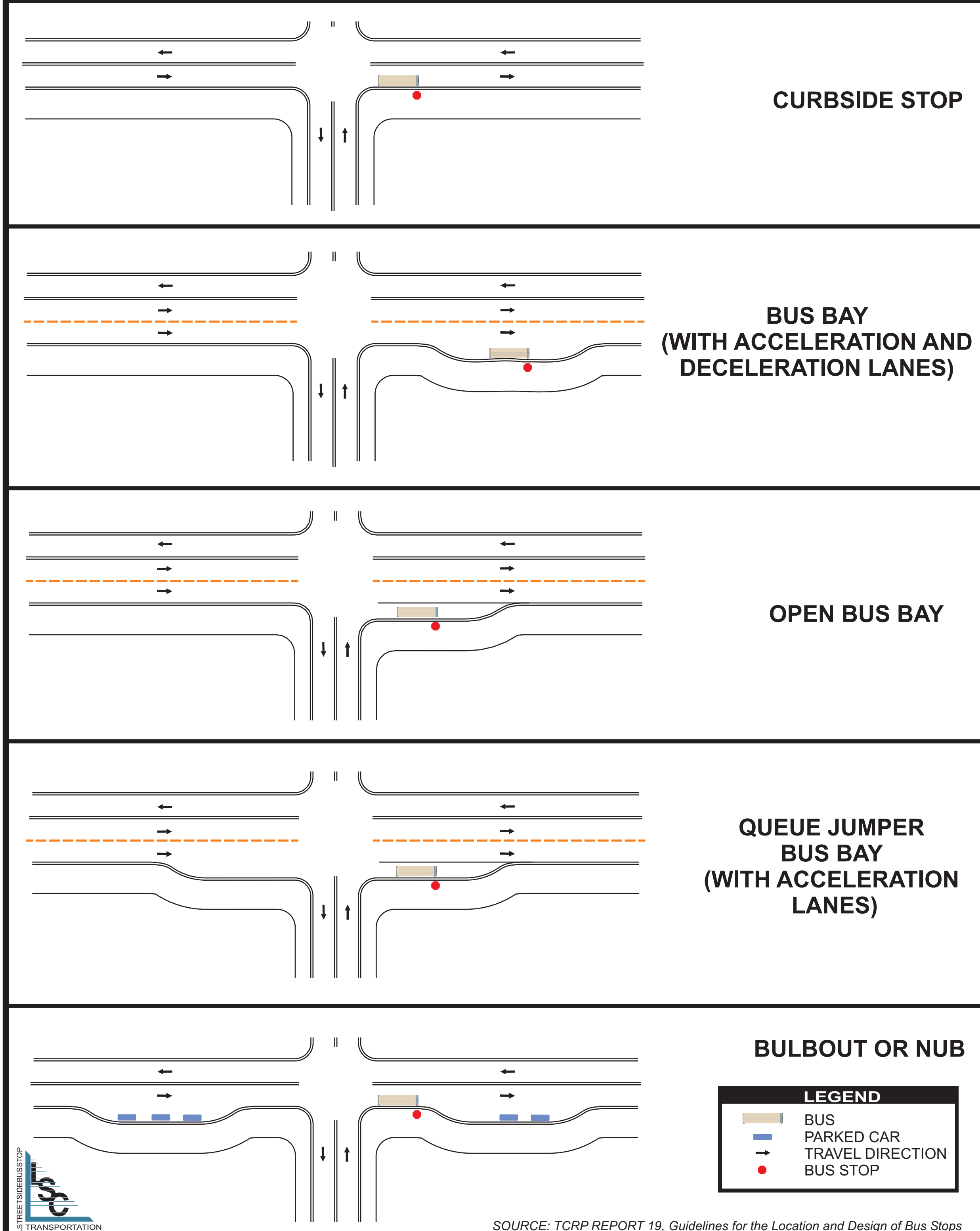
NEAR-SIDE, FAR-SIDE, AND MID-BLOCK STOPS FOR ONE OR TWO BUSES

Bus stops can be located near-side, far-side, or mid-block, as shown in Figure 9. **Near-side** stops are recommended when the coach must stop in a travel lane; when an intersection is controlled by a stop sign; or in circumstances where the accumulation of coaches at a far-side stop might exceed the length of the bus zone and therefore create the potential for queuing buses in an intersection. **Far-side** stops are recommended (1) when placed outside of the travel lanes (such as a parking lane or shoulder), so a stopped coach will not queue into the intersection; (2) at complex, signalized intersections so that the bus can travel through the green signal without stopping and the signal can provide breaks in traffic to allow the bus to re-enter the travel lane; (3) where right turns by the general traffic are heavy and stopping would create additional congestion; or (4) where buses turn left prior to the stop so the bus can have greater maneuvering distance and stop closer to the intersection. **Mid-block** stops are recommended (1) in downtown areas where multiple routes require long loading areas; (2) where traffic, bus turning movements, or physical conditions prohibit near- or far-side stops; and (3) where large transit generators are present. Each bus stop location has its advantages and disadvantages, as discussed in Table 5. When choosing among near-side, far-side, and mid-block locations, the following factors should be considered.

- Intersection geometry and impact on intersection operations,
- Potential need for future passenger amenities,
- Adjacent land use and activities,
- Bus signal priority (e.g. an extended green suggests far-side placement),
- Bus routing (e.g. does the bus turn at the intersection),
- Transfer opportunities (e.g. if bus routes operate along two intersecting streets, providing of one near-side and one-far-side stop can allow passengers to transfer without crossing travel lanes),
- Parking restrictions and requirements,
- Pedestrian access, including accessibility for persons with disabilities,
- Physical roadside constraints (e.g. trees, poles, driveways),
- Ridership potential,
- Presence of bus bypass lane, and
- Traffic control devices.

FIGURE 8

STREET-SIDE BUS STOP DESIGN



SOURCE: TCRP REPORT 19, Guidelines for the Location and Design of Bus Stops

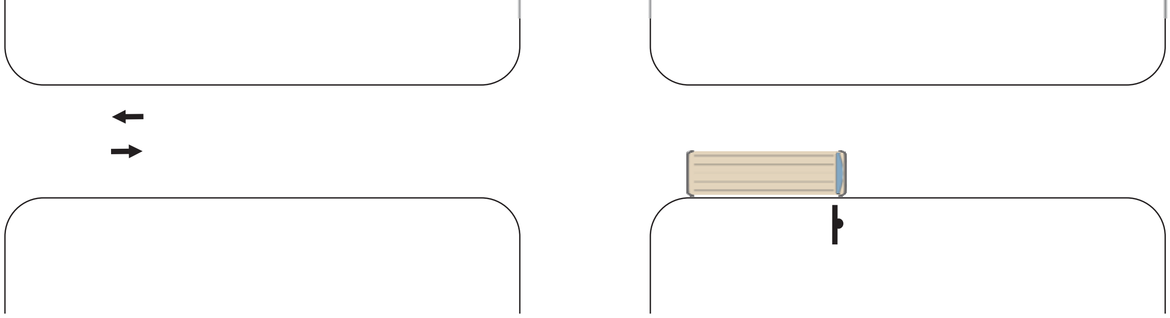
TABLE 4: Comparative Analysis of Types of Stops		
Type of Stop	**Advantages**	**Disadvantages**
Curb-Side	- Provides easy access for bus drivers and results in minimal delay to bus - Is simple in design and easy and inexpensive for a transit agency to install - Is easy to relocate	- Can cause traffic to queue behind stopped bus, thus causing traffic congestion - May cause drivers to make unsafe maneuvers when changing lanes in order to avoid a stopped bus - Can conflict with on-street bike lanes, forcing cyclists into auto travel lanes
Bus Bay	- Allows patrons to board and alight out of the travel lane - Provides a protected area away from moving vehicles for both the stopped bus and the bus patrons - Minimizes delay to through traffic and cyclists	- May present problems to bus drivers when attempting to re-enter traffic, especially during periods of high roadway volumes - Is expensive to install compared to curbside stops - Is difficult and expensive to relocate - Can require right-of-way acquisition
Open Bus Bay	- Allows the bus to decelerate (if far side) or accelerate (if near side) as it moves through the intersection - Less construction cost - See Bus Bay advantages	- See Bus Bay disadvantages
Queue-Jumper Bus Bay	- Allows buses to bypass queues at a signal, which can provide a substantial time savings at congested intersections - See Open Bus Bay advantage	- See Bus Bay disadvantages - May cause delays to right-turning vehicles when a bus is at the head of the right turn lane
Bulbout	- Removes fewer parking spaces for the bus stop - Decreases the walking distance and time for pedestrians crossing the street - Provides additional sidewalk area for stop improvements or landscaping - Eliminates delay associated with re-entering the through traffic stream	- Costs more to install compared to curbside stops - Can complicate storm-water flow - See Curb-Side disadvantages

Source: TCRP Report 19, *Guidelines for the Location and Design of Bus Stops*.

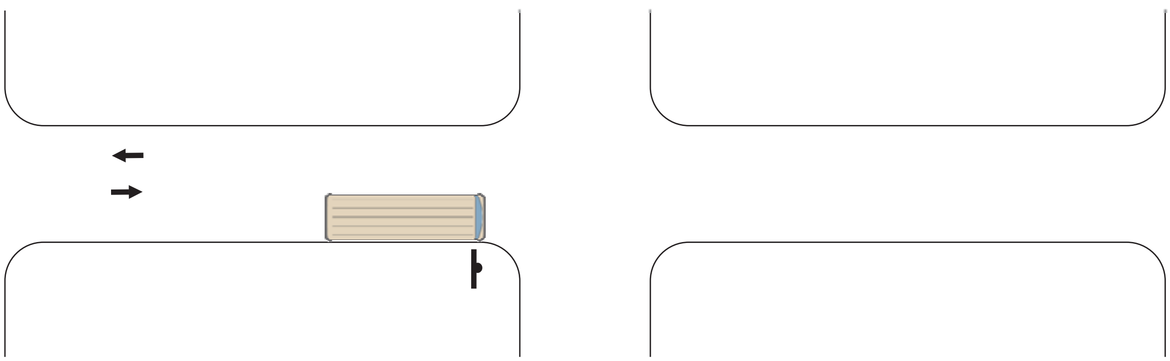
FIGURE 9

EXAMPLES OF FAR-SIDE, NEAR-SIDE AND MIDBLOCK STOPS

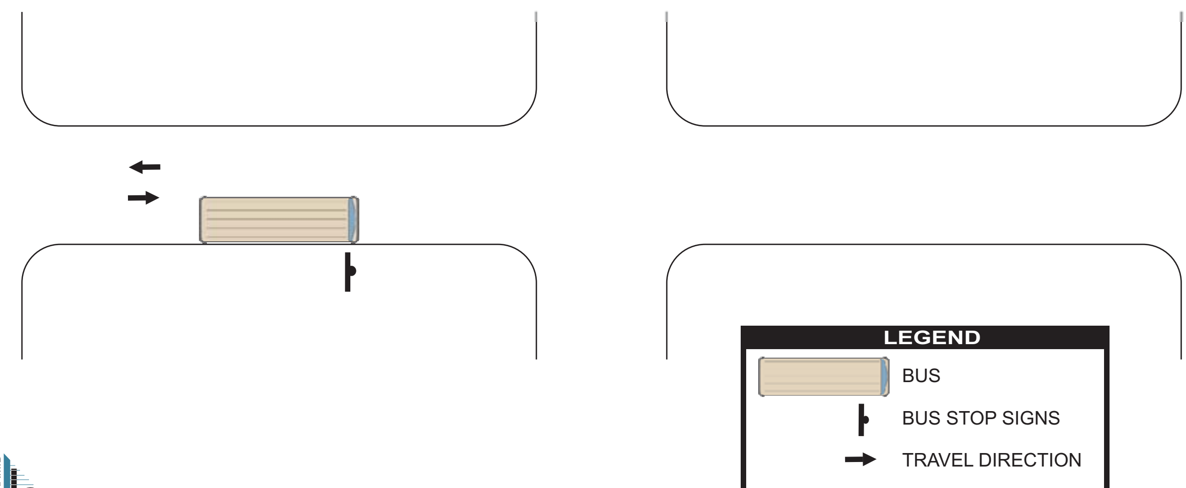
FAR-SIDE BUS STOP = BUS STOPS IMMEDIATELY AFTER PASSING THROUGH AN INTERSECTION



NEAR-SIDE BUS STOP = BUS STOPS IMMEDIATELY PRIOR TO AN INTERSECTION



MIDBLOCK BUS STOP= BUS STOPS WITHIN THE BLOCK



SOURCE: TCRP REPORT 19, Guidelines for the Location and Design of Bus Stops

TABLE 5: Comparative Analysis of Bus Stop Locations

Location	Advantages	Disadvantages
Near-Side Stop	- Minimizes interferences when traffic is heavy on the far side of the intersection - Allows passengers to access buses closest to the crosswalk - Results in the width of the intersection being available for the driver to pull away from curb - Eliminates the potential of double stopping - Allows passengers to board and alight while the bus is stopped at a red light - Provides driver with the opportunity to look for oncoming traffic, including other buses with potential passengers	- Increases conflicts with right-turning vehicles - May result in stopped buses obscuring curbside traffic control devices and crossing pedestrians - May cause sight distance to be obscured for cross vehicles stopped to the right of the bus - May block the through lane during the peak period with queuing buses - Increases sight distance problems for crossing pedestrians
Far-Side Stop	- Minimizes conflicts between right turning vehicles and buses, providing additional right turn capacity - Minimizes sight distance problems on approaches to intersection - Encourages pedestrians to cross behind the bus - Creates shorter deceleration distances for buses since the bus can use the intersection to decelerate - Results in bus drivers being able to take advantage of the gaps in the traffic flow that are created at signalized intersections	- May result in the intersections being blocked during peak periods by stopped buses - May obscure sight distance for crossing vehicles - May increase sight distance problems for crossing pedestrians - Can cause a bus to stop far-side after stopping for a red light, which interferes with both bus operations and all other traffic - May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light - Could result in traffic queued into intersection when a bus is stopped in travel lane
Mid-Block Stop	- Minimizes sight distance problems for vehicles and pedestrians - May result in passenger waiting areas experiencing less pedestrian congestion	- Requires additional distance for no-parking restrictions - Encourages patrons to cross street at mid-block (jay-walking) - Increases walking distance for patrons crossing at intersections

Source: TCRP Report 19, *Guidelines for the Location and Design of Bus Stops*.

The most critical factors in choosing among near-side, far-side, and mid-block bus stop placement are safety and avoidance of major conflicts that would otherwise impede bus, car, or pedestrian flows. The final decision on the location of a particular bus stop is dependent on several operating and safety factors which require on-site evaluation by transit staff. The recommended designs of the various types of stops served by EDCTA commuter buses are shown in Figure 10, while stops served only by local buses are shown in Figure 11.

