

ON-STREET MOTOR VEHICLE PARKING AND THE BIKEWAY SELECTION PROCESS



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CONTENTS

Introduction..... 1

On-Street Parking and Bikeway Types 1

On-Street Parking Types and Considerations 3

Bikeway Types and Considerations 6

Bikeway Assessment Strategies..... 11

Conclusion 16

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Introduction

On-street motor vehicle parking serves residents, visitors, and businesses in a wide variety of urban, suburban, and rural town settings. It can provide access for people with disabilities, via accessible parking spaces that are connected to sidewalks and accessible drop-off and pick-up areas. In denser communities, and communities built before the 1950s, homes and businesses often do not include private off-street parking, and sometimes rely on public on-street parking options. For retail corridors in these communities, customers often wish to park as close to their destination as possible. Businesses often rely on curb-side deliveries, and sometimes require dedicated commercial loading/unloading zones to support their day-to-day operations.

An auto-centric culture and car-dependent built environment in the U.S. contribute to the perception of the need for a large, free, and easy to access supply of on-street parking, which keeps the demand for this resource high in many communities. This perception exists even in communities where vehicle ownership and trips by personal vehicle are very low and the majority of people travel by transit, on foot, or by bicycle. Discussions about re-allocating parking space to bicycling or other purposes can be emotionally charged and challenging. This challenge can extend into suburban environments where parking is often plentiful, and typically located off-street in driveways and parking lots.

This resource is intended to inform discussions about on-street parking and bikeway selection. It is a supplementary resource to the FHWA [Bikeway Selection Guide](#). The discussion of trade-offs and the selection of preferred alternatives discussed in this resource should occur within the local transportation planning process, including public engagement with the full range of stakeholders, such as business owners, bicyclists, individuals with disabilities, transit riders, and pedestrians. Locally specific issues of equity, inclusion, and historical injustice should be recognized and centered as part of this planning process.

This resource begins with a discussion of on-street parking and bikeway types, with associated dimensional requirements and trade-off considerations. It then presents several strategies involving choices specifically relating to the overlap between general purpose on-street parking and passenger or commercial loading activities, design details, and bikeway selection.

On-Street Parking and Bikeway Types

Street design requires the application of community values to prioritize different users and functions of the street. On-street parking and bikeway type selection routinely compete for the same space within what is often a fixed and constrained right-of-way. Most roadways under consideration already exist and are constrained by existing buildings and property lines. To create space for a bikeway, a reallocation of existing space will be necessary. To modify the roadway in this context to provide the maximum amount of desired space for each mode and to provide superior operation and comfort to all users may not be achievable. This constrained environment is likely to require trade-offs between numerous competing interests and between fundamental goals such as mobility and safety.

While parking supports end-of-trip needs for people that drive, parking on one or both sides of the street occupies 8 to 20 feet or more of lateral space within the public right-of-way for the storage of private property (i.e., privately-owned automobiles). When used for parking, this public space is no longer available for transportation mobility functions such as vehicular lanes, bike lanes, or sidewalks. In some cases, it also displaces access functions to adjacent properties such as passenger loading zones or commercial delivery zones. A trade-off in mobility or delivery functions allows for provision of private vehicle parking on public streets for nearby homes and businesses.

ON-STREET MOTOR VEHICLE PARKING AND THE BIKEWAY SELECTION PROCESS

The quality of a bikeway generally increases as the space allocated to it expands, as this allows for more separation from motorized traffic and provides increased maneuvering space for cyclists within the bikeway. The separation from motorized traffic is especially important as traffic volumes and speeds increase. Trade-offs in the functionality and appeal of the bikeway will occur as the provided space narrows, for example resulting in the selection of conventional bike lanes or shared lanes, which impacts the mobility and safety of the bicyclist.

It is also important to note that in urban communities with higher densities, research shows bike infrastructure delivers customers and provides economic benefits to local businesses, often at a higher rate than for those who drive. A recent study by Portland State University documented economic development effects of corridor-level bicycle or pedestrian street improvements across corridors in multiple cities.¹ As with streets in general, each segment of bike infrastructure contributes to a larger connected network that serves mobility, safety, access, equity, and other goals. If one segment is unsafe or uncomfortable for bicyclists, it can create a barrier that has broader, network-wide implications.

In an ideal world, agencies could provide the vehicle parking and the higher quality bikeways they desire, but this is often not possible, especially when traffic characteristics present a real or perceived limitation on the ability to make changes to the motor vehicle travel lanes or parking supply. It is important to critically evaluate underlying assumptions in this regard, as discussed in detail in an additional supplementary resource to the *Bikeway Selection Guide on Intersections and Bikeway Selection*.

It is critical to evaluate the parking usage along a corridor, as locations that have infrequent or minimal parking demand can be problematic. For example, on streets with minimal parking utilization and shared lane markings, bicyclists preferring separation from traffic are likely to bicycle within the empty parking lane, resulting in bicyclists weaving in and out of the travel lane as they encounter the occasional parked vehicle. This weaving reduces the predictability of a bicyclist's path of travel and can increase their crash risk. The perception of the parking lane as available space for bicycling may also degrade the respect for, and understanding of, the purpose of the shared lane markings for both bicyclists and motorists. A parking demand analysis may indicate opportunities to consolidate parking areas and create more predictable parking and bicycling interactions.

Providing extended parking lanes in areas that average low parking usage can be an inefficient use of valuable space that could serve other transportation purposes. However, to those who use the parking, this space may be perceived as necessary to serve occasional peak event needs such as hosting a party, serving as overflow parking to a local park, or hosting a monthly meeting. Practitioners should differentiate between frequent parking need and occasional parking need.

It is also important to critically evaluate assumptions relating to parking. For example, a business owner may believe that a large portion of their customers get to their store via single-occupancy vehicle, but a customer survey could test this assumption and potentially demonstrate that most of the customers are actually arriving on foot or by bike. Parking assessments should evaluate not only occupancy of spaces, but who is using the spaces and for how long.

