4.3

BICYCLE FACILITY DESIGN ELEMENTS

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DESCRIPTION & INTENT

Bicycle parking provides cyclists with a safe, secure, and reliable place to park bikes whether commuting, running errands, or patronizing downtown businesses. Bicycle parking is an essential component of the downtown’s multi-modal transportation network.

Ann Arbor city code establishes requirements for bicycle parking\(^1\) and identifies three types of bicycle parking (A, B and C):

- **Long-Term Bicycle Parking (A)**: Long-term bicycle parking is typically fully enclosed, secured and sheltered storage intended to accommodate a personal bicycle for a period of several hours or days. Spaces may be individually assigned and reserved and often require prearranged authorization to access (for example via a code, card or key). Long-term bicycle parking is generally necessary at places of work or residence, and most appropriately accommodated on private property. Typical means of providing for long-term bicycle parking include bicycle lockers, bicycle cages, sheds, or rooms.

- **Mid-term Bicycle Parking (B)**: Mid-term bicycle parking accommodates daily bicycle parking demands, such as parking during typical work shifts, school days, or other activities of two to eight hours in duration. Mid-term bicycle parking is not intended for bicycle storage. This parking is sheltered, but full enclosure is not necessary as parking should be accessible to, and shared by, many uses. Mid-term bicycle parking is best located on private property but immediately accessible and visible from the public street. Mid-term bicycle parking is typically satisfied by bike racks located within a parking structure, under an eave or overhang, or fitted with a stand-alone roof.

- **Short-Term Bicycle Parking (C)**: Short-term bicycle parking supports quick trips to destinations around downtown. Short-term bicycle parking is typically appropriate in the public right-of-way either in the Amenity Zone of the sidewalk or in the Curbside Zone of the street. It should be dispersed across downtown and easily accessible to every property on a commercial block. This type of parking is most often accommodated by bicycle hoops provided singly, in clusters of two or three, or in a public bike corral.

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\(^1\) Ann Arbor City Code, Chapter 59, section 5:167 Required Parking
**USE & APPLICATION**

This design element section primarily considered Short-term bicycle parking (type C) provided by bike racks located within the street right-of-way.

**Location**

- Bicycle parking is potentially needed in any frontage type, but is particularly necessary in Commercial, Civic & University, or Mixed use areas.
- In Destination Commercial areas, there may be competing depends for use of the Amenity Zone (e.g. for cafe dining & outdoor retail) and bicycle parking should be located to keep those areas open. Consider placing bicycle parking closer to intersections and not immediately in front of potential occupancy areas.
- Bicycle parking should be plentiful, dispersed, visible and conveniently located.
- Bicycle parking should facilitate transfers between modes. It should be accessible to major transit stops, transfer points and the Blake Transit Center.
- Locating bicycle parking near to corners improves visibility, access to curb ramps, and accessibility to more block frontages. Parking should be located far enough away from the corner to avoid conflicts with curb ramps or sight lines.

**Related Design Elements**

- **Pedestrian Area**: Bicycle parking must be located and aligned in a way that does not impede the pedestrian clear zone or block access between the curbside and clear Walking Zone.
- **Bicycle lanes**: Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes, lanes, protected bicycle lanes, and trails.
- **Bumpouts**: Bicycle parking works well in bumpouts or bike corrals that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.

**Incompatible Elements:**

- **Loading Zones**: Bicycle parking should not be located next to loading zones due to potential conflicts with vehicles loading or unloading materials.
- **Cafe Seating**: Bicycle parking compete with other Amenity Zone uses such as sidewalk cafes or sidewalk vending or retail. Some amount of bicycle parking should be provided to service every commercial block of downtown.

**Policy References**

- The Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guidelines.
DESIGN & OPERATIONS

Design Requirements

**Location**: Locate bicycle parking near building entrances in direct line of sight to the point of entry. Bicycle parking should be in areas that are well lit and have many eyes on the street to improve safety, comfort, and security. Avoid placing bicycle parking along blank walls where there is limited visibility from inside the building to the racks.

**Bike Rack Durability**: Racks shall provide secure parking for a bicycle. Bolted down racks (utilizing anti-theft bolts) are preferred. In brick environments, embedding is necessary. Racks shall resist cutting, damage, or disassembly with typically available implements.

**Bike Rack Design**: A 2 inch galvanized or powder coated steel “inverted U” is the preferred bicycle rack design in Ann Arbor. Other styles, including custom or artistic designs, are acceptable provided they meet the below requirements. Maintenance responsibilities must be clear when using any non-standard bike rack; an encroachment permit or licensing may be required.

- Racks shall support a bicycle in an upright position, supporting a bicycle frame in at least two places for common bicycle frame types.
- Rack design and installation shall enable bikes to be easily, intuitively, and securely locked. If artistic bicycle rack designs are used, ensure that U-locks or other typical locking devices can be conveniently used securing both wheels and frame of a bicycle.
- Racks should permit locking of both tires and accommodate “front in” and “back in” bicycle parking.

**Bike Rack Orientation and Clearance**: Bicycle racks may be placed parallel, perpendicular or at an angle to the curb line singly or in groups of two or more.

- When perpendicular to the curb, racks shall be at least 36 inches apart on center and shall be at least 34 inches from the face of curb and edge of the sidewalk.
- When placed parallel to the curb, racks shall be at least 5 feet apart at their nearest point. Bike racks shall be at least 24 inches from the face of curb (30 inches is preferred where width permits) and 18 inches from the edge of the sidewalk.
- When at a 45 degree angle, hoops should be at least 42 inches apart at center and shall be at least 34 inches from the face of curb at the closest point.
Design References

- The APBP Bicycle Parking Guidelines provide recommendations on the design and location of bicycle parking.\(^2\)
- The City of Ann Arbor Bicycle Parking Manual for Businesses provides design guidelines for placement and lighting of bike parking.

**MAINTENANCE & MANAGEMENT**

**Special Maintenance**

- Durable material and quality installation can significantly reduce maintenance demands. The DDA cooperates with the City of Ann Arbor Community Services Unit to track and remove abandoned bicycles.

**Seasonal Use & Maintenance**

- Bicycle parking should be available year-round and in all types of weather. Covered bicycle parking can promote year-round cycling.
- Property owners are responsible for snow removal adjacent to their property; bicycle parking should be kept clear after a snow event.
- Avoid snow storage that precludes the use of bicycle racks.

**Reviews & Approvals**

- The DDA reviews proposed bicycle parking in the public right-of-way. As part of site plan review, the DDA coordinates with the City of Ann Arbor Engineering Unit to evaluate conflict with other elements.
- The City of Ann Arbor Planning and Development Services review compliance with city code requiring bicycle parking on private property for all new construction projects.
- The DDA maintains standard bicycle hoops in the public right-of-way. The AAATA manages activities on transit authority property, including the Blake Transit Center.

