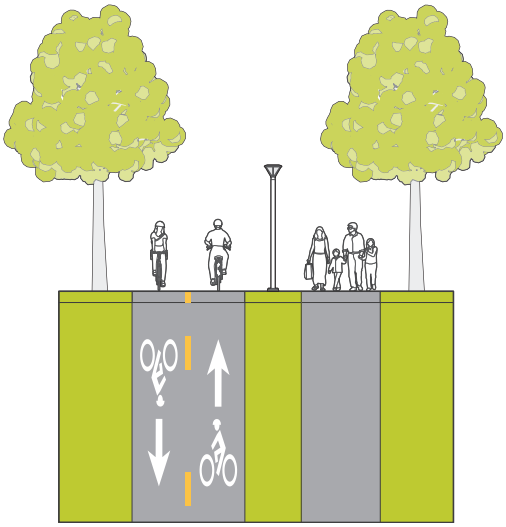
Off-road Trails

Off-road trails are shared use paths located on an independent alignment that provide two-way travel for people walking, bicycling, and other non-motorized users. Trails specifically along stream valleys are discussed elsewhere in this Toolkit.



Typical Application

Off-road trails can be considered along railway or utility corridors, and unbuilt or "paper" streets and through County-owned property.

Guidance

- The minimum paved width is 10 feet. Anticipated future traffic volumes should be used to guide design decisions.
- Maximum grade should not exceed 5 percent. Minimum grade is 0.5 percent to aid in drainage.
- Lighting should be provided at path/roadway intersections at a minimum and at other locations where personal security may be an issue.
- Sight distances are based on site conditions and user-based factors. Ensure sight distances are designed in accordance with the AASHTO Bike Guide.

Considerations

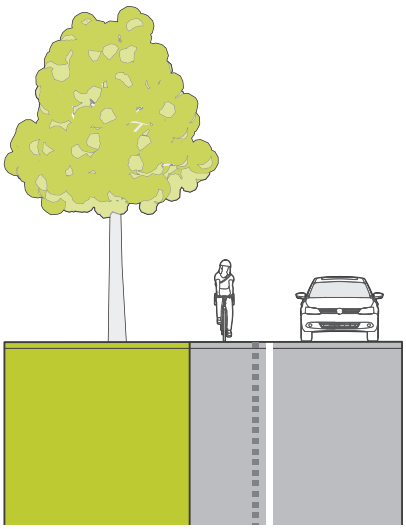
- Trails expected to serve a high percentage of pedestrians (30 percent or more) or be used by large maintenance vehicles should be wider than 10 feet.
- Trails with high traffic may require pedestrian and bicycle separation. This can take the form of pavement markings or constructing separate parallel paths for each user group. If separation is by pavement markings, the bicycle side of the pathway should be 10 feet wide and the pedestrian side should be 5 feet minimum.
- Trails on steep grades should be wider to account both for higher bicycle speed in the downhill direction and additional space for faster bicyclists to pass slower bicyclists and pedestrians in the uphill direction.
- Lighting should be pedestrian-scale (standards about 15 feet high) and be 0.5 to 2 foot candles.
- Where lighting is not provided, reflective edge lines should be marked on the pavement.

REFERENCES

AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Paved Shoulders

Paved shoulders provide space for bicycle travel along the roadway edge in addition to their use as a motor vehicle recovery area and pedestrian facility where no sidewalk exists.



Typical Application

Rural areas of the County where dedicated bicycle lanes either will not fit on the street or would not be appropriate given the surrounding context.

Guidance

- Shoulder width should be at least 4 feet if the roadway is curbless and there are no vertical obstructions. If curbs or vertical obstructions are present, shoulder width should be 5 feet minimum.
- Shoulders should be wider on roads with high levels of bicycle traffic to accommodate bicyclist passing and facilitate side-by-side bicycling.
- If speeds exceed 50 mph and/or if heavy vehicles frequently use the road, shoulders should exceed minimum widths to enhance bicyclist comfort.
- For shoulders with rumble strips, width should be measured from the strip's rightmost side. Edge line rumble strips can provide additional bicyclist space on paved shoulders. Periodic gaps should be provided to allow bicyclists to move across the strip pattern.

