Appendix O

Bicycle Best Practices Screening and Bicycle Facilities Toolkit

Best Practices Screening

In addition to traditional solutions to bicycle travel within the corridor such as bike lanes, shared lane markings, share the road signs, innovative approaches and state-of-the-practice designs were examined. Most of the design treatments are in accordance with the Manual on Uniform Traffic Control Devices (MUTCD), the American Association of State Highway and Transportation Officials (AASHTO), and New Jersey Department of Transportation's *Bicycle Compatible Roadways and Bikeways and Pedestrian Compatible Planning and Design Guidelines*. However, there are several potential solutions to bicycle and pedestrian access and safety problems currently in use which are not included in the above mentioned guidelines such as "colored bike lanes," "bike boxes," and "crossbikes." Their use is typically justified as a result of their being implemented under the FHWA/MUTCD experimental process. A few of the design treatments recommended along the corridor are highlighted below. More treatments and additional information on bicycle best practices can be found in the Bicycle Facilities Toolkit.

Buffered Bike Lane

Shared Lane Marking / Bicycle Priority Lane

Intersection Crossing Markings

Combined Bike Lane / Turn Lane

Crossbike Treatment

High-intensity Activated Crosswalk (HAWK signal)

Bicycle Loop Detector

Wayfinding Signage with time and distance

Bicycle Racks and Lockers

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BICYCLE LANES

CONVENTIONAL

Photo: Bike JC
Location: Jersey City, NJ

DESCRIPTION/FEATURES

A portion of the roadway that has been designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists.

BENEFITS

- Enables bicyclists to ride at their preferred speed without interference from prevailing traffic conditions
- Facilitates predictable behavior and movements between bicyclists and motorists
- Visually reminds motorists of bicyclists' right to the street

DRAWBACKS

- Not all users will be comfortable in a bike lane
- When next to on-street parking there is a risk of bicyclists getting 'doored'
- Greater enforcement required to prevent motorists from parking in the bike lane

WHEN TO USE/TYPICAL APPLICATION

- Bike lanes are most helpful on streets with:
  - ≥ 3,000 motor vehicle average daily traffic
  - a posted speed ≥ 25 mph
  - high transit vehicle volume
- Should typically be provided on both sides of two-way streets to prevent wrong-way riding
- The min. width of a bike lane next to a parking lane, a curb or other vertical surface is 5 ft.
- On roadways with no curb, gutter or on-street parking, the min. width is 4 ft.

TREATMENT STATUS/ADOPTION

- MUTCD - Can be implemented at present time
- AASHTO – included in *Guide to Bicycle Facilities, 4th Edition*

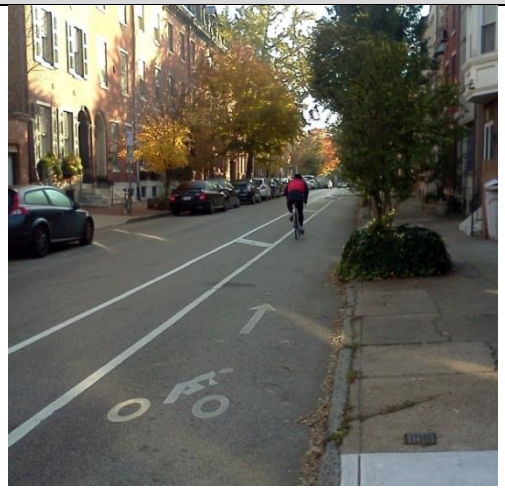
RESOURCES

- NJDOT Bicycle Compatible Roadways and Bikeways, Planning and Design Guidelines (1996)
- AASHTO *Guide for the Development of Bicycle Facilities, 4th Edition*
- NYCDOT Street Design Manual. (2009)

CURRENT USAGE

- Most common bicycle facility in use in the United States

BICYCLE LANES

BUFFERED	DESCRIPTION/FEATURES	BENEFITS
 Photo: The RBA Group Location: Philadelphia, PA	Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane.	• Provides greater shy distance between motor vehicles and bicyclists. • Provides space for bicyclists to pass another bicyclist without encroaching into the adjacent motor vehicle travel lane. • Encourages bicyclists to ride outside of the door zone when buffer is between parked cars and bike lane. • Appeals to a wider cross-section of bicycle users. **DRAWBACKS** • Reduce the natural "sweeping" effect of passing motor vehicles, potentially requiring more maintenance

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION

• Buffered bike lanes should be considered on streets with:
  ○ high traffic volume
  ○ regular truck traffic
  ○ high parking turnover
  ○ speed limit > 35 mph
	• MUTCD - can be implemented at present time if pavement markings that are compliant with the MUTCD are used
	• AASHTO – included in *Guide to Bicycle Facilities, 4th Edition*
	
	RESOURCES
	• MUTCD section 3D-01
	• National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011
	• NYCDOT Street Design Manual. (2009)
	
	CURRENT USAGE
	• Buffered bike lanes are used in the following US cities and counties: Hoboken, NJ; Brooklyn, NY; New York, NY; Billings, MT; Cape Coral, FL; Los Angeles, CA; Marin County, CA; Minneapolis, MN; Portland, OR; Phoenix, AZ; San Francisco, CA; Seattle, WA; Tucson, AZ; Austin, TX

BICYCLE LANES

LEFT-SIDE	DESCRIPTION/FEATURES	BENEFITS
 Photo: www.bikepedimages.com - Laura Sandt Location: Portland, OR	Left-side bike lanes are conventional bike lanes placed on the left side of one-way streets or two-way median divided streets.	• Improves motorists' visibility of bicyclists by having the bike lane on the driver's side. • Minimizes door zone conflicts next to parking because of fewer door openings on the passenger side of vehicles. • Fewer bus and truck conflicts as most bus stops and loading zones are on the right side of the street. **DRAWBACKS** • Bicyclists and motorists generally expect bicycle traffic to be on the right side of a street. • If parking is allowed on the left side, there can be difficulties for drivers seeing bicycles when entering or especially leaving the parking lane

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION

• On streets with:
  ○ high parking turnover
  ○ rush hour parking restrictions
  ○ high volumes of right turn movements by motor vehicles
  ○ a significant number of left-turning bicyclists.
• On streets where traffic enters into an add lane on the right-hand side, as from a freeway off-ramp.
	• MUTCD – can be implemented at present time
	• AASHTO – included in *Guide to Bicycle Facilities, 4th Edition*
	
	RESOURCES
	• National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011
	
	CURRENT USAGE
	• Left-side bike lanes are used in the following US cities: Hoboken, NJ, New York City, NY; Berkeley, CA; Boston, MA; Chicago, IL; Eugene, OR; Madison, WI; Minneapolis, MN; Naples, FL; Portland, OR; Sacramento, CA; San Francisco, CA; Seattle, WA; DC

BICYCLE LANES

CONTRAFLOW	DESCRIPTION/FEATURES	BENEFITS
 Photo: NACTO Location: Chicago, IL	Contraflow bicycle lanes are bicycle lanes designed to allow bicyclists to ride in the opposite direction of motor vehicle traffic. They convert a one-way traffic street into a two-way street: one direction for motor vehicles and bikes, and the other for bikes only. Contra-flow lanes are separated with yellow center lane striping.	• Decreases trip distance, the number of intersections encountered, and travel times for bicyclists by eliminating out-of-direction travel. • Limits dangerous wrong-way riding by allowing cyclists to safely ride in the opposite direction of cars • Reduces sidewalk riding **DRAWBACKS** • May introduce additional conflict points as motorists may not expect on-coming bicyclists

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Where it would provide substantial savings in out-of-direction travel and/or direct access to high-use destinations • Where there will be fewer conflicts when compared to a route on other streets • When there are few intersecting driveways, alleys, or streets on the side of the street with the contra-flow lane • Where bicyclists can effectively and conveniently make transitions at the termini of the contra-flow lane • The contraflow lane must be placed to the motorists left and be separated by a yellow centerline marking • Any intersecting alleys, major driveways and streets must have signs indicating to motorists that they should expect two-way bicycle traffic	• MUTCD – can be implemented at present time if signs and pavement markings that are compliant with the MUTCD are used • AASHTO – included in the *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Contra-flow bike lanes are used in the following US cities: Austin, TX; Boise, ID; Boulder, CO; Cambridge, MA; Brookline, MA; Baltimore, MD; Chicago, IL; Eugene, OR; Madison, WI; Minneapolis, MN; Portland, OR; San Francisco, CA; Seattle, WA; Washington, DC

