BUS STOP DESIGN STANDARDS MANUAL

January 2025

SMART

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LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ABA	Architectural Barriers Act
ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
APBP	Association of Pedestrian and Bicycle Professionals
APC	Automated Passenger Counting
APS	Accessible Pedestrian Signals
APTA	American Public Transportation Association
BSZ	Bus Stop Zone
CBD	Central Business District
CE	Categorical Exclusion
CFR	Code of Federal Regulations
COA	Class of Action
CPTED	Crime Prevention through Environmental Design
DOT	Department of Transportation
FTA	Federal Transit Administration
ITS	Intelligent Transportation Systems
LCD	Liquid Crystal Display
LED	Light-emitting Diode
Manual	SMART *Bus Stop Design Standards Manual*
MBTA	Massachusetts Bay Transportation Authority
MDOT	Michigan Department of Transportation
MI	Michigan
MISS DIG	Michigan Utility Notification System
MMUTCD	Michigan Manual of Uniform Traffic Control Devices
MOT	Maintenance of Traffic
MPO	Metropolitan Planning Organization
MTA	Maryland Transit Administration
MTP	Metropolitan Transportation Plan
NACTO	National Association of City Transportation Officials
NADTC	National Aging and Disability Transportation Center
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOFO	Notice of Funding Opportunity
POT	Path of Travel
PROWAG	Public Right of Way Accessibility Guidelines
PTASP	Public Transportation Agency Safety Plan
RFID	Radio Frequency ID
ROW	Right of Way
RTAP	Rural Transit Assistance Program
SEMCOG	Southeast Michigan Council of Governments
SEPTA	Southeastern Pennsylvania Transportation Authority
SHPO	State Historic Preservation Office

SMART	Suburban Mobility Authority for Regional Transportation
SMART FAST	SMART Frequent, Affordable, Safe Transit
SS4A	Safe Streets for All
THPO	Tribal Historic Preservation Office
TIP	Transportation Improvement Program
TSC	Transportation Service Center
TSP	Transit Signal Priority
TTC	Temporary Traffic Control
TVM	Ticket Vending Machine
U.S. DOT	United States Department of Transportation

1 INTRODUCTION

Established in 1967, the Suburban Mobility Authority for Regional Transportation (SMART) is a regional public transportation provider. SMART keeps the region moving, operating bus service to communities across the southeastern Michigan region. Macomb, Oakland, and part of Wayne County are SMART's defined service areas shown in **Figure 1**, in addition SMART operates some services to destinations outside of this defined area.

Supported by federal, state, and local funding sources, SMART strives to provide safe, cost-effective, and high-quality bus service. SMART's services connect communities across the metro Detroit area, providing the public with the mobility linkages they need every day.

Figure 1: SMART Service Area (July 2024)

SMART routes serve residents of Oakland, Macomb, and Wayne counties, providing access to destinations across the metro Detroit area. As SMART is a regional transit service provider, its network offers several different types of routes across many different communities.

Both fixed-route and curb-to-curb service options are offered through SMART's bus network. Fixed bus routes have designated paths and stops in addition to scheduled pick-up and drop-off points along their path, i.e. bus stops.

SMART's bus network includes the following fixed-route service options:

- **Standard Fixed-Routes**
  SMART provides several different types of fixed-route service: community, crosstown, commuter, park and ride, and major corridor routes.

- **SMART FAST (Frequent, Affordable, Safe Transit)**
  FAST service connects the suburbs to downtown Detroit quickly and easily. FAST stops are located about every mile.

Curb-to-curb transit service picks up and drops off passengers at the curb or roadside. These services do not require a bus stop since the pick-up and drop-off locations are designated by the passenger and therefore change each trip.

SMART's bus network includes the following curb-to-curb service options:

- **SMART Flex**
  Flex is a microtransit service offered via a mobile app. Passengers in a designated zone can request a ride through the SMART Flex mobile app any of the week from early morning to late night. SMART Flex serves as a first- and last-mile connection to fixed-route transit.
- **SMART Connector**
  Connector is another SMART microtransit service, offering advance-reservation curb-to-curb trips of up to 10 miles to anyone living within the SMART service area more than one-third of a mile from a fixed-route SMART service. Aptly named, Connector service is meant to link passengers living in lower-density areas to fixed-route services. Although primarily aimed at addressing the mobility needs of seniors and passengers with temporary or permanent disabilities, all passengers are welcome to use SMART Connector services.
- **ADA Paratransit Service**
  Americans with Disabilities Act (ADA) Paratransit SMART service is an advance-reservation service and operates using the same fleet of vehicles as Connector service under very similar service provision stipulations. To use SMART ADA Paratransit services, passengers must live within the paratransit service area, which extends three-quarters of a mile in either direction from a SMART fixed-route service.

SMART also partners with local communities or groups to share the responsibility of transit provision through the Community Partnership Program. Since 1995, SMART has shared jointly built, maintained, and operated local transit services with community partners to meet each local area's specific needs.

1.1 About This Guide

Location, design, and functionality of bus stops influence the performance of transit systems and transit customer satisfaction. The SMART *Bus Stop Design Standards Manual* (Manual) is intended to serve as an internal bus stop design resource for transportation planners and designers, bus stop operators, and local stakeholder units or agency officials. This Manual includes guidance on the most current regulations, and best practices in transportation planning and design, providing users with information on how to integrate bus service into the different types of streetscapes found within SMART's service area.

This document contains guidelines, standards and criteria for the planning, design and placement of stop and other bus facilities. The Manual is consistent with local, state, and federal laws and regulations, in addition to best practices from national transit organizations, drawing on recommendations made by National Association of City Transportation Officials (NACTO) in the *Transit Street Design Guide*.

The overall goals of SMART's *Bus Stop Design Standards Manual* are:

- **Safety for All**
  Both social and traffic safety are critical in passengers' decisions about where and when they choose to take transit.
- **Considerate of all Street Users**
  Organizing how all street users interact with the transit system through bus stop design and configuration makes interactions between different modes of transportation more predictable, prompt, and safe.
- **Consistent and Barrier-Free**
  Overall design of stops and their individual elements (e.g. wayfinding materials, seating, etc.) should be consistent and barrier-free to ensure all passengers feel well-informed and comfortable throughout their trip.
- **Unified Street, Vehicle, and Platform Design**
  Streets with transit, transit vehicles, and stop platforms all work together to board, transport, and alight passengers. As these elements are part of the same system, physically aligning their design provides passengers with the smoothest trip experience.
- **Universal Design is Equitable Design**
  People of all ages and abilities must be able to safely access transit. Using universal design to meets the needs of all transit passengers, not just the average passenger, benefits all riders by elevating their experiences through accessibility.

- **Integrated into the Surrounding Streetscape**
  Amenities provided at bus stops, e.g. seating or shelters, do not only enhance the waiting experience of transit passengers, but the experience of all streetscape users, seamlessly integrating the bus stop into the surrounding streetscape.

Implementing the guidance in this document, SMART will continue to improve the quality and universal usability of bus stops in the SMART service network. Users of this document should employ this Manual's recommendations in conjunction with sound engineering judgement and local expertise when designing, building, or updating bus stops or other bus facilities. Additionally, it is important to note that design solutions may need to be adjusted to satisfy specific local unit requirements and should be evaluated with respect to cost-effectiveness. The *Bus Stop Design Standards Manual* will be reviewed and revised as needed.

If Manual users have any questions or are seeking expert advice relative to information contained in this manual, they should contact SMART at innovations@smartbus.org.

The following chapters detailing bus stop facility planning and design are included:

- **Chapter 2 Design Context** provides an overview of the purpose, network placement, usage, and design differences of both off-street and on-street bus stops within SMART's bus transit network.
- **Chapter 3 Agency Coordination Requirements** discusses roles and responsibilities related to the inter-agency coordination necessary to complete bus stop design implemented by a regional transit provider like SMART.
- **Chapter 4 Operational Considerations** discusses various transportation facility physical design considerations impacting safe and smooth bus service operation throughout the SMART bus network.
- **Chapter 5 Bus Stop Placement** discusses guidelines for how far apart SMART bus stops should be depending on various factors, including but not limited to: land use, points of interest like education centers or residential complexes, customer walk distances, and bus trip times.
- **Chapter 6 Passenger Waiting Areas** addresses specific decision-making and details pertaining to the placement and design of the passenger waiting area within the bus stop zone, including: accessibility concerns and best practices, amenities, information and technologies, and other trip elements affecting bus passengers.
- **Chapter 7 Off-Street Bus Stop Facilities** addresses the benefits, disadvantages, and applications of bus transit facilities that are not on-street, meaning bus facilities that are located within a city block.
- **Chapter 8 Integrated Design** addresses the benefits of bringing together additional design elements when installing or updating bus stops, and detailing the rationale for including these elements at bus stops in SMART's service area.

- **Chapter 9 Safety and Security** addresses passenger safety and security concerns present at bus stops and how to proactively mitigate these concerns through safety and security-informed bus stop design.
- **Chapter 10 Design Criteria Scoring Sheets** provides several forms that should be completed when making key planning and design decisions about bus stops.

1.2 How to Use This Guide

The Manual is intended to assist several different audiences in planning the location and design of bus stops: transportation planners, transportation designers, stakeholder local unit or agency officials, and bus operators. These and other readers of the Manual should refer to the lists in this section to find specific answers to their bus stop questions easily and efficiently.

Transportation Planners and Designers

Transportation planners, civil engineers, real estate developers, and local agency staff may be particularly interested in the following sections of the *Bus Stop Design Standards Manual*:

- Section **2.1 General Bus Stop Types**
- Section **2.4 Local Land Use Design Considerations**
- Section **2.5 Equitable Design Considerations**
- Chapter **3 Agency Coordination Requirements**
- Chapter **4 Operational Considerations**
- Chapter **5 Bus Stop Placement**
    - Section **5.7 Modifications During Construction**
- Section **6.1 Bus Stop Accessibility**
- Section **6.2 Bus Stop Amenities**
- Section **9.1 Collision Prevention**

Stakeholder Local Unit or Agency Officials

Local government officials may be interested in the following sections of the *Bus Stop Design Standards Manual*:

- Chapter **5 Bus Stop Placement**
- Section **6.1 Bus Stop Accessibility**
- Chapter **9 Safety and Security**

Bus Operators

Bus operators may be interested in the following sections of the *Bus Stop Design Standards Manual*:

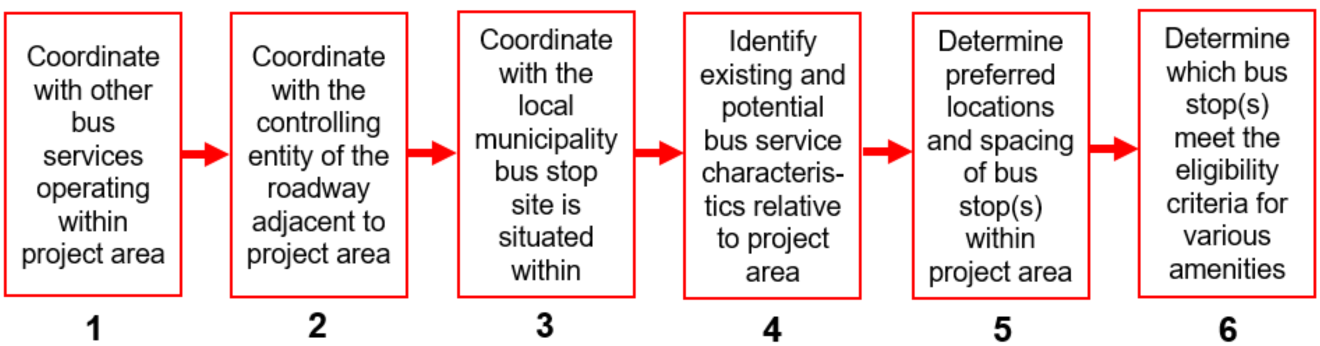
- Chapter **4 Operational Considerations**
- Chapter **5 Bus Stop Placement**
    - Section **5.7 Modifications During Construction**

- Section **6.1** **Bus Stop Accessibility**
- Section **6.2** **Bus Stop Amenities**
- Section **6.3** **Bus Stop Information and Technologies**
- Section **9.1** **Collision Prevention**

1.3 Siting, Design and Construction Process

This Manual is best used following SMART's standard siting, design, and construction processes for bus stop facilities. **Figure 2** summarizes the siting and design processes, explained in greater detail by the rest of this section. See **Chapter 10 Design Criteria Scoring Sheets** for an illustration of the siting, design, and construction workflows. The bus stop planner or designer should manage the siting and design processes, and hand off work to the Bus Stop Crew for construction management once a site plan for the bus stop is complete.

Figure 2: Standard Bus Stop Siting and Design Process



When siting a new bus stop or updating an existing stop, coordinating with other entities whose jurisdiction overlaps or is adjacent to SMART's project area is critical. First, coordinate with other entities that operate service to non-SMART bus facilities within the project area to identify if there are any conflicts or uses that should to be taken into consideration. If there are other SMART bus facilities within the project area, coordinate with SMART's Service Planning Department.

Second, share project plans with the controlling entity. Bus service typically operates on roadways that are neither owned nor controlled by the transit agency providing the bus service. SMART does not own any roadways. The controlling entity for these roadways is generally the state, county, or the local municipality. If the controlling entity is the local municipality, start by contacting the city engineer. If it is the state, contact the Michigan Department of Transportation (MDOT) Transportation Service Center (TSC) Utilities and Permits Coordinator, who will engage the local TSC Manager if needed. Regardless of the controlling entity, MISS DIG, Michigan's utility safety notification system, will also need to be engaged during stop siting to identify and coordinate with utility owners with assets running through the project area. Apart from the controlling entity, coordination with the local municipality the bus stop site is situated within is necessary to identify any zoning or other land use constraints that may affect bus stop siting. Coordinating with the non-SMART entity or entities providing all or a portion of the funding for the project is also important. They will be able to outline any specific requirements or standards attached to the funding provided that the project will need to meet.

Coordination is needed throughout the lifecycle of a project. Continued communication with the local municipality's engineer and/or MDOT TSC Utilities and Permits Coordinator is paramount. Aside from helping clarify codes, standards, and regulations that apply within the proposed project area, these individuals will help determine whether additional coordination with other parties is needed (See **Chapter 3 Agency Coordination Requirements**). Ongoing outreach to business owners or other community stakeholders impacted by the construction phase of the project is recommended, and is required in some funding cases.

After setting up coordination with the appropriate entities, existing and potential future bus service characteristics within the project area should be identified. The most influential service characteristics to identify are ridership, service frequency, bus boarding and alighting details, vehicle types providing service, and service run times at the existing or proposed bus facility location. This information in addition to other key service characteristics is typically provided by the SMART Service Planning Department or the local transit planning agency.

Once specific information about bus service within the project area is gathered, the preferred location(s) and spacing of bus stops in that area can be determined. Important factors in this determination include adjacent land use, ridership, roadway and sidewalk operational characteristics, safety, and accessibility. The Manual goes into further details on these subjects in later chapters, see **Chapter 2 Design Context**, **Chapter 4 Operational Considerations**, **Chapter 5 Bus Stop Placement**, and **Chapter 6 Passenger Waiting Areas**.

Finally, whether proposed or existing stops within the project area meet eligibility criteria for various amenities can be determined. **Table 30** and SMART's Title VI Plan should be consulted when deciding whether shelters or benches will be provided at a particular bus stop (See **Chapter 6 Passenger Waiting Areas**). All planning, design, and construction documents shall be submitted for review to the SMART Service Planning Department, the controlling entity, and project funder. Submittal of these documents should take place during project development and at the end of all project design phases.

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2 DESIGN CONTEXT

Design context refers to the physical, social, environmental, and other circumstances and settings which surround bus stops within SMART's transit network. These intersecting contexts become important considerations when planning, designing, and constructing new transit infrastructure, like bus stops. Both standard and SMART-specific contextual factors affect the bus stop design process. All are important to consider so that the design concept, or how things *should* work, best reflects the users' reality, or how things *really* work.

It is strongly preferred that all stops are designed to be maximally accessible to all passengers regardless of differing mobility needs. Some older stops in SMART's network may not be designed in this manner, but accessibility should be a primary design factor in the design of new stops and updates to older stops. For more information about accessible design, see **Section 6.1 Bus Stop Accessibility**. Data provided on SMART's bus network is current as of October 2024.

2.1 General Bus Stop Types

Many factors determine the type of bus stop that will best serve the needs of transit users at a particular location. While the placement of the bus stop in addition to the operational characteristics of the roadway it sits on, discussed in **Chapter 4 Operational Considerations** and **Chapter 5 Bus Stop Placement**, determine what features are included at a particular stop, there are six general categories of bus stops. These categories include both off-street and on-street bus stops.

The six general categories of bus stops described here are organized hierarchically based on the number of routes that serve the stop. Category 1 stops are served by the most bus routes and generally provide the most amenities, while Category 6 stops are served by the fewest routes and provide the least amenities. Amenities that may be included at Category 6 stops are also good to include at Category 5 stops, amenities that may be included at Category 5 stops are also useful at Category 4 stops, and so on. However, certain amenities are recommended or preferred for a given bus stop category, given the streetscape associated with that stop category.[1]

SMART's transit network includes at least one stop from each of the six general categories:

1. Off-street transfer centers,
2. On-street transfer centers,
3. Network hub stops,
4. Standard stops,
5. Coverage stops, and
6. Flag stops.

[1] (Maryland Department of Transportation Maryland Transit Administration (MDOT MTA), 2019)

1. Off-Street Transfer Center

Off-street transfer centers are served by several routes, which may have separate accessible stops or a single accessible stop along an off-street bus loop. **Figure 3** illustrates the design and amenities of an on-street transfer center. Other forms of transit are often connected to off-street transfer centers so that passengers can efficiently switch between both routes and modes of transit. Fare machines, covered bicycle racks, and operator comfort stations are preferred at off-street transfer centers. Shown in **Figure 4**, the Jason Hargrove Transit Center in Detroit, Michigan is an example of an off-street transfer center that SMART routes serve.

Figure 3: Illustrative Design and Amenities of Off-Street Transfer Centers

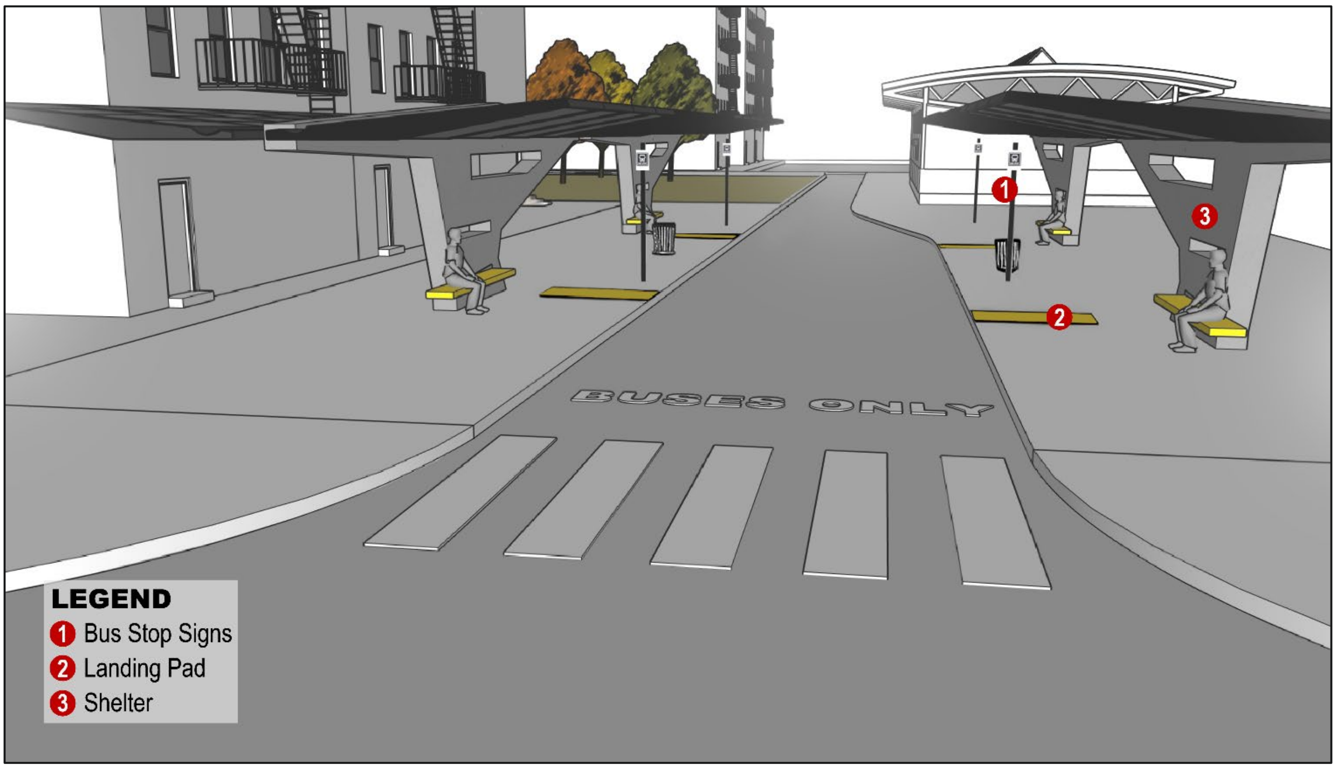


Figure 4: Jason Hargrove Transit Center in Detroit

2. On-Street Transfer Center

On-street transfer centers are also served by several routes, consisting of several combined accessible bus boarding and alighting areas arranged one after the other on the same block. **Figure 5** illustrates the design and amenities of an on-street transfer center. They create a facility where more than one bus can board and alight passengers at once, increasing trip efficiency. Emergency call boxes, video surveillance, area maps, and real-time information display are preferred at on-street transfer centers. Shown in **Figure 6**, the SMART Royal Oak Transit Center in Royal Oak, Michigan is an example of an on-street transfer center.

Figure 5: Illustrative Design and Amenities of an On-Street Transfer Center

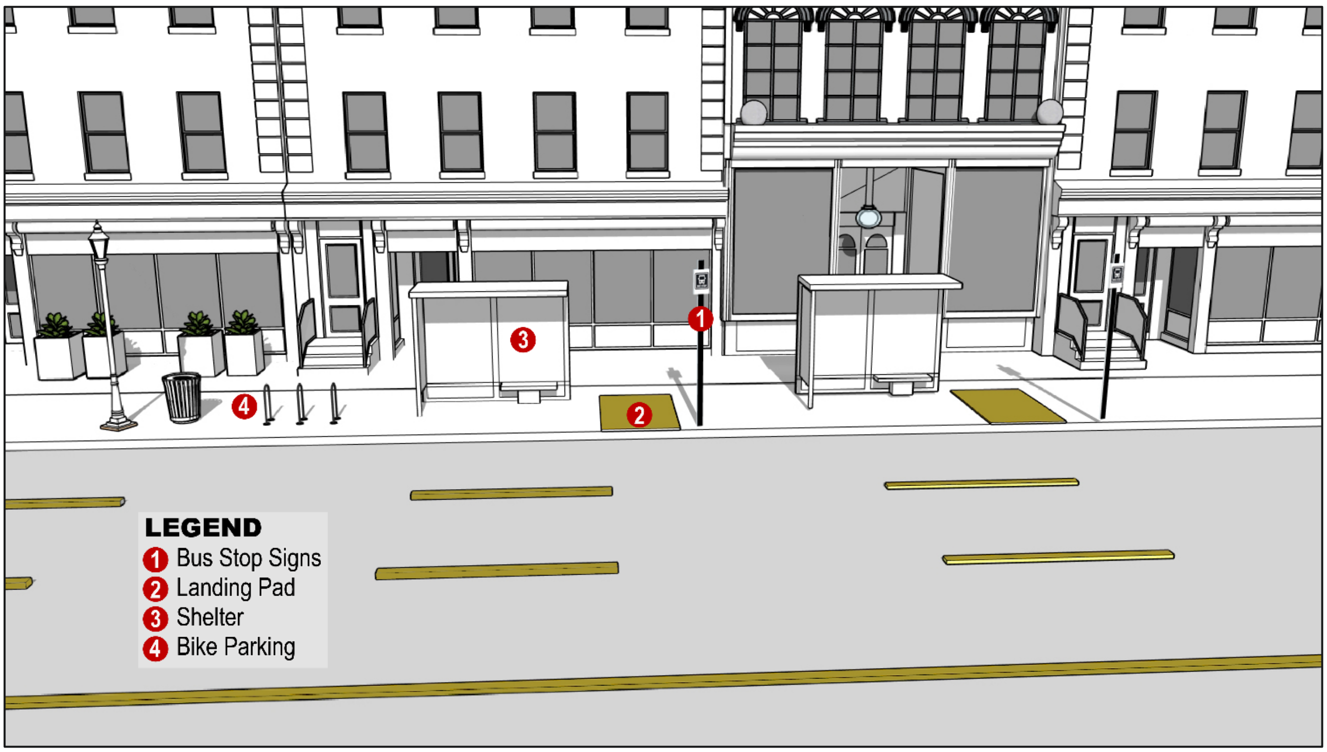


Figure 6: SMART On-Street Transfer Center, Royal Oak Transit Center in Royal Oak

3. Network Hub Stop

Network hub stops are on-street stops that are served by three or more routes, consisting of a single bus boarding and alighting area. They are characterized by their location on major streets in urban areas or suburban arterial roads. **Figure 7** illustrates the design and amenities of a network hub stop. Given that network hub stops are along roadways with high traffic volumes, a crosswalk at a controlled intersection is preferred at this type of bus stop. In-street concrete bus pads, shelters, and system maps are also preferred at network hub stops. **Figure 8** shows a SMART network hub stop located at the Oakland Mall in Troy, Michigan.

Figure 7: Illustrative Design and Amenities of Network Hub Stops

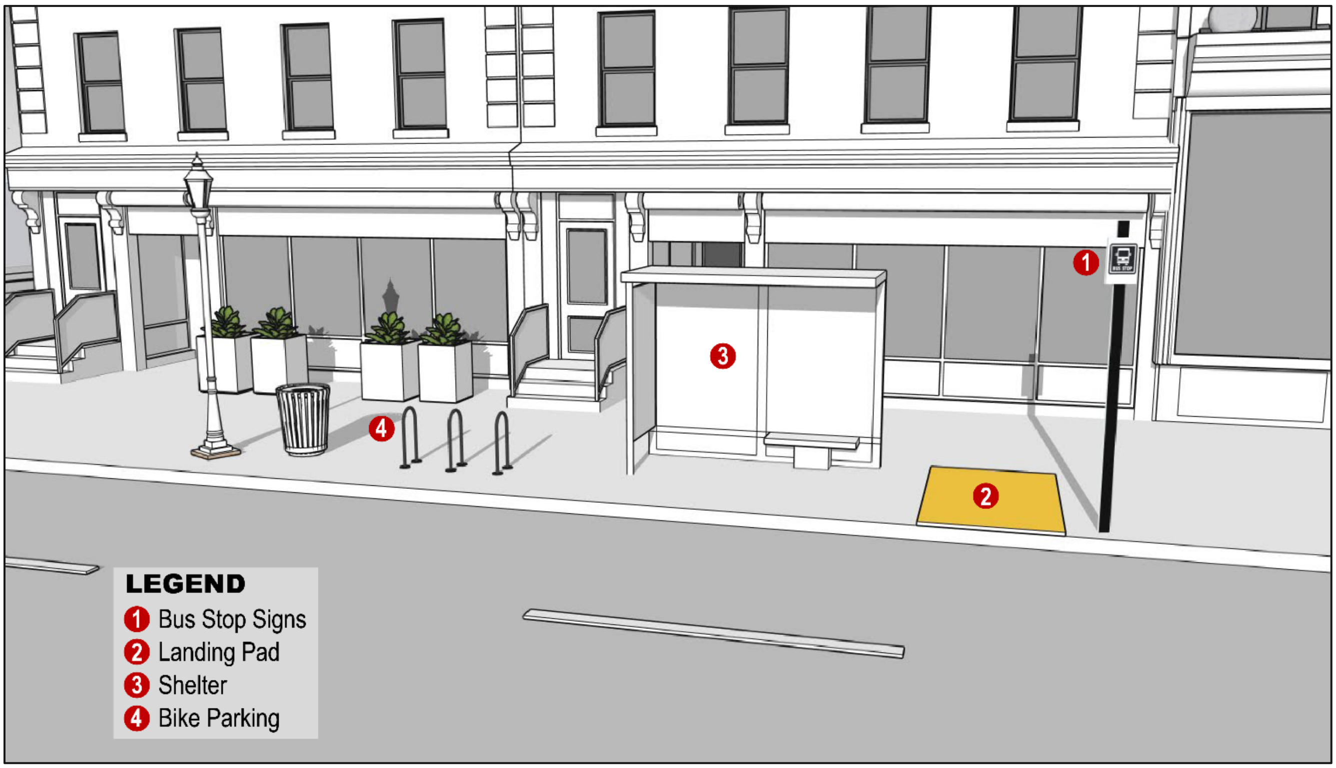


Figure 8: SMART Network Hub Stop at the Oakland Mall in Troy

4. Standard Stop

Standard stops are on-street stops served by two routes or fewer, consisting of a single accessible bus boarding and alighting area and located on streets with lower traffic volumes than network hub stops such as suburban main streets, arterial roads, and neighborhood streets. **Figure 9** illustrates the design and amenities of a standard stop. A bus stop sign, accessible boarding and alighting area, accessible crossings, and lighting are preferred at standard bus stops. **Figure 10** shows SMART standard bus stops in Oak Park, Michigan.

Figure 9: Illustrative Design and Amenities of Standard Stops

Figure 10: Standard SMART Bus Stops in Oak Park

9 Mile Road & Manistee Street

9 Mile Road & Oneida Street

5. Coverage Stop

Coverage stops are usually found in rural and suburban areas with limited to no sidewalk connectivity, typically located on rural or suburban arterial roads. **Figure 11** illustrates the design and amenities of a coverage stop. Only a bus stop sign and an accessible bus boarding and alighting area are required at a coverage bus stop. **Figure 12** shows examples of SMART coverage bus stops in Royal Oak and Ferndale, Michigan.

Figure 11: Illustrative Design and Amenities of Coverage Stops

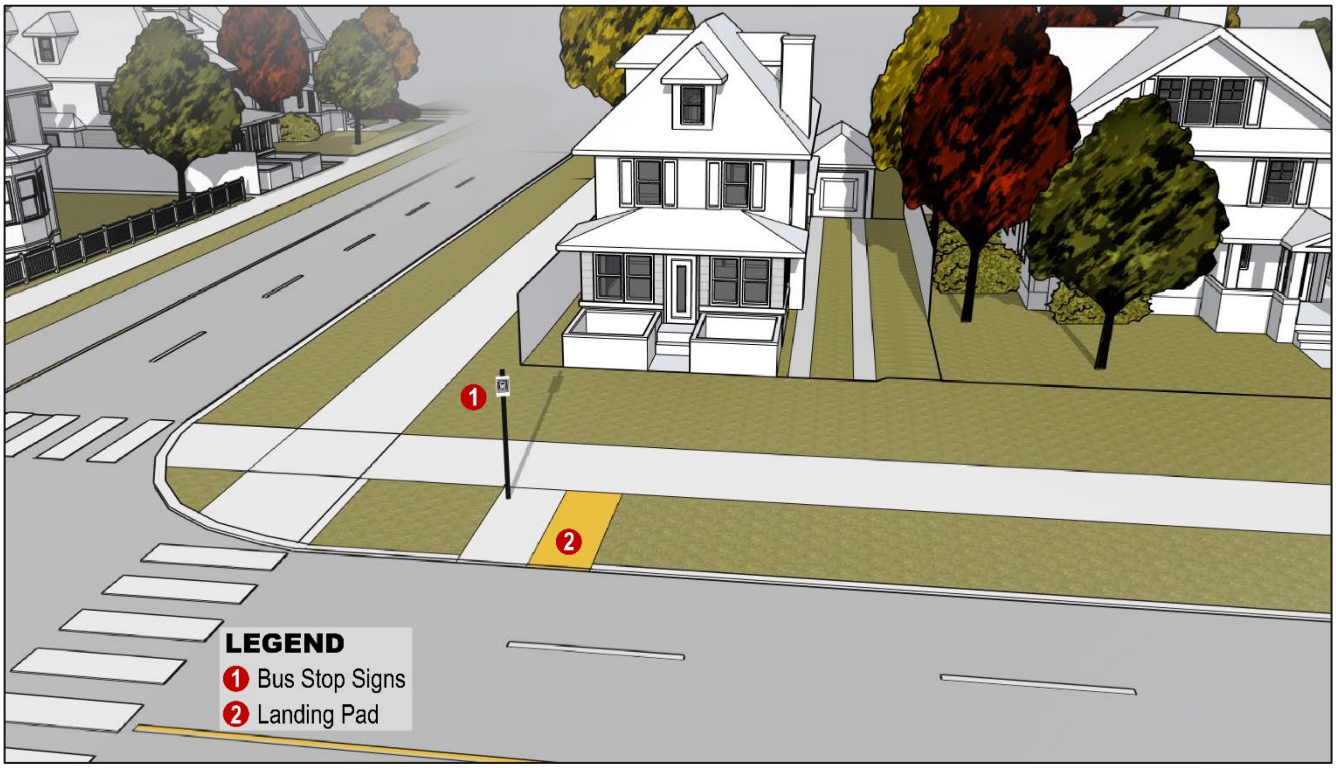
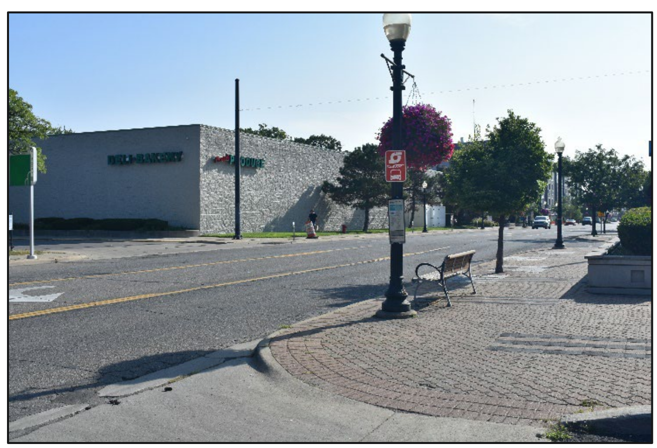


Figure 12: SMART Coverage Stops in Royal Oak and Ferndale

Woodward Avenue & 11 Mile Road
Royal Oak, MI



9 Mile Road & Livernois Street
Ferndale, MI

6. Flag Stop

Flag stops are found in areas that only allow bus routes where passengers may board a bus by flagging it down at any safe location regardless of whether there is a posted bus stop sign. These typically occur in areas that prohibit bus stop signage through local codes, regulations and standards. Flag stops are not a preferred method used by SMART. **Figure 13** illustrates the design and amenities of a flag stop. No amenities are required at a flag stop. **Figure 14** shows an example of a SMART coverage bus stop in Grosse Pointe Woods, Michigan.