\(^2\) http://www.apbp.org

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**Additional Design Considerations**

- Short-term bicycle parking is typically accommodated in the Amenity Zone of the sidewalk. Other acceptable locations include bumpouts and the Frontage Zone.
- Bicycle parking may be integrated with other street features such as parking meter posts, light poles, planters, parklets or tree guards.
- **Lighting:** Adequate lighting around bike parking is important for safety and security. Illuminate areas around bike parking to a minimum of 0.4 foot candles and max uniformity ratio of 10 to 1.
- Consider unobtrusive ways to provide cover or shelter to bicycle parking.

**Utility Considerations**

- Ensure that bicycle racks do not block access to utility boxes or hand holes.

**Sustainability Considerations**

- Bicycle parking promotes and enables human-powered, emission-free travel options providing a number of environmental benefits.
- Bicycle parking should be located proximate to street trees to avoid the temptation to lock bicycles to street trees and to reduce damage to the tree.
- Where bicycle parking is covered, consider incorporating solar panels, green roofs, and white roofs.
DESCRIPTION & INTENT

A bike corral is a designated area for short-term bicycle parking. Bike corrals provide parking for a number of bicycles in a compact area. Bike corrals may be located on sidewalks, in parking lots, or other areas behind the curb, but are often placed in the curb lane of the street. By converting a parking space into space for a bike corral, cities can accommodate parking for 12 to 20 patrons on bicycles in the space typically used to park one automobile.

Bike corrals can replace bicycle hoops, bike racks, freeing up sidewalk space for other uses such as additional pedestrian space or cafe dining. Bike corrals are an excellent solution for accommodating a large number of bicycles near specific activity areas and in areas with narrow sidewalks.

Bike corrals are often highly valued by ground floor businesses. Despite removing a valuable curbside parking space, many businesses have found that bike corrals improve accessibility and visibility to their establishment(s) in addition to relieving pressure on limited sidewalk space.

In downtown Ann Arbor, the DDA provides bike corrals and the use of the on-street parking space free of charge to businesses that request a corral and show demand (as can be accommodated).

USE & APPLICATION

Location

- Bike corrals should be used in areas of high volume of bicycle traffic, or near significant destinations such as business districts, schools or civic buildings.
- Bike corrals are suitable for all functional emphases and frontages contexts but demand for bicycle parking is likely to be highest in Destination Commercial, Commercial and Civic & University areas.
- Bike corrals are unlikely to be necessary in Near Neighborhood contexts.
- Bike corrals placed in the street may only be utilized in streets with reserved curbsides. Typically this means they will only be used on streets with on-street parking.
- Bike corrals in a northern climate like Ann Arbor may be temporary installations removed during the winter months to facilitate snow plowing activities. For this reason, additional bicycle parking alternatives may be necessary in areas where bike corrals are commonly used to continue to meet the need for bicycle parking even during winter months.
Related Design Elements

- **Bicycle Lanes**: Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes and facilities proximate to major generators or destinations.

- **Bicycle Parking**: Bicycle parking works well in bumpouts or bike corrals that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.

- **On-Street Parking**: On-street bike corrals may only be used on streets where the curb lane is not used for travel.

Incompatible Elements:

- **Loading Zones**: While bike corrals convert an on-street parking space, they should not be located in spaces reserved for loading.

- **On-street bike corrals should not be placed adjacent to locations where large trucks or transit vehicles stop, such as loading zones or bus stops.

**DESIGN & OPERATIONS**

**Design Requirements**

**Corral Design**: Ann Arbor has a standard bike corral design. To facilitate maintenance, this standard corral shall be used. Alternative designs may be possible with specific sponsorship and maintenance agreements and with Street Design Team approval.

- Racks shall be oriented perpendicular to the curb, placed 36 inches apart, and provide 42 inches between the rack and the face of curb.

- Bike corrals shall be immovable once placed, but capable of being removed and stored during winter months.

**Location**: Bike corrals shall be placed within a standard on-street parking space. Corrals placed at the end of a bank of parking can prevent parked cars from creeping too close to the intersection area.

**Corral Enclosure**:

- Provide protection on either end of the bike corral to prevent damage by autos parking or traveling.

- The Ann Arbor standard is to have the enclosed side of the standard bike corral toward the travel lane of the street with access from the sidewalk side.
Additional Design Considerations

- **Alternate Corral Designs**: There are many types of bike corral designs. Alternative designs are possible provided the design complies with above guidelines and provides protection from the travel lane (per Ann Arbor standards), and provides protection on either end of the bike corral. DDA manages and maintains since we are the only one who puts them in.

  » An alternative design, used in many cities, is an open design permit bicycle parking access from either the street or sidewalk side.

- **Shelters**: Bike corrals with roofs may provide sheltered bicycle parking as long as they do not interfere with sight lines.

- **Bumpouts**: Bike corrals may be located on bumpouts or where there is adequate space.

- **Bicycle Repair Stations**: Consider placing a bicycle repair station adjacent to or integrated with the corral. A repair station is an outdoor frame that contains tools for fixing a bicycle, such as a tire pump. Individual tools can be secured to the station with a flexible band that allows cyclists to use them on their bike without the potential for theft. There is a bicycle repair station located at city hall.

Utility Considerations

- Do not locate bike corrals over vaults.

- Consider stormwater facilities when siting.

Sustainability Considerations

- Bike corrals not only accommodate demand for bicycle parking but also promote the visibility of this low-emission form of travel.

- If bike corrals are covered, consider incorporating solar panels, green roofs, and white roofs.

### MAINTENANCE & MANAGEMENT

#### Special Maintenance

- Durable material and quality installation can reduce maintenance demands for bike corrals.

- The DDA cooperates with the Ann Arbor Community Standards Unit to track and remove abandoned bicycles.

#### Seasonal Use & Maintenance

- On-street bike corrals are typically removed and stored during winter months to facilitate snow removal.

#### Reviews & Approvals

- The DDA is responsible for installation and maintenance of standard parking corrals in on-street parking spaces. Outside of parking lanes or parking facilities, placement of bike corrals should be coordinated through the Ann Arbor Engineering Unit, Systems Planning Unit, and the DDA.
4.3 BICYCLE DESIGN ELEMENTS

[BIKE CORRAL]
DESCRIPTION & INTENT

Sharrows, or shared lane markings (SLMs), are pavement markings that indicate a lane explicitly intended to be shared by motor vehicles and significant numbers of cyclists. Sharrows alert motorists to expect cyclists, remind motorists of the legitimacy of cyclists to use the roadway, and orient bicycles to the preferred line of travel outside the dooring zone. 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 to alert motorists.

