

PORT AUTHORITY OF ALLEGHENY COUNTY

BUS STOP

and STREET

DESIGN GUIDELINES



ACKNOWLEDGEMENTS

Port Authority of Allegheny County (PAAC) provides public transportation throughout Pittsburgh and Allegheny County.

The Authority's 2,600 employees operate, maintain and support bus, light rail, incline and paratransit services for approximately 200,000 daily riders.

Port Authority is governed by an 11-member board – unpaid volunteers who are appointed by the Allegheny County Executive, leaders from both parties in the Pennsylvania House of Representatives and Senate, and the Governor of Pennsylvania. The board and its committees hold regularly scheduled public meetings.

Port Authority's budget is funded by fare and advertising revenue, along with money from county, state, and federal sources. The Authority's finances and operations are audited on a regular basis, both internally and by external agencies.

Port Authority began serving the community in March 1964.

Participants

Port Authority of Allegheny County would like to thank agency partners for supporting the Bus Stop and Street Design Guidelines, and all those who participated by dedicating their time and expertise.

These Bus Stop and Street Design Guidelines are administratively issued and maintained by the Development Division. These Guidelines are subject at all times to applicable federal, state and local laws, regulations and ordinances and any and all applicable Board-adopted policies. These Guidelines may be amended, modified or revoked at any time by Port Authority, in its sole discretion.

This document was created in collaboration with the City of Pittsburgh.

Title VI Discrimination Policy

Port Authority of Allegheny County hereby gives public notice of its policy to assure full compliance with Title VI of the Civil Rights Act of 1964. Port Authority is committed to ensuring that no person is excluded from participation in, or denied the benefits of its services on the basis of race, color or national origin as protected by Title VI of the Civil Rights Act of 1964, as amended.

No person or group of persons shall be discriminated against with regard to the routing, scheduling or quality of transportation service furnished by Port Authority of Allegheny County on the basis of race, color or national origin. Frequency of service, age and quality of vehicles assigned to routes, quality of stations serving different routes and location of routes may not be determined on the basis of race, color or national origin.

Published on July 18, 2019

**Port
Authority**

**CDM
Smith**

CONTENTS

1.	INTRODUCTION	5
	Purpose	6
	Bus Stop Goals	7
	Stakeholders	7
2.	BUS STOP LOCATION	9
	Identifying Bus Stop Need	10
	Bus Stop Placement	11
	Bus Stop Spacing	15
3.	CURBSIDE DESIGN	17
	Stop Typology	18
	Stop Considerations	23
	Bus Stop Signage	24
	Bus Stop Configurations	25
	Bike Lane Considerations	28
4.	BUS STOP AMENITIES	33
5.	STREET DESIGN STANDARDS FOR TRANSIT VEHICLES	39
	PAAC Fleet	40
	Intersection Design	41
	Roadway Design	43
6.	PROCESS FOR CHANGES	45
	Bus Stop Placement Checklist	46
	Transit Compatibility Checklist	47
	ADA Guidelines	48
	Proposing Changes	49
7.	APPENDIX	51
	Glossary of Terms	52
	Bus Dimensions	54
	Fleet Door Spacing	56
	Sources	58

1.



A photograph of a city street scene. On the left, a tall brick building with many windows is visible. A blue bus is partially visible in the lower-left corner. In the foreground, there are streetlights and a crosswalk. Pedestrians are walking on the sidewalk. The background shows other buildings and a clear sky.

INTRODUCTION

Purpose

Bus Stop Goals

Stakeholders

PURPOSE

The Port Authority of Allegheny County (to be referred to as PAAC throughout the document) serves the 775-square mile area within and immediately adjacent to Allegheny County. As of 2019, PAAC provides public transit services via 97 fixed bus routes, 2 light rail lines (with 3 total routings), 2 inclined planes, and demand-response paratransit known as ACCESS. Though PAAC oversees them, one of the inclined planes as well as the paratransit services are operated by other providers. Altogether, these services provide over sixty-two million rides annually in and around Allegheny County in southwestern Pennsylvania.

The Guidelines detailed in this document are intended to guide local comprehensive plans, land development ordinances, site or subdivision plans and transportation/mobility plans. These guidelines are based on a review of standards and best practices applied nationally and at other transit agencies.

The purpose of this document is to educate local planners, transportation agency staff, developers, property owners, and decision-makers about the needs of transit riders and transit operations and offer clear and uniform guidance to coordinate the design and placement of bus-related facilities and amenities.

A consistent set of guidelines assists municipalities in PAAC's service area, local developers, and other local partners in designing ideal transit stops. Many bus stops in Allegheny County do not necessarily meet these guidelines today. Going forward, PAAC seeks to encourage municipalities and developers to update bus stops to these Guidelines. These are only guidelines; PAAC can strongly suggest these elements be adhered to, however, PAAC can choose not to serve a particular stop if conditions are poor. PAAC actively works with communities to improve access to bus stops, by including sidewalks, safe street crossings, accessible curb ramps and bicycle lanes.

The Guidelines encourage partnerships with the community and property owners. A high-quality transit stop is one that is well connected to the neighborhood or community it serves, accommodates the needs of all transit passengers freely and comfortably, and permits efficient and cost-effective transit operations.

PAAC recognizes that every location is unique and that a given transit stop's jurisdictional and physical context may offer opportunities to meet these guidelines in some ways but not in others. As a result, this should be viewed as a guiding document, offering templates for desirable facilities and amenities wherever it is possible to provide them.

To make transit more attractive and accessible in the days ahead, especially to new riders, PAAC staff works with local governments, developers, and/or property owners as well as the Pennsylvania Department of Transportation to encourage provision of transit amenities and community infrastructure that make finding, waiting for and boarding a bus a safe, accessible, convenient and pleasant experience.

The bus stop is the first point of contact between the passenger and the bus service. The spacing, location, design, and operation of bus stops significantly influence transit system performance and customer satisfaction.

These Guidelines will encourage a more consistent, more accessible, and better connected network of bus stops over time. By assembling the information into a single document, public agencies and developers will more easily be able to incorporate transit needs into the design and operations of streets and highways, as well as in land development.



Downtown Bus Stop on Wood Street



Passengers Alighting on 5th Avenue at Atwood Street

BUS STOP GOALS

PAAC maintains the following goals for its bus stop program:



STAKEHOLDERS

The key stakeholders in bus stop location and design include:

- **The Transit Agency** - The transit agency is usually the primary provider of transit service.
- **City Government** - The authority with jurisdiction over the streets and sidewalks in the transit service area is usually a city, but county or state agencies are sometimes involved.
- **Developers** - Developers provide new construction and growth in the transit service area. Development may be either residential or commercial. Though both are concerned with access, the specific nature of those concerns may vary between residential and commercial development.
- **Employers** - Employees and retail customers are potential transit riders. Employers benefit when their employees and customers can travel to work easily and efficiently.
- **Neighborhood Groups** - Neighborhood residents are potential consumers of transit service, and potential supporters of transit, whether they use this service or not.
- **Key Destinations** - These are the trip generators (central business districts, schools, shopping areas, public buildings, medical facilities, etc.) for those who work at these locations, and for those who use the services provided at these locations.

While the individual priorities of these stakeholders may vary, they have the same interest in the potential benefit of timely, safe, and convenient transit service. They are the owners of bus stop location and design. Although specific methods must vary to suit each particular situation, the challenge is to use their common interest to productively involve relevant stakeholders so that efficient transit service can result.

2.



BUS STOP LOCATION

Identifying Bus Stop Need

Bus Stop Placement

Bus Stop Spacing



IDENTIFYING BUS STOP NEED

A transit agency considers the following when determining when a bus stop may be needed:

Transit Agency Policy

- Route types (definitions and criteria)
- Guidelines for stop installation (boardings and alightings, headways, land use)
- Special cases/Exceptions (neighborhood requests, hospitals, procedures)

Equity

- Title VI - Civil Rights Act of 1964 (equity in level of service among different segments of the community)
- Public Relations (perceptions, media attention, community leaders)
- Transit dependent areas (demographics, socioeconomic, unique needs)

Accessibility/ADA

- Access to the stop (sidewalks, curb cuts, pedestrian crossings)
- Access to amenities (shelter dimensions, width of walkways)
- Access at the stop (level loading area, lift deployment space)

Location Factors

Various factors relating to transit operations are also important in determining the need for a bus stop:

Trip Generation/Land Use

How many potential bus passengers?

Walking Distance

How far do passengers have to walk?

Boardings and Alightings

How many passengers are getting on and off?

Dwell Time

How long does the bus dwell at the stop?

Travel Time

How long is the trip from the origin to the rider's destination?

Transfer Potential

How many routes serve this stop?



5th Avenue and Bigelow Boulevard near the University of Pittsburgh



Passengers at Forbes Avenue and Murray Avenue

BUS STOP PLACEMENT

As of the issuance of these Guidelines, PAAC has approximately 7,000 bus stops in its system. Many of these stops were established by the 33 transit companies which were consolidated to form Port Authority Transit in 1964, and have been maintained at their original location. Since then, other stops have been established, moved, or eliminated in response to requests by PAAC personnel, municipal officials, property owners, and the general public.

General Locations and Considerations

As the first point of contact between the passenger and the transit service, the bus stop is a critical element in a transit system's overall goal of providing timely, safe, and convenient transportation.

Several universal concerns of both users and providers of transit services include the following:

Safety: Safety is the freedom from danger and risk. In the transit environment it includes an individual's relationship to buses and general traffic, and the bus' relationship to other vehicles. Pedestrian safety issues include the nearness of a bench to the flow of traffic on a busy street or safely crossing the street to reach the bus stop. Bus reentry into the flow of traffic is an example of an operational safety concern. Thus, pedestrians, bus passengers, buses, and private vehicles can all be involved in concerns for safety at or near a bus stop.

Transit System Performance: Travel time for a bus trip has four components: the time it takes to walk to the bus stop, the wait time for the bus, the actual in-vehicle travel time, and the time to walk to the destination. Each is affected by the bus stop location and the frequency of the bus stops.

These are the functional and performance-related concerns in public transportation. Each must be addressed to achieve the goal of timely, safe, and convenient public transportation and to satisfy the needs of the service area. More importantly, to those who plan bus stops, each area of concern is influenced by the bus stop location and design decisions.

An additional list of concerns is provided for both operating and safety when it relates to bus stop placement:

Safety

- Passenger protection from passing traffic
- Access for people with disabilities
- All-weather surface to step from/to the bus
- Proximity to passenger crosswalks and curb ramps
- Proximity to major trip generators
- Convenient passenger transfers to routes with nearby stops
- Proximity of stop in the opposite direction
- Street lighting

Operating

- Adequate curb space for stacking
- Impact of the bus stop on adjacent properties
- On-street automobile parking and truck delivery zones
- Bus routing patterns
- Directions (i.e., one-way) and widths of intersection streets
- Types of traffic signal controls (signal, stop, or yield)
- Volumes and turning movements of other traffic
- Width of sidewalks
- Pedestrian activity through intersections
- Proximity and traffic volumes of nearby driveways

BUS STOP PLACEMENT

Street Location

Bus stops can be located in one of three areas on the street: near-side, far-side, and mid-block. Each variation has their advantages and disadvantages. A brief description of each stop is also provided below.

Near-Side Stop

Advantages

- Minimizes traffic interference during peak traffic flow hours.
- Passengers are able to board the bus closer to the crosswalk.
- Bus can use the intersection for acceleration space.
- Avoids double stopping for both signal and passenger movements.
- The driver has the advantage of full view of intersection activity.
- Can be coordinated with a far-side stop to allow transfers without crossing the street.

Disadvantages

- Conflicts between the bus and right-turning vehicles may arise.
- The bus can physically obscure general traffic and pedestrian sight lines.
- Multiple buses queuing during peak hours may obstruct traffic.
- May present a conflict between pedestrians crossing and passengers boarding the bus.
- Bus may sit through two cycles of a traffic signal due to passenger boarding or dwell time.



Bus at Intersection after Near-Side Stop

Far-Side Stop

Advantages

- Minimizes conflicts with right-turning vehicles.
- Minimizes sight line conflicts for drivers and pedestrians.
- Encourages pedestrians to cross more safely behind the bus.
- Creates a shorter deceleration zone for the stop area.
- The gap in traffic flow created by the signal allows the bus to pull back into the travel lane.

Disadvantages

- Bus may be caught in the intersection, resulting in “blocking the box”.
- A bus stopped near the intersection may block sight lines for pedestrians and vehicles crossing the intersection.
- Can cause the bus to double stop (once for the light and once for passenger activity).
- Rear-end incidents may be more frequent if distracted drivers do not realize the bus is stopping beyond the intersection.



Bus Approaching a Far-Side Stop

Mid-Block Stop

Advantages

- Minimizes sight line obstructions for both driver and passengers.
- Because the stop is located away from intersection activity, conflicts with intersection traffic are minimized.
- A more spacious waiting area may be provided because the stop is located outside intersection sidewalk congestion.
- Works well when a high volume of passengers board and alight, or the bus has an extended dwell time.
- Greater passenger convenience at key mid-block trip generators.

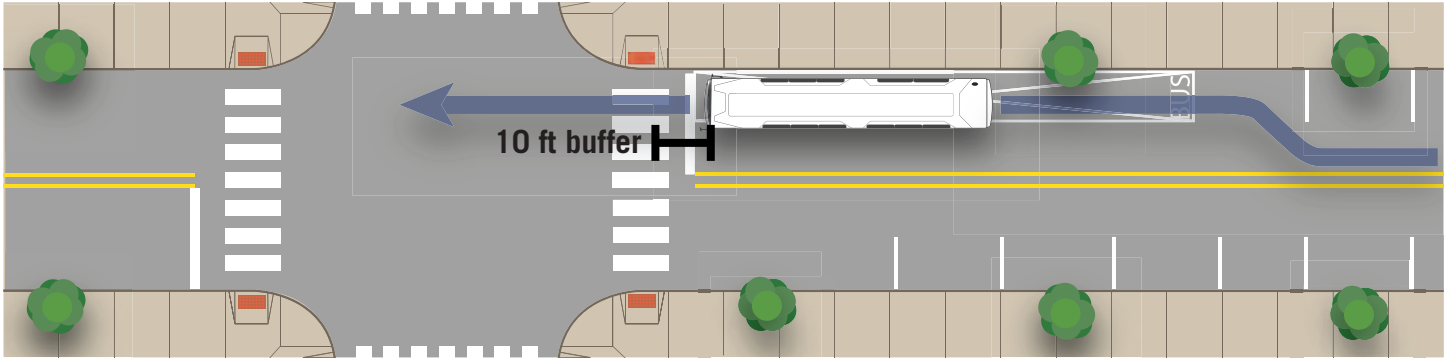
Disadvantages

- Can present safety concerns if a mid-block crosswalk is not provided.
- Requires more physical space for the bus to accelerate and decelerate.
- Reduces space available for on-street parking because this stop type requires a longer bus zone.