BICYCLE LANES

ADVISORY	DESCRIPTION/FEATURES	BENEFITS
 Photo: BikeWalkTwinCities.org Location: Minneapolis, MN	An advisory bike lane is similar to a regular bike lane, but is used on low-volume streets that are narrow. An advisory bike lane is marked with a solid white line on the right (next to parked cars) and a dotted line to the left. These markings give bicyclists a space to ride, but are also available to motorists if space is needed to pass oncoming traffic. Also known as "suggestion lanes."	• Provides bicyclists a designated place to ride while also allowing motorists to use the space to pass oncoming traffic. • Remind people that the road is a shared space. • Direct bicyclists where and how to ride. • Reduces motorist encroaching on bicyclists. **DRAWBACKS** • Unfamiliarity with the treatment can lead to confusion.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Roads that are too narrow for standard bike lanes. • Roadways with low traffic volume. • Only used on roads without marked centerlines. • Used in both rural and urban areas.	• Not included in the MUTCD or AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • City of Minneapolis, MN; http://www.ci.minneapolis.mn.us/bicycles/WCMS1P-083250 **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: Minneapolis, MN; Edina, MN

CYCLE TRACKS

ONE-WAY PROTECTED	DESCRIPTION/FEATURES	BENEFITS
 Photo: NACTO Location: Chicago, IL	A one-way protected cycle track is an exclusive bike facility that has elements of a separated path and an on-road bike lane. While still within the roadway, cycle tracks are physically separated from motor vehicle traffic with bollards, car parking or other barrier.	• Dedicates and protects space for bicyclists. • Eliminates risk and fear of collisions with over-taking vehicles. • Reduces risk of 'dooring' compared to a bike lane. • Prevents double-parking. • Low implementation cost by making use of existing pavement and drainage and by using parking lane as a barrier. • More attractive for bicyclists of all levels and ages. **DRAWBACKS** • Snow removal and street sweeping may require special equipment. • Require considerations at crossings of driveways and minor intersections.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Streets on which bike lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high traffic volumes, high speed traffic, high demand for double parking, and high parking turnover. • Along streets with high bicycle volumes • The minimum desired width for a cycle track should be 5 ft. • In areas with high bicyclist volumes or uphill sections, the minimum desired width should be 7 ft. to allow for bicyclists passing each other. • 3 ft. is the desired width for a parking buffer to allow for passenger loading and to prevent door collisions. • Special consideration should be given at transit stops to manage bicycle & pedestrian interactions	• MUTCD - since cycle tracks are not a traffic control device, the MUTCD has no restriction on its use. • AASHTO – cycle tracks are not included in AASHTO's *Guide to Bicycle Facilities, 4th Edition.* **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: New York, NY; Boulder, CO; Cambridge, MA; Chicago, IL; Long Beach, CA; Minneapolis, MN; Missoula, MT; Portland, OR; San Francisco, CA; St. Petersburg, FL; Washington, DC

CYCLE TRACKS

TWO-WAY PROTECTED	DESCRIPTION/FEATURES	BENEFITS
 Photo: The RBA Group Location: Brooklyn, NYC	Two-way cycle tracks (also known as protected bike lanes, separated bikeways, and on-street bike paths) are physically separated bike facilities that allow bicycle movement in both directions on one side of the road.	• On one-way streets, reduces out of direction travel by providing contra-flow movement • Dedicates and protects space for bicyclists. • Eliminates risk and fear of collisions with over-taking vehicles. • Reduces risk of 'dooring'. • More attractive to a wide range of bicyclists at all levels and ages. **DRAWBACKS** • May require additional considerations at driveway and side-street crossings.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• On streets with few conflicts such as driveways or cross-streets on one side of the street or extra right-of-way on one side • On streets where there is not enough room for a one-way cycle track on both sides of the street or where contra-flow bicycle travel is desired / more destinations are on one side thereby reducing the need to cross the street. • To connect with another bicycle facility, such as a second cycle track on one side of the street. • The desirable two-way cycle track width is 12 feet. Minimum width in constrained locations is 8 feet.	• MUTCD – since cycle tracks are not a traffic control device, the MUTCD has no restriction on its use. • AASHTO – cycle tracks are not included in AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Currently used in the following US cities: Austin, TX; Cambridge, MA; Eugene, OR; Indianapolis, IN; New York City, NY; Portland, OR; Saint Petersburg, FL; Washington, DC

CYCLE TRACKS

RAISED	DESCRIPTION/FEATURES	BENEFITS
 Photo: Will Vanlue Location: Hillsboro, OR	Raised cycle tracks are bicycle facilities that are vertically separated from motor vehicle traffic. A raised cycle track may allow for one-way or two-way travel by bicyclists. When placed adjacent to a travel lane, one-way raised cycle tracks may be configured with a mountable curb to allow entry and exit from the bicycle lane for passing other bicyclists or to access vehicular turn lanes. This configuration has also been known as a 'raised bike lane.'	• Dedicates and protects space for bicyclists. • More attractive to a wider range of bicyclists at all levels and ages. • Encourages bicyclists to ride in the bikeway rather than on the sidewalk. • Keeps motorists from easily entering the cycle track. • Minimizes maintenance costs due to limited motor vehicle wear. • With new roadway construction a raised cycle track can be less expensive to construct than a wide or buffered bicycle lane. **DRAWBACKS** • Raised cycle tracks may be incompatible with conventional street sweeping equipment and snow plow equipment, depending on their configuration. There should be enough shy distance on the adjacent roadway so that snow is not stored on the raised cycle track.

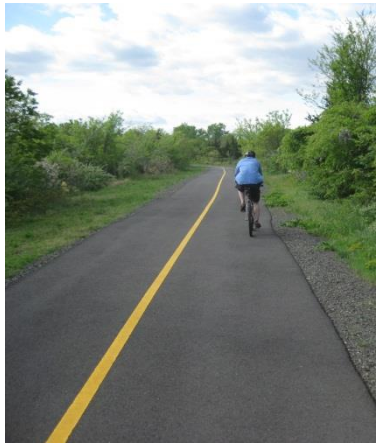
WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Along higher speed streets with few driveways and cross streets and high bicycle volumes. • Along streets on which bike lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high traffic volumes, high speed traffic, high demand for double parking, and high parking turnover. • On streets with numerous curves where vehicle encroachment into bike lanes may be a concern.	• MUTCD – since cycle tracks are not a traffic control device, the MUTCD has no restriction on its use. • AASHTO – cycle tracks are not included in AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: Brooklyn, NY; Atlanta, GA; Bend, OR; Cambridge, MA; Denton, TX; Denver, CO; Eugene, OR; Missoula, MT; Portland, OR; Rapid City, SD

CYCLE TRACKS

RAISED AND PROTECTED	DESCRIPTION/FEATURES	BENEFITS
 Photo: The RBA Group Location: Hoboken, NJ	Many raised cycle tracks are paired with a furnishing zone between the cycle track and motor vehicle travel lane and/or pedestrian area. A raised and protected cycle track may allow for one-way or two-way travel by bicyclists.	• Dedicates and protects space for bicyclists. • More attractive to a wider range of bicyclists at all levels and ages. • Encourages bicyclists to ride in the bikeway rather than on the sidewalk. • Keeps motorists from easily entering the cycle track. • Minimizes maintenance costs due to limited motor vehicle wear. • With new roadway construction a raised cycle track can be less expensive to construct than a wide or buffered bicycle lane. **DRAWBACKS** • Raised cycle tracks may be incompatible with conventional street sweeping equipment and snow plow equipment, depending on their configuration. There should be enough shy distance on the adjacent roadway so that snow is not stored on the raised cycle track.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Along higher speed streets with few driveways and cross streets and high bicycle volumes. • Along streets on which bike lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high traffic volumes, high speed traffic, high demand for double parking, and high parking turnover. • On streets with numerous curves where vehicle encroachment into bike lanes may be a concern.	• MUTCD – since cycle tracks are not a traffic control device, the MUTCD has no restriction on its use. • AASHTO – cycle tracks are not included in AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: Hoboken, NJ; Brooklyn, NY; Atlanta, GA; Bend, OR; Cambridge, MA; Denton, TX; Denver, CO; Eugene, OR; Missoula, MT; Portland, OR; Rapid City, SD