USE & APPLICATION

Location

- Sharrows may be used on all street types where road width is too narrow to accommodate a bicycle lane, except for bicycle emphasis streets which require dedicated bicycle facilities (e.g. bicycle lane, buffered bicycle lane).

- 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.

- Sharrows are most appropriate for streets with modest traffic volumes and slower travel speeds. Sharrows are not appropriate on streets with high traffic volumes and higher speeds, and dedicated bike facilities should be used or bike traffic routed onto other streets.

- Sharrows typically are not used on roadways with very low vehicle volumes and speeds, such as Near Neighborhood residential streets, except when part of a bicycle emphasis route.
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**: Bike boxes or two-stage turn queues may be used in conjunction with sharrows.
- **Street Lighting**: Streets with sharrows should be adequately lit to enhance safety.

Policy References

- The City of Ann Arbor Non-Motorized Transportation Plan Update is the city policy document on bicycle accommodations.

**DESIGN & OPERATIONS**

Design Requirements

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

**Position from Curb**: If the travel lane is adjacent to the curb, sharrows shall be positioned 4 feet from the curb face. If the travel lane is adjacent to a parking lane, sharrows shall be placed 11 feet from the face of curb.

**Placement along Street**: Sharrows shall be placed in both directions of travel if other bicycle facilities, such as climbing lanes, are not provided. Place marking immediately after an intersection and space at intervals not greater than 250 feet thereafter.

Additional Design Considerations

- Experimental treatments include the use of dotted lines and/or painted zones used in conjunction with sharrows to designate the bicycle line of travel. These are referred to as “super sharrows” or “priority shared lanes.” Although more visible, super sharrows are not an adequate substitute for dedicated bicycle facilities on bicycle emphasis streets.
- Sharrow use is not affected by seasonal variations.
• Additional street signage, such as a “Share the Road” signs, may be used in conjunction with sharrow markings to further reinforce the shared use of the road for motorist.

Utility Considerations

• Locate manholes should out of identified bicycle line of travel as they can produce a rough, slippery, and uncomfortable ride.

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.
• The NACTO Urban Bikeway Design Guide provides additional guidance on designing and using sharrows.

MAINTENANCE & MANAGEMENT

Special Maintenance

• Sharrows are additional pavement markings in the roadway that and additional maintenance to ensure they remain highly visible. Use of dotted lines and/or colored paint add further maintenance requirements.
• Placing sharrows toward the center of the lane may reduce wear and fading because the sharrows are located between the primary wheel track of vehicles.

Seasonal Use & Maintenance

• Shared lanes do not require any unique snow removal procedures. The travel lane and parking lane (where provided) should be cleared of snow for the full width to reduce vehicle encroachment onto the line of travel established by sharrows.

Reviews & Approvals

• The Ann Arbor Systems Planning Unit in collaboration with other units determines appropriate use of
4.3 BICYCLE DESIGN ELEMENTS

[SHARROWS]
DESCRIPTION & INTENT

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

On-street lanes alert motorists to the presence of a bike 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 downtown Ann Arbor. 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. See Left-Side Bicycle Lane and Contra-flow Bicycle Lane.

USE & APPLICATION

Location

- Bicycle lanes are appropriate for all Frontage Contexts and Functional Emphasis streets but may be most common on balanced and bicycle emphasis streets.

- Bicycle lanes require the least amount of space of any dedicated on-street bicycle facility, but in the narrow corridors of downtown, installation of bicycle lanes may only be possible with the removal of parking or travel lanes. This must be weighed against other needs and priorities for unique Frontage Context areas.

- On bicycle emphasis streets, bicycle lanes are required unless a higher level dedicated facility is used (buffered bicycle lane or protected bicycle lane) instead. On bicycle emphasis streets, other competing space uses (e.g., parking lanes) should be prioritized below dedicated bike facilities.

Related Design Elements

- **Transit**: Buses and bicycles may conflict at curbside bus stops. Sensitive design and/or location may reduce conflicts.

- **Roadway Widths**: Wider bicycle lanes may improve cyclist comfort and safety, but may also contribute to wider pedestrian crossings or encourage illegal parking or travel in the bicycle lane.

- **Intersection Treatments**: Using bike boxes or two-stage turn queues at signalized intersections with high bicycle usage or turn demand may increase the comfort and attraction of cycling in downtown.

- **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 not extend into the bicycle lane. See Bumpouts.

Incompatible Elements:

- **Driveways and Curb Cuts**: Motorist entering or exiting may not see approaching cyclists. Pavement markings can identify conflict zones.

- **Diagonal Parking**: Front-in diagonal parking conflicts with safe and comfortable use of a bicycle lane and should be avoided where bicycle lanes are provided. Parallel parking is preferred in downtown.

**Design Requirements**

- **Lane Width**:  
  - When the bicycle lane is between the travel lane and parking lane, combined width of a bicycle lane and adjacent parking lane shall be at least 12 feet wide. Additional width and marking the door swing zone is preferred.
  - Per the FHWA safety guidance, bicycle lanes adjacent to the curb shall be at least 4 feet wide exclusive of the gutter pan (5 feet is preferred, measured from face of curb, per the City of Ann Arbor Non-Motorized Transportation Plan Update).

  » Add 2 feet for bicycle lanes adjacent to guardrails, walls or other vertical barriers to account for the shy zone.

- **Markings**: A solid white 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 unless a separate bicycle signal is provided.
**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 motorists 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 bike tires. Ensure openings in grates are perpendicular to the bicycle direction of travel to avoid trapping bicycle tires.

- **High Visibility Paint**: Use green paint to further distinguish bicycle lanes in areas where there is a particular need. Use hatched green paint to highlight areas of bicycle/vehicle conflicts and solid green to emphasize bike-only lanes.

- **Signs**: Additional signage may be used to indicate presence of bicycle lanes.

**Design References**

- The MMUTCD provides standards for bicycle lane design.

- The City of Ann Arbor Non-Motorized Transportation Plan Update provides guidance on bicycle lanes and locations for recommended installation in downtown.

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

**Utility Considerations**

- If trenching is done in the bicycle lane, repair the entire width of the bicycle lane so there is not an uneven surface.

- Avoid locating manholes in bicycle lanes.

- Ensure any utility or vault covers are flush with the road surface and properly set and maintained.

**MAINTENANCE & MANAGEMENT**

**General Maintenance**

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

**Seasonal Use & Maintenance**

- Bicycle lanes should always be plowed during snow events and should never be used for snow storage.

**Reviews & Approvals**

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.