FIGURE 10

BUS STOP DIMENSIONS
MINIMUM REQUIREMENTS FOR COMMUTER BUS
IN A 25 MPH TO 45 MPH ZONE

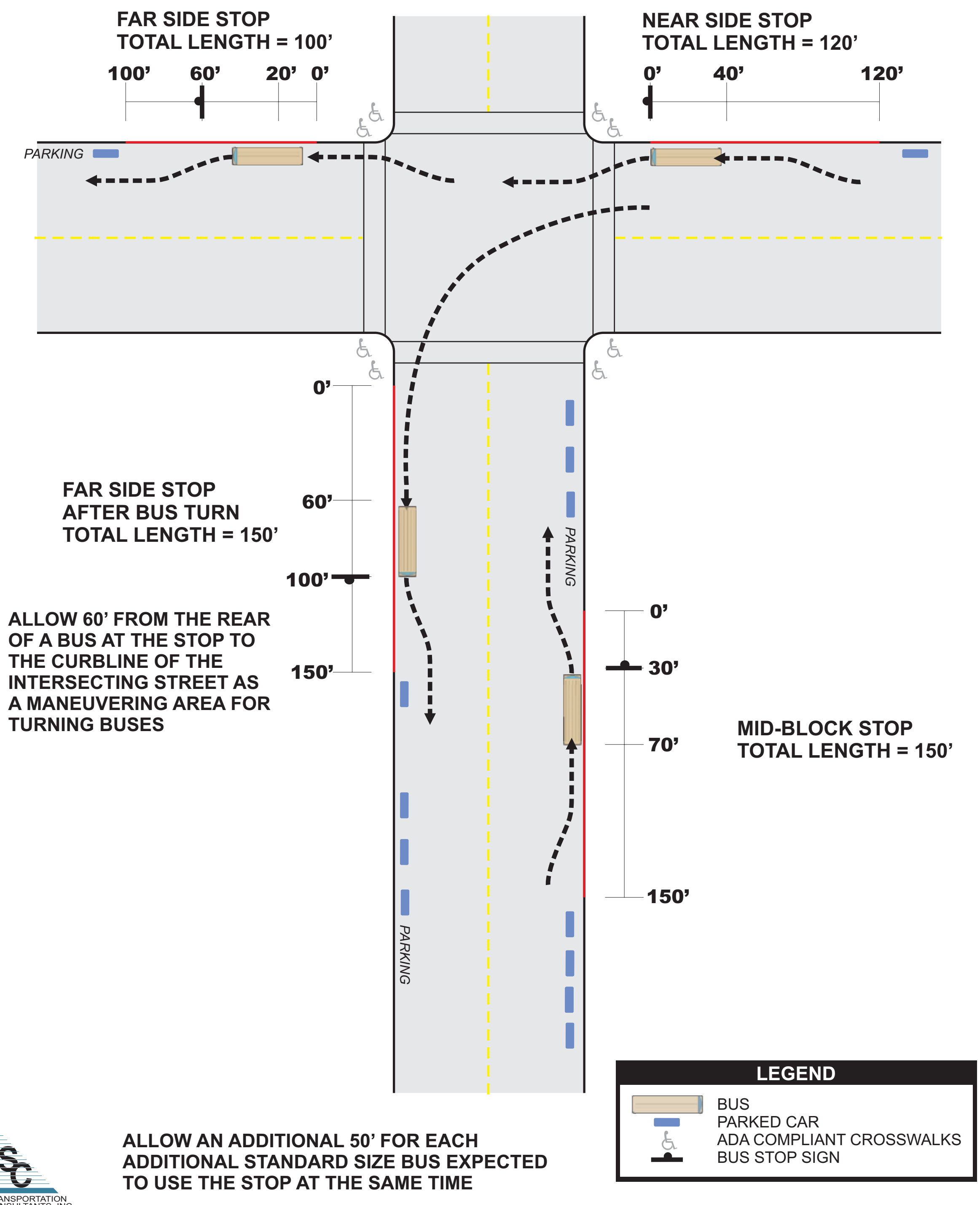
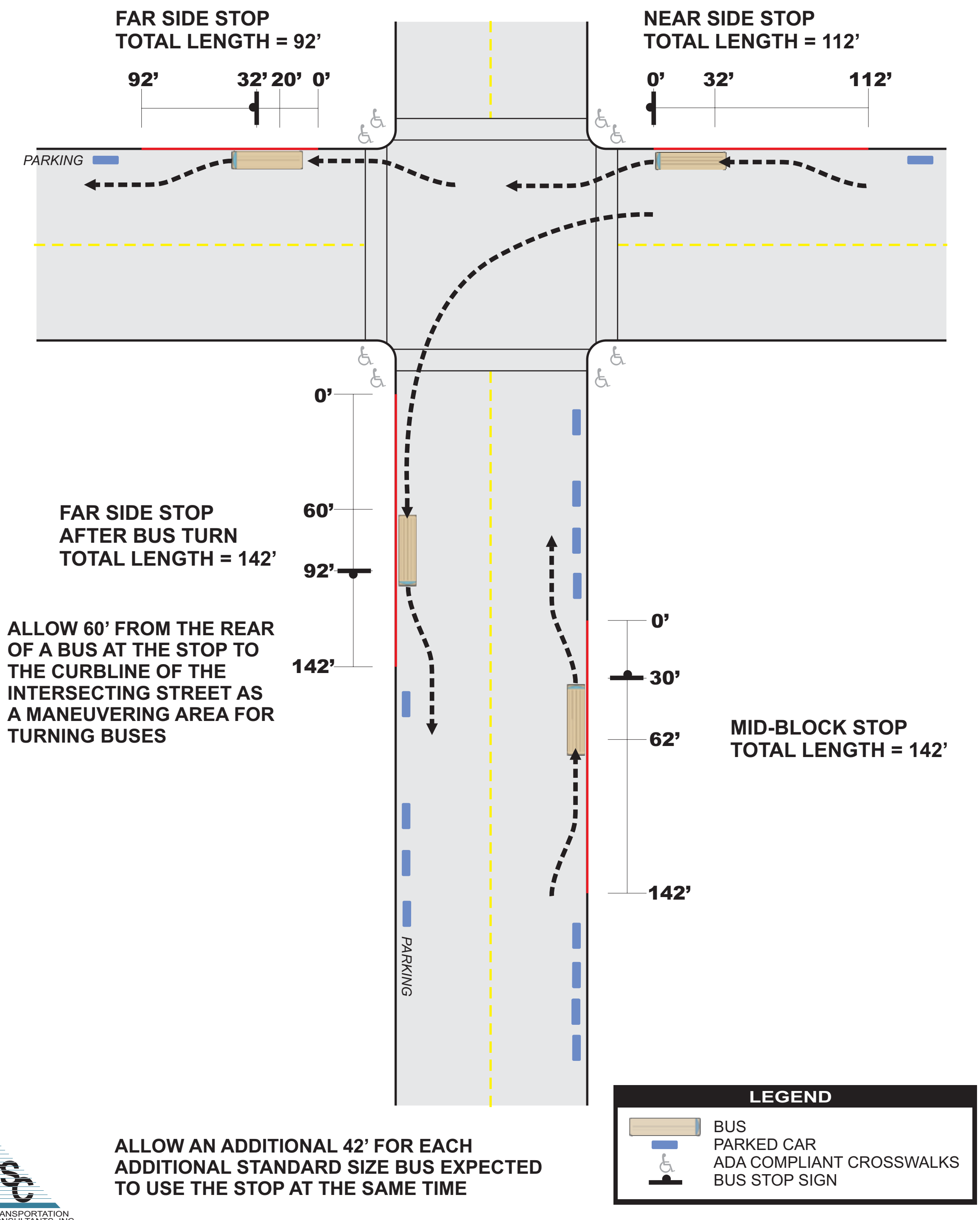


FIGURE 11

BUS STOP DIMENSIONS
MINIMUM REQUIREMENTS FOR LOCAL BUS
IN A 25 MPH TO 45 MPH ZONE



ALLOW AN ADDITIONAL 42' FOR EACH ADDITIONAL STANDARD SIZE BUS EXPECTED TO USE THE STOP AT THE SAME TIME

Section 5 • Bus Stop Spacing

Bus stop spacing has a major impact on transit vehicle and system performance. Bus stop spacing affects overall travel time, and, therefore, the demand for transit service. In general, the trade-off is between close stops versus stops further apart. Close stops (every block or one-eighth to one-fourth mile) provide short walk distances but more frequent stops and, thus, a longer bus ride. Stops further apart create longer walk distances, but because stops are less frequent and average speeds are faster, the bus trip is shorter.

CBD, URBAN, SUBURBAN, AND RURAL BUS STOP SPACING

Ideally, bus stop spacing should depend on ridership. Ridership, in turn, is affected by development type, such as residential, commercial, or Central Business District. Table 6 shows a range of bus stop spacing for various land uses, representing a composite of prevailing practices. The table also presents spacing that is recommended for application along EDCTA local routes. Figure 12 illustrates the recommended spacing.

TABLE 6: Typical Bus Stop Spacing

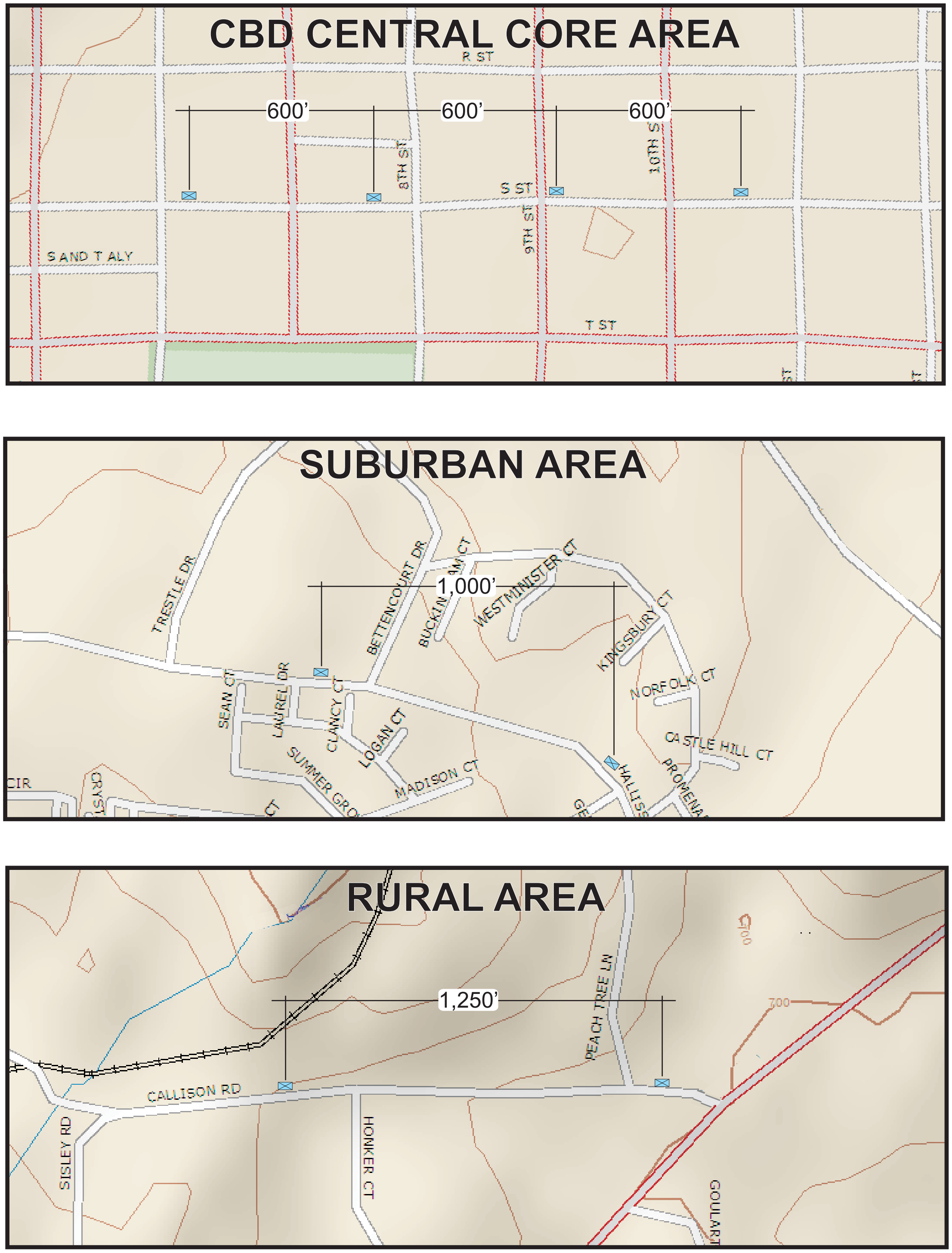
Land Use	Range of Spacing	Typical Spacing
Central Business District Areas	300 to 1,000 feet	600 feet
Urban Areas	500 to 1,200 feet	750 feet
Suburban Areas	600 to 2,500 feet	1,000 feet
Rural Areas	650 to 2,640 feet	1,250 feet

Source: TCRP Report 19, *Guidelines for the Location and Design of Bus Stops*.

The recommended spacing guidelines and other factors should be considered when planning the actual location of bus stops. Factors to be considered include the spacing of cross streets, the availability of pedestrian access, and the location of major trip generators. These factors, especially the latter, are particularly important in rural areas.

FIGURE 12

RECOMMENDED BUS STOP SPACING



Section 6 • Bus Pullouts

A bus pullout is a specially constructed area off the normal roadway section provided for bus loading and unloading. Typically at stops located on low-speed, low-volume roadways without unusually high passenger activity, it is appropriate for transit buses to stop in the travel lane. This condition applies to many of the EDCTA Local Route stops located off of the state highways or urban arterial roadways. A bus pullout is necessary at locations where it may be hazardous to stop the bus in the travel lane and no shoulder or parking lane is available. Based on design guidelines in various rural areas throughout the country, roadways adjacent to bus stops with a speed limit of 35 miles per hour (MPH) or higher and a peak-hour volume of 250 or higher in the lane of travel warrant a bus pullout[1.] Assuming a typical traffic pattern in which 10 percent of daily traffic occurs in the peak hour and daily volumes are balanced between the two directions, this corresponds to a daily two-way traffic volume of 5,000 vehicles for a two-lane roadway and 10,000 for a four-lane roadway.

Pullouts are also appropriate in the following circumstances:

- Where the potential for conflicts between transit and passenger vehicles warrants separation of the two. For example, a bus stop located in a travel lane of a signalized intersection often requires a pullout to prevent the stopped bus from causing traffic to queue through the intersection.
- Under conditions with high or increasing bus or passenger volumes or on high speed roads.
- At locations where it may be hazardous to stop the bus in the travel lane and no shoulder or parking lane is available, such as where objects or the roadway geometry unduly obstructs sight distances for oncoming drivers.

The decision to construct a bus pullout should include an evaluation of the impact on public transportation as well as on pedestrians, bicyclists, and private vehicle operations. As with most improvements, pullouts should be coordinated between transit staff and the local jurisdiction.

URBAN AND RURAL PULLOUTS FOR ONE OR TWO BUSES

A review of existing standards for transit pullouts in other jurisdictions (summarized in Appendix B), and analysis of local conditions in western El Dorado County led to the development of recommended bus pullout standards for EDCTA, as presented in Figure 13. This figure illustrates the recommended dimensions of urban and rural bus pullouts for one or two buses. EDCTA should be contacted to determine if a given location will require space for two buses. As is shown in the figure, the recommended length of an urban or rural pullout varies with the posted speed limit of the roadway. It is important that adequate driver sight distance be maintained at the pullout, as the bus will be required to leave and enter the roadway at speeds less than the posted speed limit. This is especially true for rural pullouts, as the posted roadway speed limits and actual vehicle speeds are generally higher at rural locations. It is also important that the design of the pullout allow a wheelchair pad to be accessible from both the front door of the bus as well as the rear wheelchair lift.