Unless a project is a full street reconstruction, curb locations are typically fixed, so the question for the planner and designer is often how to re-allocate limited curb-to-curb space in the context of competing needs. While this choice must be context sensitive, it will ultimately come down to a question of balancing geometric dimensional requirements, community values, and an agency's priorities for the use of the space.



To guide this conversation, providing clarity on what is being evaluated and the values represented by various tradeoffs is important. Values inherent in decisions about parking versus bikeway selection include performance of parking, motorist convenience, loading and accessibility needs of businesses and residents, quality of space, bike network connectivity, projected bicycle demand, and comfort/convenience/safety of bicyclists. It is also important to recognize and be transparent about what is being prioritized. Examples of prioritization measures include mobility, access, safety, economic development considerations, and car storage. Other location-specific prioritization measures may be applicable.

The information on the following pages presents the basic building blocks of these decisions, outlining parking and bikeway types, dimensions, and baseline considerations.

1 [Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility: A Multi-City, Multi-Approach Exploration](#)

On-Street Parking Types and Considerations

Table 1: On-Street Parking Types and Typical Dimensions

Parking Type and Example Picture	Dimensions	Safety Considerations	Parking Maneuver Considerations	Loading, Unloading, and Deliveries
<p>Reverse Angle-In</p>  <p>© Toole Design</p>	<p>17 feet minimum</p> <p>Depth depends on angle of parking stall, see Figure 1 for details</p> <p>(Note: This dimension is measured as an offset from the curb, not measured along the length of the stalls.)</p>	<p>PRO</p> <ul style="list-style-type: none"> Improved sight distance Bicyclists dooring risk eliminated Bicyclists and motorists have clear sight lines to each other Easier loading and unloading of vehicles Rear loading occurs at curb instead of in-street Wider loading zones are possible Passengers are channeled toward the curb Easy to incorporate accessible parking spaces and access aisles <p>CON</p> <ul style="list-style-type: none"> On the downhill side of a steep street, there is the possibility of improperly secured vehicles rolling into the street A conflict is possible when a driver is reversing into the parking space A reverse angle-in parked motor vehicle might overhang more into the sidewalk Some people find it more difficult to back into a parking stall than to back out of a parking stall, especially when adjoining stalls also have cars in them. 	<p>3-Step Process:</p> <ol style="list-style-type: none"> 1. Stop in lane 2. Reverse into space while turning 3. Exit space by driving out <p><i>Each step has clear sightlines</i></p> <p>Primary Challenges:</p> <ul style="list-style-type: none"> Using side mirrors to align vehicle into space Not as common a movement 	<p>Large trucks cannot access the curb spaces, requiring that they:</p> <ul style="list-style-type: none"> Load within the street blocking the parking and bike lane Load within a travel lane Be accommodated on a side street or rear alley Rely on time restrictions applied to the angle parking to allow truck loading at the curb. Dedicated parallel loading zones may be used in conjunction with angled general parking.
<p>Parallel</p>  <p>© Toole Design</p>	<p>7 feet minimum</p> <p>8 feet desirable for delivery trucks</p>	<p>PRO</p> <ul style="list-style-type: none"> Requires the least amount of street width Passenger side of vehicle has direct loading and access to sidewalk Seamlessly combines with bus zones, loading zones, and other typical street curb uses <p>CON</p> <ul style="list-style-type: none"> Doors may open up to 3 feet into travel lane or bike lane Increased dooring risk where the combined parking and bike lane width totals 13 feet or less. If used, buffers denoting door area, wider bike lanes, or parking lanes can mitigate the dooring risk Difficult for drivers and bicyclists to see each other Difficult to incorporate the access aisles needed for accessible parking spaces More driver interference with the bike lane due to time it takes to parallel park and positioning of the bike lane relative to the parking space 	<p>4-Step Process:</p> <ol style="list-style-type: none"> 1. Stop in lane 2. Back into space while turning 3. Pull forward into space 4. Exit space by driving out <p><i>Each step has clear sightlines</i></p> <p>Primary Challenges:</p> <ul style="list-style-type: none"> While a common movement in urban areas, it may be less expected in suburban or rural areas Requires more maneuvering 	<p>Large trucks can access the curb space if:</p> <ul style="list-style-type: none"> Loading zones are designated Parking is time restricted to preserve space for loading <p>It can be extremely difficult for large trucks to access curb space in parallel parking areas in practice, even if a space may accommodate the vehicle's length, because of the space needed to pull in and out. More often the trucks will park in the bike lane or general travel lane to load.</p>

ON-STREET MOTOR VEHICLE PARKING AND THE BIKEWAY SELECTION PROCESS

Table 1: On-Street Parking Types and Typical Dimensions


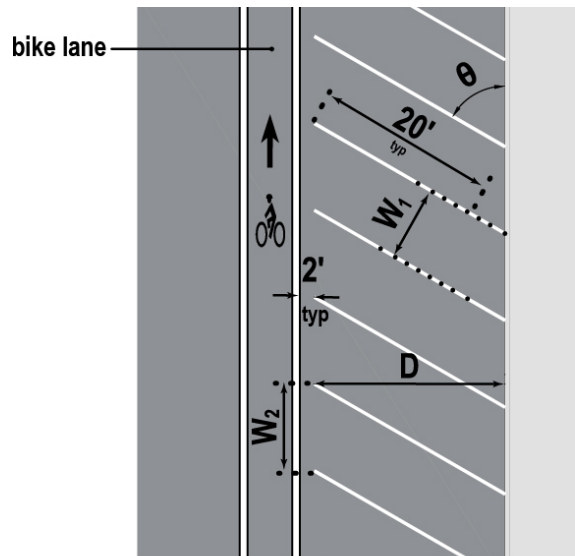
Parking Type and Example Picture	Dimensions	Safety Considerations	Parking Maneuver Considerations	Loading, Unloading, and Deliveries
Head-In Angled  <p>© Toole Design</p>	17 feet minimum Depth depends on angle of parking stall	PRO <ul style="list-style-type: none"> Requires less maneuvering on entry Easy to incorporate accessible parking spaces and access aisles Vehicle overhang onto sidewalk is more easily controlled than it is for back-in angled stalls CON <ul style="list-style-type: none"> Reduced sight distance for drivers backing out increases crash risk Drivers and bicyclists cannot see each other Rear loading and unloading happens in street Passengers are channeled toward the street On the uphill side of a steep street there is a possibility of improperly secured vehicles rolling back into the street 	2-Step Process: <ol style="list-style-type: none"> Drive into space while turning Exit space by backing out blindly Primary Challenges: <ul style="list-style-type: none"> Blind back out into traffic 	Large trucks cannot access the curb spaces requiring they: <ul style="list-style-type: none"> Load within the street blocking the parking and bike lane Load within a travel lane Be accommodated on a side street or rear alley Time restrict the angle parking to allow truck loading at the curb

