Bikeway Types

Bicycle Boulevards—Bicycle boulevards are enhanced local street corridors that give priority to bicycles. Bicycle boulevards typically run parallel to minor arterial or collector street corridors and generally serve bicyclists who are not comfortable riding on busy streets. Bicycle boulevards usually allow motorists but often include traffic calming treatments such as diverters, bump-outs, and speed humps to discourage cut-through motor vehicle trips. In some cases speed limits are reduced or there is additional traffic enforcement. Bicycle boulevards include information and wayfinding signage in addition to special pavement markings. Special attention is also given to intersections to limit bicycle delay and to create free-flow conditions for bikes whenever possible.

Bicycle Boulevard Criteria:

- Implemented on low volume local street corridors that are parallel to minor arterial and collector roadways.
- Candidate corridors should be located where there are existing diverters, ped/bike bridges, and signalized crossings to minimize the need for new infrastructure.
- Spaced in a 1-mile grid.
- Used when shared lanes, shared lanes with signage, and wide outside lanes are not expected to increase bicycle use or safety.

Above: Berkeley, CA Bicycle Boulevard Signage

Above: Berkeley, CA Bicycle Boulevard Marking

Above: Berkeley, CA Traffic Calming treatments

Above: Berkeley, CA Bicycle Boulevard Marking

Bikeway Types

Bicycle Boulevard—Below are standard and optional treatments for bicycle boulevards.

Standard: Replace street signs along bike routes to include bicycle symbols.

Option: Reversing stop signs at key intersections to allow for free-flow biking.

Standard: Addition of pavement markings clearly tells both cyclists and motorists that bicyclists are prominent.

Option: Traffic Calming Devices such as speed humps or diverters can deter motorists from using a route.

Standard: Addition of identification signage compliments the pavement marking message.

Option: Intersections can be modified to allow bicycles passage while prohibiting vehicles from entering.

Bikeway Types

Bicycle Boulevard—Bicycle Boulevards are local streets that give bicyclists priority through the use of traffic calming devices. Below are some examples of various traffic calming devices from the city of Portland, Oregon.

Above: This Bicycle Boulevard uses a choker in combination with a speed hump to slow vehicles.

Above: This choker has been designed with a rain garden. This devise helps to manage storm water.

Above: This Bicycle Boulevard includes a landscaped diverter where bicycles are able to pass through.

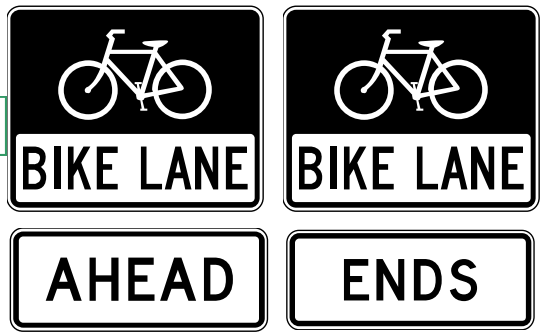
Above: A close up of this diverter reveals pavement markings used to help direct bicyclists.

Above: This traffic circle is used to slow vehicles and also deters trucks from using the corridor.

Above: This channelizing island separates motor vehicles from bikes at an intersection.

Bikeway Types

Bike Lane—A bike lane is a 5 or 6-foot wide designated space exclusively for bicycles. Bike lanes are distinguished from other traffic lanes with special signage and pavement markings. Curbside bike lanes and bike lanes adjacent to parking are common treatments. It is important that a curbside bike lane include at least 5 feet of space outside of the gutter pan to allow for snow storage and to discourage bicyclists from riding in the gutter pan. In corridors with limited space, an innovative 5-foot gutter pan bike lane with saw cut joints has been installed to accommodate bicycles. In many situations parking may need to be removed to allow for a curbside bike lane. Bike lanes should be spaced in a grid of no less than a one-mile spacing so that a bike lane is within a 1/2 mile of any location within the city. Bike lanes are commonly used throughout the city on minor arterials and collector roadways but often require parking removal or the removal of a travel lane. 8 to 10 feet of parking space is preferred next to a 5 to 6-foot bike lane so that cyclists can avoid the "door zone". The Minneapolis Design Guidelines allow 7-foot parking lanes in some circumstances adjacent to a bike lane.



Above—Regulatory signs such as these are no longer required but are still recommended.

Above—Bike Lane on 2nd Street SE

R7-9
300 x 450 mm
12" x 18"

R7-9a
300 x 450 mm
12" x 18"

Above—The MMUTCD provides signage standards and guidelines for bicycle lanes. The signs shown are used to supplement bicycle lane pavement markings.