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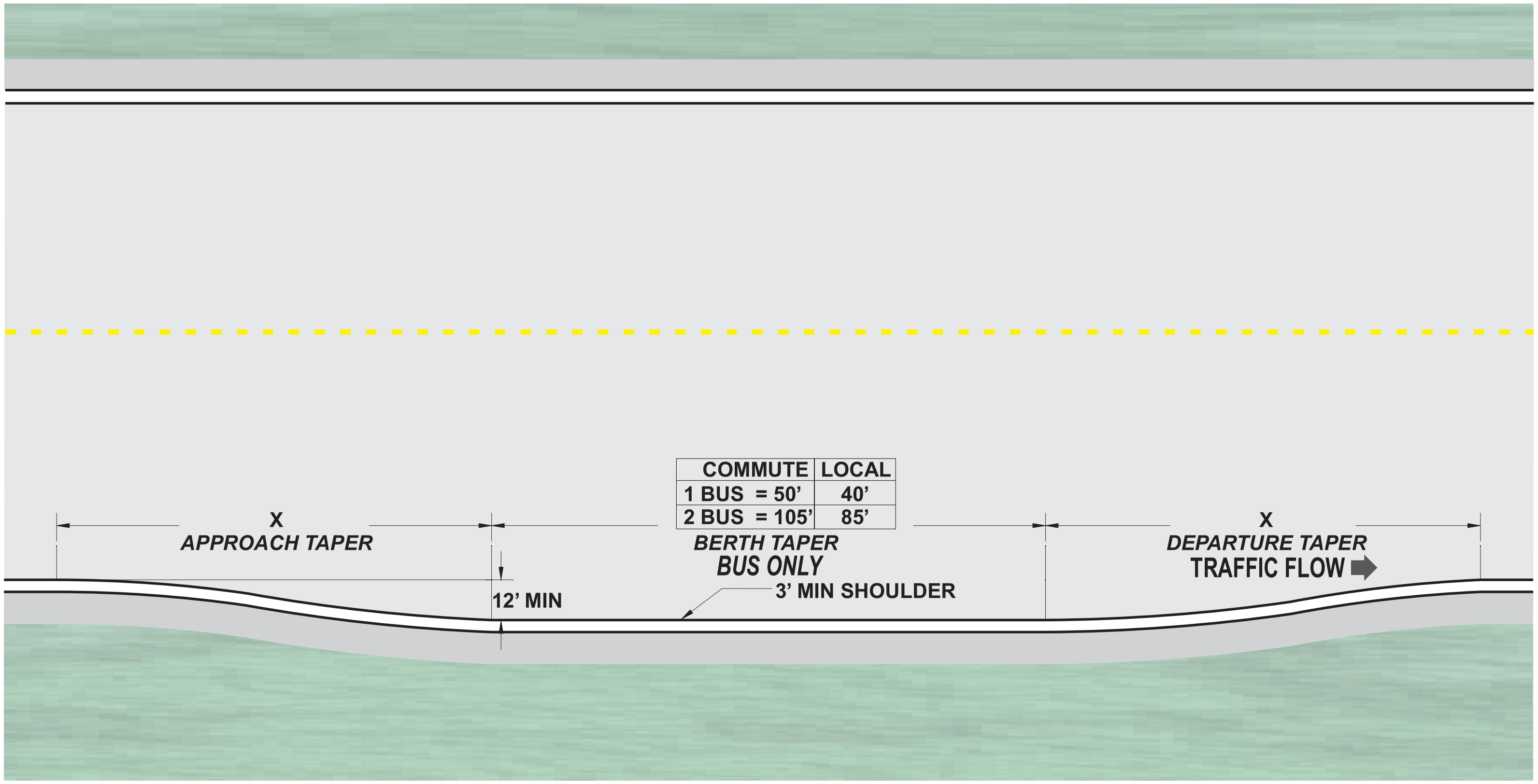
[1]The Oregon Department of Transportation, *Design Guidelines for Public Transportation*, Section 12, 12-6.

FIGURE 13

BUS TURNOUT SPECIFICATIONS



	COMMUTE	LOCAL
1 BUS	= 50'	40'
2 BUS	= 105'	85'

URBAN ENVIRONMENT
X=40" FOR POSTED SPEED LIMIT 25 MPH OR LESS
X=60' FOR POSTED SPEED LIMIT ABOVE 25 MPH
RURAL ENVIRONMENT
X=80' FOR POSTED SPEED LIMIT 45 MPH OR LESS
X=100' FOR POSTED SPEED LIMIT ABOVE 45 MPH

SOURCE: REGIONAL TRANSPORTATION COMMISSION OF WASHOE COUNTY, PLANNING FOR TRANSIT

BUSTURNOUTSPECS
TRANSPORTATION CONSULTANTS, INC.

Acceleration and deceleration lanes are specifically not recommended for pullouts along the majority of EDCTA local routes, due to the high construction cost and visual impact of such lanes. The only exception may be at any future bus stop locations on high-volume roadways with speed limits posted above 45 mph where limited sight distance for vehicles in the through travel lane may pose a potential traffic safety problem. The need for acceleration and deceleration lanes in these conditions should be determined by a traffic engineer on a case-by-case basis.

The pullout should be constructed of Class A concrete with a pavement thickness of 8.5 inches. This will reduce maintenance costs compared to asphalt construction and avoid the deformation of asphalt pavement created by heavy bus vehicle weights on hot days. Pullouts in urban areas should include a curb and gutter constructed as detailed in the City of Placerville *Street Standards* or the El Dorado County Department of Public Works *Design Standards*, depending on the location of the pullout. The ends of the tapers should be joined by an arc with a radius of 15 feet, so that street sweepers are able to efficiently clean the area. Final design and construction of all pullouts should be reviewed by staff in the affected jurisdiction.

FAR-SIDE, MID-BLOCK, AND NEAR-SIDE PULLOUTS

A given bus pullout may not require the full dimensions depicted in Figure 13. A far-side pullout will not require an approach taper, while a near-side pullout will not require a departure taper. However, a mid-block pullout, which must have both an approach and a departure taper, will require the full dimensions illustrated in Figure 13. See Section 3 of this handbook for a discussion of the advantages and disadvantages of the placement of a bus stop or pullout at far-side, mid-block, and near-side locations.

Section 7 • Passenger Amenities

Passenger amenities are significant elements in attracting public transportation users. Shelters provide some protection from the elements and benches add comfort; kiosks, signs, trash receptacles, lighting, and other amenities add convenience and safety. Passenger amenities should be located within the public right-of-way, and should not impede auto, bus, bicyclist, or pedestrian flows. The bus stop should be located so that the future installation of amenities will not require the relocation of other structures or utilities. Amenities must meet ADA requirements, such as those presented in Figure 7 for passenger boarding pads and shelters.

BENCHES AND SHELTERS

A bus bench and shelter provide patrons with seating and protection from the elements while they are waiting for a bus. Benches should be placed at bus stops wherever possible. A number of factors should be considered when determining where shelters are warranted. The optimal size and design of benches and shelters is affected by various factors, including demand and frequency of service, availability of right-of-way width, existing street furniture, utility pole locations, landscaping, existing structures, and the maintenance of proper pedestrian circulation around existing features of the site.

Shelters are typically constructed with clear or perforated metal side-panels for visibility. Interior panels of shelters can be used for posting route and schedule information. Side panels may be large enough to display the entire system map and can include backlighting for display at night. Shelters that lack side panels can display route and schedule information on the interior roof of the shelter. Shelters may also provide advertising space as a revenue source.

There are various methods that can be used to determine when a bench or shelter should be installed at a given location. The most commonly used criteria, the number of passenger boardings, is the criteria recommended to determine which EDCTA stops warrant installation of a bench or shelter. The following recommended minimum boardings represent a composite of prevailing practices:

- Bench: 5 to 9 boardings per day
- Shelter: 10 or more boardings per day

Other criteria that EDCTA and local decision-makers may wish to consider when evaluating the installation of a shelter or multiple shelters may include:

- The number of transfers at a stop
- The availability of space to construct a shelter and waiting area
- The number of elderly or physically challenged individuals in the area
- The proximity to major activity centers
- The frequency of service
- Adjacent land uses

Figure 7 in Section 3 of this handbook illustrates the recommended dimensions of a bus shelter and pad. Figure 14 shows the recommended dimensions and location of a bench at a bus stop.

SIGNS

Bus stop signs are an important element of the transit system, serving as a source of information for patrons and as a marketing tool. It is recommended that signs be posted at all bus stops. The most common type of sign is a flag sign displaying route and passenger information. The design of bus stop signs should be standardized throughout the system so they are instantly recognizable. It is useful for signs to be double-sided so they can be read from both directions and reflectorized for easy night reading. The design elements on the sign should include the EDCTA logo, the route numbers that serve the stop (or a route color-coding scheme), a phone number for transit information, and, optionally, the major destination of the routes available at the stop. The ADA requires the lettering on the signs to be a minimum of five-eighths inches high, all uppercase, and in a sans serif typeface. The signs should have a non-glare surface. Schedule holders, mounted on the sign post or inside the shelter, where available, should be provided at sites with larger passenger volumes. Trash receptacles may be mounted on the sign posts as well.

The bus stop sign should, wherever possible, be placed even with the front door of the bus, to let patrons know where to stand and to serve as a guide for the operator. The bottom of the sign should be at least 7 feet from the ground, and the sign should not be closer to the curb than 2 feet unless it is on a pre-existing pole or building. Signs closer to the curb should be positioned to face toward the sidewalk to prevent bus mirrors from hitting the signs. Placement within an existing sidewalk of 4 feet or less width should be avoided wherever possible. Signs can be located on existing poles, such as street lights or other traffic information signs. Such existing poles should be used for sign placement wherever possible. Metal poles at stops served by multiple routes should be engraved with Braille at a height of 4 feet for visually impaired patrons. A small plaque with the route number in Braille should be provided on wooden sign posts. Unprotected sign posts should be of the break-away type to minimize injuries and damage resulting from motor vehicle accidents. Figure 15 illustrates bus stop sign design and placement appropriate for various sidewalk configurations.

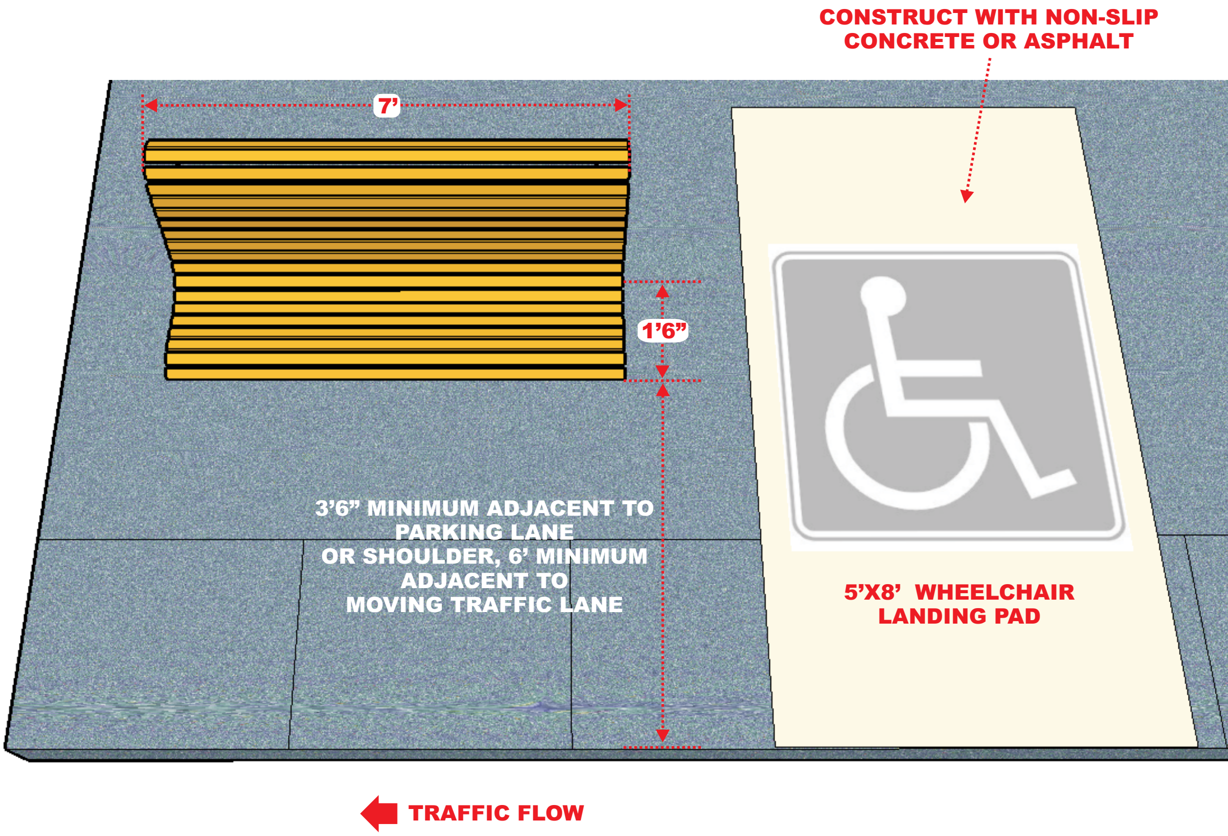
TRASH RECEPTACLES

Litter at a bus stop is a negative image for the transit agency as well as the community. The installation of trash receptacles at bus stops can alleviate this problem. Not all bus stops require trash receptacles; the decision to include a receptacle at a stop is usually based on boarding counts. If litter is a problem at a particular stop (due, perhaps, to the presence of a fast food outlet or a convenience store near the stop), a trash receptacle should be installed regardless of boarding counts. Trash receptacles should only be placed at those stops that the transit agency can reliably schedule for trash pickup. At present, EDCTA only places trash recepticles at shelters. Following are recommendations for free-standing trash receptacles:

- Anchor the receptacle securely to the ground or pole
- Do not locate the receptacle in the wheelchair landing pad area
- Install the receptacle at least two feet from the curb
- Ensure that the receptacle does not visually obstruct adjacent land uses or driveways