Considerations

- For roads too narrow for shoulders in both directions, prioritize providing a shoulder in one direction in the following situations:
  - On hilly roads in the uphill direction to reduce conflicts between slow-moving bicyclists and fast-moving motor vehicles
  - Where there are sight distance issues, along the inside of a horizontal curve and/or the downgrade of a vertical curve
- Paved shoulders should be considered on roadways popular with recreational bicyclists that have significant motor vehicle traffic during periods when recreational bicycling is known to occur.
- Bicyclists will not use a shoulder if it is covered in gravel, glass, and other road debris, so regular street sweeping is important.
- In rural areas, paved shoulders can also provide space for pedestrians on roadways without sidewalks. In situations where a shoulder is intended for pedestrian use, it must meet ADA requirements to the maximum extent possible.

REFERENCES

AASHTO. Guide for the Development of Bicycle Facilities. 2012.

FHWA. Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts. 2016.

Shared Streets

Shared streets prioritize pedestrian and bicycle travel by using design features and signage to ensure all road users move at slower speeds.

Typical Application

Urban areas where intermingling of different travel modes furthers local economic and livability goals

Guidance

- Shared streets generally do not have vertical curbs. All travel modes share the same space and must pay close attention to the movements of other street users of traveling by all modes.
- Speeds for motor vehicles on shared streets should not exceed 15 mph and will generally be reduced to a slower pedestrian pace by those on foot sharing the space. Chicanes or other traffic calming can be used to lower vehicle speed.
- Shared street gateway treatments should inform drivers they are entering a shared space. Common ways to do so include:
  - Narrowing entrances to one lane
  - Raising the surface of the shared street above that of the surrounding streets
- Traffic volumes should not exceed 100 vehicles in the peak hour.

Considerations

- The curbless nature of shared streets furthers universal access, but to best design shared streets for users with physical handicaps and/or blindness/low vision, different street zones should be delineated using pavement materials or street furniture.
  - Where the street is wide enough, traditional sidewalk space in front of buildings should be paved with a surface that is smooth, vibration free and distinguished from space where motor vehicles can be present by different colored pavers, bollards, or other means.
- Stormwater on shared streets can be captured using valley gutters, proper grading, and/or bioswales or other green infrastructure.
- A curbless shared street can be easily closed to motor vehicles to host public events. Care should be taken to maintain access for bicyclists when it is closed to other vehicles.
- If traffic volumes exceed thresholds, consider limiting access to only taxis, deliveries, and paratransit.

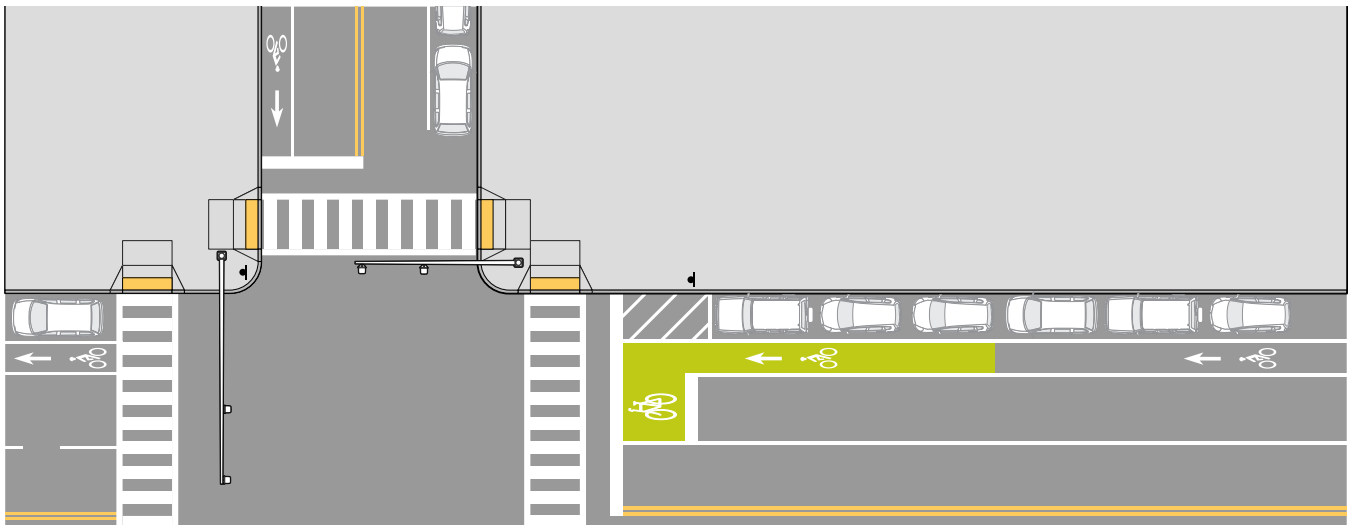
REFERENCES

FHWA. Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts. 2016.

