



STREET TYPOLOGY								
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BICYCLE FACILITIES

BICYCLE FACILITY SELECTION

DESCRIPTION & INTENT

Inherent to establishing **Complete Streets** across the City of Kalamazoo is ensuring that people on bicycles are able to safely access neighborhood and city-wide destinations using the public street network.

The challenge with accomplishing this is two fold. First, each roadway is unique and how cyclists can be accommodated safely and comfortably given site constraints will vary from street to street. There is not a one-size fits all solution. Second, not all bicycle riders have the same level of comfort and risk tolerance when cycling on streets, which means that a facility that works for one type of cyclist may not work for another.

When implementing bicycle facilities, it is important to consider connectivity and the overall routes. More specifically, determining which type of facility is appropriate given project’s target audience and its role within the bicycle network is critical. Bicycle facilities fall broadly into two categories:

- **Low Stress Bicycle Facilities:** Low stress facilities, sometimes called “all ages and abilities” facilities, are those that are designed to be safe, comfortable, and welcoming to the majority of the bicycle-inclined populace. This includes people are that “interested but concerned” with riding their bicycles on major roads, the youth, elderly, and other less confident but willing riders—typically reflecting 50% or more of a city’s population. Selecting the appropriate low stress facility depends on the roadway conditions and context, intersection treatments, and careful attention to the overall route.

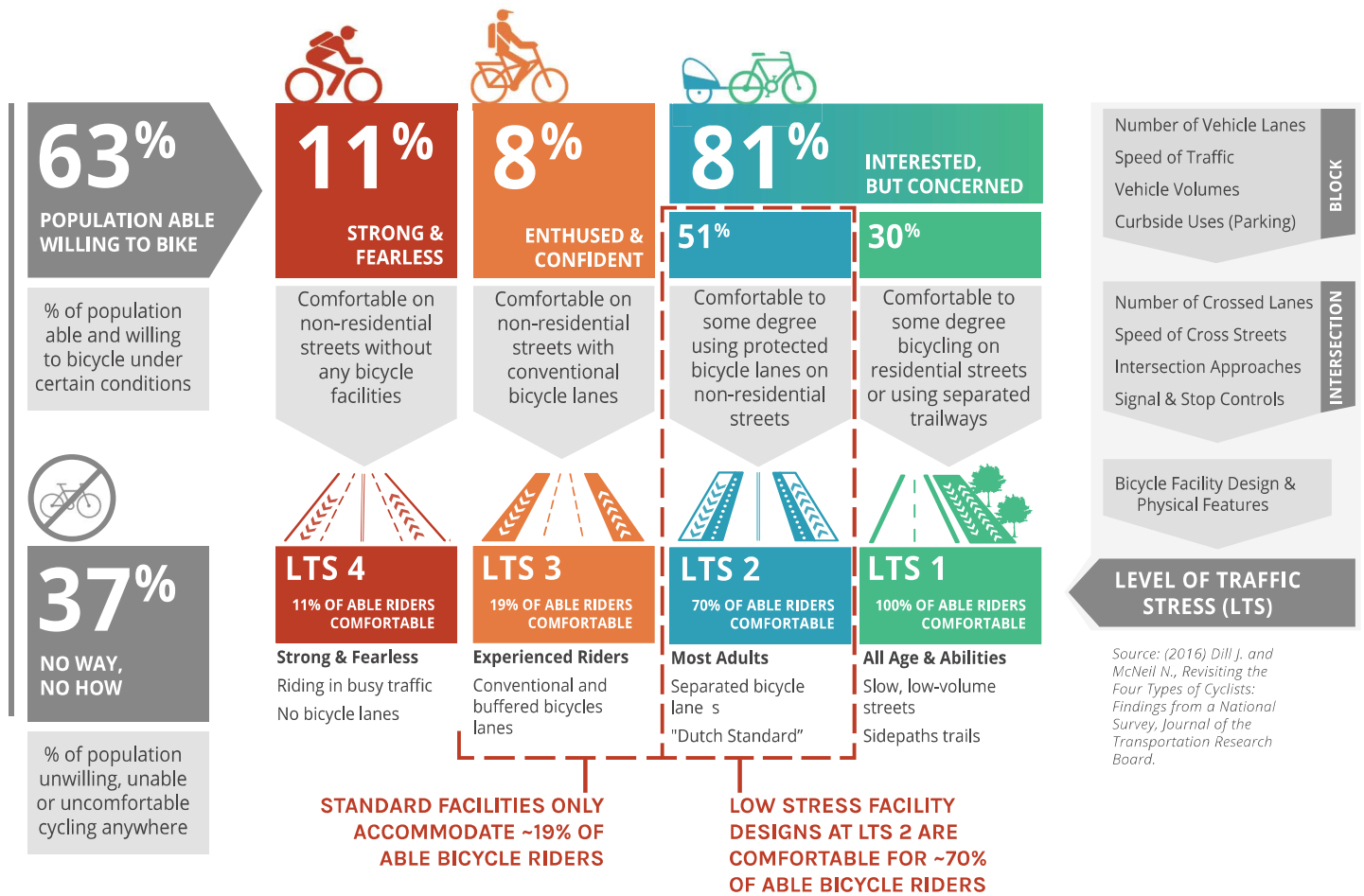
- **Standard Facilities:** Standard bicycle facilities are those where the design treatments seek to reduce stress and maximize safety and comfort to the greatest extent, yet due to site conditions or constraints, may not be comfortable for the majority of riders. Standard facilities on major roads typically serve only about 19% of the willing bicycle riding population.

The graphic on the next page summarizes the relationship between type of bicycle rider and their stress tolerance and associated facility types.

USE & APPLICATION

- How cyclists are accommodated on streets must be assessed on every street project. Even simple resurfacing and re-striping projects can be an opportunity to improve bicycle access, comfort, and safety, through the following methods:
 - » Providing more dedicated space for bicycles to travel by creating dedicated facilities;
 - » Raising the visibility and awareness of bicycle rider presence to drivers through pavement markings, signage, and other treatments; and,
 - » Creating calmer, safer street environments for all users but employing best practices for safe roadway design (e.g. appropriate lane widths, speed management techniques).

STANDARD VS LOW STRESS BICYCLE FACILITIES & RIDER ALIGNMENT



- Non-motorized network or connectivity plans in the city should identify bicycle routes and a desired level of traffic stress. Determining which routes should be “low stress” versus which are “standard” is vital.
- Non-motorized plans should consider establishing two distinct bicycle networks within the city, one that is low stress focused and one that uses more standard approaches.
- Routes that connect directly to schools and parks should utilize low stress facilities.
- The level of stress of a bicycle route is only as low as its most stressful location. Intersections design is vitally important for achieving low stress routes.
- Routes identified as desired neighborhood greenways or bicycle boulevards should emphasize use of appropriate low stress facilities in combination with traffic volume and speed management measures.

BICYCLE INFRASTRUCTURE TOOLS & REFERENCES

- Designing for All Ages & Abilities: Section 3.2 provides a chart (NACTO, 2017) for aligning roadway conditions (traffic volume, speed, lane configuration, curbside uses) with potential facility types.
- Southwest Michigan Region Non-Motorized Transportation Plan 2020: Identifies regional trails and connections.
- KATS Pedestrian, Greenways, and Transit Plan: Identifies proposed (and existing) greenways or shared use paths, bicycle boulevards, and buffered/protected bicycle lanes.

FACILITY SELECTION GUIDANCE

The chart below identifies City of Kalamazoo street typologies and indicates a typical “low stress” versus “standard” facility that should be considered.