- The Ann Arbor Field Operations Unit is responsible for maintaining bicycle lanes.
4.3 BICYCLE DESIGN ELEMENTS
[CONVENTIONAL BICYCLE LANES]
DESCRIPTION & INTENT

Buffered bicycle lanes are on-street bicycle facilities with separation between the bicycle facility and other roadway uses. Buffered bicycle lanes are distinct from protected 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, or other bicycle facilities offering an enhanced level of comfort and safety, are an important tool in creating a bicycle network that meets the needs and demands of cyclists of all abilities from young novices, to casual cyclists, experienced riders and cautious older bikers.

Buffered bicycle lanes increase comfort over conventional bicycle lanes by providing greater separation from conflicting uses. Buffered bicycle lanes may not offer the same level of comfort as protected bicycle lanes, but may be installed at a lower cost, offer lower maintenance challenges, and require a modestly smaller cross-section.

Buffered bicycle lanes increase the distance between vehicles and cyclists. The additional buffer may also reduce the risk of cyclists getting “doored” by parked cars and allows cyclists to pass one another without entering the general traffic lane. Buffers significantly reduce driver encroachment on bicycle facilities increasing safety, operations, and comfort; in turn, helping increase the appeal of cycling and share of bicycle trips for people of all ages and abilities.

USE & APPLICATION

Location

- Buffered bicycle lanes are most appropriate on bicycle emphasis streets and should be used over conventional bicycle lanes if there is sufficient room. Buffered lanes should be considered as an alternative to conventional bicycle lanes whenever bicycle lanes are proposed.

- Buffered bicycle lanes may be used on one- or two-way streets with or without on-street parking. Buffered bicycle lanes require more space than conventional bicycle lanes. Implementing them may require reduction of other street elements such as narrowing or converting a travel or parking lane.

- Buffered lanes are more effective and appealing on streets with longer blocks and few interruptions, such as driveways or transit stops. Buffered facilities should ideally extend for several contiguous blocks along a corridor.

Related Design Elements

- **Intersections**: Buffered bicycle lanes require additional considerations in the design of intersections and associated pavement markings.
**Bike Boxes**: Consider using a bike box at intersections to give cyclists in the buffered bicycle lane additional protection.

**Bicycle signals** can provide cyclists with their own signal phase, giving them a conflict-free path across the intersection.

**Traffic Signal Timing**: Due to the increased likelihood of bike traffic where buffered bicycle lanes are used, consider timing traffic signals to accommodate bicycle speeds.

### Incompatible Elements

**Bus Bulbs**: Buffered bicycle lanes can conflict with bumpouts, especially at transit 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 Bulb Design Element for Additional Guidance.

**Mid-Block Crossings**: Buffered bicycle lanes may conflict with mid-block pedestrian crossings.

**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 bicycle travel way or lane shall be at least 5 feet wide measured from the face of curb.

**B Buffer Width**: The buffer shall be a minimum of 2 feet wide measured from the center of the bicycle lane stripe. 3 feet is preferred. Buffer may be up to 6 feet wide in the event of a converted travel lane.

- Buffered area consists of two solid painted lines (6-8 inch outside line, 4 inch inside line) with diagonal stripes in between at 30 to 45 degrees and spaced 10 to 40 apart on center.

**Intersection Transitions**: Address transition and/or conflicts at intersections. Treatments may include conversion to a conventional curbside bicycle lane, cross-over through lane, or shared space, among other applications.

### Additional Design Considerations

- **Marking Recess**: Recess marking to minimize maintenance requirements and maintain reflectivity.

- **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 may be used for the entire buffered bicycle lane, at entrances to the bicycle lane, or through intersections.
4.3 BICYCLE DESIGN ELEMENTS
[BUFFERED BICYCLE LANE]

**Design References**

- The City of Ann Arbor Non-Motorized Transportation Plan Update provides guidance on buffered bicycle facilities and priority bicycle corridors. MMUTCD provides standards on markings and signage associated with buffered bicycle facilities.
- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design buffered bicycle lanes and where to use them.

**Utility Considerations**

- If trenching is done in a buffered bicycle lane, repair the entire width of the bicycle lane to avoid an uneven surface, which can be dangerous for cyclists.

**Sustainability Considerations**

- Buffered bicycle facilities may offer an opportunity for porous concrete or asphalt treatments; however, use of non-standard materials in the roadway must be carefully reviewed and specifically approved.

**MAINTENANCE & MANAGEMENT**

**Special Maintenance**

- Buffered bicycle facilities introduce additional pavement markings that must be maintained. Buffered bicycle facilities should be swept of debris.

**Seasonal Use & Maintenance**

- Providing a flush painted buffer facilitates snow removal. Bicycle lanes of any type should not be used for snow storage.

**Reviews & Approvals**

- The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.
- The Ann Arbor Field Operations Unit is responsible for maintaining bicycle lanes.
4.3 BICYCLE DESIGN ELEMENTS

[BUFFERED BICYCLE LANE]
DESCRIPTION & INTENT

Protected bicycle lanes, also known as cycle tracks or separated bicycle lanes, are exclusive bicycle facilities that are physically separated from general traffic. Protection and separation is provided by a vertical barrier of some type, commonly a curb, parked vehicles, planted medians, or flexible posts. These physical protections distinguish separated bicycle lanes from buffered bicycle lanes.

Protected bicycle lanes may be one directional on one or both sides of a street or bi-directional in the center or on either side.

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

USE & APPLICATION

Location

- Protected bicycle lanes are appropriate where there are high levels of bicycle activity (or where cycling activity is expressly desired to be concentrated or accommodated). Protected bicycle lanes are recommended on bicycle emphasis streets as an enhanced alternative to conventional bicycle lanes or buffered bicycle lanes where room can be provided.

- Protected bicycle lanes have the most attraction and impact when implemented for multiple contiguous blocks.

- While protected bicycle lanes offer more protection and attraction than standard on-street bicycle lanes, they also require a greater amount of street space. Protected bicycle lanes often require the conversion of curbside parking or a travel lane for implementation, which may be a significant concern in Destination Commercial and pedestrian and access emphasis Commercial areas.

Related Design Elements

- Crosswalks: Protected bicycle lanes are exclusively for bicycle travel and should not be used as pedestrian walkways or waiting areas. Pedestrian medians may be provided in near the protected area to provide additional refuge opportunities for pedestrians when crossing the street.
• **Two-stage turn queues or bicycle boxes** should be used to facilitate left turns from protected bicycle lanes to other bicycle corridors or facilities.

• **Bicycle Parking**: Provide bicycle parking regularly along protected bicycle lanes.

• **Sidewalk Furnishings**: Place sidewalk curbs and furnishings in such a way to discourage pedestrians from walking on the protected bicycle lane.