Figure 1: Design Criteria for Reverse Angle-In Parking



Source: FHWA

Table 2: Design Criteria for Reverse Angle-In

Back in Angle Parking			
θ (Degrees)	W_1 (feet)	W_2 (feet)	D (feet)
0°	7-10	20	7-10
30°	8-9	16-18	16.9-17.8
45°	8-9	11.3-12.7	19.8-20.5
60°	8-9	9.2-10.4	21.3-21.8

W_1 = stall width

W_2 = striping width

D = depth to face of curb

θ = angle

Benefits and Costs of On-Street Parking

In addition to convenience, on-street parking provides physical and operational benefits. On-street parking provides a buffer for pedestrians, increasing their comfort and safety and it can increase access for some people with disabilities. It can provide a physical separation—vertical and horizontal—between a separated bike lane and moving traffic. Parking may reduce automobile traffic speeds on the street by narrowing the field of view and introducing intermittent delay due to parking turnover, which can slow traffic throughout a corridor.

At street corners or mid-block locations, restricting a few parking spaces creates beneficial space for the implementation of sidewalk curb bulbs, protected intersections, convenient bicycle and scooter parking, and other street elements such as utilities and street trees. In some communities, some parking spaces have been replaced by trees at regular intervals in locations with constrained right-of-way to create wider sidewalks, provide more space for a bikeway, promote slower traffic speeds, provide shade, reduce runoff, and improve the overall street environment.

On-street parking is inherently flexible and can be quickly adapted to other purposes. For example, in some cases it can be repurposed on a temporary or permanent basis to accommodate outside restaurant seating, pedestrian benches, potted plants, parklets, or to serve as a wider or additional pedestrian walking area, or an additional vehicle travel lane or dedicated bus lane. In areas with varying needs throughout each day, the parking lane can serve different purposes at different times of day, such as peak-hour travel or accessory turn lanes. Prior to implementation and as part of the planning process, transportation agencies will need to determine if any uses are prohibited on a Federal-aid or state roadway.

In many places however, the provision of continuous on-street parking uses roadway width that is necessary to provide sufficient space for a continuous travel lane or higher-quality bikeway. In these cases, it is a decision to provide either a bikeway or on-street parking. The absence of a bikeway will likely result in a reduction in comfort and safety for bicyclists and/or other modes. On-street parking introduces potential conflicts and can exacerbate visibility issues between bicyclists, motorists, and pedestrians. On-street parking can increase crash risks for all users of the roadway. For these reasons, prohibiting on-street parking, converting free parking to regulated parking, and implementing time-limited parking restrictions are all highlighted as countermeasures within the [Crash Modification Factors \(CMF\) Clearinghouse](#). The orientation of the on-street parking and the time restrictions associated with it are key determinants in understanding



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potential conflicts and trade-offs. Any analysis of parking demand and need should recognize that on-street parking is typically supplemented by private off-street parking (e.g., residential driveways and private structure parking) and public structure parking in the vicinity.

Efforts should be made to determine the utilization of existing parking by individuals with disabilities so the agency can work with the community to ensure that sufficient accessible parking is available. Even if designated accessible spaces are not currently available, parking spaces may be utilized by people using vans with a lift they can deploy directly onto the sidewalk. When on-street parking spaces are designated, a portion of those spaces must be accessible to individuals with disabilities. The ADA prohibits discrimination against individuals with disabilities in the provision of a public entity's services, programs, and activities. The provision of on-street parking is a service provided by public entities. Accordingly, a city must ensure that it provides some accessible on-street parking where it provides on-street parking.

Options for Reallocating Space from On-Street Parking

- Intermittent reductions (i.e., trimming) in select numbers of parking spaces to meet other needs
- Converting head-in angled parking to parallel parking²
- Removing parking on one or both sides, relocating capacity to adjacent streets, surface lots, or structured parking
- Hybrid combination of changes above based on local context
- Implementing parking management strategies to more effectively match parking demand to parking availability

2 Note that converting angle parking to parallel parking is listed as a countermeasure within the [Crash Modification Factors \(CMF\) Clearinghouse](#).