- This chart should be used as a starting point for establishing a baseline approach for accommodating bicycles and in consideration of the street’s network role.
- Depending on the available right-of-way space, scope of the street project (e.g. full reconstruction versus repaving and re-striping), and specific roadway conditions, different facilities may be used to achieve the desired stress target.

Bicycle Facility Types

Detailed design guidance for each of the listed facility types are described subsequently in this section. Briefly, these facility types include the following:

- **Sidepaths:** Sidepaths are shared-use facilities for non-motorized use, mixing both bicycle and pedestrian traffic. Sidepaths are separated from the roadway and are typically located in the sidewalk zone of the street, often being substituted for normal sidewalks.
- **Separated Bicycle Lanes:** Separated bicycle lanes are either one-way or two-way dedicated bicycle lanes which are separated from vehicle travel lanes by a physical, vertical buffer, such as delineator posts, curbing, bioswales, landscape or decorative planters.

- **Buffered Bicycle Lanes:** Buffered bicycle lanes are one-way dedicated bicycle lanes with a painted buffer zone in between the bicycle lane and vehicle lane, providing additional separation and clearance between bicycle riders and motor vehicles.
- **Bicycle Lanes/Conventional Bicycle Lanes:** Conventional bicycle lanes are dedicated one-way bicycle lanes that are typically positioned between the curb and a vehicle travel lane. There are no buffers between the bicycle and vehicle lanes, so the level of comfort for cyclists can vary significantly based on vehicle speeds, traffic volumes, and the proximity of passing vehicles.
- **Advisory Bicycle Lanes:** Advisory bicycle lanes are one-way bicycle lanes demarcated with a dashed line and combined with shared bi-directional vehicle lanes. The advisory bicycle lane is periodically shared with motor vehicles during passing operations. Advisory bicycle lanes are typically used on low volume and low speed (25 MPH or less) neighborhood streets to help raise the visibility of cyclists and manage vehicle behaviors.
- **Sharrows:** Sharrows or “share the road” markings are pavement markings placed within a vehicle travel lane to indicate the potential presence of cyclists.

Typical Bicycle Facilities	Low Stress Facility	Standard Facility	Notes
Urban Center (UC)	Separated Bicycle Lanes	Bicycle Lanes or Sharrows	See note (1) below
Event/Festival (E/F)	Sharrows typically appropriate		Low speed/volume or shared space streets
Downtown Main (MS)	Separated Bicycle Lanes	Bicycle Lanes or Sharrows	See note (1) below
Neighborhood Business (NB)	Separated Bicycle Lanes or Sidepaths	Conventional Bicycle Lanes	Separated bicycle lanes vs. sidepaths depends on overall connectivity and curbside uses.
Commercial Business (CB)	Sidepaths	Conventional Bicycle Lanes	
City Connector (CC)	Sidepaths	Conventional Bicycle Lanes	
Neighborhood Network (NN)	Separated Bicycle Lanes or Sidepaths	Conventional Bicycle Lanes	
Enhanced Neighborhood (EN)	Separated or Buffered Bicycle Lanes, Advisory Bicycle Lanes	Sharrows	
Local Neighborhood (LN)	Advisory Bicycle Lanes	Sharrows or no facility	

- (1) Sharrows may be preferred where space does not allow bicycle lanes to be buffered from door swing when next to parking lanes

GENERAL BICYCLE FACILITY DESIGN CONSIDERATIONS

Pavement Markings

Bicycle facilities, particular more elaborate ones such as separated bicycle lanes, requires additional pavement markings and the maintenance of such markings should be considered during project development.

- Where bicycle facility markings cross between vehicle travel lanes, consider recessing pavement markings so that snow plows traverse over them and do not wear them down more quickly.
- Durable markings materials should be used. Avoid using waterborne paint products. Polyurea, MMA, epoxy, and polymer cement surfacing (e.g. Endurablend) should be used.
 - » Green paint markings used in larger solid areas (such as within bike boxes, turn boxes, or intersections) should be specified with materials that reduce loss of traction for cyclists.

Winter Maintenance and Snow Clearing

- Bicycle facilities that are within the roadway zone, including separated bicycle facilities, are the responsibility of the city to clear. The design of bicycle facilities should consider available maintenance equipment to ensure that it can be cleared efficiently.
 - » When curb islands, concrete medians, or other permanent elements are used as part of the bikeway design, horizontal clearance widths should be considered relative to available maintenance equipment. Pick-up sized plows are generally around 7-feet wide, and so clear widths of 8-feet may be suitable. Narrower widths or lack of available equipment may require hand clearing or use of smaller specialized equipment.
 - » Non-permanent bikeway treatments, such as signage, rubber curbing, or delineator posts should be removable if needed. Items can be removed on a regular seasonal basis or temporarily as needed, to assist with snow clearing operations.
- Snow should never be piled on or stored on top of bicycle facilities. Care should be taken to ensure that drainage structures are not blocked and that ice does not form within a bicycle lane.

- Where on-street parking is present, it is important that snow is cleared all the way to the curb face, at a minimum, so that parking does not drift away from the curb and encroach on bicycle facilities.
- It is important for sidepaths to be promptly cleared of snow. Sidepaths should be maintained consistent with other designed shared-use trails in the city and/or installed with a maintenance agreement with adjacent property owners or other sponsoring entities.

Utilities

- Where the bicycle lane must travel over inlet structures, use bicycle-friendly grate designs, such as Type-L vane inlet covers or ADA accessible inlet covers. Must ensure that selected inlet covers meet required drainage criteria in consideration of stormwater flows.
- If trenching or pavement removals are done within the bicycle lane, repair the entire width of the bicycle lane so there is not an uneven surface or longitudinal seam that can catch bicycle tires.
- Avoid locating manholes within bicycle lanes (if feasible).
- Ensure any utility or vault covers are flush with the road surface and properly set and maintained.

Sweeping

- Separated bicycle lanes require street sweeping and should be designed to accommodate the width of available street sweeping equipment.

Stormwater Drainage

- Where bicycle facilities incorporate curbed medians, planters, concrete medias/dividers, or other linear vertical elements, the design must address stormwater flows and ensure that drainage can be maintained.



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BICYCLE FACILITIES

SIDEPATHS

DESCRIPTION & INTENT

Sidepaths are paved areas within a street right-of-way but outside of the roadway zone that are intended for non-motorized travel. They are wider than typical sidewalks and are designed as shared-use trail facilities, which provides space for pedestrians, cyclists, and other non-motorized users.

Sidepaths can be an important tool for providing lower stress bicycle facilities by provided a space to ride that is fully separated from the roadway. Sidepaths can be particularly beneficial where there is a higher frequency of younger children, senior, or less confident cyclists anticipated.

Sidepaths function as an alternative to a standard sidewalk and implementing them typically consumes less overall right-of-way space than having both sidewalks and dedicated bicycle facilities. However, as a shared-use facility, care must be given to ensure that pedestrians remain safe and that the speed of bicycle travel is managed appropriately.

USE & APPLICATION

Location

- **Usage:** Sidepaths may be utilized on nearly any street type within the city, in consideration of the below (see [Bicycle Facility](#) selection):
 - » Sidepaths are most suitable in locations where there is ample room in the pedestrian area (minimally 14-feet, ideally at least 20-feet) to accommodate a sidepath and where other competing uses that

might conflict with sidepaths users are minimal (e.g. cafe dining, curbside parking or loading areas). Typically these include commercial business, city connector, and neighborhood network street types.

- » Sidepaths are less suitable on streets with higher volumes of pedestrian traffic moving both along and crossing the sidepath. Urban center streets, main streets, and neighborhood business streets where active ground floor uses front directly onto to the sidewalk are generally not well-suited for sidepaths.