Figure 13: Illustrative Design and Amenities of Flag Stops

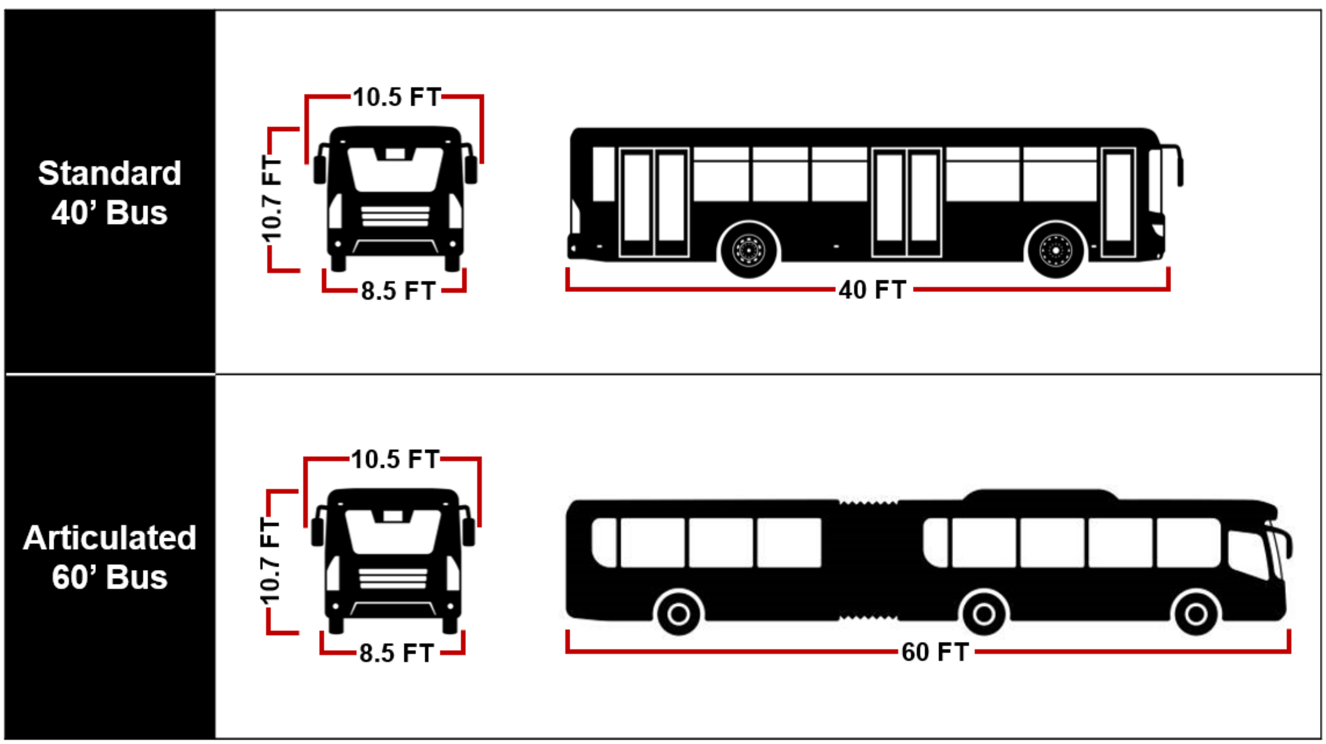
Figure 14: SMART Flag Stop at Mack Avenue & Severn Road in Grosse Pointe Woods

2.2 Vehicle Fleet

SMART's active vehicle fleet consists of vehicles to accommodate both fixed-route and curb-to-curb service. As of 2024, SMART's vehicle fleet includes buses both 40 and 60 feet in length. In the future, SMART plans to continue to upgrade its vehicle fleet, potentially by adding smaller buses for use on some fixed routes. Generally, bus stops should be designed to accommodate the largest vehicle length that will stop at them. Stops designed for 40-foot buses will also be able to accommodate smaller vehicles.

All SMART buses are low floor accessible for those with mobility impairments and are equipped with bicycle racks. For design purposes, the vehicle dimensions and use cases in **Figure 15** and **Table 1** should be assumed.[2] It is important to note that bus stop design should not cater solely to pre-determined transit vehicles, although transit vehicle selection directly impacts bus stop facility and surrounding street design.

Figure 15: SMART Design Vehicle Technical Specifications[3]



Source: SMART, NACTO (2024)

[2] (National Association of City Transportation Officials (NACTO), 2016)
[3] (National Association of City Transportation Officials (NACTO), 2016)

Table 1: SMART Design Vehicles by Street Type[4]

Bus Type	Length	Width*	Height	Street Type
Standard	40 feet	10.5 feet	10.7 feet	Neighborhood, Corridor, Downtown
Articulated	60 feet	10.5 feet	10.7 feet	Corridor, Downtown

**Including mirrors*
Source: SMART, NACTO (2024)

2.3 Ridership

SMART reports ridership data monthly over the course of each fiscal year (July 1st-June 30th). SMART's ridership data is collected using automated passenger counting (APC). APC sensors are installed over the front and back doors of transit vehicles to detect and count the number of people entering and exiting. Accurate travel behavior modeling is essential to effective and efficient stop and service provisions, and these models depend in large part on the design context provided by reliable ridership counts.

2.4 Local Land Use Design Considerations

Population and building density, associated land use and zoning, and street typology are key in determining bus stop spacing and design criteria. Land use is typically determined by zoning and the associated character of the land, intensity or mix of uses that consequently influence streetscapes and rider modes (i.e. biking, walking, bus, carpool, park-and-ride).

In general, higher population densities generate higher levels of transit demand and ridership. As such, bus stops in areas with higher population densities should be more frequent than stops located in areas with lower population densities. In densely populated areas with high passenger boarding and alighting rates, it is recommended that bus stops are placed every two blocks and/or every block. Similarly, design treatments and/or facilities that work well in a suburban neighborhood or residential street typologies do not keep buses running efficiently in a central business district (CBD) or major corridor streets.

Regarding bus stop spacing, it is essential to provide intermediate bus stops at frequencies based on the distance that it takes riders to arrive at a bus stop given the land use typology the site is situated in. As a general rule, bus stops in CBDs and major commercial districts are closest together, followed by high to medium density areas.[5] The frequency of bus stops is lowest in areas with low density and rural areas. Specific metrics for bus stop spacing in unique land use contexts are discussed in detail in **Section 5.1 Bus Stop Spacing**.

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[4] (National Association of City Transportation Officials (NACTO), 2016)
[5] (Orange County Transportation Authority (OCTA), 2004)

It is also important to consider the influence of land use and associated population densities on rider modes of arrival. Typically, riders in CBDs and central city districts arrive by foot and by bus to transit stops. In inner ring suburbs, riders typically arrive by bus and/or park-and-ride. In low density land use typologies such as outer ring suburbs and exurbia, riders typically rely on park-and-ride facilities exclusively.[6]

CBDs and other major passenger generators contribute to higher density and land use intensity, and consequently transit demand. Major passenger generators affecting transportation service can be found on arterial, major and collector streets in areas with diverse zoning and land use designations. Generators can include hospitals, stadiums, shopping centers, or educational facilities and infrastructure like recreational areas, parking areas, or transit transfer centers. In addition to large institutions, retail centers, and transfer centers, high density residential areas can also be major passenger generators. Stops near major passenger generators should be equipped with an array of amenities, like signage, shelters, benches, ADA-compliant bus stop landing pads, and bike racks. Conversely, bus stops located in areas with lower demand and ridership require fewer amenities. In these areas, signage and ADA-compliant bus stop landing pads typically suffice relative to typical passenger volumes.

Zoning designation and street typology should also be considered to determine facilities and spacing between stops. Overarchingly, the design and spacing of bus stop sites on arterial, major arterial, collector and neighborhood streets can vary based on street typology and nearby passenger destinations. Street typology additionally dictates whether buses stop in traffic or outside of traffic flow and what transit priority measures are possible.

Community vulnerabilities should also be considered when planning and designing stops. Vulnerabilities can arise from sensitive land uses and in areas where increases in traffic may cause particular safety concerns, such as historic places or public open space. Population groups such as children and the elderly, people with disabilities, limited English proficiency, and minority populations may warrant special attention in planning and decision making.[7]

The key general guidelines for integrating bus stop site with local land use elements are:

- **Minimize barriers to access.**
  Passenger travel to and from stops should be as barrier-free as possible.
- **Site stops nearby major passenger generators.**
  Deviating from standard stop spacing is appropriate when surrounding land uses generate large passenger volumes.

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[6] (Transit Cooperative Research Program (TCRP), 2012)
[7] (Transit Cooperative Research Program (TCRP), 2012)

- **Design stops for the passengers that local land uses generate.**
  Stop position, configuration, and amenities should consider the passengers most likely to use the stop relative to local land uses.

2.5 Equitable Design Considerations

Transit designed without centering and addressing the needs of those it is meant to serve is destined to fail. Centering and addressing the needs of passengers requires implementing several different types of equity related to transit. Equity, as distinct from equality, involves understanding and meeting everyone's unique needs, rather than just providing everyone enough to meet the average or 'standard' person's needs. SMART riders across the Southeastern Michigan region have varying transit needs, and equitable bus stop design will help meet these for each SMART rider.

There are four forms of equity that are foundational to transit networks optimally planned for all users: procedural, distributional, structural, and transgenerational equity.

Procedural Equity

Inclusively, accessibly, and authentically engaging and representing those affected by transit decisions over the course of the decision-making process.

Distributional Equity

Transit decision-making processes should result in fair distributions of both benefits and burdens across all stakeholders. Decisions regarding the distribution of transit resources should prioritize stakeholders with the most need for transit.

Structural Equity

Transit professionals must build accountability into decision-making processes and ensure that those processes recognize and address historical, cultural, and institutional dynamics and structures that routinely provide only privileged societal groups with a mobility advantage. Without this recognition, all other groups are continually at a chronic mobility disadvantage.

Transgenerational Equity

Transit decisions must be made with consideration for generational impacts, so that they do not result in unfair burdens on future generations.

Procedural equity builds distributional equity, distributional equity builds structural equity, and structural equity in turn builds transgenerational equity. These forms of equity are not alternatives that can be applied piecemeal. They are essential and mutually reinforcing components of any equity strategy employed throughout public agencies' design decision-making processes. When updating existing or placing new bus stops, designers should align associated processes with these forms of equity.[8]

[8] (TransitCenter, 2021)

3 AGENCY COORDINATION REQUIREMENTS

Inter-agency coordination should be involved at the start of the bus stop planning and design process. It is important to maintain communication with all parties which will help facilitate a fluent process going forward through design of the bus stop. Planning and installing new bus stops within a cross-jurisdictional service area like SMART's involves understanding both who to contact, when to contact, and what to ask. This section will discuss roles and responsibilities related to the inter-agency coordination necessary to bus stop design implemented by a regional transit provider like SMART.

3.1 Agency Coordination

In the development of a bus stop, communication with all the involved parties is important to facilitate a smooth implementation process through planning and design. Key stakeholders in this process are the local municipality, developers, property owners, state government agencies, and federal government agencies. Coordination may be prescribed through standard practices like email and phone communication.

Typically, the first contact should be the local municipality that the roadway is located in to see if it is a local jurisdictional road. One of the standard practices is to reach out to a local municipality’s engineering and building department as well as the planning department or their equivalencies. These local departments will facilitate what coordination with local agencies might need to be done for a bus stop site. For example, this could be working with utilities and/or public safety concerns. Bus stop designers will need to determine if the stop is whose right of way (ROW) the bus stop site is in and who will need to be contacted such as the property owners near the proposed new bus stop. All communication should be well documented and required permits obtained. The county that the proposed bus stop is located in may have additional authority and jurisdiction over the project site. There should be correspondence with the bus stop county's road commission/transportation/planning departments and necessary requirements from the county should be followed.

The metropolitan planning organization (MPO) for Metro Detroit is the Southeast Michigan Council of Governments (SEMCOG). They approve transportation projects with the development of a Transportation Improvement Program (TIP). These approvals are for projects that have federal funding. SMART should contact SEMCOG when this approval process is necessary. Coordinating with SEMCOG also strengthens regional planning cohesion. Also, at the metropolitan-area level SMART should notify transit agencies that might have jurisdiction where the bus stop project area is located. Depending on the ownership of the roadway the state government may need coordination. This would be defined as having communication with MDOT.

All required federal processes need to be followed if federal funds are used in the transit project; for example, funds allocated from the Federal Transit Administration (FTA). If there are federal funds present in the project, National Environmental Policy Act (NEPA) work will need to be completed and documented. See the **Environmental Review** section for more information about NEPA requirements.

- **FTA –** Follow all federal guidelines and standards.
- **MDOT –** Contact the MDOT Transportation Service Center (TSC) Utilities and Permits Coordinator, who will engage the local TSC Manager if needed.
- **SEMCOG -** Contact SEMCOG planning.
- **Oakland, Macomb, and Wayne Counties –** For the county the bus stop site is within, contact the road commission or public works department.
- **Local Municipalities within SMART's Service Area –** Contact a city engineer at the local municipality to make sure coordination is happening and they know about the planned project.

3.2 Roadway Codes, Standards, and Regulations

Generally, the majority of roads in a metro area are local jurisdiction, but bus stops tend to be located along arterial and collector roads.

- Local roads are defined as roads that perform the primary access to residential areas, businesses, farms, and other miscellaneous land uses.
- Collector roads are the connections between local roads and arterial roads. They have more traffic than local roads but are not to the level of mobility that arterial roads have. Some examples are main entrance roads to a neighborhood or a highway with a mixture of residential and some strip malls located throughout.
- Arterial roads are usually long-distance roadways with the main example being the U.S. interstate highway system.

These road classifications can also prove useful with figuring out who may have jurisdiction over a given road. Commonly local roads will be under local municipality jurisdiction, where Collectors might have more county level jurisdiction, and arterial may have more federal jurisdiction, but this could also not be the case. SMART will have to implement agency coordination best practices to find out who has jurisdiction of the roadway.

- **State of Michigan –** All proposed bus stops on MDOT roads will need to follow MDOT's standard plans and specifications. The *Michigan Manual on Uniform Traffic Control Devices* (MMUTCD) should be consulted for any signage or roadway alterations at the bus stop site. Reach out to the MDOT TSC Utilities and Permits Coordinator for more information.
- **Oakland, Macomb, and Wayne Counties –** All proposed bus stops on county roads will need to follow the county road commission, department of roads and/or department of public works standard plans and specifications. Reach out to either SMART's county road commission or department of public works contact for more information.

- **Local Municipalities within SMART Service Area –** All proposed bus stops on county roads will need to follow local municipal codes. Look up local ordinances relating to bus stops in addition to relevant safety codes and reach out to the local municipality's project engineer. See **Chapter 9 Safety and Security** for more safety information.

Environmental Review
The FTA provides both National Environmental Policy Act (NEPA) guidance and National Historic Preservation Act (NHPA) Section 106 guidance, including when and how transit authorities like SMART must complete these statutory environmental review processes for a project.

The National Environmental Policy Act (NEPA) of 1969, is a procedural law that is applicable when federal money is used to fund projects. When adding, moving, or removing a bus stop, the NEPA process may apply. If so, it is likely to qualify as a Class II Action, a Categorical Exclusion (CE), in which no significant environmental impact is anticipated. The FTA provides a checklist for properly documenting categorical exclusions. However, to make the Class of Action (COA) determination, SMART will work with the FTA Region 5 to determine the appropriate COA and expectations to complete documentation for Section 106.[9]

Section 106 is governed by the National Historic Preservation Act (NHPA) of 1966 and is applicable to bus stop design when a stop will be located near a historic property or in a historic district.[10] The FTA NEPA CE checklist describes the 106 process as follows:

1. Describe and map any cultural, historic, or archaeological resources located in the immediate vicinity of the proposed project and the impact of the project on the resources.
2. FTA initiates all consultations per Section 106 of the NHPA.
3. FTA also makes a determination of "No Effect/No Historic Properties" or "No Historic Properties Affected," if no historic resources or potential to affect resources exists.
4. FTA requests concurrence for this determination from the Michigan State Historic Preservation Office (SHPO) or Tribal Historic Preservation Office (THPO).
5. If an "Adverse Effect" determination is made as a result of the proposed project, rather than a "No Effect/No Historic Properties" or "No Historic Properties Affected" determination, then FTA may determine a new NEPA class of action to evaluate alternatives or mitigation measures to deter these adverse effects.

If the COA is greater than a CE, additional coordination with FTA and documentation will be required.

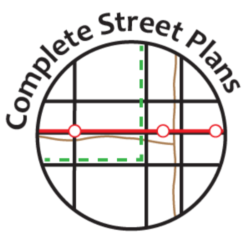
[9] (Federal Transit Administration (FTA), 2024)
[10] (Federal Transit Administration (FTA), 2015)

3.3 Planning and Design Documents to Review

During the bus stop planning and design process, it is good practice to consult comprehensive plans of the area in question that may help define specific transit policies. Regularly updated planning and design documents outlining development surrounding a bus stop site will shape bus stops' architecture and installation in the near and long-term. These comprehensive plans should be reviewed while in the bus stop planning and design process, so that project goals align with those of the community the bus stop site is situated in.

Community master plans are municipal plans that establish a framework for development and programming. These establish what the community considers to be priorities over a set period of time. They are available on municipal government websites, usually as pdf documents on the planning department page.

Corridor plans focus on various components of a particular stretch of roadway, or corridor, often producing a geospatial analysis of it that is meant to direct future improvements. In the transportation sector, many of these plans are initiated by county road commissions and departments of transportation and can be found as pdf documents on their websites.



Complete street plans are documents that focus on the implementation of roadway design projects that emphasize multimodal design practices. For example, this includes designing a roadway equipped to accommodate the transportation needs of cars, transit, cyclists, and pedestrians. Complete street plans can be written at any level in the planning sector.

Comprehensive safety action plans use a data-driven analysis to improve roadway safety, finding ways to eliminate serious-injury and fatal crashes affecting all roadway users. Federal SS4A NOFO grant applicants are required to produce them as part of their applications. SMART should enquire for this type of plan if the project area is under federal funded designations. More information can be found on the U.S. DOT website.[11]

Transportation Improvement Programs (TIP) are functionally master lists of planned upcoming transportation projects, usually spanning a period of at least four years, developed in cooperation with state and public transit providers. Projects in SEMCOG's FY 2023-2026 TIP consist of projects that receive FHWA or FTA funds and non-federal funded projects from SEMCOG's Metropolitan Transportation Plan (MTP).

[11] (U.S. Department of Transportation (U.S. DOT), 2024)

4 OPERATIONAL CONSIDERATIONS

In siting and designing bus stops it is key to consider interactions between facilities supporting other forms of transportation, like automobiles or active transportation. Physical design parameters and constraints of transportation facilities outside of bus stops impact the efficiency bus service operation through the SMART bus network. These considerations and constraints are addressed in this chapter.

4.1 Motor Vehicle Turning Radii and Paths

Pedestrian safety around and near buses is a critical item that all bus design should take into consideration. A few ways to do this is to minimize the turning speeds by modifying geometry of an intersection through corner radii, on street parking, stop lines and carefully balancing the safety of buses and pedestrians. The following is a list of best practices that should be considered when designing stops in the SMART service area.

- SMART has both standard 40-foot and articulated 60-foot buses. These buses have an inner turning radius of approximately 22 feet, and an outer turn radius of approximately 44 feet.
- Turning speeds should be limited to 15 miles per hour or less, with turn radii as small as is feasible.
- Curb radii on streets where buses operate should be designed with a target radius of 15 feet.
- Parking may need to be restricted close to a street corner to achieve the required effective turn radii. This is a form of “daylighting” an intersection, meaning parking is limited to improve visibility and safety.
- A stop line on a receiving street may need to be relocated back from an intersection to achieve the required effective turn radii. This is also a form of ”daylighting” an intersection.
- Other modifications to striping at intersections may be made to achieve the required effective turn radii, including shifting through lanes.
- At intersections where buses turn, bus stops for the turning bus route should be located only on the far side of the intersection.

Left Turns

The distance between the bus stop and intersection is of great importance when a bus needs to make a left turn after it serves a bus stop. There needs to be adequate distance for the bus to enter traffic, switch lanes and come to a stop at the intersection. This distance is determined by the speed and number of lanes the bus needs to cross before the left turn. **Table 2** provides minimum distances needed based on speed and number of lanes. An example of a left turn approach after a bus stop on a shoulder is provided in **Figure 16**.

Figure 17 and **Figure 18** and show the front-end, front-wheel, and rear-end turning sweeps for standard and articulated buses, respectively.

Figure 16: Example of a Left Turn Approach after a Bus Stop on a Shoulder

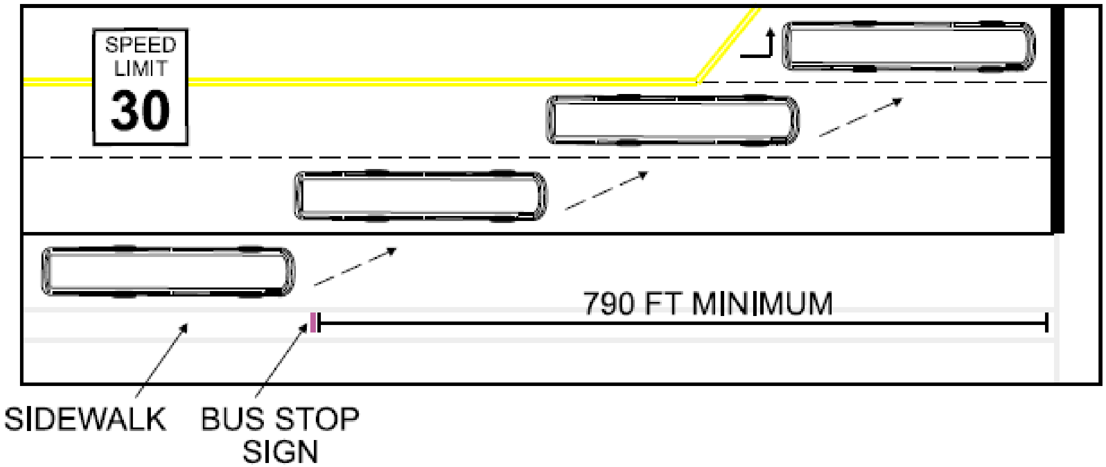


Table 2: Minimum Distance Between Bus Stop and Left Turn (in feet)[12, 13, 14]

Posted Speed Limit (MPH)	Number of Lane Changes			
	1	2	3	4
30 or less	430	610	790	970
35	625	875	1,125	1,375
40	780	1,080	1,380	1,680
45	1,080	1,430	1,780	2,130
50	1,415	1,865	2,315	2,765
55	1,830	2,380	2,390	3,480

Sources: Maryland DOT MTA 2019, AASHTO 2011, IDOT 2010

[12] (Maryland Department of Transportation Maryland Transit Administration (MDOT MTA), 2019)
[13] (Illinois Department of Transportation (IDOT), 2010)
[14] (American Association of State Highway and Transportation Officials (AASHTO), 2011)

Figure 17: Standard Bus Turning Sweep at a "Daylighted" Intersection

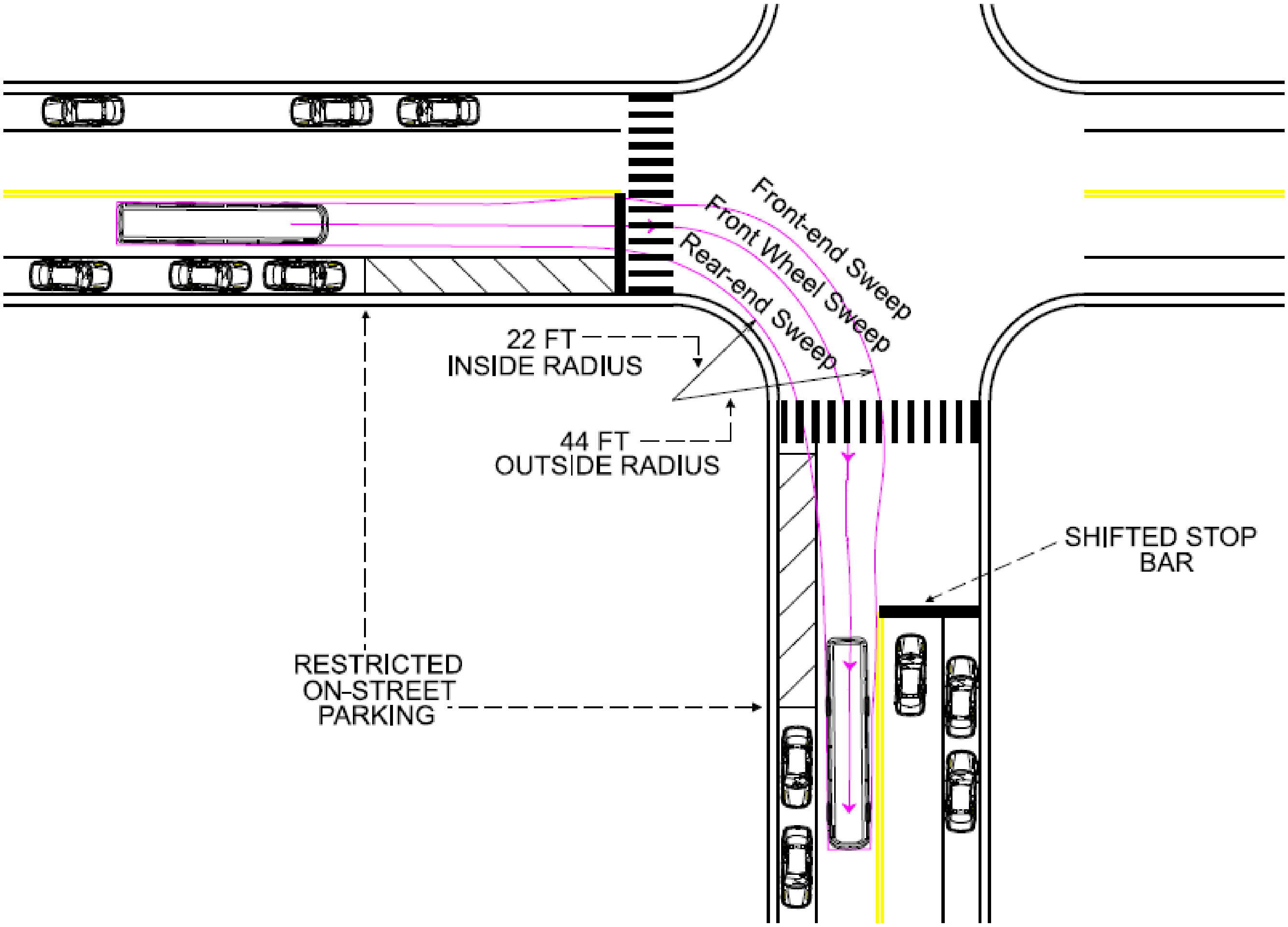
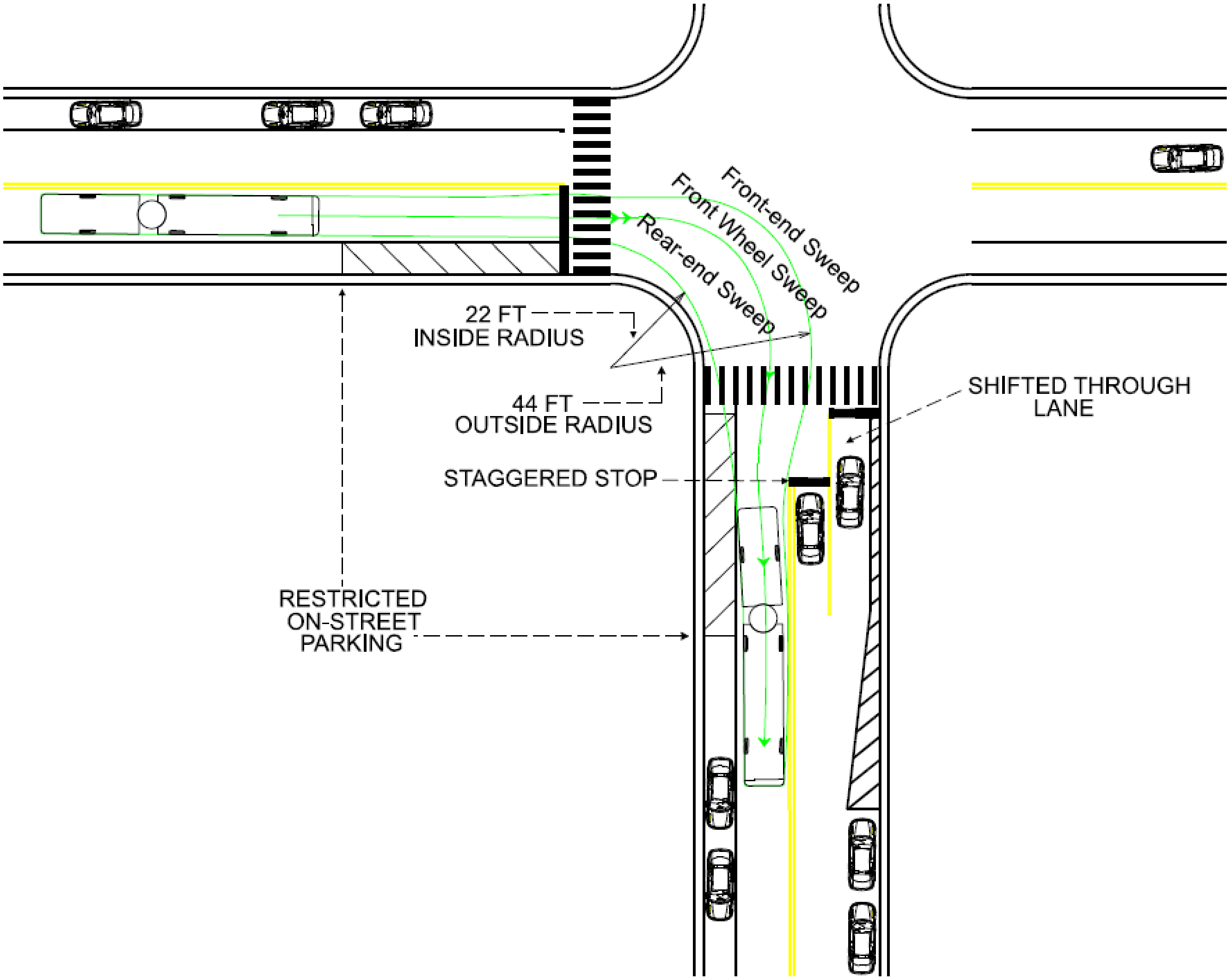


Figure 18: Articulated Bus Turning Sweep at Intersection with Shifted Through Lane



4.2 Roadway Characteristics

Roadways are the main physical area of overlap between transit and other modes of transportation, like motor vehicles, active transportation, or pedestrians. The characteristics of roadways largely define interactions between different modes of transportation on the roadway, which in turn dictates transit operation, service efficiency, and facility design. Each of the roadway characteristics discussed in this section can have impacts on transit operations.

Design Speed

If higher speeds are being reached when using existing roadway geometry, signal timing, or other factors try reducing speeds through street design. For example, set signal timing progression for desired design speed, use smaller curb radii, apply traffic calming measures and other measures.

Geometrics

Geometric features, such as horizontal and vertical curves, should match the desired design speed of the roadway. One way to achieve this would be by eliminating super elevation of the roadway and using a normal crown section on a curve.

Lane Widths

All types of vehicle use (motorists, transit, freight and/or bicyclist) need to be looked at when designing new lane widths. To keep design speeds lower minimum lane widths should be used for all lane types as allowed by the controlling design authorities.

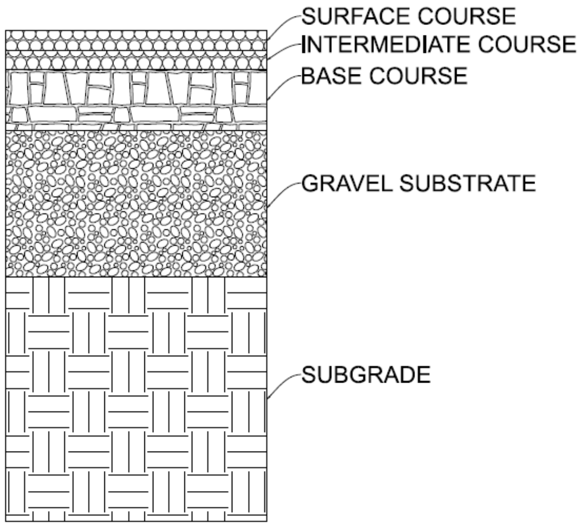
Pavement

Pavement design for bus lanes, turning areas, layovers and pull-outs needs to prioritize durability to handle the loads buses will put on pavement. Reinforced concrete pads are recommended for bus stops, especially at sites like transfer centers, network hub stops, or park and ride lots, where multiple routes and heavier loads on pavement can be expected. Concrete bus pads provide a surface that can handle frequent heavy vehicle stress. **Figure 19** shows how roadway design can be retrofitted to integrate a concrete bus pad. Standard pavement markings used to alert other traffic that there is a bus stop at a particular location along the roadway are illustrated in **Figure 20**.[15]

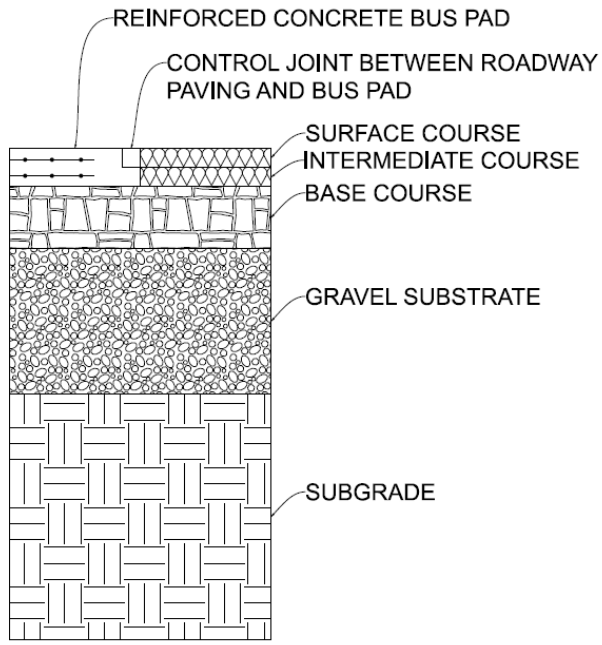
SMART is not the final authority on roadway design or construction. All roadway design recommendations should adhere to local construction and code requirements and be approved by a roadway's controlling authorities before being implemented.