Above—Bike Lane on 2nd Street South

Bikeway Types

Bike Lane—Bike lanes are most commonly installed on collector and minor arterial streets with traffic volumes between 2,000 and 20,000 vehicles per day. In most situations, bike lanes are not appropriate for local streets. Since most collector and minor arterial streets are CSA or MSA roadways, trade-offs must be made between parking, bike lanes, and traffic capacity needs to meet standard street widths. Below are examples of different roadway cross sections along corridors with bike lanes.

Above: Example of a 48' MSA roadway (60' ROW) with three 12' lanes and a pair of 6' bike lanes (Plymouth Ave N). Previously this roadway segment was a four-lane roadway with excess capacity.

Above: Example of a 40' MSA two lane roadway (60' ROW) with two 12' lanes, a pair of 6' bike lanes, and 2' gutter pans (42nd Ave N). Parking was removed on both sides of this road to allow for new bike lanes.

Above: Example of a 50' MSA (80' ROW) two lane roadway (11th Ave S) with bike lanes and parking on both sides. This segment has little traffic congestion so three or four traffic lanes are not needed.

Above: Example of parking removal on one side along a 44' MSA two lane roadway (80' ROW) to allow for a 6' bike lane, a pair of 12' traffic lanes and 10' parking lane (40th St S).

Above: Example of a 54' CSA two lane roadway (100' ROW) with two 13' lanes, a pair of 6' bike lanes and 10' parking lanes (Minnehaha Ave S). Buses require extra lane widths so that they do not block the bike lane.

Bikeway Types

Paved Shoulder—Paved shoulder accommodations are often used on higher speed roadways and are typically 8 or 10 feet wide. Paved shoulders allow for bicycles to be separated from traffic using an edge line, but some corridors allow off-street parking. Shoulders also accommodate stalled vehicles and allow for safer traffic enforcement. Many of the river and freeway bridges in Minneapolis have paved shoulders with parking restricted. Most paved shoulders are not signed and are located in rural and suburban locations, however some urban roadways have been treated with an edgeline to achieve the same benefits of a paved shoulder. There is no substitute for a bike lane, however this treatment can be used where parking can not be lost but parking demand is sparse.

Signed Paved Shoulder Criteria: The MnDOT Bicycle Modal Plan outlines guidance with regard to signed shoulders. Signed shoulders may be used on roadways with:

- Designated bicycle routes and/or popular bicycling roadways.
- ADT's that typically exceed 2,000 ADT.
- Average vehicles speeds that exceed 35 mph.

Signed shoulders should be designed to the following specifications:

- Signed shoulders should be at least 4 feet in width.
- Signed shoulders should be located 5 feet from the face of the guardrail, curb or other roadside barriers.
- Signed shoulders should be 8 feet wide if motor vehicle speeds exceed 50 mph or if the percentage of trucks, buses, and recreational vehicles is high.
- Shoulders should be wider where higher volumes of bicyclists are expected.

Above: Paved shoulder in Maplewood, MN.

Above: Paved shoulder in Maplewood, MN

Above: A shoulder may be signed to prohibit other uses including parking. By statute, bicycles may choose to ride in the travel lane, however most bicyclists would prefer to ride on the shoulder.

Bikeway Types

Shared Lane—A shared use lane does not include any special signage or pavement markings for bicycles. Bicyclists share the same space with motor vehicles and follow the same laws as motor vehicle operators. Minnesota State Law allows bicycles to be on all streets and highways except for freeways. Local jurisdictions may impose further regulations, but all roadways should be designed and regulated with bicycles in mind.

It is important to note that all streets should be designed to be bicycle friendly. Roadways should be designed so that catch basins or roadway joints will not entrap a bicyclist's tire. In addition, manholes should be placed in locations that will not impede bicycle travel. Efforts should also be made to keep roadway surfaces smooth and free from potholes. All Minneapolis roadways are plowed after all major snow events and streets are regularly swept to remove debris.

According to the MnDOT Bicycle Facility Design Guidelines, shared lanes with no signage or wide outside lanes are appropriate on two lanes roadways with less than 500 vehicles per day. This describes the majority of local city streets throughout the city.

Above: W 36th Street is a shared use corridor.

Above: Bicyclists riding in traffic.

Bikeway Types

Shared Lane With Signage — A shared lane may be supplemented with "Bike Route" or "Share the Road" signage to encourage bicyclists to use a given corridor and to remind motorists that they may encounter a bicycle. Bike Route signage should be placed at key decision points along a corridor and Share the Road signage should be spaced at regular intervals. "Bike Route" signage should be used on designated bike routes that complete a comprehensive network. This network should consist of a grid of regularly spaced routes such that bicyclists are no further than one quarter mile of any signed route from any point in the city.