FIGURE 14

RECOMMENDED BENCH PLACEMENT



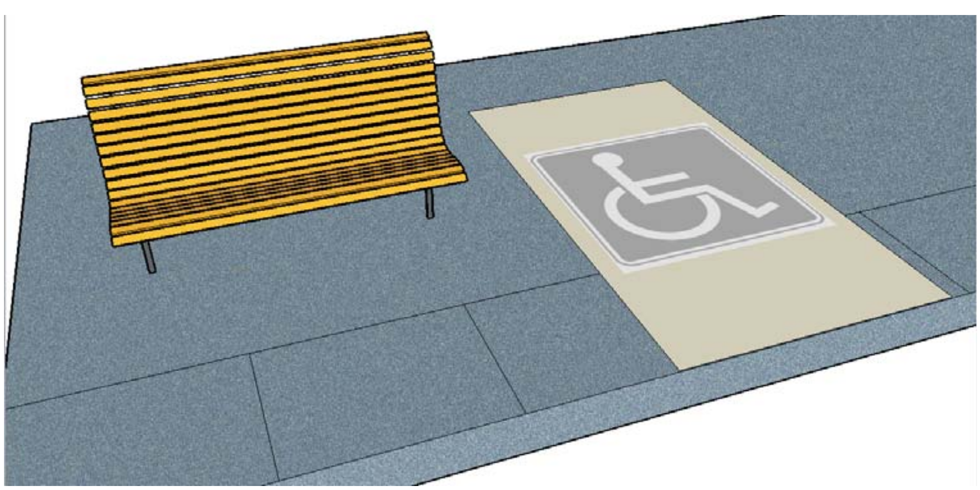
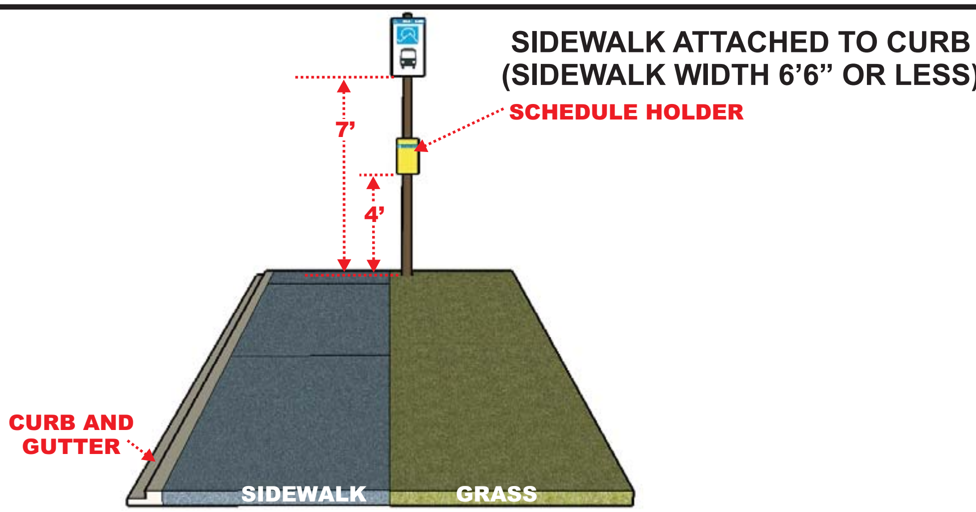
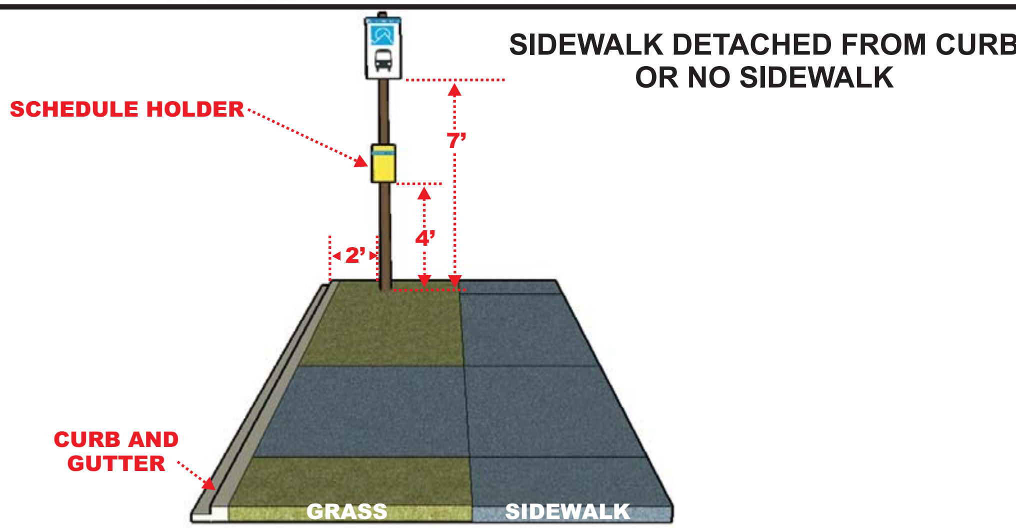
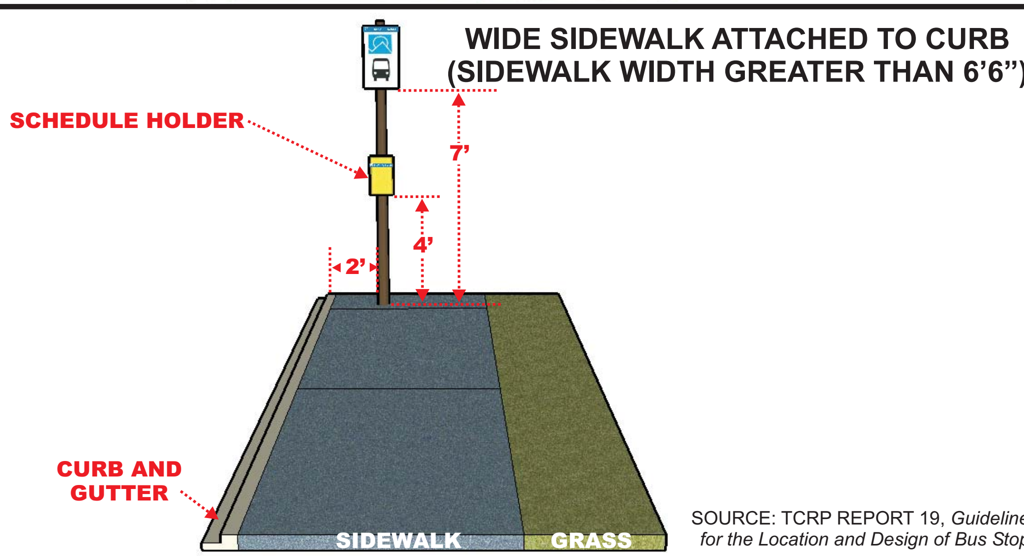


FIGURE 15

GUIDELINES FOR BUS STOP SIGN PLACEMENT







SOURCE: TCRP REPORT 19, *Guidelines for the Location and Design of Bus Stops*

- Use a design that does not allow the pooling of liquids near the receptacle
- If possible, place the receptacle in a shaded location to hinder the development of foul odors
- Trash receptacles should be of a uniform size, shape and color

Figure 16 illustrates the recommended placement of free-standing trash receptacles at stops with and without shelters. Another alternative is 10-gallon pole-mounted trash receptacles. This option can have advantages; such containers tend to attract less household garbage and less vandalism. The placement of pole-mounted trash receptacles is illustrated in Figure 15.

LIGHTING

The lighting at a bus stop affects the safety of patrons and the use of the stop by patrons and non-patrons in the hours after sunset. A well-lit bus stop enhances the waiting passengers' comfort and security, while a dimly lit or unlit stop encourages non-patrons to loiter at the stop. It is recommended that from 2 to 5 foot-candles of illumination be provided at all bus stops that will be in use after daylight hours. Lighting fixtures should be vandal-proof and easily maintained; the use of exposed bulbs and other elements that can be easily tampered with or destroyed should be avoided. Lighting fixtures should be equipped with cut-off shields as necessary to meet "dark sky" ordinances and minimize glare on neighboring properties. When possible, bus stops should be located near existing street lights as this is a cost-effective method of providing adequate lighting. Figure 17 illustrates a bus stop located near an existing street light.

BICYCLE PARKING

It is appropriate to provide bicycle parking at some bus stops, which should be considered on a case-by-case basis. The provision of bike parking facilities discourages bicycle riders from locking their bikes to the bus stop structures or to structures on adjacent properties and reduces visual clutter and pedestrian hazards by locating bikes together in one area. Bicycle parking facilities should be located out of the pedestrian flow of other activities in order to reduce congestion and improve safety. At lighted stops, the bike parking should be located near the lighting to offer protection from theft. The bike parking should not restrict views into the bus stop area. It is recommended that bike parking be provided at bus stops where there is the potential for a high level of patron access by bike, such as near educational facilities. Bike lockers are also appropriate at some stops, particularly those used by regular riders such as commuters. Bike lockers should only be installed at locations that can be easily monitored, to avoid their use as long-term storage facilities. Figure 18 illustrates the recommended space allowance for a bike rack providing parking for six bicycles.

OTHER AMENITIES

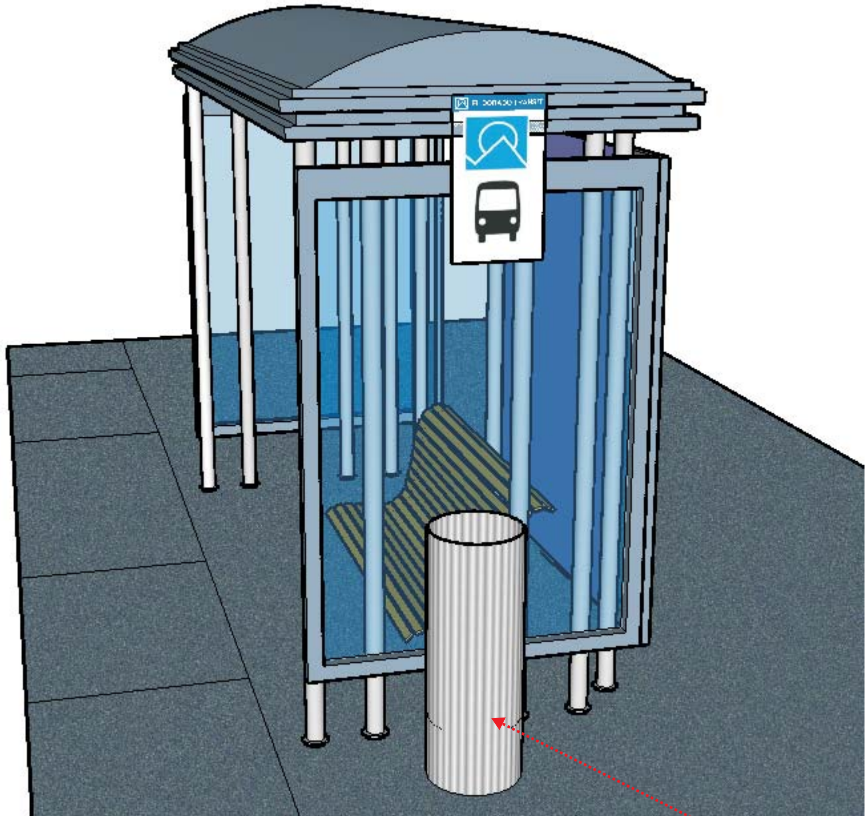
Phones

Even in the age of mobile phones, standard pay phones provide some patrons with their only opportunity to make personal and emergency calls while waiting for the bus. However, experience with phones at bus stops has been mixed. Public phones can create opportunities for illegal or unintended activities, such as drug dealing and loitering. It is recommended that

FIGURE 16

RECOMMENDED TRASH RECEPTACLE PLACEMENT

WITH SHELTER



WITHOUT SHELTER

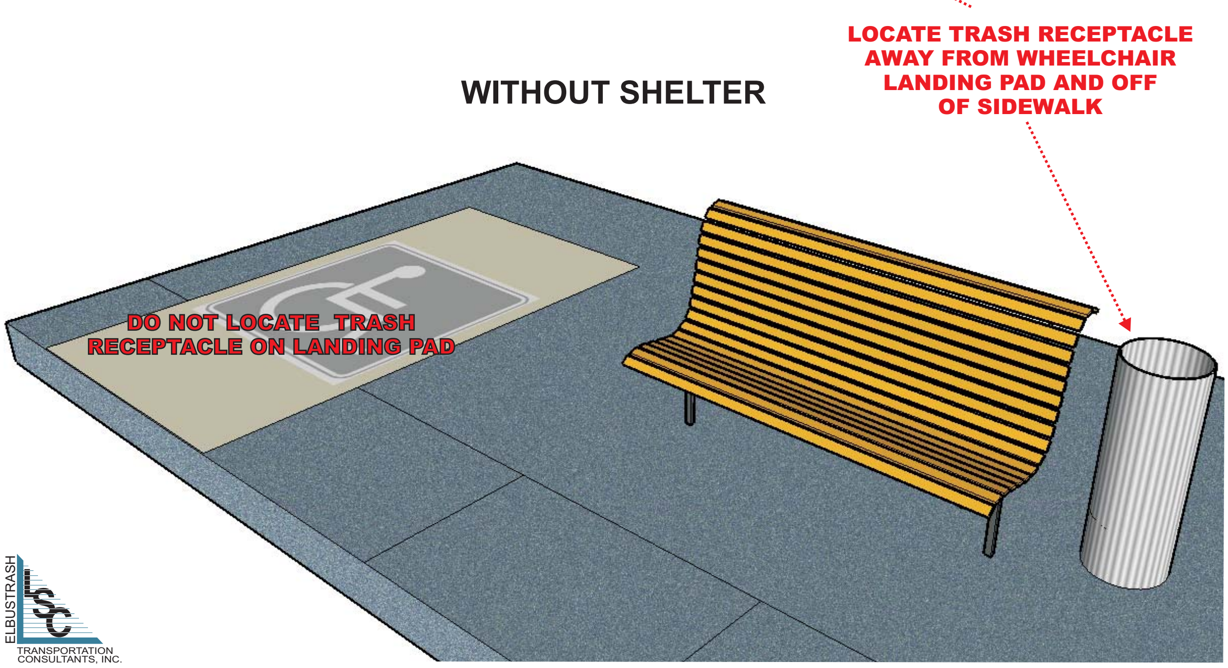
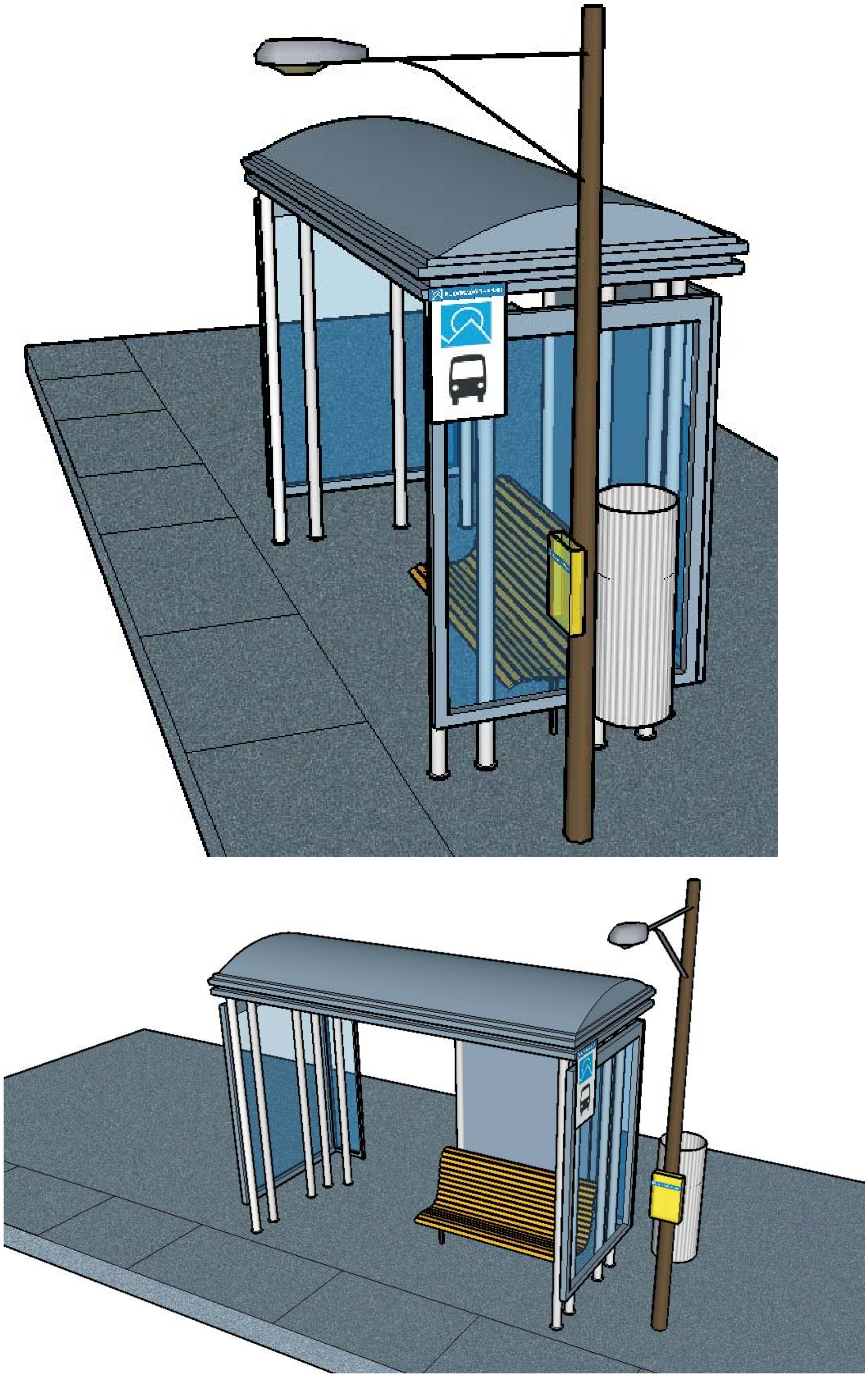