[15] (Southeastern Pennsylvania Transportation Authority (SEPTA), 2012)

Figure 19: Bus Facility Roadway Paving Components



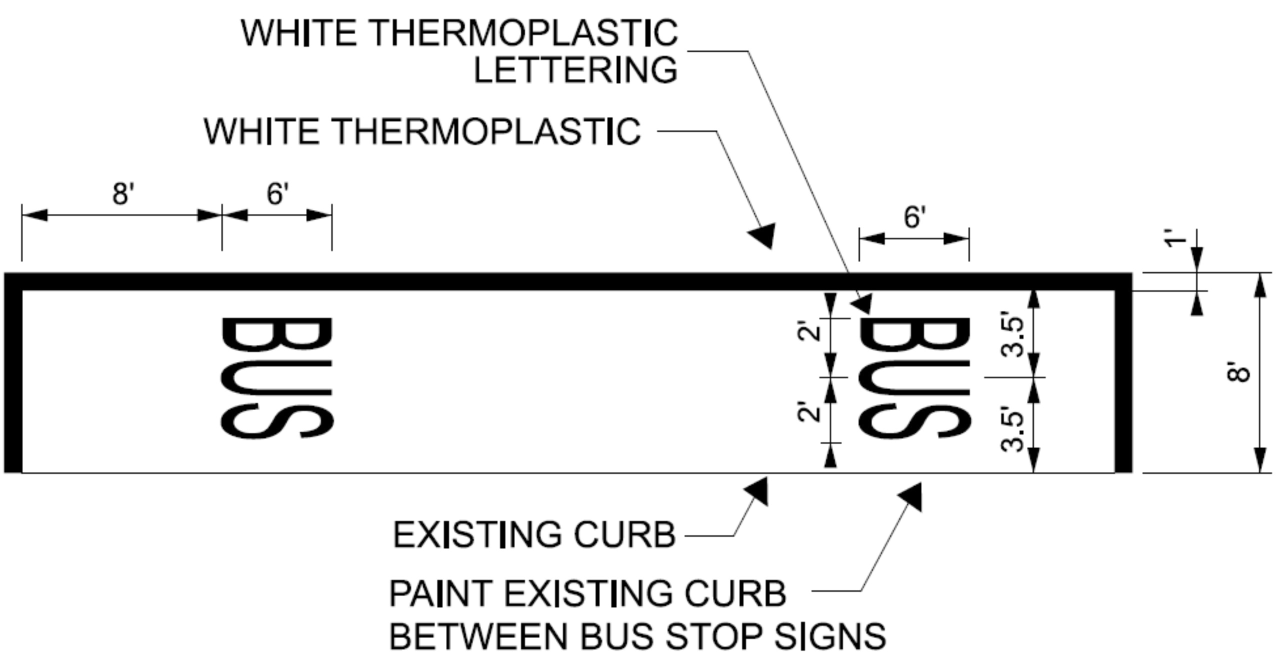
Flexible paving components for high-volume roadways



Concrete Bus Pad Integrated into flexible paving components for high-volume roadways

Source: SEPTA (2012)

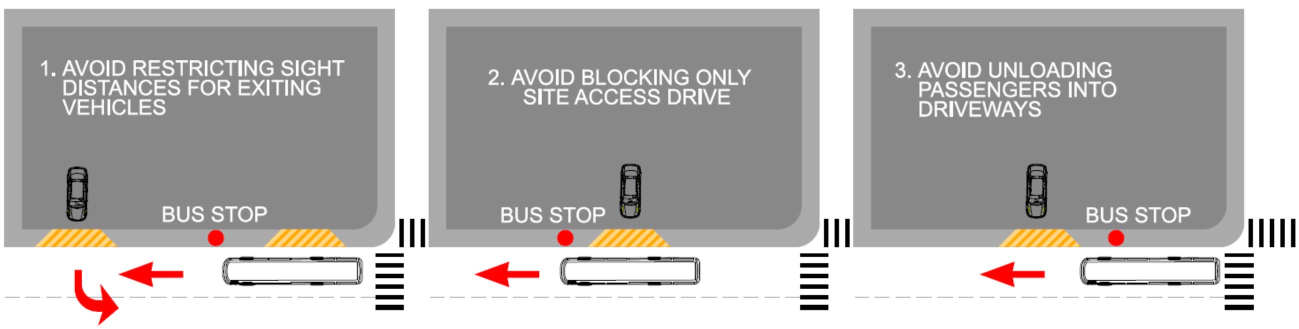
Figure 20: Standard Bus Stop Pavement Markings



Visibility
Proper visibility is very important when looking at placing new stops on a roadway. All waiting passengers, crossing pedestrians and other vehicles should be considered when placing a new bus stop to maximize safety.

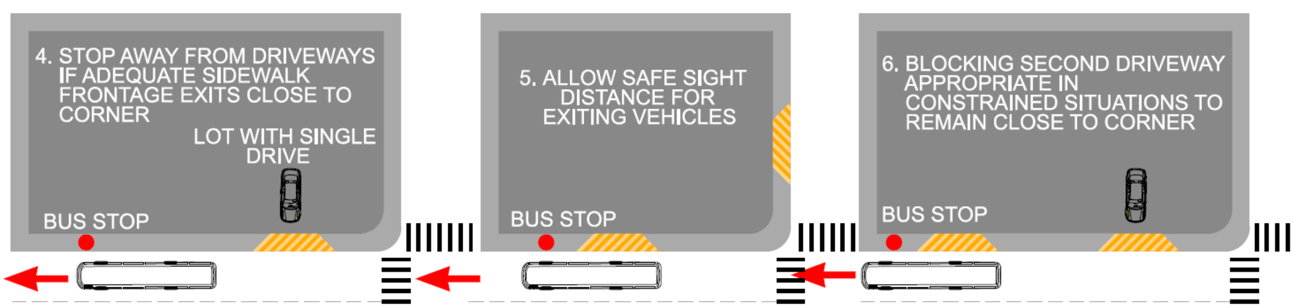
Driveways and Loading Zones
When looking to place new bus stops try and avoid all driveways and loading zones. If the safest area for the new stop needs to be placed in a loading zone permission from the responsible local transportation department should be obtained. Avoid sight restrictions when placing a new stop near driveways. **Figure 21** and **Figure 22** illustrate undesirable and acceptable driveway arrangements near bus stops.

Figure 21: Undesirable Driveway Arrangements Near Bus Stops



Source: Maryland DOT MTA (2019)

Figure 22: Acceptable Driveway Arrangements Near Bus Stops



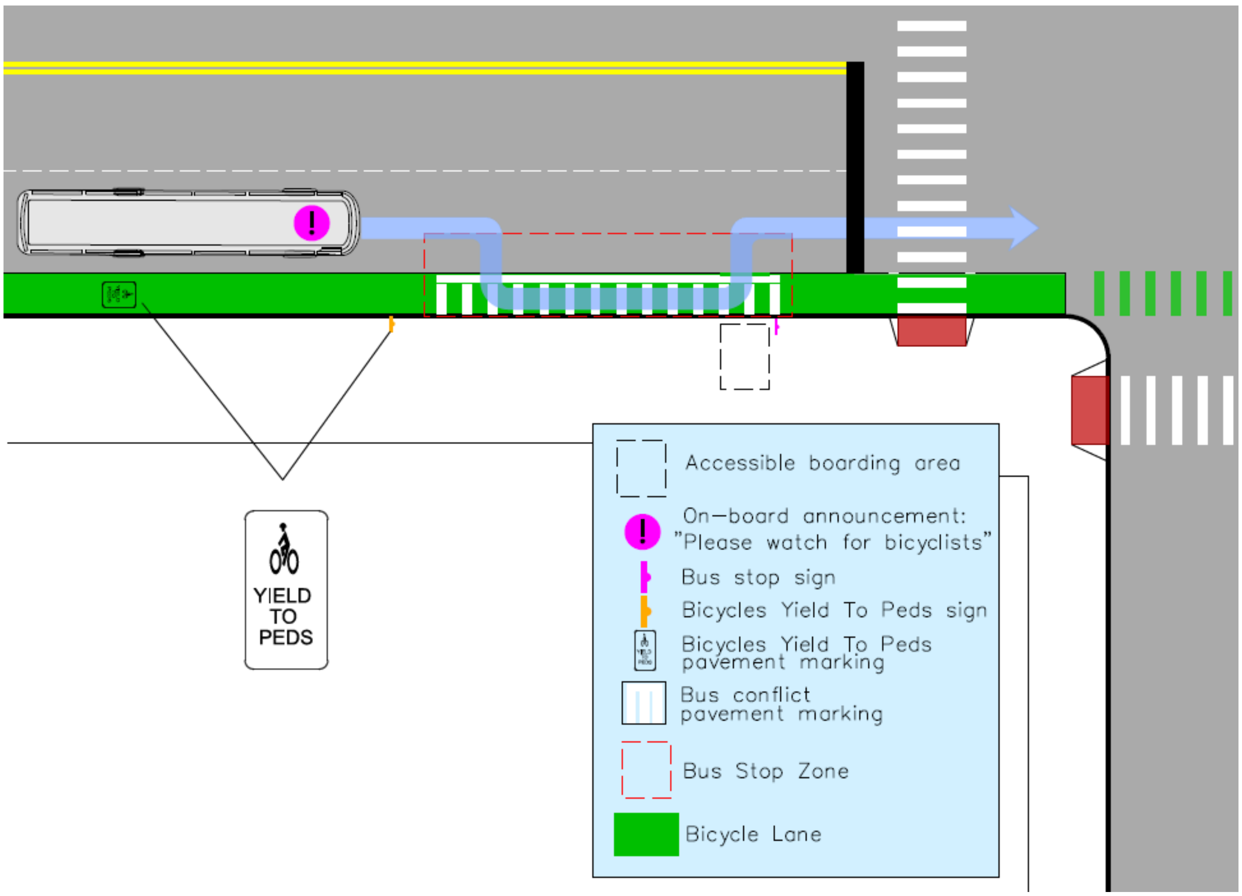
Source: Maryland DOT MTA (2019)

4.3 Active Transportation Facilities

Connecting bus transit with bicycle facilities is what many cities and roadway authorities are looking to achieve in their metro areas. Robust bike networks extend the reach of transit and using a bike is one way transit riders travel from their origin/destination to the bus stop.

Bus Stop Bicycle Lane Mixing Zone
A bus stop bicycle lane mixing zone is a design where an on-street bike lane overlaps with the bus stop vehicle zone length, and buses must cross over the bike lane to merge into the curb. **Figure 23** shows the design of a bus stop bicycle lane mixing zone. Bicycles must navigate with buses and other vehicles but do not navigate with pedestrians or bus passengers.

Figure 23: Bus Stop and Bicycle Lane Mixing Zone



Curbside Boarding Area
To be fully accessible bus stops shall be adjacent to curb with a boarding and alighting area adjacent to curb. This boarding and alighting area will meet all ADA standards referenced in §810.2 of the guidance provided by the U.S. Access Board. All accessible route and walking surface standards referenced in §402 and §403 of the U.S. Access Board. ADA standards guidance should also be adhered to for paths of travel surrounding the bus boarding and alighting area.

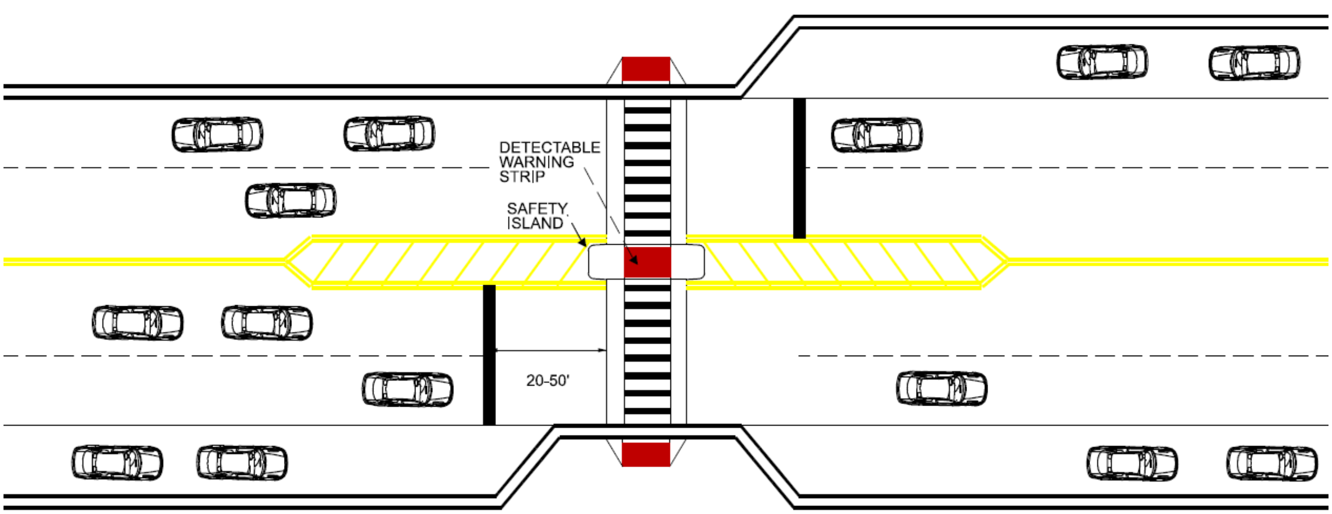
Regular vs. Enhanced Crosswalks

While SMART does not install or maintain crosswalks outside of those included within SMART off-street or on-street transfer centers, SMART can coordinate with local units to improve crosswalks nearby or adjacent to SMART bus stops. Crosswalks are often separated into two different categories based on the elements they provide for user safety and accessibility: regular and enhanced.

Regular crosswalks consist of two transverse lines, stretching from curb to curb perpendicular to parking and travel lanes. To be ADA compliant, all crosswalks must include curb ramps. Conversely, enhanced crosswalks include differing pavement markings and or additional features to improve pedestrian visibility and the accessibility of the street crossing. Enhanced crosswalks often include high-visibility crosswalk markings, meaning patterns made of reflective materials like inlay or thermoplastic tape instead of two transverse lines. Where feasible and allowed, enhanced crosswalks should be used nearby or adjacent to bus stops for safety of pedestrians and better visibility for drivers of all vehicles. See **Section 6.1 Bus Stop Accessibility** for more information about accessible street crossings, and consult NACTO's Urban Street Design Guide for more detailed crosswalk design standards.

The type of crosswalk that provides pedestrians the most safety and accessibility crossing the street depends on how many lanes they must cross. [16] As an example, **Figure 24** illustrates the type of crosswalk preferred at a mid-block crossing of a four-lane street.

Figure 24: Mid-Block Enhanced Crosswalk across Four-lane Roadway



[16] (National Association of City Transportation Officials (NACTO), 2016)

Mobility Hubs and Micromobility Connections

Mobility hubs provide multiple different types of transportation modes, like a bike or scooter share in addition to public transit, at a central location, like a bus stop. Mobility hubs allow transit users to use micromobility modes to make connections from public transit to their destination. Micromobility modes of travel are small, low-speed, lightweight vehicles driven by users, like bike shares, scooter shares, e-bikes, electric skateboards, or bike taxis. These help transit passengers bridge first and last-mile gaps between their trip origins or destinations and public transit stops.[17] Converting bus stops into mobility hubs by locating micromobility modes near them make stops more functional for their passengers, helping extend the reach of transit by connecting it to more households and workplaces.

4.4 ROW Considerations

When looking to expand facilities and add new bus stops and shelters, areas should be looked at that can accommodate these new facilities while staying within the existing ROW to the greatest extent possible. When a potential new or update to an existing bus stop location would require additional ROW or a grading easement, SMART should coordinate with the controlling entity of the ROW as soon as possible.

- **Public ROW**
  When expanding facilities, areas should be looked at that have adequate ROW, existing sidewalk or new sidewalk that can be constructed and provide pedestrian access to the new stop. If stop will have heavy ridership extra waiting areas should be provided.
- **Private**
  All new bus stops and facilities will avoid private ROW.

[17] (Price, Blackshear, Blount, Jr. , & Sandt, 2021)

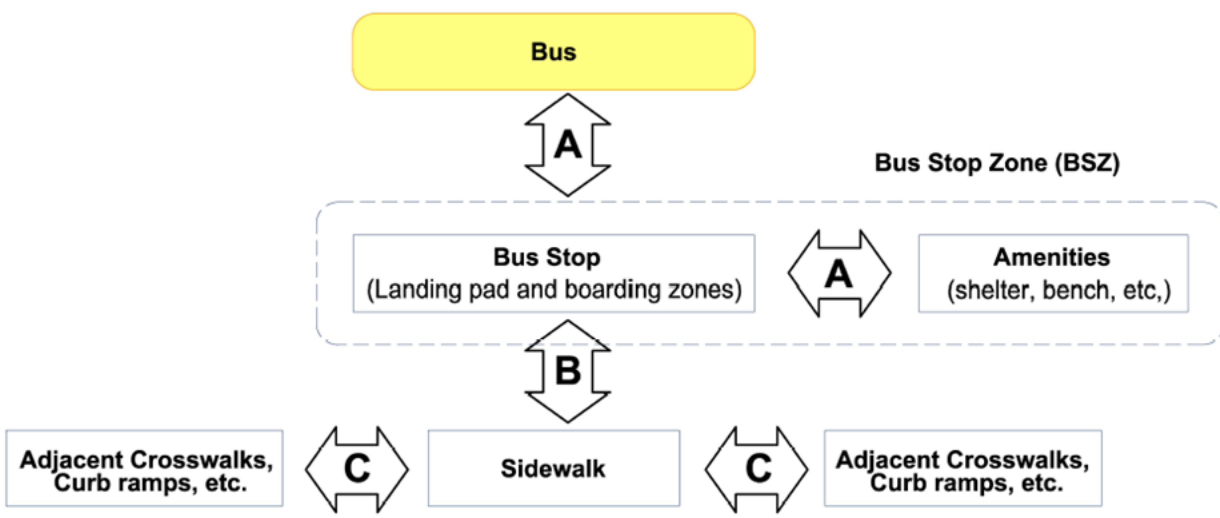
5 BUS STOP PLACEMENT

Several different decision-making processes are involved in bus stop placement. Bus stop spacing along the street, position within a block, on-street configuration, alignment with a block, and interaction with adjacent streetscape components are all integral to consider prior to deciding on the ultimate placement of a particular bus stop. The decision-making processes associated with each of these key bus stop placement considerations are discussed in this chapter.

It is best practice to place bus stops with careful consideration of their necessity, accessibility to transit passengers, and likelihood of being relocated.

Bus stop placement within the streetscape must consider how the bus stop interacts with all streetscape components. Following, it is helpful to conceptualize a bus stop in terms of a bus stop zone (BSZ) linked to other components of the streetscape. The bus stop zone is the area in which passengers wait for, board and alight a bus, typically extending for the length of a bus and the width of the sidewalk. At minimum, the bus stop zone must include an accessible landing pad. **A**, **B**, and **C** in **Figure 25** delineate where accessible paths must be provided between the bus stop landing pad and amenities in the bus stop zone (**A**), between the adjacent sidewalk and bus stop zone (**B**), and between the sidewalk and adjacent crosswalks (**C**).[18]

Figure 25: Bus Stop Zone[19]



Source: MBTA (2018)

[18] (Massachusetts Bay Transportation Authority, 2018)
[19] (Massachusetts Bay Transportation Authority, 2018)

5.1 Bus Stop Spacing

Bus stops must be spaced appropriately to help buses arrive at predictable intervals and maintain efficient trips. Stop spacing depends on three major factors; land use and population density, service type, and the presence of major passenger generators or places of community interest along the bus route. Overarchingly, stop spacing decision-making relative to these major factors hinges on balancing service speed and access. Closely spaced stops mean more time on the transit vehicle but shorter walking distances for passengers and stops spaced farther apart mean less time on the transit vehicle but longer walking distances for passengers.[20]

In general, in areas with high concentrations of people living, working, or moving through for other reasons, bus stops should be closer together. Stops should ideally be placed at intersections, as intersections are normally activity and movement hotspots—streets with long distances between intersections should have fewer stops.[21] SMART does not prefer to place stops in street environments without pedestrian infrastructure. See **5.6 Sidewalk Policy** for more information on SMART's stance on stop placement and pedestrian infrastructure.

Bus stops should be placed at any major passenger generators and transfer points between bus routes, even if this deviates from the area's normal bus stop spacing pattern. Stops should also be located at places of community interest, which are major passenger generators for certain populations in a particular community, e.g. senior centers and local medical offices.[22]

There are several common standards that quantify appropriate bus stop spacing. Typically, consistently spacing bus stops between a 1/4 to 1/2 mile apart provides the highest level of transit access while maintaining service speed.[23] Under this guidance, transit passengers should never have to walk more than a 1/4 mile to a transit stop, which is the standard recommended by the FTA.[24]

SMART uses local land use, service type, and population density along a transit corridor as stop spacing criteria for fixed-route service. SMART employs two different sets of bus stop spacing criteria for standard service fixed-route buses, one for residential areas and one for CBDs and areas nearby CBDs. The set of criteria for residential areas is based on variations in population density, resulting in closer stop spacing in areas with higher population

[20] (CapMetro, 2023)
[21] (Santa Clara Valley Transportation Authority (VTA), 2018)
[22] (Santa Clara Valley Transportation Authority (VTA), 2018)
[23] (CapMetro, 2023)
[24] (Federal Transit Administration (FTA), 2015)

concentrations. Conversely, the criteria for CBDs and areas nearby CBDs is unilateral, given that these areas have relatively unilaterally high population and built densities.

SMART uses a different spacing standard for express service FAST routes, which are meant to provide reliable service to downtown Detroit and major passenger generators at traditional commute times. The number of stops bus express service makes to collect passengers should be limited to the smallest number possible. Specific guidance on bus stop spacing for express service routes is as follows:

- In high auto ownership areas, buses should be loaded entirely at one location, e.g. a park-and-ride lot.
- In low auto ownership areas, while stops should be minimized, they should be placed so that patrons do not need to travel more than a 1/4 mile to any stop.

Both sets of criteria for standard fixed-routes and standard spacing for express service FAST routes are provided in **Table 29** (see **Chapter 10 Design Criteria Scoring Sheets**).

Optimizing bus stop spacing can increase operational efficiency and reliability, reduce trip times, and introduce more consistent spacing between stops, all improving passenger and operator safety. The process used to review bus stops and respond to bus stop requests is described in **Chapter 10 Design Criteria Scoring Sheets**. As a note, all stops are reviewed relative to their unique location and context within SMART's bus service network, so there may be exceptions to the process as described by this flowchart. SMART periodically reviews bus stops throughout an entire route or corridor to comprehensively optimize bus stop spacing.

Moving or removing a bus stop may trigger a public hearing, which SMART will provide public notice for. Consult SMART's Title VI and Public Participation Plans for more information on what service changes require a public hearing and how public hearings must be advertised and conducted. Though stop spacing will not be uniform throughout SMART's system, to maintain transit accessibility, service availability must adhere to the policies outlined in SMART's Title VI plan.

Public input on stop spacing is received by SMART on a rolling basis and analyzed based on the nature of the request, existing conditions, and timeframe. Transit patrons, transit operators, community groups, elected officials, and others looking to provide input or for information on bus stop spacing decisions should contact SMART at innovations@smartbus.org.

5.2 Bus Stop Position

Bus stop position is the location of a stop relative to an intersection or between two intersections. Stops are usually positioned at the near-side or far-side of intersections to maximize accessibility from both sides of the street and minimize parking impacts. In certain situations, bus stops may also be positioned at a mid-block or across-from location. **Figure 26** and **Figure 27** illustrate these four possible bus stop positions. In the direction of travel, near-side stops are located in advance of an intersection and far-side stops are located after an intersection. Mid-block stops are not located next to an intersection, but in the middle of a block. Across-from stops are located at T-intersections along the approach that continues straight through the intersection.[25, 26]

Figure 26: Far-side, Near-side, and Mid-block Bus Stop Positions

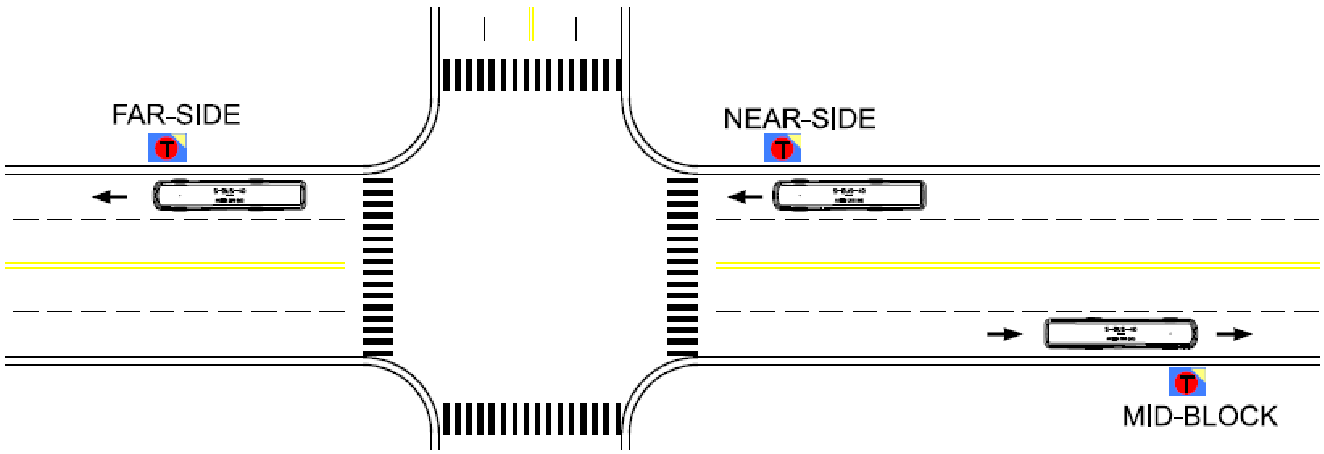
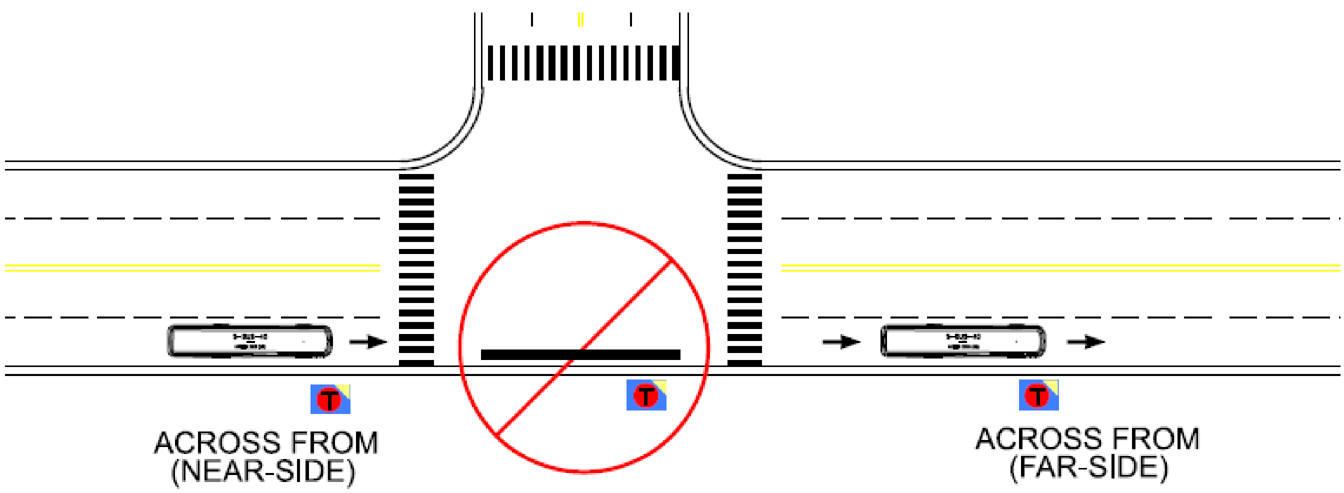


Figure 27: Across-from Bus Stop Positions



[25] (Massachusetts Bay Transportation Authority, 2018)
[26] (Metro Transit, 2023)

Generally:

- On multi-lane roadways, near-side stops should not be considered if the bus route turns left, as this would require buses cross multiple lanes of traffic to turn and continue their route.
- After tight right turns, far-side stops may need to be placed slightly down the block from the intersection, as buses may require additional length to maneuver to the curb.
- Mid-block stops are less desirable overall than far or near-side stops, as placing stops at intersections places passengers at safe locations to cross the street and get to their destinations. If there is a mid-block street crossing or a long distance between intersections, mid-block stops should be considered.
- Across-from stops should be located before (at the far-side) or after (at the near-side) of the intersection, not in the intersection. Locating bus stops in the intersection would cause buses to block street crossings when they stop and could cause interference with sight lines.
- At intersections where there are a lot of transfers between routes traveling perpendicular to one another, a far-side and near-side stop can be paired to minimize the distance passengers must walk to transfer between routes. Pairing a far-side and near-side stop so transferring passengers do not need to cross the street to make their transfer is advisable.

Apart from this general guidance, there are a host of situations in which each of the possible bus stop positions is recommended in addition to advantages and disadvantages associated with these recommendations. **Table 3**, **Table 4**, **Table 5**, and **Table 6** summarize bus stop position recommendations considerations for far-side, near-side, mid-block, and across-from stops respectively.

Table 3: Far-Side Bus Stop Position Recommendations and Considerations[27]

Far-Side Stops		
Recommended Where	**Advantages**	**Disadvantages**
Traffic on the approach side (near-side) is heavier than on the leaving side (far-side) of the intersection	Conflict with turning vehicles is minimized	When a bus is stopped in the travel lane, traffic behind the bus may queue into the intersection
Existing pedestrian conditions and mobility are worse on the near-side of the intersection	Encourages pedestrians to cross the street behind the bus	Pedestrians may be stepping off the curb as the bus approaches the stop
The street crossing the bus route is a one-way street	Passengers moving through the intersection after alighting the bus are not within the	

[27] (Federal Transit Administration (FTA), 2015)

Far-Side Stops		
Recommended Where	**Advantages**	**Disadvantages**
where the direction of travel is left to right	turning radii of vehicles turning from the cross street into the street the bus route is on	
Buses turning left do not have to cross traffic to turn, i.e. approach the left turn from the left lane	Buses do not need to cross traffic to turn	
Heavy vehicular right turns or heavy left and through turns may cause conflicts	Makes the curb lane available for other traffic, providing additional right turn capacity	Sight lines at the far-side of the intersection and on side streets may be obscured
Intersection has queue jump lanes, TSP, or other priority treatments	Passenger declaration distances for buses are shorter and area needed for bus stop zone is smaller	Vehicles in opposing right turn only lanes that proceed through the intersection instead of turning cut off bus approaching stop
Intersection has multi-phase signals or dual turn lanes removing buses from area of complicated traffic movements	Buses are able to take advantage of gaps in traffic flow behind the stop created by intersection signals	Bus may need to stop twice, at a red light and then at the stop, interfering with traffic and risking rear end collisions

Table 4: Near-Side Bus Stop Position Recommendations and Considerations[28]

Near-Side Stops		
Recommended Where	**Advantages**	**Disadvantages**
Traffic is heavier on the leaving side (far-side) than on the approach side (near-side) of the intersection	When traffic is heavier on far-side of intersection, minimizes interference with bus operation	Increases sight line problems from the approach side for crossing pedestrians
Existing pedestrian conditions and mobility are worse on the far-side of the intersection	Allows passenger boarding close to crosswalk and pedestrian crossing while bus is not moving	Increases conflicts between vehicles passing in front of the bus to turn right
The street crossing the bus route is a one-way street where the direction of travel is right to left	Passengers moving through the intersection after alighting the bus are not within the turning radii of vehicles turning from the cross street into the street the bus route is on	
Bus route does not turn at the intersection or the stop must be set back a reasonable distance from	Width of the intersection is available for the bus to pull away from the curb and merge with traffic	Stopped buses may obscure traffic control devices and pedestrians crossing the street

28 (Federal Transit Administration (FTA), 2015)

Near-Side Stops		
Recommended Where	**Advantages**	**Disadvantages**
the intersection to make a right turn		
A curb extension prevents vehicles from turning right directly in front of a bus	Bus does not need to double stop for both the traffic signal and customer movements	Through lane may be blocked during peak periods if multiple buses arrive at the stop
Where an accumulation of buses at a far-side stop will spill over into the intersection	Passengers can board and alight	

Table 5: Mid-block Bus Stop Position Recommendations and Considerations[29]

Mid-block Stops		
Recommended Where	**Advantages**	**Disadvantages**
Traffic, street, or sidewalk conditions at intersection do not allow a near or far-side stop	May be less pedestrian congestion at passenger waiting areas	Relative to other stop positions, will require greatest amount of curb space for no-parking restrictions
Major passenger generators are located mid-block or adjacent intersections are too far apart	Sight line obstructions are minimized for both vehicles and pedestrians	Encourages unsafe pedestrian crossings, unless mid-block crossing is present
Waiting passengers will cause pedestrian congestion or conflicts with persons entering or leaving the sidewalk	Helps minimize passenger congestion at intersection	
Curbside parking removal is not a problem	Bus stop does not interfere with other transportation infrastructure	

Table 6: Across-from Bus Stop Position Recommendations and Considerations[30]

Across-from Stops		
Recommended Where	**Advantages**	**Disadvantages**
At a T-intersection	Pedestrians do not need to cross traffic twice to get to destinations diagonally across the intersection from the stop	Do not provide a cross-street to drop off passengers in the event the stop is windrowed by snow

[29] (Federal Transit Administration (FTA), 2015)
[30] (Federal Transit Administration (FTA), 2015)

5.3 On-Street Bus Stop Configurations

There are six main bus stop configurations appropriate for use throughout SMART's transit network. Each of these configurations is characterized by how it influences the design of vehicle lanes, curbs, active transportation facilities, and movement throughout the streetscape as a result of the BSZ it establishes for bus operations. **Table 7** summarizes the six bus stop configurations discussed in this section, followed by more detailed descriptions and figures later in the section.

Apart from On-Street Transfer Centers and Median Stops, all bus stop configurations discussed can be located at the far-side (after) or near-side (before) positions relative to the intersection the route is approaching, or mid-block (in-between) position relative to the intersections the route is approaching and departing from. Not all bus stop configurations are appropriate for the across-from position relative to the intersection. Configurations for which the across-from position is not recommended are noted in this section.