Bikeway Types and Considerations

Table 3: Bikeway Types and Typical Dimensions




Bikeway Type	Example Picture	Dimensions	Considerations
<p>Shared Lane (Not a bikeway)</p>	 <p>© Toole Design</p>	<p>10-15' travel lanes typical Shared Lane Markings may be provided</p>	<ul style="list-style-type: none"> • Bicyclists must ride with motorized vehicles; no dedicated space for bicyclists • May not meet the needs of all ages and abilities without additional traffic-calming measures • Dooring is a concern • Drivers will create obstacle while parallel parking • Not appropriate for use on streets with high traffic volumes and/or speeds
<p>Bike Lane (parking on curb side of bikeway)</p>	 <p>© Toole Design</p>	<p>Adjacent to curb or edge of pavement: 5-7 feet Adjacent to parking: 6-7 feet Desirable door zone buffer: 3.5 feet</p>	<ul style="list-style-type: none"> • Provides some separation between moving traffic and bicyclists • Will not typically meet the needs of all ages and abilities due to proximity between moving traffic and parked vehicles • Drivers may have difficulty ascertaining the presence of bicyclists when turning right at intersections, which could lead to a potential right-hook crash • Dooring is a concern in locations without door zone buffer • Exiting drivers will be within bike lane • Drivers will block bike lane while parallel parking • Loading/unloading, trash collection, and other activities may block the bike lane
<p>One-Way Separated Bike Lane (parking on street side of bikeway)</p>	 <p>© Toole Design</p>	<p>Refer to Table 4</p>	<ul style="list-style-type: none"> • Provides separation between moving traffic and bicyclists accommodating all ages and abilities • Provides bicyclists with better access between bikeway and sidewalk/destinations • The parking provides additional space for intersection treatments to increase driver awareness of presence of bicyclists • With sufficient width in buffer, dooring can be eliminated • Pedestrians accessing parked vehicles will cross bike lane • One-way operation may require out of direction travel • Loading/unloading, trash collection, and other activities may block the bicycle travel way if not accommodated • Drivers may have difficulty ascertaining the presence of bicyclists when turning at intersections, which could lead to a potential right-hook crash • Eliminates possibility of deploying an accessible lift onto the sidewalk.
<p>Two-Way Separated Bike Lane</p>	 <p>© Toole Design</p>	<p>Refer to Table 5</p>	<ul style="list-style-type: none"> • Provides separation between moving traffic and bicyclists, providing greater accommodation of all ages and ability than standard bike lanes. • The parking provides additional space for intersection treatments to increase driver awareness of presence of bicyclists; however, visibility must be provided at intersections and two-way SBL on two-way traffic street may create additional complexities at intersections and driveways • With sufficient width in buffer, dooring can be eliminated • Pedestrians accessing parked vehicles will cross bike lane • Eliminates possibility of deploying an accessible lift onto the sidewalk • Bikeway on one-side of the street may not provide direct access to all destinations • Loading/unloading, trash collection, and other activities may block the bicycle travel way if not accommodated

Table 4: One-Way Separated Bike Lane Widths Based on Existing or Anticipated Volumes³

Peak Hour Directional Bicyclist Volume	One-Way Separated Bike Lane Width (ft)		
	Between Vertical Curbs	Adjacent to One Vertical Curb	Between Sloped Curb or at Sidewalk Level
<150	6.5 - 8.5	6 - 8	5.5 - 7.5
150-750	8.5 - 10	8 - 9.5	7.5 - 9
>750	≥10	≥9.5	≥9
Constrained Condition*	4.5	4	3.5

*Peak Hour Directional Bicyclist Volume not applicable

Table 5: Two-Way Separated Bike Lane Widths Based on Existing or Anticipated Volumes

Peak Hour Directional Bicyclist Volume	Preferable Two-Way Bike Lane Width (ft)		
	Between Vertical Curbs	Adjacent to One Vertical Curb	Between Sloped Curb or at Sidewalk Level
<150	10 - 12	9.5 - 11.5	9 - 11
150-350	12 - 16	11.5 - 15.5	11 - 15
>350	≥16	≥15.5	≥15
Constrained Condition*	8.5	8	7.5

*Peak Hour Directional Bicyclist Volume not applicable

Benefits and Costs of Bikeways

Bikeway selection will have significant safety implications and will determine whether the facility contributes to a connected “low stress” network that meets the needs of all ages and abilities. A detailed discussion of the benefits and costs of the full range of bikeway types is provided in the *Bikeway Selection Guide*.

Spatial Considerations When Evaluating Bikeway Types

As discussed in the Evaluating Feasibility section of the *Bikeway Selection Guide*, there are distinct spatial considerations between bikeways, which may inform the evaluation of options and limit the choice of bikeways available within a constrained space where parking must remain. Within each bikeway type there are additional options that can enhance the experience for bicyclists, as noted in Table 6 below. See the *AASHTO Bicycle Facilities Planning and Design Guide*, *FHWA’s Achieving Multimodal Networks*, *FHWA’s Separated Bike Lane Planning and Design Guide*, and the *Manual on Uniform Traffic Control Devices (MUTCD)* for additional information.

Table 6: Additional Options to Enhance Bicyclist Comfort and Safety

Bikeway	Spatial Impact	Additional Options to Enhance Experience
Shared Lanes	None	<ul style="list-style-type: none"> Traffic calming to manage speed Traffic diversion to lower volumes Shared lane markings
Conventional Bike Lanes	10-12 feet	<ul style="list-style-type: none"> Green color in bike lanes
Buffered Bike Lanes	12 – 16+ feet of space	<ul style="list-style-type: none"> Green color in bike lanes
One-Way Separated Bike Lanes	12 – 16+ feet of space	<ul style="list-style-type: none"> Vertical barriers Green color in bike lanes Protected intersections Phase separation at signals
Two-Way Separated Bike Lane (one side of street)	10 feet (constrained) 12+ feet	<ul style="list-style-type: none"> Vertical barriers Green color in bike lanes Protected intersections Phase separation at signals

3 These tables do not include buffers to traffic or parking which are desirable.

Connecting People with Disabilities to the Sidewalk

On-street parking can provide access for people with disabilities. Where on-street parking is designated, accessible parking spaces must be provided. The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG), published by the U.S. Access Board in 2011, provide a useful framework to help public entities meet their obligations under the ADA to make their programs, services, and activities in the public rights-of-way readily accessible to and usable by individuals with disabilities. Efforts should be made to determine the utilization of existing parking by individuals with disabilities so the agency can work with the community to ensure that sufficient accessible parking is available. Even if designated accessible spaces are not currently available, parking spaces may be utilized by people using vans with a lift they can deploy directly onto the sidewalk. The practitioner should coordinate with the local agency ADA Coordinator to establish the ADA parking requirements for each individual project. The key consideration is to ensure that safe and convenient access between the street and the sidewalk is provided. Practitioners should refer to the PROWAG for more information, and information is also available in other national resources such as FHWA's *Achieving Multimodal Networks* report.