FIGURE 17

EXAMPLE OF COORDINATING BUS STOP LOCATION WITH AN EXISTING STREET LIGHT



ELBUSSTREETLIGHT

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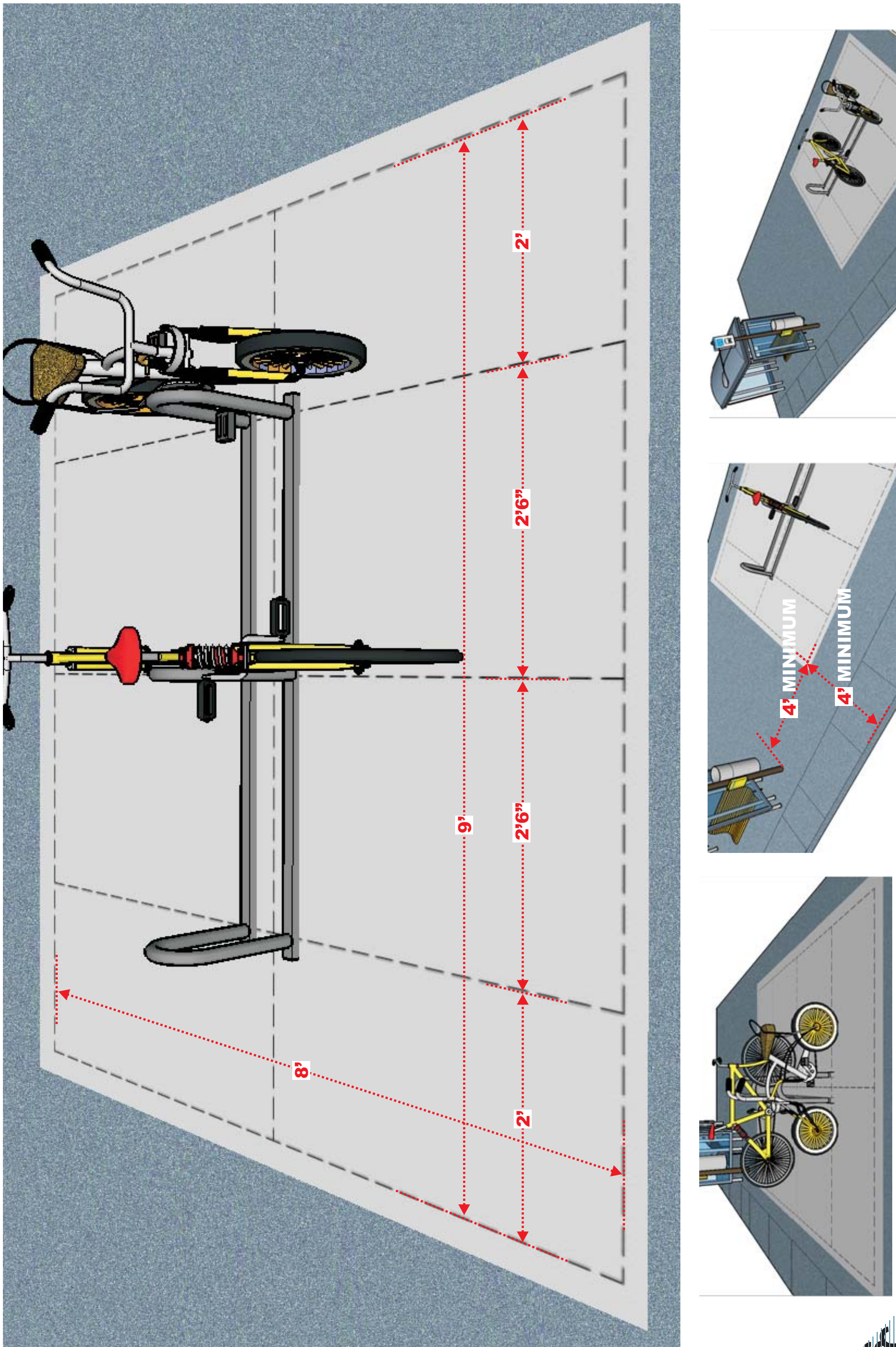
FIGURE 18

RECOMMENDED SPACE FOR BICYCLE PARKING



EDCTA install phones only at high activity locations (such as at intermodal centers), and at bus stops that can easily be monitored for undesirable activity.

Additional Amenities

There are other amenities that may be useful at specific stops. It may be helpful to install shopping cart storage at bus stops near grocery stores, to reduce visual clutter by gathering carts together. Landscaping, such as the installation of trees and shrubbery, can make a bus stop much more attractive to patrons, as well as providing shade. Landscaping should not interfere with visibility at the stop.

Recommended Overall Bus Stop Design

Putting together the various elements of a bus stop discussed above, Figure 19 presents an overall site plan for a stop in an urban or suburban setting served by a local EDCTA route (with a maximum of one vehicle at the stop), and warranting a bus pullout and shelter. Note that the specific dimensions of the approach and departure tapers for the pullout will depend upon the posted speed limit (as presented in Figure 13). Also, site access driveways or intersecting streets could potentially be located within the approach taper, so long as adequate sight distance is provided for drivers pulling out of the side roadway to see oncoming traffic along the main roadway. This design allows a wheelchair lift to be deployed anywhere along the bus bay and thus can easily accommodate a wide range of transit vehicle types, though smaller dimensions may be allowable as shown in Figure 7.

Figure 20 depicts an existing EDCTA stop that provides a good example of the guidelines presented in this *Manual.* The stop at Wal-Mart on Missouri Flat Road could be further improved by provision of 8 feet of sidewalk rather than the existing 6 feet between the curb and the shelters, bicycle parking, and a more direct pedestrian connection to the park-and-ride spaces.

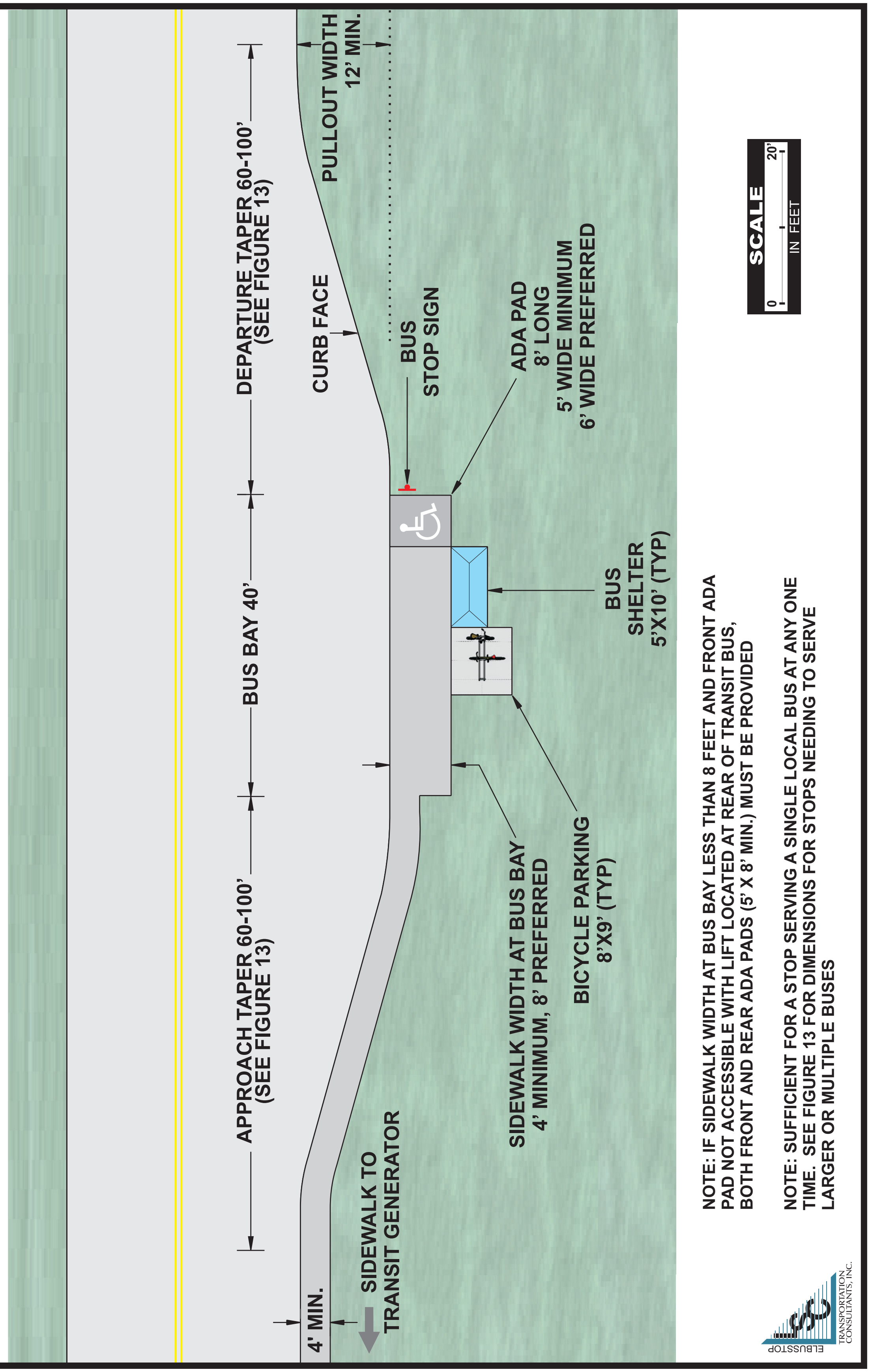
CONSTRUCTION MATERIALS

Various materials can be used to construct amenities at a bus stop. The best materials are those that are weather resistant, can withstand continual use, and can be easily maintained. Easy to clean materials are desirable, especially as bus stops are easy targets for vandalism.

Wood, aluminum, concrete, plastic, tempered glass, and ventilated metal panels are the most commonly-used materials for the construction of bus stop amenities. See Table 7 for the advantages and disadvantages of each.

FIGURE 19

RECOMMENDED BUS STOP DESIGN FOR A TYPICAL LOCAL ROUTE STOP IN AN URBAN AREA



NOTE: IF SIDEWALK WIDTH AT BUS BAY LESS THAN 8 FEET AND FRONT ADA PAD NOT ACCESSIBLE WITH LIFT LOCATED AT REAR OF TRANSIT BUS, BOTH FRONT AND REAR ADA PADS (5' X 8' MIN.) MUST BE PROVIDED

NOTE: SUFFICIENT FOR A STOP SERVING A SINGLE LOCAL BUS AT ANY ONE TIME. SEE FIGURE 13 FOR DIMENSIONS FOR STOPS NEEDING TO SERVE LARGER OR MULTIPLE BUSES

ELBUSSTOP
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FIGURE 20

EXAMPLE OF GOOD EXISTING BUS STOP

MISSOURIFLAT
LSC
TRANSPORTATION CONSULTANTS, INC.

TABLE 7: Advantages and Disadvantages of Various Construction Materials		
Material	**Advantages**	**Disadvantages**
Wood	- Is used to construct benches - Is repaired or replaced easily	- Weathers easily - Can be vandalized easily
Aluminum	- Can be used to construct multiple elements at a bus stop - Resists weathering - Can be inexpensive	- Can be vandalized easily by scratching
Concrete	- Can be installed as a non-slip paving service	- Is too heavy and cumbersome for use other than paving
Plastic	- Is lightweight - Allows unobstructed view into and out of shelter - Can be formed into different shapes	- Can be easily scratched - Declines with exposure to sun and repeated cleaning
Tempered Glass	- Withstands environmental demands better than plastic - Can be cleaned easily - Can be perceived as more attractive than plastic - Allows unobstructed view into and out of shelter	- Can be broken, which can present a safety hazard to patrons
Ventilated Metal Panels	- Resists weathering - Can be inexpensive - Withstands environmental demands	- Can be vandalized easily by scratching
Source: TCRP Report 19, *Guidelines for the Location and Design of Bus Stops.*		

Section 8 • Park-and-Ride/Multi-Modal Facilities

Modern transit passenger facilities are described under a variety of labels. *Park-and-ride* facilities are designed to provide a common location for individuals to park their vehicles and bicycles and transfer to a high-occupancy vehicle for the remainder of their trip. *Multimodal* or *intermodal* centers are designed to provide convenient connections between transit, pedestrian, and bicycle travel modes, and often also provide access to less common forms of public transit, such as rail or ferry services. No matter the name, the common goal of these facilities is to encourage additional public transit usage by maximizing the convenience and safety associated with changing travel modes.

The planning and development of a park-and-ride facility is usually undertaken by the area's transit agency, Caltrans, and local jurisdictions. Caltrans may have excess right-of-way available at desirable park-and-ride locations, or may have the authority to acquire needed property. Caltrans has often undertaken the lead role in developing park-and-ride facilities to meet their own goals and policies and may be most effective when the desired location is outside city limits adjacent to major thoroughfares. The transit agency would likely be involved in the planning, design and ongoing operation of the facility.

Multimodal, or intermodal, centers are typically defined as facilities designed to encourage the transfer between travel modes, over and above the auto – transit transfer provided by a park-and-ride facility. Multimodal facilities collectively address multiple modes of transportation. Transportation is viewed as an integrated system working toward meeting multiple societal goals, and efficient and productive transfer of people and goods from one mode to another is emphasized. Multimodal centers for the purposes of this study are those that facilitate the transfer to buses of users of other modes of transportation. Generally, park-and-ride lots and transit transfer facilities meet this criterion.

PLACEMENT, LOCATION, AND ACCESS

Important factors to consider when planning park-and-ride or other multimodal facilities consist of the following.

- *Impact on Existing Parking Supply* – Transit facilities are often considered for sites currently used wholly or in part for off- or on-street parking. Any proposal that would reduce parking supply in activity centers with "tight" parking supply requires that a parking study be conducted to ensure that adequate parking can be provided for adjacent land uses.

- *Impact on Urban Design* – Transit facilities, particularly in downtown core areas, can be an important "tool" in improving the urban design of established activity centers. By providing a generator of pedestrian activity, a transit facility can revitalize an underutilized portion of a commercial district. In addition, the building can fill a gap in development that can encourage increased pedestrian activity. Any such facility should therefore be considered in light of the potential to stimulate redevelopment of adjacent properties.

- *Impact on Passenger In-Vehicle Travel Time* – Constructing and serving new transit facilities can significantly impact route travel times if located off of an existing route or if traffic congestion results in delays in accessing the facility. As in any route change, the potential benefits to the transit system (such as improved amenities to existing riders or opportunities to attract new riders) needs to be balanced against any increase in overall travel time for existing "through" riders.

- *Impact on Transit Vehicle "Deadheading"* – Transit facilities are often used as the start or end of a transit route. The distance traveled by transit vehicles running out-of-service to and from the vehicle storage yard ("deadhead") can, over time, add substantial costs to the operation of a transit program.

- *Provision of Adequate Land Area* – In addition to providing space for passenger loading and bus bays, a transit passenger facility must also accommodate vehicle circulation, interior space, any setbacks required by local regulation, and landscaping. A site program should be developed prior to the identification of potential sites, and used as criteria for site evaluation.

- *Pedestrian Access* – This factor is critical to the success of a transit facility in generating new ridership in the surrounding area. Transit facilities should be located to maximize the number of potential rider destinations and origins (such as stores, public facilities, and social service agencies) within a one-fourth mile walk distance.

- *Adjacent Land Uses* – It is preferable for transit passenger facilities to be located near commercial establishments, such as drycleaners, convenience stores, and banks, to allow passengers to complete personal errands as part of their transit trip. Some transit properties have also found it beneficial to locate passenger facilities adjacent to day-care centers.

- *Vehicle Access* – Given the high number of transit vehicle movements through a passenger facility over the course of the day, safe and efficient transit access to and from adjacent arterial streets is a crucial consideration. Delays to transit vehicles such as left-turn movements onto busy streets can cause substantial delay to the entire transit system. To avoid this delay, a signalized intersection or modern roundabout may be required to provide adequate access. Vehicle travel paths must also be carefully designed to minimize conflict with pedestrians.