Related Design Elements

- **Parking and Loading Zones:** Sidepaths should be considered carefully where on-street parking is present and frequently utilized. Frequent crossings of the sidepaths by curbside users can create conflicts with bicyclists on the sidepath.
- **On-Street/Dedicated Bicycle Facilities:** Sidepaths on only one side of the street can transition to two-way separated bicycle facilities on the same side of the street more readily than single direction bicycle lanes. Transitions to single direction bicycle lanes should occur at signalized or all-way stop intersections to allow cyclists to cross to other side of the street in a controlled manner.
- **Lighting:** Sidepaths should be well lit, especially at intersections or crossing points. Pedestrian scaled street lighting located between the sidepaths and the edge of the roadway can help provide a vertical buffer and improve comfort. See [Street Lighting](#) section for applicable lighting targets by street type.
- **Trees:** Trees should be planted along sidepaths wherever feasible to create a comfortable atmosphere. Trees also help provide a buffer between the sidepath and adjacent roadways.

DESIGN & OPERATIONS

Design Requirements

- A Travel Path Width:** Sidepaths should provide a minimum width of 10-feet clear as the travel path. Exceptions to this minimum may be considered, reducing the width to a minimum of 8-feet, where right-of-way conditions are constrained and/or usage and volumes are expected to be low ⁽¹⁾.
- B Clear Zone:** Sidepaths should have a 2-foot clear zone on both sides of the main travel path. This clear zone may be paved or a maintained lawn area. This clear zone should be free from signage, posts, tree trunks, or other obstructions ⁽¹⁾.
- C Separation from Roadway or Curbside Zone:** The sidepath should be separated at least 4-feet from the face of an adjacent roadway curb or the edge of roadway pavement for curbsless streets. This separation area encompasses the clear zone listed above.
 - » This separation zone allows for placement of signage and site fixtures while meeting clearances for both the sidepath and adjacent roadway. This separation zone can be paved or landscaped and is part of the amenity zone of the street.
 - » A narrower zone may be considered under constrained circumstances, so long as horizontal clearances from the roadway (typically 2-feet from the face of curb) can be maintained. This may require reducing the width of the sidepath.

» Wider separation (8-feet or more) is generally desired on higher speed (30 MPH or higher) and volume roadways and on streets with curbside zone uses (e.g. parking and loading) where users may cross the sidepath.

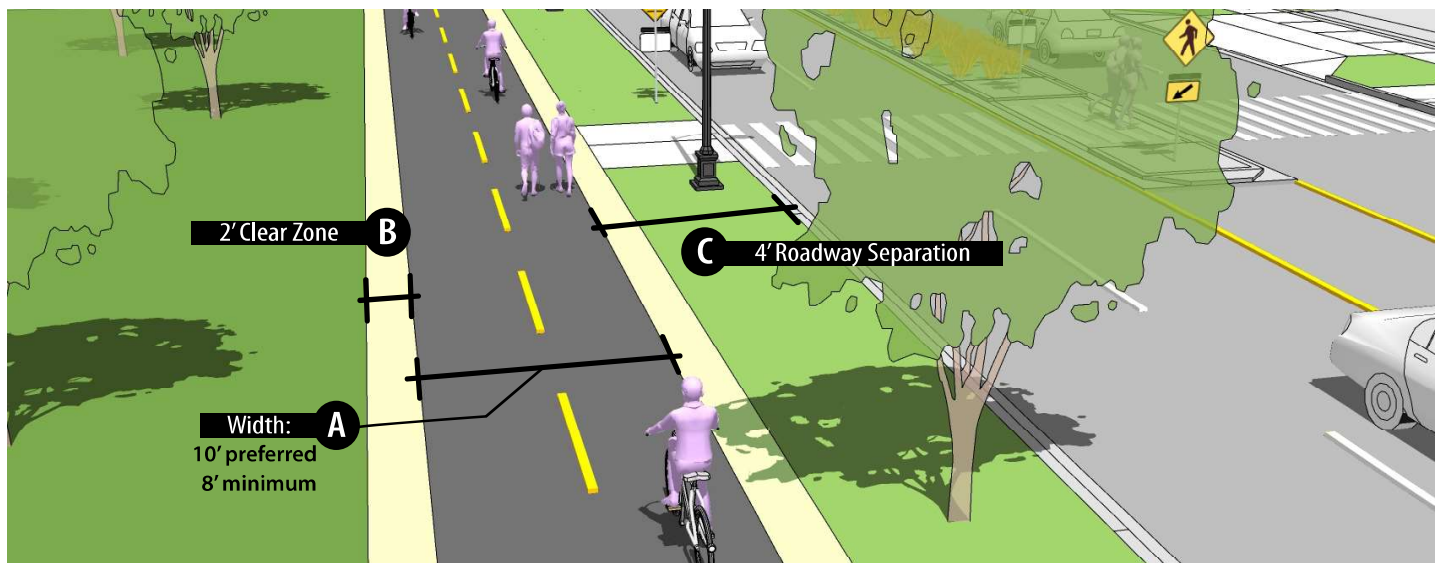
- **Materials:** Sidepaths should be constructed from concrete or asphalt. Concrete is preferred in denser urban areas and/or where heavy vehicles are regularly crossing the sidepath, whereas asphalt may be used on other street types.
- **Pavement Markings and Signage:** Sidepaths should use signage and pavement markings consistent with those used on shared-use trails. Centerline marks are recommended in order to guide travelers in opposing directions.
- **Crossings, Driveways and Curb Cuts:** The design of sidepaths should consider the spacing and frequency of use for curb cuts, driveways, or other crossings over the sidepath. AASHTO provides detailed guidance on the design of safe, visible, sidepath crossings ⁽¹⁾.

Design References

- AASHTO (2012) Guide for the Development of Bicycle Facilities provides details guidance on the construction of shared-use trails and sidepaths.

MAINTENANCE & MANAGEMENT

- It is important for sidepaths to be promptly cleared of snow. Sidepaths should be maintained consistent with other shared-use trails in the city.





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BICYCLE FACILITIES

SEPARATED BICYCLE LANES

DESCRIPTION & INTENT

Separated bicycle lanes are bicycle facilities that provide physical barriers and separation between the bicycle lane and adjacent travel lanes.

Physical separation can be provided using delineator posts, curbing, raised medians, raised bicycle lanes, planter boxes, or other treatments depending on the available space and overall roadway context.

The physical protection increases the sense of safety and comfort for cyclists. Separated bicycle lanes correlate positively with increased cycling activity, as separated facilities improve comfort for more timid, less experienced, and/or more vulnerable cyclists. Separated facilities dramatically reduce the risk of bicycle/vehicle conflicts, as well as the risk of “dooring” from parked vehicles.

Separated bicycle lanes may be one directional with one separated lane on each side of the street, or may be designed as a two-way facility with both directions in a combined facility.

USE & APPLICATION

Location

- **Usage:** Separated bicycle lanes are appropriate where there is a desire for a low stress bicycle facility and where the roadway conditions (traffic volume, speed, etc.) require separation to comfortably accommodate bicycle users (see [Bicycle Facility](#) section).
- Separated bicycle lanes have the most attraction and impact when implemented for multiple contiguous blocks.

- While separated bicycle lanes offer more protection and attraction than standard on-street bicycle lanes, they also require a greater amount of street space. Separated bicycle lanes often require the conversion of curbside parking or a travel lane. These trade-offs should be resolved as part of establishing a modal hierarchy for the street project and in considering the full range of street users.