Equity and Inclusion

When considering bikeway type selection in the context of on-street parking, it is critical to consider race, equity, and social justice in the planning and public policy discussion. A history of injustice in a community needs to be recognized and considered during project planning. In order to achieve the vision and goals of a specific community, it may be necessary to consider non-traditional design solutions by applying engineering judgment and design flexibility.⁴ Achieving transportation equity requires incorporating equity into all aspects of the transportation planning, design, and implementation process, including:

- **Setting the context:** All transportation planning, design, and implementation processes happen within a context that helps to shape how the process will proceed and its eventual outcomes before the process even gets started.
- **Establishing project scopes and schedules:** The project scope and schedule have a strong influence on how well a project addresses equity. The project scope defines what will and will not be considered as part of a project. The project schedule determines how much time is available for the project overall and for each project element.



- **Involving the public:** Engagement techniques should be culturally competent, linguistically appropriate, and recognize the needs and constraints of historically oppressed groups.
- **Determining the project visions and goals:** It is important to work with members of historically oppressed groups to develop a shared understanding of equity in the context of the project then incorporate that understanding of equity into the project vision and goals.
- **Analyzing existing conditions:** Existing conditions analysis establishes the foundation for project recommendations. If this analysis fails to identify the needs of historically oppressed groups, then it is unlikely to result in equitable project recommendations.
- **Developing alternatives:** The process of developing alternatives establishes the universe of what will be considered in future stages of the project and is, therefore, critical to achieving equitable outcomes. If the more equitable alternative is excluded at this stage, then including equity criteria when deciding between alternatives is likely to be a meaningless exercise.
- **Prioritizing alternatives:** Once alternatives have been developed, it is necessary to determine which alternative or alternatives should be selected or given higher priority for implementation. Equity can be explicitly incorporated into the prioritization process. If the prioritization process primarily involves deciding between alternative locations, then the prioritization formula should include an equity factor. If the prioritization process primarily involves deciding between alternative designs, then equity should be incorporated in a qualitative way. It is important to avoid using criteria that may be biased to historically advantaged communities and it is necessary to use judgment and get additional feedback from people from historically disadvantaged groups prior to and after completing an initial prioritization.
- **Evaluating the process and outcomes:** Evaluation is a critical aspect of the transportation planning, design, and implementation process. The public outreach and engagement process should be evaluated on an ongoing basis throughout the project as well after the project is over. Outcomes, including what projects or designs ultimately get constructed or non-infrastructure strategies implemented, often fail to reduce historical inequities and may exacerbate them, so it is important to evaluate outcomes even if the planning and design process is felt to be relatively equitable.

Incorporating equity into all the steps above will influence project outcomes, and in some cases may require flexible design solutions that balance competing needs, while

⁴ Refer to [FHWA Bicycle and Pedestrian Facility Design Flexibility Memorandum](#) for more information.

potentially still providing parking and/or connectivity in the bicycle network. Examples of design solutions which required an application of engineering judgment and design flexibility to meet the needs of a broad range of stakeholders are detailed in Table 7 below.

Table 7: Case Studies: Flexible Solutions to Accommodate to All Users

Case Study	Image
<p>Challenge: A Separated Bike Lane was the highest quality bikeway facility being considered for Williams Avenue in Portland, OR; however, this bikeway type would have required elimination of on-street motor vehicle parking serving local businesses. Many of these businesses were Black-owned businesses, which had experienced a history of injustice in public policy decision-making.</p> <p>Design Choice: The public agency chose a Buffered Bike Lane over a Separated Bike Lane in part to accommodate business owners that believed that they needed on-street parking for customers.</p> <p>Solution: In this case, a reduction in the quality of the bikeway type was accepted in order to retain parking.</p>	 <p>© Toole Design</p>
<p>Challenge: In Downtown Raleigh, a north-south separated bikeway was being considered to link a future greenway trail and the growing warehouse district near Raleigh Union Station. Two parallel streets (West Street and Harrington Street) offered two-way vehicle travel, multiple driveways, and on-street parking on both sides for a large portion of the corridors.</p> <p>Design Choice: The public agency presented bikeway alternatives that included directional separated bike lanes and two-way separated bike lanes to minimize the impact to on-street parking and maintaining the maximum amount of separation for bicyclists based upon existing driveways.</p> <p>Solution: The City of Raleigh considered a variety of trade-offs and moved forward with one-way pair of directional separated bike lanes—one on each parallel street—to preserve on-street parking and two-way travel. West Street is used for northbound bicycle travel and will connect to the future greenway trail while Harrington Street is used for southbound travel back to the Warehouse District downtown.</p>	 <p>Source: FHWA</p>
<p>Challenge: In Utrecht, Netherlands, narrow streets make it impossible to serve the needs of all users in dedicated spaces.</p> <p>Design Choice: In this case, despite high volumes of bicyclists, the public agency allows loading and unloading to happen in the bike lane and sidewalk early in the morning (by time limit) on constrained corridors, requiring bicyclists to ride on the sidewalk or in the road.</p> <p>Solution: This solution works, in part, because delivery time restrictions ensure that bikeways are generally only blocked early in the morning when bike demand and motor vehicle volumes are lower and the bike lane is designed to allow bicyclists to enter the roadway via a mountable curb or to the adjacent sidewalk which is constructed at the same level. It important to note that this solution relies on a different driver population who, among other differences, are also more likely to use bicycling for transportation.</p>	 <p>© Toole Design</p>