• **Wayfinding** systems will allow protected bicycle lane users to navigate the bicycle network and find their way to local destinations.

• **Traffic Signals**: Due to the increased likelihood of bicycle activity where protected bicycle lanes are used, traffic signals should be timed cognizant of bicycle speeds. Reducing delays for cyclists will increase the likelihood that cyclists using the protected bicycle lane will comply with the traffic signal.

**Incompatible Elements**

• **On-Street Parking**: Introducing protected bicycle lanes in downtown Ann Arbor will likely require the removal of on-street parking or a travel lane. This may be unacceptable in many block contexts, but is most appropriate and beneficial on bicycle emphasis streets and on blocks that transition from neighborhood to commercial streets. Creative solutions can maintain the qualities of the protected bicycle lanes while meeting other local context objectives as well.

• **Curb Cuts**: Driveways, alleys, curb cuts and frequent loading activity introduce conflict into a protected facility. Protected bicycle lanes work best on corridors with minimal conflicts.

• **Mid-block pedestrian crossings** may introduce conflict between bicycles and pedestrians. Design solutions should be sought where this condition is necessary.

### DESIGN & OPERATIONS

#### Design Requirements

**Lane Width**: Protected bicycle lanes shall have a minimum of 5 feet for a one-directional facility and 8 feet for a two-way protected bicycle lane (10 feet is preferred).

**Lane Separation**: Protected bicycle lanes shall be separated from motor vehicle traffic and clearly distinct from pedestrian zones.

**Buffer Width**: A minimum of 3 feet is required for the separation barrier (5 feet is preferred) between the bicycle lanes and travel lanes.

**Parked cars** (parking lane) may be used as a barrier between the protected bicycle lane and travel lanes. In this case, temporary or permanent curbing and/or flexible posts should be used to ensure parkers do not encroach upon the bicycle facility.
Protected 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 from pedestrian space.

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

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

- **Signage and Markings**: Use colors, yield lines, and “Yield to Bikes” signage to make it clear that the protected bicycle lane has priority over crossing traffic. Point of conflict or intrusion, such as at intersections, alleys or significant driveways, should be clearly marked for both the cyclist and motorist.

- **Sight Lines**: Maintain visibility and sight triangles at driveways, alleys, or intersections.

**Additional Design Considerations**

- **Bus Bulbs**: Protected bicycle lanes shall be routed behind transit bus bulbs to eliminate conflicts between boarding or alighting passengers and through cyclists. See Bus Bulbs Design Element for additional guidance.

- **Snow Clearing**: Protected bicycle lanes may be designed to permit snow clearance using existing equipment. Snow should be cleared from protected bicycle lanes the same as any other roadway facility.

- **Bike Signals**: Bicycle signals may be necessary for two-way protected bicycles lanes.

- **Traffic Controls**: Flexible posts may be necessary at entry points to the protect bicycle lane to prohibit vehicles from entering.

**Utility Considerations**

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

**Sustainability Considerations**

- Given the lighter weight of cyclists and lower volumes, protected bicycle lanes may be opportunities for permeable pavement techniques.

**Design References**

- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design protected bicycle lanes and where to use them.

- The MMUTCD offers standards on signage and pavement markings for protected bicycle facilities.

- The CROW Design manual for bicycle traffic (Netherlands) provides additional guidance for facility design related to volume of users.
MAINTENANCE & MANAGEMENT

General Maintenance

• Protected bicycle lanes require street sweeping and should be designed to accommodate existing equipment.

• Special measures may be necessary to deter motorist or delivery vehicles from parking in protected bicycle lanes.

Seasonal Use & Maintenance

• Design protected bicycle lanes to accommodate snow removal equipment (or enter into special maintenance agreements to independently remove snow from bicycle facilities).

• Removable barriers such as flexible posts or rubber curbing should be removed prior to the winter snow season. Do not store snow in bicycle facilities.

Reviews & Approvals

• The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.

• The Ann Arbor Field Operations Unit is responsible for maintaining bicycle lanes.
INTERSECTION ZONE

BIKE BOXES

DESCRIPTION & INTENT

A bike box is a dedicated area for cyclists at the front of a traffic lane at a signalized intersection. Bike boxes make cyclists more visible to motorist by positioning them at the head of a queue during a stop cycle. They provide a space for cyclists to queue outside of crosswalk areas. Bike boxes enable cyclists to safely position for a left turn during a stop cycle at an intersection. On corridors of high bicycle activity, bike boxes cluster multiple cyclists and enable them to progress forward at the onset of the green signal cycle. This clears a bicycle lane more quickly allowing for a sooner progression of right turning vehicles. Bike boxes can improve safety by reducing or eliminating the need for bicycles to weave across travel lanes to make a left turn and reducing conflicts with right turning vehicles, “right hooks.”

Bike boxes can significantly increase the visibility and appeal of bicycling in a downtown area and support increased bicycling activity.

USE & APPLICATION

Location

- Bike boxes are used only at signalized intersections.
- Bike boxes must be used in conjunction with “No Right Turn on Red” (and “No Left Turn on Red”) restrictions. This limitation must be considered when determining appropriate locations for the use of bike boxes.
- Bike boxes are most beneficial on streets with high bicycle volumes1 (5 or more in queue during peak hours), locations with significant left turn bicycle activity, and/or intersections where conflicts between right turning vehicles and bicycles are common.
- Bike boxes may be appropriate in any street type but generally should be reserved for areas where high bicycle activity is anticipated or desired, such as on bicycle emphasis streets.
- Bike boxes may also be desirable in high pedestrian zone areas to protect crosswalks from encroachment by bicycles or vehicles.
- Bike boxes are a new application in Michigan. While relatively logical, straightforward and easy to use, education and outreach to motorist, cyclists and pedestrians may be necessary to ensure their safe and appropriate use.

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1 “High bicycle volume” is a subjective measure. Precise warrant thresholds for bike boxes do not presently exist. Typically bike boxes are applied at locations where several cyclists (5 or more) may queue in a bicycle lane during the peak hour, though bike boxes may also serve an important purpose at lower volume locations and should not be precluded based on volumes alone.
Related Design Elements

Incompatible Elements:

- **Right on Red**: Bike boxes may not be used where a right-turn on red is permitted.
- **Unsignalized Intersections**: Bike boxes may not be used at unsignalized intersections.

**DESIGN & OPERATIONS**

**Design Requirements**

- **Box Size**: The bike box is formed by two parallel pavement marking lines at least 6 inches thick forming a box at least 10 feet or more in depth and extending from the outside of the bicycle lane across all travel lanes in the direction of travel.
- **Placement**: Bike boxes are located between the crosswalk and the vehicle advance stop bar.