Above: Bicycle Route Signage in Prospect Park.

Above: Bicycle Route Signage in Prospect Park.

Above: Bicycle Route Signage in Windom Park.

Above: Bicycle Route Signage in St. Paul.

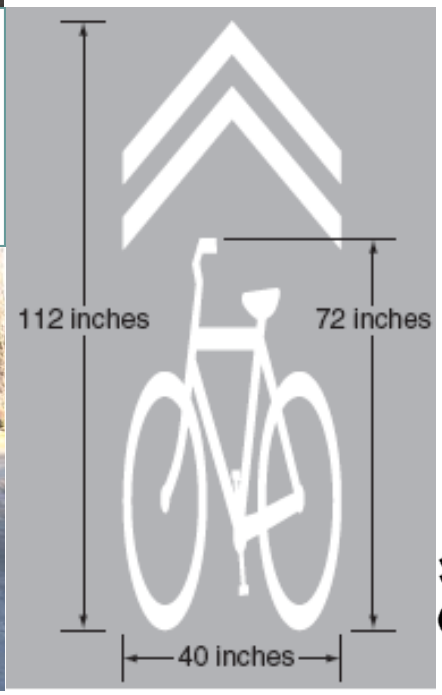
Bikeway Types

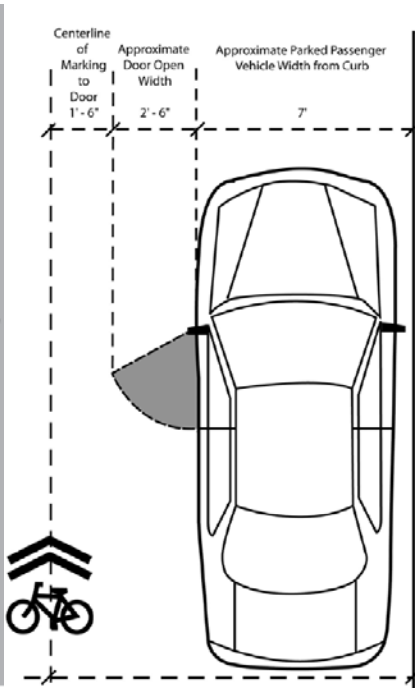
Shared Use Pavement Markings—Shared use markings enhance the visibility of bicycles along collector and minor arterial roadways. Shared use markings are intended to help bikers position themselves in lanes too narrow for a motor vehicle and a bicycle to travel side by side within the same traffic lane, to encourage safe passing of bicyclists by motorists, to reduce the chance of a bicyclist's impacting the open door of a parked vehicle in a shared lane with on-street parallel parking, to alert road users of the lateral location bicyclists may occupy, and to reduce wrong-way bicycling. Treatment used when there is not enough space for bike lanes.

Shared Use Markings with Signage Criteria:

- Shared use markings (also called Sharrows) shall not be used on shoulders or in designated bicycle lanes.
- Shared use markings with Signage should be implemented on corridors with speed limits at or below 35 mph.
- Pavement marking should be placed 11 feet (or greater) from face of curb to avoid the door zone when parking exists.
- Pavement markings should be used in combination with informational and wayfinding signage, share the road signage, or bike route signage to deliver a clear message to both bicyclists and motorists.
- Shared use markings should be placed immediately after an intersection and spaced at intervals not greater than 250 feet thereafter (2 markings on a short block, 3 on a long block).

Above: San Francisco, CA
Below: Bryant Avenue South Bike Lane Minneapolis, MN
Bottom Middle Diagram: Sharrow dimensions (MUTCD)
Bottom Right: San Francisco, CA Shared Lane Marking Study





Bikeway Types

Shared Use Pavement Markings— Shared Use Pavement Markings originated in Denver with the "bike in the house". Several communities have experimented with different variations of this treatment with the San Francisco "sharrow" being adopted for use nationally.

Above: Marking in Denver, CO.

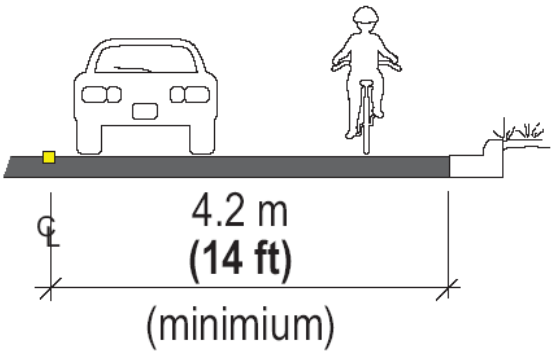
Above: Shared Use Pavement Marking in Boulder, CO.