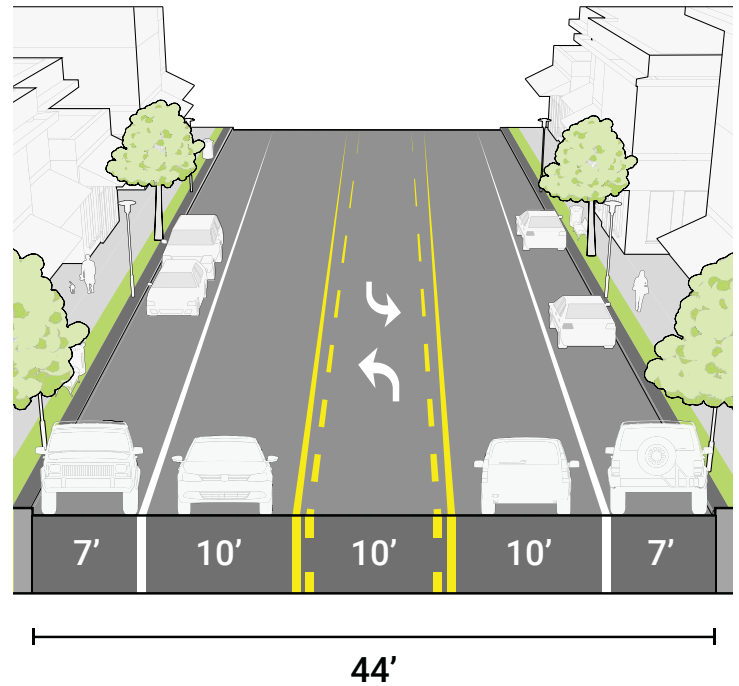


Bikeway Assessment Strategies

The following pages describe strategies for using these factors and decision points when assessing options and trade-offs. The first strategy focuses on decision points and considerations at the cross-section level. The second strategy discusses ways that on-street parking can be used proactively to accomplish other complete streets goals. The third strategy focuses on opportunities to implement small adjustments to existing on-street parking, while still generally maintaining parking along a corridor.

Strategy 1: Assessing Tradeoffs at the Cross-section Level

This Main Street, with locally-owned storefront retail on both sides, generates significant pedestrian activity and has high loading, delivery, and parking demand. The center-turn lane services intermittent driveways. Unsafe motor vehicle passing movements occur occasionally in the continuous center-turn lane. Pedestrian crossing demand is high at intersections and mid-block locations due to the block length, mid-block bus stops, retail distribution, and on-street parking. Bicyclists are concerned about their safety and avoid this street. Despite the presence of off-street parking facilities in the vicinity, the public perceives a parking shortage and many believe that the on-street parking is critical to the success of the retail. The Main Street is controlled by the State Department of Transportation, but is operated and maintained by the local transportation agency. Note that in this existing condition and in the options presented at right, buses and freight might need 11-foot lanes.

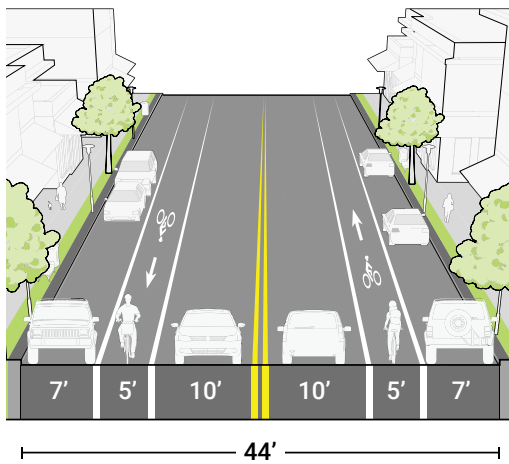


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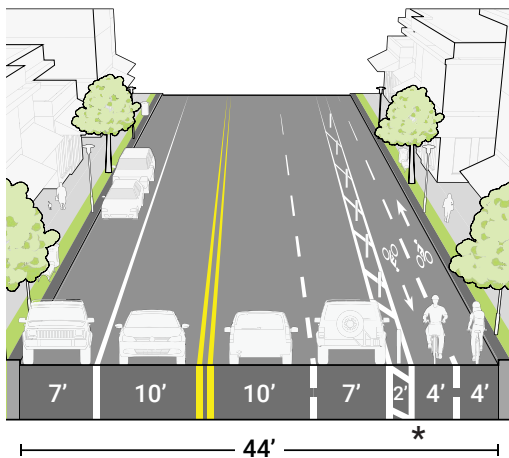
The table below outlines key data-driven decisions and questions to be discussed as part of the planning process.

Data Driven Decisions	Questions to Discuss in the Planning Process
What is the Average Annual Daily Traffic (AADT) on this street and what do the 15 minute, hourly, daily, and seasonal peaks look like?	Is there excess capacity on the street or within the network? If not, can existing capacity be managed or reduced?
What is the percent occupancy of on-street parking spaces and the frequency of parking turnover?	Who is using the parking and for how long - customers, employees, delivery vehicles? How is it managed or regulated?
Have any customer surveys been completed to assess how people are getting to the various stores?	To what extent is customer reliance on the on-street parking real or perceived? How does retailer opinion compare to customers?
How many driveways and intersections exist along the corridor?	What are the safety and operational dynamics today caused by turning vehicles? Can movements be managed or relocated?
How often are drivers and pedestrians using the center turn lane today?	Are there locations with a center turn where there is no demand? Where do pedestrians cross? How are drivers using the center turn lanes? Are they being used to pass other vehicles?
Is there relevant qualitative and observational data that should be considered?	What is generating pedestrian crossings away from intersections? Are crossing islands viable at 400 foot intervals?
What are the motor vehicle speed profiles - 50th, 85th 95th? How many drivers exceed speed limit during which time periods?	Is speeding a significant issue?
What crashes have occurred along the roadway in recent years?	How much can we discern about the circumstances of the crash based on available data?
Are accessible parking spaces available and connected to the sidewalk?	Are individuals with disabilities utilizing the existing parking?

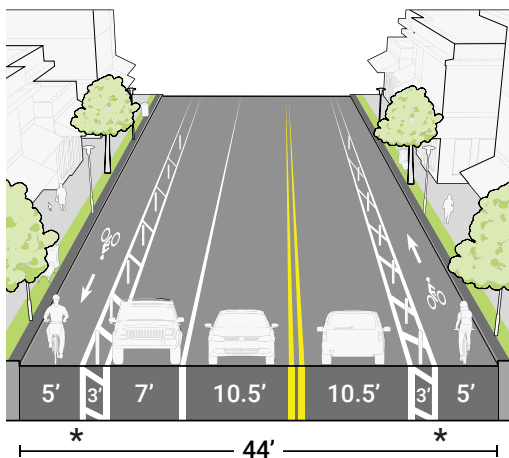
OPTION A Implement a road diet, or space reallocation, keep on-street parking on both sides, and add bike lanes in both directions.



OPTION B Implement a road diet, or space reallocation, keep on-street parking on both sides, and add a two-way separated bike lane on one-side.