- **Placement**: The vehicle stop bar shall be moved back to the rear of the bike box. Stop bars may be moved back up to an additional 7 feet to prevent encroachment into the bike box.

**Additional Design Considerations**

- **“Wait Here”**: “Wait Here” pavement marking or signs may be used to indicate to vehicles where to stop to avoid encroachment on the bike box.
- **Special Pavement Markings**: Green pavement marking is commonly used in bike boxes but is not required.
- **Bike Boxes Without Bike Lanes**: When bicycle lanes are not present, bike boxes can still be used by providing a short ingress bike lane to provide bicycles access to the bike box as they approach the intersection. Green pavement marking may be used in the bicycle approach lane.

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**Diagram Notes**

- **A**: Bike Box Min 10’ in depth
- **B**: “Wait Here” markings
- **C**: Bike boxes shall be separate and distinct from the crosswalk and may be moved further back from the crosswalk to create more separation and prevent cyclists from blocking the crosswalk.
- **D**: Bicycle Markings: Bicycle symbol pavement markings are located within the bike box in all lanes over which it extends.
- **E**: No Right Turn on Red: Right turn on red shall be prohibited where bike boxes are used and shall be signed accordingly.
• Bicycle egress lanes may continue into the intersection to indicate the area of potential conflict between motorists and cyclists. Green pavement marking may be used.

• **Two-Stage Turn Queues:** While bike boxes facilitate the positioning of cyclists to make left-hand turns, lateral movement by a cyclist after the initiation of the green phase could introduce conflicts with motorists. Two-stage turn queues are an alternative to accommodate left turning cyclists.

• **Enforcement:** Driver encroachment into bike boxes is typically no more common than encroachment into crosswalks and typically requires no additional enforcement.

**Design References**

• Bike boxes are currently experimental treatments. The National Committee on Uniform Traffic Control Devices (NCUTCD) Bicycle Technical Committee has proposed draft guidance for bike boxes to be adopted into the MUTCD.²

• The NACTO Urban Bikeway Design Guide provides further guidance on the use and design of bike boxes.

**MAINTENANCE & MANAGEMENT**

**General Maintenance**

• Bike boxes are additional pavement markings that will require maintenance.

**Reviews & Approvals**

• The Ann Arbor Engineering and Systems Planning Units work collaboratively to determine locations for installation of bike boxes in coordination with the Street Design Team.³
INTERSECTIONS

TWO-STAGE TURN QUEUE

DESCRIPTION & INTENT

A two-stage turn queue provides a protected area for cyclists to move out of the through traffic lane on the right hand side of a street and wait for the green cycle of the intersecting road before proceeding across to complete the turn.

Left turns can be a difficult challenge for cyclists who typically travel along the right side of a roadway. Merging across travel lanes can be dangerous and stressful, particularly for novice or concerned cyclists. Two-stage turn queues reduce bicycle/vehicle conflicts and provide a less stressful left-turn option.

While two-stage turn queues increase bicycle comfort and accommodation at multi-lane intersections, they do require two separate stages for a cyclist to complete a left-turn (first proceeding across, then proceeding through to the left). This may increase travel time for cyclists, although the benefit of comfort outweighs the time penalty. This makes two-stage turn queues a net positive in expanding cycling in downtown and making cycling more accessible to a broader range of cyclists.

Even where two-stage turn queues are provided, their use is optional. Cyclists may still lawfully complete a left turn from the left-most travel lane where vehicular left turns are also permitted.

USE & APPLICATION

Location

- Two-stage turn queues may be used on any street type, but are especially appropriate where there are significant volumes of turning cyclists, along preferred travel routes where the City wishes to encourage cyclists, and/or where accommodation of less confident cyclists is needed.

- Two-stage turn queues are beneficial where traffic volumes can make it difficult to get into a normal left-turn position and/or where cyclists frequently need to pause in the intersection to wait for on-coming traffic to clear before turning. This is a common situation on many downtown streets in congested Destination Commercial and Commercial areas.

- Two-stage turn queues are particularly beneficial on multi-lane streets (e.g. streets with more than one travel lane in any one direction including turn lanes).

- Two-stage turn queues are commonly used to provide left turns where cyclists typically travel on the right-hand side of the street but may similarly be used to accommodate right turns from a left-side bicycle facility.

- Two-stage turn queues are generally used in conjunction with other bicycle facilities, such as bicycle lanes or protected bicycle lanes, but may be used on any corridor where safe and comfortable accommodation of left-turning bicycles is needed.
Related Design Elements

- **Intersections**: Two-stage turn queues rely on a safe and protected location for bicycle queuing prior to completing the turn. Two-stage turn queues must be considered in the complexity of an intersection and must not block through travel during the first stage crossing (including through bicycle travel).

- **Curbside Uses**: Two-stage turn queues work well on streets with on-street bicycle parking (corrals), bumpouts or other reserved curbside use, but may be used elsewhere as well.

- **Signals**: Two-stage turn queues may be used at signalized or unsignalized intersections. While typically unnecessary at stop-controlled intersections, they may be used. If signals are actuated, locate detectors and/or turn queues where bicycles will be detected.

Incompatible Elements

- Two-stage turn queues should not be placed in front of right-turning vehicle lanes when right turns on red are allowed.

- Two-stage turn queues should not be placed adjacent to transit stops, as there may be a conflict between passengers boarding and cyclists waiting in the queue.

### DESIGN & OPERATIONS

**Design Requirements**

- **Bicycle Movement**: A two-stage turn queue shall consist of a “first stage” bicycle travel facility, a bicycle lane, and a “second stage” queue box that accommodates cyclist waiting for the signal prior to completing the turn.

- **Queue Size**: The two-stage turn queue shall be at least 10 feet wide by 4 feet deep but may be increased in size based on the expected volume of queued cyclists.

- **Queue Location**: Two-stage turn queue for a second stage queue shall be in a protected location, between the crosswalk and the closest through bicycle or travel lane. Two-stage turn queue should align with the right-side travel lane or bicycle facility of the receiving street.

- **Pavement markings** in the two-stage turn queue shall signify cyclist and indicate proper direction and positioning.

- **Right on red turn** shall be prohibited where turn boxes are used to avoid conflicts with queued and waiting cyclists.
Additional Design Considerations

- **High-Visibility Markings**: Use green pavement to increase visibility and legibility of the two-stage turn queue.

- **Bicycle Lane Markings**: If bicycle lanes are present, use dashed lines to indicate bicycle lane through the intersection and ensure queued cyclists stay clear of this travel facility.

- **Signal Detection**: If detectable/actuated signals are used, ensure bicycles will be detected in the two-stage turn queue. Bicycles should not be required to use pedestrian actuation to gain crossing.