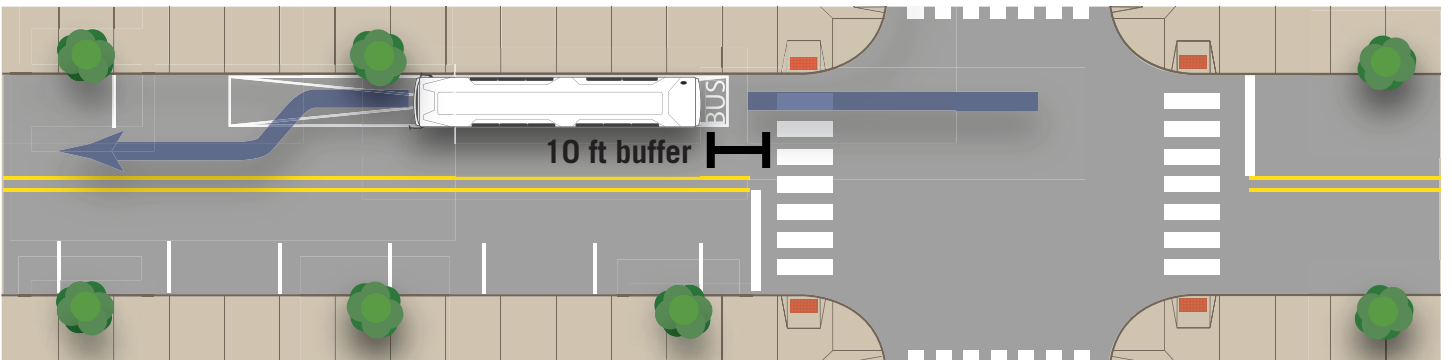


Mid-Block Stop on Wood Street

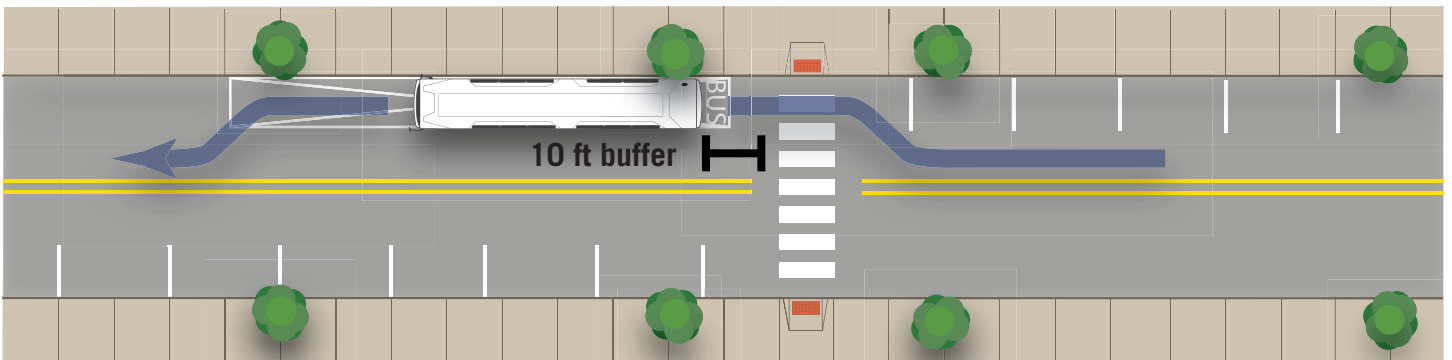
Near-Side Stop



Far-Side Stop



Mid-Block Stop



BUS STOP PLACEMENT

PAAC's transit system is focused on areas of activity within a network of intersections that emphasize pedestrian mobility at its core. The system operates within Pittsburgh's existing and growing development space, so overlap with commercial driveways is common. The interaction of buses with intersections and driveways introduces opportunities for conflict, both for buses and passengers.

Driveways

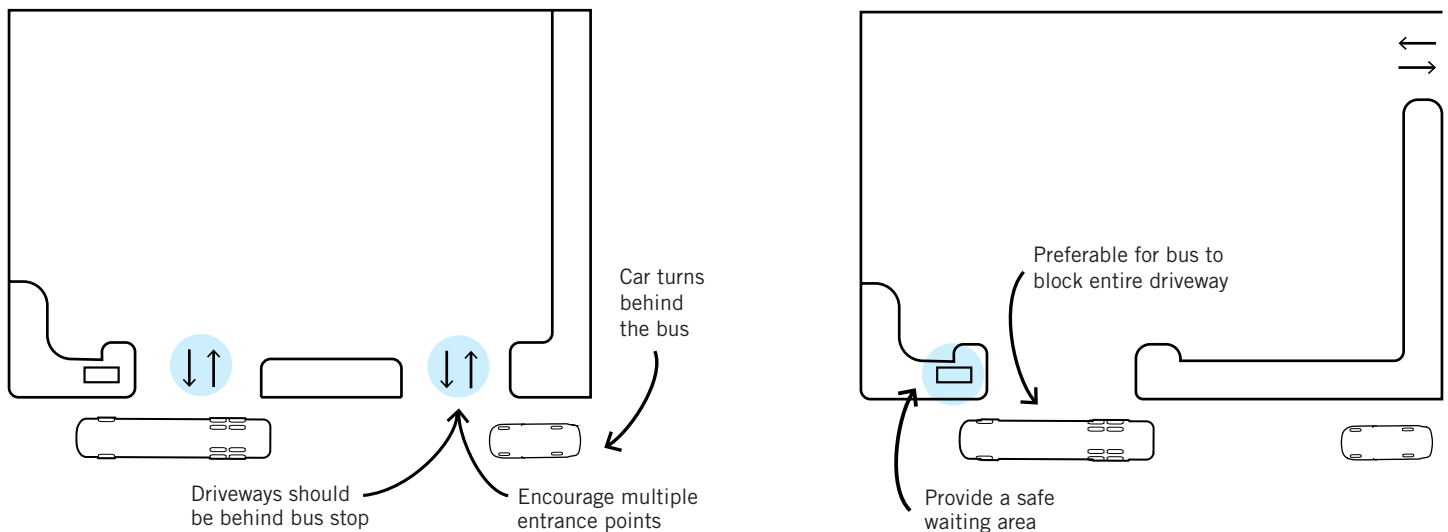
Stops need to make the best use of available space and avoid sight distance issues. Buses stopped at intersections may block visibility for both pedestrians attempting to cross the street and vehicles attempting to enter the roadway. Placement of the stop should balance the need to be near the intersection for passenger access and the need to maintain safe visibility. Placement near driveways should be avoided when possible, but poor access along corridors may make the occurrence unavoidable. When presented with an instance that involves intersections and driveways, it is preferable to block driveways rather than intersections.

Guidelines

It is preferable that bus stops are not placed near a driveway; however, if placement near a driveway is unavoidable, the guidelines below should be followed:

- Locate bus stops to allow adequate visibility for vehicles leaving the property and to minimize vehicle/bus conflicts. This is best accomplished by placing bus stops where driveways are behind the stopped bus.
- Attempt to keep at least one exit and entrance open to vehicles accessing the property while a bus is loading or unloading passengers.
- When there are two driveways to a parcel on the same street, the upstream driveway would preferably be blocked in order to force vehicles to turn behind the bus to access the driveway.
- It is preferable to fully block rather than partially block a driveway to prevent vehicles from attempting to circumvent the bus in a situation with reduced sight distance.
- Ensure that passengers have a safe area to wait when loading must occur in or adjacent to a driveway.

ACCEPTABLE DRIVEWAY CONFIGURATIONS IN CONSTRAINED SITUATIONS



BUS STOP SPACING

Bus stop spacing has a major impact on transit vehicle and system performance. Stop spacing also affects overall travel time, and therefore, demand for transit. In general, the trade-off is between:

Close stops (every block or 1/8 to 1/4 mile), short walk distances, but more frequent stops and a longer bus trip.

or

Stops farther apart, longer walk distances, but more infrequent stops, higher speeds, and therefore, shorter bus trips.

The determination of bus stop spacing is primarily based on goals that are frequently subdivided by development type, such as residential area, commercial, and/or a central business district (CBD). Another generally accepted procedure is placing stops at major trip generators.

Many systems, including PAAC, formerly operated under a historic system of electric street cars that stopped at most intersections, especially in dense, urban areas. With research of how far passengers are willing to walk to a transit stop—including research conducted in the Pittsburgh region with a focus on how slope affects peoples' willingness to walk – agencies improved efficiency, travel time and passenger comfort by increasing the space between bus stops to optimize walkable access without excess stopping. During the last two decades, many transit systems across the U.S. have undergone a stop consolidation program after research on optimal spacing between stops became clear in the 1990's.

PAAC has had a minimum stop spacing guidelines since the Transportation Development Plan (TDP) in 2009, but has not yet undertaken a system-wide project to adjust the spacing between its stops. In advance of the broad rollout of a new wayfinding program to better provide signage and stop amenities throughout the system, PAAC will begin to address this issue in the coming years.

In 2016, many of PAAC's transit routes did not meet average stop spacing guidelines over the course of their route. PAAC did not begin its stop optimization project in calendar year 2017 due to other planning projects, but has developed a plan for rolling this program out using a data-driven process. PAAC will roll-out this program on two bus routes with high ridership and closely spaced stops.

The following table exhibits PAAC's determination of appropriate guidelines for the average spacing between transit stops. Spacing guidelines are differentiated for the different types of service PAAC provides and at different levels of population density. Areas of higher population density (defined as greater than 5,000 persons and jobs per square mile) should generally have more frequent stops, whereas areas with lower population density (defined as less than 5,000 persons and jobs per square mile) should have fewer stops.

STOP SPACING (in feet)

	<i>Minimum Spacing</i>	High Population Density <i>Spacing Guideline</i>	Low Population Density <i>Spacing Guideline</i>
Rapid Routes	1,000	2,600 1/2 mile	2,600 1/2 mile
Express Routes	650	1,300 1/4 mile	1,300 1/4 mile
Key Corridor and Local Routes	650	900 1/6 mile	1,300 1/4 mile

Exceptions to these guidelines should only be made in cases where the following conditions exist:

- 1. Safety and accessibility to an existing stop**
- 2. Residential concentration of senior citizens and persons with disabilities**
- 3. Locations near activities for senior citizens and persons with disabilities**
- 4. Type of terrain**
- 5. General demographics**
- 6. Location of important buildings**
- 7. Availability of sidewalk space**
- 8. Distribution of patrons at stops**
- 9. Public Demand**

It is important to seek a balance between the convenience of patrons (i.e. those desiring to board the bus and those already on the bus) and the speed of operation.

3.





CURBSIDE DESIGN

Stop Typology

Stop Considerations

Bus Stop Signage

Bus Stop Configurations

Bike Lane Considerations

STOP TYPOLOGY

PAAC has categorized its stops into four main types: Basic Bus Stop, Bench Stop, Shelter Stop, and Station. These stops are described further on the following pages. PAAC recommends basic amenities to be included at each stop within the system. The amenity matrix includes amenities that can be included based on a variety of factors, including ridership, stop location, stop area, and others.

AMENITY MATRIX

	Sign	Pad	Sidewalk	Bench	Trash	Shelter	Light	Bike Rack	Route Info	System Info	Ticket Vending	Real-Time Sign
BASIC												
BENCH						✓	✓	✓	✓	✓		
SHELTER								✓	✓	✓	✓	✓

 - Basic Requirement

 - Recommended Amenity

Bus Stop Type Selection Considerations

The type of stop provided is primarily driven by ridership volumes and available space. The following tables show the recommended attributes for stops based on their type and location. PAAC staff will assist developers or municipal agencies in determining the appropriate stop on a case-by-case basis.

Stop Length

The design of bus stops has a significant influence on construction costs, parking restrictions, traffic flow and bus operating speeds. All stop locations should be examined to determine traffic volumes, traffic speeds, passenger volumes, bus frequencies, bus dwell times, pedestrian and bicycle facilities, roadway infrastructure, accessibility, and planned roadway improvements as these elements can affect the length needed for a bus stop.

DESIRED MINIMUM PLATFORM LENGTH BY VEHICLE DIMENSION (in feet)

	Pull-Out Stop Applies to Curbside Stops in a Parking Lane and Bus Bays				In-Travel Lane Stop Applies to Curbside Stops without Parking in a Travel Lane, Bus Bulbs, and Boarding Islands			
	40' Bus	60' Bus	2 x 40' Bus	2 x 60' Bus	40' Bus	60' Bus	2 x 40' Bus	2 x 60' Bus
Near-Side	100	120	145	185	35	55	80	115
Far-Side	90	100	125	165	45	65	90	130
Far-Side, after right turn	140	160	140	230	-	-	-	-
Mid-Block	120	145	185	210	35	55	80	115

Basic Bus Stop

Basic Stops are characterized by the presence of a bus stop sign only and do not contain any passenger amenities like benches or shelters. These stops are generally utilized in rural areas or those areas with lower density and lower ridership. Basic Stops should meet ADA design requirements.



Basic Stop at Stanhope Street and West Carson Street

Bench Stop

Bench Stops are basic transit stops with the addition of a bench and trash receptacle for waiting passengers. In some cases, additional amenities such as lighting or bicycle racks may be warranted. Bench Stops are best suited for areas with low to medium density and ridership.



Bench Stop on Brownsville Road opposite Dewalt Avenue

Shelter Stop

Shelter Stops are located in areas with higher ridership and medium to high density. Shelter stops should include an ADA compliant concrete pad, bench, and trash receptacle. Additional amenities like lighting and bicycle racks are highly encouraged. The design of a Shelter Stop is dependent upon the existing features of the site, including sidewalk design, right-of-way and proximity to existing structures.



South Busway at Pioneer Avenue Ramp

Station

Stations are associated with Rapid routes as defined by PAAC Service Guidelines. These stops have enhanced passenger amenities, including more robust transit system information signage and branded shelters. This stop type is included for reference and is not expected to be utilized by organizations other than PAAC.



East Liberty Station

The following pages provide detail of the design and elements of each of the stop types described above.

STOP TYPOLOGY

BASIC STOP ELEMENTS

1. Loading Pad

5 ft. long x 8 ft. deep; per ADA requirements, a pad must be firm, stable, and slip resistant, and connected to the pedestrian path. Provides a 5 ft. diameter clear turning radius for wheelchair users.

Sign should be located adjacent to the loading pad to clearly indicate bus stop.

2. Waiting Area

7 ft. long x 4 ft. deep; waiting area can be accommodated in the pedestrian path if pedestrian volumes are low. The suggested passenger waiting area should be 7 SF per person. This configuration provides enough area for 4 passengers at 7 SF per person, 28 SF total.