Above: Shared Use Pavement Marking along Market Street in San Francisco, CA.

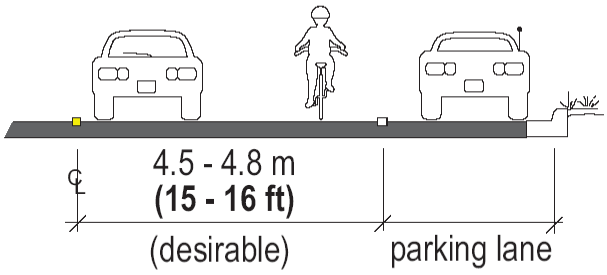
Above: Pavement Marking in St. Louis, MO.

Bikeway Types

Wide Outside Lane—A wide outside lane allows for motor vehicles to safely pass a bicyclist and can be next to the curb or adjacent to parking. Minnesota State Statute requires that a motor vehicle provide at least three feet of clearance when passing a bicycle. It is recommended that this treatment be used when there is not enough room for a bicycle lane along minor arterials and collector streets.



WIDE OUTSIDE LANE
NO PARKING



WIDE OUTSIDE LANE
WITH PARKING LANE

Above: Wide outside lane along Cedar Lake Road.

Wide Outside Lane Criteria: The MnDOT Bicycle Facility Design Guidelines provide guidance with regard to wide outside lanes.

Wide outside lanes may be used on roadways with:

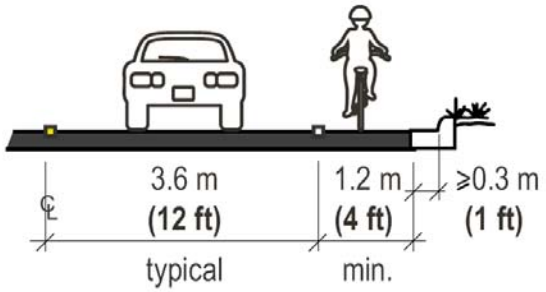
- Designated bicycle routes and/or popular bicycling roadways.
- Roadways with and without parking.
- Two, three, and four-lane roadways.
- Roadways that are not wide enough for bicycle lanes.

Wide outside lanes should be designed to the following specifications:

- A wide outside lane with 14-foot width is appropriate where vehicle speeds are 35 mph or less and traffic volumes are less than 10,000 ADT.
- A wide outside lane with 15 to 16-foot width is appropriate where vehicle speeds are 40 mph or greater, or where bicyclists need extra maneuvering room. Roadways with greater than 10,000 ADT should also include a wide outside lane 15-16 feet in width.
- Wide outside lanes greater than 16 feet are not recommended, because drivers may try to form two travel lanes, where striping a bike lane may provide better channelization of vehicles and bicycles.
- Wide outside lanes widths should not include the gutter pan width.
- Shared Use Pavement Markings or Share the Road Signs may be used in conjunction with wide outside lanes.

On-Street Bikeway Design

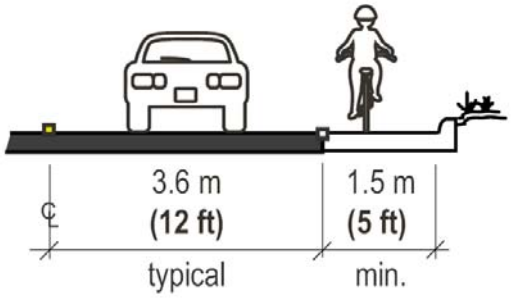
Bike Lane Design—A bicycle lane is defined by the MnDOT Bicycle Facility Design Manual as a portion of a roadway designated by striping, signing, and pavement markings for the preferential or exclusive use of bicycles. Bicycle lanes are often found in urban and suburban settings, and must carry bicycle traffic in the same direction of travel as adjacent motor traffic. The MMUTCD provides additional design guidance.



NO PARKING WITH STANDARD GUTTER PAN

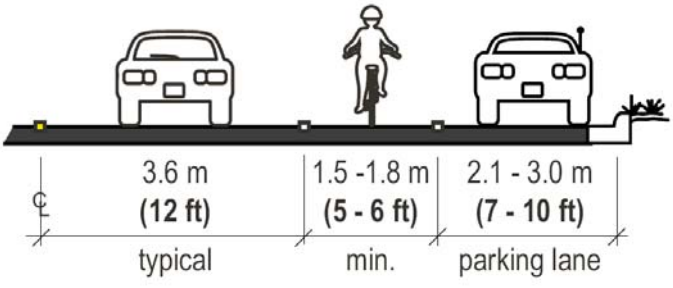
Bicycle Lanes Widths: Bicycle lane widths should be determined based on roadway volumes, traffic speeds, and the presence of parking. Every roadway jurisdiction has different standards for bicycle facilities based on roadway functional classification and for rural and urban settings.