- **Crosswalks and Bike Boxes**: Under constrained circumstances, crosswalks may be adapted to enable space for bicycle queuing. Alternatively a standard bike box (see Bike Box) may be used; this, however, requires cyclists to cross the pedestrian line of travel and should only be used where pedestrian volumes are low.

Design References

- MMUTCD provides standards on pavement marking and signage standards.

- The NCUTCD Bicycle Technical Committee has proposed draft guidance for two-stage turn queues to be adopted into the MUTCD.¹

- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of two-stage turn queues.²

MAINTENANCE & MANAGEMENT

General Maintenance

- Two-stage turn queues result in additional pavement marking that will require maintenance. The use of green markings may add additional maintenance complexity.

- Placing markings between vehicle tire tracks may reduce wear and tear.

Seasonal Use & Maintenance

- **Snow Removal**: Two-stage turn queues should be cleared of snow concurrent with all other street snow removal activities. Bicycle facilities should not be used for snow storage.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning units work collaboratively to determine locations for installation in coordination with the Street Design Team. Since this is a new treatment for Ann Arbor, the Street Design Team should work with staff to educate the community before and during the initial installation phase.

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¹ [http://www.ncutcdbtc.org/sponsors.html](http://www.ncutcdbtc.org/sponsors.html)

² [http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/two-stage-turn-queue-boxes/](http://nacto.org/cities-for-cycling/design-guide/intersection-treatments/two-stage-turn-queue-boxes/)
4.3 BICYCLE DESIGN ELEMENTS
[TWO-STAGE TURN QUEUE]
DESCRIPTION & INTENT

Bicycle signals are separate traffic signals used to guide and direct cyclists at intersections. Instead of the standard circle or arrow symbols, bicycle signal heads display a bicycle outline in each color phase. Bicycle signals are designed to reduce conflicts by separating bicycle and motor vehicle movements.

USE & APPLICATION

Location

Bicycle signals are used only at signalized intersections and when bicycle-only and/or leading bicycle intervals are required during a signal cycle. This may occur:

- Where contra-flow bicycle lanes join or cross an intersection.
- Where bicycle and pedestrian volumes are sufficiently high that a bicycle leading interval would be advantageous to safety and/or operations.
- Where two-way protected bicycle lanes are used.
- At intersections with high bicycle volumes, a significant number of vehicle/bicycle crashes and/or geometrically complex intersections.

At present, there are no nationally established thresholds or warrants for bicycle signals. The California MUTCD is a leading state example that provides warrants for volume and collision and volume and geometric thresholds (at least 50 bicycles per peak hour, two or more bicycle/vehicle collisions within a 12-month period of types that could be reduced by a bicycle signal, and/or a movement or connection not open to vehicles is required). ¹

Some jurisdictions have adopted signs instructing cyclists to follow pedestrian signals in lieu of bicycle signals. This is not generally recommended.

Use of bicycle signals will generally be limited to bicycle emphasis street intersections. At present, few, if any, intersections in downtown Ann Arbor exist where bicycle signals are necessary. However, with enhanced bicycle facilities and anticipated increased bicycle activity, installation of bicycle signals may be desired.

Related Design Elements

- Bicycle signals shall not be used in conjunction with sharrows.
- Bicycle signals and their associated stop zone should not impede the Sidewalk or crosswalk zone.
- Bicycle signals may necessitate prohibition of right on red.

**DESIGN & OPERATIONS**

**Design Requirements**

- **Orient signal heads** to be clearly visible to on-coming cyclists.

- **Signal Activation**: Automatic detection is preferred. If manual activation is required, push buttons shall be located where cyclists can easily access them without leaving the bicycle facility. If the bicycle signal is not programmed into each light cycle actuate bicycle signal manually (e.g. push button) or automatically (e.g. in-pavement loop detector).

**Additional Design Considerations**

- **Right-Turn On Red**: If the bicycle signal separates bicycle movements from motor vehicle turning movements, right turn on red should be prohibited.

- **Signage**: Bicycle signals may be accompanied by unique signage targeted at the cyclist to explain the function and use of the signal. This is particularly valuable if bicycle signals are uncommon or if the movement governed by the signal is unique to bicycles.

- **Signal Timing**: The introduction of bicycle signals may require overall signal re-timing and periodic timing reassessment. There is no specific established guidance at present as to bicycle clearance intervals or other phasing.

**Design References**

- The FHWA has provided interim approval for the optional use of a bicycle signal face (December 2013).

- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of bicycle signals.

- MUTCD provides standards for traditional traffic signals, however not all guidance may be applicable specifically to bicycle signals.

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**MAINTENANCE & MANAGEMENT**

**General Maintenance**

- Bicycle signals will require additional infrastructure and maintenance and long-term maintenance will be the same as other signalized intersections.

**Seasonal Use & Maintenance**

- Bicycle signals do not demand any special snow removal protocols.

**Reviews & Approvals**

- The Ann Arbor Engineering Unit, in collaboration with Systems Planning and Field Operations Units, will review proposed signals and recommend installation if needed.
ROADWAY ZONE

CONTRA-FLOW BICYCLE LANES

DESCRIPTION & INTENT

One-way streets are common in downtown Ann Arbor. While one-way operations may facilitate auto mobility, for cyclists, one-way networks require out-of-the-way travel that adds additional time and exposure to their bicycle trip. In response, cyclists may violate the one-way operation or ride on sidewalks. In these situations, contra-flow bicycle lanes may provide an improvement for cyclists, motorists and pedestrians alike.

Contra-flow bicycle lanes stripe a narrow space into the one-way streets that provides a lane that permits cyclists to lawfully travel in the opposite direction of motorized traffic. They effectively make the street two-way for cyclists while maintaining one-way operations for vehicles. Blocks of Ann Arbor such as Fifth or Division Avenues or segments of Detroit Street may benefit from these connections.

Contra-flow bicycle lanes typically address unique and limited conditions in a downtown where one-way vehicular operations result in inefficient bicycle connections. Contra-flow bicycle lanes are tools to bridge short interruptions in desired bicycle travel paths. They improve the ease, attraction, and efficiency of this travel mode and reduce bicycle riding on sidewalks.

USE & APPLICATION

Location

- Contra-flow bicycle lanes are often established on single blocks or short segments in the area(s) of highest demand.
- Contra-flow lanes can be used in any frontage type or transport emphasis; however, recommended locations in downtown are limited. Careful design is necessary when locating contra-flow lanes on major vehicular and/or transit corridors, such as Fifth and Division Avenues, to ensure safe operations.
- Contra-flow bicycle lanes should only be used where there is a clear observed need for the connection.
Related Design Elements

- **Bumpouts**: Additional consideration is required where bicycle lanes intersect with bumpouts, both at corners and mid-block.