3. Stop Area

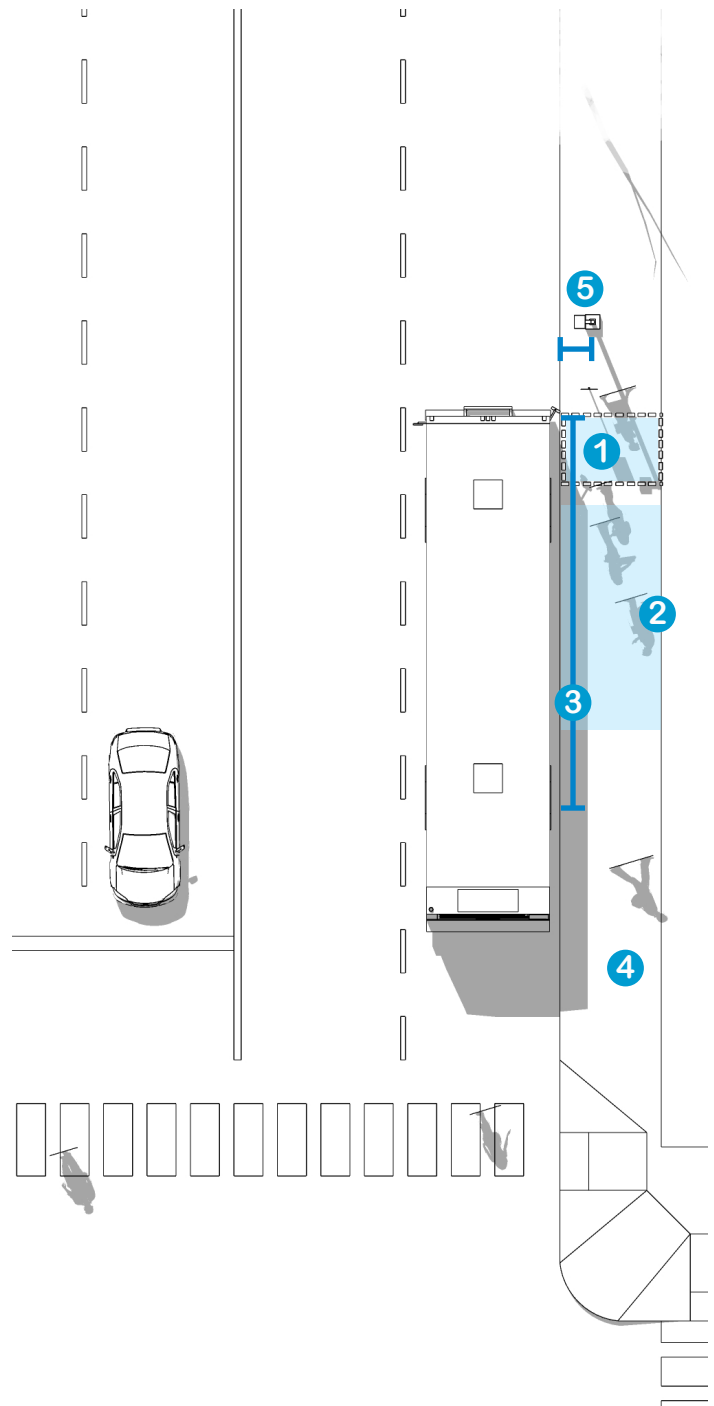
A 12 ft. area along the curbline should be kept free from obstructions. The length should provide free access to the vehicle's front doors.

4. Pedestrian Clearway Zone

Minimum 4 ft. deep pedestrian path, or wider, as called for by local sidewalk standards, along a sidewalk or similar walkway. Should be a firm, stable, and slip resistant surface connected to the loading pad. Wider path is desirable to provide space for passing. This area should also be free of all obstructions up to 80" high.

5. Clear Area

An area 2 ft. from the curb edge and 11 ft. minimum height that provides clearance so that the bus mirror does not hit any fixed objects in its path as it pulls up along a stop.



BENCH STOP ELEMENTS

1. Loading Pad

5 ft. long x 8 ft. deep; per ADA requirements, a pad must be firm, stable, and slip resistant, and connected to the pedestrian path. Provides a 5 ft. diameter clear turning radius for wheelchair users. Where possible, loading pads should be provided for both front and rear doors (as pictured here). Sign should be located adjacent to the front loading pad to clearly indicate bus stop.

2. Waiting Area

16 ft. long x 6 ft. deep between bus doors; waiting area can be accommodated in the pedestrian path if pedestrian volumes are low. After subtracting the bench dimension, waiting area provides enough space (86 SF) for 12 standing passengers at 7 SF per person, plus seating space for 3.

3. Stop Area

26 ft. long area should be kept free from obstructions along the curb edge. The length should provide free access to vehicle's front and rear doors.

4. Pedestrian Clearway Zone

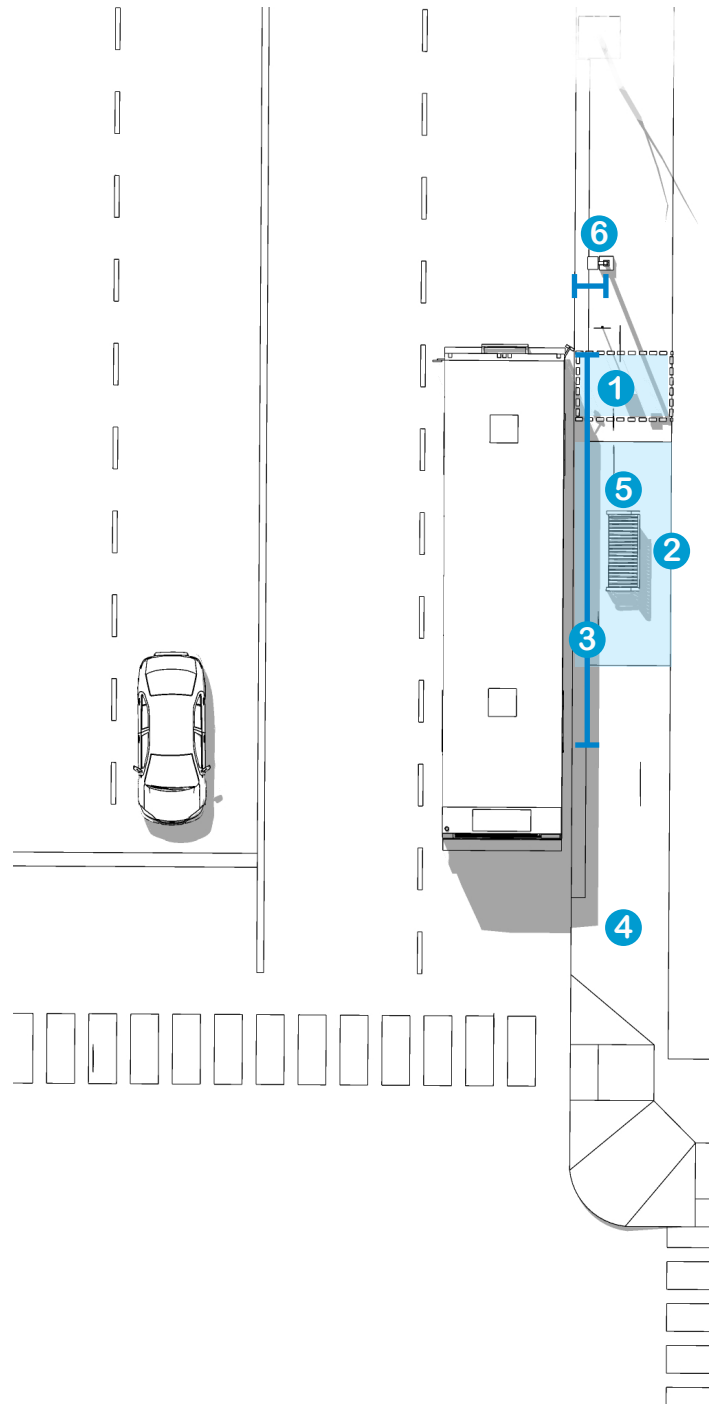
Minimum 4 ft. deep pedestrian path, or wider, as called for by local sidewalk standards, along a sidewalk or walkway. Should be a firm, stable, and slip resistant surface connected to the loading pad. Wider path is desirable to provide space for passing. This area should also be free of all obstructions up to 80" high.

5. Furniture

A bench should be 6.5 ft. long, with 3 seats with hand rails for seniors and those with disabilities. Made of a durable material, with or without a back. Keep at least 3 ft. clear around all furniture, which should be located close to the street or adjacent to buildings rather than in the middle of the primary pedestrian path.

6. Clear Area

An area 2 ft. from the curb edge and 11 ft. minimum height that provides clearance so that the bus mirror does not hit any fixed objects in its path as it pulls up along a stop.



STOP TYPOLOGY

SHELTER STOP ELEMENTS

1. Loading Pad

5 ft. long x 8 ft. deep; per ADA requirements, a pad must be firm, stable, and slip resistant, and connected to the pedestrian path. Provides a 5 ft. diameter clear turning radius for wheelchair users. Where possible, loading pads should be provided for both front and rear doors (as pictured here). Sign should be located adjacent to the loading pad to clearly indicate bus stop.

2. Waiting Area

16 ft. long x 4 ft. deep between doors; waiting area can be partially accommodated in the pedestrian path if pedestrian volumes are low. Provides enough net area for 9 passengers, including 6 within the shelter at 7 SF per person, 64 SF total. Shelter design and configuration may vary.

3. Stop Area

26 ft. long area should be kept free from obstructions along the curb edge. The length should provide free access to vehicle's front and rear doors.

4. Pedestrian Clearway Zone

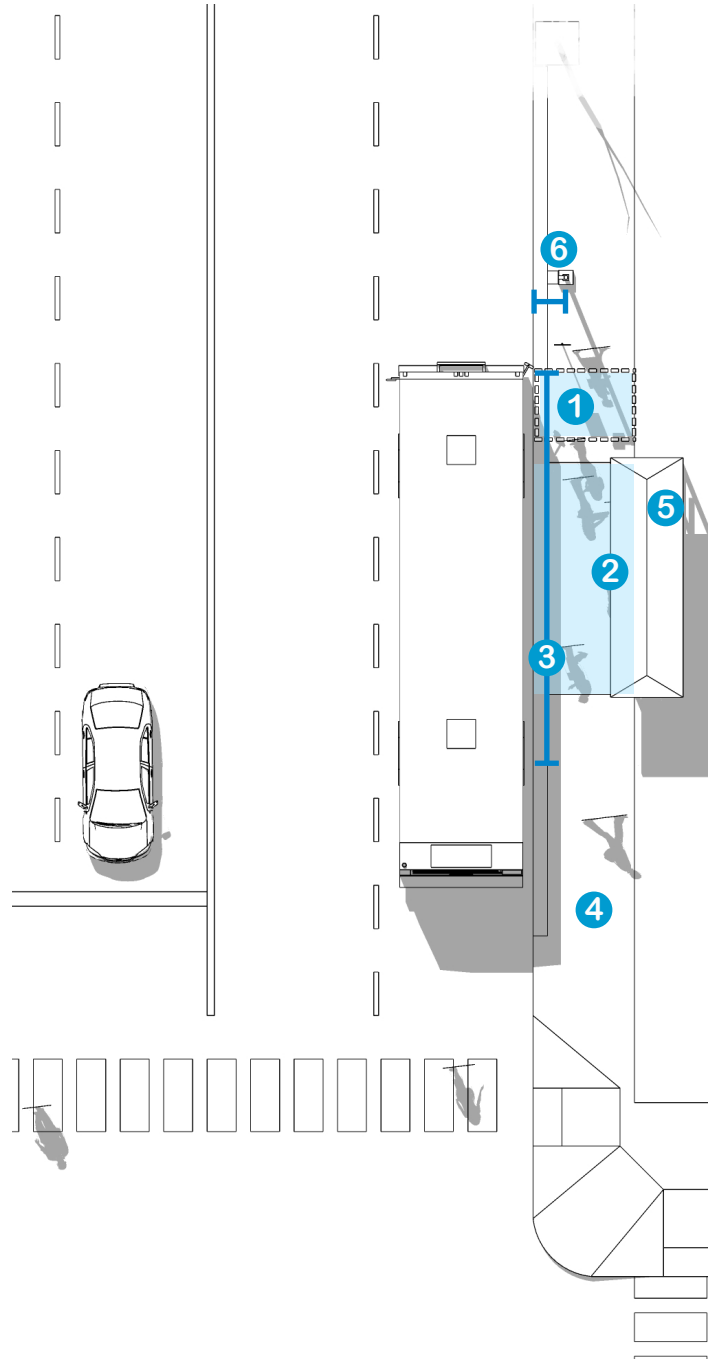
Minimum 4 ft. deep pedestrian path, or wider, as called for by local sidewalk standards, along a sidewalk or walkway. Should be a firm, stable, and slip resistant surface connected to the loading pad and separate from waiting area. Keep 3 ft. clear around all street furniture and building elements. This area should also be free of all obstructions up to 80" high.

5. Furniture

15 ft. long x 3 ft. wide x 9 ft. high shelter with bench, stop information, and advertising panel. Glass panels allow view of arriving bus and weather protection. 45 interior SF can accommodate 6 passengers.

6. Clear Area

An area 2 ft. from the curb edge and 11 ft. minimum height that provides clearance so that the bus mirror does not hit any fixed objects in its path as it pulls up along a stop.



STOP CONSIDERATIONS

Paved Waiting Area

The incorporation of a paved passenger waiting area into the sidewalk design is recommended to provide a safe, comfortable and convenient experience for all transit users and to promote access for persons with disabilities. Paved waiting areas should be connected to the sidewalk and provided bus stops along arterial streets or where an unpaved parking strip exists.

In some cases, existing sidewalks may serve, in part, as a paved waiting area. However, the overall paved area should be a minimum 10' wide by 8' deep back from the curb. If practical, the existing street sidewalk may be widened, slightly relocated or otherwise modified to accommodate the bus boarding area and still leave adequate room for pedestrians and the disabled. A minimum of 4' clearance is required for wheelchairs.

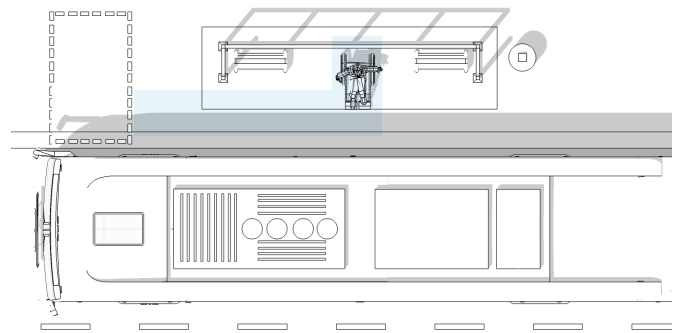


Passengers Wait to Board Bus on Wood Street

ADA Landing Pad

ADA landing pads are pursued at new and existing stops, stops with moderate or better ridership (minimum 20 daily boardings), and stops with any lift activity; preferred at all stops.