Off-Road Facilities

Shared Use Path	Description/Features	Benefits
 Photo: The RBA Group Location: Henry Hudson Trail, Middlesex County, NJ	Shared use paths are bikeways that are physically separated from motorized vehicular traffic by an open space of barrier and either within the highway right-of-way or within an independent right-of-way. Shared use path facilities accommodate a variety of non-motorized uses, most often bicycle and pedestrian traffic. Shared use paths are an addition, and complimentary, to the roadway network.	• Completely separated from motor vehicle traffic. • Can provide users with shortcuts. • Can provide an enjoyable recreational opportunity. • Have few intersections and as a result are safer for bicyclists than facilities located alongside or on roadways. • Appeal to users of all ages and abilities. **Drawbacks** • Rarely the most direct means of transportation. • Shared-use paths attract a variety of user groups who often have conflicting needs.

When to Use/Typical Application	Treatment Status/Adoption

• Shared-use paths that provide different lanes for users who travel at different speeds prevent conflicts between user groups on high use trails.
• 10 ft. is the recommended minimum width for a two-way, shared use path on a separate right of way.
• 2 ft. of graded area should be maintained adjacent to both sides of the path and 3 ft. of clear distance should be maintained between the edge of the trail and lateral obstructions.
• Shared use paths fall under the accessibility requirements of the Americans with Disabilities Act (ADA)
  ○ Paths in the public right-of-way should be designed in accordance with *PROWAG*
  ○ Paths built in independent rights-of-way should meet the guidelines in *ANPRM*
	• MUTCD – can be implemented at present time
	• AASHTO – included in *Guide to Bicycle Facilities, 4th Edition*
	
	Resources
	• AASHTO *Guide for the Design of Bicycle Facilities*
	• New Jersey DOT's Bicycle Compatible Roadways and Bikeways
	• *Proposed Right-of-Way Accessibility Guidelines (PROWAG)*
	• *Advance Notice of Proposed Rulemaking (ANPRM) on Accessibility Guidelines for Shared Use Paths*
	
	Current Usage
	• Common examples include rail rights-of-way (usually, though not necessarily abandoned or inactive), canal tow-paths, greenways along stream corridors and utility rights of way.

Off-Road Facilities

SIDEPATH	DESCRIPTION/FEATURES	BENEFITS
 Photo: AASHTO Location: Unknown	Sidepaths are a specific type of shared use path that run adjacent to the roadway.	• They provide an element of separation from motor vehicles. • Appeal to a wider variety of users. **DRAWBACKS** • A 2-way sidepath on one side of the road may need additional road crossings. • Bicyclists using the roadway may be harassed by motorists who believe bicyclists should be on the sidepath. • Potential conflicts with motorists at driveways and intersections.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Where right-of-way or other physical constraints prohibit path alignment in independent rights-of-way and there are no practical alternatives for improving the roadway or accommodating bicyclists on nearby parallel streets. • When the sidepath can be built with few street and/or driveway crossings. • When the adjacent roadway has relatively high-volume and high-speed traffic • The minimum recommended distance between a path and the roadway curb is 5'. When the separation is less than 5', a physical barrier or railing should be provided. • Utilizing or providing a sidewalk as a shared use path is undesirable.	• MUTCD – can be implemented at present time • AASHTO – included in *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • AASHTO *Guide for the Design of Bicycle Facilities* • New Jersey DOT's Bicycle Compatible Roadways and Bikeways • *Proposed Right-of-Way Accessibility Guidelines (PROWAG)* • *Advance Notice of Proposed Rulemaking (ANPRM) on Accessibility Guidelines for Shared Use Paths* **CURRENT USAGE** • Common throughout the United States.

INTERSECTION TREATMENTS

Bike Boxes	Description/Features	Benefits
 Photo: National Association of City Transportation Officials Location: New York, NYC	A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase.	• Reduces right-turn ("right-hook") conflicts between bicyclists and motorists at intersections by increasing cyclist visibility to drivers and providing a space for cyclists to wait at signalized intersections. • Allows cyclists to position themselves properly to execute a left turn and increases their visibility to drivers traveling in the opposing direction **Drawbacks** • Right turns on red must be prohibited, though an exception may be made for cyclists ("Except Bikes"). Bicycle boxes may not be compatible at intersections with high volume of right-turning vehicles.

When to Use/Typical Application	Treatment Status/Adoption
Bike boxes should be considered on streets with: • At signalized intersections with high volumes of bicycles and/or motor vehicles • Intersections with frequent bicyclist left-turns and/or motorist right-turns. • Where a left turn is required to follow a designated bike route • When the dominant motor vehicle traffic flows right and bicycle traffic continues through.	• Bike boxes and green pavement for bike lanes are considered experimental treatments that may be adopted by the MUTCD in the future. **Resources** • National Association of City Transportation Officials Urban Bikeway Design Guide **Current Usage** Currently used in the following US cities: Austin, TX; Alexandria, VA; Boston, MA; Baltimore, MD; Boston, MA; Cambridge, MA; Chicago, IL; Minneapolis, MN; New York, NY; Phoenix, AZ; Portland, OR; Roswell, GA; San Francisco, CA; Seattle, WA; Tucson, AZ and Washington, DC.

INTERSECTION TREATMENTS

INTERSECTION CROSSING MARKINGS	DESCRIPTION/FEATURES	BENEFITS
 Photo: National Association of City Transportation Officials Location: Chicago, IL	Intersection crossing markings indicate the intended path of bicyclists. They guide bicyclists on a safe and direct path through intersections, including driveways and ramps.	• Raises awareness for both bicyclists and motorists to potential conflict areas. • Reinforces that through bicyclists have priority over turning vehicles or vehicles entering the roadway (from driveways or cross streets). • Guides bicyclists through the intersection in a straight and direct path. • Makes bicycle movements more predictable. **DRAWBACKS** • May give cyclists a false sense of safety while crossing intersections with high volumes of right-turns.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
Intersection Crossing Markings should be considered with: • Signalized intersections, particularly through wide or complex intersections where the bicycle path may be unclear. • Along roadways with bike lanes or cycle tracks. • Across driveways and Stop or Yield-controlled cross-streets. • Where typical vehicle movements frequently encroach into bicycle space, such as across ramp-style exits and entries where the prevailing speed of ramp traffic at the conflict point is low enough that motorist yielding behavior can be expected.	• Accepted by MUTCD and AASHTO's Guide to Bicycle Facilities, 4th Edition **RESOURCES** • FHWA Manual on Uniform Traffic Control Devices. (2009). • DC Bicycle Facility Design Guide. (2005). • Portland Bicycle Plan for 2030: Survey of Best Practices. (2009). **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Seen in the form of dotted line extensions in most US bicycle-friendly cities. • Found in the form of color or other innovation in the following cities: Austin, TX; Boston, MA; Chicago, IL; Decatur, GA; Denver, CO; Eugene, OR; Memphis, TN; New York, NY; Portland, OR; San Francisco, CA; Washington, DC.