Curbside Bicycle Lanes: A curbside bike lane must be at least 5 feet in width on any Municipal State Aid (MSA), County State Aid (CSA), and Trunk Highway (TH) route within the City of Minneapolis. The picture on the right shows a seamless gutter pan that has been approved for use on all MSA, CSA, and TH routes within the city. Bicycle lanes on all City of Minneapolis streets must be located outside of the gutter pan and must be at least 4 feet in width. Refer to the table in the "Selecting a Bicycle Facility" section of these guidelines.



NO PARKING WITH NO GUTTER SEAM IN BIKE LANE

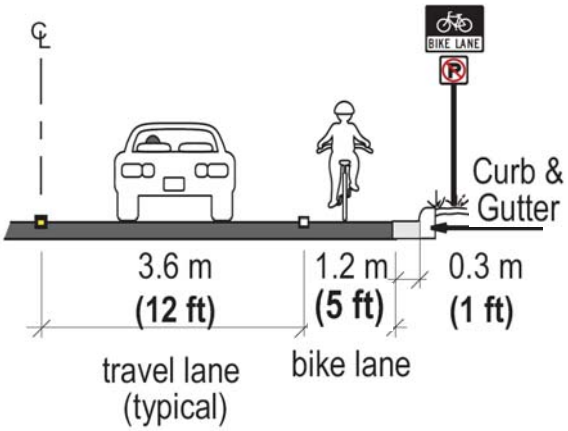
Bicycle Lanes Adjacent to Parking: Bicycle lanes next to parked vehicles must be at least 5 feet wide on MSA routes with 6 feet recommended on all CSA and TH routes. Parking lane widths vary based on traffic volumes with most MSA routes requiring a minimum 8 to 10 foot parking lanes. Most CSA and TH routes require parking widths of 10 feet. Wider parking lane widths reduce the chance of a biker being "doored" and add snow storage space in the winter.