Table 7: Summary of Bus Stop Configurations Discussed

Common Stop Configurations	
Pull-Out Stop **(Figures: page 53)**	Pull-Out stops are one of the most commonly applied bus stop configurations. Pull-Out stops are recommended on streets with vehicle parking. Pull-Out stops require buses to shift out of the travel lane and into part of the parking lane signed as a bus stop to board and/or alight passengers, then pull back into the travel lane.
In-Lane Stop **(Figures: page 57)**	In-Lane stops are the most applied bus stop configuration, as they require little to no new infrastructure. In-Lane stops are recommended on streets without vehicle parking. In-Lane stops require buses to stop in a signed section of the travel lane adjacent to the curb.
Boarding Bulb Stop **(Figures: page 61)**	Boarding Bulb stops function as an alternative to Pull-Out stops. Similarly to Pull-Out stops, Boarding Bulb stops are recommended on streets with vehicle parking and bulb-outs, a type of curb extension. Buses stop at this curb extension rather than pulling in and out of the parking lane to board and/or alight passengers.
On-Street Transfer Center **(Figure: page 65)**	On-Street Transfer Centers are meant to streamline areas where multiple buses need to board and/or alight passengers at once, most often bus stops served by several routes that are located in busy urban areas. On a block, rather than signing one stop for several routes, multiple stops each served by one or more routes are signed.
Stop Configurations Commonly Paired with Bicycle Facilities	
Boarding Island Stop **(Figure: page 68)**	Boarding Island stops provide a boarding/alighting area separate of the cycle track for bus passengers on an island situated between the cycle track and travel lane.
Shared Cycle Track Stop **(Figure: page 70)**	Shared Cycle Track stops allow buses to stop in the travel lane, boarding and/or alighting passengers in a section of the cycle track shared by bicycles and bus passengers.

Pull-Out Stop
Pull-Out stops require that buses shift out of the travel lane to get to stop at the adjacent curb. Depending on the street, buses pull into either the vehicle parking lane or, if there is no vehicle parking lane, a bus bay to board and alight passengers. After all passengers board or alight the bus, the bus must pull back out into the travel lane to continue on its route.

In most cases, using Boarding-Bulb stops in place of Pull-Out stops is more efficient for bus operations and more comfortable for passengers. There are still several contexts in which Pull-Out stops are preferred over Boarding-Bulb stops. These are described after **Table 8**, which discusses the advantages and disadvantages of Pull-Out stops.

Table 8: Pull-Out Stop Advantages and Disadvantages

Advantages	Disadvantages
• Require little new infrastructure on streets with existing vehicle parking	• To ensure buses can shift in/out travel lane safely, longer clear curb zones required than for in-lane stops • Bus operations typically slowed by need to shift in/out of travel lane • On high vehicular and/or pedestrian volume streets, through-traffic that will not yield for buses re-entering travel lane can cause significant bus delays and inefficiencies for all street users

Referencing **Table 8**, *Pull-Out stops are recommended where*:

- **Transit currently serves In-Lane stops, but through-traffic flow is still a concern.** Periodic Pull-Out stops on streets where this is a concern allows other vehicles to pass while a bus is stopped to board and/or alight passengers.
- **Other transit stations are not served by off-street transfer centers.** Using Pull-Out stops in this situation can reduce traffic congestion caused by large volumes of passengers transferring between transit modes.
- **Express bus service and local bus service run on the same street.** Pull-Out stops for local bus service can be placed adjacent to in-lane stops for express bus service, allowing express buses to pass local buses easily if necessary.
- **On-street bus layovers are needed.** In this context, Pull-Out stops can be used as layover areas where necessary.

Pull-Out stops can be positioned at the far-side of the intersection, near-side of the intersection, or mid-block relative to two consecutive intersections. **Figure 28**,

Figure 29, and **Figure 30** illustrate the design of pull-out stops based on their position, summarized in **Table 9.** Referencing the general bus stop types covered in **Section 2.1 General Bus Stop Types**, Pull-Out stops can be applied to network hub, standard, and coverage bus stop types. See **Table 18** and **Table 19** at the end of this section for Pull-Out stop BSZ design metrics based on bus length and position.

Table 9: General Pull-Out Stop Guidance based on Stop Position

Far-Side	Near-Side	Mid-Block
• Paint pull-out taper ahead of the boarding area, with a regulatory sign at front edge • Install bus stop sign at rear edge of the taper of the bus boarding area • Second bus stop marking rear of the stop may be installed where BSZ parking or stopping violations have been observed • Where there is a bicycle lane between the travel lane and curb, a bus pull-out taper must also be painted ahead of BSZ	• Should only be applied at major near-side destinations, transfer points, queue jump intersections, or locations where far-side conditions are not appropriate • Pull-out taper should be painted behind the area where buses dwell while passengers are boarding/alighting • Boarding area should be located at least 10 feet from crosswalk • Place stop close enough to intersection so that right-turning vehicles cannot merge and turn on red in front of bus • If bus turns right after stop, cross street must be designed to accommodate right-turning buses potentially sweeping across the second lane or oncoming lane	• Should only be applied at destinations in the middle of long blocks, on blocks with unsafe bus or pedestrian conditions at intersections, to facilitate smoother transfers at rail stations, or to provide bus layover space at the end of a route • Pull-out taper should be painted ahead of the boarding area, with a sign at the rear edge of the taper • Pull-in taper should be painted behind the area where buses dwell while passengers are boarding/alighting, with a regulatory sign should be installed at its forward edge • Signalized or traffic-calmed pedestrian crossing should be provided at stop

Figure 28: Far-Side Pull-Out Stop for Standard 40-ft Buses

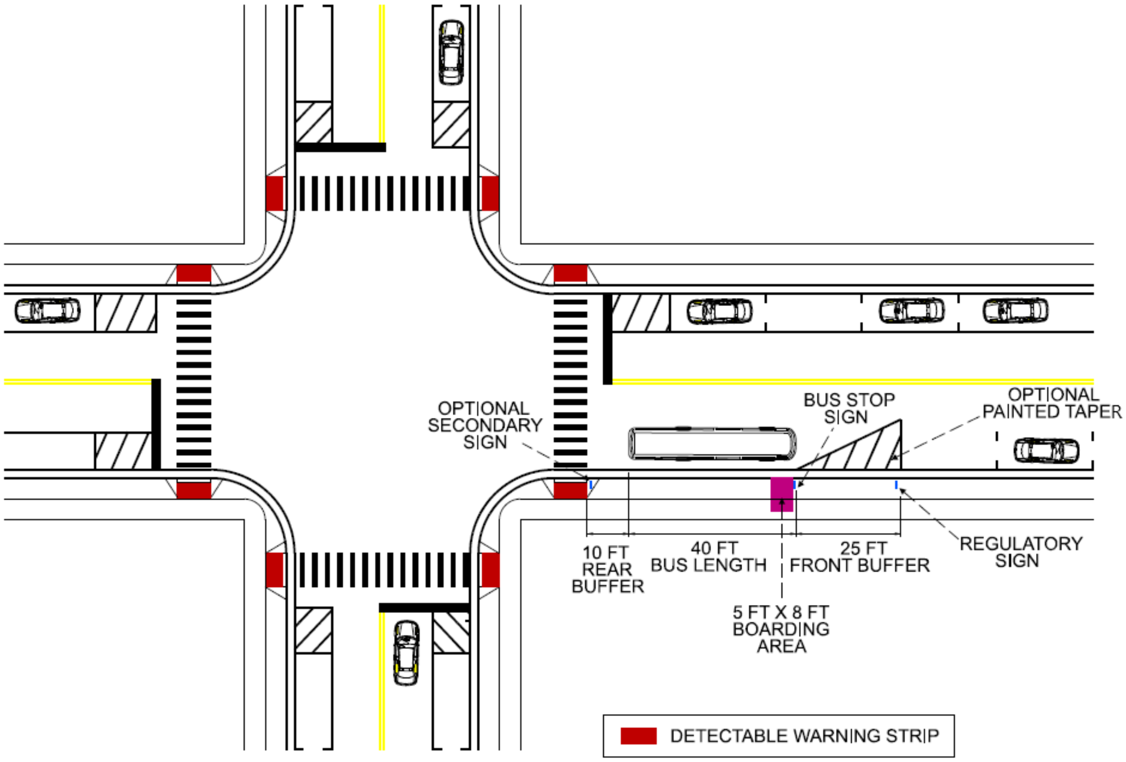


Figure 29: Near-Side Pull-Out Stop for Standard 40-ft Buses

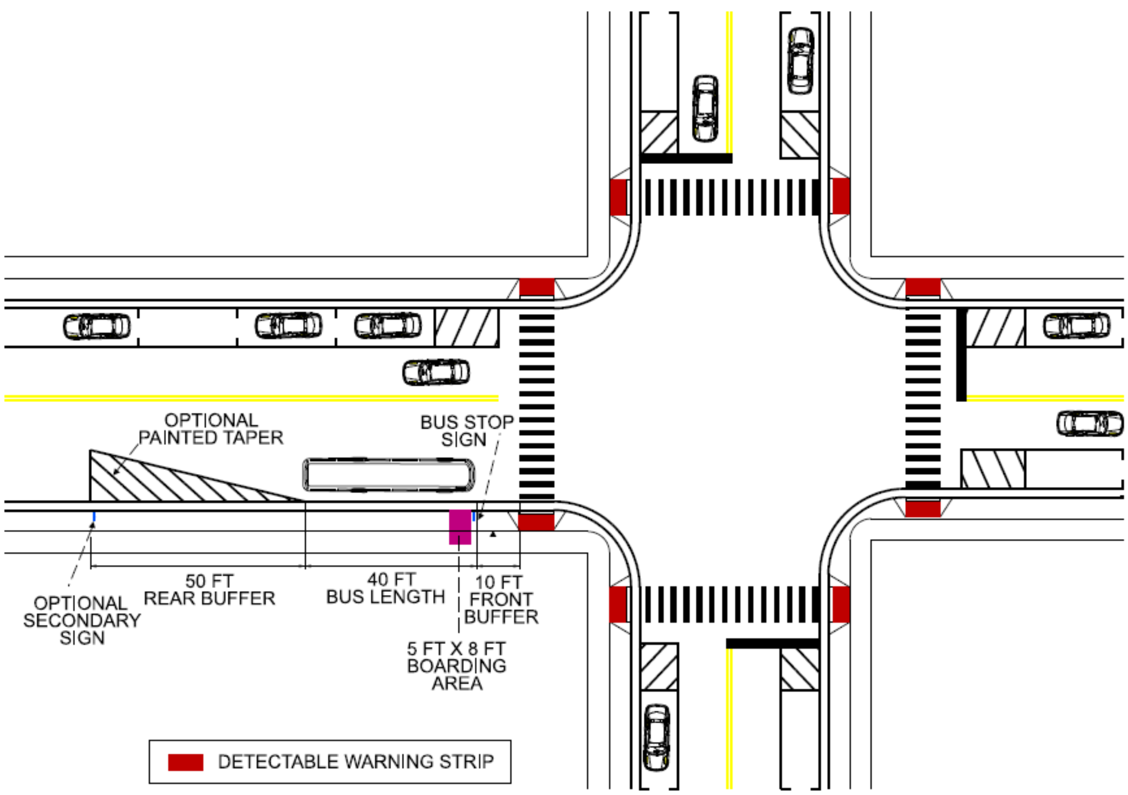
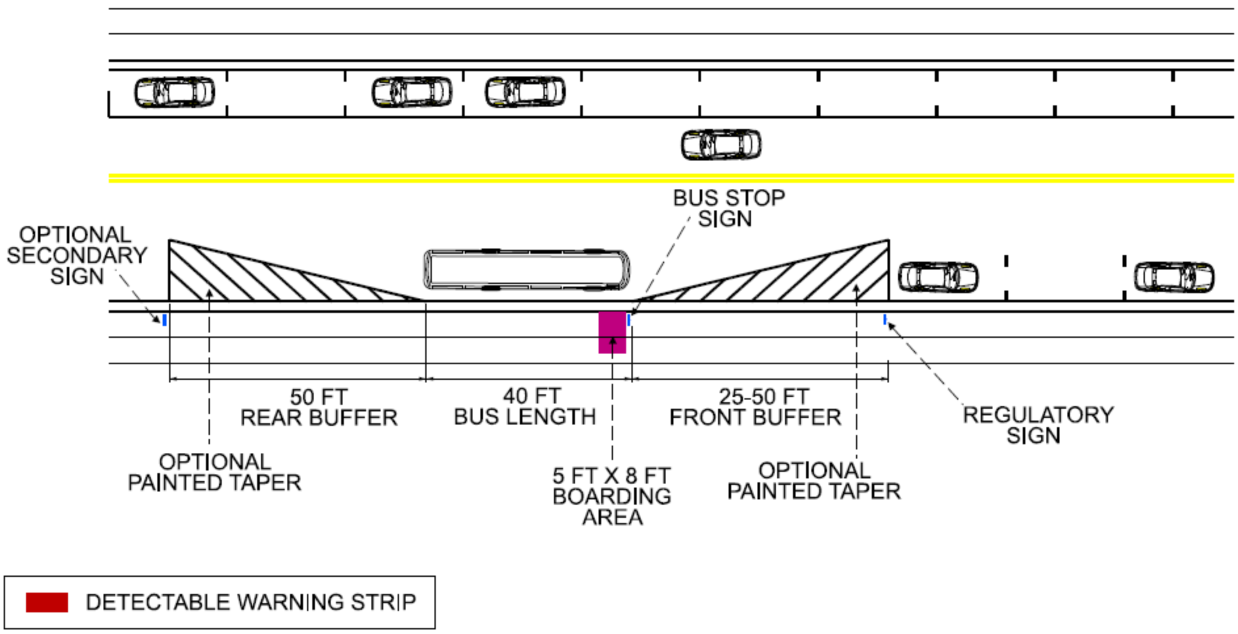


Figure 30: Mid-Block Pull-Out Stop for Standard 40-ft Buses



In-Lane Stop
In-Lane Stops allow buses to dwell, to board and alight passengers without leaving the travel lane. Buses in the travel lane adjacent to the curb can simply stop in that same lane to more accessibly and efficiently board and alight passengers at the curb. **Table 10** enumerates additional advantages and some key disadvantages of In-Lane Stops.

Table 10: In-Lane Stop Advantages, Disadvantages

Advantages	Disadvantages
• Bus is not delayed by through-traffic that would prevent it from re-entering travel lane at e.g. a Pull-Out Stop, reducing trip times and keeping buses more on-time • Requires little new infrastructure on streets without on-street vehicle parking • Results in a more compact BSZ compared to Pull-Out Stops, preserving more sidewalk area in places with high pedestrian volumes • Reduce wear on and associated maintenance costs for transit vehicles due to lack of lane shifts during braking	• Requires other vehicles to pass the bus in an adjacent travel lane if possible, or queue behind the bus while it's dwelling at the stop

Referencing **Table 10**, *In-Lane Stops are recommended where*:

- **The transit street is at or near vehicle capacity.**
  Streets that are at or near vehicle capacity have a high potential for traffic congestion. In-Lane Stops don't require buses to leave the travel lane, minimizing trip inefficiencies caused by pull-out delay.
- **The transit street is single-lane in both directions of travel.**
  Similarly to streets at or near vehicle capacity, applying In-Lane stops in this situation minimizes pull-out delays.
- **The transit street has long cycle length traffic signals.**
  Long traffic signals increase the probability of long queue lengths. Using In-Lane Stops at intersections with long cycle length traffic signals likewise works to minimize pull-out delay.

In-Lane Stops can be positioned at the far-side of the intersection, near-side of the intersection, or mid-block relative to two consecutive intersections. **Figure 31**, **Figure 32**, and **Figure 33** illustrate the design of in-lane stops based on their position, summarized in **Table 11.** Referencing the general bus stop types covered in **Section 2.1**

General Bus Stop Types, In-Lane Stops can be applied to network hub, standard, coverage and flag bus stop types. See **Table 18** and **Table 19** at the end of this section for In-Lane Stop BSZ design metrics based on bus length and position.

Table 11: General In-Lane Stop Guidance based on Stop Position

Far-Side	Near-Side	Mid-Block
• Buses should dwell at least 10 feet away from the crosswalk • On single-lane streets with high traffic volumes, enough space should be left between the crosswalk and stop for several vehicles to queue behind a dwelling bus after the intersection	• Buses should dwell at least 10 feet away from the crosswalk • Place stop close enough to intersection so that right-turning vehicles cannot merge and turn on red in front of bus • If bus turns right after stop, a signal phase for turning buses should be established or the cross street must be designed to accommodate right-turning buses sweeping across the second lane or oncoming lane	• Should only be applied at destinations in the middle of long blocks, on blocks with unsafe bus or pedestrian conditions at intersections, or to facilitate smoother transfers at rail stations • Signalized or traffic-calmed pedestrian crossing should be provided at stop

Figure 31: Far-Side In-Lane Stop for Standard 40-foot Bus

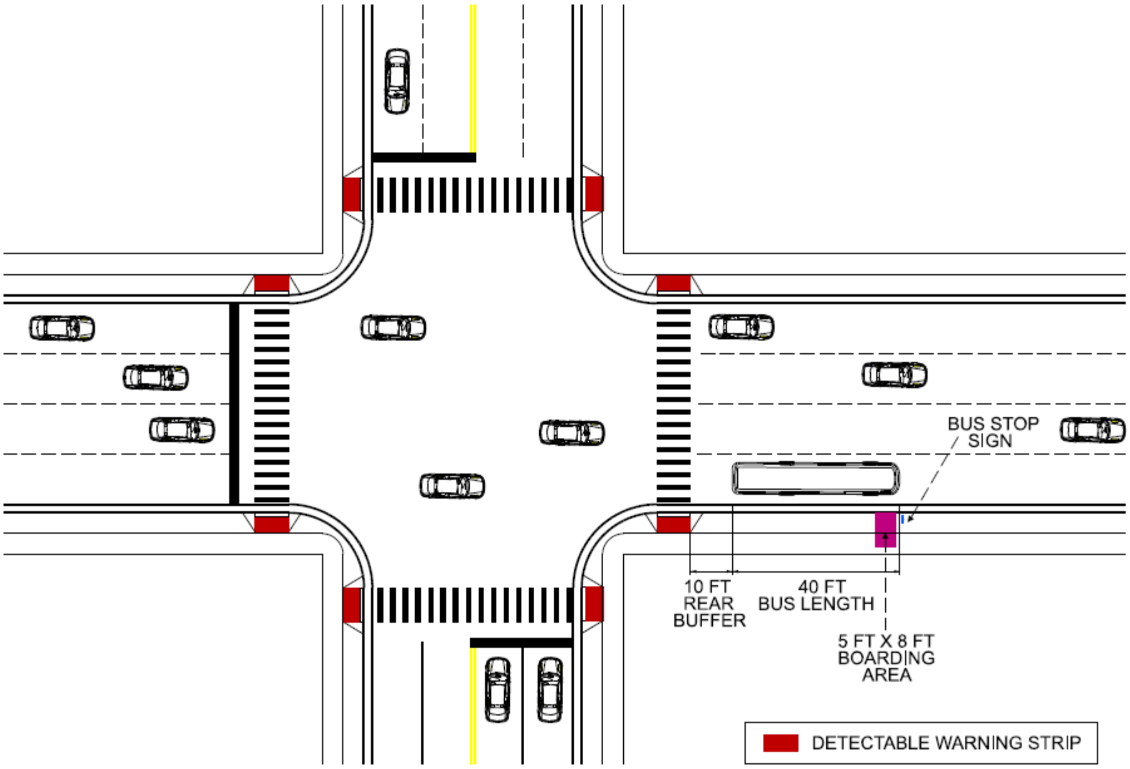


Figure 32: Near-Side In-Lane Stop for Standard 40-foot Bus

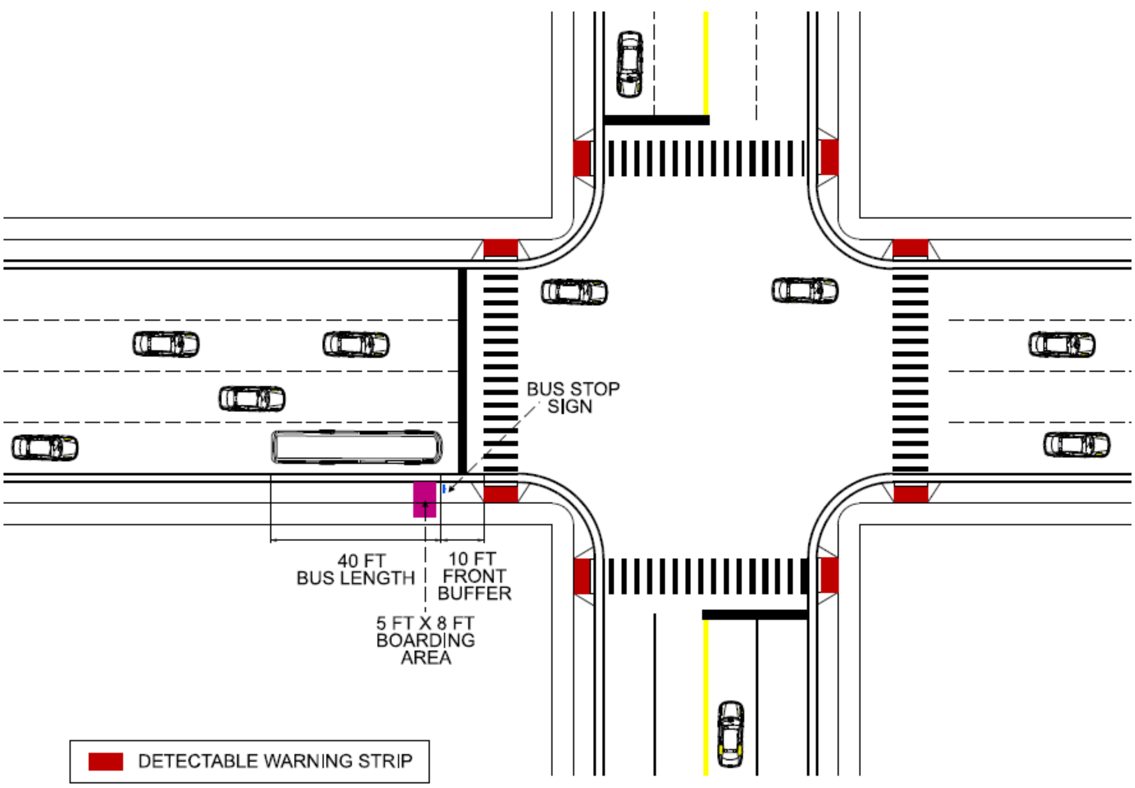
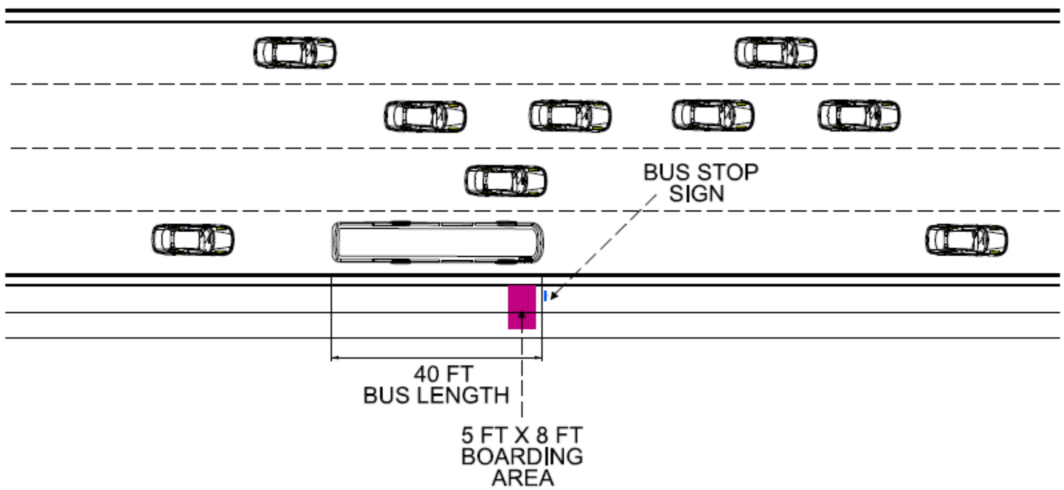


Figure 33: Mid-Block In-Lane Stop for Standard 40-ft Bus



Boarding Bulb Stop

Bus boarding bulbs are curb extensions across on-street vehicle parking lanes that allow passengers to board and alight a bus without the bus shifting out of the travel lane. Bus boardings bulbs are may also be referred to as bus bulbs or neckdowns. Like In-Lane Stops, Boarding Bulb Stops reduce operational delays attributable to buses shifting in and out of the travel lane. **Table 12** identifies additional advantages and disadvantages of Boarding Bulb Stops.

Table 12: Boarding Bulb Stop Advantages, Disadvantages

Advantages	Disadvantages
• On streets that are at or near their vehicle capacity, eliminate operational delays caused by buses shifting in and out of the travel lane • Compared to pull-out stops, reduce curb length required for BSZ, freeing up sidewalk space for pedestrians and other infrastructure • Make stop more accessible by providing a larger and wider path to boarding area, additionally ensure that buses can pull to the curb to deploy ramps • At stops with high passenger volumes, provision additional space for stop waiting area and amenities • Reduce street crossing distances and vehicle speeds, improving pedestrian safety around stop • Reduce bus and pavement wear and tear due to lack of need for bus to shift in and out of travel lane	• Not compatible with bicycle facilities on the right side of the street • Boarding bulb construction often requires significant drainage modifications

Referencing **Table 12**, *Boarding Bulb Stops are recommended where*:

- **There is on-street vehicle parking.**
  On most streets with vehicle parking, far-side boarding bulb stops are recommended. If a far-side boarding bulb stop is not possible, a near-side boarding bulb stop is recommended on streets with vehicle parking.
- **Merging into traffic creates operational delays.**
  Applying Boarding Bulb Stops on streets with vehicle parking minimizes operational delays, as buses do not need to pull in and out of the travel lane to board and alight passengers.

Boarding Bulb Stops can be positioned at the far-side of the intersection, near-side of the intersection, or mid-block relative to two consecutive intersections. **Figure 34, Figure 35,** and **Figure 36** illustrate the design of boarding bulb stops based on their position, summarized in **Table 13.** Referencing the general bus stop types covered in **Section 2.1 General Bus Stop Types**, Boarding Bulb Stops can be applied to network hub, standard, and coverage bus stop types. See **Table 18** and **Table 19** at the end of this section for Boarding Bulb Stop BSZ design metrics based on bus length and position.

Table 13: General Boarding Bulb Stop Guidance based on Stop Position

Far-Side	Near-Side	Mid-Block
• Buses should dwell at least 10 feet away from the crosswalk • Boarding bulb should extend to within 2 feet of the travel lane so that buses only need to make a minor shift toward curb to board/alight passengers • Longer boarding bulbs should be constructed on streets with heavier traffic volumes, so that vehicles queuing behind the bus do not block the intersection • Should not be located immediately after a right turn in bus route, as bus turn radii makes a far-side stop difficult to serve in this case	• Bus boarding area should be at least 10 feet away from the crosswalk • Boarding bulb should extend to within 2 feet of the travel lane so that buses only need to make a minor shift toward curb to board/alight passengers	• Typically not preferred for Boarding Bulb Stops, *unless:* there is a destination along a long block with on-street vehicle parking, potentially unsafe conditions for buses or waiting passengers at intersections, or mid-block rail stations without off-street bus loops that bus passengers need to transfer to • Signalized or traffic-calmed pedestrian crossing should be provided at stop

Figure 34: Far-Side Boarding Bulb Bus Stop for Standard 40-foot Buses

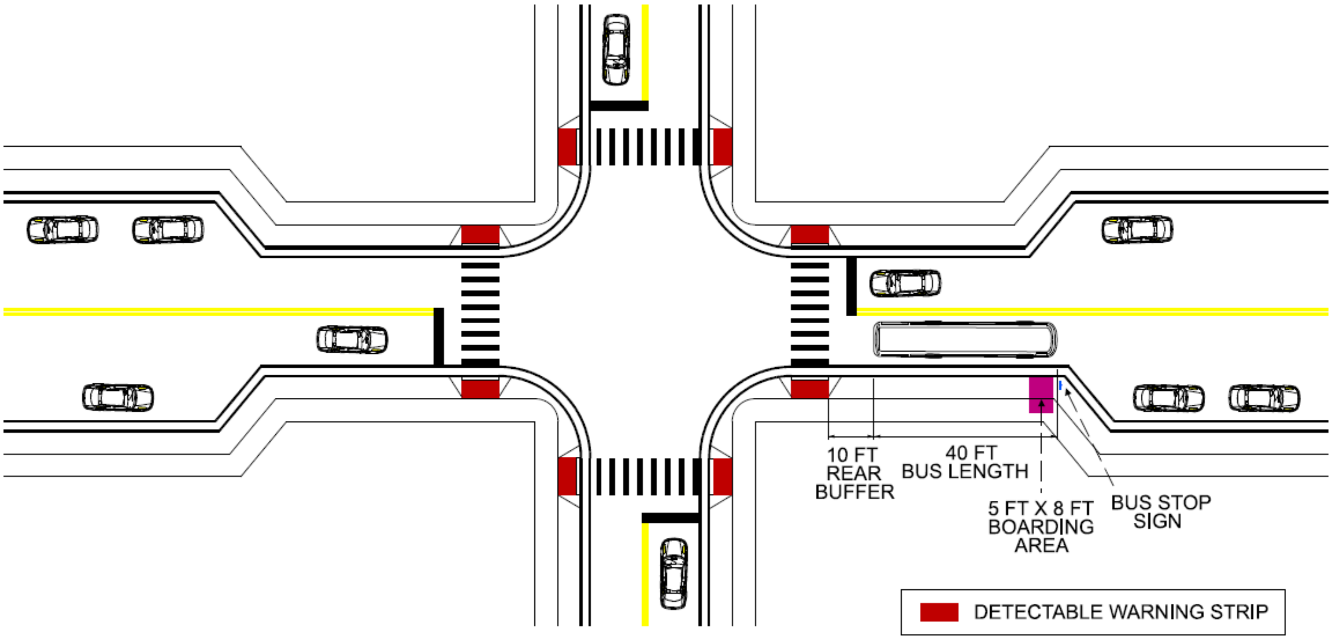


Figure 35: Near-Side Boarding Bulb Stop for Standard 40-foot Buses

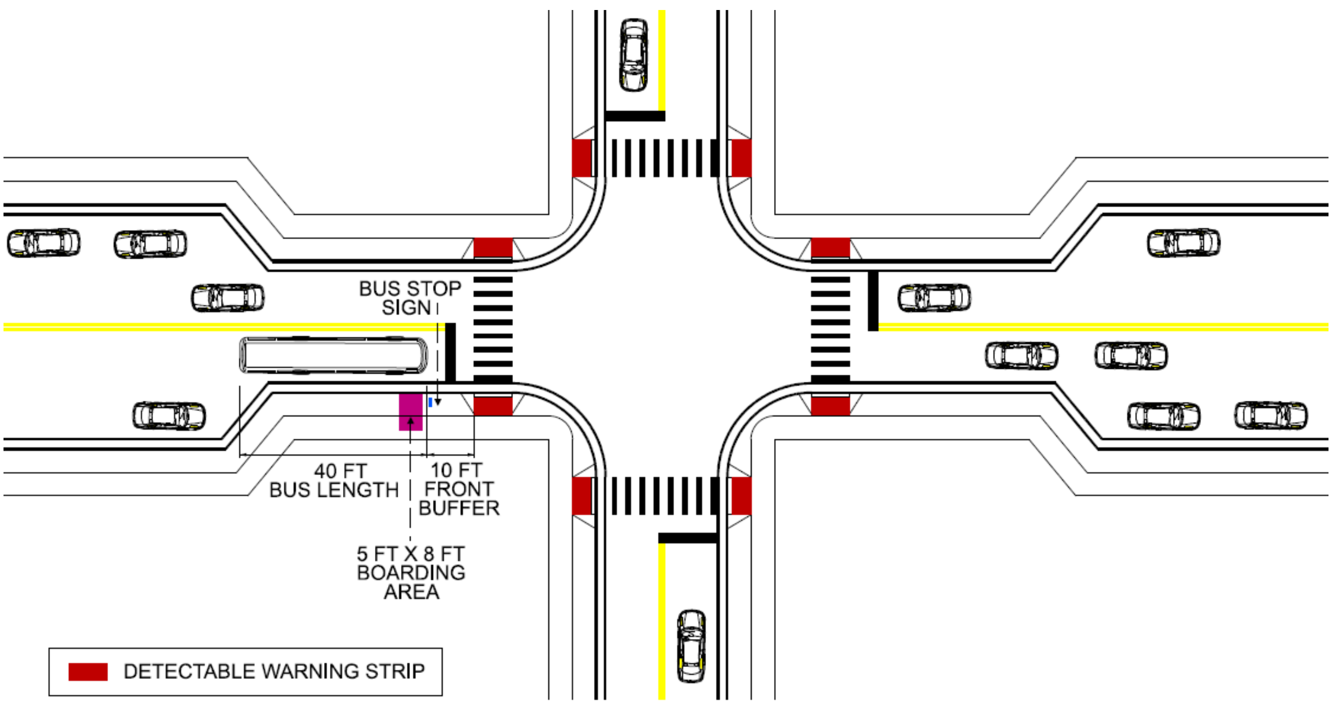
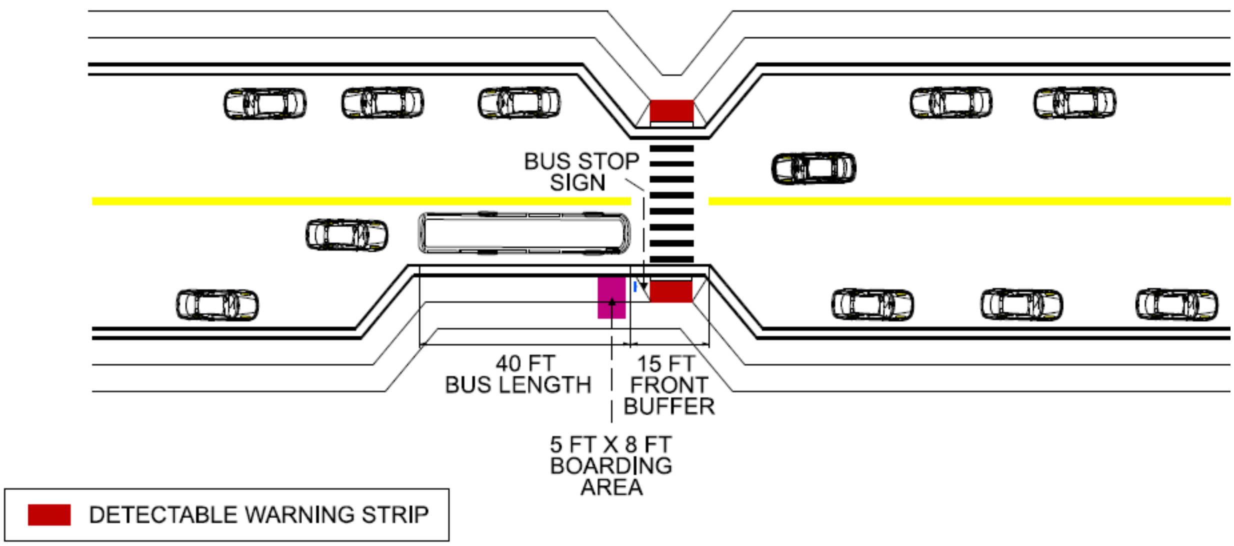


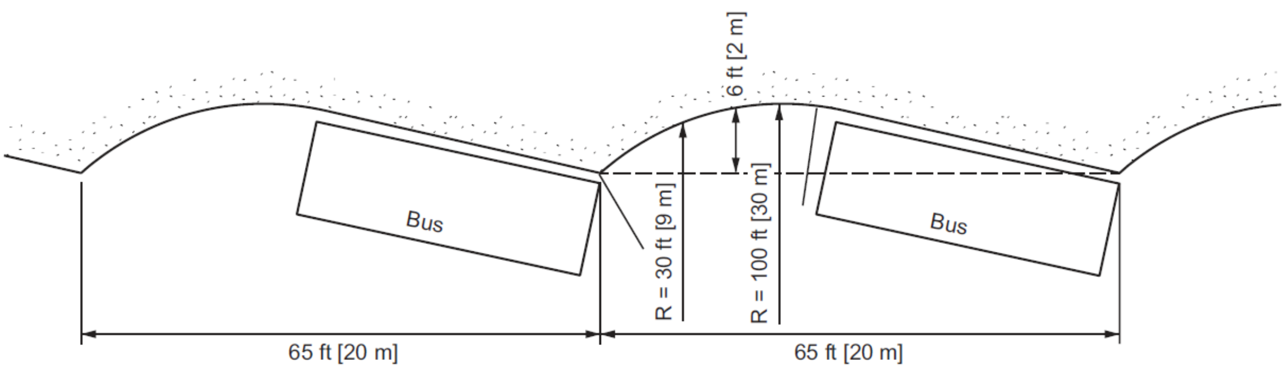
Figure 36: Mid-Block Boarding Bulb Stop for Standard 40-foot Buses



On-Street Transfer Center

On-Street Transfer Centers include several bus boarding and alighting areas in series, creating a larger bus stop zone where multiple buses can board and alight passengers at once. Usually, each individually signed boarding and alighting area serves just one or two routes. These individually signed boarding and alighting areas can be along the curb or adjacent to sawtooth bus bays. **Figure 37** illustrates the design parameters for sawtooth bus bays. Using sawtooth bus bays or bus-only lanes as the dwelling space for buses stopping at On-Street Transfer Centers allows boarding and alighting areas to be arranged in a skip-stop configuration, meaning arriving buses can pass dwelling buses and skip several stops to service just one out of all those at the transfer center.