INTERSECTION TREATMENTS

TWO-STAGE TURN QUEUE BOXES	DESCRIPTION/FEATURES	BENEFITS
 Photo: National Association of City Transportation Officials Location: Portland, OR	Two-stage left (aka Copenhagen-Left, Melbourne-Left, jug-handle turn) offers bicyclists a safe left-turn movement where there are physical/safety barriers to entering the roadway in advance of the intersection. Bicyclists proceed straight across the intersection to the far side and then queue in front of the cross-street traffic.	• Reduces conflicts between motorists and bicyclists. • Bicyclists can position themselves in front of traffic on cross street. • Reduces complexity of left-turn for bicyclists. **DRAWBACKS** • Bicyclists must wait for two signals rather than one. • Bicyclists may feel uncomfortable in the queuing area.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
This treatment should be considered in an environment where cycle tracks or bike lanes are adjacent to multiple motor vehicle travel lanes. In addition, several specific areas for typical usage are: • Signalized intersections. • Along roadways with high traffic speeds and/or traffic volumes. • Where a significant number of bicyclists turn left from a right side facility. • To safely navigate streetcar tracks.	• Adopted in Portland, OR as an experimental treatment. **RESOURCES** • Portland Bicycle Plan for 2030: Survey of Best Practices. **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities and Atlanta, GA; Cambridge, MC; Philadelphia, PA; Portland, OR; New York, NY; Salt Lake City, UT; Chicago, IL

INTERSECTION TREATMENTS

MEDIAN REFUGE	DESCRIPTION/FEATURES	BENEFITS
 Photo: National Association of City Transportation Officials Manual Location: New York, NY	Median refuge islands are protected spaces placed in the center of the street to facilitate bicycle and pedestrian crossings. Crossings of two-way streets are facilitated by allowing bicyclists and pedestrians to navigate only one direction of traffic at a time. Medians configured to protect cycle tracks can both facilitate crossings and also function as two-stage turn queue boxes.	• Calms traffic and provides space for safe bicycle and pedestrian crossing • Allows bicyclists and pedestrian to cross while focusing on one direction of traffic at a time • On two-way streets allows bicyclists to take advantage of gaps in one direction of traffic at a time. **DRAWBACKS** • May restrict left-turn movements of automobiles. • Requires right-of-way that may result in loss of parking spaces or a travel lane. • Cost.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• A median refuge should be considered for relatively wide roadways with multiple lanes and few gaps in traffic. • May be used at signalized or un-signalized crossings. • Can be effective when located at intersections between signalized intersections that create gaps.	• Accepted by AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • AASHTO *Guide for the Development of Bicycle Facilities.* **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: Austin, TX; Los Angeles, CA; Minneapolis, MN; Portland, OR; San Francisco, CA.

INTERSECTION TREATMENTS

THROUGH BIKE LANES	DESCRIPTION/FEATURES	BENEFITS
 Photo: League of Michigan Bicyclists Location: Lansing, MI	For bicyclists traveling in a conventional bike lane or from a truncated cycle track, the approach to an intersection with vehicular turn lanes can present a significant challenge. For this reason it is vital that bicyclists are provided with an opportunity to correctly position themselves to avoid conflicts with turning vehicles. A "through bicycle lane" or 'bicycle pocket' at the intersection provides that protection.	• Enables bicyclists to correctly position themselves to the left of right turn lanes or to the right of left turn lanes. • Reduces conflicts between turning motorists and bicycle through traffic. • Provides bicyclists with guidance to follow the preferred travel path. • Leads to more predictable bicyclist and motorist travel movements. • Alerts motorists to expect and yield to merging bicycle traffic. • Signifies an appropriate location for motorists to safely merge across the bike lane into the turn lane. **DRAWBACKS** • Routine roadway maintenance is needed.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
A through bike lane should be considered when: • On streets with right-side bike lanes and right-turn only lanes at intersections. • On streets with left-side bike lanes and left-turn only lanes at intersections. • On streets with bike lanes and an auxiliary right-turn-only lane added in advance of the intersection. • On streets with bike lanes and a parking lane that transition into a turn lane at intersections.	• Most US jurisdictions are familiar with their design and application as described in the MUTCD and AASHTO *Guide for the Development of Bicycle Facilities*. **RESOURCES** • AASHTO Guide for the Development of Bicycle Facilities. • FHWA Manual on Uniform Traffic Control Devices. **CURRENT USAGE** • Bicycle lanes are the most common bicycle facility in use in the US.

INTERSECTION TREATMENTS

COMBINED BICYCLE LANE/ TURN LANE	DESCRIPTION/FEATURES	BENEFITS
Photo: National Association of City Transportation Officials Manual Location: Bend, OR	A combined bike lane/turn lane places a suggested bike lane within the inside portion of a dedicated motor vehicle turn lane. Using shared lane markings or conventional bicycle stencils with a dashed line delineates the space for bicyclists and advises motorists and bicyclists of proper positioning within the lane.	• Preserves positive guidance for bicyclists in a situation where the bicycle lane would otherwise be dropped prior to an intersection. • Allows "dual use" of lane where there is insufficient space for both bicycle lane and dedicated right-turn lane. • Reduces the risk of 'right hook' collisions at intersections. • Maintains bicyclist comfort and priority in the absence of a dedicated bicycle through lane. **DRAWBACKS** • Through-bicyclists may block right-turning motorists where turn capacity is needed.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION

• A combined bicycle lane/turn lane should be considered where a bike lane approaches a congested intersection that requires an exclusive right-turn lane for motorists.
• This treatment should be considered when:
  ○ < 10% of auto traffic is right-turning.
  ○ If > 25% of auto traffic is right-turning, use bike box in adjacent through lane if bike demand is sufficient.
  ○ Use shared lane marking in right-turn lane to show through bicycle movement.
	• Adopted in Portland, OR as an experimental treatment.
	
	RESOURCES
	• Portland Bicycle Plan for 2030
	
	CURRENT USAGE
	Currently used in the following US Cities: Austin, TX; Bend, OR; Billings, MT; Colorado Springs, CO; Chicago, IL; Eugene, OR; Kona, HI; New York, NY; Portland, OR; Provo, UT; San Francisco, CA; Washington, DC.

INTERSECTION TREATMENTS

CYCLE TRACK INTERSECTION APPROACH	DESCRIPTION/FEATURES	BENEFITS
 Photo: National Association of City Transportation Officials Manual Location: Cambridge, MA	The approach to an intersection from a cycle track should be designed to reduce turn conflicts for bicyclists and/or to provide connections to intersecting bicycle facility types. This is typically achieved by removing the protected cycle track barrier or parking lane (or lowering a raised cycle track to street level), and shifting the bicycle lane to be closer to or shared with the adjacent motor vehicle lane. At these intersections, the experience is similar to a conventional bike lane and may involve similar applications of merging area treatments and intersection crossing markings. At the intersection, the cycle track may transition to a conventional bike lane or a combined bike lane/turn lane. Cycle track crossings of signalized intersections can also be accomplished through the use of a bicycle signal phase that reduces conflicts with motor vehicles by separating in time potentially conflicting bicycle and motor vehicle movements.	• On one-way streets, reduces out of direction travel by providing contra-flow movement • Dedicates and protects space for bicyclists. • Eliminates risk and fear of collisions with over-taking vehicles. • Reduces risk of 'dooring'. • More attractive to a wide range of bicyclists at all levels and ages. **DRAWBACKS** • May require additional considerations at driveway and side-street crossings.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
A cycle track intersection approach should be considered when: • Where cycle tracks approach intersections where turning movements across the path of the bicyclist (either left or right) is allowed. • At intersections with a single dedicated right turn lane for motor vehicles. • On cycle tracks protected by on street parking or otherwise removed from the travel lane.	• Since cycle tracks are not a traffic control device, the MUTCD has no restriction on its use. **RESOURCES** • National Association of City Transportation Officials Manual **CURRENT USAGE** • Commonly used in dozens of European bicycle friendly cities. • Currently used in the following US cities: Brooklyn, NY; Cambridge, MA; Chicago, IL; Long Beach, CA; Missoula, MT; New York City, NY; Portland, OR; San Francisco, CA; Washington, DC

INTERSECTION TREATMENTS

GRADE SEPARATED CROSSINGS	DESCRIPTION/FEATURES	BENEFITS
 Photo: North Carolina Department of Transportation Location: Unknown	A grade-separated crossing provides continuity of a bicycle/pedestrian facility over or under a barrier. A bicycle/pedestrian crossing structure may be either a bridge or an underpass.	• A grade-separated crossing is a safe way for bicyclists and pedestrians to cross rivers, streets, and railroads. • This type of crossing provides continuity of the bicycle or pedestrian facility.
		DRAWBACKS
		Many bicyclists and pedestrians will not use an overpass that is inconvenient. Instead, pedestrians may choose a time saving, and sometimes more hazardous crossing. Fencing or other controls may be required to reinforce the safe crossing point.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
A grade-separated crossing should be considered when a bicycle facility meets a barrier, such as an active multi-track railroad, stream, or freeway, and continuity of the route is desired. There are two main types of grade-separated crossings: overpasses (bridges) and underpasses (most often these would be culverts). When a heavily utilized multi-use pathway intersects with a high volume multi-lane roadway, it is desirable to provide an overpass or an underpass to separate multi-use pathway users from conflicts with motor vehicle traffic.	Most US jurisdictions are familiar with their design and application as described in the MUTCD and AASHTO *Guide for the Development of Bicycle Facilities*.
	RESOURCES
	• AASHTO *Guide for the Development of Bicycle Facilities*. • FHWA Manual on Uniform Traffic Control Devices.
	CURRENT USAGE
	• Commonly used throughout the world.