PAAC defines an ADA landing pad as a clear, level landing area a minimum of 5' X 8' (10' X 8' is ideal) located adjacent to the PAAC bus stop sign. At new construction sites PAAC requires pads to be a minimum of 8' X 8'. Construction of ADA pads is pursued at locations where connection to a pedestrian pathway is possible. It is also important that landscaping and other street furniture at bus stops does not block the back door exit.



ADA Path and Landing Area

Universal Design

Universal design means that facilities for transportation are designed to be not only used easily by those with disabilities, but also by users who may be temporarily encumbered, such as someone carrying a large load of groceries, a parent with a stroller, or someone temporarily using crutches. Special attention is given to the path of travel for pedestrians to the bus stop, the loading area clearances, and any furnishings that may be part of the bus stop. All new or newly renovated facilities must be designed and upgraded to meet current Americans with Disabilities Act (ADA) accessibility standards.



Shelter at Station Square

BUS STOP SIGNAGE

Sign Content

As previously mentioned, sign size and content can vary as transit wayfinding programs are funded and developed. At a minimum, all bus stop signage installed from here on out will indicate the location of the bus stop, identify the bus stop number, the routes, and display the customer service telephone number. Additional information signage (referred to as At Stop Panels) advertising the bus schedule and or a route map and identification numbers are often attached to the sign post, as well as limited real-time information displays. All sign content should be ADA-compliant as to font and point size lettering.



Existing Signage in Process of Replacement



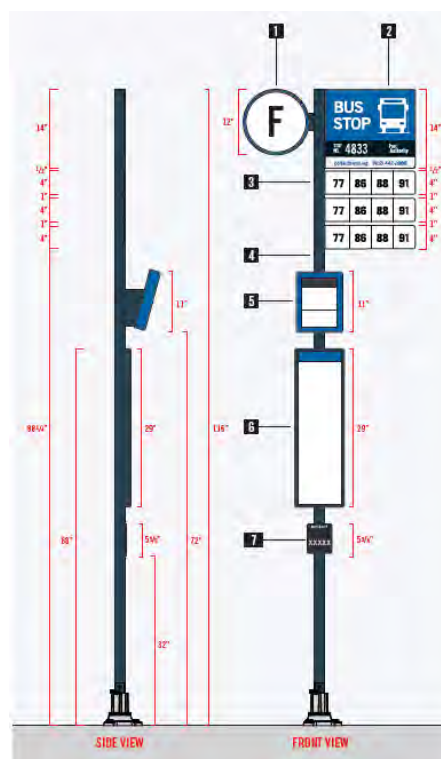
New Style PAAC Bus Stop Sign in Process of Being Installed

Bus Stop Signs

There are two types of signs that identify the precise location of a fixed-route transit stop for motorists, pedestrians and bus operators. The signs are placed at all of the 7,000 bus stops in the PAAC service area and are cataloged and geo-referenced by PAAC for traveler wayfinding and real-time arrival information, analysis and monitoring. PAAC buses will stop only at authorized bus stop locations, except in emergencies and reasonable accommodation situations (such as snow blocking a bus stop, a vehicle accident, or other unplanned emergency situation affecting the designated stop area). For more information on bus stop signs, reference PAAC's Bus Stop Sign Design Standards document.

Stop ID Numbers

Stop ID numbers are required and assigned to each bus stop. During PAAC Fiscal Year 2017 (ended June 30, 2017), a project was undertaken to add Stop ID numbers on more than 3,900 bus stops. Stop ID numbers will be added to new bus stop signs as they are installed. Because deployment began with PAAC's busiest routes, over 56 percent of bus stops have Stop ID's posted at their stop. PAAC's long range plan is to have Stop ID numbers added to all active stops by 2025 as manpower and financial limitations allow.



Complete PAAC Signage Example

BUS STOP CONFIGURATIONS

Bus stops can be placed along the public right-of-way in a variety of manners depending on the context. The following describe each condition.

Curbside

The most common design is a Curbside stop that consists of a dedicated zone on the street curb for passenger loading and unloading. Bus stops must be clear of parking and loading zones in order to guarantee space for the bus to stop. PAAC cannot guarantee bus stop accessibility unless the bus has a clear path to the curb.

In order for buses to be able to pull completely to the curb, space before and after the stop area must be free from obstructions. Total length needed can be seen in the Stop Length Table.



Curbside Stop on Liberty Avenue at Wood Street

Bus Bulb

Bus bulbs have a sidewalk that extends out into parking lane, allowing the bus to remain in the rightmost travel lane when boarding and alighting passengers. The bulb typically replaces a small section of on-street parking to allow passengers to safely reach the bus, which allows for a larger waiting area and also allows for buses to proceed quickly after loading passengers. PAAC encourages bus bulbs to be used whenever possible.



Bus Bulb at Smithfield Street and 6th Avenue

Boarding Island

A bus boarding island is a form of a bus bulb where other travel lanes, such as a bike lane, are present. It is desirable that the travel lane go behind the boarding lane. This configuration provides the opportunity for bikes to pass to the right of the passenger waiting area so as not to compromise bicyclist safety. PAAC encourages boarding islands to be used with bike lanes wherever possible to minimize conflicts between transit riders and cyclists.



Boarding Island in Seattle, WA

Bus Bay

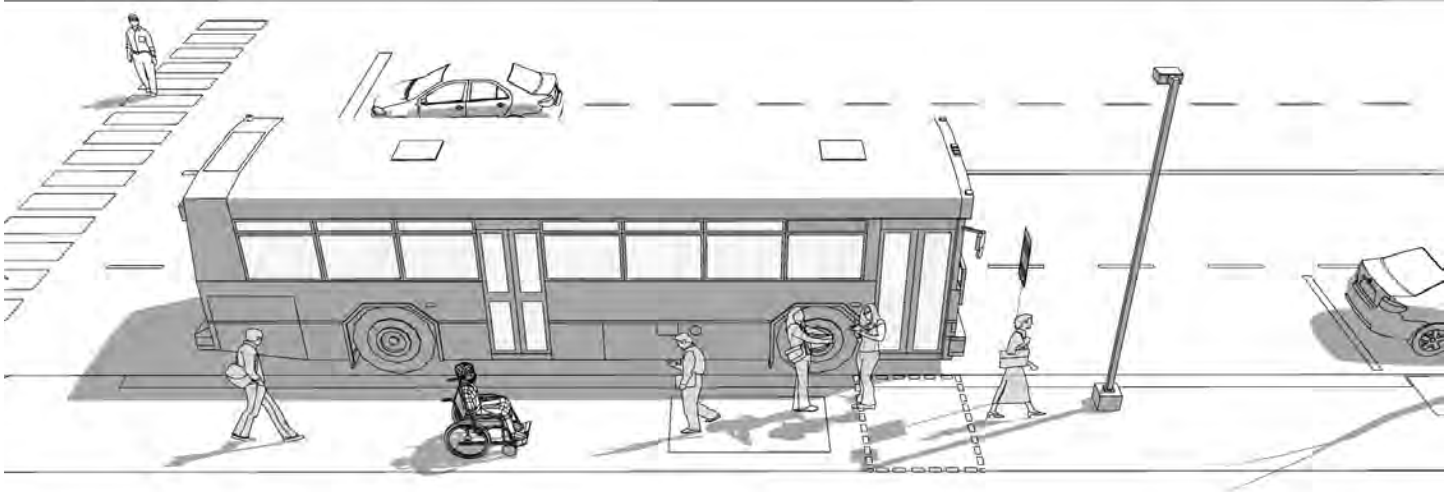
Bus bays are areas outside the normal travel lanes where a bus can exit traffic to serve the stops. The type typically consists of an entrance taper, a deceleration zone, a stopping zone, and acceleration zone and an exit taper. They require the curb to be setback from the travel lane to bring the bus out of the flow of traffic. PAAC encourages bus bays to only be used on high speed streets.



Bus Bay at Forbes Avenue and Morewood Avenue

BUS STOP CONFIGURATIONS

CURBSIDE STOP



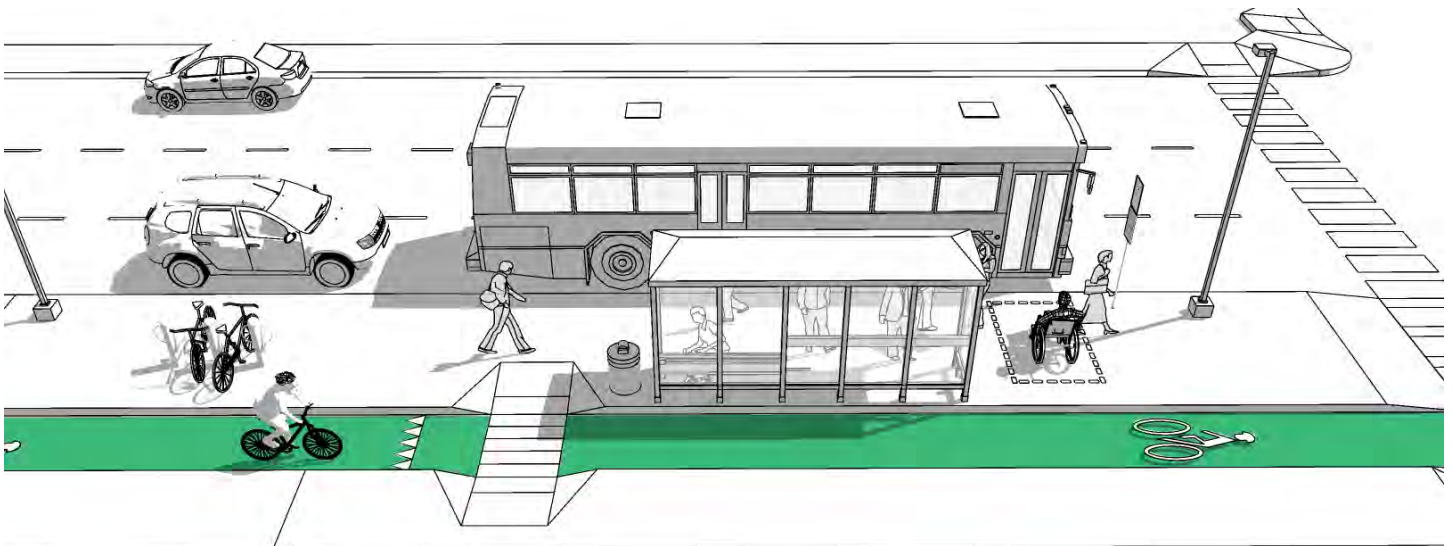
Standards

- Stop length varies depending on location, refer to chart on page 18
- Use on roadways with speeds lower than 45 mph

Considerations

- Allows for stopping in travel lane or parking lane, depending on the street
- Bus may disrupt traffic flow if there is no passing lane

BOARDING ISLAND



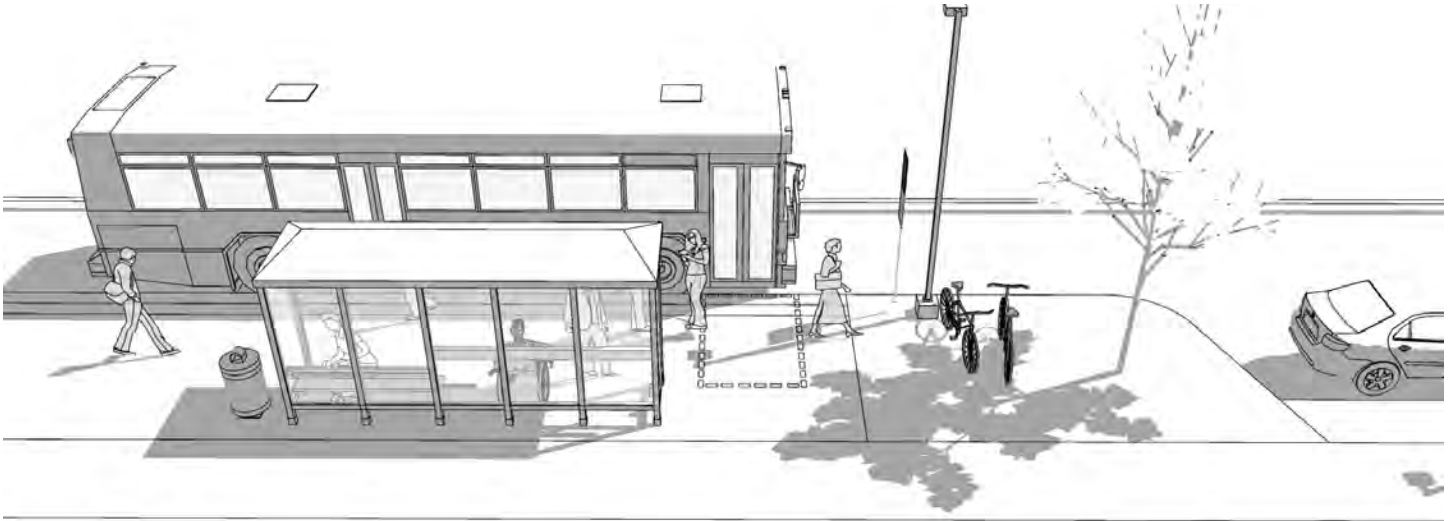
Standards

- Stop length will vary, refer to chart on page 18
- Use colored bike lane for clear separation

Considerations

- Provides separate boarding area for passengers
- Bus able to stay in travel lane while boarding and alighting

BUS BULB



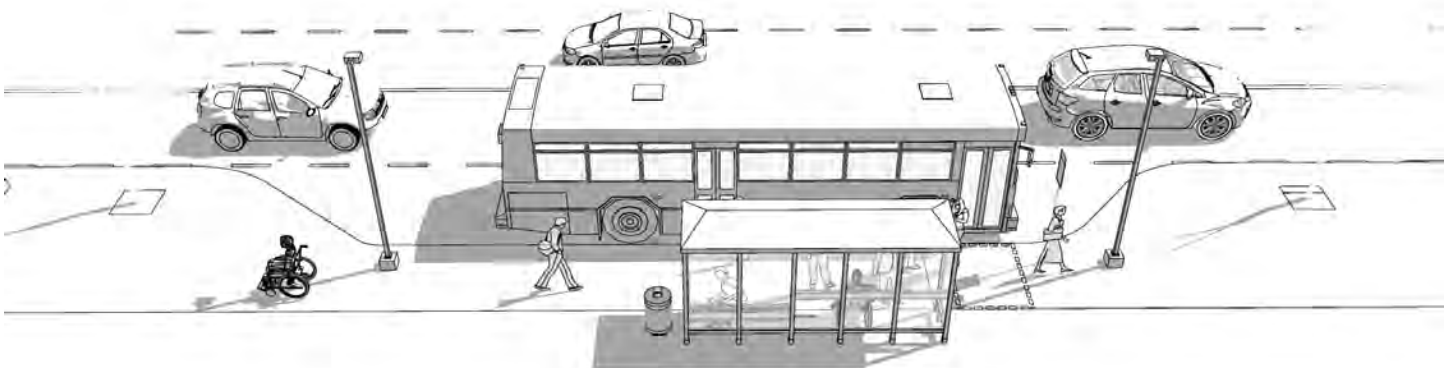
Standards

- Minimizes conflicts between waiting passengers and pedestrians walking through the bus stop area
- Use on roadways with speeds lower than 30 mph

Considerations

- Uses least amount of curb space
- Safe separate area for boarding and alighting

BUS BAY



Standards

- Stop length will vary, refer to chart on page 18
- Use on roads exceeding 45 mph

Considerations

- Increases bus running time when buses have to re-enter traffic
- Does not block a travel lane for loading and unloading

BIKE LANE CONSIDERATIONS

When bus stops and bike lanes are co-located, there are four suggested configurations: the bicycle lane continues in front of the stop at street level; the bicycle lane continues in front of the stop at curb level, with separate or shared space for pedestrians; or a boarding island is constructed and the bicycle lane is re-routed behind the stop.