OPTION C Implement a road diet, or space reallocation, remove on-street parking on one side, and add a one-way separated bike lane on both sides.



Source: FHWA

Trade-Off Considerations

1. Eliminating the center-turn lane is likely feasible if there are fewer than 100 vehicles per hour using it. A gap analysis can be conducted and access control/management can be considered to consolidate driveways and encourage left turns at intersections. It may be possible to replace the continuous center-turn lane with dedicated left-turn pockets at select locations.
2. The elimination of the center-turn lane could lead to some amount of additional congestion, but this may only be for a short time in the AM and PM peak and it could improve safety for everyone by slowing speeds.
3. Providing bike lanes could impact the ability to provide other beneficial roadway design features such as

pedestrian crossing islands at midblock locations and curb extensions.

4. Driveways and intersections will cause drivers to turn across the path of bicyclists in the bike lanes. It may be necessary to eliminate on-street parking spaces near driveways and intersections to ensure adequate visibility.
5. The on-street parking may contribute to a dooring concern for bicyclists in the bike lanes, especially if there is high parking turnover.
6. On-street parking is maintained on both sides of the street at the expense of a higher quality bikeway.
7. A bike lane may not meet the needs of all ages and abilities so this could remain a gap in the low stress network even after this change.

Trade-Off Considerations (Applies: 1, 2, 3, 4)

8. Measures should be taken to ensure that drivers don't attempt to enter the separated bike lane.
9. People with disabilities must be able to safely and conveniently cross the separated bike lane to access the on-street parking and the sidewalk.
10. On-street parking is maintained on both sides and a high-quality bikeway is provided.
11. The two-way operation of the separated bike lane in this option may present increased risk as compared to the one-way separated bike lanes in Option C below.
12. Special planning and design attention will be needed to ensure adequate transitions at termini and safe intersection operations given that bicyclists will be traveling on the same side but in an opposite direction as motor vehicles. Provisions need to be made for bicyclists to turn at intersections (right way cyclists have hard time turning left, contraflow cyclists have hard time turning right).
13. If there are destinations on both sides of the street, bicyclists may not be able to conveniently access everything.
14. Roadway design will contribute to a low stress bike network by providing a bikeway that is physically separated from motor vehicle traffic by vertical elements and a horizontal buffer.

* Constrained roadway, not preferred dimension

Trade-Off Considerations (Applies: 1, 2, 3, 4, 9, 14)

15. Drivers may execute U-turns in order to access on-street parking on the other side of the street, which could create potential conflicts with all road users.
16. Parking occupancy, frequency of turnover, and customer surveys may indicate that on-street parking on one side can be eliminated.
17. A high-quality bikeway is provided at the expense of some amount of customer convenience.
18. Eliminating on-street parking removes a physical barrier (when there are parked cars) between bicyclists and the travel lane.
19. One-way bike operations will make driveways, intersections, and transitions more intuitive and straightforward.
20. Separated bike lanes on both sides will maximize bicyclist access to destinations along the entire corridor.

* Constrained roadway, not preferred dimension





Strategy 2: Strategies for Adjusting On-Street Motor Vehicle Parking to Better Accomplish Complete Streets Goals

The presence of on-street parking will influence cross-section selection as described on the previous page; however, in assessing bikeway selection and complete streets options, it is also important to think of on-street parking as a feature that can contribute to broader corridor-level goals and objectives. Table 8 below describes strategies for using parked cars as a contributing component toward complete streets goals.

Table 8: Strategies for Adjusting On-Street Motor Vehicle Parking to Better Accomplish Complete Streets Goals

Toolbox	Discussion	Example and/or Resource
<p>Swap Parallel Parking with Painted Bike Lane to Provide a Separated Bike Lane</p>	<p>Action: Remove travel lane and/or narrow lanes</p> <p>Tradeoff: Vehicle Level of Service and travel speeds are reduced</p> <p>Eliminates the option of deploying a lift from an accessible vehicle directly to the sidewalk.</p> <p>Benefit: High comfort bikeway</p> <p>Discussion: In this case, a high-quality bikeway and parking are prioritized, and the trade-off typically comes from the adjacent motor vehicle travel lanes via a “road diet” and “lane diet.”</p> <p>This arrangement does not always require removal of a travel lane. If existing lanes are wide and a conventional bike lane is already present, lanes can simply be narrowed to provide the width needed for buffer.</p>	 <p>© Toole Design</p>
<p>Creating Space for Bike and Micromobility Parking</p>	<p>Action: Remove selected motor vehicle parking spaces and replace with on-street bike and micromobility parking</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Increased parking capacity for non-auto modes</p> <p>Discussion: In this case, one or more parallel parking spaces are converted to convenient and comfortable bike and scooter parking off the sidewalk.</p> <p>A bike corral can accommodate an average of 9 to 10 bicycles in the space of one car parking space and there is data to prove that these spaces benefit adjacent local businesses.</p>	 <p>© Toole Design</p>
<p>Organizing Street Elements</p>	<p>Action: Organize street elements within spaces currently utilized by on-street parking</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Less cluttered roadway and sidewalk environment and potential improvement to the accessible pedestrian zone</p> <p>Discussion: The presence of on-street parking provides space to organize a range of street elements such as utilities, street trees, mailboxes, newspaper boxes, and green infrastructure. This reduces the number of parking spaces but introduces structure and order, while providing features critical to a complete street.</p>	 <p>© Toole Design</p>