- *Hazardous Materials* – To best serve established commercial centers, transit facilities are often located on "brownfield" sites that have historically been used for industrial or commercial purposes. These sites have a high potential for the presence of hazardous materials, which can dramatically increase the amount of financial resources as well as time needed to complete a project.

- *Environmental Impact* – Transit passenger facilities must also be located and designed to avoid or minimize any potential negative impact of their construction or operation. These potential impacts can include the following.

  - Noise (particularly with respect to nearby residential land uses)
  - Air Quality
  - Wetlands
  - Historic Properties/Parklands
  - Displacement of Existing Land Uses
  - Water Quality
  - Flooding
  - Endangered Species
  - Aesthetics
  - Safety/Security
  - Traffic
  - Parking
  - Ecologically Sensitive Areas
  - Land Use/Local Plans

Any significant impacts associated with a facility will require mitigation, which can often become a large proportion of the total project cost. For smaller communities, the most potentially significant of these impacts are commonly noise, historic properties/parklands, aesthetics, traffic, and parking.

It is evident from this list of factors that the appropriate location of a transit passenger facility requires a careful balancing between the various factors. A successful site selection process entails a quantitative assessment of a wide range of potential sites, as well as a strong public input process.

BUS ACCOMMODATION

For proper systemwide bus circulation, buses should be able to access park-and-ride/ multimodal facilities from all major street directions. The location should, if possible, facilitate left hand turns from one-way streets and right-hand turns from two-way streets for safer movement. Circulation into the site should separate automobile and bus traffic to ease access for both. When feasible, access points should be a minimum of 150 feet from the centerline of the nearest intersection to avoid traffic conflicts. Two access points located on different streets should be provided to the facility whenever possible. Vehicle and pedestrian access should be designed to minimize conflict between buses and pedestrians.

Bus bays should have less than two percent slope along the longitudinal axis of the bus. This will avoid uncomfortable, and potentially unsafe, side slope for wheelchair passengers boarding or deboarding the vehicles.

A key operational factor is the provision of travel paths to and from each bus bay that do not conflict with buses parked in adjacent bays. This allows each route to operate without waiting for other buses to move before entering or exiting the bay, enhancing on-time performance. Modern transit passenger facilities commonly provide these travel paths through the provision of “sawtooth” transit bays. By angling the bays by approximately 16 degrees, buses can be maneuvered to and from each bay while minimizing the total length of curb required to accommodate all bays.

In addition to the passenger loading bays, it is often beneficial to provide at least one parking location for an out-of-service transit bus. This can allow one vehicle to be traded out for another without affecting traffic flow around the center. Parking for transit center staff, and for drivers stopping for transit information, should also be considered.

AMENITIES

Park-and-ride/multimodal facilities should have amenities present to make use of the facilities more pleasant. Amenities that may be useful at such facilities include:

- *Bus shelter(s) and bench(es)* – One or more shelters with benches (the number will depend on demand) should be provided at every facility for the convenience of the passengers. Shelters should be designed to provide the opportunity for protection from winds in all directions, as well as protection from strong, low-angle sun exposure near the end of the day. Larger, staffed centers should provide at least a minimal level of indoor, climate-controlled waiting space, particularly if transit schedules require some passengers to wait substantial periods while transferring.

- *Lighting* – The facility must be well lit, to ensure the safety and convenience of the passengers. The lighting requirements for a specific facility will depend on the layout of the facility.

- *"Kiss and ride"* – A pedestrian curb zone and short-term parking area should be provided for morning drop-off and evening pick-up at park-and-ride lots where there is a demonstrated demand for such uses. The drop-off and pick-up site should be in close proximity to the bus, carpool, and vanpool loading area.

- *Bicycle racks and/or bicycle lockers* – Bicycle parking and storage should be located near the bus shelter/passenger loading area as demand justifies.

- *Motorcycle parking* – Such parking should be provided as demand justifies. If provided, motorcycle parking should be in a specially designed area. The parking stalls should measure 3 feet in width by 8 feet in length.

- *Toilet kiosk* – Where feasible, a conventional water closet and lavatory should be provided at the facility, near the bus shelter.

- *Landscaping* – Landscaping will make the facility more attractive to both current and potential users. Landscaping should be placed where it will not interfere with the safety and personal security of the passengers. Generally, landscaping should be focused on the entrances to the facility and the perimeter of the site. When placing landscaping in the passenger waiting area it is important that the landscaping not interfere with the ability of the waiting passengers to see around them.

PUBLIC/PRIVATE PARTNERSHIP OPPORTUNITIES

Public/private partnerships in the development of park-and-ride/multimodal facilities can be a cost-effective way to construct and maintain such facilities. A partnership can provide benefits to both the transit agency and the development partner. The transit agency should thoroughly analyze the expected cost/benefit ratio to ensure that the proposed partnership will assist the agency in increasing ridership and will generate revenue for use in maintaining the transit service.

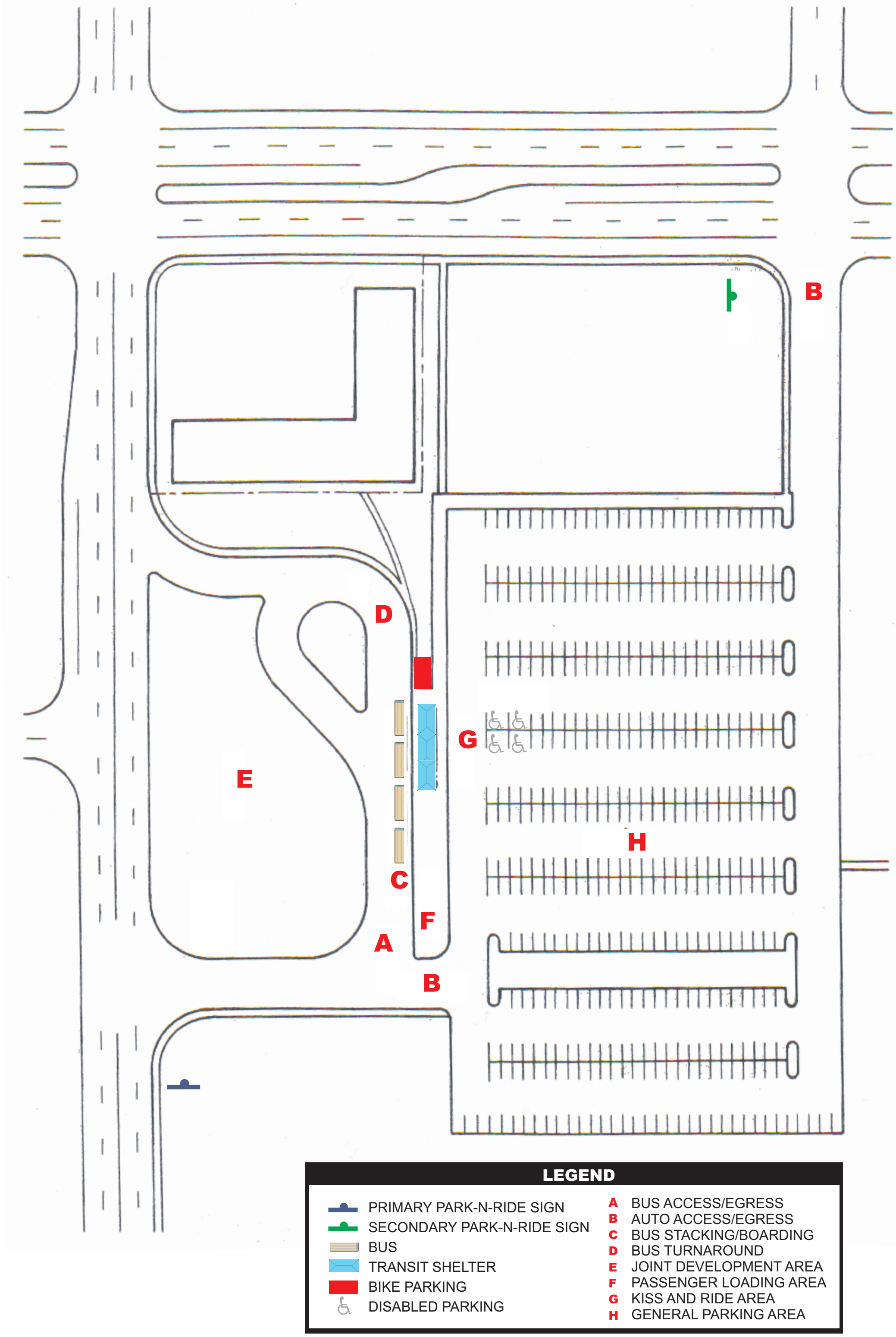
A good example of a public/private park-and-ride facility is the Yuba-Sutter Transit's park-and-ride lot along US 99 at Bogue Road in Yuba City, California, where a convenience store was developed along with the park-and-ride lot. The park-and-ride lot provides additional patronage for the convenience store, while the presence of the store's personnel helps to reduce the potential for vandalism in the park-and-ride lot.

CONCEPTUAL DRAWING

Figure 21 presents a conceptual layout of a park-and-ride lot. The layout is an example only, and is not intended to be a blueprint for the design of a facility. The purpose of the conceptual layout, rather, is to illustrate the features that should, if possible, be included in a park-and-ride facility.

FIGURE 21

CONCEPTUAL DESIGN FOR A PARK-AND-RIDE LOT



ELPARKNRIDE

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SOURCE: TRANSIT FACILITY DESIGN GUIDELINES, REGIONAL TRANSPORTATION DISTRICT, DENVER, COLORADO

Section 9 • Vehicle Turning Radii

Though the importance of the design of turning radii may not be at first apparent, it is of the utmost importance that at any given corner the turning radius be such that the largest vehicle expected to utilize the corner will to be able to turn safely, without damaging either the vehicle or the curb. Inadequate curb radius can also require vehicle travel paths the swing into additional travel lanes, creating potential safety problems. Excessive requirements, however, can increase pedestrian exposure to traffic, thereby increasing potential pedestrian safety problems.

Design templates for a variety of vehicle types and design conditions are presented in Figures 22 to 25. Copying these figures over a clear plastic sheet allows them to be easily laid onto site plans. Each of these templates can be used for either a right-turn design (used face up, as shown) or a left turn (by using face down).

The larger turn radius template for a 40-foot bus presented in Figure 22 is recommended for design of street intersections and other locations where transit vehicles can be expected to travel at speeds greater than 5 mph. The minimum radius template for a 40-foot bus presented in Figure 23 is recommended as a *minimum* feasible design for locations (such as within intermodal centers) where vehicles can be expected to operate at very low speeds, and where space is at a premium.

STREET DESIGN FOR LARGE BUSES

One-Centered-Curve Curbs

One-centered or simple radius curves are adequate for street intersections in urban, low-speed operations, and avoid the higher design and construction cost associated with more complex curves. The minimum curb radius needed to accommodate large transit buses depends upon the presence of on-street parking in the approaching and departing legs of the intersection, and on the number of lanes provided on the departure leg, as shown in Figure 26:

- When turning onto a 2-lane street where parking lanes are provided, a 25-foot minimum curb radius is required, so long as no parking is allowed within 30 feet from the point of tangency of the departure leg.

- When turning onto a 2-lane street from a street where parking lanes are provided, a 25-foot minimum curb radius is required, so long as no parking is allowed within 30 feet from the point of tangency of the departure leg.

- When turning onto a 2-lane or 4-lane street where parking lanes are not provided, a 30-foot minimum curb radius is required.

Note that the El Dorado County Design Standards identify a 20-foot radius for local to collector intersections, a 30-foot radius for minor collector to collector/arterial intersections, and a 32-foot radius (as part of a three-centered curve) for major collector to collector/arterial intersections.