Related Design Elements

- **Crosswalks:** Separated bicycle lanes are exclusively for bicycle travel and should not be used as pedestrian walkways or waiting areas. Pedestrian medians may be provided near the separated bicycle lane to provide additional refuge opportunities for pedestrians when crossing the street (see [Protected Intersections](#)).
- **Two-stage Turn Queues or Bike Boxes** should be used to facilitate left turns from separated bicycle lanes to other bicycle corridors or facilities (see [Bike Boxes](#) and [Two-Stage Turn Queues](#)).
- **On-Street Parking:** On-street parking, located between the separated bicycle lane and the roadway can pose visibility concerns to bikers in the separated bicycle lanes. They can limit bicycle maneuvering space, lead to vehicle encroachment into the bicycle lane, creating conflict points with pedestrians and situations for “dooring” bicycle riders. Due to the above concerns, it is generally not recommended.
 - » If on-street parking is necessary, consider using a two-way separated facility on one side of the road with a lane of parking on the other side.

- **Bicycle Parking:** Provide bicycle parking regularly along separated bicycle lanes.
- **Sidewalk Furnishings:** Place sidewalk curbs and furnishings in such a way to discourage pedestrians from walking on the separated bicycle lane.
- **Curb Cuts:** Driveways, alleys, curb cuts and frequent loading activity introduce conflict into a separated facility. Separated bicycle lanes work best on corridors with minimal conflicts.
- **Mid-block and Pedestrian Crossings:** Pedestrians crossing separated bikeways, either at an intersection or as part of a mid-block crossing, should treat the crossing as if it were a vehicle crossing and provide appropriate curb ramps and detectable warnings when approaching the separated bicycle lane.
- **Bus stops:** Separated bikeways can pose a challenge for transit vehicles trying to access street curbs. Integrating a raised bicycle lane into a transit bus bulb or bumpout can provide curb height access for buses and still accommodate the bicycle lane.

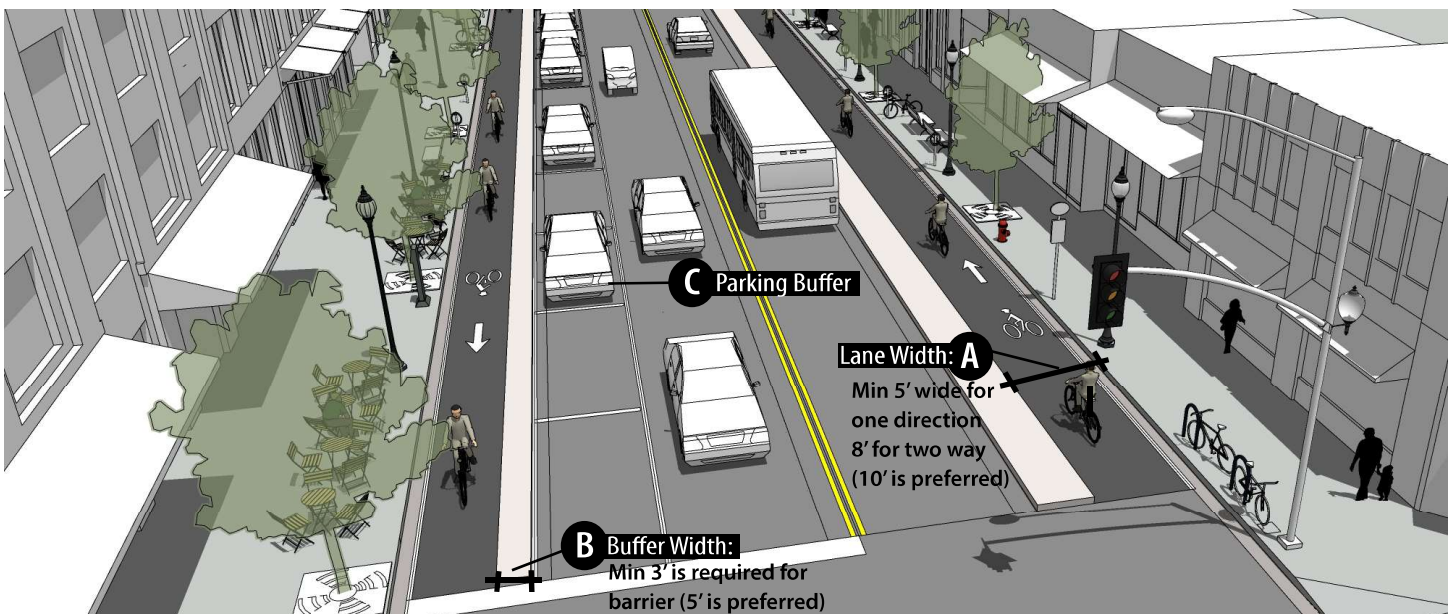
DESIGN & OPERATIONS

One-Way Separated Bicycle Lanes

- A Lane Width:** Separated bicycle lanes should have a minimum of 5-feet of width for a one-directional facility. 7-feet of width should be considered where higher bicycle volumes are anticipated to allow for bicycles to pass.

Bicycle Lane Separation

- B** Separated bicycle lanes should be separated from vehicle traffic and clearly distinct from pedestrian zones.
 - » A minimum of 3-feet is desired for the buffer (5-feet is preferred) between the bicycle lanes and travel lanes.
 - » Separation should use delineators and painted buffers, curbing, planters, and/or raised medians. Gaps in the buffer should be minimized to the extent possible.
- C Parking Buffer:** A parking lane may be used as a buffer treatment.
 - » Rigid curbing, concrete medians, or curb stops should be provided to prevent vehicles from encroaching into the bicycle lane. These features can create additional obstacles for pedestrian access.
 - » The overall width of parking and the buffer should be a minimum of 11-feet wide and parking should be stopped at least 30-feet from the edge the nearest crosswalk to provide for adequate sight lines to cyclists at the intersection approach ⁽¹⁾.



Two-Way Separated Bikeways

Where available right-of-way width precludes using one-way separated bicycle lanes and/or in locations where sidepaths and trails (with two-way movement) need to transition onto the roadway zone, two-way separated bicycle lanes (called bikeways) may be used. Two-way bikeways introduce additional complexities in the design and operations, discussed below.

D Lane Width: Each direction of bicycle travel in the bikeway must be a minimum of 4-foot wide (8-foot total width). 5-foot wide lanes are preferred (10-foot total).

E Centerline: The centerline of the bikeway should be a single dashed yellow line, 4 or 6 inches wide. When approaching intersections, the centerline should be solid within 20-feet from the stop bar.

- **Bicycle Turning Movements:** For two-way bikeways, turning movements into and out of the bikeway require careful consideration. Use two-stage turn queues located in a manner clear from cross street traffic where cyclists can wait for a signal change (see *Two-Stage Turn Queues* for additional guidance).

- **Vehicle Management:** Encroachment by vehicles into the wider two-way bikeway should be prevented.

- » Use delineator posts placed on the centerline of the bikeway to prevent vehicles from entering.
- » If delineators are used to provide separation, where there are concerns about vehicles parking in the bikeway, they should be placed 10-feet apart.

- » **No Turn on Red:** No Turn on Red signage should be used where right turning may cross over the two-way bikeway and/or turn queue boxes.

Pavement Markings and Signage

- **Pedestrian Crosswalks** should cut through buffers or barriers to provide a continuous ADA accessible path of travel for pedestrians.