The following table summarizes the application of each of these four types of stop based on the available width of right-of-way, which includes the bike lane, sidewalk and any available right-of-way behind the sidewalk.

Width	Stop Type
Less than 10'	Curbside Stop with Cycle Lane
Between 10' and 13'	Raised Cycle Lane (Shared)
Between 13' and 21'	Raised Cycle Lane (Exclusive)
Greater than 21'	Boarding Island

Curbside

Curbside bike lanes create conflict between the bicyclist and bus and may lead to the cyclist either diverting into the adjacent travel lane or onto the sidewalk to avoid the bus or having to stop behind a bus while it occupies the bicycle lane. In addition, neither the bus stopping in the travel lane (requiring passengers to step down into the bike lane to access the bus) nor pulling into the bike lane is desirable from an operations and safety perspective.

Raised Cycle Lane (Shared)

The raised bike lane with shared space extends the area in front of the shelter, creating a safer space for waiting where the cyclist would walk their bike through the shared pad area. If the available width is between 10' and 13', the 5-foot minimum clear path requirement and 8-foot long ADA landing pad can be maintained through the additional space added by the raised cycle lane.



Cycle Lane in Vancouver, BC

Raised Cycle Lane (Separate)

The raised cycle lane with separate space puts the cyclist and pedestrian on the same level but with clearly delineated space for each. If a raised cycle lane is implemented at a location where at least 8 feet of sidewalk exists, stop amenities can be implemented on the sidewalk without conflicting with minimum clear path requirements.

Boarding Island

When bike lanes are present, the preferred configuration is to route the bike lane behind the stop, creating a boarding island. This eliminates the conflict between bicycles and passengers during boarding and alighting, which reduces dwell times and minimizes the disruption for bicyclists.

Guiding Principles

There are trade-offs when considering different configurations that affect operations, riders, and cyclists. Accessibility, safety, drainage, and utilization of space are all important guiding principles that are outlined below:

Accessibility

All configurations should adhere to the same ADA accessibility requirements as typical stops, including maintaining accessible routes, slopes, and clear space. ADA is an important consideration when placing new bike lanes near bus stops.

Space Utilization

Every effort should be made to keep the boundaries of the stop within existing right-of-way to reduce the need for agreements with other property owners. Boarding islands require the most space but offer the best combination of safety and operational improvements.

Drainage

The introduction of a raised cycle lane or the re-routing of the cycle lane behind the bus stop may alter existing site drainage by introducing obstacles to the flow of water. This will be a site-specific consideration that may require additional surveying and design effort to properly address.

Safety

PAAC's priority is to always minimize bus and bicycle conflict. Each configuration introduces conflict between buses, cyclists and passengers, as there is no solution that can eliminate the interaction of bicycles with buses or passengers. The designer should strive for clear demarcation between buses and cyclists throughout the route, using different stop configurations where applicable. The designer must make the choice that best mitigates the number of ways in which the users conflict.

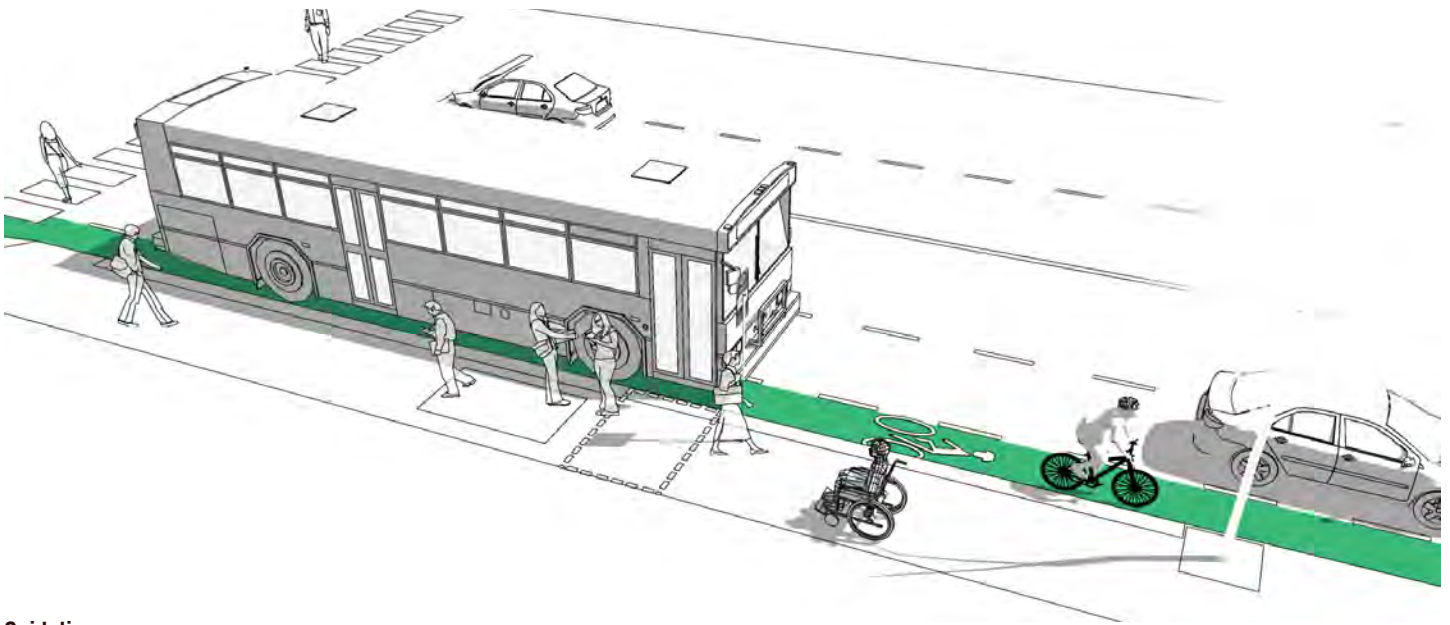
Comparative Assessment

The table below provides an assessment of the advantages and disadvantages of each of the stop configurations discussed in the previous section.

Stop Type	Advantages	Disadvantages
Curbside	<ul style="list-style-type: none"> Minimal disturbance to operations Most modal zones are clearly delineated Occupies less space 	<ul style="list-style-type: none"> Potential conflict between bus and bicycle Potential for bicyclist to merge into traffic to avoid stopped bus
Raised Cycle Lane (Shared)	<ul style="list-style-type: none"> Moderate disturbance to operations Bus/Bike conflict removed 	<ul style="list-style-type: none"> Potential conflict between bicyclists and pedestrians in shared space No clear delineation between bike and pedestrian areas May impact site drainage
Raised Cycle Lane (Separate)	<ul style="list-style-type: none"> Moderate disturbance to operations Bus/Bike conflict removed Clear delineation between bike and pedestrian areas 	<ul style="list-style-type: none"> Requires more signing and striping to clarify conflicts May impact site drainage Potential conflict between bicyclists and pedestrians in shared space
Boarding Island	<ul style="list-style-type: none"> Minimal disturbance to operations Modal zones are clearly delineated Bus/Bike conflict removed Improves pedestrian visibility Provides additional surface for amenities 	<ul style="list-style-type: none"> Requires more right-of-way May impact site drainage Requires more signing and striping to clarify conflicts Introduces conflict area between pedestrians and cyclists

BIKE LANE CONSIDERATIONS

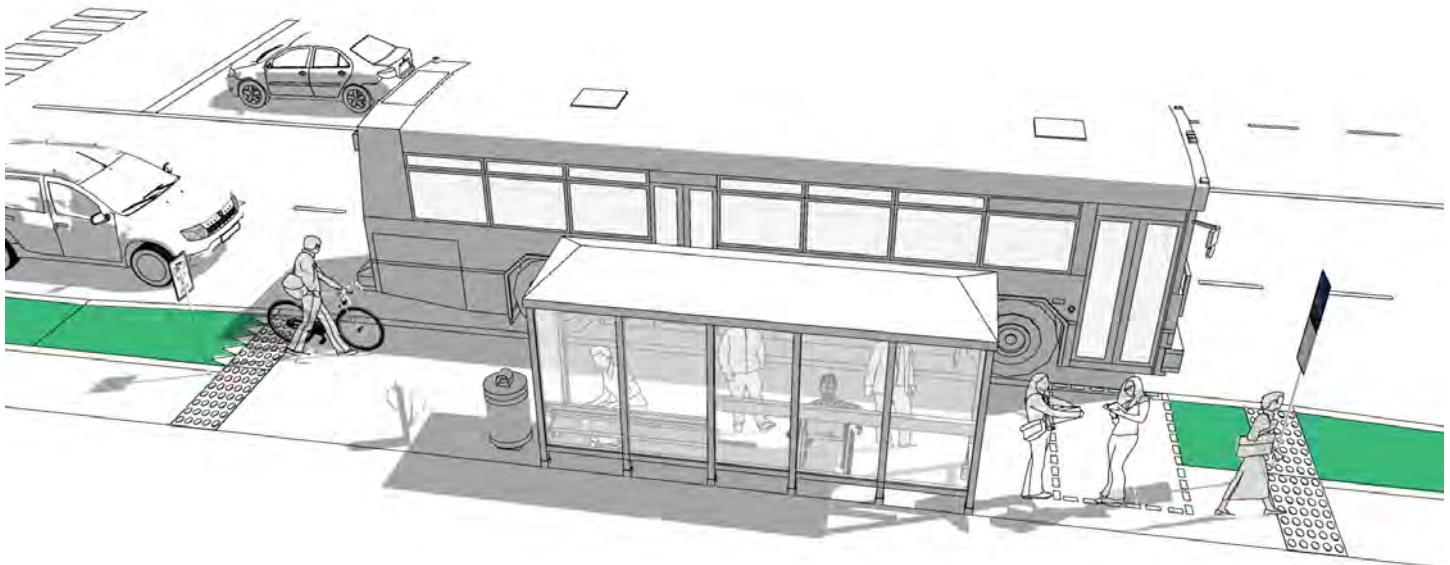
CURBSIDE STOP WITH CYCLE LANE



Guidelines

- Bike lane remains at street level
- Recommended use of colored pavement to delineate bike lane
- Not ideal due to potential conflict between cyclists and the bus

RAISED CYCLE LANE - SHARED SPACE SCENARIO



Guidelines

- Bike lane should be colored only on the ramp portion
- Crosswalks should not be used across the pathway but use yield teeth to warn cyclists of pedestrians
- Detectable warning strips should extend perpendicular to the sidewalk to demarcate shared space for visually impaired

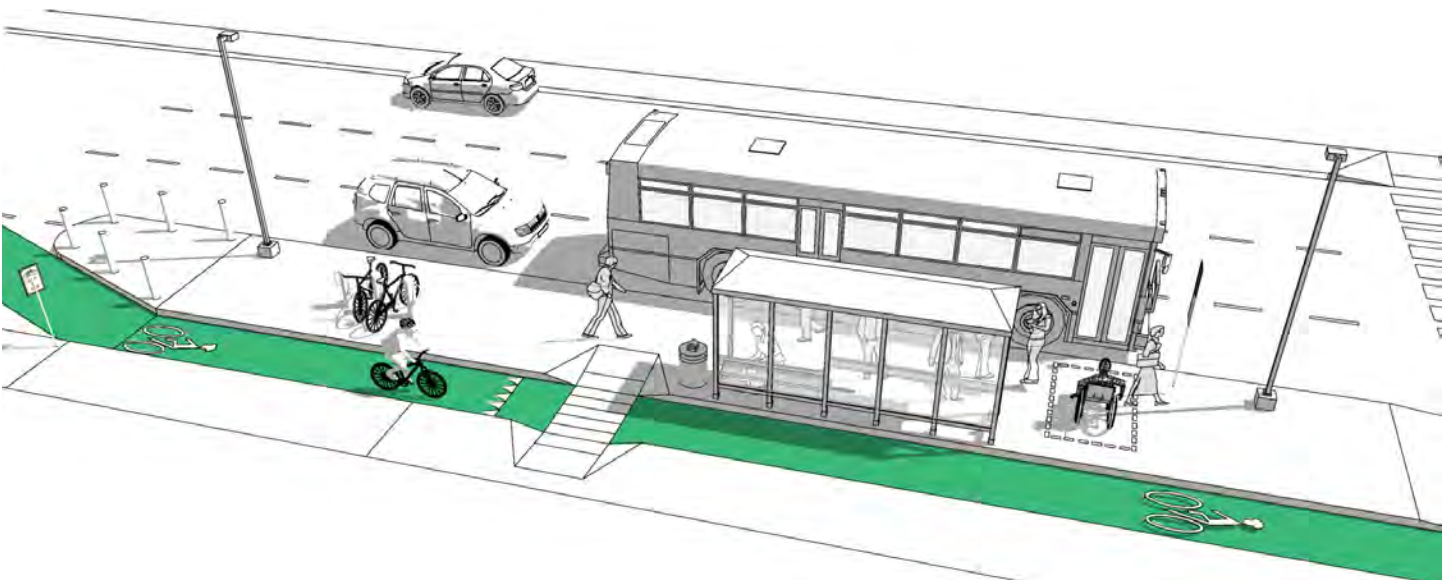
RAISED CYCLE LANE - SEPARATE SPACE SCENARIO



Guidelines

- Bike lane pavement should be colored for length of stop to delineate separate use.
- Detectable warning strips should be applied for the length of the bike lane and perpendicular for the visually impaired
- Crosswalks should be used to indicate loading zones

BOARDING ISLAND



Guidelines

- ADA accessible ramp should be provided to cross the bike lane
- Detectable warning strips should be placed at entry to crosswalk
- Yield teeth placed prior to crosswalks to alert bikes of crosswalk
- Bike plan pavement should be colored for high visibility

4.