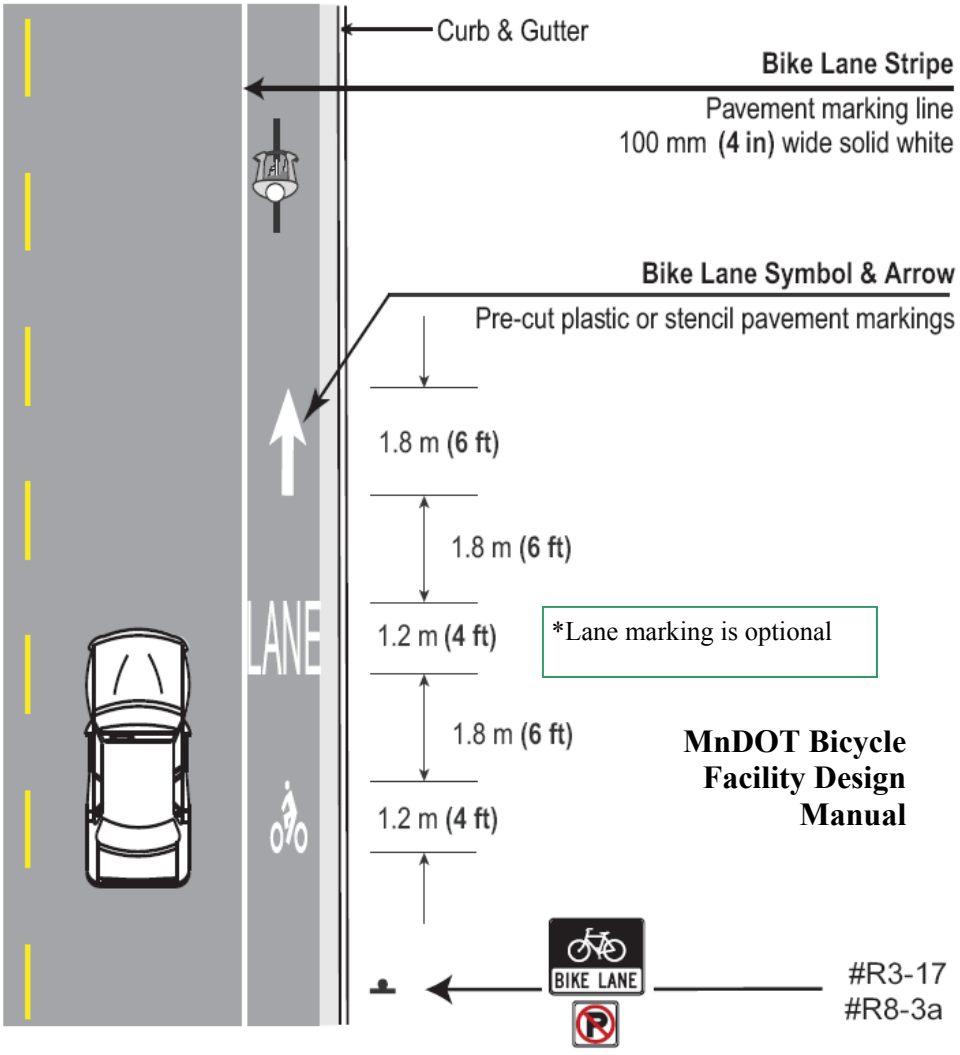


WITH ON STREET PARKING ALLOWED

On-Street Bikeway Design

Bicycle Lane Design—When installing bicycle lanes on collector and minor arterial roadways it is important to try to maintain roadway symmetry whenever possible. Both two-way roadways and one-way pairs should have bicycle lanes in each direction.





*Lane marking is optional

MnDOT Bicycle Facility Design Manual

Diagrams— The diagrams shown present the typical placement of signage/striping for a typical curbside bike lane. A bike lane must be at least 5 feet wide and must be properly signed in accordance with the Minnesota Manual on Uniform Traffic Control Devices. (MMUTCD).

** Not to Scale **

Install #R3-17 signs and pavement symbols at periodic intervals along the bicycle lane

Note:
Application of MN MUTCD Series R7-9 or R7-9a "NO PARKING BIKE LANE" signage may be used. Check current MN MUTCD for any changes to signs and striping configurations.

On-Street Bikeway Design

Bicycles Allowed Full Use of Lane—The purpose of this signage is to inform roadway users that bicycles may occupy the travel lane when the existing travel lane is too narrow to safely allow sharing with motor vehicles.

Advantages/Disadvantages: The primary advantage to this signage is that it clearly conveys the message that bicycles may exercise their statutory right to take the full lane when necessary. Sometimes it is difficult for a bicyclist to assess whether or not they may use the full lane. On the other hand, an argument can be made to limit the installation of this type of signage to prevent confusion, to reduce sign clutter, and to convey a statute that bicyclists should already be familiar with. There are countless locations throughout the city where there is not enough room for a motorist to safely pass, however on-street parking gaps provide ample space for a motorist to safely pass a biker by at least 3 ft.

Signage Criteria: In accordance with the MUTCD, the Uniform Vehicle Code (UVC) defines a "substandard width lane" as a "lane that is too narrow for a bicycle and a vehicle to travel safely side by side within the same lane."

- The Bicycles May Use Full Lane (R4-11) sign may be used on roadways with no bicycle lanes or adjacent shoulders usable by bicyclists and where travel lanes are too narrow for bicyclists and motor vehicles to operate side by side.
- The Bicycles May use Full Lane sign may be used in locations where it is important to inform road users that bicyclists may occupy the travel lane in order to prevent unsafe passing.
- The sign must be black on white with 30"x30" dimensions and a 4"D Legend.

Minnesota State Statute 169.222; Operation of Bicycle
Subd. 4. Riding on roadway or shoulder

A) Every person operating a bicycle upon a roadway shall ride as close as practicable to the right-hand curb or edge of the roadway except under any of the following situations:
  1) When overtaking and passing another vehicle proceeding in the same direction.
  2) When preparing for a left turn at an intersection or into a private road or driveway
  3) When reasonably necessary to avoid conditions, including fixed or moving objects, vehicles, pedestrians, animals, surface hazards, or Narrow width lanes, that make it unsafe to continue along the right-hand curb.

B) If a bicycle is traveling on a shoulder of a roadway, the bicycle shall travel in the same direction as adjacent vehicular traffic.