Figure 37: Sawtooth Bus Bays[31]



Source: AASHTO (2018)

Table 14: On-Street Transfer Center Advantages, Disadvantages

Advantages	Disadvantages
• Increase size of waiting area available to transit passengers, distributing them along a corridor instead of corralling them all in one spot along a block • Reduce vehicle traffic congestion in corridors with high automotive and transit volumes • Reduce conflicts between transit vehicles in corridors with heavy transit volumes due to convergence of multiple routes • Facilitate transfers of large volumes of passengers	• Causes conflicts between bicycles and transit vehicles in corridors with bicycle facilities on both sides of the street • Active warning systems are likely needed, due to the convergence of multiple transportation modes • If the transfer center is a terminal stop, additional space for transit vehicles to lay over between runs may be needed • All activities on the sidewalk unrelated to transit should be prohibited, due to the volume of passengers waiting and moving between stops at transfer centers.

[31] (American Association of State Highway and Transportation Officials (AASHTO), 2018)

Referencing **Table 14**, *On-Street Transfer Centers are recommended where*:

- **Many bus routes converge on the same street.**
  High-volume transit corridors serving large passenger volumes may benefit from On-Street Transfer Centers, given their ability to improve operational efficiency and passenger facilities on streets with several bus routes.

Some points of guidance for On-Street Transfer Centers regardless of street context:

- Sawtooth bus bays are preferred, due to their ability to smoothly facilitate buses pulling in and out of the stop to board and alight passengers compared to curb stops.
- Making at least the lane closest to the curb a dedicated transit, or bus-only, lane is strongly recommended. Pairing this with sawtooth bus bays is most efficient for buses pulling in and out of the transfer center. **Figure 37** illustrates the design of sawtooth bus bays.
- To minimize passenger confusion and stress, it is essential that clear, legible wayfinding information be provided to passengers at transfer centers. This information should be clear, concise, and highly visible whether it is presented as a simple static display at each stop or a dynamic real-time display.
- Due to the volume of passengers waiting and moving between stops at the transfer center, activities unrelated to transit should be prohibited at On-Street Transfer Centers.
- If the transfer center is a terminal stop or otherwise used as a layover point, this should be factored into the dimensions of the transfer center to ensure adequate space for all transit vehicles during peak periods.

On-Street Transfer Centers normally span the length of a block. **Figure 38** illustrates the design of an On-Street Transfer Center. Referencing the general bus stop types covered in **Section 2.1 General Bus Stop Types**, On-Street Transfer Centers are their own stop type. **Table 15** provides minimum bus zone lengths for On-Street Transfer Centers, based on their position relative to adjacent intersections. This table is a useful guide, but it should be noted that a formal engineering and design process is needed to definitively determine the dimensions of On-Street Transfer Centers, as they are large, complex facilities situated in unique street contexts with different operational needs.

Figure 38: On-Street Bus Transfer Center

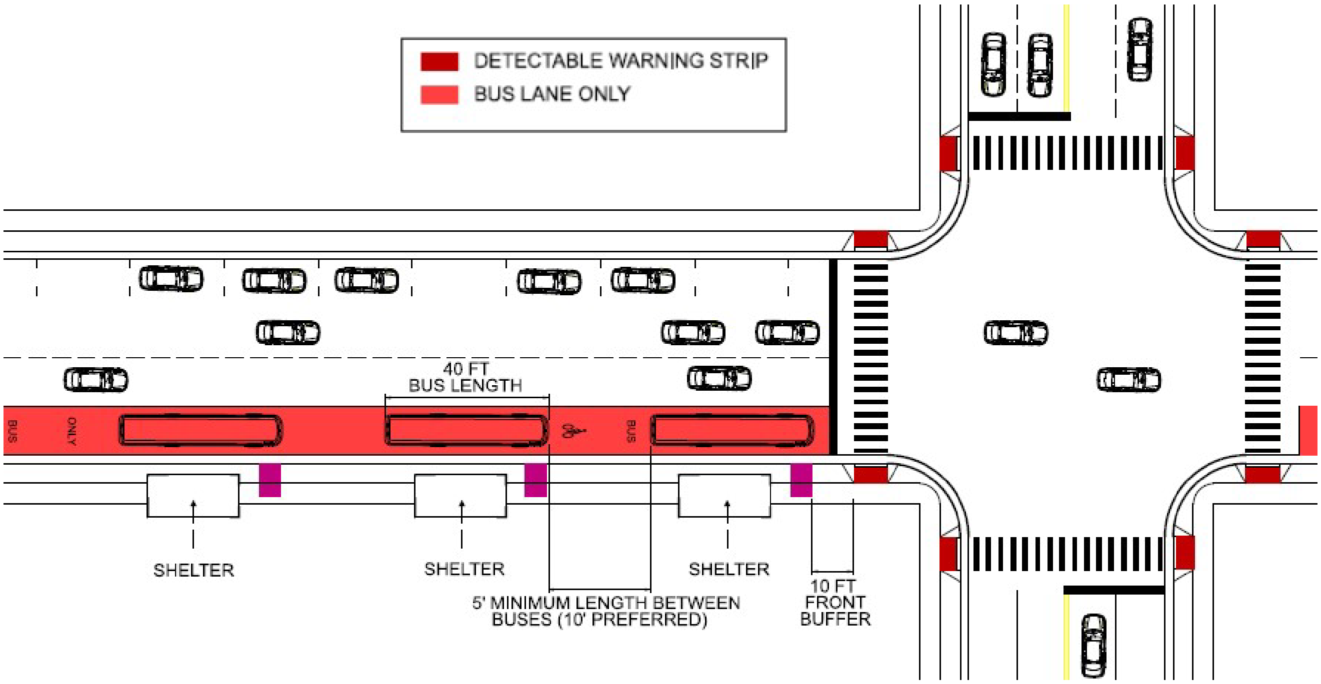


Table 15: Minimum Bus Zone Lengths for On-Street Transfer Centers[32]

On-Street Transfer Center Position*	40-foot Standard Bus	2 x 40-foot Standard Bus**	60-foot Articulated Bus	2 x 60-foot Articulated Bus**
Far-side	35	55	80	115
Near-side	45	65	90	130
Mid-block	35	55	80	115

NOTE: *A 5-foot minimum and 10-foot preferred minimum space should be left between each bus.*

**Relative to intersection.*

***For each additional bus, generally: minimum bus zone length = (length for one bus) + [(bus length)*(number of additional bus stops)] + [(10)*(number of additional bus stops)]*

[32] (National Association of City Transportation Officials (NACTO), 2016)

Boarding Island Stop
Also referred to as floating island bus stops, Boarding Island Stops provide a boarding island separated from the sidewalk by a bicycle traffic channel. They maintain the continuity of bicycle lanes and help provide a clearer separation of a street's transportation facilities for users. Passengers board and alight the bus from this boarding island. Side boarding islands are separated from the sidewalk by a non-motorized traffic channel, or bicycle lane. As such, a raised crosswalk is recommended between the curb and boarding island at various points along the island for passenger access to the bus stop. The bicycle channel, or lane, between the boarding island and curb can be street-grade, or it can be raised.

Table 16: Boarding Island Stop Advantages, Disadvantages

Advantages	Disadvantages
• Add efficiency to transit service, reducing stop delays by enabling buses to make in-lane stops • Eliminate bus-bicycle "leapfrogging" conflicts arising at in-lane stops by allowing buses and bicycles to move straight in their respective travel lanes at and past the stop • Maintain clear pedestrian path of travel on sidewalk while providing more space for waiting passengers and for amenities • Bus operators can deploy ramps as needed onto the island without disrupting pedestrians' path of travel • Boarding islands provide a refuge for passengers and other pedestrians crossing the street • Usually require less complex drainage modifications than Boarding Bulb Stops • Help facilitate level or near-level boarding	• Do not eliminate pedestrian-bicycle conflicts at in-lane stops, as pedestrians must still cross the bicycle lane to board or when alighting buses at the stop • May require additional signage or traffic signals to manage conflicts between transit, vehicular, and bicycle traffic, especially at high-volume stops and/or intersections, requiring other traffic to yield to pedestrians crossing to get to boarding island • May be most effective at intersections that do not experience conflicts presented by left-turns

Referencing **Table 16**, *Boarding Island Stops are recommended where*:

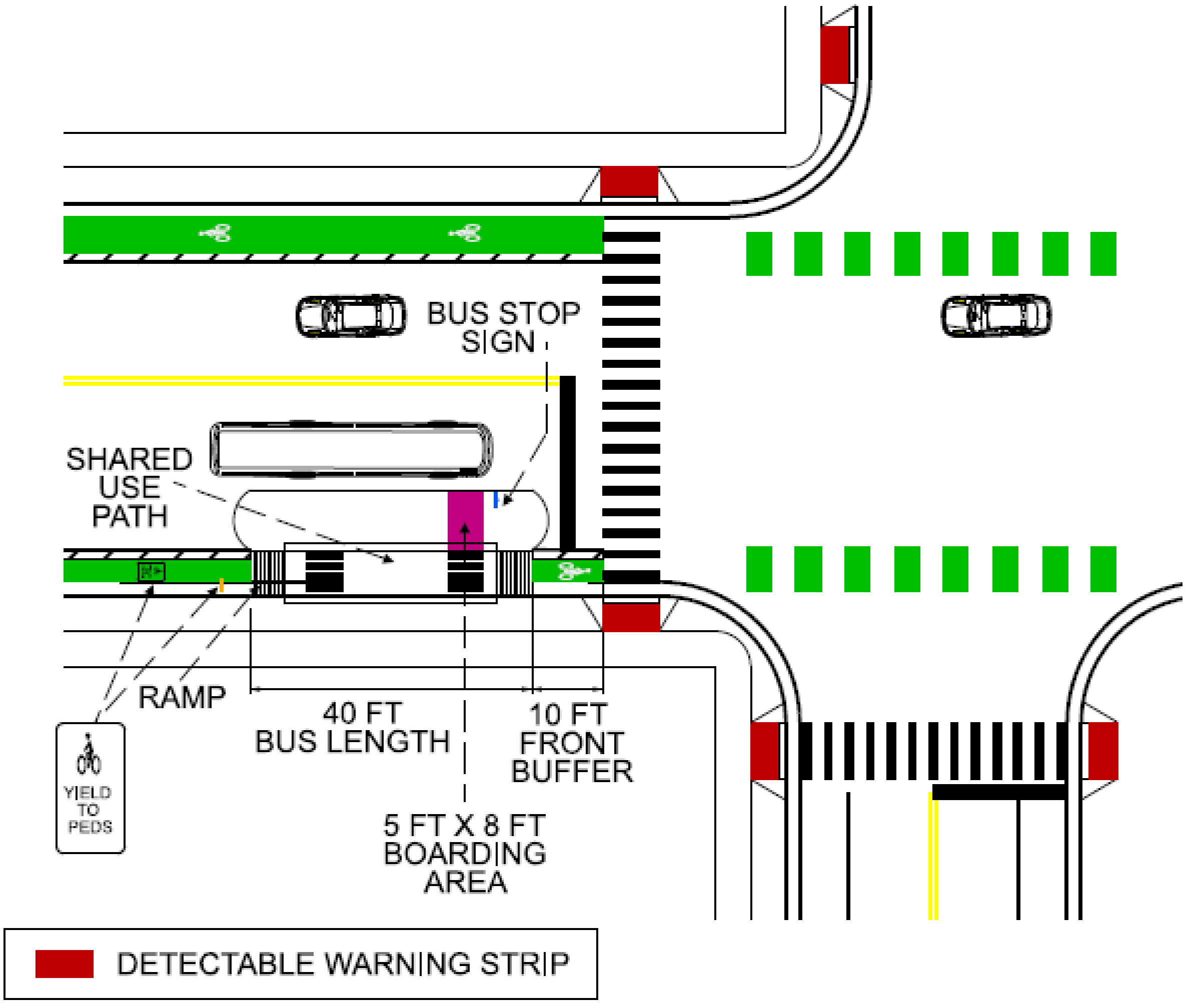
- **There are bicycle facilities adjacent to the curb and/or on-street vehicle parking.** Boarding islands are especially preferred on these streets to eliminate bus-bicycle conflicts in travel lanes at a bus stop.

Boarding Island Stops can be positioned at the far-side of the intersection, near-side of the intersection, or mid-block relative to two consecutive intersections. **Figure 39** illustrates the design of a Boarding Island Stop. Referencing the general bus stop types covered in **Section 2.1 General Bus Stop Types**, Boarding Island Stops can be applied to network hub, standard, and coverage bus stop types. See **Table 18** and **Table 19** at the end of this section for Boarding Island Stop BSZ design metrics based on bus length and position.

Some points of guidance that apply regardless of Boarding Island Stop position:

- Boarding Island Stops should be applied at controlled intersections, meaning those with stop signs or signals, to facilitate safe pedestrian access to the island.
- At a minimum, boarding islands must extend from the front to the rear door of a bus. They should be extended as needed to meet capacity demands at a particular stop.
- Boarding islands should be at a height that allows for accessible level or near-level boarding onto buses.
- Unsafe waiting areas along or adjacent to boarding islands, e.g. travel lanes to the left or right of the boarding island and the edge of the boarding island adjacent to these lanes, should be clearly marked in a manner actively discouraging passengers from waiting there.
- At high-volume stops or intersections, additional signage or signals requiring bikes to yield to or stop for pedestrians crossing the bicycle lane to get to the boarding island may be needed.
- At boarding island stops with bicycle channels at sidewalk level, provide a raised crosswalk between the boarding island and sidewalk.
- At boarding island stops with bicycle channels at street level, differentiate the bicycle channel from the sidewalk using contrasting materials or green color treatments commonly applied to bicycle facilities.

Figure 39: Boarding Island Stop for Standard 40-foot Buses



Shared Cycle Track Stop
When the street and/or ROW includes bicycle facilities but is not wide enough to accommodate a boarding island, Shared Cycle Track Stops are recommended. Ramping up to curb height, the standard bicycle lane or cycle track continues through the boarding area and then ramps back down to street height. The boarding and alighting area along with the bus stop sign are located within this raised portion of the bicycle facility, but stop amenities are still located on the sidewalk for this configuration.

Table 17: Shared Cycle Track Stop Advantages, Disadvantages

Advantages	Disadvantages
• Add efficiency to transit service, reducing stop delays by enabling buses to make in-lane stops • Maintain clear pedestrian path of travel on sidewalk while providing more space for waiting passengers and for amenities • Bus operators can deploy ramps as needed onto the island without disrupting pedestrians' path of travel • Help facilitate level or near-level boarding	• May require additional signage or traffic signals to manage conflicts between transit, vehicular, and bicycle traffic, especially at high-volume stops and/or intersections, requiring other traffic to yield to pedestrians crossing to get to boarding island

Referencing **Table 17**, *Shared Cycle Track Stops are recommended where*:

- **There are bicycle facilities adjacent to the curb on streets with limited ROW.** On streets with limited ROW and bicycle facilities adjacent to the curb but without on-street vehicle parking, boarding islands may not be possible.

Some points of guidance that apply regardless of Shared Cycle Track Stop position:

- The bicycle channel should be differentiated from the sidewalk and travel lane using contrasting materials or color treatments.
- Ramps raising bicycle channel through bus stop zone should not exceed a 1:8 slope.
- Streetscape elements that conflict with bicycle movements or obstruct views of the bus stop should be situated at least 20 feet away from ramps raising the bicycle channel. However, crosswalks need only be 10 feet away from these ramps.
- For accessibility, a waiting area free from conflicts with bicycles should be provided for wheelchair users. Additionally, multi-sensory information like tactile curb ramp detectable warning strips should be included in the bus stop zone to assist individuals with visual disabilities in avoiding conflicts with bicycles.
- The bicycle channel should be wide enough to be cleared by available sweeping and plowing equipment, for bicyclist and transit passenger safety.

Shared Cycle Track Stops can be positioned at the far-side of the intersection, near-side of the intersection, or mid-block relative to two consecutive intersections. **Figure 40** illustrates the design of a Shared Cycle Track Stop. Referencing the general bus stop types covered in **Section 2.1 General Bus Stop Types**, Shared Cycle Track Stops can be applied to network hub, standard, and coverage bus stop types. See **Table 18** and **Table 19** at the end of this section for Shared Cycle Track Stop BSZ design metrics based on bus length and position.

Figure 40: Shared Cycle Track Stop for Standard 40-foot Buses

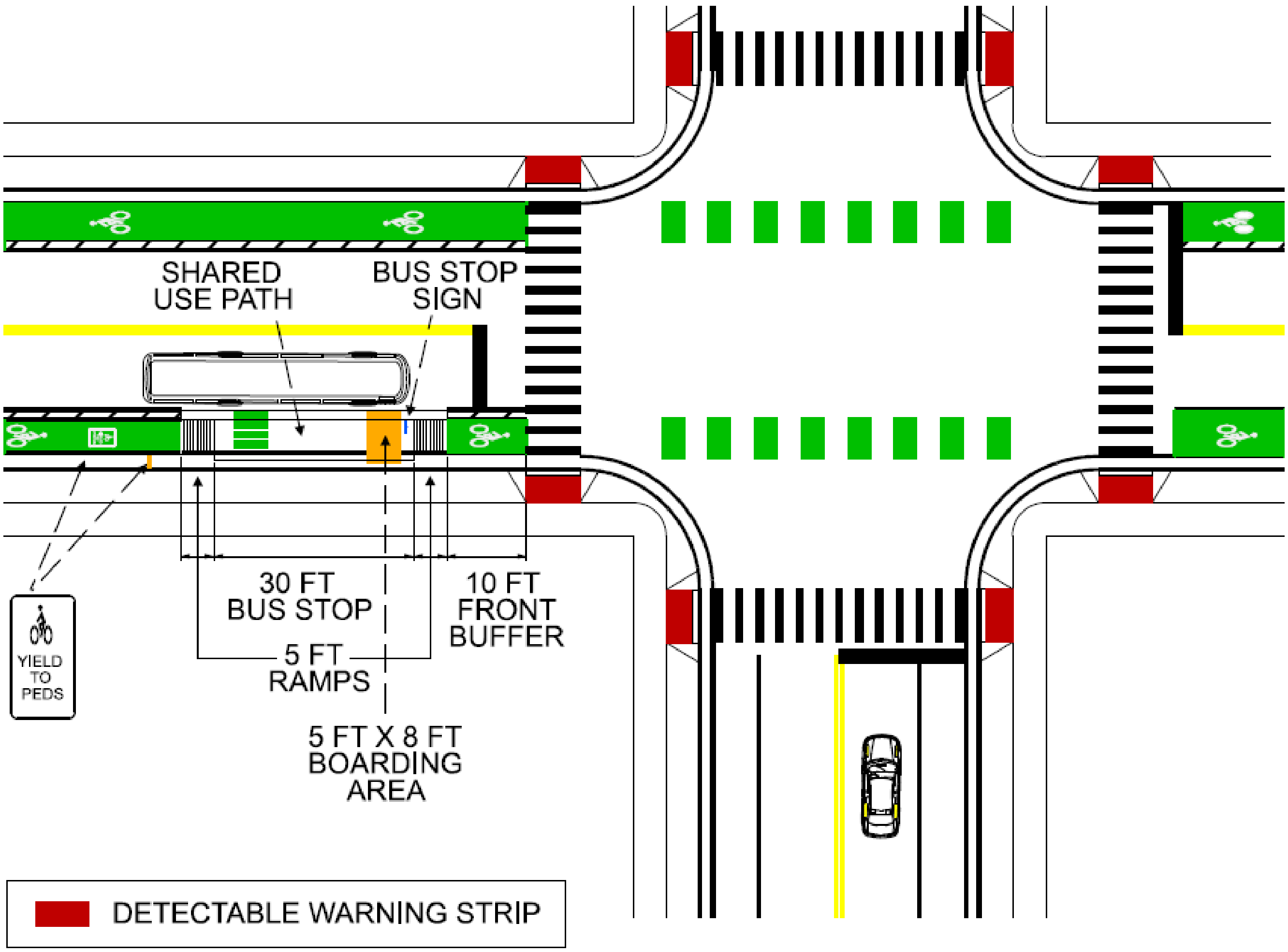


Table 18 and **Table 19** summarize minimum lengths of bus stop zone elements for stops served by buses up to 40-foot-long and 60-foot-long buses, respectively. Minimum lengths for bus stop zone elements are provided by stop configuration and stop position. Bus stops that may be served by more than one bus at once will require additional length. If multiple standard 40-foot buses will serve a stop, add 45 feet to the total bus stop length for each additional bus. If multiple articulated 60-foot buses will serve a stop, add 65 feet to the total bus length for each additional bus.

Table 18: Bus Stops Served by up to 40-foot Buses Minimum Bus Zone Lengths

Stop Position	Rear Buffer *	Pull-Out Buffer	Front Buffer *	Ramp to Bicycle Facility	Ramp from Bicycle Facility	Total Bus Stop Length	Number of Parking Spaces †
Pull-Out Stop							
Far-Side	25	25	-	-	-	90	5
Far-Side, after right turn	75	25	-	-	-	140	7
Far-Side, after left turn	40	25	-	-	-	105	5
Near-Side	50	10	-	-	-	100	5
Mid-Block	50	25-50**	-	-	-	115-140**	7-8
In-Lane Stop							
Far-Side	10	-	-	-	-	50	-
Far-Side, after right turn	55	-	-	-	-	95	-
Far-Side, after left turn	25	-	-	-	-	65	-
Near-Side	-	-	10	-	-	50	-
Mid-Block	-	-	-	-	-	40	-
Boarding Bulb Stop							
Far-Side	10	-	-	-	-	50	3
Far-Side, after left turn	25	-	-	-	-	65	3
Near-Side	-	-	10	-	-	50	3
Mid-Block	15	-	15	-	-	55	3
Boarding Island Stop							
Far-Side	10	-	-	-	-	50	3
Far-Side, after right turn	45	-	-	-	-	85	4
Far-Side, after left turn	15	-	-	-	-	55	3
Near-Side	-	-	10	-	-	50	3
Mid-Block	-	-	-	-	-	40	2
Shared Cycle Track Stop							
Far-Side	10	-	-	5	5	50	-
Far-Side, after right turn	45	-	-	5	5	85	-
Far-Side, after left turn	15	-	-	5	5	55	-
Near-Side	-	-	10	5	5	50	-
Mid-Block	-	-	-	5	5	40	-

NOTE: *All measurements provided in feet.*

**Rear buffer measured from tangent of intersecting street, front buffer measured from crosswalk.*

***Depends on roadway's posted speed limit and traffic safety analysis.*

†Number of parking spaces bus stop will take up based on a parking space length of 20 feet.

Table 19: Bus Stops Served by up to 60-foot Buses Minimum Bus Zone Lengths

Stop Position	Rear Buffer *	Pull-Out Buffer	Front Buffer *	Ramp to Bicycle Facility	Ramp from Bicycle Facility	Total Bus Stop Length	Number of Parking Spaces †
Pull-Out Stop							
Far-Side	25	25	-	-	-	110	5
Far-Side, after right turn	75	25	-	-	-	160	7
Far-Side, after left turn	40	25	-	-	-	125	5
Near-Side	50	10	-	-	-	120	5
Mid-Block	50	25-50**	-	-	-	135-160**	7-8
In-Lane Stop							
Far-Side	10	-	-	-	-	70	-
Far-Side, after right turn	55	-	-	-	-	115	-
Far-Side, after left turn	25	-	-	-	-	85	-
Near-Side	-	-	10	-	-	70	-
Mid-Block	-	-	-	-	-	60	-
Boarding Bulb Stop							
Far-Side	10	-	-	-	-	70	3
Far-Side, after left turn	25	-	-	-	-	85	3
Near-Side	-	-	10	-	-	70	3
Mid-Block	15	-	15	-	-	75	3
Boarding Island Stop							
Far-Side	10	-	-	-	-	70	3
Far-Side, after right turn	45	-	-	-	-	105	4
Far-Side, after left turn	15	-	-	-	-	75	3
Near-Side	-	-	10	-	-	70	3
Mid-Block	-	-	-	-	-	60	2
Shared Cycle Track Stop							
Far-Side	10	-	-	5	5	70	-
Far-Side, after right turn	45	-	-	5	5	105	-
Far-Side, after left turn	15	-	-	5	5	75	-
Near-Side	-	-	10	5	5	70	-
Mid-Block	-	-	-	5	5	60	-

NOTE: *All measurements provided in feet.*

**Rear buffer measured from tangent of intersecting street, front buffer measured from crosswalk.*

***Depends on roadway's posted speed limit and traffic safety analysis.*

†Number of parking spaces bus stop will take up based on a parking space length of 20 feet.

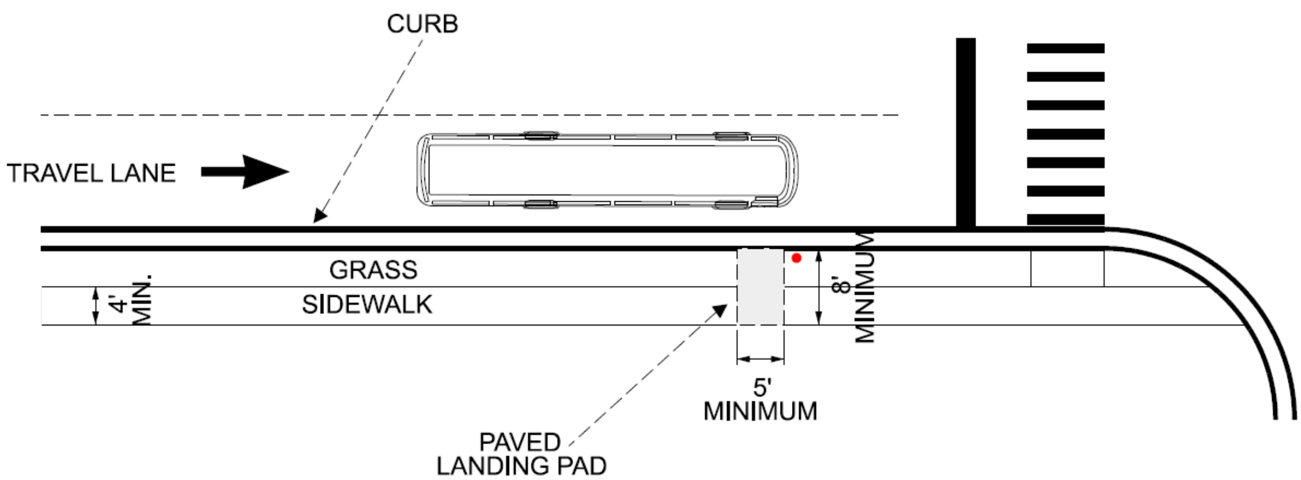
5.4 Bus Stop Alignment

Whether the bus should service a stop from a travel lane, by pulling out of the travel lane into a parking lane entirely depends on many factors. It depends on roadway and sidewalk design, posted speed limit, traffic signalization, traffic conditions, on-street parking, the number of buses servicing the stop at a time, length of the stop layover, curb clearance, and position of the stop related to the intersection.

Travel Lane Alignment

Figure 41 shows a bus stop aligned with the travel lane. Travel lane alignment is the most preferred alignment as buses do not need to re-enter the travel lane after stopping, therefore limiting delays to the route. However, depending on traffic volumes, speed limit, number of passengers and other factors conflicts with traffic can occur and make this a traffic hazard. In these cases, pulling off the road into a parking area would be preferred and prevent disruption to traffic flow.

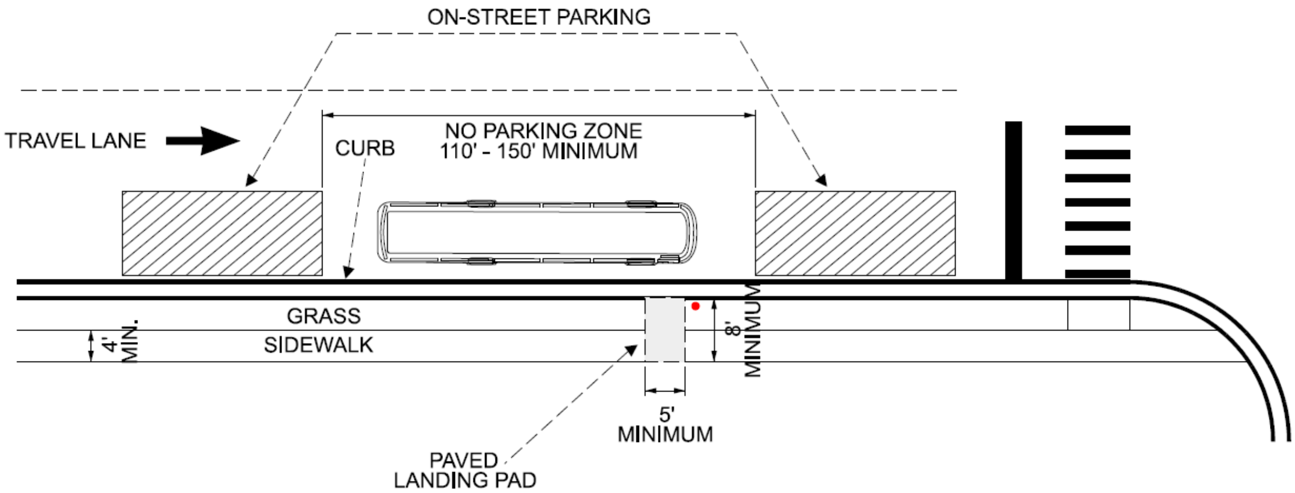
Figure 41: Bus Stop Aligned with Travel Lane



Parking Lane Alignment

Figure 42 shows a bus stop aligned with the parking lane. When using a parking lane it is key to have the bus stopping area and acceleration/deceleration area designated and enforced as a no-parking area to ensure parked cars do not block bus access to the curb, blocking accessible paths of travel to the bus stop. This type of stop will remove parking spaces and needs to be considered when designing this type of stop.

Figure 42: Bus Stop Aligned with Parking Lane

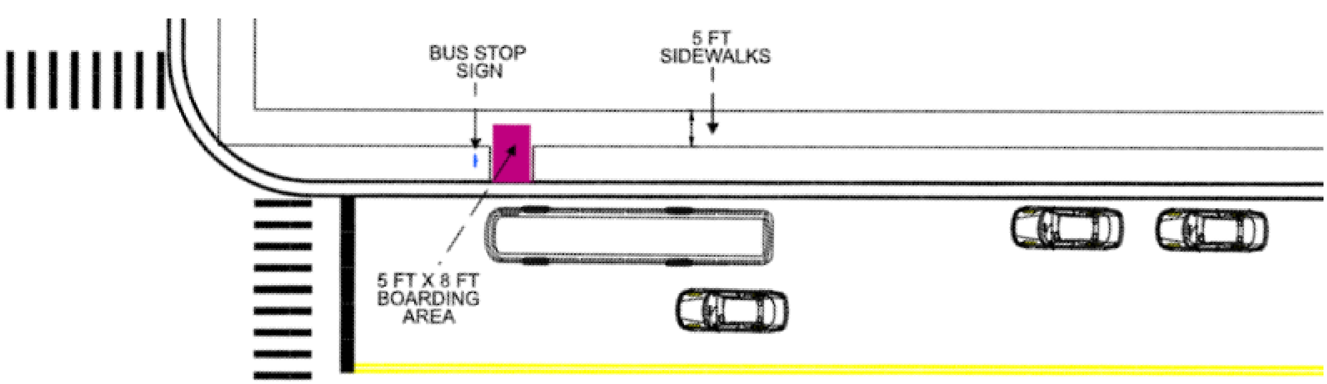


NOTE: *For the "NO PARKING ZONE," the 110 feet is the minimum and 150 feet is the preferred minimum. This applies to 40-foot buses.*

5.5 Bus Stop Landing Pad

Directly adjacent to the bus stop sign, bus stop landing pads are the accessible boarding and alighting area provided for passengers to get on and off the bus. This is also the space bus drivers use to deploy ramps for wheeled passengers or those using mobility aids. Shown in **Figure 43**, the bus stop landing pad is made up of a concrete surface a minimum of 8 feet by 5 feet. It will be measured perpendicular to the curb or vehicle roadway edge and measured parallel to the vehicle roadway. This area will be ADA compliant in all directions. See **Key Accessibility Considerations: Bus Stop Landing Pads** for more information on landing pad accessibility standards. The ADA pad needs to be adjacent to a curb line or a minimum of at least four inches above the existing road elevation so the buses can deploy their ramps for riders with mobility devices, such as a wheelchair. The bus stop landing pad size may need to be increased from the ADA minimum due to high ridership at a particular stop.