INTERSECTION TREATMENTS

CROSSBIKE	DESCRIPTION/FEATURES	BENEFITS
 Photo:, IBPI, Alta Planning & Design, Portland State Univ Location: Berkeley, CA	Pavement markings adjacent to the crosswalk indicating space for bicycles to cross major intersections. Increases visibility of bicycles at intersections and encourages motorists to yield right-of-way to bicyclists waiting to cross.	• Provides greater visibility for bicyclists at intersections. • Informs all roadway users of where bicyclists should cross. • Separates modes to reduce conflicts. **DRAWBACKS** Cross-bike will have higher than normal wear based on the level of crossing auto traffic.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
Cross-bike intersection treatment should be considered when: • Where main bicycle routes cross relatively minor collectors. • Where cross traffic has to yield right-of-way to crossing bicyclists. • Not appropriate where speeds exceed 30 mph unless signalized.	• Currently considered an experimental treatment and is recognized by city and state DOTs, notably Portland Bureau of Transportation and City of Tucson. **RESOURCES** • United State Department of Transportation Federal Highway Administration. (2006). *BikeSafe: Bicycle countermeasure selection system.* **CURRENT USAGE** Currently installed in Tucson, AZ; Portland, OR; Berkeley, California; Delta, BC; London, England; Vancouver, BC; Vienna, Austria; Paris, France; Groningen, Netherlands.

INTERSECTION TREATMENTS

ZIG-ZAG LINE TREATMENT	DESCRIPTION/FEATURES	BENEFITS
 Photo: Virginia Transportation Research Council Location: Loudoun County, VA	Zig-Zag lines marked on the road before the crossing advise motorists that they are approaching a crossing that may be hidden because of a curve or crest or dip in the road. Zig-zag pavement markings are perceptual countermeasures used to create safer driving environments by attempting to increase motorist awareness near crosswalks.	• The zig-zag pavement markings had a sustained positive effect on speed reduction at problem intersections. **DRAWBACKS** • Lower speed reactions by drivers due to zig-zag pavement markings are often a direct result of confusion and cautiousness, since the markings are met with limited understanding as to their purpose.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Zig-zag pavement markings should be included considered as a safety countermeasure at mid-block crossings where there is a need for higher awareness. • The longitudinal length of the pavement markings be based on sight distance and posted speed limit	VDOT's Northern Region Traffic Engineering Division is involved in an experiment with the Federal Highway Administration that studies whether zig-zag pavement markings be included in the Manual on Uniform Traffic Control Devices. **RESOURCES** Virginia Transportation Research Council: *Best Practices in Traffic Operations and Safety: Phase II: Zig-zag Pavement Markings*. **CURRENT USAGE** Currently being experimented with in Hawaii and Virginia.

SIGNING & STRIPING

SHARED LANE MARKINGS OR SHARROWS	DESCRIPTION/FEATURES	BENEFITS
 Photo: The RBA Group Location: Philadelphia, PA	Shared lane markings or "sharrows" are road markings used to indicate a shared lane environment for bicycles and automobiles. They are not a facility type but are used to support a complete bicycle network. Shared lane markings are most appropriate for lower volume, lower speed streets.	• Reinforces the legitimacy of bicycle traffic on the street. • Assists bicyclists with lateral positioning away from the door zone & other hazards. • May be configured to offer directional and wayfinding guidance. • Requires no additional street space. • Reduces the incidence of sidewalk riding and wrong-way riding. • Can provide wayfinding. **DRAWBACKS** • Does not dedicate exclusive use for bicyclists.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION

• When there is insufficient width to provide bike lanes.
• On a steep downgrade.
• On streets with posted 35 mph speeds or faster and motor vehicle volumes higher than 3,000 aadt shared lane markings *is not a preferred treatment*. On these streets other bikeway types are preferred.
• Sharrows shall not be used on shoulders or in designated bicycle lanes.
• On-streets with parallel parking, the centers of the sharrows should be placed at least 11 feet from the face of the curb.
• On-streets without parking, the centers of the sharrows should be at least 4 feet from the face of the curb.
• They should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter.
	• MUTCD – can be implemented at present time
	• AASHTO – included in in AASHTO's *Guide to Bicycle Facilities, 4th Edition*
	RESOURCES
	• Included in:
	  ○ MUTCD section 9C.07
	  ○ AASHTO section 4.4
	• National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011
	CURRENT USAGE
	• Commonly used throughout the US including in: Hoboken, NJ; Princeton, NJ; New Brunswick, NJ; New York, NY

SIGNING AND STRIPING

GREEN COLORED PAVEMENT	DESCRIPTION/FEATURES	BENEFITS
 Photo: The RBA Group Location: Philadelphia, PA	Colored pavement can be utilized as a corridor treatment along the length of a bike lane or cycle track, or as a spot treatment, such as a bike box, conflict area, or intersection crossing marking.	• Increases the visibility of the bicycle facility. • Promoted the multi-modal nature of a corridor. • Reinforces priority to bicyclists in conflict areas. Conflict points are locations where motorists and cyclists must cross each other's path (e.g., at intersections or merge areas). • Increases motorist yielding behavior. **DRAWBACKS** • Colored pavement may require additional maintenance.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Across intersections, particularly through wide or complex intersections where the bicycle path may be unclear. • Across conflict areas such as driveways, yield-controlled cross-streets, and ramp exits and entries. • Within bike lanes or cycle tracks. • The pavement should be skid resistant and retro-reflective. • A "Yield to Bikes" sign should be used at intersections or driveways where bicyclists have the right of way. • Normal white bike lane lines shall be provided along the edges for consistency and enhance nighttime visibility. • The color green is required by the MUTCD for bicycle facilities to minimize confusion with other traffic control markings	• MUTCD - Interim approval has been granted for the use of green pavement markings for bike lanes and cycle tracks within intersections, green bike lanes at conflict points or green behind bike lane symbols and arrows • AASHTO – can be used based on FHWA interim approval **RESOURCES** • National Association of City Transportation Officials, *Urban Bikeway Design Guide*, April 2011 **CURRENT USAGE** • Application of colored pavement is seen in the following US cities: New York, NY; Washington, DC; Austin, TX; Boston, MA; Cambridge, MA; Chicago, IL; Columbia, MO; Eugene, OR; Indianapolis, IN; Minneapolis, MN; Missoula, MT; Portland, OR; Salt Lake City, UT; San Francisco, CA; Seattle

SIGNING & STRIPING

Bicycle Priority Lanes	Description/Features	Benefits
 Photo: Salt Lake City, Transportation Division Location: Salt Lake City, UT	A Bicycle Priority Lane is a shared lane treatment in which a sharrow along with paint or dashed lines delineate a bicycle zone as a lane-within-a-lane. The name alludes to priority seating on a bus: if a cyclist is there, motorists should yield the space, but if not they are free to use it.	• More visible than sharrows alone. • Further defines ideal road position for bikes in the right hand lane in order to induce motorists to completely change lanes to pass. • Encourages cyclists to ride away from the door zone & to encourage motorist acceptance of those who do. • Encourages sidewalk cyclists to ride in the street. **Drawbacks** • Bicycle priority lanes are not separated, so those riders who are not comfortable sharing the lane with motorists are unlikely to use it. • Requires periodic maintenance to renew paint, and use of paint materials that are not slippery.