Boston. Complete Streets Design Guidelines. 2013.

Bicycle Boxes

This treatment provides exclusive queuing space for bicyclists at signalized intersections, reducing conflicts between bicyclists and right-turning motor vehicles.



Typical Application

- Where through bicyclists and right-turning motor vehicles conflict
- Where left-turning bicyclists are a large percentage of total bicyclists

Guidance

- Bicycle boxes should only be installed at signalized intersections.
- Bike boxes should be a minimum of 10 feet deep from the stop bar.
- A bike box should only extend across one travel lane. A bike box may only be placed in front of a left turn lane if a lead-in left turn bike lane exists. A two-stage turn queue box is the preferred method of accommodating left turns.
- Green pavement can be used within the bike box to further deter motor vehicles from encroaching.
- At least 50 feet of bicycle lane must connect the the approach leg of the intersection to the bike box so bicyclists do not have to weave between queueing motor vehicles to access it.

Considerations

- Bike boxes can be particularly effective at intersections with either dedicated bicycle signals or where bicyclists can take advantage of a leading pedestrian interval because they allow more bicyclists to traverse an intersection before motor vehicles are permitted to enter.
- Bike boxes should be accompanied by appropriate signage in line with the MUTCD.

REFERENCES

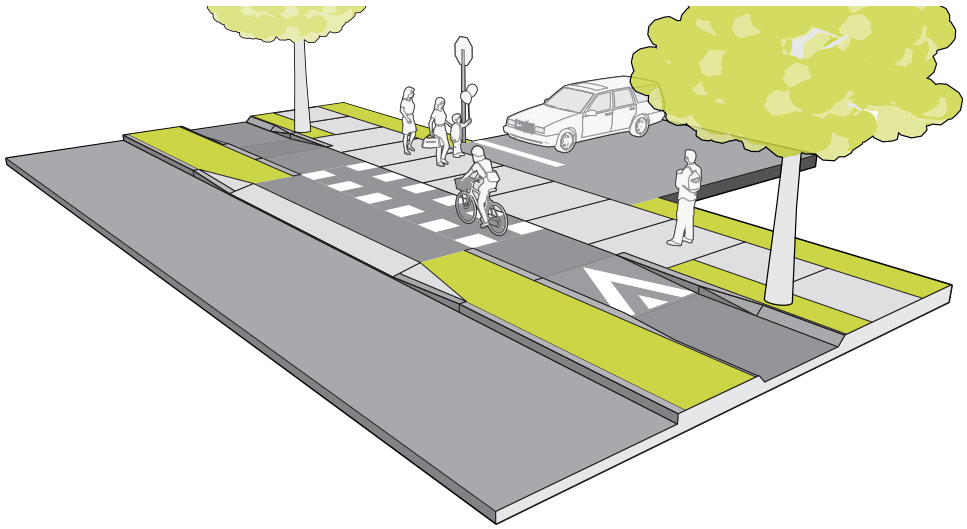
Boston. Complete Streets Design Guidelines. 2013.

NACTO. Urban Bikeway Design Guide. 2nd Edition.

FHWA. Bicycle Facilities and the Manual on Uniform Traffic Control Devices - Bicycle Box. 2015.

Driveway Treatments

These treatments help mitigate the conflict between through bicyclists on shared use paths or separated bike lanes and motor vehicles entering or exiting driveways that cross the bikeway.



Typical Application

Any time a driveway crosses a separated bike lane or shared use path

Guidance

- All SBL and SUP driveway crossings should be raised. If the SBL is street-level, at driveways it should be raised to sidewalk-level. In these situations, the transition ramp for bicyclists from street to sidewalk-level should have a maximum 10 percent slope.
- Driveway approach ramps from street-level should be between 5 and 15 percent slope.
- Sight triangles must be maintained, based on traffic speeds and volumes. Consult the MassDOT SBL Planning and Design Guide for additional guidance.
- Driveway curb radii should cause motor vehicles slow down and yield as they leave the roadway. Design speed should be 15 mph or less.
- SBL/SUP surface material, color, and texture should continue across the driveway to encourage motor vehicle yielding and delineate the bicycle route.

Considerations

- If the bicyclist transition ramp is longer than 6 feet with a slope greater than 5 percent, speed hump markings are recommended.
- If there are many driveways in quick succession and the planned bikeway is at street-level, designers should consider an intermediate or sidewalk-level bikeway because frequent transition ramps are not comfortable for bicyclists.
- Recommended driveway widths differ depending on driveway type:
  - Residential: 10 feet
  - Commercial: 20 feet
- At uncontrolled commercial and high-volume residential driveways, Bicycle Warning or Bicycle/Pedestrian warning signage (W11-15) should be installed facing those exiting the driveway. If the SBL is two-way, the two-directional plaque should be added (W1-7 alt.).
- At controlled commercial and high-volume residential driveways, consider installing a protected intersection.