Figure 43: Bus Stop Landing Pad



5.6 Sidewalk Policy

Pedestrian routes to bus stops should be designed to be ADA compliant and meet the needs of all users. Paving pedestrian pathways makes them more accessible for everyone. If possible, provide accessible circulation routes that include curb cuts, ramps, visual guides, signage (visual and Braille) and railings where needed. Place ADA-compliant curb ramps at each corner of an intersection.

Stops should be located and constructed to make use of existing sidewalk facilities, or new sidewalk facilities should be constructed to provide ADA compliant pedestrian access to each bus stop. Bus stops should not be placed where the stop does not connect a sidewalk—this should be avoided if at all possible. SMART will work with local jurisdictions to advocate for sidewalk infrastructure. Stops should not be placed at locations like those pictured in **Figure 44**, where accessible infrastructure connecting them to adjacent sidewalks does not exist or cannot be constructed. See **Key Accessibility Considerations: Bus Stops without Sidewalk Access** for design guidance on stops that must be placed in locations without connecting sidewalk infrastructure.

On most two-way streets, bus stops are typically located across the street from each other. This makes safe and accessible street crossings critical. Passengers who are using the same bus route to return to where they started their trip and passengers who are transferring between bus routes will need to cross the street at some point during their trip to access the correct stop. See **Regular vs. Enhanced Crosswalks** and **Key Accessibility Considerations: Adjacent Street Crossings** for more information on street crossing safety and accessibility.

At stops with heavy ridership, additional passenger waiting/standing areas should be constructed off the main sidewalk within the ROW so that waiting passengers do not block passage of through pedestrians. Where a bus stop serves as a transfer point, there should be a paved connection to the connecting route stops.

Figure 44: SMART Bus Stops not Connected to Sidewalk Infrastructure

Stop at 12 Mile Road and South Red Leaf Lane in Southfield not connected to sidewalk infrastructure.

Stop at Southfield Road and Rainbow Drive in Lathrup Village next to a stormwater runoff ditch.

Stop at Woodward Avenue and Edgewood Boulevard in Berkley placed in road verge on uneven surface.

Stop at Woodward Avenue and Vinton Road in Berkley placed in the middle of the sidewalk.

5.7 Modifications During Construction

Public infrastructure, private development construction or maintenance activities near bus stops are to be expected. State and local government agencies and private developers managing these construction or maintenance activities should coordinate and share their plans with SMART. Through this coordination, SMART can ensure continual, safe access to their transit network during construction and maintenance activities. Coordination with SMART should address and outline adherence to several requirements to maintain access to bus stops situated within areas where construction or maintenance activities are occurring.

If existing, ADA-compliant routes to a stop are blocked, channelized alternative routes accessible to passengers with disabilities and detectable by passengers with visual impairments must be provided. Alternative routes must be ADA-compliant and must include:

- A smooth, continuous hard surface through their entire length.
- Grades and ramps that do not exceed a slope of 1:20.
- Signage, barriers, and channelizing devices for pedestrian traffic to the bus stop, regardless of whether this temporarily reduces the street's vehicle capacity.
- 5-foot by 5-foot passing spaces every 200 feet along temporary walkways less than 5 feet wide through their entire length.

Review PROWAG R205 to ensure that all requirements for alternative accessible route requirements for ADA compliance are met.

If an alternative accessible route cannot be provided, a temporary bus stop must be included in both the Temporary Traffic Control (TTC) and Maintenance of Traffic (MOT) plans associated with the construction or maintenance activities. Temporary bus stops must include:

- Temporary boarding and alighting areas a minimum of 5 feet in width and 8 feet in length, accessible to passengers with disabilities.
- SMART temporary bus stop signage.

Variable message signs and other traffic control devices providing construction or maintenance information to vehicles must not interfere with pedestrian access to a bus stop. An accessible temporary bus stop must be provided if a traffic control device related to construction or maintenance activities must block access to a permanent stop.

SMART must provide appropriate notice to passengers of temporary alterations in service provision due to facility adjustments during construction and maintenance activities adjacent to bus stops.

Apart from these requirements, there are several additional guidelines for maintaining access to bus stops when construction or maintenance activities are occurring around them. The organization managing the construction and maintenance activities should involve SMART in the development of the associated TTC and MOT, so that SMART can minimize delays due to these activities. Alternative routes and existing accessible stops or temporary accessible stops should be on the same side of the street to minimize pedestrians crossing through the construction zone to get to transit.

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6 PASSENGER WAITING AREAS

Specific decision-making and details pertaining to the placement and design of the passenger waiting area within the BSZ (see **Figure 25**) are discussed in this chapter, including accessibility concerns and best practices, amenities, information and technologies, and several other trip elements affecting passengers at the bus stop. **Chapter 10 Design Criteria Scoring Sheets** contains additional information about criteria used to determine what amenities are appropriate at various bus stops.

6.1 Bus Stop Accessibility

Centering accessibility in all decision-making processes is essential to the success of transit networks. Bus stops are key links in every bus passenger's journey as their first and last point of contact with the transit network as they travel from trip origin to destination, making providing passengers a barrier-free user experience at bus stops critical. Inaccessible bus stops limit the disability community's mobility, deterring the use of fixed-route bus service and severely impacting bus ridership regardless of passenger disability status.

Accessibility Regulations and Standards

The basic accessibility requirements SMART must follow under federal law are stipulated under the Americans with Disabilities Act. Best practices for adhering to ADA requirements are communicated through the Public Right-of-Way Accessibility Guidelines (PROWAG). Apart from the ADA and associated PROWAG, there a few other laws or policies that transit providers like SMART must follow to maintain accessibility throughout their networks.

Any project that constructs, moves, or alters a bus stop is required to comply with the following accessibility regulations and standards:

- **US DOT ADA Regulations**
  The ADA states that no entity shall discriminate against persons with disabilities in connection with transportation service provision. Parts 27, 37, and 38 under Title 49 Subtitle A of the Code of Federal Regulations (CFR) delineate standards transit agencies must adhere to as federally funded entities providing transportation services.
  - → Part 27 discusses nondiscrimination practices required of entities receiving federal funds.
  - → Part 37 discusses implementation of transportation and related provisions required under Title II and Title III of the ADA Regulations.
  - → Part 38 discusses transportation vehicle accessibility specifications.

  Amendments to the ADA and related standards and regulations are ongoing. As such, best practice is to check US Access Board guidelines, provided on their website by legislation. Additionally, the DOT and FTA collaboratively update and provide ADA guidance for transportation service providers. Another resource relevant to transit agencies serving non-urban areas is the recently published National Rural Transit Assistance Program's (RTAP) ADA Toolkit, which addresses key ADA regulations, standards, and guidance by service type and more.

- **Architectural Barriers Act (ABA)**
  Any facilities that are built or altered with federal funds must adhere to the ABA. Chapter 5 of the ABA Guide discusses passenger loading zones, including bus loading areas and on-street stops. Bus loading areas and on-street stops are discussed in §F209.2.2 and §F209.2.3 of the ABA itself.[33]

- **PROWAG**
  PROWAG encapsulates best practices for adherence to ADA and ABA regulations and standards, specifically applied to pedestrian facilities in the public ROW. *Chapter 2: Scoping Requirements* (R2) and *Chapter 3: Technical Requirements* (R3) encompass most of the content provided in PROWAG. The scoping requirements specify when and where pedestrian facility elements in the public ROW must be accessible, while the technical requirements specify the design criteria for those elements.

  The following sections of PROWAG may be particularly useful when evaluating the accessibility of transit stops and streetscape elements within the bus stop zone:

  → Permanent, Alternate Pedestrian Access Routes: R203, R204, R302, R303
  → Detectable Warning Surfaces: R205, R305
  → Street Furniture: R209
  → Transit Stops and Shelters: R204, R210, R309, R303
  → Permanent, Alternate Passenger Loading Zones: R204, R212, R311

  It is important to note that this is not an exhaustive list of all PROWAG standards relating to transit stops. To ensure that accessibility requirements are being met, all elements of the transit stop and streetscape elements within the bus stop zone should be checked against all PROWAG standards.

- **SMART Title VI Policies**
  Title VI of the Civil Rights Act of 1964 prohibits programs and activities that receive federal assistance from discriminating on the basis of race, color, and national origin in their service provision. Recipients of federal assistance, like SMART, must annually assess if their services and associated policies are compliant with Title VI. Any person who believes she or he has been aggrieved by any unlawful discriminatory practice under Title VI may file a complaint with SMART by calling the civil rights complaint hotline at (313)-223-2198, mailing their complaint to

[33] (Office of Research Facilities (ORF), 2020)

SMART's Civil Rights Department at 535 Griswold Street, Suite 600, Detroit, MI 48226, or on the SMART website.

- **American National Standards Institute (ANSI)**
  ANSI manages the development and coordinates the application of national and international design standards across many different industries. Though ANSI standards are not always regulation, transit facilities must adhere to ANSI 117.1 under CFR Title 49 Part 37.9. The most relevant guidance for bus stops that are not part of off or on-street transfer center facilities may be found in ANSI 117.1 Chapter 4, specifically 402, 403, 405, and 406, applies to the design of accessible routes, walking surfaces, ramps, and curb ramps, respectively. Off and on-street transfer centers that include publicly accessible buildings should adhere to all facility guidance provided by ANSI 117.1 Chapter 4.

SMART provides more information about their programs related to accessibility on their website.

Meeting ADA regulations and standards may seem convoluted. However, it is the responsibility of transit agencies to do so for the benefit of all transit users, not just persons with disabilities. Centering barrier-free design, wayfinding, and safety and warning may help maintain focus on accessibility and ADA compliance throughout the planning and construction of bus stops.[34]

Barrier-Free Design

The design of bus stops and connecting pathways should not impede persons with a disability from accessing them.

Applied to bus stop design:

→ Outdoor elements, like utility pole support cables, low signage, or planters, should not protrude into the Path of Travel (POT).
→ Street furniture like newspaper vending boxes or benches should be positioned so that they are connected to the POT and bus boarding and alighting area, but not obstructed by the main flow of pedestrian traffic.
→ Seating should be supplied frequently, adjacent to the POT.
→ Grade-level changes in sidewalks and platforms should be avoided wherever possible.
→ Slip-resistant finishes, good grips, and sure footing are key to ensuring any surface, from seating to bus stop pads, are safely accessible.

[34] (National Aging and Disability Transportation Center (NADTC), 2016)

Wayfinding

'Wayfinding' is the process of going from one location to a specific destination, demanding an acute awareness of physical surroundings. Wayfinding systems allow users to determine their location, their destination, and then determine how to get from their location to their destination.

Applied to bus stop design:

→ Consistency and uniformity of wayfinding elements and their layouts is critical, making them more digestible to any person.
→ Use right angles to orient wayfinding elements and layouts further improves their ease of use.
→ Utilize tactile cues within the built environment in addition to visual cues and landmarks to help users find their way. For example, planters adjacent to the POT or sidewalks with grass shoulders are good tactile, not-necessarily visual cues indicating to the user that they have left the POT.
→ Walkways, hazards, and waiting areas should be illuminated.
→ POTs from the sidewalk to the bus boarding and alighting area or bus shelter should be both logical and continuous for simplicity, efficiency, and ease of use. Color contrast, sound, light, and shade can all be used to accentuate POTs and further clarify them.

Safety & Warning

Safety and adequate warning for hazards and other POT concerns is critical in all parts of bus operations, including bus stop design.

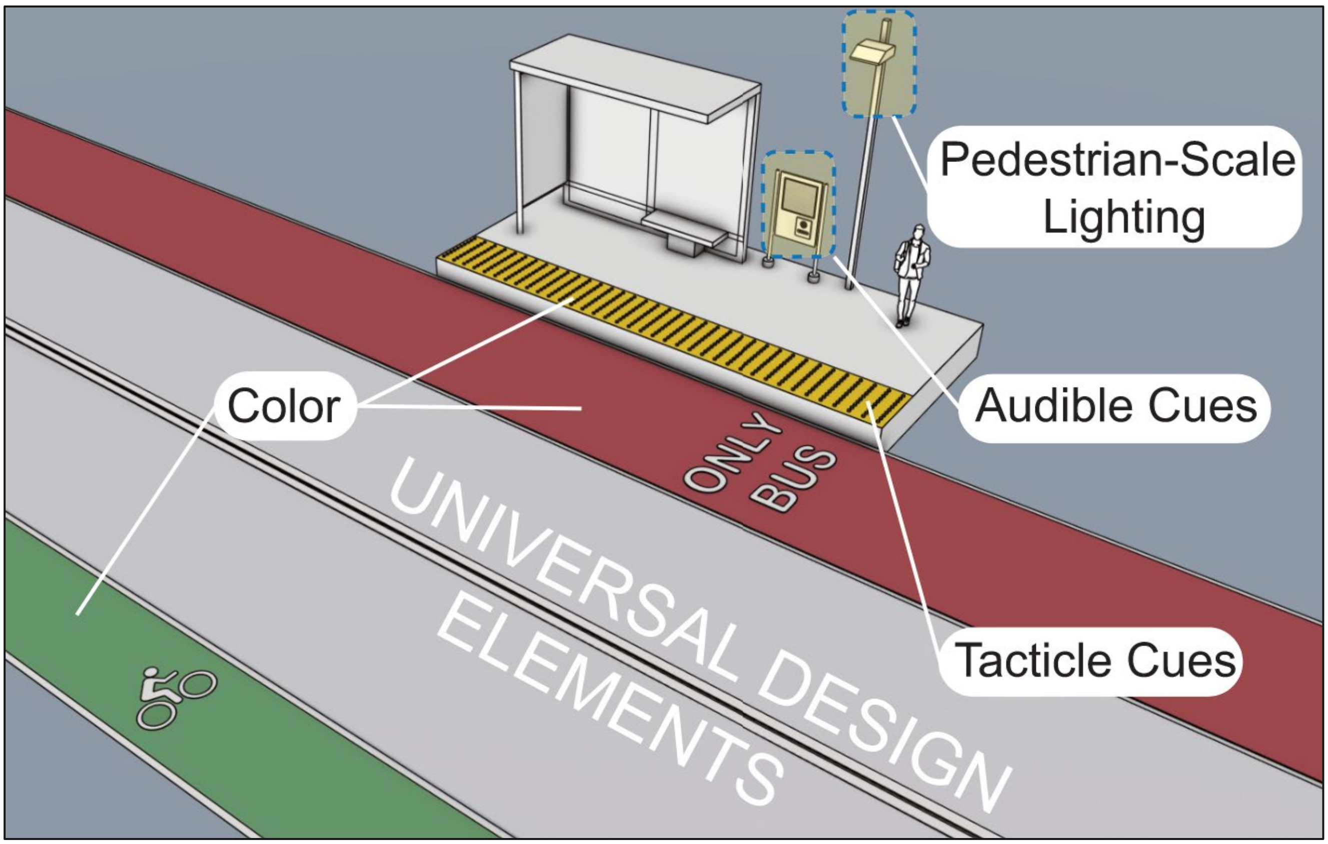
Applied to bus stop design:

→ Good ergonomics and effective wayfinding help to mitigate and provide warning of safety concerns within the bus stop zone.
→ Street furniture, like benches, planters, or newspaper vending boxes can be placed so that they act as barriers from hazards.
→ Good lighting and visibility from areas surrounding the bus stop zone is critical to safety, helping maintain 'eyes on the street.'
→ Distinct markings and signs in addition to greater illumination where exposure to hazards cannot be blocked highlights the safety concern, providing the user with ample warning.

Universal Design Elements
Beyond meeting standards and following regulations, applying universal design concepts to bus stops sustains equitable access to them. Universal design concepts promote design that is not only accessible, but usable by all people without the need for adaptation or specialized design.[35] ADA standards and requirements do not cover the needs of groups with differing enhanced mobility needs, like passengers with children in strollers or passengers carrying goods. Universal design broadens the functionality of bus stops for the populations they serve, enabling any transit user to access any bus stop comfortably and conveniently.

Figure 45 shows the basic universal design elements that are increasingly incorporated into bus stop design to guide passengers of all abilities through the streetscape.

Figure 45: Basic Universal Design Elements Incorporated into Bus Stop Design



- **Tactile Cues**
  Tactile cues are any streetscape elements that trigger users' sense of touch. Tactile cues help street users orient themselves within a built environment that can be overwhelmingly busy or illegible regardless of ability. They assist users' navigation through the streetscape by pointing them in the right direction.

[3535] (The UD Project, 2024)

Detectable warning strips are the most applicable tactile cue within the bus stop zone, especially useful to individuals using wheelchairs or other mobility devices. They consist of a raised tactile surface that alerts street users to potential hazards like drop-offs or oncoming traffic. Generally, detectable warning strips:

- → Should be at least 24 inches deep and applied over the entire length of all curb ramps leading to street crossings.
- → Along the entire length of the boarding area platform edge, if the boarding area is a platform that is higher than curb height, there should be 24-inch-deep detectable warning strips.
- → Are aligned with boarding and alighting door locations at sidewalk-level bus stops.
- → Should use a grid truncated dome pattern instead of a diamond dome pattern. The diamond pattern can present difficulties for wheeled passengers and passengers using mobility aids.
- → Are required at curb ramps within transit facilities and must be placed on both sides of every passenger crossing over a bicycle lane.

- **Color**
  Color is particularly useful when delineating transitions between different transportation modes within areas where travel via those different modes conflicts. For example, bicycle lanes are often painted a different color when they are adjacent to bus stops to draw attention to the fact that pedestrians will need to cross a bicycle travel lane when boarding and alighting the bus. Detectable warning strips are often applied in a color that strongly visually contrasts that of bicycle and other travel lanes to further alert pedestrians that they are crossing from one modal zone to another.

- **Pedestrian-Scale Lighting**
  While many streets have lamp poles with streetlights, more rural or less densely populated areas may not. Providing pedestrian-scale lighting at bus stops, meaning lamps less than 25 feet high, helps passengers safely access the stop at any time of day. To avoid creating virtual shadows, or shadows and reflections that appear to be real objects to drivers or bicyclists, bus stop lighting should gradually increase illumination rather than suddenly to allow drivers' and bicyclists' eyes to adjust.

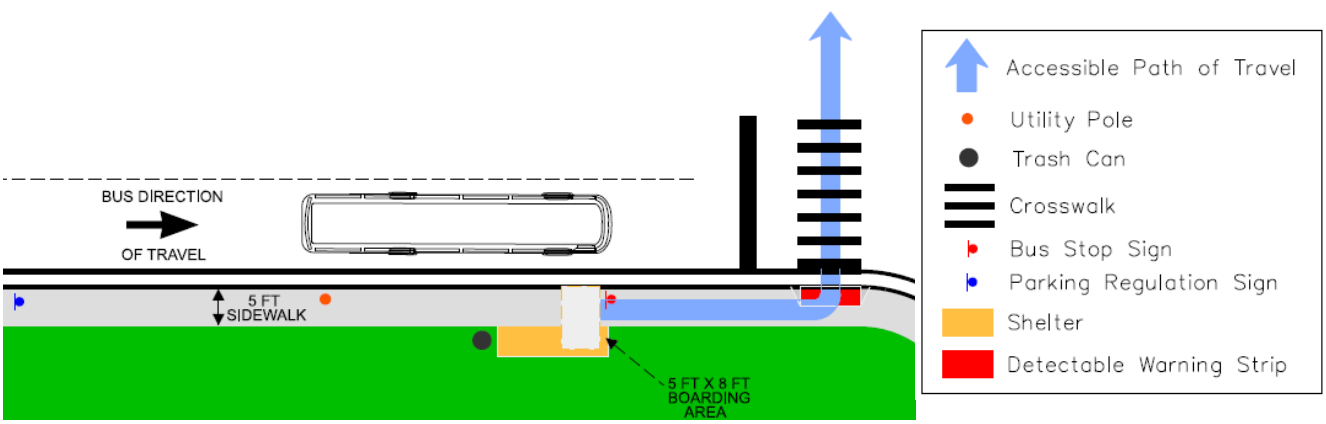
- **Audible Cues**
  Streetscapes that bus stops are situated within can be very visually crowded places, overwhelming passengers ability to be aware of various through movement or when they themselves should move from one area to the next. Audible cues like accessible pedestrian signals (APS) or bus arrival announcements at stops with real-time arrival information can greatly assist people in getting to where they need to be within the bus stop zone without coming into conflict with other transit modes.

There are more universal design elements than this standard set recommended by NACTO's Transit Street Design Guide that can be incorporated into bus stop planning and design, if time and budget allow. Additional universal design elements are catalogued in research and technical resources publicly offered by the American Public Transportation Association's (APTA) 2020 Transit Universal Design Guidelines.[36]

Key Accessibility Considerations
There are several key accessibility considerations for passenger waiting areas and bus stop zones that are critical to safe, functional mobility. These are discussed here, in addition to associated bus stop ADA requirements and universal design recommendations. As a note, the United States Department of Transportation (U.S. DOT) recognizes that there may be some situations where it is not feasible to adhere to all ADA requirements for bus stop landing pads and expects compliance to the greatest extent feasible. Coordination with and approval from the FTA may be required to confirm that it is not feasible to meet all ADA requirements at a particular site.

Adjacent Paths of Travel

Figure 46: Bus Stop Layout with an ADA-Compliant Accessible Path



Pedestrian paths of travel adjacent to the bus stop should be accessible to ensure that all passengers reach their destination comfortably and safely. Providing paths of travel to and from a stop that are unobstructed, firm, stable, slip resistant and wide is critical to facilitating holistic passenger access to the stop. Excessive cross-slopes, grades, and rough terrain are not allowed to accommodate passengers using wheelchairs, scooters or other mobility aids whose travel to and from the stop may be limited by decreased stability, slower speeds, reduced endurance or floor reach, and an inability to react quickly to dangerous situations. **Table 20** lists the ADA requirements and universal design guidelines that should be applied to the greatest extent possible along all paths of travel adjacent to bus stops. **Figure 46**

[36] (National Association of City Transportation Officials , 2016)

illustrates the components of an ADA-compliant accessible path of travel surrounding a bus stop site.

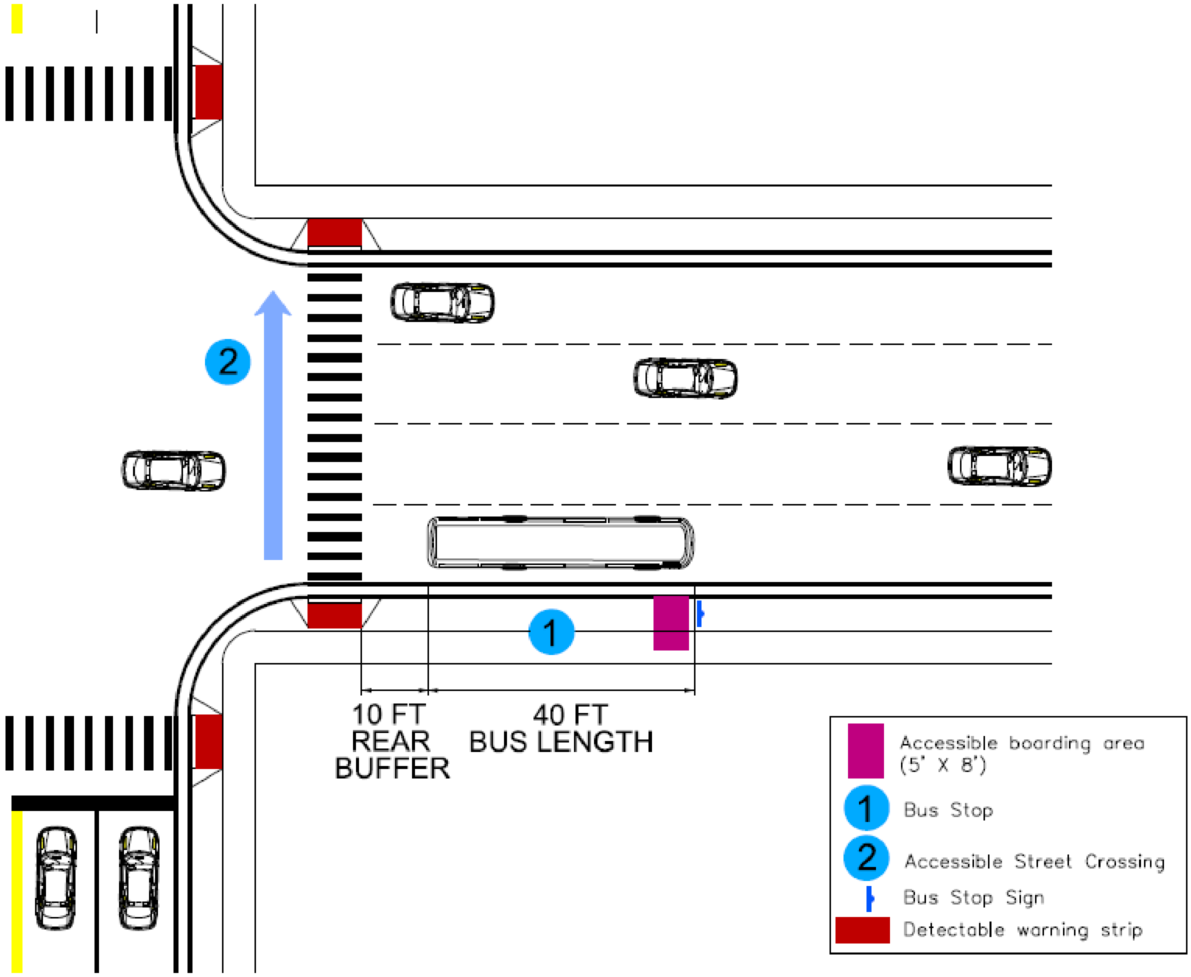
Table 20: Adjacent Paths of Travel Key Accessibility Considerations[37]

ADA Requirements	Universal Design Guidelines
• Stable, firm, and slip-resistant surface • Minimum clear passage width of 4 feet exclusive of curb, especially near curb drop-offs • Minimum of 80 inches of clear headroom, or provision of barrier for those with visual impairments if protruding objects prohibit this • Maximum cross slope of 1:48 • Maximum grade of 1:20 • No change in vertical elevation greater than ¼ inch, or greater than ½ inch if beveled on a slope greater than 1:20 • Openings in surface, like grates, cannot allow passage of a sphere greater than a ½-inch in diameter, and elongated openings should be perpendicular to the dominant direction of travel • Objects projecting from walls with leading edges 27 to 80 inches from path surface cannot protrude more than 4 inches into path • Objects mounted with their leading edges at or below 27 inches from path surface may protrude into path any amount • Free-standing objects mounted on posts or pylons can overhang a maximum of 12 inches from 27 to 80 inches above the path surface, including sign panels	• Should be widened to 5 feet or more to accommodate two-way travel and discourage passerby from traveling through bus stop passenger waiting area • Primary path of travel should be shortest travel distance between stop and adjacent destinations • Street furniture, signage and other amenities should be located outside the path of travel and path junction points, and in a manner which does not obstruct access to the function of the furniture, signage, or amenity • Include curb ramps at grade-level changes • Use different surface textures contrasting colors, tactile strips, curbs, audible cues, and/or infographics to help passengers of all abilities delineate paths of travel from bus stop landing pad • Cleared of snow, ice and other debris via regular maintenance

[37] (National Aging and Disability Transportation Center (NADTC), 2016)

Adjacent Street Crossings

Figure 47: Accessible Street Crossing at Intersection



Safe street crossings are necessary for all passengers to travel to and from bus stops. SMART does not have ownership or jurisdiction over street crossings, except within any Off-Street Transfer Centers operated by SMART, and is not responsible for the design, installation, or maintenance of accessible crossings. However, SMART may make recommendations to local, state, or federal units with ownership over a roadway who do have the responsibility to provide accessible street crossings. When all street crossings along a transit street are not accessible, passengers traveling to and from a bus stop may do so in a manner that places their safety at risk or decide not to use transit services provided along the street due to the difficulties getting to a stop. **Table 21** summarizes the ADA requirements and universal design guidelines pertaining to street crossings. **Figure 47** shows the components of an accessible street crossing at an intersection.

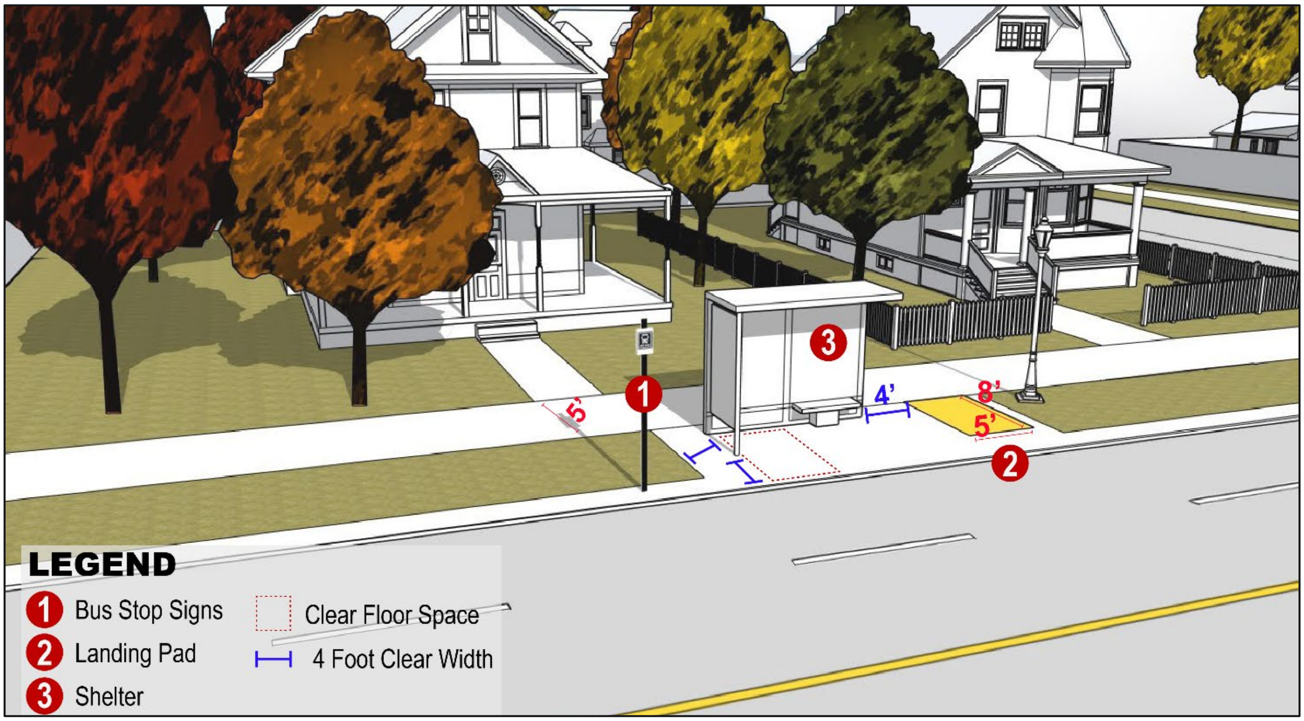
Table 21: Street Crossings Key Accessibility Considerations[38]

ADA Requirements	Universal Design Guidelines
• Must have curb ramps at least 3 feet in width with a maximum grade of 1:12, situated fully within the width of striped crosswalks • Detectable warning strips measuring at least two feet in length perpendicular to the curb must be installed on all curb ramps • Detectable warning strips must be installed at all transitions to and from the roadway, including at medians and transitions to and from protected bicycle facilities	• Curb ramps should be at least 4 feet in width • Detectable warning strips should be a contrasting color from surrounding surfaces • Pedestrian countdown signals should be incorporated at signalized crossings • Accessible pedestrian signals should be included at new signalized crossings so pedestrians are audibly informed of when it is safe to cross • Walk signals should not depend on whether pedestrians push an accessible pedestrian signal button • Appropriate street lighting should be present near any street crossings adjacent to bus stops to enhance passenger safety. See the sections on **Lighting** and **Natural Surveillance** for more information about lighting and bus stops.

38 (National Aging and Disability Transportation Center (NADTC), 2016)

Bus Stop Shelters

Figure 48: Accessible Bus Stop Shelter



Shelters protect bus patrons of all abilities from the elements as they wait to board the bus, providing a waiting area for passengers out of the public way. Shelters are only included at SMART stops that meet the criteria for them. At stops where shelters are included, shelters should be located in areas with good visibility and lighting for the safety of passengers using them. **Table 22** lists the ADA requirements and universal design guidelines pertinent to bus stop shelters. A bus stop shelter that is placed in the bus stop zone in adherence with ADA requirements is shown in **Figure 48**.

Table 22: Bus Stop Shelters Key Accessibility Considerations

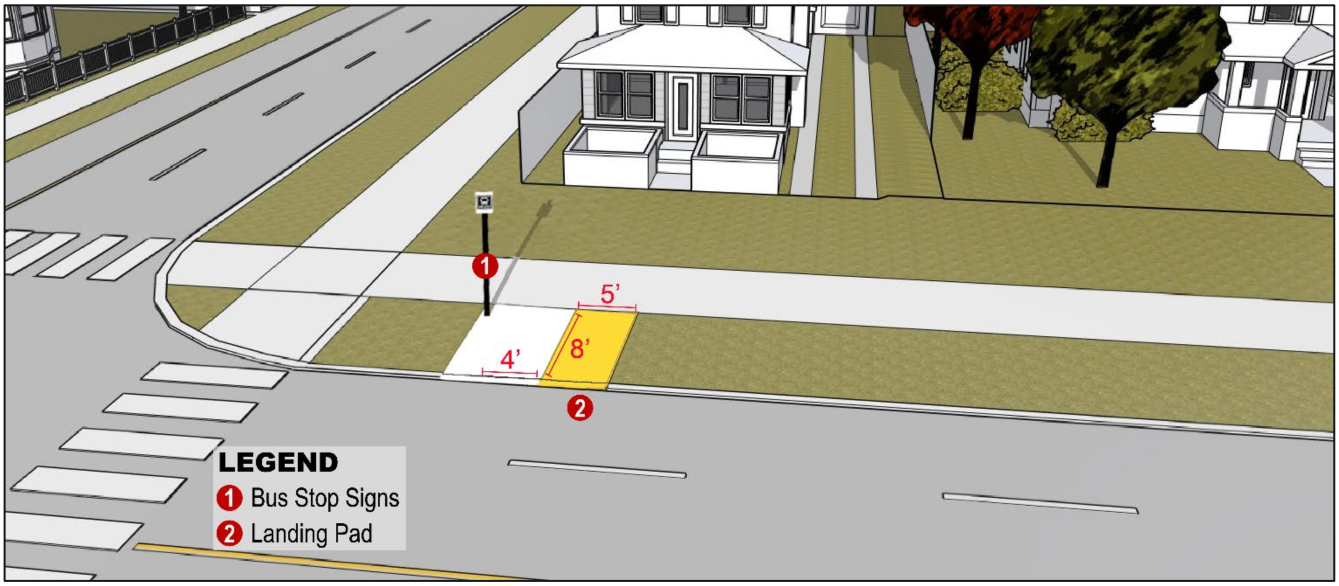
ADA Requirements	Universal Design Guidelines[39]
• Clear floor space of 30 inches by 48 inches* • Clear floor area must not impede use of bench if included in shelter • Cannot obstruct the bus stop landing pad or clear width and maneuvering requirements around bus stop landing pad • Minimum clearance of 4 feet must be maintained around the shelter and adjacent connecting sidewalk • Minimum turning space of 5 feet must be provided at all turning points. • Must be connected to bus stop landing pad by an accessible path	• Visible to approaching buses and passing traffic • Located as close as possible to bus stop landing pad • Minimum distance of two feet between back-face of curb and roof or panels of shelter to permit clear passage of bus and side mirrors • Minimum clearance of a foot between shelter and adjacent buildings to permit waste removal and shelter cleaning • Shelter opening should be a minimum of 3 feet wide to allow passengers using wheelchairs, scooters, or other mobility aids to enter • Mark transparent shelter panels with distinctive patterns to indicate presence of panels • Provide seating if feasible • Provide surfaces to lean against if seating is not feasible • Steps and other changes in elevation between the shelter and bus stop landing pad must be omitted

This is a function of the number of wheelchair users expected at a particular stop relative to ridership data. For each additional wheelchair user expected, another 30' x 48' of clear floor space should be added to the shelter.