When to Use/Typical Application	Treatment Status/Adoption
• When more visibility is desired than sharrows alone. • The green sharrow lane is useful for streets where traffic speeds are slow, allowing for a comfortable mixing of bicycle and motor vehicle traffic. • Business districts with space constraints that do not allow for bike lanes or cycle track facilities are candidates for this treatment.	• FHWA is currently experimenting with green highlighted sharrows. **Resources** • *Bicycle Priority Lanes: A Proposal for Marking Shared Lanes*, by Peter Furth • Cycle Tracks and Bicycle Priority Lanes: More Tools to Serve Traffic-Intolerant Riders; **Current Usage** • Salt Lake City, UT; Brookline, MA; Long Beach, CA

SIGNING AND STRIPING

WAYFINDING SIGNAGE AND MARKINGS

DESCRIPTION/FEATURES

A bicycle wayfinding system consists of comprehensive signing and/or pavement markings to:

- Designate a system of routes.
- Designate a continuous or preferred route.
- Provide location specific guidance.

Wayfinding Signage

Photo: The RBA Group
Location: Philadelphia, PA

Wayfinding Markings

Photo: NACTO
Location: Portland, OR

BENEFITS

- Indicates to bicyclists and motorists that they are on a designated bikeway.
- Identifies the best routes to destinations. May include time and distance.
- Pavement markings can be installed to help reinforce routes and directional signage and to provide bicyclist positioning and route branding benefits.
- Under urban conditions, pavement markings may often be more visible than signs to users of the route.

DRAWBACKS

- When used alone, bike route signs convey little meaning. They should include destinations and distances as displayed on MUTCD signs D1-1. A Bike Way map can also provide supplemental information that supports the use of Signed Shared Routes.

WHEN TO USE/TYPICAL APPLICATION

- Signs are typically placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes.
- Signs should be oriented so bicyclists have sufficient time to comprehend the sign and change their course, when needed.

TREATMENT STATUS/ADOPTION

- MUTCD - can be implemented at present time if signs and pavement markings that are compliant with the MUTCD are used, but currently is experimental if a non-compliant sign or marking is used.

RESOURCES

- MUTCD Chapter 9 – section 9B.20
- AASHTO *Guide to Bicycle Facilities, 4th Edition* – Section 4.11

CURRENT USAGE

- The use of bicycle wayfinding signs is very common.
- The use of pavement markings to identify bikeways has been experimented with in Portland, OR and Berkeley, CA

SIGNING AND STRIPING

BICYCLES MAY USE FULL LANE SIGN (R4-11)	DESCRIPTION/FEATURES	BENEFITS
Photo: arlnow.com Location: Arlington, VA	The BICYCLES MAY USE FULL LANE sign may be used in locations where it is important to inform road users that bicyclists might occupy the travel lane.	• Reinforces the law to both motorists and bicyclists that bicyclists might occupy the travel lane. **DRAWBACKS** • Fear that the sign could mislead inexperienced bicyclists into occupying inappropriate, and unsafe, positions within a roadway.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• The BICYCLES MAY USE FULL LANE sign may be used on roadways where no bicycle lanes or adjacent shoulders usable by bicyclists are present and where travel lanes are too narrow for bicyclists and motor vehicles to operate side by side. • The sign may be used in addition to or instead of the Shared Lane Marking. • AASHTO's *Guide for Bicycle Facilities, 4th Edition* recommends using the BICYCLE MAY USE FULL LANE Sign when lane widths are less than 14 ft.	• MUTCD – can be implemented at present time • AASHTO – included in in AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • MUTCD Chapter 9 - section 9B.06 • AASHTO *Guide to Bicycle Facilities* - section 4.3.2 **CURRENT USAGE** • Commonly used throughout the United States

SIGNING & STRIPING

SHARE THE ROAD SIGNS (W11-1 & W16-1P)

Photo: The RBA Group
Location: Highlands, NJ

DESCRIPTION/FEATURES

A SHARE THE ROAD sign assembly is intended to alert motorists that bicyclists may be encountered and that they should be mindful and respectful of bicyclists.

BENEFITS

- Alert motorists that bicyclists may be encountered and that they should be mindful and respectful of bicyclists.

DRAWBACKS

- Sign is not a substitute for design measures that can improve the quality of service for bicyclists.
- Sign says nothing about where on the road bicyclists are expected to ride.

WHEN TO USE/TYPICAL APPLICATION

- In situations where there is a need to warn motorists to watch for bicyclists traveling along the highway, the SHARE THE ROAD (W16-1P) plaque (see Figure 9B-3) may be used in conjunction with the W11-1 sign.
- AASHTO's *Guide for Bicycle Facilities, 4th Edition* recommends using the SHARE THE ROAD sign when lane widths are greater than or equal to 14 ft.
- At the end of a bike lane, or where a shared use path ends.
- In work zones where bicyclists may need to share a narrower space than usual.
- Sign should not be used to address reported traffic operational issues, as the addition of this warning sign will not significantly improve bicycling conditions.
- Sign should not be used to indicate a bike route.

TREATMENT STATUS/ADOPTION

- MUTCD – can be implemented at present time
- AASHTO – included in in AASHTO's *Guide to Bicycle Facilities, 4th Edition*

RESOURCES

- MUTCD Chapter 9 – section 9B.19
- AASHTO *Guide to Bicycle Facilities, 4th Edition* – section 4.3.2

CURRENT USAGE

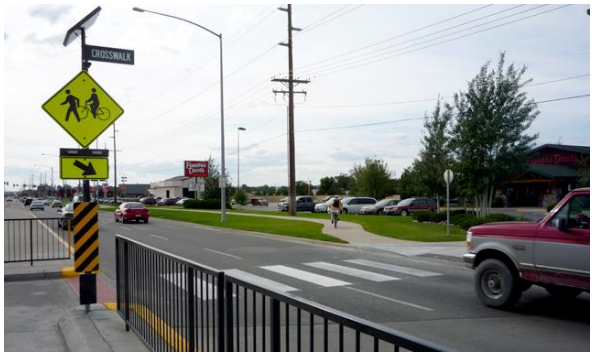
- Commonly used throughout the United States

SIGNING AND STRIPING

WRONG WAY RIDING SIGNS (R5-1B)	DESCRIPTION/FEATURES	BENEFITS
R5-1b R9-3cP	Bicycles are vehicles and when operated on a roadway they should travel in the same direction as other roadway traffic.	• Reinforces the legal requirement of bicyclists to ride with traffic. **DRAWBACKS** • Can contribute to sign clutter if not mounted back-to-back with other signs.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• For locations where wrong-way riding by bicyclists is frequently observed. • The Bicycle WRONG WAY (R5-1b) sign and RIDE WITH TRAFFIC (R9-3cP) plaque (see Figure 9B-2) may be placed facing wrong-way bicycle traffic, such as on the left side of a roadway. • This sign and plaque may be mounted back-to-back with other signs to minimize visibility to other traffic. • The RIDE WITH TRAFFIC plaque should be used only in conjunction with the Bicycle WRONG WAY sign, and should be mounted directly below the Bicycle WRONG WAY sign.	• MUTCD – can be implemented at present time • AASHTO – included in in AASHTO's *Guide to Bicycle Facilities, 4th Edition* **RESOURCES** • MUTCD Chapter 9 – section 9B.07 • AASHTO *Guide to Bicycle Facilities, 4th Edition* – section 4.3.2 **CURRENT USAGE** • Commonly used throughout the United States

SIGNING AND STRIPING

ACTIVE WARNING BEACON	DESCRIPTION/FEATURES	BENEFITS
 Photo: NACTO Location: Billings, MT	Active warning beacons are user-actuated amber flashing lights that supplement warning signs at unsignalized intersections or mid-block crosswalks. Beacons can be actuated either manually by a push-button or passively through detection. Rectangular Rapid Flash Beacons (RRFBs), a type of active warning beacon, use an irregular flash pattern similar to emergency flashers on police vehicles and can be installed on either two-lane or multi-lane roadways.	• Offers lower cost alternative to traffic signals and Hybrid Beacons. • Significantly increases driver yielding behavior at crossings when supplementing standard crossing warning signs and markings. • The unique nature of the stutter flash (RRFBs) elicits a greater response from drivers than traditional methods. **DRAWBACKS** • Depending on power supply, maintenance can be minimal. If solar power is used, RRFBs should run for years without issue.