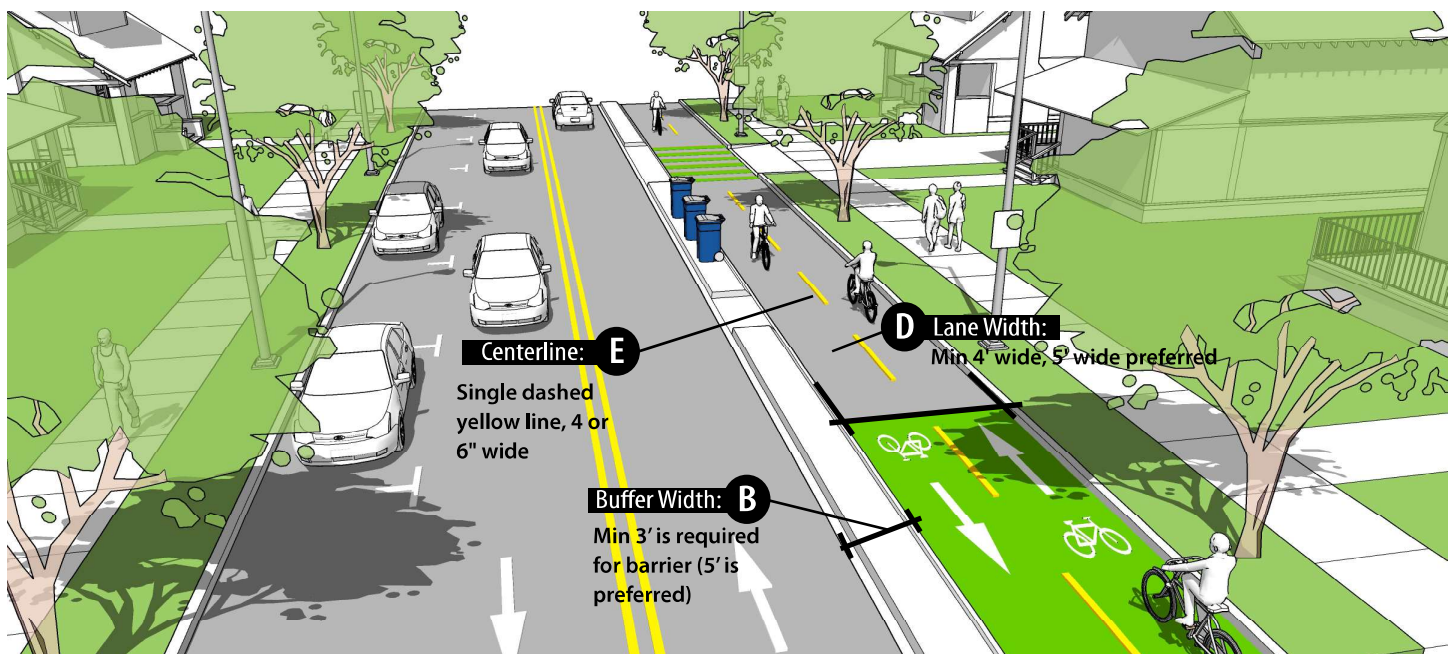
- **Intersection Markings:** To raise visibility of bicycle riders in intersections, separated bicycle lanes should be painted solid green traversing through an intersection and within 20-feet of the approach.

- » One-way facilities should include dashed white lines highlighting the edge of the bikeway.
- » Two-way facilities should use “elephant feet” (12x12 or 18x18) white squares along the edge of the painted crossing zone.

- **Driveways and Curb Cuts:** Use dashed green bars where the bicycle lanes cross driveways, alleys, curb cuts, or minor street crossings.

Intersections

- **Intersections:** Separated bicycle lanes require careful design at intersections to minimize conflicts with turning vehicles and improve legibility, visibility, and predictability for all travelers.





- **Bicycle Signals:** Bicycle signals may be necessary for two-way separated bicycles lanes. A traffic and signal analysis should be conducted to determine the necessity for bicycle signals.
- **Sight Lines:** Maintain visibility and sight triangles at driveways, alleys, or intersections.
- **Traffic Signal Timing:** On streets where signals are coordinated, consider adjusting timing to account for bicycle travel times to encourage continuous bicycle movement.

Raised Bikeways

- Separated bicycle lanes may be flush with the street-level, raised to the sidewalk-level, or at an intermediary-level between street and sidewalk.
- For sidewalk-level bicycle lanes, use different colors, materials or pavement markings to differentiate the bicycle lanes from pedestrian space. At conflict points, use yield-marks and “Bikes Yield to Peds” signage to indicate that pedestrians have the right-of-way.
- Two-way bikeways can be raised up to the sidewalk-level, using ramps to transition back down to street-level at intersections.

Additional Design Considerations

- **Curbing:** The face of new curbs directly adjacent to the bikeway should be designed with a chamfered 45-degree angle to reduce pedal strikes.

Utility Considerations

- Configure gutter seams, drainage inlets, and utility covers so they do not impede bicycle travel. Make the separated lane wider where gutter seams extend more than 12 inches from the curb. Barriers should be designed as not to impede effective roadway drainage.

Sustainability Considerations

- Curbed medians or buffer areas can be designed to capture stormwater runoff and provide additional storage or infiltration capacity.

Design References

- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design separated bicycle lanes and where to use them (see [Cycle Track](#) section in the guide book).
- The MMUTCD offers standards on signage and pavement markings for separated bicycle facilities.

MAINTENANCE & MANAGEMENT

- See [Bicycle Facility](#) section for overall guidance on maintenance of bicycle facilities.



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BICYCLE FACILITIES

BUFFERED BICYCLE LANES

DESCRIPTION & INTENT

Buffered bicycle lanes are on-street bicycle facilities with a painted buffer zone between the bicycle facility and other roadway uses. Buffered bicycle lanes are distinct from separated bicycle lanes in that no physical separation or protection is provided. Buffering is provided by a flush, painted zone between the bicycle facility and vehicular travel lanes.

Buffered bicycle lanes increase comfort over conventional bicycle lanes by providing greater separation from adjacent travel lanes and wider operating space for bicycles. Buffered bicycle lanes may not offer the same level of comfort as separated bicycle lanes, but may be installed at a lower cost, and impose fewer maintenance challenges.

Buffered bicycle lanes allow cars to travel across them to enter curbside zones (i.e. for on-street parking or loading). The buffered lanes can be designed with additional buffers between the bicycle lane and parking area to minimize the risk of getting “doored” by people existing parked vehicles.

USE & APPLICATION

Location

- **Usage:** Buffered bicycle lanes are most appropriate on moderate traffic volume roads and where lower travel speeds can be achieved (ideally 25 MPH). While they provided greater separation and reduce bicycle rider stress, they do not provide physical separation (see [Bicycle Facility](#) section).
- The flexibility of the painted buffer area can make buffered lanes more viable in commercial areas with active curbside uses.

- Buffered lanes should be considered as an alternative to conventional bicycle lanes whenever bicycle lanes are proposed.
- Buffered lanes are more effective and appealing on streets with longer blocks and few interruptions, such as driveways or bus stops. Buffered facilities should ideally extend for several contiguous blocks along a corridor.

Related Design Elements

- **Travel Lane Width:** Buffered bicycle lanes can be used as a tool for narrowing travel lane width. Where existing conventional lanes are adjacent to overly wide travel lanes, consider re-striping as buffered bicycle lanes.
- **Intersections:** Buffered bicycle lanes require additional considerations in the design of intersections and associated pavement markings. Consider using a bicycle box and/or two-stage turn queues at intersections to give cyclists in the buffered bicycle lane additional protection (see [Bicycle Boxes](#) and [Two-Stage Turn Queues](#)).
- **Traffic Signal Timing:** On streets where signals are coordinated, consider adjusting timing to account for bicycle travel times to encourage continuous bicycle movement.
- **Bus Bulbs:** Buffered bicycle lanes can conflict with bumpouts, especially at bus stops. When approaching a bus bulb, a buffered bicycle lane should move between the sidewalk and bus bulb so cyclists do not cross paths with passengers stepping on or off the bus (see [Bus Bulbs](#)).