FIGURE 22

STANDARD 40' BUS LARGE TURNING RADII

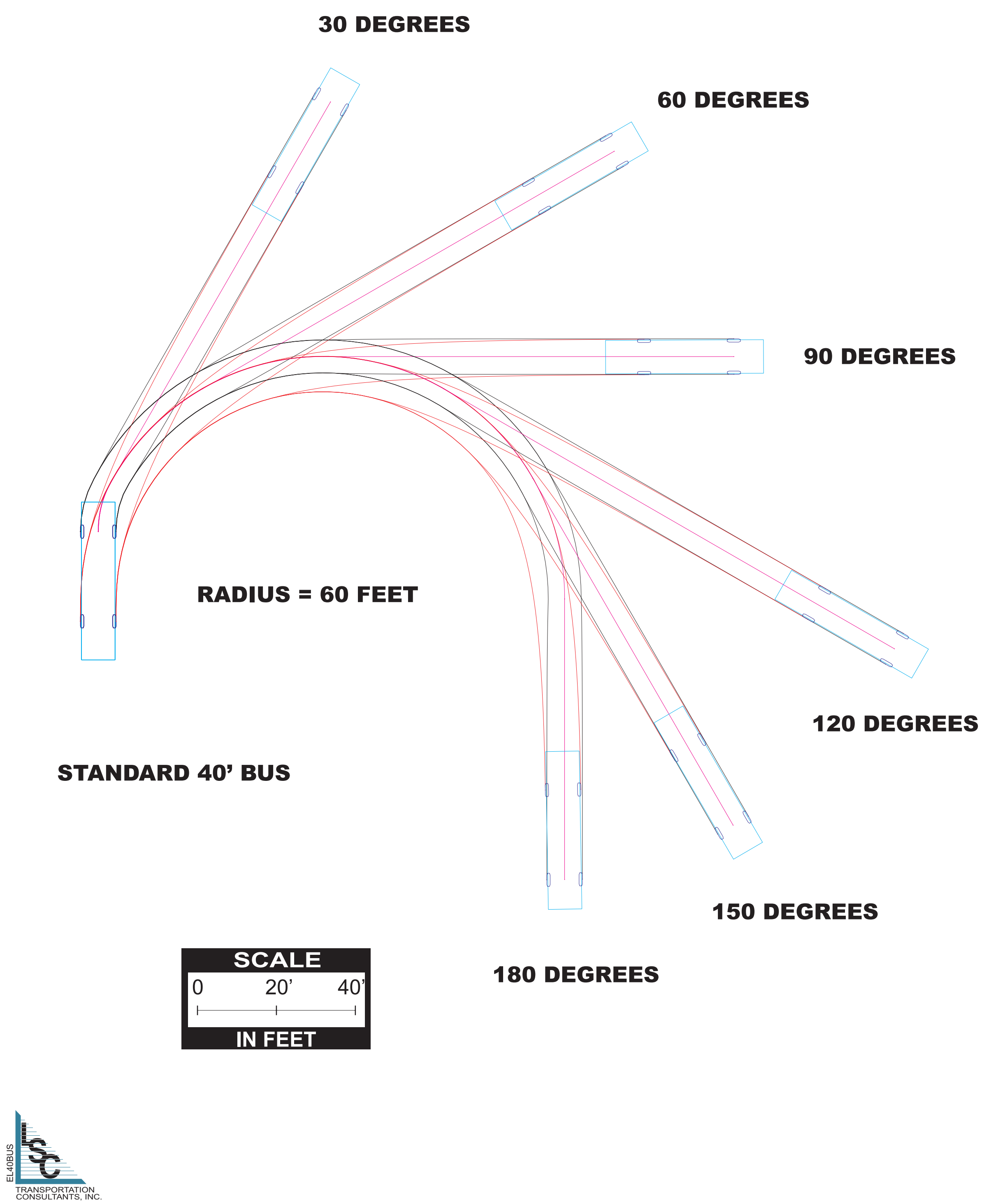


FIGURE 23

STANDARD 40' BUS MINIMUM TURNING RADII

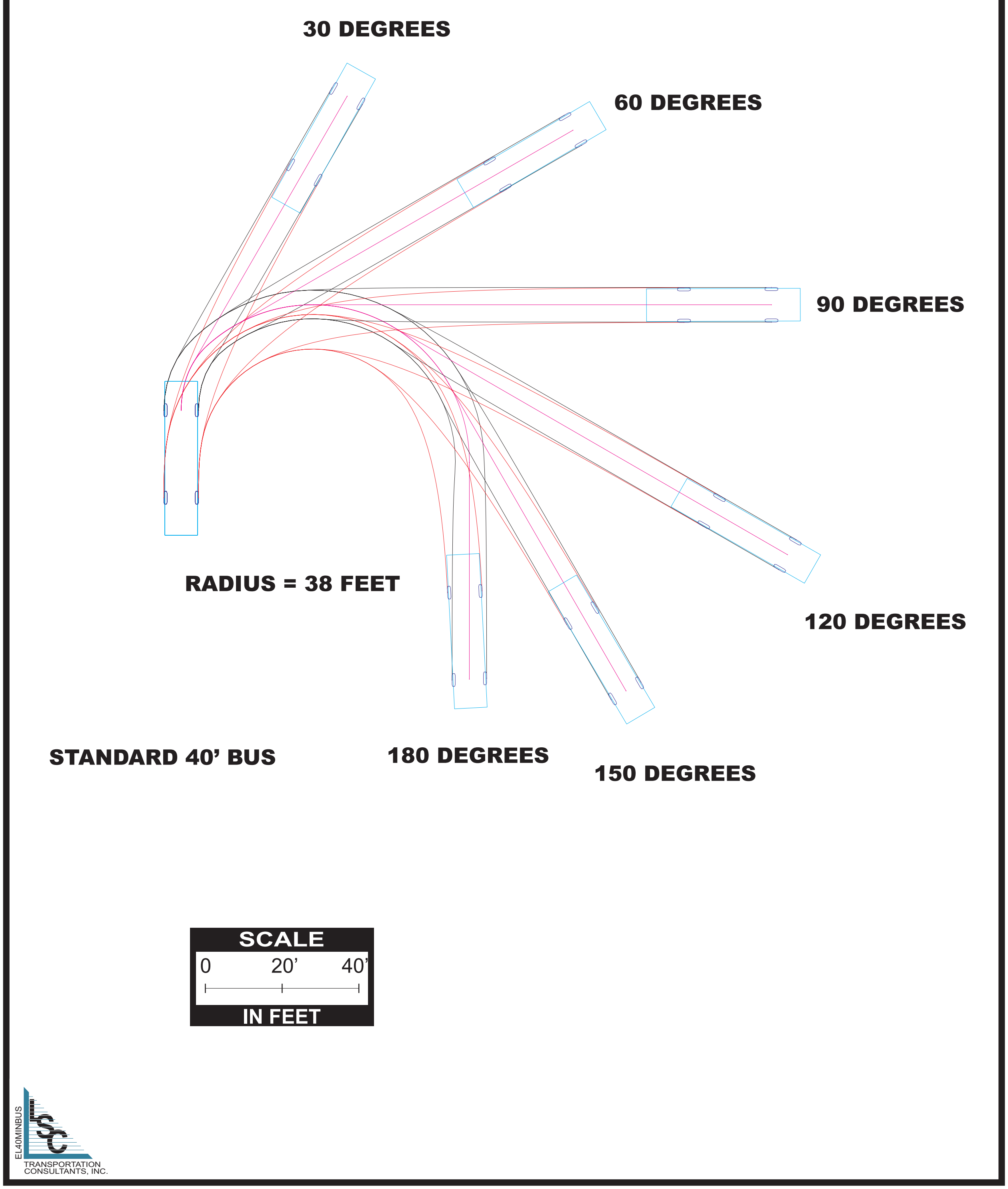


FIGURE 24

STANDARD LOCAL BUS TURNING RADII

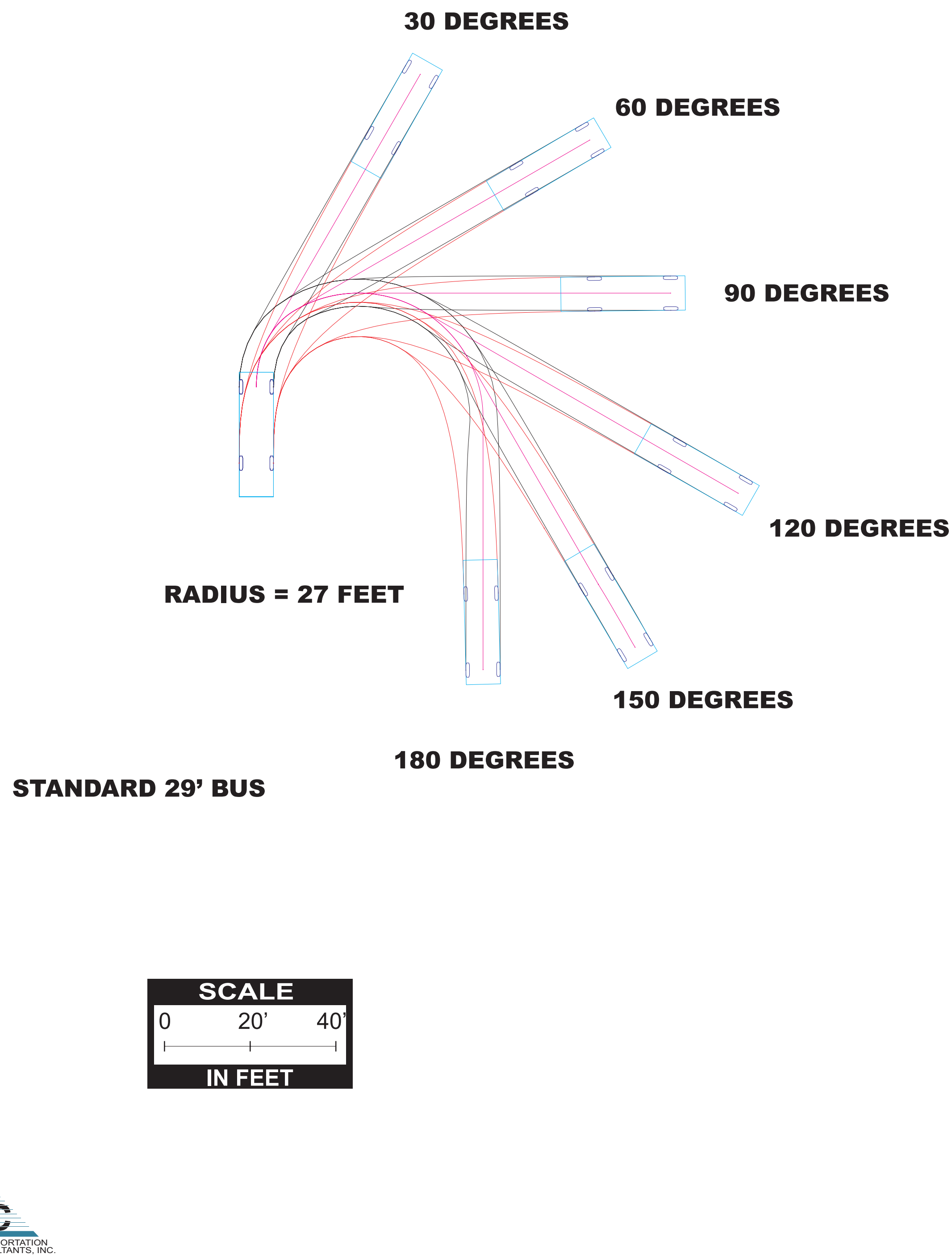


FIGURE 25

STANDARD 16' PARATRANSIT VAN TURNING RADII

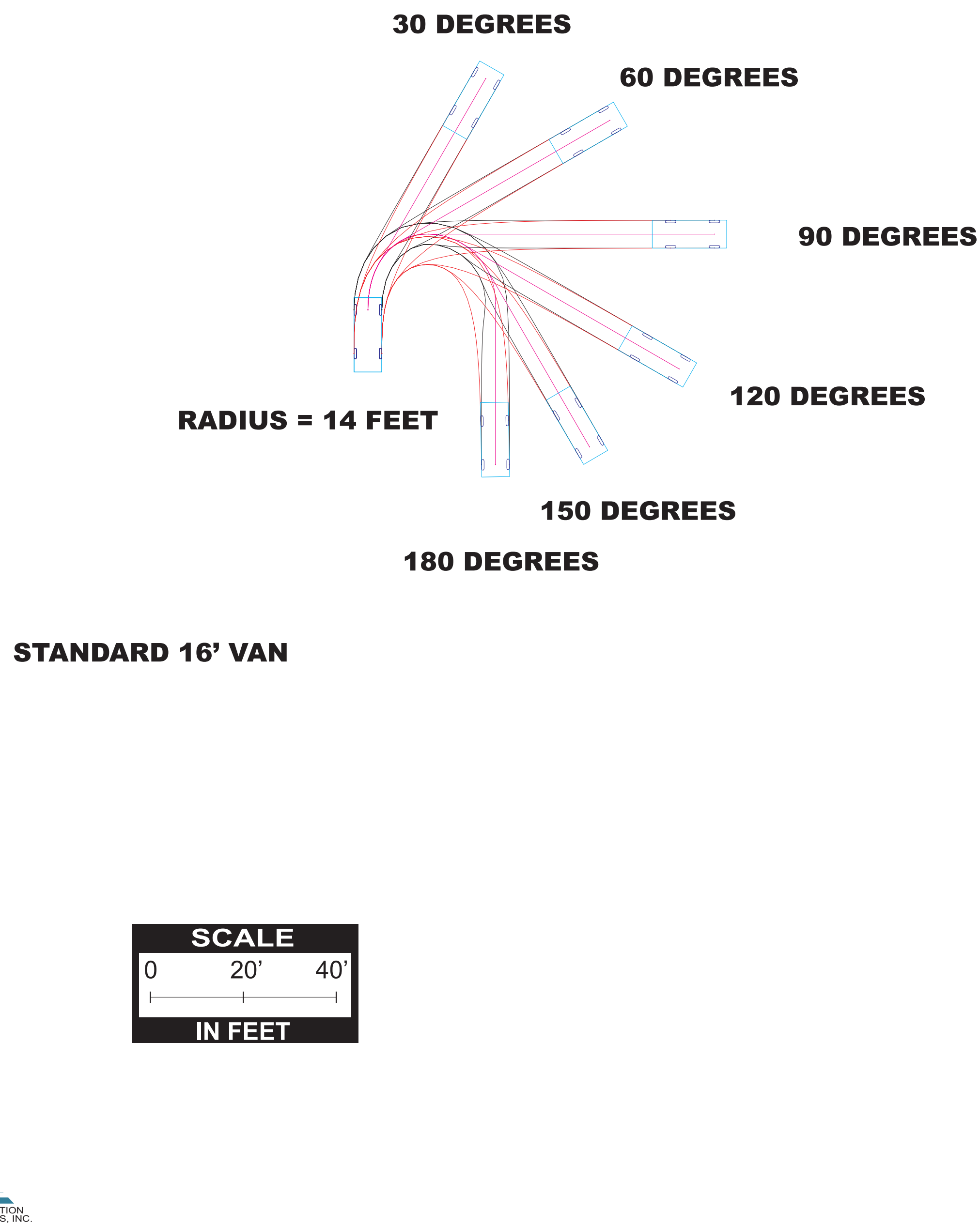
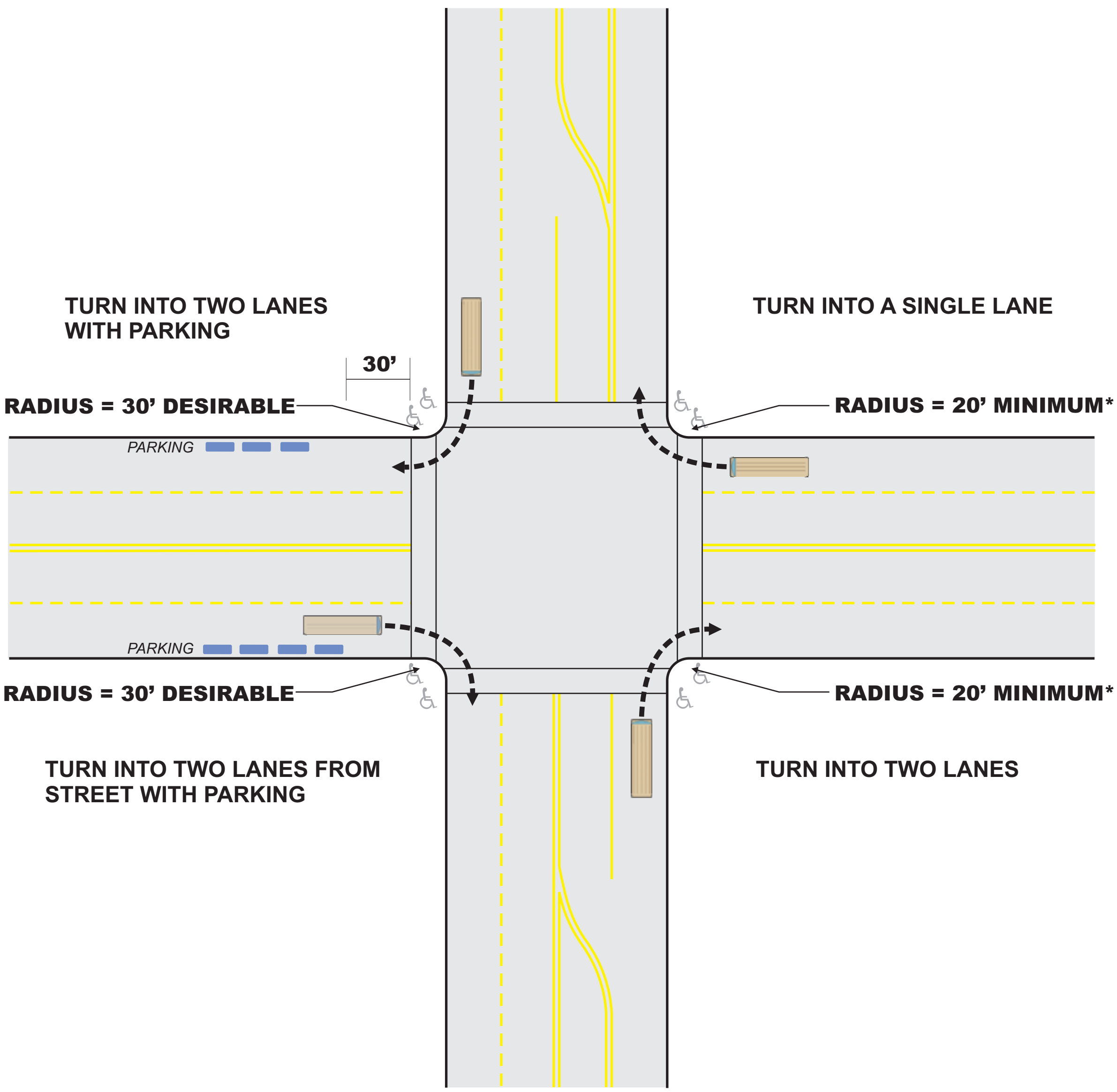


FIGURE 26

INTERSECTION DESIGN FOR BUS TURNS

(with no encroachment in adjacent lanes)



**ASSUMING MINIMUM OF 12' TRAVEL LANES*

LEGEND	
(bus symbol)	BUS
(parked car symbol)	PARKED CAR
♿	ADA COMPLIANT CROSSWALKS
(sign symbol)	BUS STOP SIGN

ELBUSTURNS

LSC TRANSPORTATION CONSULTANTS, INC.