REFERENCES

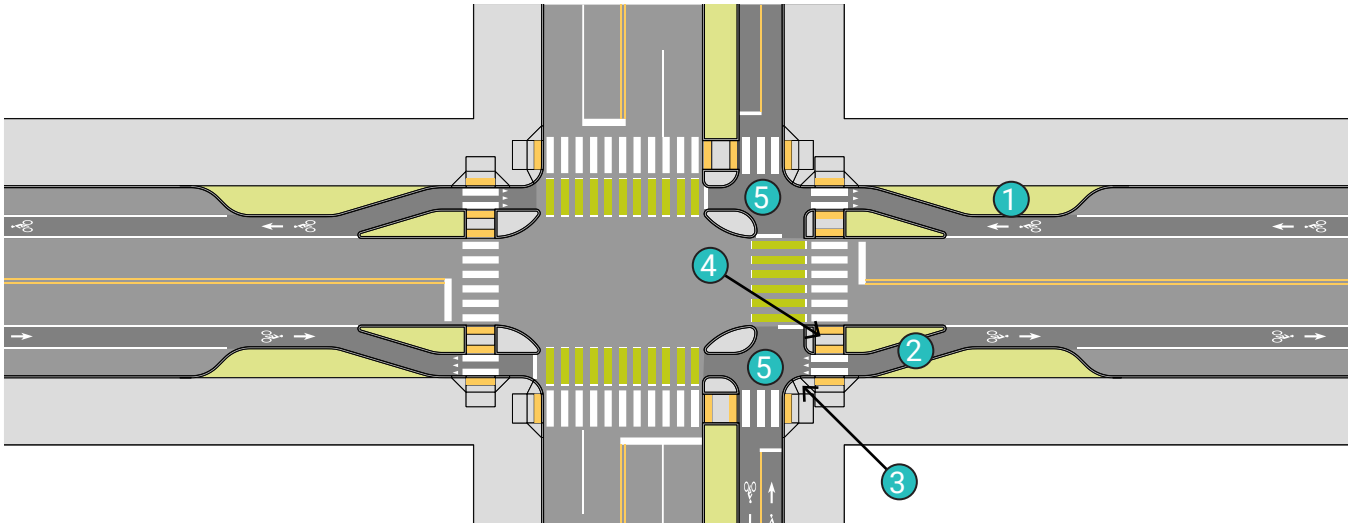
NACTO. Urban Bikeway Design Guide. 2nd Edition.

MassDOT. Separated Bike Lane Planning and Design Guide. 2015.

FHWA. Separated Bike Lane Planning and Design Guide. 2015.

Transition from Two-Way Separated Bike Lane to Conventional Bike Lane on Intersecting Street

This treatment provides an example of a typical design of a two-way separated bike lane transition to conventional bike lanes on an intersecting street.



Typical Application

All two-way separated bike lane locations that require a transition to conventional bike lanes on a cross street

Guidance

1. Conventional bike lanes should transition to separated bike lanes as they approach the intersection.
2. For separated bike lane widths, see page 4.
3. A 15-foot corner radius is recommended for turns from the two-way bike lane onto the one-way bike lane.
4. Provide a minimum 10 foot curb radius to allow left turning bicyclists to enter the one-way bike lane.
5. Ensure the forward bicycle queuing area is sufficiently sized to accomodate predicted bicycle volumes, especially for those bicyclists turning from the conventional bike lanes.

- For guidance on protected intersection dimensions, see page 20.

Considerations

The transition design should:

- Maintain separation through the intersection.
- Guide right turning bicyclists to slowly turn at all times, yielding to pedestrians in crosswalks.
- Maintain a vertical or visual separation between bicyclists and pedestrians where sidewalk buffers are eliminated.
- Clearly communicate how bicyclists are intended to enter and exit the separated bike lane minimizing conflicts with other users.

If conventional bike lanes are on roadways without on-street parking, it may be necessary to provide additional right-of-way or convert sidewalk space to bicycling space to accommodate transitions to a protected intersection.

REFERENCES

NACTO. Urban Bikeway Design Guide. 2nd Edition.

MassDOT. Separated Bike Lane Planning and Design Guide. 2015.

FHWA. Separated Bike Lane Planning and Design Guide. 2015.