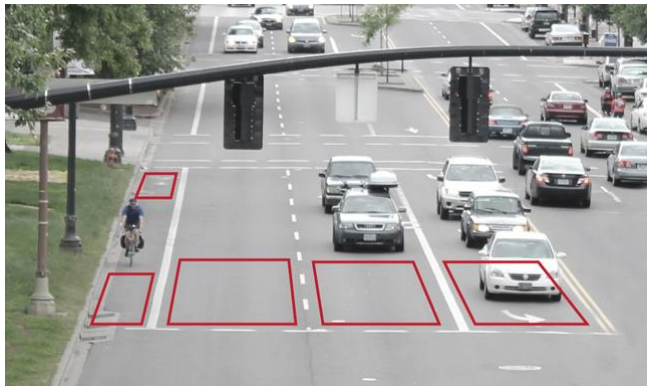
WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
• Usually implemented at high-volume pedestrian crossings, but may also be considered for priority bicycle route crossings. • At locations where bike facilities cross roads at mid-block locations or at intersections where signals are not warranted or desired. • At locations where driver compliance at bicycle crossings is low. • Beacons shall be unlit when not activated. • If intended for use by bicyclists, push button actuation shall be provided, and should be located so bicyclists can activate the signal without dismounting. Push buttons should have a supplemental sign facing the bicyclist's approach to increase visibility.	• MUTCD - can be implemented at present time **RESOURCES** • MUTCD –not included in the 2009 MUTCD because it was granted Interim Approval status too late to include in the January 2008 Notice of Proposed Amendments (NPA). **CURRENT USAGE** Several municipalities and counties in the United States have experimented with and evaluated RRFBs for bicycles (as well as pedestrians), including the following: Billings, MT; Boulder, CO; Las Cruces, NM; Miami-Dade, FL; Portland, OR; St. Petersburg, FL; Wilmington, NC

SIGNALS

Hybrid (HAWK) signal	Description/Features	Benefits
Photo: National Association of City Transportation Officials Location: West Bloomfield Township, MI	A hybrid beacon, also known as a High-intensity Activated Crosswalk (HAWK), consists of a signal-head with two red lenses over a single yellow lens on the major street, and pedestrian and/or bicycle signal heads for the minor street.	• Can be implemented where a conventional traffic signal is not desired due to the potential to increase traffic volumes on minor street approaches. • Associated with very high driver compliance (studies show greater than 95% driver compliance with red indications). **Drawbacks** • HAWK's major disadvantage is its high price, at $75,000 to $100,000 per crossing.

When to Use/Typical Application	Treatment Status/Adoption
A hybrid/HAWK signal should be considered when: • Where bike routes intersect major streets without existing signalized crossings. • Where off-street bicycle or pedestrian facilities intersect major streets without existing signalized crossings. • At mid-block crossings of major roadways with high bicycle or pedestrian volumes.	Chapter 4F of the 2009 MUTCD provides guidance and standards for hybrid beacons at un-signalized and mid-block pedestrian crossings, but does not consider hybrid beacons for bicyclist crossings. **Resources** • FHWA Manual on Uniform Traffic Control Devices (but should be installed using pedestrian guidelines and used by bicyclists.) • National Association of City Transportation Officials Manual **Current Usage** Hybrid beacons have been implemented in several US cities, including the following: Alexandria, VA; Bloomington, IN; Fort Collins, CO; Madison, WI; Miami, FL; Salt Lake City, UT; Phoenix, AZ; Portland, OR; Tucson, AZ; Washington, DC.

SIGNALS

SIGNAL DETECTION (LOOP DETECTORS, VIDEO DETECTION, BICYCLE PUSHBUTTONS)	DESCRIPTION/FEATURES	BENEFITS
 Photo: National Association of City Transportation Officials Location: Portland, OR	Bicycle detection is used at actuated signals to alert the signal controller of bicycle crossing demand on a particular approach. Bicycle detection occurs either through the use of push-buttons or by automated means (e.g., in-pavement loops, video, microwave, etc).	• Improves efficiency and reduces delay for bicycle travel. • Increases convenience and safety of bicycling and helps establish bicycling as a legitimate mode of transportation on streets. • Discourages red light running by bicyclists without causing excessive delay to motorists. • Can be used to prolong the green phase to provide adequate time for bicyclists to clear the intersection. **DRAWBACKS** • High cost.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
An automated signal detector should be considered : • At intersections with bicycle signal heads and/or bicycle-specific phasing that are actuated. • In bike lanes on intersection approaches that are actuated. • In left turn lanes with actuated left-turn signals where bicyclists may also turn left.	Most US jurisdictions are familiar with their design and application as described in the MUTCD and AASHTO Guide for the Development of Bicycle Facilities. **RESOURCES** • AASHTO Guide for the Development of Bicycle Facilities. • FHWA Manual on Uniform Traffic Control Devices. **CURRENT USAGE** Bicycle signal detection is widely used in North American and European cities, both at standard signalized intersections and those with bicycle signal phases.

BICYCLE PARKING

SHORT TERM BICYCLE PARKING			DESCRIPTION/FEATURES
Inverted U – intuitive and secures bicycle at two points; easy to park when properly sited and spaced; accessible from both sides. Photo: The RBA Group	**Post and Ring** – similar usability as Inverted U but is easy to implement by retrofitting parking meter posts with rings. Photo: Streetsblog.org	**Tree guard bicycle racks** – Intuitive, similar in usability to Inverted U but only accessible from one side. Photo: City of Berkeley, CA	Short- term parking facilities can be used at locations where it is expected that the user will be using the space for the length of a typical errand (2 hours or less). In these instances, bicycle racks provide easy access and are typically easy to locate.

BENEFITS	DRAWBACKS
• Low cost and fast implementation. • May be able to use existing fixtures such as meters and tree guards to retrofit racks. • Highly secure and requires little maintenance other than snow removal.	• Bicycle is not completely secure and parts can be removed by vandals. • Cannot be reserved and may not be consistently available for daily commuting to a transit facility or workplace. • Bicycle is typically exposed to the elements and possible weather damage such as rust.

WHEN TO USE/TYPICAL APPLICATION	TREATMENT STATUS/ADOPTION
A short-term parking fixture should be: • Convenient to cyclist destination • Placed no more than 50' from the entrance. • Visible from the destination to provide security. • Located in a high-traffic area for security. • Identified by MUTCD sign D4-3 "Bicycle Parking." • Located along natural "desire lines" from bikeways.	• Accepted by MUTCD and AASHTO's *Guide to Bicycle Facilities, 4th Edition*
	RESOURCES
	• APBP *Bicycle Parking Guidelines*
	CURRENT USAGE
	• Commonly used in most US cities.

BICYCLE PARKING

LONG TERM BICYCLE PARKING FACILITIES

Bike parking in parking garage, New York, NY.
Photo: Streetsblog.org

Bike Lockers at stations on NJ TRANSIT's Morris and Essex rail line.
Photo: TransOptions TMA

Bike station Facility in Washington, D.C. Indoor secure parking is sold to commuters.
Photo: Mobis Transportation Alternatives, Inc.

DESCRIPTION/FEATURES

Long-term parking consists of a wider variety of fixture types and site plan layouts and includes cages and bicycle rooms, as well as lockers located in a variety of different settings, both indoors and outdoors. Security is important, since most long-term parking is located in low traffic and out of the way locations.

BENEFITS

- Highly secure, with low risk of vandalism or theft.
- Offers protection from the elements and weather related damage and corrosion.
- Leased spaces allow for consistent availability for daily cyclist commuters.

DRAWBACKS

- High construction and maintenance costs

WHEN TO USE/TYPICAL APPLICATION

- Easy access using effective signage.
- Controlled access through either a smart card or key.
- A portion of lockers are available to lease as well as on-demand.
- Can also be proved by using a dedicated bicycle room or caged area in a garage with smartcard/secure access.
- Generally a high level of security is provided with effective lighting, security cameras or security guards.
- Protection from weather and the elements is provided, either indoors or with a shelter.