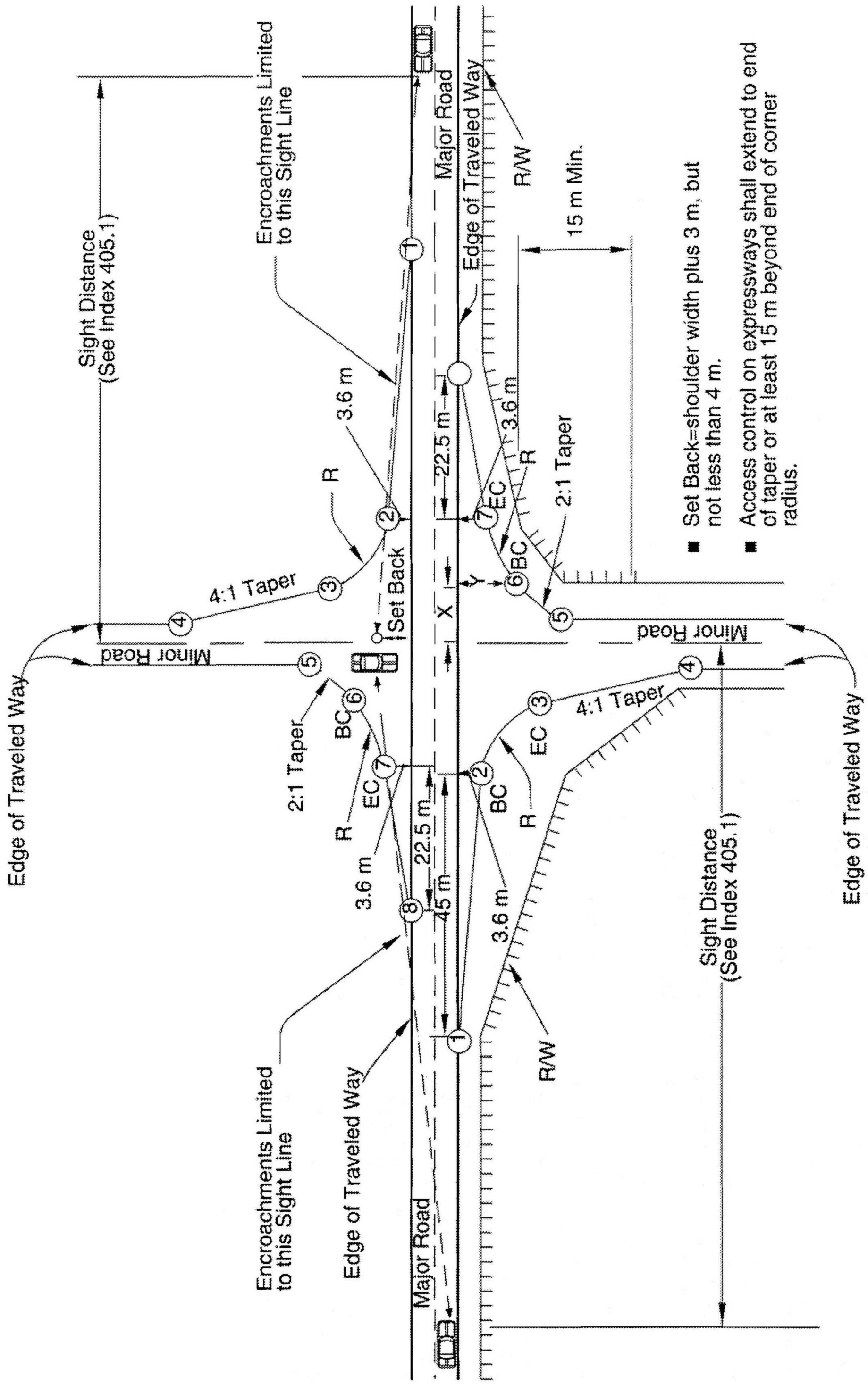
Curbs at High Speed Roadway Intersections

A simple, single curb return radius is generally not appropriate for intersections along public roads with relatively high speed limits (50 mph or above), as they require vehicles to slow to a low speed when exiting the main roadway, or require vehicles to enter the main roadway at a low speed. Traffic flow on the main roadway can be better maintained through the provision of additional transition roadway space for turning vehicles.

Rather than employing compound (two- or three-center curves), Caltrans recommends the use of transition tapers at high-speed public roadway intersections. Figure 27 presents Caltrans' recommended basic design for such intersections, as identified in Figure 405.7 of the Caltrans *Highway Design Manual, 5th Edition*, 1995, as amended. A right-turn off of the main roadway consists of a 9-meter curve radius joined with a 45-meter taper off of the main roadway and a 4:1 taper to the side street. A right turn onto the main roadway consists of a 9-meter curve joined by a 2:1 taper on the crossroad and a 22.5 meter taper on the main highway.

FIGURE 27

CALTRANS RECOMMENDED BASIC INTERSECTION DESIGN



X - Distance measured from centerline of minor road along major road - m.
Y - Offset distance measured from edge of traveled way of major road to any given point - m.

Radius of Curve	Design Vehicle	Pt ① X	Pt ① Y	Pt ② X	Pt ② Y	Pt ③ X	Pt ③ Y	Pt ④ X	Pt ④ Y	Pt ⑤ X	Pt ⑤ Y	Pt ⑥ X	Pt ⑥ Y	Pt ⑦ X	Pt ⑦ Y	Pt ⑧ X	Pt ⑧ Y
9 m	Bus	61.26	0.0	16.26	3.6	8.25	10.39	3.6	28.97	3.6	12.20	5.47	8.46	12.10	3.6	34.60	0.0
12 m	California	64.52	0.0	19.52	3.6	8.84	12.65	3.6	33.61	3.6	16.01	6.56	10.08	15.40	3.6	37.90	0.0
15 m	STAA	67.85	0.0	22.83	3.6	9.47	14.91	3.6	38.39	3.6	22.69	9.09	11.70	20.14	3.6	42.64	0.0

Source: Figure 405.7, Public Road Intersections, Highway Design Manual, 400-21, November 1, 2001.

Section 10 • Glossary of Terms

Accessway – a paved connection, preferably non-slip concrete or asphalt, which connects the bus stop waiting pad with the back face of the curb.

Advertising shelter – a bus shelter that is installed by an advertising agency for the purpose of obtaining a high-visibility location for advertisements. By agreement, the bus shelter conforms to the transit agency specifications but is maintained by the advertising company.

ADA – American's with Disabilities Act of 1990. The Act supplants a patchwork of previous accessibility and barrier-free legislation with a comprehensive set of requirements and guidelines for providing *reasonable* access to and use of building, facilities, and transportation.

Amenities – specific passenger or bus features that enhance public transportation by providing or increasing comfort or convenience.

Approach Leg – the leg of a street intersection that a vehicle travels to enter the intersection.

Bollards – a concrete or metal post placed into the ground behind a bus shelter to protect the bus shelter from vehicular damage.

Bus bay – a specially constructed area off the normal roadway section for bus loading and unloading.

Bus berth – the designated space for a bus at a transit facility.

Bus stop – a waiting, boarding, and alighting area designated by distinctive signs.

Bus stop zone length – the length of a roadway marked or signed as available for use by a bus loading or unloading passengers.

Bus turning radii – the turning radii necessary to accommodate bus turning movements.

Bus pullout – a bus stop located in a recessed curb area, separated from moving lanes of traffic.

Catchment Area – the area around a bus route in which people are considered within walking distance of the service (usually 1,500 feet).

Corridor – an area between two termini distinguished by certain physical or travel characteristics that set it apart from the surrounding area.

Curb-side factors – factors that are located off the roadway that affect patron comfort, convenience, and safety.

Curb-side stop – a bus stop in the travel lane immediately adjacent to the curb.

Deadhead – a bus operating without passengers and not on a designated revenue route, such as to or from the garage and the beginning or end of a route.

Departure leg – the leg of a street intersection that a vehicle travels to exit the intersection.

Dwell time – the time a bus spends at a stop, measured as the interval between its stopping and starting.

Entrance radii – dimensions for curves which form the intersection of an access point to a development and an abutting street.

Far-side stop – a bus stop located immediately after an intersection.

Grade – the rate of ascent or descent of a roadway, expressed as a percent.

Headway – the interval between the passing of the front ends of successive buses moving along the same lane in the same direction, usually expressed in minutes.

HOV – High occupancy vehicle such as a bus.

Landing pad – a paved, usually concrete, surface upon which a passenger can wait for a bus at a bus stop.

Layover – time built into a schedule between arrivals and departures, used for recovery of delays and preparation for the return trip.

Level of service (LOS) – the comfort, convenience, safety and utility of transportation service, measured differently for various types of transportation systems.

Load factor – the number of passengers actually carried by divided by the total passenger capacity of the vehicle (generally expressed as a percentage).

Local service – Low speed transportation operation designed to make frequent stops along a route, and typically provided by buses.

Mid-block stop – a bus stop within the block.

Modal split – the proportion of trips split between travel modes, a term describing the proportion of persons using alternative forms of transportation.

Near-side stop – a bus stop located immediately before an intersection.

Nub – a stop where the sidewalk is extended into the parking lane, which allows the bus to pick up passengers without leaving the travel lane, also known as bus bulbs or curb extensions.

Off-peak – those periods of the day when demand for transit service is not at its maximum.

Paratransit – flexible transportation services which are operated publicly or privately, are distinct from conventional fixed-route, fixed-schedule transit, and can be operated on the existing highway and street system, generally with low-capacity vehicles. Examples include vanpools, jitney, shared-ride taxi, subscription bus service, and demand-responsive services.

Park-and-Ride – a location which provides parking for individual automobiles and a transfer point to HOVs.

Passenger alighting – passengers getting off a transit vehicle.

Passenger boarding – passengers getting on a transit vehicle.

Peak service - operation of the maximum number of vehicles during the peak period.

Point of curvature – the point on a straight line where a curved line begins.

Point of tangency – the point on a curved line where a straight line begins.

Priority lane - a lane reserved generally during specific hours for high-occupancy vehicles (e.g. buses, carpools, or vanpools).

Queue – a waiting line of vehicles.

Revenue miles – vehicle-miles operated when in customer service.

Right-of-way – a general term denoting land, property, or interest therein; usually in a strip acquired for or devoted to transportation purposes.

Roadway geometry – the proportioning of the physical elements of a roadway, such as vertical and horizontal curves, lane widths, cross sections, and bus bays.

Route – specified path followed by a bus along which it picks up and discharges passengers.

Running time – the scheduled elapsed time between certain points along each route. Scheduled running time varies with the time of day due to expected delay created by other transportation modes.

Service area – a geographic locale or region where transit service is provided.

Shelter – a curb-side amenity designed to provide protection and relief from the elements and a place to sit while patrons wait for the bus.

Sight distance – the portion of the highway environment visible to the driver.

Street-side factors – factors associated with the roadway that influences bus operations.

TCRP– Transit Cooperative Research Program sponsored by the Federal Transit Administration; provides reports and data used as sources throughout this handbook.

Terminus – either end of a route.

Trip – a one-way movement of a person or vehicle between two points for a specific purpose.

Upstream – toward the source of traffic.

Vehicle loading – the ratio of passengers to seats on a transit vehicle.

Waiting or accessory pad – a paved area that is provided for bus patrons and may contain a bench or shelter.

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Appendix A

EDCTA Development Review Checklist

<table>
<tr><th colspan="6">EDCTA DEVELOPMENT REVIEW CHECKLIST</th></tr>
<tr><td colspan="6">Project/Title</td></tr>
<tr><td colspan="6">Jurisdiction/Location</td></tr>
<tr><td colspan="3">Reviewer</td><td colspan="3">Date</td></tr>
<tr><td>Type of Project</td><td>☐ Capital Project</td><td colspan="2">☐ Development Project</td><td colspan="2">☐ Other:</td></tr>
<tr><td>Type of Review</td><td>☐ Initial Consultation</td><td colspan="2">☐ Project Application Review</td><td colspan="2">☐ Other:</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td colspan="4">Key Issues</td><td>Yes/No /NA</td><td>Notes</td></tr>
<tr><td colspan="6">Transit Operations</td></tr>
<tr><td colspan="4">Is the project on an existing or planned transit route?</td><td></td><td></td></tr>
<tr><td colspan="4">Does the project provide for direct, efficient transit service?</td><td></td><td></td></tr>
<tr><td colspan="4">Does the project provide for safe transit service?</td><td></td><td></td></tr>
<tr><td colspan="4">Does the project warrant bus pullouts?</td><td></td><td></td></tr>
<tr><td colspan="4">If roadway improvements are proposed, do they meet EDCTA standards?</td><td></td><td></td></tr>
<tr><td colspan="4">If the site will be served by Dial-A-Ride, is adequate access and passenger loading area provided?</td><td></td><td></td></tr>
<tr><td colspan="6">Bus Stop Improvements</td></tr>
<tr><td colspan="4">Does project propose to provide a transit stop or stops?</td><td></td><td></td></tr>
<tr><td colspan="4">Do proposed stop locations provide safe conditions, including adequate passenger and driver sight distances?</td><td></td><td></td></tr>
<tr><td colspan="4">Is the site adequately served by existing stops?</td><td></td><td></td></tr>
<tr><td colspan="4">Considering ridership and existing stops, is a new stop warranted?</td><td></td><td></td></tr>
<tr><td colspan="4">Is a bus bench warranted?</td><td></td><td></td></tr>
<tr><td colspan="4">Is a bus shelter warranted?</td><td></td><td></td></tr>
<tr><td colspan="4">Pedestrian access?</td><td></td><td></td></tr>
<tr><td colspan="4">If improvements are proposed, do they meet EDCTA and ADA standards?</td><td></td><td></td></tr>
</table>

EDCTA DEVELOPMENT REVIEW CHECKLIST		
Site Design		
Does the design concentrate activity near transit stops?		
Does the design provide safe and attractive pedestrian connections to activity centers?		
Does the land use and pedestrian network design maximize the potential ridership within a quarter-mile walk of a stop?		
Does the design provide pedestrian/bicycle connections to nearby facilities?		
Does the project generate the potential for transit passengers crossing busy streets at unprotected locations?		
Are there opportunities to provide passenger amenities (canopies, benches) as part of building designs?		
Does the design enhance security through adequate lighting and line of sight?		
Other Comments:		

Appendix B

Examples of Recommended Bus Pullout Dimensions in Other Jurisdictions

TABLE B-1: Examples of Recommended Bus Pullout Dimensions						
	Dimensions (feet)					
Source	Berth For One Bus	Approach Taper	Departure Taper	Deceleration Lane	Acceleration Lane	Total Length
Washoe County, Nevada, *Planning for Transit*						
25 mph or Less	50	40	40	n/a	n/a	130
26 to 35 mph	50	60	60	n/a	n/a	170
36 to 45 mph	50	80	80	n/a	n/a	210
Above 45 mph	50	100	100	n/a	n/a	250
San Diego, California, *Designing for Transit*						
Minimum	50	60	40	n/a	n/a	150
Desirable	50	80	60	n/a	n/a	190
Maryland Department of Transportation, *Access by Design*						
Local Street	50	50	50	n/a	n/a	150
Minor Arterial (Minimum)	50	50	50	n/a	n/a	150
Minor Arterial (Desirable)	50	100	100	n/a	n/a	250
Major Arterial (Minimum)	50	100	100	n/a	n/a	250
Major Arterial (Desirable)	50	150	150	n/a	n/a	350
TCRP Report 19, *Guidelines for the Location and Design of Bus Stops*						
Through Speed 35 mph	50	170	170	184	250	824
Through Speed 40 mph	50	190	190	265	400	1,095
Through Speed 45 mph	50	210	210	360	700	1,530
Through Speed 50 mph	50	230	230	470	975	1,955
Through Speed 55 mph	50	250	250	595	1,400	2,545
Through Speed 60 mph	50	270	270	735	1,900	3,225