[39] (National Aging and Disability Transportation Center (NADTC), 2016)

Bus Stop Landing Pads

Figure 49: Accessible Bus Stop Landing Pad



As the main and most heavily used component of the passenger waiting area, bus stop landing pads should be clear of all mobility obstructions so that all passengers are able to safely board, alight, and wait for the bus. The landing pad should be firm, stable, and level so that passengers using wheelchairs, scooters or other mobility aids that require bus lift and ramp deployment do not encounter difficulties boarding or alighting the bus. It should be connected to accessible paths to allow passengers using wheelchairs, scooters or other mobility aids enough space to maneuver when boarding or alighting the bus. Enhancing this connectivity between the bus stop landing pad and surrounding land uses requires coordination with local units and any adjacent businesses. This coordination should occur during the planning and design phase of siting new or updating existing stops, so that they are placed in a manner that connects the landing pad to accessible paths. **Table 23** lists the ADA requirements and universal design guidelines for bus stop landing pads. **Figure 49** shows the dimensions of an accessible bus stop landing pad.

Table 23: Bus Stop Landing Pad Key Accessibility Considerations[40]

ADA Requirements	Universal Design Guidelines
• Firm, stable, and slip-resistant surface • Minimum clear length of 5 feet, minimum clear width of 8 feet, measured perpendicular from curb or vehicle roadway edge and parallel to vehicle roadway respectively • Maximum cross slope of 1:48 on boarding and alighting area perpendicular to the roadway • Slope parallel to roadway must be the same as roadway slope to accommodate bus lift and ramp alignment • Landing pad must be connected to accessible paths of travel, via the street, sidewalk, or pedestrian path adjacent to the bus stop	• Landing pad and front and rear door zones should be clear of all obstacles, including trees, newspaper boxes, waste and recycling receptacles • Street furniture, like benches or bus stop shelters, should maintain a clear width of 4 feet and clear headroom of 7 feet from the pedestrian path to the stop • Sidewalk, street, or pedestrian path adjacent to landing pad should be wide enough for two people using wheelchairs to pass each other traveling in opposite directions, or 5 feet wide

[40] (National Aging and Disability Transportation Center (NADTC), 2016)

Bus Stops without Sidewalk Access

Figure 50: Accessible Bus Stop without Sidewalk Access

While SMART prefers not to place bus stops where there is no connecting sidewalk infrastructure, some areas with bus service may not have curbs or sidewalks providing access to bus stops. In these cases, passengers traveling to and from the stop must walk on the shoulder of the road, which is often comprised of gravel, dirt, or other types of loose material. Roadways in rural or suburban areas often do not have curbs to allow water to flow into open ditches on the side of the road. Without alteration, these elements make boarding, alighting, and traveling to and from a bus stop difficult, especially for passengers using wheelchairs, scooters or other mobility aids. Installing an ADA-compliant five-foot by eight-foot concrete or asphalt pad abutting the shoulder of the road, including detectable warning surfaces where the pad meets the road shoulder, as shown in **Figure 50**, helps make transit more accessible in areas without sidewalks. If the pad is elevated, it should include curb cuts at either end in addition to detectable warning strips parallel to the roadway where passengers board and alight the bus. Curb cuts should be a minimum of three feet wide with a maximum floor slope of 1:12 that does not cross the curb, meaning the curb cut should be perpendicular to the curb. They should also be flush at the top and bottom of their slope and their surface should be joint-free, slip-resistant and free-draining in all weather conditions. Like detectable warning strips, their color and or texture should contrast the surrounding surfaces.

6.2 Bus Stop Amenities

Well-equipped bus stops improve passenger experience and can result in increased ridership. Amenities are intended to improve passenger comfort and provide passengers a sense of safety and security during their transit trip.

Table 24: Amenities Provided by SMART

Funded, Installed, and Maintained	NOT Funded, Installed, or Maintained
Signage	Lighting
Shelters	Heating or Cooling
Benches	Emergency Response Phones (Blue Light)
Trash Cans	Bicycle Parking
Wayfinding Information	Landscaping
Real-Time Information Displays	

Signage

Uniform bus stop signs marking where passengers should wait to board and alight the bus should be placed at every bus stop throughout SMART's network. Though passengers have more access to transit information online than ever before, they and bus operators rely on bus stop signs to be certain of where exactly transit access points are.

At minimum, bus stop signs should include the SMART logo and stop ID. The following are also useful to include on bus stop signs:

- *Route Identifier*
  The number, color, or other identifier of route(s) serving the stop.
- *Route Destination*
  The direction of travel of route(s) serving the stop, including their endpoint.
- *Route Frequency*
  The headway or frequency of the route, noting if service is only available during certain periods of the day or week.
- *Route Span*
  The route's span of service, or the hours during which route service is operational.

Information boxes, or wayfinding information often attached to bus stop sign poles, may include important route information. The headway or frequency of the route, noting if service is only available during certain periods of the day or week. **Figure 51** includes an example from SMART's bus network of bus stop signage with an Information Box.

Figure 51: Properly Mounted SMART Bus Stop Signs in Ferndale

Woodward Avenue & West Marshall Street in Ferndale, MI

E 9 Mile Road between Leland Street & Bermuda Street in Ferndale, MI

To ensure bus stop signage is visible to all passengers, bus operators, and other street users, bus stop sign placement should adhere to the following guidelines:

- Bus stop signs should not be mounted on existing signage or other infrastructure belonging to entities other than SMART, e.g. speed limit signposts or streetlight posts like the bus stop signs show in **Figure 52**. SMART bus stop signs should be mounted on their own signpost, like those shown in **Figure 51**.
- All bus stop signs should be mounted at least 8 feet above the ground. In areas with parking or higher volumes of pedestrian movements that may obstruct view of the sign, the nearest edge of the sign should be at least 2 feet away from the curb or roadway edge.
- In rural areas, if there is a roadway shoulder 6 feet or wider, the nearest edge of the sign to the street should be at least 2 feet away from the shoulder edge. If there is no shoulder, the nearest edge of the sign to the street should be at least 6 feet away from the roadway edge.[41]
- Bus stop signs should be mounted at angles perpendicular to the street.
- Bus stop signs should not block or be blocked by other signage.

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[41] (Michigan Department of Transportation, 2022)

- Landscaping features or other objects within the streetscape should not block bus stop signs.
- Where bus stops SMART serves are served by other transit providers who own the stop, SMART bus stop signs should still be installed.

Figure 52: Incorrectly Mounted SMART Bus Stop Signs in Ferndale and Berkley

East 9 Mile Road at Ferndale Police Department in Ferndale, MI

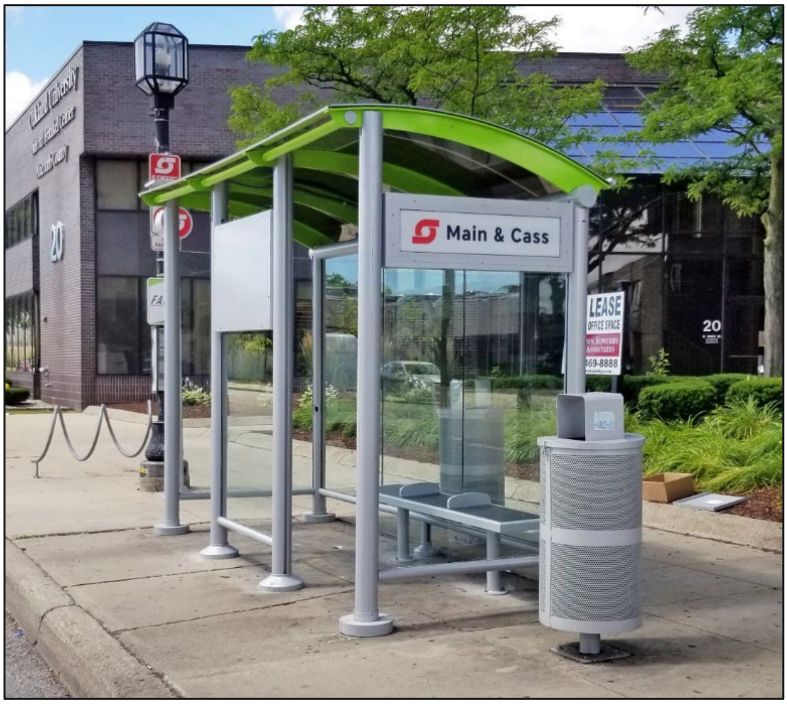
Coolidge Highway and Sunnyknoll Avenue in Berkley, MI

All bus stop signage must comply with SMART graphics standards—contact the SMART Marketing Department at marcomm@smartbus.org for more information.

Shelters

Shelters provide passengers with comfort and protection from the elements while waiting for a bus. In Michigan, shelters help moderate these more unpleasant aspects of southeastern Michigan's climate waiting passengers experience high temperatures and humidity in the summer, snow in the winter, and regular rain throughout the year. Similarly to signage, shelters are also helpful in identifying a stop. An example of a SMART bus stop shelter is shown in **Figure 53**.

Figure 53: SMART Bus Stop Shelter in Mt. Clemens



Shelter at South Main Street & Cass Avenue
in Mt. Clemens, MI

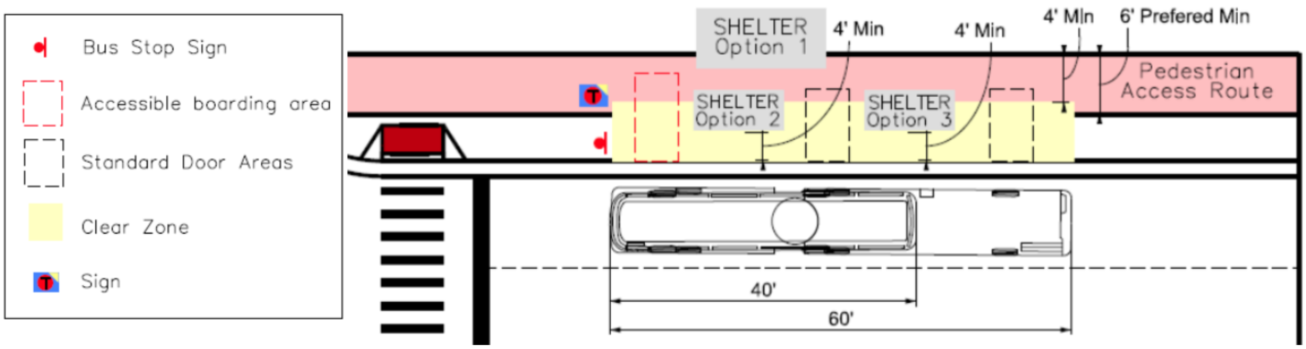
SMART provides shelters at key locations within the SMART bus network, aiming to improve the most passenger transit trips. Shelter locations are chosen using an amenity need scoring system described in **Table 30** of **Chapter 10 Design Criteria Scoring Sheets**.

Once a shelter location is chosen using the SMART amenity need scoring system, the following guidelines apply to shelter placement:

- Shelters should not block the stop's boarding and alighting area, bus door zones, or information posted at the stop.
- A minimum 4-foot-wide clear path of travel to the shelter must be maintained. A 5-foot-wide clear path of travel to the shelter is preferred.
- Shelters must have a clear floor area of 30 inches by 48 inches minimum to accommodate passengers using wheelchairs, scooters, and other mobility aids. Access or foot space for other passengers shall not impede this clear floor space.
- System maps should be posted at all on and off-street transfer centers. Information boxes, discussed in **Section 6.3 Bus Stop Information and Technologies,** are recommended at all transfer points and frequent network stops, in addition to stops that may serve visiting or occasional passengers who may be less familiar with the SMART network.

Figure 54 illustrates recommended shelter placements within the bus stop zone. Within the bus stop zone, the 'clear zone' is defined as an accessible, traversable area in which obstructions may not be placed, so that access to stop amenities and accessible paths of travel around the stop are maintained.

Figure 54: Possible Shelter Placements within Bus Stop Zone



SMART installs aluminum shelters which all have four sides with a front-centered windscreen including two ADA compliant openings three feet wide.

Table 25 provides the dimensions and minimum site envelope for the shelter SMART installs at its bus stops.

Table 25: Standard SMART Shelter

Dimensions (LxWxH)*	Minimum Site Envelope (LxW)*
12' 2" x 5' x 8'	17'2" x 13'

**L = length, W = width, H = height*

SMART is committed to maintaining all shelters under its ownership, regularly sending out its maintenance crew to clean shelters. Volunteers wishing to partner with SMART to help maintain a bus stop can do so through SMART's Adopt-A-Stop program. Members of the public may report damaged shelters to SMART by emailing innovations@smartbus.org.

Benches

Places for passengers to sit while they wait for transit makes trips much more comfortable and accessible, as some passengers may experience difficulty standing while they wait. SMART provides benches at key locations within the SMART bus network, aiming to improve the most passenger transit trips. Which bus stops will include a bench is determined using an amenity need scoring system described by **Table 30** of **Chapter 10 Design Criteria Scoring Sheets**. SMART encourages local units to install benches at bus stops that do not meet SMART's amenity need scoring criteria for a bench, especially stops that have longer headways in between bus arrivals and stops frequently used by older adults, persons with disabilities, and children.

Bench placement at bus stops should adhere to the following guidelines:

- Benches must be at least 72 inches long and 25 inches wide, with the seat 18 inches above the ground. [42]
- Benches should not block accessible paths of travel to the stop, stop boarding and alighting areas, bus door zones, shelters, or information posted at the stop.
- Materials used to construct benches should not become excessively hot in direct sunlight or cold in freezing temperatures and should shed water easily.
- Benches should be mounted or otherwise secured to the sidewalk, or heavy enough that they cannot be moved without equipment.
- Where benches are provided, clear areas at least 30 by 48 inches should also be provided for wheeled passengers.

Figure 55: Bench provided at SMART Bus Stop

Bench at East 9 Mile Road & Woodward Avenue in Ferndale, MI

Lighting

Many passengers wait for the bus at dawn, dusk, or after dark when there is little to no natural light, especially during the winter months. Providing adequate lighting at bus stops is important for passenger comfort, safety and security. When adequate lighting is provided at a stop, passengers waiting at bus stops are more visible to transit vehicle operators and other vehicle operators. Passengers are also able to observe other waiting passengers and pedestrians passing by the stop. Stops can be adequately lit by placement under overhead

[42] (National Association of City Transportation Officials (NACTO) , 2016)

streetlights, interior lighting and back-lit advertising panels in shelters, or lighting mounted on bus stop sign poles. Except when installed within the interior of SMART bus stop shelters, lighting is not funded, installed or maintained by SMART.

To provide adequate bus stop lighting, the following guidelines should be considered:

- Interior bus stop lighting should provide between 2 to 5 candles of light at night and should not adversely affect surrounding land uses.
- Stops should be placed beneath or near pedestrian-scale streetlights, or streetlights that are a maximum of 25 feet tall.
- Where pedestrian-scale streetlights are not present but “cobra” streetlights overhanging the roadway are, stops should be placed beneath or near “cobra” streetlights.

Heating or Cooling

At stops where shelters are included, passenger heating and cooling needs should be considered. SMART operates in a climate that experiences hot, humid summers and windy, cold winters—shelter design should accommodate these environmental extremes. Shelter cooling can be accomplished by providing opaque instead of transparent roofs for shade and sun protection, in addition to leaving gaps between shelter panels and the ground for air circulation. In Michigan, heating needs are often more prominent than cooling needs. Though a uniform gap between the ground and shelter panels reduces wind protection to some degree, using panels made of a non-porous material in addition to installing heaters at stops with shelters minimizes passenger discomfort on cold and or windy days.

Emergency Response Phone (Blue Light)

Emergency response phone are communications devices that allow users to call emergency services by simply pressing a button. They are integrated into a pylon that is mounted on the sidewalk or some other accessible location. Emergency response phones greatly increase passenger safety, especially in areas with little pedestrian activity and or high crime rates. While SMART is not responsible for the installation or maintenance of emergency response phones at its bus stops, choosing to include them at stops in areas where emergency call boxes are particularly beneficial often has positive effects on transit ridership.

Electrical power and telecommunications connections are needed to install an emergency response phones at a particular location. Depending on the location, these are provided by utility conduits or solar power and cellular voice connection. A bright blue light should be included on top of the pylon housing the emergency call box so that it is easily identifiable, even from a distance.

Figure 56 shows an example of an emergency response phone at a SMART bus stop located at Woodward Avenue and 9 Mile Road in Ferndale, Michigan.

Figure 56: Emergency Response Phone at SMART Bus Stop

Emergency response phone at Woodward Ave & West 9 Mile Road in Ferndale, MI

Bicycle Parking
Providing bicycle parking near bus stops enables bus passengers to easily travel non-transit segments of their trips by bicycle. When bicycle parking is provided, passengers are deterred from locking bicycles to trees, sign poles, parking meters, or benches and obstructing use of those objects or paths of travel.

At most bus stops, one "post-and-ring" or "inverted U" bicycle rack will meet bicycle parking needs. Association of Pedestrian and Bicycle Professionals (APBP) guidelines state that "inverted U" bicycle racks are preferred, as they support bicycle frames at two points.[43] At stops with high passenger volumes like transfer centers or network hub stops, bike lockers or cages can help further confine bicycles to one area, reducing visual clutter and security risks while maintaining clear paths of travel.

Bicycle parking adjacent to bus stops should follow these guidelines:

- Bicycle racks should only be installed on sidewalks that are at least 8 feet wide.
- Bicycle racks should be placed away from the bus stop curb clear zone, paths of travel to the bus stop, and areas with lots of pedestrian activity. Racks should be placed so that no matter how bicycles are locked to them, they do not obstruct paths of travel.

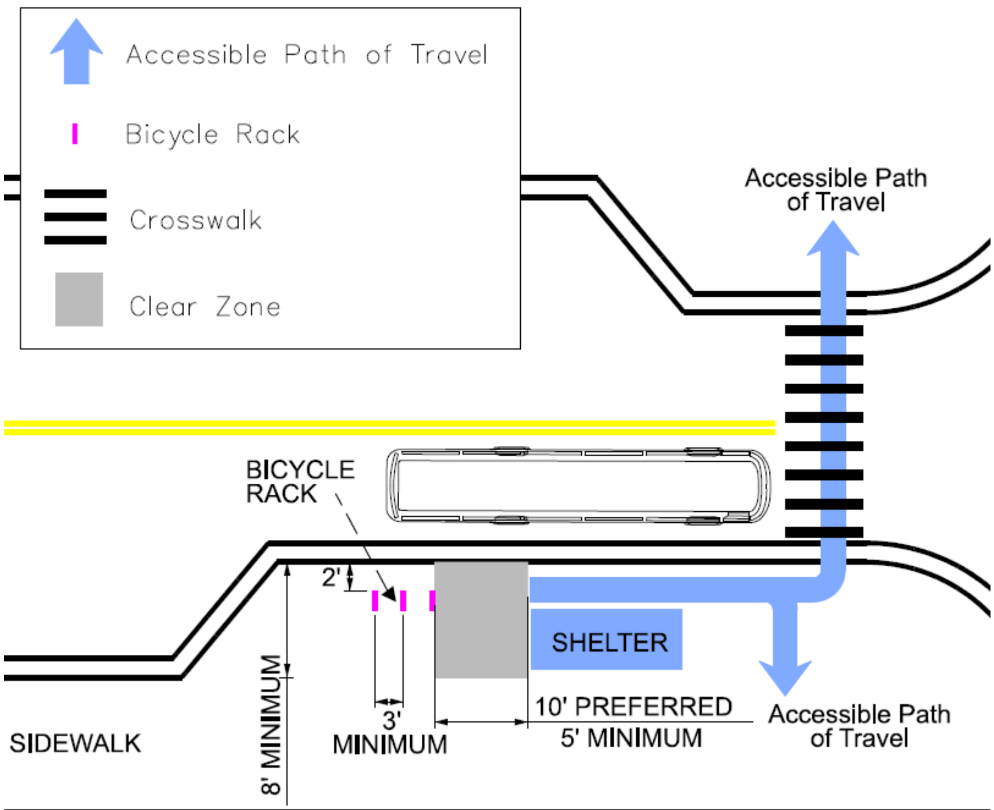
[43] (Broom, et al., 2015)

Figure 57 illustrates where bicycle racks should be placed relative to other bus stop elements.

- Multiple bicycle racks are installed in a row should be at least 3 feet apart.
- Where multiple rows of bicycle racks are installed in a row, the rows of racks should be at least 4 feet apart.

SMART does not install or maintain bicycle parking except when provided at Off-Street Transfer Centers owned and operated by SMART. However, SMART encourages local units and other organizations to install bicycle parking facilities near SMART bus stops.

Figure 57: Bicycle Rack Placement within Bus Stop Zone



Landscaping

Including landscaping features at bus stops enhances their aesthetic appeal to passengers and can provide a more pleasant passenger waiting area experience. Landscaping features like planters, bushes, or uneven grass surfaces should not be positioned in a manner that obstructs safe access to any part of the bus stop or bus stop zone.

Landscaping features adjacent to bus stops should follow these guidelines:

- Landscaping features should not obstruct visibility of bus stop signage, if present.

- Planters should not be placed within the bus stop zone itself, but directly adjacent to it, to avoid obstructing bus boarding and alighting areas.
- Trees that extend into the roadway below 12 feet should be trimmed back so that they do not extend beyond the curb.
- All tree branches above paths of travel should be at least 80 inches above the path surface to maintain safe access to the bus stop.
- Tree grates within the bus stop zone are discouraged, as they can become uneven surfaces over time. Tree routes growth over time can heave tree grates and obstruct paths of travel.

6.3 Bus Stop Information and Technologies

Including landscaping features at bus stops enhances their aesthetic appeal to passengers and can provide a more pleasant passenger waiting area experience. Landscaping features like planters, bushes, or uneven grass surfaces should not be positioned in a manner that obstructs safe access to any part of the bus stop or bus stop zone.

Real-Time Information Displays

Real-time information displays make bus arrival information immediately available to passengers waiting at a bus stop. Ranging from simple one-line, one-color LED text displays or large LCD screens, real-time information displays decrease perceived wait times, increasing satisfaction with trip times. They are also incredibly useful for passengers without mobile devices, enabling these passengers to access real-time arrival information. **Figure 58** shows an example of a real-time information display provided by SMART. Real-time information displays are included at stops with higher passenger volumes.

Guidelines for real-time information displays are similar to those for bus stop signage:

- → Site and mount display so it does not interfere with pedestrian traffic. Displays should not be mounted on existing signage or other infrastructure belonging to entities other than SMART, e.g. speed limit signposts or streetlight posts.
- → Information presented on the display should be succinct: the route name and/or number, route endpoints, and the number of minutes until the bus serving the route arrives.
- → Audible announcements should accompany information presented on the display for passengers with visual impairments. Audible announcements are preferred over tactile signs for passengers with visual impairments, as tactile signs require that the reader knows where the sign is and can locate it.
- → Commercial content should not be broadcast over displays.

Figure 58: Real-Time Information Display at SMART Bus Stop

Real time information display at Fairlane Transit Center in Dearborn, MI

Intelligent Transportation Systems (ITS)

The use of emerging transit technologies can play a critical role in helping agencies achieve their missions, enable more effective service, and provide an enhanced user experience. The following technologies should be considered based on observed bus stop needs:

→ Digital signing for general messaging, system notifications, real-time arrival status, and/or advertisements
→ Interactive kiosks for access to trip planning tools
→ Wi-Fi connectivity for user convenience
→ Off-vehicle fare collection for increased efficiency
→ Charging stations with plug-in and USB ports for riders to charge devices
→ Intelligent lighting for efficiency and security
→ Wireless cameras for bus station monitoring and security
→ Emergency call box for security
→ Active warning system for notification when bus is arriving and/or riders in a non-permitted area

Wayfinding Signage

Signage including maps and bus network information are important to include at stops to help customers way-find while traveling using transit, especially at stops served by more than one route or stops with higher passenger volumes. Uniformity in wayfinding signage layouts throughout SMART's network is critical. Wayfinding signage can be provided as an addition to the bus stop sign or shelter, or as a stand-alone sign at stops and transfer centers. Wayfinding signage should not be mounted on existing signage or other infrastructure belonging to entities other than SMART, e.g. speed limit signposts or streetlight posts. **Figure 59** shows an information box and stand-alone wayfinding sign in SMART's network.

Wayfinding information is often attached to SMART signposts in the form of information boxes, which usually include important transit service information. Information boxes should be mounted to the same post or pole as the bus stop sign, and their design and layout should be consistent with SMART's other printed materials. The bottom of the information box should be more than 27 inches above the ground and should not stick out from its support more than 4 inches from any side for passenger accessibility.

Figure 59: Examples of SMART Information Box and Stand-alone Wayfinding Sign

Information box at Woodward Avenue & Marshall Street in Ferndale, MI

Stand-alone wayfinding sign at Royal Oak Transit Center, on-street transfer center in Royal Oak, MI

Wi-Fi

As reliance on internet connectivity for daily tasks and activities increases, public Wi-Fi provision at bus stops is more and more common.[44] Electrical power, a router, and an LTE antenna are needed to provide Wi-Fi at bus stops. Wi-Fi is usually provided at stops with shelters, as the infrastructure needed for Wi-Fi provision can be easily integrated into shelter design. SMART bus stop shelters are equipped with solar panels and a connected battery enclosure from which electrical power can be sourced. Routers should be installed in an enclosed and weather-protected location within the shelter. LTE antennas should be installed on shelter roofs, or as close to the roof as possible.[45] Additional on-board Wi-Fi is available on SMART's limited-stop routes.

6.4 Fare Collection Considerations

There are several different options for passenger fares, including:

- Cash paid directly to the driver upon boarding.
- Printed Tickets or Passes purchased from a ticket vending machine (TVM), also known as a fare machine. Fare machines can be located on or off-board the bus. Tickets or passes are shown to the driver on-board the bus or scanned by a reader on or off-board the bus.
- Radio frequency ID (RFID) Cards purchased from a fare machine or alternate location authorized to sell RFID cards for a transit service. Credit or debit cards can sometimes be used in the same manner as RFID cards to pay fares. Cards are scanned by a reader located on or off-board the bus.
- Mobile App used to add fare credit to a digital ticket or pass. The digital ticket or pass is either shown to the driver on-board the bus or scanned by a reader that may be on or off-board the bus.

Fare collection varies based on fare media and whether fares are collected on or off-board the bus.

If fares are collected on-board the bus:

→ Passengers may either pay the driver cash, scan fare media, or show the driver their fare media. In systems where printed tickets or passes and RFID transit, credit, or debit cards are used, fare machines are needed at multiple stops along a bus route.

→ In systems where fare media are scanned on-board the bus, scanners can be placed at the front or multiple doors of the bus.

If fares are collected off-board the bus:

→ Passengers will need to scan fare media prior to boarding to the bus. In systems where printed tickets or passes and RFID transit, credit, or debit cards are used, fare machines are needed at multiple stops along a bus route.

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[44] (Schrenk, Benedikt, Egger, Eizinger, & Farkas, 2010)

[45] (Social Wifi, 2024)

→ In systems where fare media are scanned off-board the bus, scanners are placed at each stop.

Generally, the following fare collection considerations are relevant for bus stop design:

- In systems where fare media must be shown to the driver, stops with high passenger boarding volumes should have space for queuing boarding passengers within the bus stop zone. Bus stop amenities should not be placed in a manner that does not leave space for boarding passenger queues.
- In systems where fare media can be purchased from fare machines, fare machines should be placed in close proximity to bus boarding areas. Instructional signage for the fare machines should also be provided. Fare machines should not block accessible paths and boarding areas, door zones, amenities, or posted information at the bus stop.
- In systems where fare media are scanned on-board, placing scanners at multiple doors of the bus speeds up passenger boarding, reducing total trip times and congestion within bus stops' passenger waiting area.
- In systems where fare media are scanned off-board, bus stop maintenance costs may be higher. Though off-board scanners speed up passenger boarding, they add maintenance needs that can incur additional costs at each stop.

6.5 Advertising

SMART reserves the right to contract with companies to provide advertisements within SMART bus stops and transit vehicles. Any outdoor advertising signs must adhere to all applicable local zoning regulations. If the bus stop that advertising is proposed for is on a state-owned roadway, advertising signs must additionally adhere to MDOT's advertising standards. Further guidelines for advertising on SMART property may be issued through SMART's procurement processes and any contracts it has with advertising companies. Parties interested in advertising on SMART facilities or vehicles should visit SMART's Business: Advertise webpage or contact SMART's Marketing Department for more information.

6.6 Power Needs and Locations

All SMART bus shelters can be equipped with solar power panels. Solar power will be the main power source unless standard power is already present at new sites. These panels will be big enough to provide power to provide light, USB ports, accent lighting, backlit signs and digital messaging signs.

6.7 Waste Management

Apart from waste receptacles at Off-Street Transfer Centers and On-Street Transfer Centers owned and operated by SMART, waste receptacles at bus stops within SMART's network are installed and maintained by local units or non-governmental organizations with jurisdiction over or approval to operate within the ROW in which the bus stop is in. **Table 26** summarizes requirements and guidance related to waste receptacles adjacent to SMART bus stops.

Table 26: Requirements and Guidance for Waste Receptacles Adjacent to Bus Stops

Requirements	Guidance
• Must not block accessible paths and boarding areas, door zones, amenities, or posted information at the bus stop	• Placed at least 3 feet away from benches or shelters • If possible, placed in shaded areas to avoid sustained direct sunlight exacerbating foul odors • Secured to sidewalk to prevent tipping or unauthorized movement • Receptacle design should prevent liquids from pooling near the receptacle and attracting insects • Emptied at regular intervals by owning authority to prevent overflow from filling above capacity in addition to foul odors within passenger waiting area at bus stop • Must be approved by local unit with jurisdiction over ROW if installation adjacent to bus stop is proposed by a non-governmental organization like a Downtown Development Authority

6.8 Maintenance and Cleaning

Maintaining bus stops is a crucial area that is a positive to the image of the transit system. Full trash cans and damaged street furniture need to be taken care of immediately for an overall positive impression to the riders of the transit system. Any street furniture or miscellaneous items that pose a threat to public safety need to be taken care of right away.

- **Winter** – Snow and ice removal need to be taken care of in a timely manner so the riders have a safe path to the bus stop and clean path to the bus doors.
- **Summer** – All street furniture and shelters should be clean and kept in presentable condition so the transit riders will use them as intended.

7 OFF-STREET BUS STOP FACILITIES

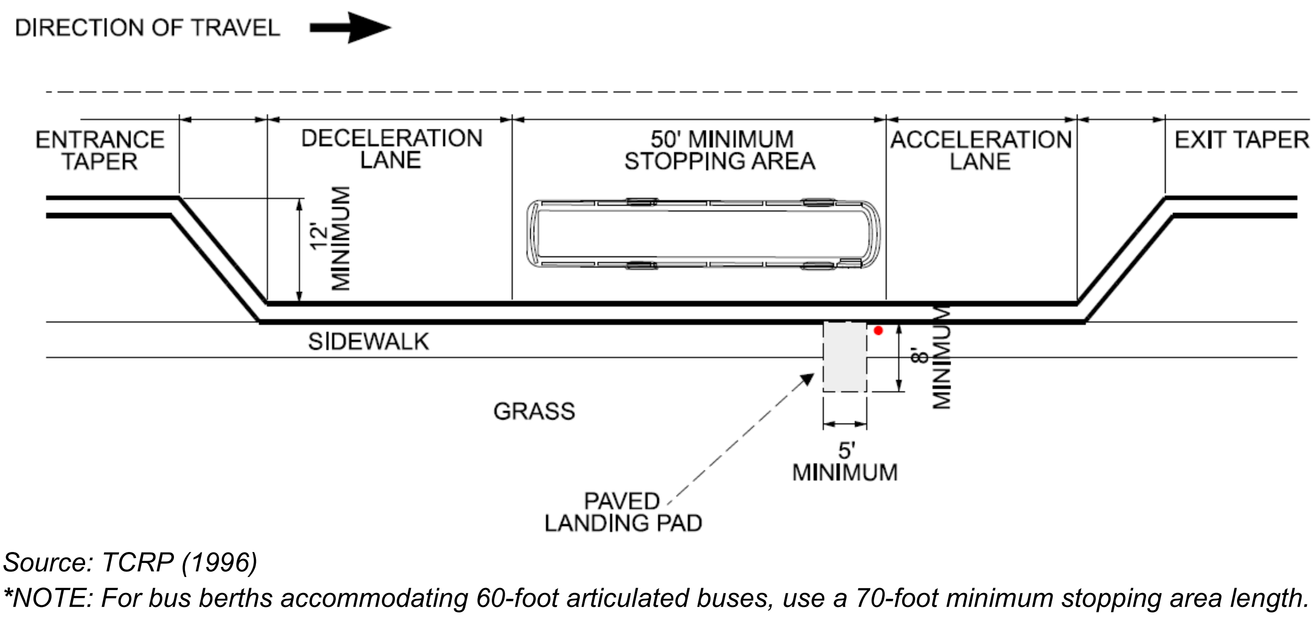
Bus stop facilities have benefits and best use cases to implement off-street bus stop design. Traffic congestion and safety are key factors that can contribute to an agency's choice of designing an off-street bus stop facility. Removing the bus from the ROW of traffic helps achieve better traffic flow and safer facility conditions. Disadvantages can be attributed to the cost of construction and the available space that is required to add to a location, as well as the repetitive maintenance if the facility and third-party involvement with landownership agreements. In this section we will discuss bus berths, turnarounds, and Park and Ride facilities.