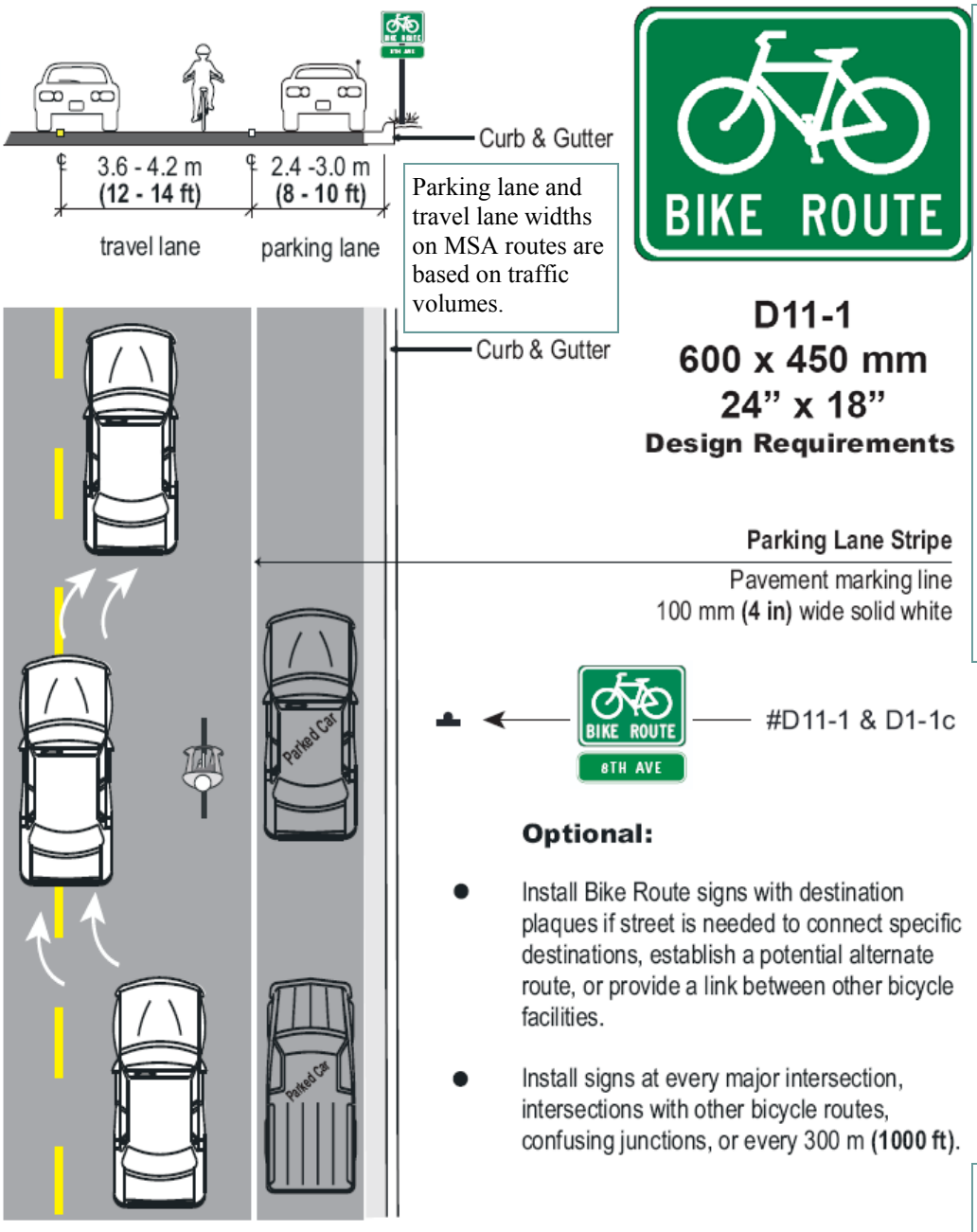
C) Persons riding bicycles upon a roadway or shoulder shall not ride more than two abreast and shall not impede the normal and reasonable movement of traffic, and on a laned roadway, shall ride within a single lane.

D) A person operating a bicycle upon a sidewalk, or across a roadway or shoulder on a crosswalk, shall yield the right-of-way to any pedestrian and shall give an audible signal when necessary before overtaking and passing any pedestrian. No person shall ride a bicycle upon a sidewalk within a business district unless permitted by local authorities. Local authorities may prohibit the operation of bicycles on any sidewalk or crosswalk under their jurisdiction.

E) An individual operating a bicycle or other vehicle on a bikeway shall leave a safe distance when overtaking a bicycle or individual proceeding in the same direction on the bikeway, and shall maintain clearance until safely past the overtaken bicycle or individual.

F) A person lawfully operating a bicycle on a sidewalk, or across a roadway or shoulder on a crosswalk, shall have all the rights and duties applicable to a pedestrian under the same

Bike Route Signage—Bike Route Signage is often used along bike routes throughout the city where it is not appropriate or possible to add bicycle lanes. Bike Route Signage is used to bridge bikeway gaps and to provide bicyclists with basic information about where to ride. Bike routes should be placed along local, collector, and minor arterial routes that are relatively flat, provide direct access to neighborhood destinations, have minimal conflicts with larger vehicles (trucks and buses), and are located on corridors with safe volumes and speeds.