- **Curb cuts** and driveways can erode the attraction and operation of buffered bicycle facilities. Curb cuts should be avoided or minimized wherever possible.

DESIGN & OPERATIONS

Design Requirements

- A Lane Width:** The preferred lane width for the bicycle lane is 5-feet wide, outside of any gutter line. This may be reduced to 4-feet in highly constrained areas ⁽¹⁾.
- B Buffer Width:** The buffer shall be a minimum of 2-feet wide (3-feet preferred) measured from the center of the bicycle lane stripe. Buffers may be up to 6 feet wide in the event of a converted travel lane ⁽¹⁾.
 - » When adjacent to on-street parking, an additional buffer on the parking side of the bicycle lane should be used to minimize “dooring.” This buffer should be 3-feet in order to provide effect clearance, and where space is limited and on-street parking frequent, may be preferred over a travel lane buffer.
 - » The combined bicycle lane and widths of buffers should be no less than 7-feet overall.
 - » Buffered area consists of two solid painted lines (6- to 8-inch parallel lines) with diagonal stripes in between at 45-degrees and spaced 10- to 40-feet apart on center.

Additional Design Considerations

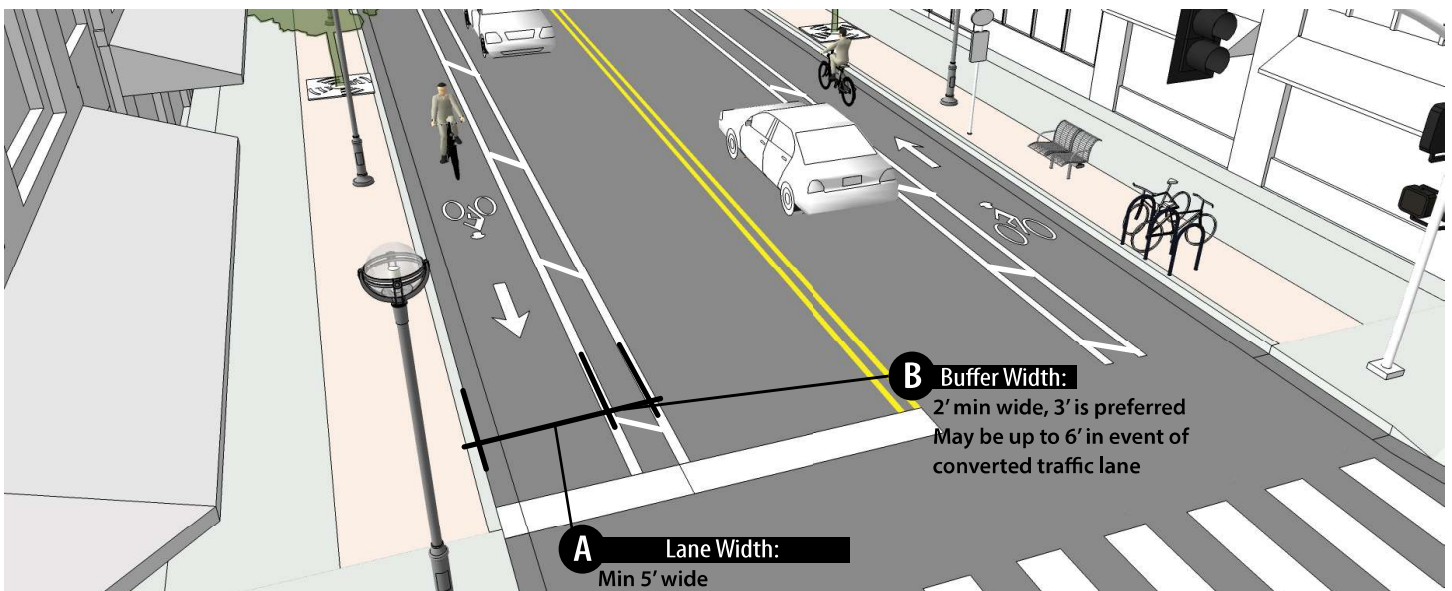
- **Recessed Pavement Marking:** Consider recessing markings to improve longevity of pavement markings.
- **Parking Lane Markings:** Use “T” markings or solid lines next to a parking lane to show where parked cars should be placed.
- **High Visibility Paints:** Green paint should be used to raise the visibility of the buffered bicycle lanes.
 - » Use 2-foot wide green bars spaced in alignment along the bicycle lane path through intersections and across driveways or curb cuts.
- **Delineators:** Delineators can be added to buffered bicycle lanes over time, converting them into separated bicycle lanes.

Design References

- The NACTO Urban Bikeway Design Guide provides additional design guidance on buffered bicycle lanes.

MAINTENANCE & MANAGEMENT

- See *Bicycle Facility* section for overall guidance on maintenance of bicycle facilities.





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BICYCLE FACILITIES

CONVENTIONAL BICYCLE LANES

DESCRIPTION & INTENT

Bicycle lanes are dedicated bicycle facilities delineated by striping, signage, and pavement markings. Distinct from buffered or separated bicycle lanes, conventional bicycle lanes are typically immediately adjacent to a vehicle travel lane.

On-street lanes alert motorists to the presence of a bicycle route, allow cyclists to use the street with less interference from traffic, and increase comfort for cyclists and predictability for all roadway users.

The provision of bicycle lanes or other dedicated bicycle facilities may reduce the incidence of cyclists riding on sidewalks in Kalamazoo. However, conventional bicycle lanes alone may not provide a high enough level of comfort for the most risk intolerant or vulnerable cyclists who desire a higher level of separation from traffic.

Bicycle lanes are typically located on the right-hand side of the street running in the same direction as motor vehicle traffic, but alternative configurations are possible.

USE & APPLICATION

Location

- **Usage:** On priority bicycle routes or designated low stress bicycle routes, conventional bicycle lanes may only be appropriate when adjacent vehicle volumes, speeds, and points of conflict are low enough to achieve low stress target. See *Bicycle Facility* section.

Related Design Elements

- **Transit:** Buses and bicycles may conflict at curbside bus stops. For high frequency stops, consider using a bus bulb that allows the bicycle lane to continue through (see *Bus Bulbs*).
- **Bumpouts:** Additional consideration is required where bicycle lanes intersect with bumpouts, both at corners and mid-block, due to potential conflicts with pedestrians. Bumpouts should stop short and provide enough width for bicycle lanes to continue up to the intersection (see *Bumpouts*) or else the corner can be designed as a protected intersection (see *Protected Intersection*).
- Bumpouts should not extend into the bicycle lane.
- **Driveways and Curb Cuts:** Motorist entering or exiting may not see approaching cyclists. Dashed pavement markings can identify conflict zones.

DESIGN & OPERATIONS

Design Requirements

- **A Lane Width:**
 - » The preferred operational width of bicycle lanes is 5-feet (minimum 4-feet), free from any longitudinal pavement lines (i.e. gutters) and obstructions.
 - » Wider lanes should be provided where higher volumes are anticipated or where conflicts (i.e. door swings) are present.

- B Markings:** A solid white 6-inch wide line shall be used to differentiate the bicycle lane from the general traffic lane. At intersections, place bicycle lane markings outside of the vehicle path to prevent car tires from wearing them down.
- Location:** Bicycle lanes shall be placed on the right-hand side of the street, between the travel lane and the parking lane, or between the travel lane and the curb.
 - » Avoid placing bicycle lanes to the right of a right turn lane or the left of a left turn lane.