BUS STOP AMENITIES



BUS STOP AMENITIES

Benefits of Amenities

The design of a bus stop can make transit more convenient, accessible, and aesthetically appealing to users. Passenger amenities are different elements that can be added to a stop to improve the experience for the user. Recommended criteria for when and where to use amenities are provided to the right.

Amenity Placement

A variety of amenities can be provided at bus stop locations to enhance the overall attractiveness of public transportation. Installing bus stop amenities is necessary if public transportation is to be competitive with other transportation modes in terms of overall travel experience.

Because resources and space are limited in addition to property control limitations, not every bus stop can provide the desired extent of amenities beyond the bare minimum sign post.

Considerations

Well-lit, maintained, and secure bus stops are crucial to the image and performance of the transit system. At PAAC-owned stops, damaged property and trash build-up are attended to as expeditiously as possible by dedicated PAAC Facilities teams, to maintain comfort and a positive impression for transit patrons and the general public. However, PAAC does not maintain property that PAAC does not own as indicated earlier in the Guidelines. Specific maintenance procedures are beyond the scope of these Guidelines. PAAC staff welcomes the reporting of problems, constructive comments or suggestions from all parties on this topic that can be considered for future incorporation into these Guidelines or the preventative maintenance and other procedures utilized by PAAC Facilities teams.

Recommended Amenity Criteria

- **Density**
- **Land Use and Development:** Located ¼ mile (max.) from employment center, mixed use development or other major activity center
- **Population Considerations:** Seniors, people with disabilities, youths, low-income households (within ¼ or 1/8 mile from population)
- **Connections** with other PAAC routes, paratransit, regional transit provider or feeder service
- **Location** within Planned Enhanced Development Corridor



Liberty Avenue at Wood Street Bus Stop in Downtown Pittsburgh



Bus Stop at Forbes Avenue and Murray Avenue

Bus Shelters

A bus shelter is a covered passenger waiting area, often semi-enclosed with a bench that provides protection from the sun, wind, and rain. The size and design of shelters will vary depending on space, availability, and the number of passengers to be accommodated.

It is the intention of PAAC to care for its riders from the point where they enter the system to the point where they leave it. Therefore, transit shelters are provided whenever possible.

PAAC shelter design is consistent and available in multiple sizes. However, the City of Pittsburgh, multiple municipalities, and private property owners also maintain shelter contracts for the installation of amenities throughout PAAC's service area, many through multiple advertising agencies. Shelter requests in these areas are referred directly to these parties for consideration prior to a specific site being evaluated by PAAC.

Shelter Pad Minimum Specifications

Shelter pads should meet the municipality's minimum sidewalk construction specifications. In addition, shelter pads should be located a minimum of 4' behind the curb adjacent to bus stop pole, to accommodate an accessible path of travel. In some cases the pad needs to be added to the rear of a sidewalk that is already connected to the curb. In other cases, there will need to be an additional concrete connection added between the sidewalk and the curb to cover both bus front and back doors. For additional information, regarding PAAC installed shelters, contact PAAC to obtain a copy of PAAC's Transit Shelter Guidelines or the municipality.

Criteria for Shelter Placement

The following are factors in determining the need for a transit shelter as established in the PAAC Transit Shelter Guidelines:

- **Heavy Patronage**
 - At **inbound** transit stops in the outer system.
 - At **outbound** transit stops in central business districts.
- **Transfer Points** - Locations where patrons must stand to transfer from one transit vehicle to another.
- **Older Adults and People with Disabilities** - Locations where there are heavy concentrations of senior citizens or people with disabilities.
- **Park and Ride Lots** - Lots in the Park and Ride program where riders waiting for transit service would use shelters.
- **Topography** - Stops restricted by the surrounding development and/or lying close to the road so as to subject riders to flying dirt, debris and water from passing traffic.
- **Weather** - Stops in exposed locations where riders are subject to high winds and inclement weather.



PAAC Shelter



Non-PAAC Shelter

BUS STOP AMENITIES

Benches and Lean Rails

Lean bars or rails afford patrons a level of comfort when incorporated at a stop where there is little to no seating, and where stop width is limited.

The decision of where and how much seating to place at stops depends on availability of space, ridership, and cost. Placement of lean rails and benches should conform to ADA guidelines.



Lean Rails Offer an Alternative to Benches

Trash Receptacles

High ridership, transfer locations and places where the potential for accumulating trash is apparent influence the decision to place cans. Trash receptacles shall not be placed on the wheelchair landing pad. They must not obstruct pathways between the sidewalk, shelter access (when applicable), the landing area or posted information. The receptacles should be secured to the pavement to prevent accidental tripping or unauthorized movement. PAAC works with the community regarding the proper placement of trash cans located within their jurisdiction.

Where trash cans are placed, considerations should be given to maintenance and trash pick-up whenever trash receptacles are provided.



Standard PAAC Trash Receptacle

Lighting

Practical, adequate lighting should be provided at bus stops and waiting areas for passengers. A well-lit waiting area will not only increase a pedestrian's feelings of security but will also allow a transit vehicle operator to clearly see the bus stop area and identify waiting passengers or spot possible obstructions in the stop area.

In order to reduce environmental impact of bus stops, lighting at bus stops should use LED lights and solar power. Bus stops lacking a lighting system may warrant a solar-powered stop or similar product that provides illumination of a stop and information sign from the push of a button. PAAC has a few solar-powered bus stop lights within the CBD that are being tested through a pilot project.



Lighting at a Shelter Stop in Nashville

Electronic Messaging

At high usage stops, PAAC may implement Intelligent Transportation Systems (ITS) that improve convenience and safety.

ITS can provide real-time electronic “next vehicle” displays at transit stops. These systems can also display current traffic conditions and emergency notifications.

Real-time displays reduce the anxiety of transit passengers by confirming the actual arrival times of their next bus and allow for better trip planning and connections.



Next Bus Arrival Sign in Downtown Pittsburgh

Bicycle Racks and Bike Share Stations

Bicycle racks can be provided near bus stop locations to encourage bicycle use to and from transit. Weather protection and security from theft and vandalism should be considered when selecting the bicycle storage device and to determine its location. The facility should be located in a well-lit area that has a high degree of visibility.

The location of any bicycle racks should be sufficient distance away from surrounding structures and the curb to ensure easy circulation and access to bicycles and other amenities. Bicycle racks should be located at the periphery of the bus tops area away from where passengers will board and alight the bus.



Bicycle Rack

Landscaping

Landscaping near the passenger boarding area is encouraged to improve the bus stop environment and maximize passenger comfort, but planted areas should be manageable and far enough back from the curb face as not to interfere with bus operations or pedestrian safety. Landscaping design is beyond the scope of these Guidelines.



Landscaping at East Liberty Station

5.





STREET DESIGN STANDARDS FOR TRANSIT VEHICLES

PAAC Fleet

Intersection Design

Roadway Design

PAAC FLEET

PAAC Buses

PAAC currently operates a fleet of standard transit buses in three sizes. They are as follows: 35', 40' and 60'.

The vast majority of buses operated in PAAC's service area are 40' in length. The 35' buses are used in hilly neighborhoods with tight turns. 60' articulated buses are used on routes with high demand.

All buses are equipped with bicycle racks, front wheelchair ramps and a front-end kneeling feature that reduces step height for mobility-impaired patrons.

Although paratransit vehicles are not owned or operated by PAAC, bus stop locations exist where the curb space is shared by multiple vehicles to accommodate passengers.

General PAAC Bus Design Standards

Any space that will be served by a PAAC bus should consider the height, width, and length of PAAC vehicles to ensure safe accommodation. PAAC's fleet falls in to three classifications for design standards: articulated transit bus, standard transit bus, and paratransit vehicle. Each classification has design standards for height, width and length required for proper accommodation. The following design standards are the minimum dimension of space needs to adequately accommodate each type. Each includes at least a foot of cushion to account for variance in bus movement.

Presently, the most common lifts used on buses are conventional wheelchair lifts. Since the wheelchair lift may be at the front or rear door, bus stop designs need to allow for either possibility. Low floor buses can be adjusted so the floor height is approximately 10 inches above the street level. Bus passengers in wheelchairs are then able to reach the sidewalk by using a ramp deployed from the floor of the bus. The length of the ramp typically extends 2 to 3 feet from the edge of the bus for a standard height curb.

Several transit agencies now have on-vehicle bus storage programs. In some cases, passengers are allowed to bring their bicycles into the interior of the bus. In others, a bicycle rack is attached to the front of the bus. These racks generally hold two bicycles. Bus turning radius design needs to allow for the additional length of a bus with a bicycle rack attached (generally 3 feet).



Wood Street in Downtown Pittsburgh



Bus at 5th Avenue and Atwood Street

VEHICLE DESIGN STANDARDS

	Height	Width	Length
Articulated 60'	12'	11'	65'
Standard 35' & 40'	12'	11'	35' or 40'
Paratransit	10'	9'	25'

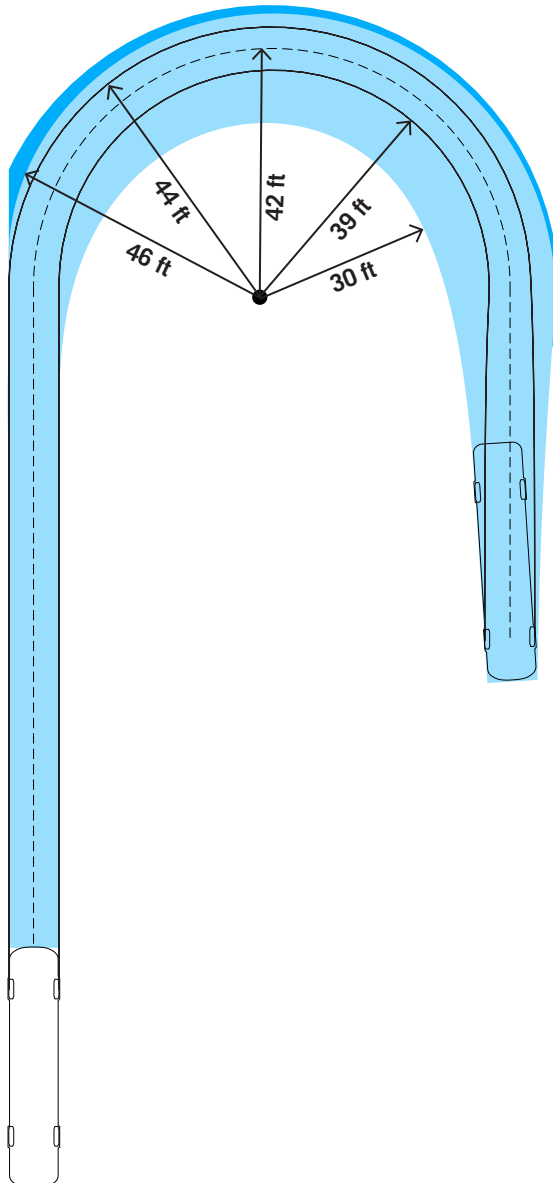
INTERSECTION DESIGN

Vehicle Turning Radius

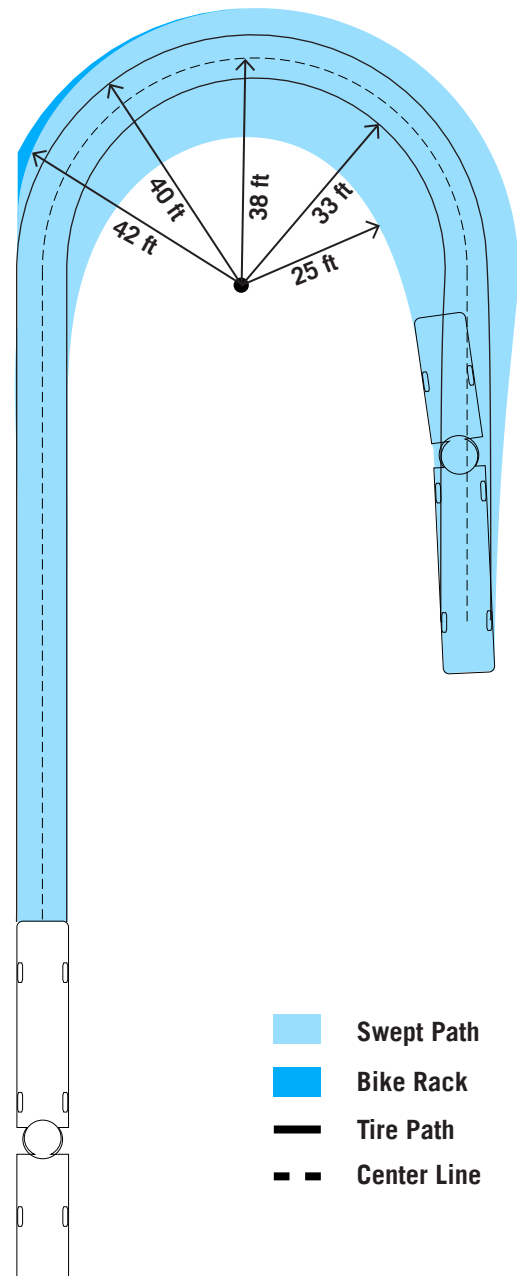
Turning radii standards should be applied whenever possible, especially on all streets identified as potentially having an issue. When radii below these standards are used, it could result in a degradation of smooth vehicle turning movements and damage to curbs.

Turning radii should adhere to both inner and outer radii to ensure safe turning movements. A minimum 50-foot outer radius will ensure that large transit buses can safely conduct turning movements. In congested areas such as shopping centers, a 55-foot radius provides smoother maneuvering. For the inner radii, 28 feet in the minimum and 30 feet is desirable.

40' STANDARD BUS TURNING RADIUS



60' ARTICULATED BUS TURNING RADIUS



- Swept Path
- Bike Rack
- Tire Path
- Center Line

INTERSECTION DESIGN

Distance from Crosswalks and Bus Stops

A 10' buffer from crosswalks and bus stops should be maintained to allow for the safe crossing of pedestrians. The buffer also allows the bus space to accelerate after the boarding and alighting of passengers. This distance should be taken into consideration when determining stop length.

Queue Jumps and Bypass Lanes

Queue jumps and bypass lanes are a form of priority in which buses are allowed to use restricted lanes to bypass queued vehicles at signalized intersections, reducing travel time and providing improved service reliability.

A queue jump allows a bus to enter into a short lane (that can also be used as a right turn lane) that is located adjacent to the through lane, stopping at the near side of the intersection. A separate signal would provide an early green light to the bus to move through the intersection and into the through travel lane prior to general traffic. Near-side bus stops are typically used with queue jump lanes.

A bypass lane, which would be adjacent to the through lane, would not have separate signal, but would continue through the intersection with general traffic into a receiving lane on the opposite side of the intersection prior to entering into the lane. Far-side stops are typically used with bypass lanes.