TREATMENT STATUS/ADOPTION

- Accepted by AASHTO's *Guide to Bicycle Facilities, 4th Edition*

RESOURCES

- APBP Bicycle Parking Guidelines

CURRENT USAGE

- Vital component of a bicycle network and used extensively by NJ TRANSIT
- Found in various forms in the many US cities.

Other

Shared Bike Bus Lanes (SBBL)	Description/Features	Benefits
 Photo: JoAnne Fiebe Location: Washington, DC	Bike-bus lanes are travel lanes restricted to buses, bicycles, and (usually) vehicles turning right. The lane is separated from general purpose lanes by a solid white line, and designated by signs and painted legends. This configuration requires bicyclists and buses to pass one another in "leapfrog" fashion.	• On a busy arterial street with conventional bike lanes, buses frequently block the bike lane at bus stops. Bicyclists may also be squeezed between the door zone of parked cars on the right and adjacent traffic on the left. A shared lane eliminates these issues. • Provides some degree of space separation between general traffic and bicyclists for their greater safety and comfort. **Drawbacks** • For safe sharing of bike-bus lanes, education of bus drivers is considered important. • Enforcement of SBBL

When to Use/Typical Application	Treatment Status/Adoption
• Where constrained right-of-way prevents provision of a separate bicycle lane. • Where municipalities seek ways to accommodate buses and bicycles for better multimodal service. • Necessary width for an SBBL is estimated to be 16 feet, seven inches, where all the following conditions exist: curb and gutter; posted speed limit 30 mph or less, operating speed of buses is 30 mph or less.	• No current national standards for SBBL **Resources** • State design manuals with guidance regarding SBBLs include Maryland, Illinois, Washington, and the District of Columbia. **Current Usage** 27 cities in the United State employ shared bike-bus lanes including Tucson, AZ; Madison, WI; Toronto, Ontario; Vancouver, BC; and Philadelphia, PA.

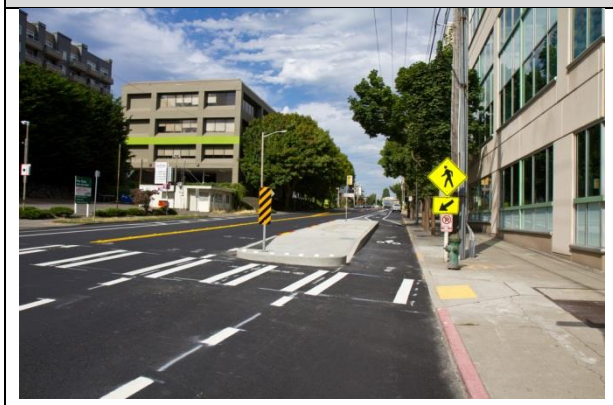
Other

Bicycle Boulevards	Description/Features	Benefits
 Photo: www.pedbikeimages.org-Adam Fukushima Location: San Luis Obispo, CA	Bicycle boulevards are low-volume and low-speed streets that have been optimized for bicycle travel through treatments such as traffic calming and traffic reduction, signage and pavement markings, and intersection crossing treatments. These treatments allow through movements for cyclists while discouraging similar through trips by non-local motorized traffic. Motor vehicle access to properties along the route is maintained.	• Bicycle boulevards are effective at increasing cycling levels and perceptions of safety and can be accomplished with minor changes to street configuration. • Slower vehicle speeds accomplished with traffic-calming measures reduce risk of serious collisions. • Since they are shared facilities, no additional street width is needed. • Bicycle boulevards can be combined with neighborhood greening efforts to enhance street closures and traffic circles with trees and landscaping. **Drawbacks** • Residents and officials often raise concerns related to traffic reduction and calming: access to property; impact on traffic patterns; enforcement issues with motorcycles and mopeds; and emergency response.

When to Use/Typical Application	Treatment Status/Adoption

• Bicycle boulevards are best suited for two-lane residential streets where vehicle traffic can be restricted to low volumes and slow speeds. Ideally they are parallel to major streets and provide an alternative without lengthy deviation.
• Design elements may include but are not limited to:
  ○ Traffic diverters at key intersections to reduce through motor vehicle traffic while permitting bicyclists to pass.
  ○ Neighborhood traffic circles and mini-roundabouts to slow motor vehicle traffic but allow bicyclists to maintain momentum.
  ○ Wayfinding signs and shared lane markings and crossing improvements such as a traffic signal, median refuges, curb extensions
• Bicycle boulevard design must also take into consideration access for emergency vehicles.
	• AASHTO – included in *Guide to Bicycle Facilities, 4th Edition*
	Resources
	• AASHTO *Guide to Bicycle Facilities, 4th Edition*
	• *Fundamentals of Bicycle Boulevard Planning & Design*, Portland State University, July 2009
	Current Usage
	Cities that have utilized the bicycle boulevard concept include: Ocean City, NJ; Albuquerque, NM; Berkeley, CA; Emeryville, CA; Eugene, OR; Palo Alto, CA; Portland, OR; Tucson, AZ; Vancouver, BC

Other

Bike Channels at Transit Stops	Description/Features	Benefits
 Photo: Flickr/AtomicTaco Location: Seattle, WA	A bike channel runs between the sidewalk and a public transit boarding island. They can be painted green and/or marked with pavement markings to help clarify the right of way for bicycling and not to walk in the bike lane.	• Separates bicyclists, buses and pedestrians. • Allows bicyclists to go around stopped buses without having to go into traffic. • The buses will stop in the traffic lane to load passengers, allowing them to run more smoothly because they do not have to merge back into traffic after each stop. **Drawbacks** • Potential conflicts with pedestrians exiting transit. • Potential conflicts between bicyclists and public transit vehicles when entering and exiting the bike channel.

When to Use/Typical Application	Treatment Status/Adoption
• At bus/transit boarding islands. • Where there is adequate space for transit riders to get off the bus without stepping directly into the bicycle path. • Where there is adequate visibility for pedestrians to safely cross the bicycle path. • A crosswalk should be painted across the bike lane to indicate to bicyclists to stop for people crossing. • The bike route can be raised to the level of the sidewalk at the stop, so that passengers don't have to negotiate multiple curbs and helping cyclists know that it's a shared area.	• No current national standards for Bike Channels around transit boarding islands. **Resources** • See AASHTO for bicycle lane requirements **Current Usage** • San Francisco, CA; San Jose, CA; Seattle, WA; Vancouver, BC • Copenhagen and Amsterdam

Other

Bicycle Lift or CycloCable

Photo: mylittlenorway.com
Location: Trondheim, Norway

Description/Features

The bicycle lift or 'trampe' works much like a ski lift except that it is integrated into the bike path. At the bottom of the steep 425 meter long hill cyclists place their right foot on the lift and receive a push which transports them upwards at a comfortable speed of 2 meters per second. Since its introduction in 1993, 'Trampe' has assisted more than 220,000 cyclists.

Benefits

- Helps promote bicycling in areas with steep hills.
- 41 % of the lift users claim they're using the bicycle more often because of the lift.
- Encourages people who don't want to get warm and sweaty from riding up hills.
- There have been no accidents.

Drawbacks

- Some new users have difficulty maintaining balance which can result in falling off.
- During winter time the lift is closed.
- Cost is about $440-550/foot

When to Use / Typical Application

- On hills less than 1,312 feet.
- To increase the use of bicycles.

Treatment Status / Adoption

- Design Management AS owns all the patents and licenses. The prototype in Brubakken, Trampe, belongs to the Public Road Administration. Together with the Municipality of Trondheim, the Public Road Administration also pays for the administration of Trampe. Design Management AS is hired to see to and maintain the stability of the prototype.

Resources

- http://www.trampe.no/english/index.php
- http://mylittlenorway.com/2011/08/bike-lift/

Current Usage

- Trondheim, Norway
- According to the Trampe website, both Design Management AS and POMA are now following up a number of cities in Europe, USA, Canada and South Korea.