Additional Design Considerations

- Parking Lane Marking:** Use a continuous solid line or place “T” marks between the bicycle lane and the parking lane to mark the inside of the bicycle lane and discourage motorist from encroachment.
- Lane Markings:** Use dotted/dashed lines to indicate areas of bicycle/vehicle conflict, such as bicycle lane markings continuing through intersections or where right turning lanes cross bicycle lanes.
- Surface Transitions:** Make gutter seams, drainage inlets, and utility covers flush with the ground to prevent conflicts with bicycle tires. Ensure openings in grates are perpendicular to the bicycle direction of travel to avoid trapping bicycle tires.
- High Visibility Paint:** Use white sharrow markers/outlines to emphasize bicycle only lanes.
- Signs:** Additional signage may be used to indicate presence of bicycle lanes.

Design References

- The MMUTCD provides standards for bicycle lane markings.
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of conventional bicycle lanes.

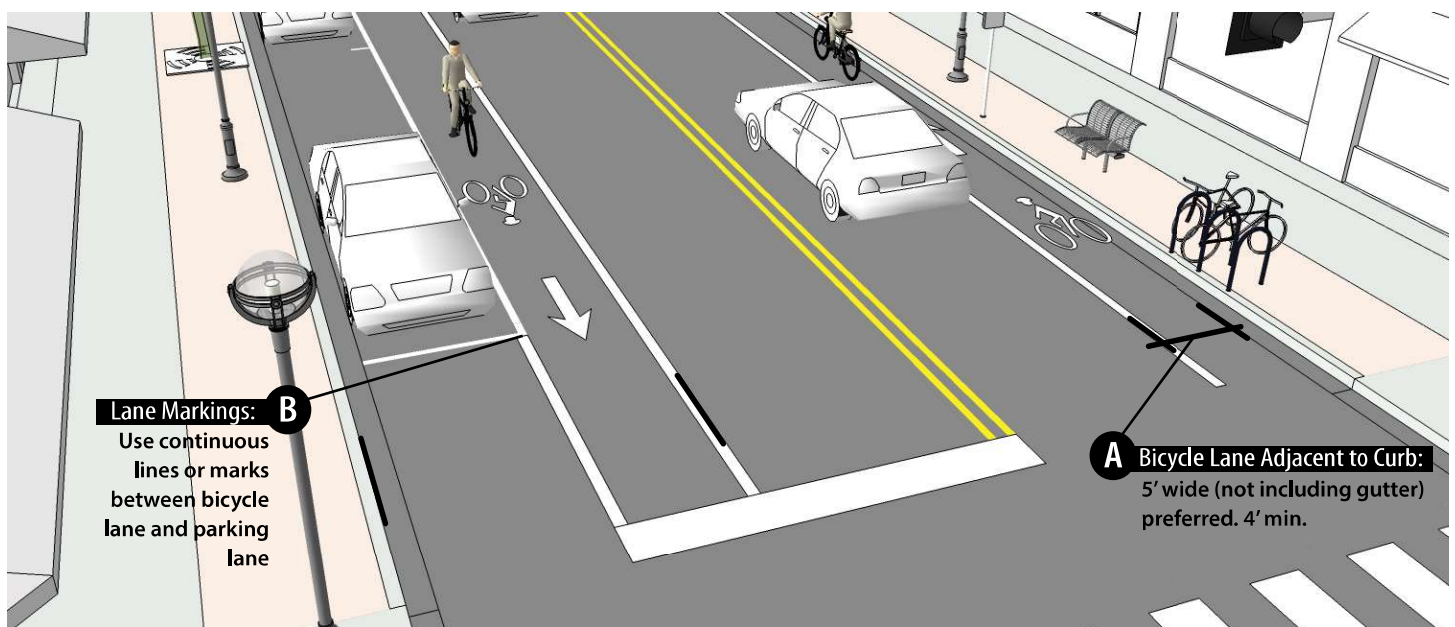
MAINTENANCE & MANAGEMENT

General Maintenance

- Bicycle lanes and associated signs and symbols are additional markings that will require maintenance and replacement.

Seasonal Use and Maintenance

- Bicycle lanes should always be plowed during snow events and should never be used for snow storage.
- See *Bicycle Facility* section for overall guidance on maintenance of bicycle facilities.





STREET TYPOLOGY

UC	E/F	MS	NB	CB	CC	NN	EN	LN
Res.	Res.	Res.	Res.	Res.	Res.	Res.	Rec.	Rec.

BICYCLE FACILITIES

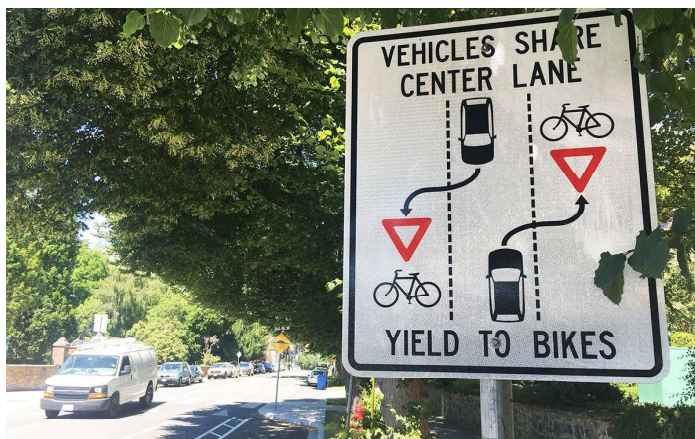
ADVISORY BICYCLE LANES

DESCRIPTION & INTENT

On lower volume neighborhood streets without lane markings, vehicles tend to drive in the middle of the roadway (staying clear of any on-street parking). When vehicles approach in opposing directions, they both slow down and bear right to pass each other.

Advisory bicycle lanes is a way to formalize the above behavior through pavement markings and to incorporate a designated zone for cyclists to ride. When vehicles traveling in only a single direction are present, bicycles effectively have dedicated lanes in which to travel. When opposing car traffic is present, vehicles will slow down and share a portion of the bicycle lane (yielding to cyclists if they are ahead of the vehicle) until the vehicles pass each other.

Beyond formalizing roadway behaviors on such neighborhood streets, the use of a narrow defined travel lane can incite vehicles to drive at calmer speeds and help raise the visibility of cyclists along the corridor, putting drivers on the alert.



USE & APPLICATION

Location

- **Usage:** Advisory bicycle lanes are only appropriate on streets that do not have delineated and marked travel lanes. Typically this will be on lower volume and lower speed (25 MPH or less) residential streets (see *Bicycle Facility* section).
- Advisory bicycle lanes should be considered along low stress neighborhood routes, and as part of neighborhood greenways or bicycle boulevards. Advisory bicycles lanes are a treatment that can go beyond merely signing “designated bike route” in that the pavement markings can change driver behavior and create a street condition where the priority of cyclists is elevated.

Related Design Elements

- **On-Street Parking:** Advisory bicycle lanes can be designed alongside on-street parking on one or both sides of the street.
- **Bumpouts:** At intersections with bumpouts, the approach to the intersection should transition to more conventional demarcated travel lanes with sharrow markings or kept wide enough to allow the bicycle lane to carry through the intersection in a conventional manner.

DESIGN & OPERATIONS

Design Requirements

- A Vehicle Lane Width:** The shared travel lane for vehicles should be a minimum of 10-feet and a maximum of 18-foot wide, with a preferred range of 13.5- to 16-feet ⁽¹⁾.
 - » Narrower shared lanes (closer to 10-feet) have a greater impact on controlling vehicle speeds.
 - » Widths wider than 18-feet should consider using narrow but fully delineated separate travel lanes.
- B** The overall clear width between the edge of any parking lanes or gutter lines, including both the shared travel lane and the bicycle lanes, should not be less than 20-feet, in order to allow the full range of vehicles to pass each other.
- C Advisory Bicycle Lane Width:** The advisory bicycle lanes should be a minimum of 5-feet wide.
 - » Where space allows, provide a 2-foot buffer adjacent to on-street parking to reduce dooring risk.
 - » Excess vehicle lane width can be allocated to bicycle lanes to provide greater passing space.
- D Pavement Markings:**
 - » The line separating the vehicle travel lane and the bicycle lane should be a white dashed line (3-foot segments with 6-foot gaps) ⁽¹⁾.