These facilities would typically only be justified at locations with high passenger volumes which are also impeded by traffic.



Bus Lane on Liberty Avenue at Smithfield Street

Parking Near Intersections

Parking setbacks (no parking zones) near intersections will allow proper transit vehicle turns without conflicting with parked cars. To accommodate the bus' 50' radius turn, parking should either be restricted near intersections and approaches to and departures from bus stops. The Authority recommends a 40' no-parking setback zone on the bus' approach to the transit stop and a 30' setback zone for the entry back onto the road. Parking ordinances should clearly indicate the necessary space for bus stops or the advantages of the stops will be greatly minimized.

Transit Signal Priority (TSP)

Delays from signalized intersections typically account for 10 to 20 percent of all bus delays. TSP can be implemented at intersections with traffic signals to reduce transit delay and improve service reliability. TSP refers to a variety of real-time strategies designed to provide priority for a transit vehicle approaching an intersection.

With signal priority, a bus approaching an intersection requests priority and normal signal operation is modified to provide preferential treatment for this oncoming bus. Common types of priority include green extension (extending the green time to allow the approaching bus to continue without stopping), early green (shortening the preceding phases to minimize red time for the approaching bus), phase insertion (inserting a special priority phase into the normal signal sequence), and phase rotation (modifying the order of signal phases).



Example of a Transit-Only Signal

ROADWAY DESIGN

Roadway Design Standards

Many factors contribute to roadway design including the aforementioned bus dimensions and turning radii, anticipated vehicle volume and on-street parking conditions. These guidelines define specific standards for lane width, grades, and roadway pavement.

Overhead Clearance

PAAC buses travel in the curbside traffic lane and make frequent stops to pick up and drop off passengers. Therefore, it is important to keep these areas clear of potential obstructions.

Overhead obstructions such as trees, signs, and utility wiring should not enter into the bus profile area, i.e. less than 13' 6" above the street surface.

Street-side obstructions should not be located within two feet of the edge of the street to avoid being struck by a bus mirror when the vehicle travels by or is parked close to the curb or pavement edge. This lateral clearance is important at both ground level and at the top of the bus.

Bus stop placement must be in an area with good line of sight visibility and clear of storm drains, obstructions, and tripping hazards, providing access to all doors.



Overhead Clearance Includes Avoiding Existing Landscaping

Lane Width

For both public and private roadways that accommodate transit vehicles, PAAC recommends a 12' travel lane width for the curb lane to ensure proper maneuverability of the buses. This width provides adequate maneuvering space.

Bus travel lanes should also be designed to ensure the safety of both the passenger on-board and the surrounding vehicles, bicycles and pedestrians.

Road Surfaces

Road pavements need to be of sufficient strength to accommodate repetitive bus axle loads of up to 25,000 lbs. Concrete is preferred to avoid failure problems that are experienced with asphalt, especially where buses start, stop or turn. Concrete aids in the retention of roadway surface shape, drainage capabilities and skid resistance.

Concrete bus pads are not recommended. The differing adjacent materials cause significant issues at the interface between the materials. Pavement design at the bus stop shoulder should match the pavement design of the traveled roadway.



Road Surface May Change Based on Different Developments

6.



PROCESS FOR CHANGES

Bus Stop Placement Checklist

Transit Compatibility Checklist

ADA Guidelines

Proposing Changes



BUS STOP PLACEMENT CHECKLIST

A summary of elements to consider when placing a bus stop are provided in the following checklist:

Bus Stop Placement Checklist	
<i>Considerations</i>	<i>Result</i>
Standardization: One of the most critical factors in the street-side design and placement of a bus stop involves standardization or consistency. Standardization is desirable because it results in less confusion for bus operators, passengers, and motorists. Consistency in design, however, can be difficult to achieve since traffic, parking loss, turning volume, community preference, and political concerns can influence the decisions.	
Periodic Review: A periodic review of bus stop conditions (both street side and curb side) is recommended to ensure the safety of bus passengers. This will encourage the timely reporting of items such as missing bus stop signs and poor pavement.	
Near-Side/Far-Side/Mid-block Placement: Each type of placement has advantages and disadvantages. In general, each bus stop location should be evaluated individually to decide the best placement for the stop.	
Visibility: Bus stops should be easy to see. If the bus stop is obscured by nearby trees, poles, or buildings, the bus operator may have difficulty locating the stop. More importantly, however, motorists and bicyclists may not know of its existence and will be unable to take necessary precaution when approaching and passing the stop. In addition, visibility to pedestrians crossing a street is also an important consideration in areas that permit right turns on red.	
Bicycle Lanes and Thoroughfares: When a bike lane and a bus stop are both present, the operators need to be able see cyclists in both directions while approaching the stop. Sufficient sight distance for cyclists to stop safely upon encountering a stopped bus is also needed.	
Traffic Signal and Signs: Bus stops should be located so that buses do not restrict visibility of traffic signals and signs from other vehicles. Because all bus passengers become pedestrians upon leaving the bus, pedestrian signal indicators should be considered at nearby signalized intersections.	
Roadway Alignment: Horizontal and vertical roadway curvature reduces sight distance for bus operations, motorists, bicyclists, and pedestrians. Additionally, bus stops located on curves make it difficult for the bus operator to stop the bus parallel to the curb and safely return to the driving lane. Where possible, bus stops should be located on sections of relatively straight and flat roadway. Trees and poles should not obstruct the visibility of the bus operator for cross traffic and passenger and pedestrian movement.	
Driveways: Avoid locating bus stops close to a driveway. If placing a bus stop close to a driveway is unavoidable (for example, to lessen the loss of parking in a commercial area), keep at least one driveway open to vehicles accessing the adjacent development while a bus is loading or unloading passengers. Also, locate bus stops to allow full visibility for vehicles leaving an adjacent development and to minimize vehicle/bus conflicts. Placing bus stops on the far side of driveways will minimize conflicts; however, sight distance for left-turning vehicles from the driveway will still be a concern.	
Location of Pedestrian Crosswalks: A minimum clearance distance of 10 feet between a pedestrian crosswalk and the front or rear of a bus at a bus stop is desirable.	
Location of the Curb: Where possible, locate stops where a standard curb height of 6 inches exists. Bus steps are designed with the assumption that the curb is the first step. It is more difficult for elderly persons and passengers with mobility impairments to board and alight from the bus if the curb is absent or damaged.	
Street Grades: Where possible, bus stops should not be located on an upgrade in a residential area, since the bus engine noise created when the vehicle accelerates from a stop will bother area residents. Placing bus stops on steep grades should be avoided if slippery winter conditions prevail.	
Road Surface Conditions: Since alighting passengers generally move from their seats when the bus decelerates on approach to a bus stop, do not locate a bus stop where the roadway is in poor condition such as areas with broken pavement, potholes, or ruts or where a storm drain is located. The resultant motion of the bus in such a situation may cause bus passengers to fall and injure themselves. Boarding and standing passengers are also susceptible to falls or injuries where poor pavement conditions or low drainage basins exist.	

TRANSIT COMPATIBILITY CHECKLIST

This checklist is designed to be used to evaluate a project's overall compatibility with buses, transit amenities and pedestrian accessibility. The responses would indicate if the project has indeed been designed with transit in mind. Projects covered in this checklist include, but are not limited to, new developments, renovations, road projects, and streetscape projects. PAAC stands ready to provide suggestions and solutions if your project would be deemed transit unfriendly. This is only a partial list and should serve as a guide when designing new projects.

Transit Compatibility Checklist	
<i>Development Standard or Criteria</i>	<i>Response</i>
Is the project adjacent to existing bus routes and bus stops?	
Is it at a suitable location for a new bus route or bus stop?	
Is the project suitable for a transfer hub, transfer center, park and ride or other high-intensity transportation activity center?	
Have the project proponents consider transit-friendly design?	
Are the perimeter or frontage streets adequate for bus maneuvering?	
Has public works reviewed the project for bus transit compatibility?	
Will an existing sub-standard bus stop be upgraded for this project?	
Has sufficient right-of-way been provided for a bus stop?	
Will the bus stop design be sufficient in length, width, and surfacing?	
Has enough street side space been provided for bus shelters, lean rails, the regular sidewalk and sufficient space for people with disabilities?	
Do the utility plans accommodate lighting and electronic messaging for upgraded bus stops?	
Is there a central collector street or driveway accessible to transit?	
Are there adequate pedestrian walkways for building entrances to transit stops?	
Are walkways, bus stops, building entrances, and parking lots designed to accommodate the mobility limited?	
Are there breaks in the project's perimeter walls to allow pedestrian access to bus stops?	
Does the subdivision street layout avoid making long hikes necessary to access transit?	
Has the project been reviewed by PAAC staff?	

ADA GUIDELINES

Background and Applicability of ADA

The Americans with Disabilities Act of 1990 (ADA) is broad legislation intended to make American society more accessible to people with disabilities. It consists of five sections or titles (employment, public services, public accommodations, telecommunications, and miscellaneous). Titles II and III (public services and public accommodations) affect bus stop planning, design, and construction.

Although the definition of disability under the ADA is broad, bus stop placement and design most directly affect persons with mobility and visual impairments. These impairments, which relate to the more physical aspects of bus stop accessibility, have received the most attention.

Making new stops conform to ADA physical dimension requirements is relatively easy. Modifying existing stops to comply with ADA, though desirable from an accessibility perspective, is not required under ADA. Modification of existing stops is more difficult, especially if the stops are at sites with limited easement or not subject to the transit agency's control, such as shopping malls, on state rights-of-way, or suburban subdivisions.

The ADA, however, is concerned with more than physical dimensions. It also involves accessibility from the point of origin to the final destination. For example, to get to the bus stop, individuals with limited mobility or vision need a path that is free of obstacles, as well as a final destination that is accessible. A barrier-free bus stop or shelter is of little value if the final destination is not accessible.

Though the ADA does not require retrofitting transit vehicles with lifts, an accessible vehicle is clearly a critical link in the barrier-free trip. Full accessibility is more difficult to achieve when different organizations are responsible for different portions of the path (which is usually the case).

Either way, the "equal access" provisions of the ADA require that the route for persons with limited mobility or vision be as accessible as the route used by those without disabilities. A person with disabilities should not have to travel further, or use a roundabout route, to get to a designated area.

Basic Principles for Bus Stop Design and Location to Conform to ADA

Basic aspects of design exist that encourage accessibility and are applicable to most situations.

Specific dimensions are available from several references, some of which are listed below. Some general design considerations involve obstacles, surfaces, signs, and telephones.

Obstacles

Examine all the paths planned from the alighting point at the bus stop to destinations off the bus stop premises. Determine whether any protrusions exist that might restrict wheelchair movements. If protrusions exist and they are higher than 27 inches or lower than 80 inches, a person with a vision impairment may not be able to detect an obstacle (such as a phone kiosk) with a cane. A guide dog may not lead the person with the impairment out of the path. Although it may not be the transit agency's responsibility to address accessibility problems along the entire path, an obstacle anywhere along the path may make it inaccessible for some transit users with disabilities.

Surfaces

Surfaces must be stable, firm, and slip-resistant. Such provisions are beneficial for all transit users, but especially for those who have disabilities. Avoid abrupt changes in grade, and bevel those that cannot be eliminated. Any drop greater than 1/2 inch or surface grade steeper than 1:20 requires a ramp.

Signs

Signs providing route designations, bus numbers, destinations, and access information must be designed for use by transit riders with vision impairments. Specific guidelines are given for these signs in Section 4.30 of Accessibility Guidelines for Buildings and Facilities, Transportation

Facilities and Transportation Vehicles. In some cases, two sets of signs may be needed to ensure visibility for most users and to assist users with sight limitations. Route maps or timetables are not required at the stop, though such information would be valuable to all passengers.

Telephones

Telephones at bus stops are not required under ADA, but if telephones are in place, they must not obstruct access to the facility and must be suitable for users with hearing impairments. At least one phone must be accessible for wheelchair users. Telephone directories must also be accessible. Figure 28 illustrates a design approach to a bus stop with a shelter that would meet ADA requirements.

PROPOSING CHANGES

Construction, for the purposes of this document, is defined as any project resulting in a disturbance to PAAC bus stops. PAAC should be contacted as soon as possible during the preliminary project planning phase to participate in any decisions on both design and construction that will require temporary or permanent stop closures, relocations or route disruptions.

Temporary or General Construction Provisions

Projects that will cause temporary disruption to a bus route and/or bus stop during construction, but will result in returning the roadway to its existing condition after completion of construction are “temporary construction impacts” Examples of these types of projects include utility work, bridge repairs or building construction adjacent to the roadway. Typically, these projects require temporary lane closures or detours, but existing conditions are eventually restored and PAAC service operations return to its previous level of service. Road Operations is the primary contacts for temporary construction impacts.

Within the City of Pittsburgh, a process is in place for temporary bus stop relocations to be administered alongside traffic obstruction permits. A Bus Stop Temporary Request form can be obtained from the City’s website or the Department of Mobility and Infrastructure.

Permanent Construction Impact

Permanent construction impacts involve projects within the public right-of-way such as the construction or rehabilitation of intersections, roadways and sidewalks. These activities may result in bus service or bus stop removal, relocation, or establishment. Projects falling in this category or typically sponsored by the Pennsylvania Department of Transportation (PennDOT), Allegheny County Department of Public Works, the City of Pittsburgh Department of Mobility and Infrastructure or a local municipality. It is beneficial to both the project sponsor and PAAC to have the appropriate coordination begin early in the design process.

General provisions for both temporary and permanent construction projects are as follows:

- The appropriate PAAC representative (listed above) should be invited to the projects pre-construction conference
- The project sponsor or contractor should contact PAAC and provide a written notification fourteen (14) days prior to any construction that will take affect nearby bus stops or service
- The contractor shall notify PAAC at least five (5) business days in advance of all street closures affecting transit operations regardless of the duration of the closure
- This will allow PAAC sufficient time to plan detours and notify the general public
- The contractor shall work with PAAC to establish an approved temporary bus stop location
- PAAC will provide and post the appropriate temporary bus stop signage and notification
- The contractor shall notify PAAC at least five (5) days in advance of construction completion so that permanent bus stop signs can be re-installed by PAAC or contractor (with signage provided by PAAC)
- Contractor may not remove any bus stop signs without prior authorization from PAAC

Contact Information

Please reach out with any questions regarding bus stops: busstops@portauthority.org. The PAAC Administration Office can also be reached at 412-566-5500.

7.



APPENDIX

Glossary of Terms

Bus Dimensions

Fleet Door Spacing

Sources



GLOSSARY OF TERMS

This glossary provides a partial list of selected terms, defining words or phrases that are frequently used or heard in transportation and transit planning.

Access: Universal ability to board a bus.

ACCESS: Is a coordinated shared ride paratransit service providing door-to-door, advanced reservation transportation in Allegheny County.