7.1 Bus Berths

Bus berths are zoned areas for buses to wait in during periods of non-service. Berths help riders distinguish between buses that are currently in operation and buses that are not in service. Benefits of bus berths include decreasing congestion, especially at transfer centers, and establishing better logistic systems for bus's status at stop facilities. Disadvantages include additional cost with construction and maintenance of the additional assets.

Figure 60 illustrates the design of a typical bus berth and **Figure 61** shows an example of bus berths from SMART's transit network. **Table 27** provides the appropriate length of the acceleration lane, deceleration lane, and taper relative to the through speed of the roadway the bus berth is situated on and the bus's berth entering speed. Note that entry tapers should have a minimum slope of 5:1 and exit tapers should not exceed slopes of 3:1.

Figure 60: Bus Berth Design for 40-foot Buses[46]*



Source: TCRP (1996)

NOTE: For bus berths accommodating 60-foot articulated buses, use a 70-foot minimum stopping area length.

[46] (Transportation Reasearch Board National Research Council, 1996)

Table 27: Bus Berth Recommended Deceleration, Acceleration, and Taper Lengths[47]

Through Speed (MPH)	**Entering Speed*** (MPH)	**Deceleration Lane Length**** (Feet)	**Acceleration Lane Length** (Feet)	**Taper Length** (Feet)
35	25	184	250	170
40	30	265	400	190
45	35	360	700	210
50	40	470	975	230
55	45	595	1400	250
60	50	735	1900	270

Source: TCRP (1996)
*****Bus speed at the end of the entry taper. Buses should be within 10 MPH of travel lane speed at this point.*
******Based on a 2.5 MPH/s deceleration rate.*

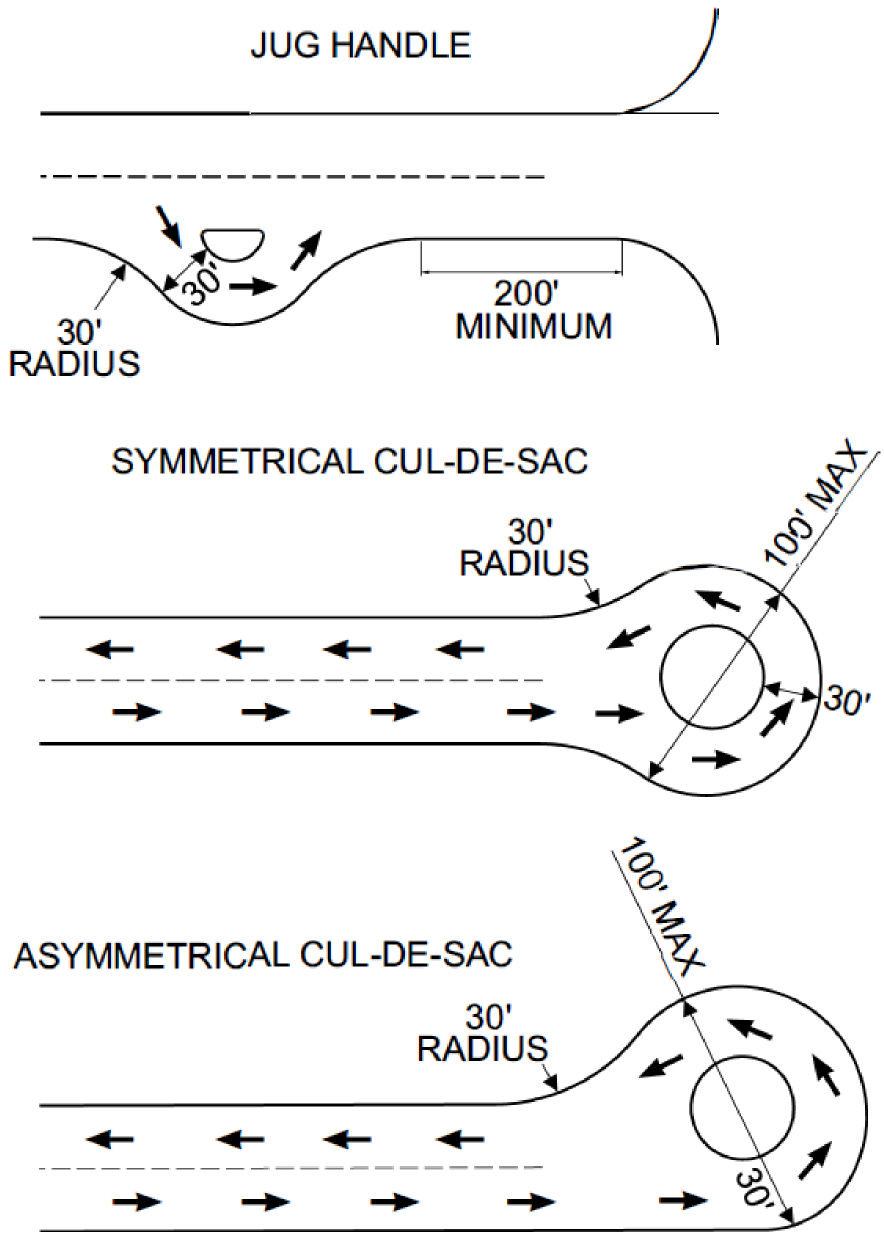
Figure 61: SMART Bus Berth at Fairlane Town Center in Dearborn

[47] (Transportation Reasearch Board National Research Council, 1996)

7.2 Bus Turnarounds

Bus turnarounds are zoned areas for buses to shift their direction along routes. Since these particular areas are off-street they are dedicated to bus infrastructure. They establish the advantage of enabling a faster and safer method for buses to U-turn on routes instead of using on-street roadway design that also includes mixed-traffic. Disadvantages for turnarounds are the land allocation and or landownership agreements that are needed, as well as the cost with construction and maintenance of the property. **Figure 62** shows three different common designs for bus turnarounds.

Figure 62: Jug Handle, Symmetrical and Asymmetrical Cul-de-sac Bus Turnarounds



7.3 Park and Ride Facilities

Park and Ride facilities are zoned areas for private transportation parking with bus stop infrastructure present. These locations are generally popular with commuting trips. SMART uses pre-existing parking lots for these centers. Many of these Park and Ride facilities have bus stop amenities present, like bus shelters, seating, bicycle racks, or enhanced lighting.

Park and Ride lot pavement should be able to support the weight of a bus and may need to be reinforced to do so. See the **Pavement** section for more information about reinforcing pavement to support the load of a bus.

Figure 63 provides an example design of a Park and Ride facility and **Figure 64** shows an example Park and Ride from SMART's network.

Figure 63: Illustrative Design of a Park and Ride Facility

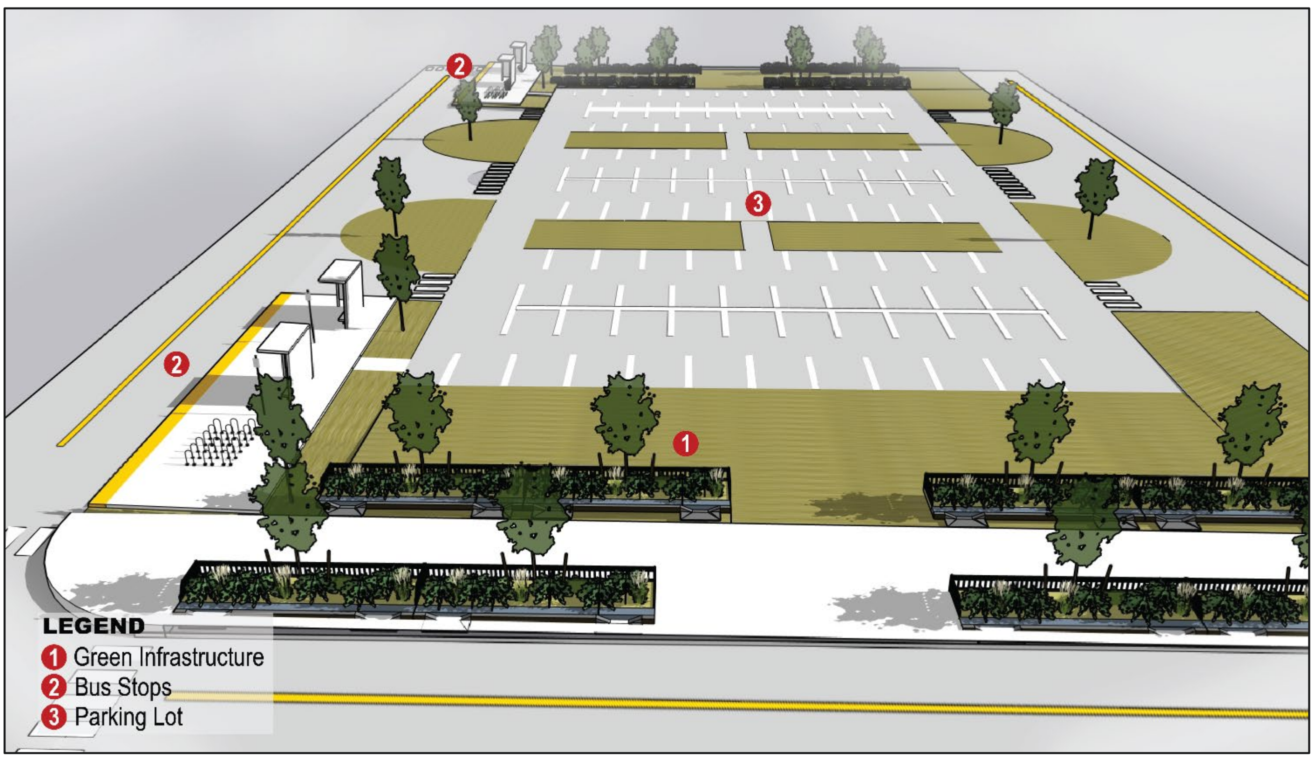


Figure 64: Example of SMART Park and Ride Facility

SMART Bus Stop at Oakland Community College Orchard Ridge Park and Ride

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8 INTEGRATED DESIGN

In this chapter additional design elements are detailed for consideration when applicable for SMART bus stops.

8.1 Design Flexibility

Creating functional design that also exhibits attributes to the built environment that the bus stop is located in is important for creating integrated design of bus stops throughout an agency's jurisdiction. This can involve using a downtown's uniquely designed benches for bus amenities at the bus stop as one example, and consulting with municipality planning departments or downtown development authorities on the type of streetscape preferences a community might have. The other major importance with design flexibility is that the general guidelines can't factor in every possibly scenario in the bus stop planning and design process. There are times when a unique change is required for a specific location.

Another factor that may require flexibility, is the size that a bus stop's ROW may be. Not all stop locations will have the required space for carrying out the full general design guidelines. There may be limitations on the road itself or the area that is available for a bus stop zone. A bus shelter may need to be made smaller or perhaps larger based on need and availability of space. As an example, one stop may have the request for additional ADA guideline practices for a bus stop to have more barrier free amenities. Another example of design flexibility is the use of implementing a transit boarding island between the road and an active transportation lane. This would help remove buses from the active transportation lane. For further coordination on unique requirements for a stop, contact SMART at innovations@smartbus.org.

8.2 Drainage

When adding a new bus stop, drainage should be considered to make sure it is adequate for increased impervious surfaces and the upgrades a bus stop brings. The accessible path and pedestrian crossings need adequate drainage so a pleasant and safe passage can be provided to all transit users. Designers should adhere to governing drainage design standards.

8.3 Green Infrastructure and Sustainability

When developing bus stop infrastructure green infrastructure and sustainability practices should be considered. Sustainability is important and a fundamental for agencies serving the community because it stives to achieve long-term prosperity and quality to the system and its' riders. It also helps mitigate long lasting climate change externalities that have and continue to become far more frequent in this century. Incorporating green infrastructure into a bus stop could look like installing tree pits or rain gardens close to the stop. **Figure 65** shows an example of green infrastructure design at a Park and Ride.

Figure 65: Example of Green Infrastructure at Park and Ride

Green infrastructure helps reuse rainwater and deaccelerate the heat island effect in cities by increasing the shade area. Designing bus stops with recycled material would be one example that is in sync with sustainability practices. A few other examples are:

- **Greenways**
  Greenways can buffer bus stop amenities. Active transportation like biking can be important to have bike racks incorporated on the bus stops. This helps promote active transportation as a viable option compared to auto transportation, by creating more biking infrastructure to the transportation network. This can help with lowering carbon emissions are well.
- **Bioswales**
  Bioswales are landscaped depressions that capture stormwater. These green stormwater systems help create a first pass of the filtration process in a city. This can help slow the runoff velocity especially during a storm event.
- **Solar Panels**
  Solar panels offer a way for a bus stop to get renewable energy to power their amenities that require electricity. These can be simple lighting fixtures or even a travel time dashboard that has current schedules for the stop as an example.

8.4 Resiliency

Staying resilient in bus stop design is a key priority. The ability for passengers to remain comfortable year-round at a high amenity bus stop is aligned with resiliency in bus stop design.

Bollards add additional protection to a bus stop. These are concrete pilons that orbit around a pedestrian zone of interest. They are frequently cited around urban plazas where high traffic intersections may be present. Having these strong concrete barriers adds an additional level of safety and resiliency to a bus stop especially if it is in a highly populated area.

Consistent maintenance practices lead to a resilient bus stop system. Maintaining a level of bus stop quality throughout the agency's jurisdiction establishes resiliency.

8.5 Aesthetics

Aesthetics come into focus when a bus stop location is in a unique environment that has an established character or in the case of an art installment maybe a historical significance. In some instances, this could be integrating a public art piece at a stop if the opportunity arises.

Communities can implement streetscape preferences to develop neighborhood unique distinctions. Transit agencies may get involved with creating unique aesthetics to complement these community preferences.

For this goal it is important to form consensus with the community and include community input as an artist is chosen to design the bus stop.

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9 SAFETY AND SECURITY

This section addresses passenger safety and security concerns that are present at bus stops and how to proactively address and mitigate these concerns through safety and security-informed design standard and/or stop amenities.

9.1 Collision Prevention

Transit agencies should use a holistic design approach to help prevent collisions at bus stops and promote the safety of transit users, pedestrians, bus operators and other transit employees, and other motorists and road users. Bus stops should incorporate intentional and practical design of vehicles, streets, and traffic flow to help mitigate bus collisions. Mitigation planning should include an in-depth analysis of bus stop placement, accessibility, visibility, and street design.

Beyond stop design and placement, SMART has a Public Transportation Agency Safety Plan (PTASP) that describes how SMART addresses and manages safety risks through management techniques, from internal policies, procedures and training for employees, to minimum process requirements for safety assurance and promotion activities. Proposed modifications to the design of bus stops should be subject to the review and evaluation by affected SMART operations and maintenance departments, from the bus operations staff who are highly familiar with affected routes and potential safety issues, to the facilities and vehicle maintenance staff who will be required to maintain and repair these assets and who may identify potential safety and security concerns.

Collision Mitigation (Between Vehicles and Pedestrians/Passengers)

Bus Stop Placement

Bus stop spacing must balance reasonable bus trip times and customer walk distances. Closely spaced stops mean shorter walking distances but more frequent stops and longer trip times. Longer stop spacing means less frequent stops and shorter travel times but longer walking distances. Bus routes have many opportunities to adjust stop spacing to serve customers better and reduce bus stop and service impacts on the community.

Bus stops are generally located at intersections on the near-side or far-side of an intersecting cross street. This maximizes pedestrian accessibility from both sides of the street and minimizes parking impacts. Under certain situations, bus stops may also be placed at a mid-block location. Bulb outs or curb extensions allow buses to stop in the travel lane. Buses are expected to pull out of traffic to the curb, but this practice de-prioritizes transit, especially on mixed-traffic streets. In-lane stops eliminate that delay. They also create shorter and safer pedestrian crossings, provide more walking space on the sidewalk, and make the street more predictable by sorting out bike-bus conflicts at stops. **Table 28** discusses the advantages and disadvantages of various bus stop placement treatments relative to collision prevention.

Table 28: Bus Stop Placement Treatments and Collision Prevention

	Advantages	Disadvantages
Curb-side	Is easy to relocate or adjust.	May cause traffic queues behind stopped bus, depending on lane configuration
	Least costly; doesn't require curb line adjustment	Sensitive to illegal parking obstructions
	Allows customers to board and alight out of the travel lane	May be harder for bus operators to re-enter traffic, especially during peak periods/busy roadways.
	Provides a protected area away from moving vehicles for both the stopped bus and the bus customers	Potentially reduces sidewalk width
	Encourages pedestrians to cross the street behind the bus	
Bus Bays or Turnouts	Minimizes delay to through traffic	Is more expensive to install and/or relocate
	Shorter stop reduces impact on parking	May result in bus obstructing the travel lane
	Decreases the walking distance (and time) for pedestrians crossing the street at crosswalk	
	Provides additional sidewalk area for bus	
Curb Extensions or Bulb-Outs	Provides additional sidewalk area for bus customers and amenities	
	Reduces bus dwell time	

Visibility

Bus stops should not be located over the crest of a hill, immediately after a road curve to the right, or at other locations that might prevent oncoming traffic from seeing a stopped bus.

The National Transit Database found:

- Approximately 42% of injuries and fatalities from bus-to-person collisions occurred at roadway intersections, compared to the mid-block of roadways 38%, bus stops 15%, and all other locations 5%.[48]
- Approximately 53% of crosswalk pedestrian injuries and fatalities occurred when the bus turned left, compared to turning right or proceeding straight.[49]
- Of the fatalities and injuries that occurred at the mid-block of roadways, approximately 32% were with bicyclists, and 30% were with non-crosswalk pedestrians.[50]

Bus stops are frequently located at signalized intersections. Traffic signal design should accommodate both the bus and bus customers. The following should be considered in designing new traffic signal systems and/or upgrading/redesigning signals at existing intersections:

- Bus stops should not be located where stopped buses could obstruct visibility of traffic and/or pedestrian signals. (Far-side stops generally address this problem).
- Pedestrian signals with push buttons are especially important at bus stops since bus customers are likely to cross the street.
- At near side stops, traffic signal detectors should be programed to be triggered by a bus servicing the stop. Otherwise, the signal controller may not be actuated until other traffic passes.
- Where feasible, signal systems should incorporate Traffic Signal Priority functions to expedite bus service through the intersection.

Bus technology safety improvements refer to practices that enhance passenger safety and reduce collision accidents by increasing the bus's visibility for pedestrians and drivers of other vehicles. Examples include low-floor buses, improved doors and door controls, improved driver vision through mirrors and lighting, high-visibility brake lights and warning signs, and daytime running lights.

Road/Street Design

The bus stop roadway length should be sufficient to accommodate the largest bus likely to be used on the route served to allow for proper curbing. Curb extensions, also known as bus

[48] (Federal Transit Administration (FTA), 2021)
[49] (Federal Highway Administration (FHWA), 2013)
[50] (Federal Highway Administration (FHWA), 2013)

nubs or bulb-outs, align the bus stop with the parking lane, creating an in-lane stop. This enables buses to stop without making significant lateral shifts. On streets where speeding is a known concern for pedestrians, bulb-outs may assist in traffic easing and improve pedestrian crossing safety.

ADA Accessibility

In designing bus stops, transit systems must decide whether to place the bus stop on the street or off the street (i.e., whether to use bus bays), how to provide pedestrian access and ADA access, and which of the bus stop amenities to provide (e.g., waiting areas, benches, shelters, bus stop signs, public route and schedule information, and illumination). See **Section 5.5 Bus Stop Landing Pad**, and **Chapter 6 Passenger Waiting Areas** for more information.

Other Pedestrian and Passenger Injury Hazards

An accessible path of travel is defined as a four-foot wide, stable, firm, and slip-resistant pathway (generally concrete or asphalt), clear of obstructions, with a cross slope not exceeding 2% and a running slope not exceeding the slope of the adjacent roadway and preferably not more than 5%.

Collision Mitigation for Buses and Other Vehicles

Ensure Visibility

All signposts shall be installed 18 inch (12 inch minimum) from the face of the curb or edge of the roadway. This will prevent collisions with most vehicles and bus mirrors. Bus stop signposts must not interfere with a safe and accessible pedestrian path of travel. A minimum of four-foot clear path of travel must be maintained around posts. At locations with narrow sidewalks or other constraints to the path of travel, it may be necessary to install the signpost at the back of the sidewalk.

Road/Street design

Buses operate in a variety of environments including highways, parkways, bus lanes, streets with and without parking, and streets with bicycle lanes. Each environment may impact the space necessary for a bus to access the stop safely. Various modes of transportation should be separated where speeds and traffic volumes necessitate it to reduce conflicts and increase safety and comfort for people walking, biking, and taking transit.

Roadways and intersections with bus traffic and bus stops should be designed to accommodate the size, weight and turning requirements of buses. Because of their need to make frequent stops, buses generally travel in the traffic lane closest to the curb.

Therefore, the following bus clearance requirements in roadway design are important:

- Overhead obstructions shall be a minimum of 12 feet above the street surface

- Obstructions shall not be located within two feet of the edge of the street or curb to avoid being struck by a bus mirror
- A traffic lane used by buses should be at least 12 feet in width because the maximum bus width (including mirrors) is about 10.5 feet. In certain situations, 11 feet may be acceptable.

The maximum roadway grade for buses is 6%. Steeper grades will interfere with bus performance where snow and ice are factors.

The curb reveals at bus stops should be between six inches and nine inches. Anything above this will interfere with the buses' ability to align parallel and adjacent to the sidewalk since it will often have to overhang the curb while pulling in.

Bus starting and stopping maneuvers can introduce a force of over 28,000 pounds per axle on a repetitive basis at bus stops and in bus lanes. This force is best absorbed by the roadway when the bus stop pad is constructed with reinforced concrete or bituminous pavement.

Reducing Opportunities for Incursions with Other Vehicles

Bus stop placement can be determined in part by the level of use by customers. Both boardings and alighting should be considered. It is critical to the safety of customers, pedestrians, cyclists and motorists.[51, 52, 53, 54, 55]

- One of the considerations in bus stop placement is avoidance of areas where there is a conflict with pedestrians and avoid placements that will create difficult operating conditions
- Proximity to cross street (near-side, far-side, mid-block)
- Proximity to expected customer trip generators
- Pedestrian safety and access to stop; accessibility of nearby sidewalks, curb ramps, etc.
- Stop spacing along the route
- Availability of sidewalk and curb
- Adequate right-of-way and sidewalk width to accommodate accessibility and amenities
- Adequate curbside space for single or multiple bus operations
- Proximity to transit transfer points

[51] (Transit Cooperative Research Board (TCRP), 2015)
[52] (Massachusetts Bay Transportation Authority, 2018)
[53] (Transit Advisory Committee for Safety (TRACS), 2022)
[54] (Sullivan County, n.d.)
[55] (Federal Transit Administration (FTA), 2021)

- Impact on existing street parking
- Potential for transit signal priority and/or a queue jump lane
- Impact on adjacent property owners
- Impact on other transit vehicles, vehicular traffic, bicycles and pedestrians
- Proximity and usage of nearby driveways
- Street and sidewalk grades, curb height
- Unusual intersection angles or predominant turning movements
- Sight distance at adjacent intersections and driveways
- Availability of existing amenities (shelter, seating, etc.)

9.2 Crime Prevention through Environmental Design (CPTED)

This section will define Crime Prevention Through Environmental Design (CPTED) purpose and application, inclusive of the American Public Transportation Association's (APTA) CPTED standards. It is important to note that CPTED continues to evolve and requires community engagement in the planning and maintenance of a location for success.

CPTED Principles

Incorporating these principles is considered a best practice when designing and maintaining a bus stop:

- CPTED is a multidisciplinary approach to deterring criminal behavior. Applying CPTED principles of natural surveillance, natural access control and territorial reinforcement to the design and placement of a bus stop/shelter location is essential to identifying space issues and concerns.[56] It is crime prevention that uses urban and architectural design and management of built and natural environments. CPTED strategies aim to reduce victimization, deter offender decisions that precede criminal acts, and build a sense of community among inhabitants so they can gain territorial control of areas, reduce crime, and minimize fear of crime.[57]
- According to APTA's Bus Stop Design and Placement Security Considerations (APTA SS-SIS-RP-008-10 Rev 1), crime prevention through environmental design CPTED is a multidisciplinary approach to deterring criminal behavior. Applying CPTED principles (e.g., natural surveillance, natural access control and territorial reinforcement) to the design and placement of a bus stop/shelter location is essential to identifying space issues and concerns.[58]
- Each transit agency should complete a CPTED survey to identify and recommend the appropriate enhancements to implement crime prevention or homeland security

[56] (American Public Transportation Association (APTA), 2010)
[57] (International CPTED Association (ICA), 2024)
[58] (American Public Transportation Association (APTA), 2010)

measures. The Recommended Practice Application of Crime Prevention Through Environmental Design (CPTED) for Public Transit Facilities should be reviewed. It contains information about performing a CPTED survey.[59]

- The main components of CPTED include natural surveillance, natural access control, activity support and maintenance, and target hardening through mechanical enhancements. These strategies are all important concepts when designing and maintaining a location.

CPTED Design Strategies

This section is based on the concept that the physical environment can be designed to influence certain human behavior and provide the end user with a safer experience. The principles of natural surveillance, natural access control, territorial reinforcement, and mechanical surveillance and access control are included in this section.

Natural Surveillance

Natural Surveillance is the condition of the site that is under human senses and observable without the enhancement of mechanical devices. This allows for the detection of behavior by both the user and community. The design should give the sense that the site is under observation by the surrounding area.

- Layout should maintain transparency and be visually accessible, avoid blind corners and hidden areas, barriers are permeable, signs should not obstruct sightlines, and vegetation should be low.
- Existing land uses should be considered, i.e. what's currently in the area, like stores or businesses that can serve as enhanced surveillance.
- Lighting should be consistent and uniform throughout the day through the use of lighting that is low maintenance, LED overhead, vandalism proof, color enhanced, standard two to five foot candles.

Natural Access Control

Natural Access Control focuses on the movement of people through space and directing them to areas with natural surveillance and away from criminal opportunities.

- The layout should be designed for safe and convenient movement of pedestrians.
- The circulation routes must be defined with clear sight lines for all intended functions.
- The site should have a limited number of entry and exit points to allow for identifying approaching threats and escape.

[59] (American Public Transportation Association (APTA), 2010)

Territorial Reinforcement

Territorial Reinforcement is used to provide a sense of ownership of the property. This sense of proprietorship gives a clear perception of a boundary and control. Territorial Reinforcement strategies include both natural surveillance and natural access control strategies.

- Connectivity of the site with the community is important. The area should not be isolated. The site should have a clear orientation to the movement of pedestrians and buildings around them.
- Transition zones should clearly define the space as public to semi-public. This includes well defined borders, low landscaping and signage that do not impede sightlines.
- Maintenance of the site conveys ownership and safety. Cleanliness of the site, including trash removal and absence of graffiti conveys that the site is cared for and not abandoned.

Activity Support and Maintenance

Activity Support and Maintenance is the care and upkeep to demonstrate ownership and intolerance for disorder. Encouraging appropriate activities preserves the intended use of the space.

- Maintain the cleanliness and functionality of areas and spaces.
- Inspect assets, equipment and facilities to ensure satisfactory operation.
- Enforce a zero-tolerance policy for graffiti and vandalism.
- Identify activities that create community involvement in the public space.
- Ensure that public space activities complement other activities in the same space.

Mechanical Reinforcement

Mechanical Reinforcement of surveillance and access control should support and enhance the natural design strategies of CPTED. Mechanical reinforcement strategies may not be appropriate or practical for all levels of bus stops. Consideration should be given to enhancing both natural surveillance and natural access control strategies at high risk and high priority areas.[60, 61, 62, 63]

- Access controlled areas/gates for ticketed riders into a waiting space restricts movement of people.
- Enclosed structural designs like fences and gates can support territoriality.
- The use of call boxes and video surveillance support and enhance natural surveillance.

[60] (American Public Transportation Association (APTA), 2010)
[61] (American Public Transportation Association (APTA), 2010)
[62] (Maryland Department of Transportation Maryland Transit Administration (MDOT MTA), 2019)
[63] (The International Crime Prevention Through Environmental Design Association, 2024)

10 DESIGN CRITERIA SCORING SHEETS

This chapter includes information and forms associated with bus stop improvements, specifically bus stop spacing optimization and amenity provision. **Figure 66** provides a flowchart illustrating the process associated with bus stop improvements, delineating how internal or external requests to change bus stop spacing or add amenities at a particular stop are dealt with. **Table 29** provides the bus stop spacing criteria SMART uses, and **Table 30** is the form used to score the need for amenities at a particular bus stop. Both tables should be used in conjunction with **Figure 66**, as referenced in that flowchart.

Figure 66: SMART Bus Stop Improvement Process

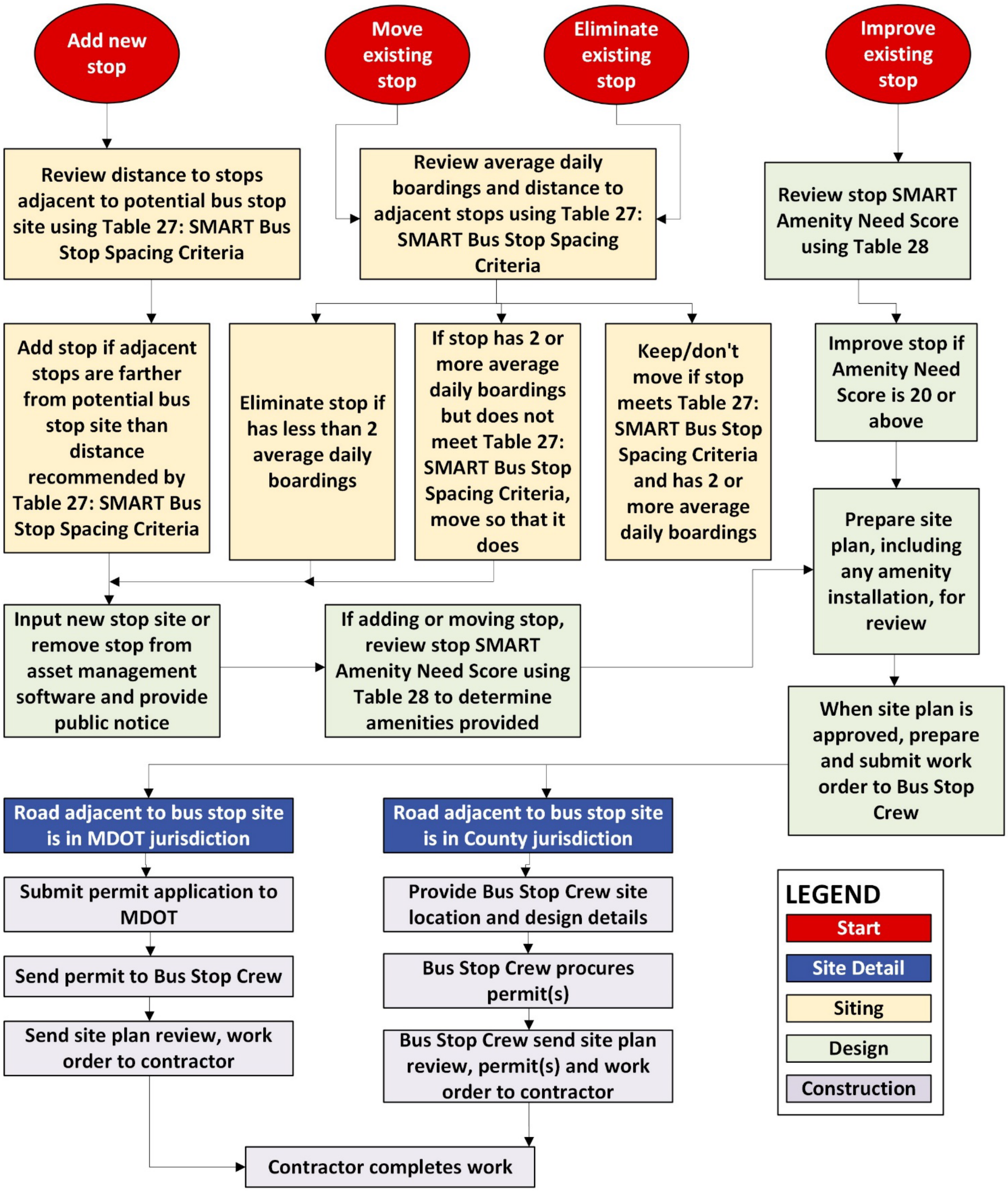

Table 29: SMART Bus Stop Spacing Criteria

Service Type	Local Land Use Type	People per Mile^2	Recommended Distance between Bus Stops (Miles)
Standard Fixed-Route	Residential Areas	Less than 2,880	0.42 – 0.50
		2,880 – 9,660	0.33 – 0.42
		More than 9,660	0.25 – 0.33
	Central Business District (CBD) and Near CBD		2 blocks and/or every block with high passenger boarding/alighting rates
Express Limited-Stop			1 – 2

Source: SMART (2021), CapMetro (2023), VTA (2018)

Table 30: Bus Stop Amenity Need Scoring

	Bus Stop Name/Location		Bus Stop Number	
	Amenity Need Factor	**Range**	**Point Value**	**Point Total**
1	**What is the average number of daily boardings at the stop?**	N/A	1 per boarding	
2	**How frequent is bus service to the stop?**	Less than 15 minutes	0	
		15 – 29 minutes	1	
		30 – 44 minutes	3	
		45 – 59 minutes	5	
		60 minutes or more	7	
3	**How many different bus routes serve the stop?**	1	1	
		2	3	
		More than 2	5	
4	**Is the stop a transfer point between buses or buses and other modes of transportation?**	No	0	
		Yes	1	
5	**What major passenger generators are within a quarter mile of the stop?**	Medical	2	
		Grocery	2	
		Educational	2	
		Multi-family Housing	2	
		Elderly/Assisted Living	2	
6	**How many wheelchair ramp deployments per week are there at the stop on average?**	0 times per week	0	
		1 or more times per week	2	
			TOTAL AMENITY NEED SCORE:	

Amenities based on Need Score	**Less than 20**	**No Amenities**
	20 to 30	**Bench, Trash Can**
	More than 30	**Shelter, Trash Can**
Reasons for Disqualification	Not enough space for amenity No connecting sidewalk* Slope or conditions make amenity cost prohibitive	

**Amenity should not be an island.*

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