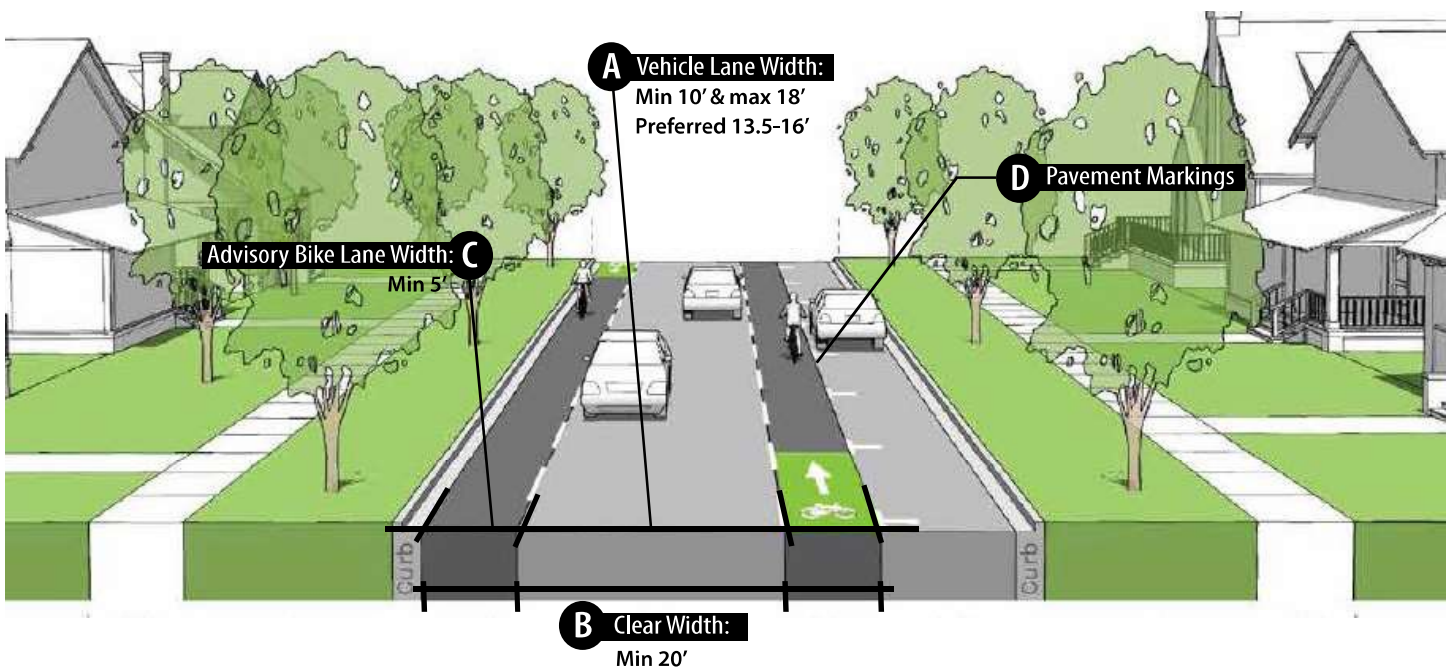
- » For the shared vehicle lane, do not use centerline markings during the mid-block portions of the roadway. When approaching an intersection that is stop or signal controlled, terminate the advisory lanes 30- to 50-feet from the stop bar and use sharrow markings (see *Sharrows*) with a normal vehicle lane centerline on the approach.
- **Signage:** Use signage (see example on prior page) to indicate the proper yield behavior for drivers. Using two-way traffic signs can also help reinforce that the roadway is intended for two-way travel.

Design References

- Small Town and Rural Multi-modal Network (FHWA, 2016) document provides additional design and geometric guidance on “advisory shoulders,” which are advisory bicycle lanes.
- Advisory Bike Lanes in North America (Alta, 2017) provides extensive review of case studies and findings, supporting effective design and implementation of advisory bicycle lanes.

MAINTENANCE & MANAGEMENT

- See *Bicycle Facility* section for overall guidance on maintenance of bicycle facilities.





STREET TYPOLOGY								
UC	E/F	MS	NB	CB	CC	NN	EN	LN
Opt.	Opt.	Opt.	Opt.	Lim.	Lim.	Opt.	Rec.	Opt.

BICYCLE FACILITIES

SHARROWS

DESCRIPTION & INTENT

Sharrows, also called shared lane markings, are pavement markings that indicate that a vehicle travel lane is intended to be shared with bicycle riders.

Sharrows remind drivers to expect the presence of cyclists and orient bicycles to the preferred line of travel along the roadway. Sharrows also remind cyclists to ride with traffic, not against it.

Sharrows are not a dedicated bicycle facility and not all cyclists will be comfortable riding in travel lanes and relying on sharrows.

USE & APPLICATION

Location

- Sharrows are most appropriate for streets with modest traffic volumes and slower travel speeds, including many downtown streets where slower driving speeds can be achieved.
- Sharrows are not appropriate on streets with high traffic volumes and higher speeds. Dedicated bicycle facilities should be used or bicycle traffic routed onto other streets.
- Sharrows should be used on roadways where the travel lane width is as narrow as possible (e.g. 10-feet) so that cars do not have adequate width to pass bicycle riders without crossing double-yellow centerline markings.

- Because cyclists remain in mixed traffic, sharrows generally do little to enhance comfort for the most vulnerable or risk intolerant cyclists and should be used cautiously on streets with high traffic volumes and higher speeds, such as vehicle emphasis streets.

Related Design Elements

- **Travel Lanes:** Sharrows are applied in otherwise typical vehicle travel lanes and do not affect overall dimension or assembly of the typical section.
- **Intersection Treatments:** Bicycle boxes or two-stage turn queues may be used in conjunction with sharrows.

DESIGN & OPERATIONS

Design Requirements

- **Marking Pattern:** Sharrows markings are two chevrons positioned above a bicycle symbol. See MMUTCD for detailed marking design.

- A Position from Curb:** Sharrows should be positioned in the center of the travel lane to encourage bicycles to utilize the full lane width where they will be more visible and better protected against door swing from parked vehicles.
 - » The MMUTCD specifies minimum (but not maximum) distances from center of the marking to the face of the curb as 11-feet where on-street parking is present and 4-feet where there is no on-street parking. These are the listed minimums, but there is maximum, which therefore allows placement within the center of the travel lane ⁽¹⁾.

- B Placement along Street:** Sharrows shall be placed in both directions of travel (unless other dedicated lanes are provided on just one side of the street). Sharrows should be placed at the start of a lane after an intersection, and spaced at 250-foot intervals or less (down to a minimum of 100-feet) ⁽¹⁾.

- **Signage:** At the start of each block where sharrows are used, install a “Share the Road” sign to properly alert drivers.

Sustainability Considerations

- Because sharrows are located in an otherwise typical vehicle travel lane, they do not present any obvious opportunities for green street treatments.

Design References

- The MMUTCD provides standards on shared lane markings (Part 9, Shared Lane Markings).
- The NACTO Urban Bikeway Design Guide provides additional guidance on designing and using sharrows.

MAINTENANCE & MANAGEMENT

- See *Bicycle Facility* section for overall guidance on maintenance of bicycle facilities.