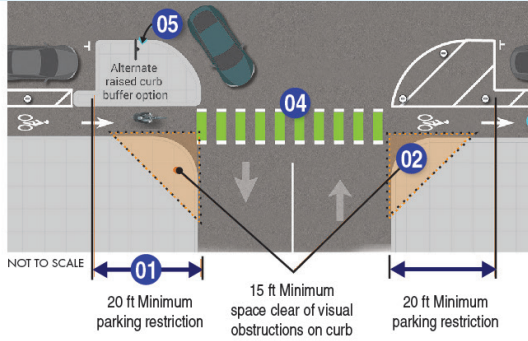
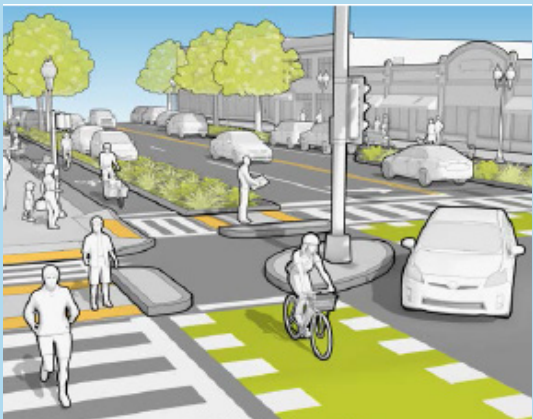
Table 8 (Continued): Strategies for Adjusting On-Street Motor Vehicle Parking to Better Accomplish Complete Streets Goals

Toolbox	Discussion	Example and/or Resource
<p>Parklets and Outside Seating</p>	<p>Action: Remove selected motor vehicle parking spaces and replace with parklets or outside seating</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: More livable, Complete Street, that benefits local businesses</p> <p>Discussion: In some cases, selected on-street parking spaces can be converted to outdoor seating areas. This approach is especially useful in areas where there is insufficient sidewalk width to provide sidewalk seating areas. Prior to implementation and as part of the planning process, transportation agencies will need to determine if any uses are prohibited on a Federal-aid or state roadway. Parklets can also present accessibility challenges. There should be some accessible seating and if these are permitted, the permits should address accessibility.</p>	 <p>© Toole Design</p>
<p>Providing Accessible Parking and Improving Pick-Up and Drop-Off Conditions</p>	<p>Action: Remove selected motor vehicle parking spaces and replace with accessible parking or use space to provide enhanced pick-up and drop-off conditions</p> <p>Tradeoff: Accessible parking capacity increases, but overall motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved accessible parking capacity and enhanced pick-up and drop-off conditions</p> <p>Discussion: Reducing on-street parking can provide for more accessible parking spaces. When parking is provided, a portion must be accessible.</p>	 <p>© Toole Design</p>
<p>Providing Better Bus Stop Accommodations</p>	<p>Action: Remove selected motor vehicle parking spaces in order to provide higher quality bus stop accommodations</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved transit accommodations along corridor</p> <p>Discussion: Reducing parking in advance of a bus stop provides better visibility to passengers for oncoming buses and drivers to see passengers waiting at stops. It can also reduce the need for buses to abruptly weave in and out of travel lanes, potentially reducing delay along the corridor and for transit operations.</p>	 <p>© Toole Design</p>
<p>Commercial Loading and Shared Mobility Pick-Up and Drop-Off</p>	<p>Action: Remove selected motor vehicle parking spaces to provide space for commercial loading and designated locations for shared mobility pick-up and drop-off</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved loading benefits local businesses, can decrease instances of parked trucks impeding the bicycle travel way, and organizes shared mobility operations</p> <p>Discussion: Strategic conversions of on-street general parking to dedicated loading zones can provide enhanced accommodations for freight, deliveries, and shared-mobility service (e.g. Uber, Lyft, etc.) drop-off and pick-up.</p>	 <p>© Toole Design</p>

Strategy 3: Strategically Reducing Parking to Improve Safety

When assessing on-street parking and bikeway selection, it is also important to recognize that it may be possible to strategically reduce selected parking spaces while still maintaining parking along the broader corridor. This could potentially help to avoid having to choose between a high-quality bikeway and on-street parking. Table 9 below shows examples of how strategic parking reductions can provide an important safety benefit.

Table 9: Strategic Reductions in Parking Spaces to Improve Safety

Toolbox	Discussion	Example and/or Resource
<p>Daylighting Mid-Block Pedestrian Crossings</p>	<p>Action: Remove selected motor vehicle parking spaces in advance of a pedestrian crossing to improve visibility at the crossings</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved pedestrian safety</p> <p>Discussion: Reducing on-street parking in advance of a mid-block crossing is recommended to enhance visibility of pedestrians crossing the street. The no-parking area near an intersection is typically 20 ft. from crosswalks and 30 ft. from stop signs. This parking reduction can be done in combination with curb extensions, delineator posts, signs, and other treatments. In many cases this strategy simply involves enforcing parking laws that are already in place. Enforcement may mean striping out no parking areas around crossings and this doesn't necessarily require police enforcement.</p>	 <p>© Toole Design</p>
<p>Increasing Visibility of Bicyclists in Separated Bike Lanes</p>	<p>Action: Remove selected motor vehicle parking spaces in order to improve visibility of bicyclists in Separated Bike Lanes</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved bicyclist safety</p> <p>Discussion: Strategic parking reductions at intersections can improve visibility of bicyclists and pedestrians for drivers turning onto and off of perpendicular streets and driveways. Parking should be prohibited 20-50 feet from an intersection depending on factors such as motor vehicle speed and sight distance.</p>	 <p>NOT TO SCALE</p> <p>Source: FHWA⁵</p>
<p>Improved Intersection Design</p>	<p>Action: Remove selected motor vehicle parking spaces in order to improve intersection design and operations</p> <p>Tradeoff: On-street motor vehicle parking capacity along corridor is reduced</p> <p>Benefit: Improved intersection safety for all users</p> <p>Discussion: On-street parking can be used in conjunction with separated bike lanes to provide high quality multi-modal intersections. The lane offset created by on-street parking allows fully protected intersection design treatments. Additionally, as above, parking limits are pulled away from the intersection to enhance visibility of bicyclists and pedestrians.</p>	 <p>Source: MassDOT⁶</p>

5 Refer to the FHWA [Separated Bike Lane Planning and Design Guide](#) for more information.

6 Refer to the MassDOT [Separated Bike Lane Planning and Design Guide](#) for more information.

Conclusion

This resource is intended to inform discussions about on-street parking and bikeway selection. It discusses on-street parking and bikeway types, with associated dimensional requirements and trade-off considerations. It also presents several strategies involving choices specifically relating to the overlap between general purpose on-street parking and passenger or commercial loading activities, design details, and bikeway selection.





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