- **Bus Stops**: Contra-flow lanes should not be placed in front of transit stops. Where possible, place the transit stop in an island with the bicycle lane traveling between it and the curb.

- **Curb Cuts**: Driveways and curb cuts present a significant conflict with bicycle lanes as motorist entering or exiting may not see approaching cyclists. Use markings and green color treatment to identify conflict zones with curb cuts.

- **Curbside Uses**: Contra-flow bicycle lanes may conflict with curbside activities. Contra-flow lanes often require the removal of curbside parking or loading.

DESIGN & OPERATIONS

**Design Requirements**

**A Position**: Marked contra-flow lane shall be on the left side of travel lanes.

**Separation**: The contra-flow lane shall be separated from on-coming traffic by a double yellow stripe, which indicates to motorist and cyclists that they are not allowed to cross.

> Alternatively or additionally, the contra-flow lane may be separated by a buffer, median or other barrier.

**B Width**: Contra-flow bicycle lanes shall be a minimum of 5 feet wide between the yellow striping and face of curb.

**Signage**: Orient stop signs and traffic signals along the street to face both motorists going one-way and cyclists in the contra-flow lane.
4.3 BICYCLE DESIGN ELEMENTS
[CONTRA-FLOW BICYCLE LANES]

Additional Design Considerations

- **Bicycle Lanes:** Cyclists travel in the same direction as vehicle traffic should be accommodated via sharrows, bicycle lanes or other bicycle facilities on the right-hand side of the road.
  
  » Alternatively, a two directional protected bicycle lane facility (e.g. cycle track) can be used to provide

- **Left Side Bicycle Lanes:** Contra-flow bicycle lanes may be paired with left side bicycle lanes to create side by side bi-directional bicycle facilities. If separated, this is equivalent to a two-way protected bicycle lane. Buffers can consist of yellow lane markings, or a physical barrier such as a curb or a with-flow parking lane.

- **On-Street Parking:** If space exists, parking may be located between the contra-flow bicycle lane and travel lanes, where it can act as a buffer, or be permitted between the contra-flow bicycle lane and the curb to its right.

- **Intersection Markings:** Extend contra-flow lane markings across the intersection to signal the presence of two-way traffic to motorist on cross streets and direct cyclists.

- **High Visibility Marking:** Colored pavement may be used to identify the contra-flow lane.

Utility Considerations

- If trenching is done in the contra-flow lane, repair the entire width of the bicycle lane so there is not an uneven surface.

Design References

- The MMUTCD provides standards for markings and signage required for contra-flow lanes.

MAINTENANCE & MANAGEMENT

Seasonal Use & Maintenance

- Bicycle lanes should always be plowed during snow events. They should never be used for snow storage.
- Contra-flow lanes can be used year-round.

Reviews & Approvals

- The Ann Arbor Engineering and Systems Planning Units will make determinations regarding the use, design and placement of contra-flow bicycle lanes.
4.3 BICYCLE DESIGN ELEMENTS
[CONTRA-FLOW BICYCLE LANES]
DESCRIPTION & INTENT

Left-side bicycle lanes are conventional bicycle lanes placed on the left-hand side of a one-way street or against the center median of a two-way street.

In general, right-side bicycle lanes should be used as they are more familiar and predictable to motorist, cyclists and pedestrians.

However, left-side lanes can reduce conflicts with parking, loading and/or transit vehicles on the right side of the street, as well as right-turning vehicles. They may reduce the risk of dooring from parked cars, as fewer people exit a car on the right side.

Because left-side bicycle lanes are less common, pedestrians may not anticipate cyclists in a left-side lane. Signs or markings alerting pedestrians to “look right” at crosswalks for cyclists (or vehicles) may be beneficial. Also, vehicles turning left across a left-side bicycle lane may not anticipate cyclists. Traffic calming, signage, and other strategies should be applied to discourage vehicles from traveling faster than the posted speed to reduce the potential for and severity of crashes.

USE & APPLICATION

Location

- Left-side bicycle lanes may be preferable on one-way streets when curb cuts are predominantly located on the right-hand side, there is heavy vehicular right turns, and heavy bicycle left turn demand can be demonstrated.

- Left-side bicycle lanes can be used on all frontage typologies, especially Commercial and Destination Commercial frontages where there is a high incidence of curbside uses (e.g. loading zones, on-street parking, etc.)

- Left-side bicycle lanes are suitable for all Functional Emphasis street types, especially transit emphasis, where transit lanes or upgraded transit stops are recommended and there are frequent bus stops.

Related Design Elements

- **Transit Stops**: Left-side bicycle lanes are generally used when fewer conflicts exist on the left side of the street compared to conventional bicycle lanes located on the right side of the travel way – commonly resulting from transit stops and operations.

- **Vehicle Speeds**: Left-side bicycle lanes may be combined with bike boxes or two-stage turn queues to facilitate safe right turning movements.
• **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 not extend into the bicycle lane (*See Curb Extensions*).

Incompatible Elements

• **Diagonal Parking**: Front-in diagonal parking should be avoided where bicycle lanes are provided to prevent conflicts with bicycle lanes. Parallel parking is preferred.

### DESIGN & OPERATIONS

#### Design Requirements

• **Bicycle lanes**: Left-side bicycle lanes follow the same design requirements as conventional bicycle lanes. *See Conventional Bicycle lanes Design Element for Additional guidance.*

#### Utility Conflicts or Considerations

• If trenching is done in the bicycle lane, repair the entire width of the bicycle lane so there is not an uneven surface. Avoid locating manholes in bicycle lanes. Ensure any utility or vault covers are flush with the road surface and properly set and maintained.

#### Design References

• The MMUTCD provides standards for bicycle lane design.

• The City of Ann Arbor Non-Motorized Transportation Plan Update provides guidance on bicycle lanes and locations for recommended installation in downtown.

• The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of left-side bicycle lanes. ¹

### MAINTENANCE & MANAGEMENT

#### General Maintenance

• **Markings**: Bicycle lanes and associated signs and symbols are additional markings that will require maintenance and replacement.

#### Seasonal Use & Maintenance

• **Snow Removal**: Bicycle lanes should always be plowed during snow events. They should never be used for snow storage.

#### Reviews & Approvals

• The Ann Arbor Engineering and Systems Planning Units oversee bicycle lane installation. For public projects, the project manager should coordinate with the Ann Arbor Engineering and Systems Planning Units.

• The Ann Arbor Field Operations Unit is responsible for maintaining bicycle lanes.

¹ [http://nacto.org/cities-for-cycling/design-guide/bike-lanes/conventional-bike-lanes/](http://nacto.org/cities-for-cycling/design-guide/bike-lanes/conventional-bike-lanes/)