ADA compliance: Characteristics of transit equipment, service and boarding areas that comply with the Americans with Disabilities Act (ADA) of 1990 and subsequent amendments. ADA legislation that mandates equal access to all public transportation services, regardless of mobility status. The ADA requires that fixed-route transit be accessible and that paratransit (curb-to-curb is required, but PAAC currently exceeds this requirement by providing door-to-door) service be provided in the same geographic areas on the same days and hours as the fixed route service.

Alightings: Passengers getting off a transit vehicle at a bus stop.

Amenities: Specific passenger or bus features that enhance public transportation, including lighted, paved, handicapped-accessible walkways, shelters, benches, waiting pads, turnouts and bus stop signs.

Articulated bus: A high capacity (60-75 seated passengers) transit vehicle consisting of two sections hinged to each other, permitting the vehicle to turn within a relatively short turning radius, yet with one engine and one driver.

ATIS: Advanced Travel Information Systems provide real-time status of travel vehicles and services, such as the predicted time of arrival of the next bus or buses. The ATIS data can be found on the internet, handheld devices, message boards or public kiosks at bus or rail stations.

Best practices: An approach to transit planning that requires adherence to nationally recognized industry standards for physical facilities and services.

Boardings: Passengers getting on a transit vehicle at a bus stop.

BRT: Bus Rapid Transit offers rail-like transit on an upgraded, rubber-tired bus service. BRT is characterized by attention to major transit corridors, simple but frequent service, preferential traffic light controls and reduced number of stops,

Bus pad: An area of the street, adjacent to the bus stop that is concrete-paved.

Bus shelter: A covered passenger waiting area, often semi-enclosed with benches, that provides protection from the elements.

Bus stop: A linear curbside area that is specifically designed for buses stopping to board and/or alight passengers and should be accompanied by a “No Parking” sign.

Bus stop spacing: The linear distance between individual bus stops.

Bus turning radii: The dimensions necessary to accommodate bus turning at intersections, parking lots, transit centers and elsewhere.

Bus turnout: A bus stop located in a recessed curb area, separated from traffic. Also known as a “buy bay” or “bus berth”.

Bus bulb or bump out: Portion of the curb juts into the roadway to meet the bus and provides extra loading room for patrons.

Commuter bus: Transit over mostly major highways or busways, with few stops and service provided primarily at peak morning and evening hours.

Dwell time: The time a bus spends at a stop, primarily for passengers to get on and off, measured as interval between its stopping and starting.

Egress: Motion of a person or vehicle leaving or exiting a place. Both passengers and buses make their own manner of egress movements.

Far side: A location of a bus stop placed immediately beyond the intersection.

Feeder service: Service designed to feed into existing transit routes by picking up passengers from locations in a neighborhood or jobsite and dropping them off at a stop along the bus or rail line.

Fixed route bus service: Transit provided along dependable and defined routes with published schedules and stops at designated locations.

Headway: The frequency interval between the passing of successive buses moving along the same route in the same direction, usually expressed in minutes.

High-rise development: A concentration of development characterized by multi-story buildings in excess of six stories. Clusters of high-rise buildings are frequently found in activity centers.

Ingress: Motion of a person or vehicle entering a place. Both passengers and buses make ingress movements.

ITS: Intelligent Transportation Systems will integrate bus operations and planning with higher levels of new technology. ITS is characterized by GPS tracking of vehicles, on-board cameras, linkage with highway and police agencies and accurate monitoring of passenger boarding patterns.

Kneeler: A feature that can lower the body of the bus or entrance door to facilitate boarding by senior citizens or people with disabilities.

Layover: Additional time included into a bus schedule between arrivals and departures, used for recovery of delays, driver breaks and preparation for the return trip.

Lollipop: A deviation that causes a bus to leave an otherwise linear path.

Mid-block bus stop: A transit stop located between distant intersections.

Mobility-limited: Individuals having a physical or mental impairment that adversely affects their ability to use various types of transportation, including public transit.

Mode shift: During a complete trip, the traveler will often divide the means of mobility among various conveyances. Various modes include walking, bicycling, bus, rail, paratransit, shared vehicles, single-occupancy vehicles, carpools or aircraft. Even a split between different kinds of buses – local or express buses – is considered a mode shift.

Near side: The location for a bus stop that is placed on the approach side of an intersection.

Overhang: Portion of the bus body extending beyond the front or rear axle.

Queue jumper: A short section of preferential traffic lane that permits transit vehicles to bypass an automobile queue at traffic signal or congested section of the roadway.

Park and ride lot: A designated parking area provided for bus, light rail, van pool and car pool users to park and leave their cars and to continue to their trip in a multi-occupant vehicle, such as a car pool, van pool or bus.

Pedestrian accessway: A lighted, paved and handicap-accessible walkway that provides convenient access to transit facilities and bus stops from adjacent developments.

Road grade: The maximum slope or grade that a standard 40-foot transit bus can negotiate safely on a street, highway or ramp.

Transit furniture: Objects provided at a bus stop or transit center for the comfort and convenience of waiting passengers, such as a shelter bench, trash receptacle or other components.

Transportation modeling: The combining of data from traffic and land use patterns, road capacities, traffic counts, population, employment information and other data into scenarios that describe existing and future travel behavior.

Travel lane: A lane devoted exclusively to vehicular traffic.

Trip generator: A land use or discrete activity that by nature of its operations tends to create a significant amount of travel. Also referred to as a “trip attractor”.

Wheelchair ramp: A slightly sloping paved area designed and designated to provide handicapped access across height and texture difference such as sidewalks, stairs or other barriers to free movement of wheelchairs. PAAC buses are equipped with mechanical ramps that are controlled by operators and lowered from the bus door to allow wheelchair patrons to safely and easily board buses.

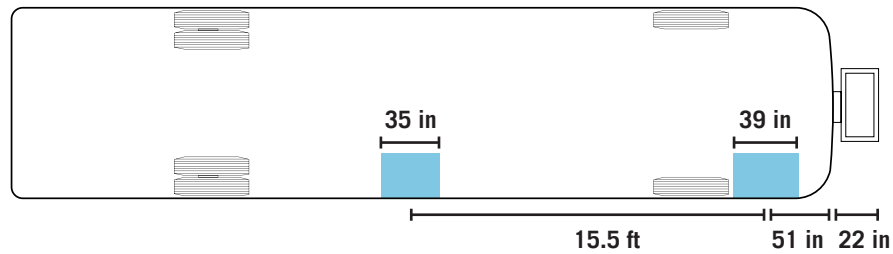
BUS DIMENSIONS

Vehicle Feature	Standard (40')	Articulated (60')	Hybrid
OVERALL HEIGHT	123 in.	126 in.	133 in.
OVERALL LENGTH	40.9 ft.	60.8 ft.	40.9 ft.
OVERALL LENGTH, WITH BUMPERS AND BIKE RACK DEPLOYED	43.9 ft.	63.8 ft.	43.9 ft.
OVERALL LENGTH, WITH BUMPERS AND BIKE RACK STOWED	41.9 ft.	61.8 ft.	41.9 ft.
OVERALL VEHICLE WIDTH, NO MIRRORS	102 in.	102 in.	102 in.
OVERALL VEHICLE WIDTH, WITH MIRRORS	123.7 in.	120 in.	123.7 in.
FRONT AXLE TO FRONT BUMPER	90.2 in.	87.3 in.	90.2 in.
REAR AXLE TO REAR BUMPER	122.6 in.	120.8 in.	122.6 in.
STEP TO GROUND, FRONT ENTRANCE	15.3 in.	13 in.	15.3 in.
STEP TO GROUND, FRONT ENTRANCE WITH KNEELER	13.3 in.	9 in.	13.3 in.
STEP TO GROUND, CENTER EXIT	-	14 in.	-
STEP TO GROUND, REAR EXIT	15.7 in.	15.5 in.	15.7 in.
VEHICLE CURB WEIGHT	28,420 lbs.	39,675 lbs.	29,310 lbs.
VEHICLE GROSS WEIGHT	41,280 lbs.	66,354 lbs.	39,600 lbs.
GROSS VEHICLE WEIGHT AT FRONT AXLE	14,600 lbs.	15,520 lbs.	9,200 lbs.
GROSS VEHICLE WEIGHT AT CENTER AXLE	-	25,350 lbs.	-
GROSS VEHICLE WEIGHT AT REAR AXLE	27,000 lbs.	28,484 lbs.	20,110 lbs.
SEATED CAPACITY	40 persons	57 persons	40 persons
CAPACITY WITH STANDEES	72 persons	106 persons	67 persons
WHEEL CHAIR CAPACITY	2 wheel chairs	2 wheel chairs	2 wheel chairs

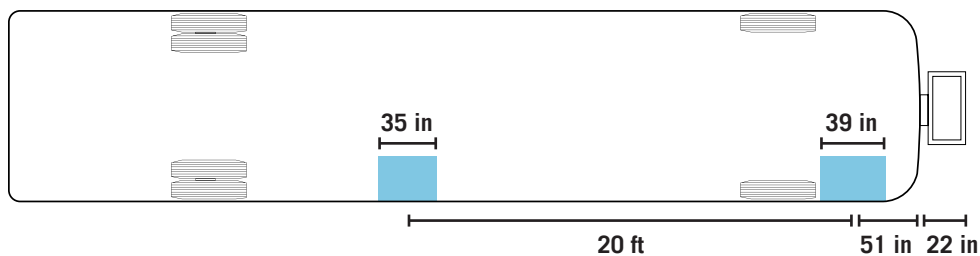


FLEET DOOR SPACING

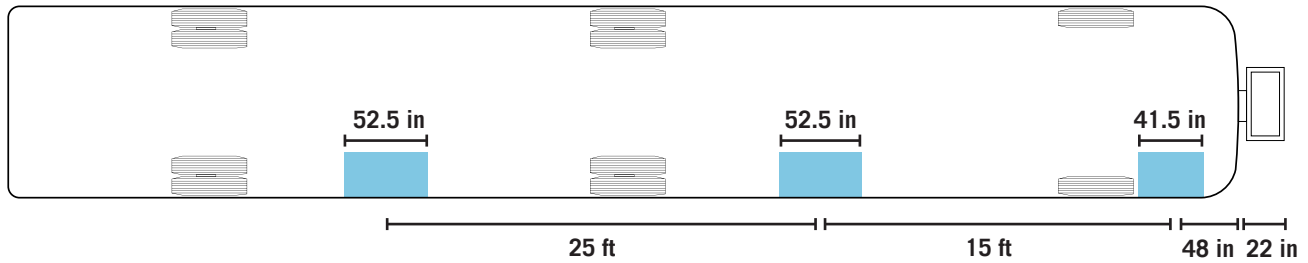
35 feet Gillig (1700's)



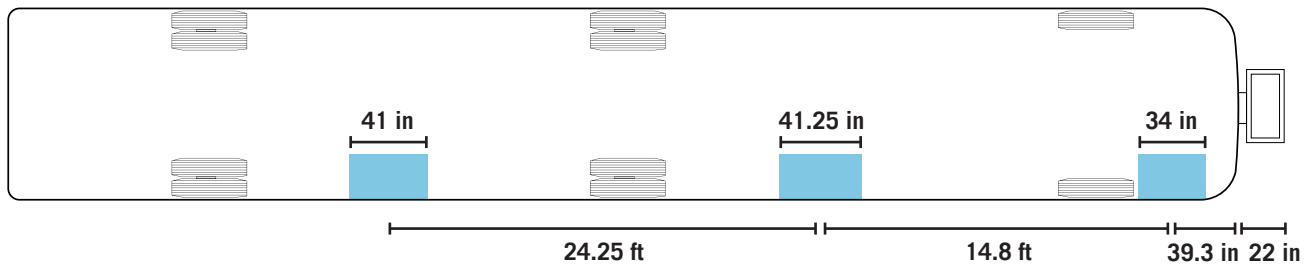
40 feet Gillig (5200's-6400's)



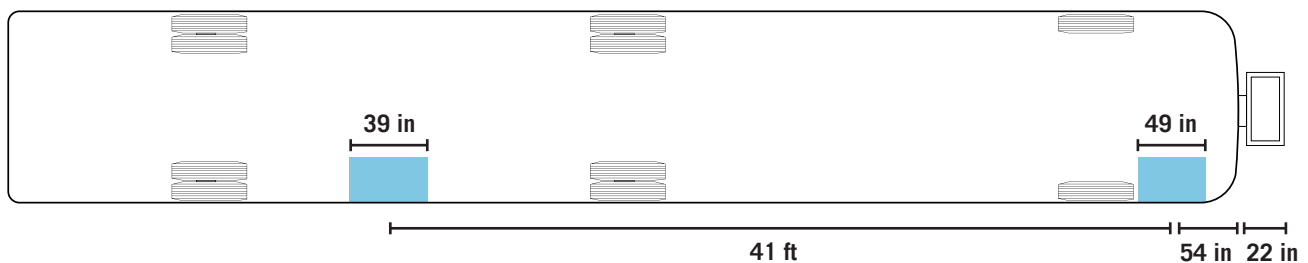
60 feet New Flyer (3200's-3300's)



60 feet New Flyer (3400's)



60 feet Neoplan (3100's)



SOURCES

All images and text not sourced below are provided by PAAC or CDM Smith.

Text

- *Bus Stop Placement, Advantages and Disadvantages, p. 12* - Southeastern Pennsylvania Transportation Authority Bus Stop Design Guidelines
- *Driveways, p. 14* - WeGo Transit Guidelines
- *Table: Stop Lengths, p. 18* - NACTO
- *Stop Typology Elements, p. 20-22* - Southeastern Pennsylvania Transportation Authority Bus Stop Design Guidelines
- *Universal Design, p. 23* - Southeastern Pennsylvania Transportation Authority Bus Stop Design Guidelines
- *Bike Lanes, p. 28-31* - WeGo Transit Guidelines

Images

- *Bus Stop Placement, Far, Near, Mid Graphics, p. 13* - Southeastern Pennsylvania Transportation Authority Bus Stop Design Guidelines
- *Driveway Configurations, p. 14* - TCRP 19
- *ADA Landing Pad example p. 23* - WeGo Transit Guidelines
- *Boarding Island example, p. 25* - GreenLane Project, Flickr, Adam Coppola Photography
- *Cycle Lane example, p. 28* - Flickr, Paul Krueger
- *Transit Signal Priority example, p. 42* - Wikimedia Commons, Raysonho



This document provides an overview of planning for bus transit compatibility. For a copy of this document and to learn more about the transit standards in these Guidelines, please contact the PAAC Planning staff at:

Port Authority of Allegheny County

345 Sixth Avenue, Third Floor

Pittsburgh, PA 15222

Phone: 412.566.5500

Website: www.portauthority.org

These Guidelines are by no means exhaustive of the planning considerations surrounding public transit.