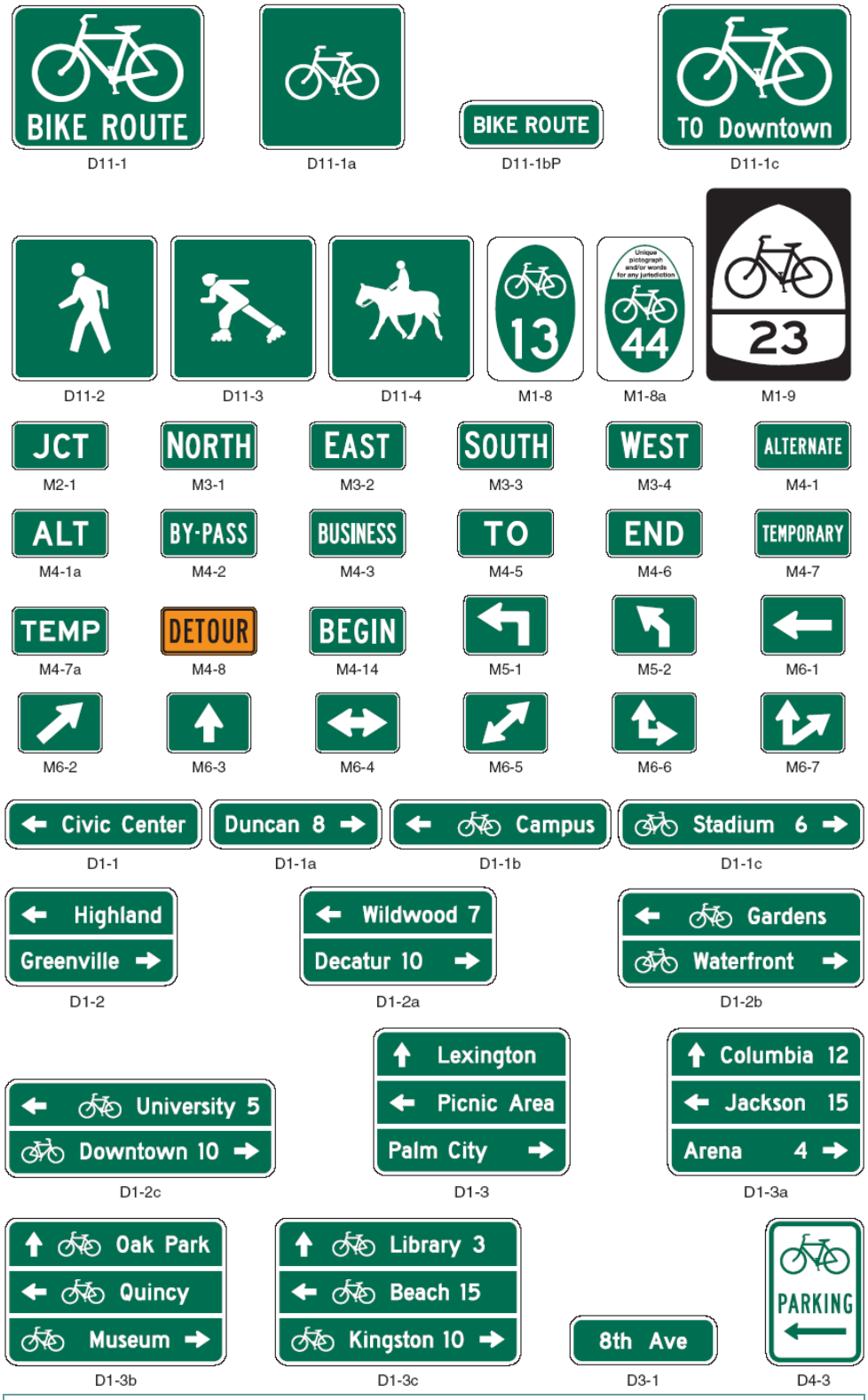
Parking lane and travel lane widths on MSA routes are based on traffic volumes.

D11-1
600 x 450 mm
24" x 18"
Design Requirements

Left: The 2009 MUTCD recommends that the D11-1 sign with the words "Bike Route" be replaced with a D-11-1a sign with a destination or route designation (such as "To Downtown" instead of the generic bike route words. This would replace the two-sign array of the D11-1 and D1-c sign shown below.

Note: Check current MN MUTCD for any changes to signs and striping configurations.

Left: Diagram from the 2007 MnDOT Bicycle Facility Manual.



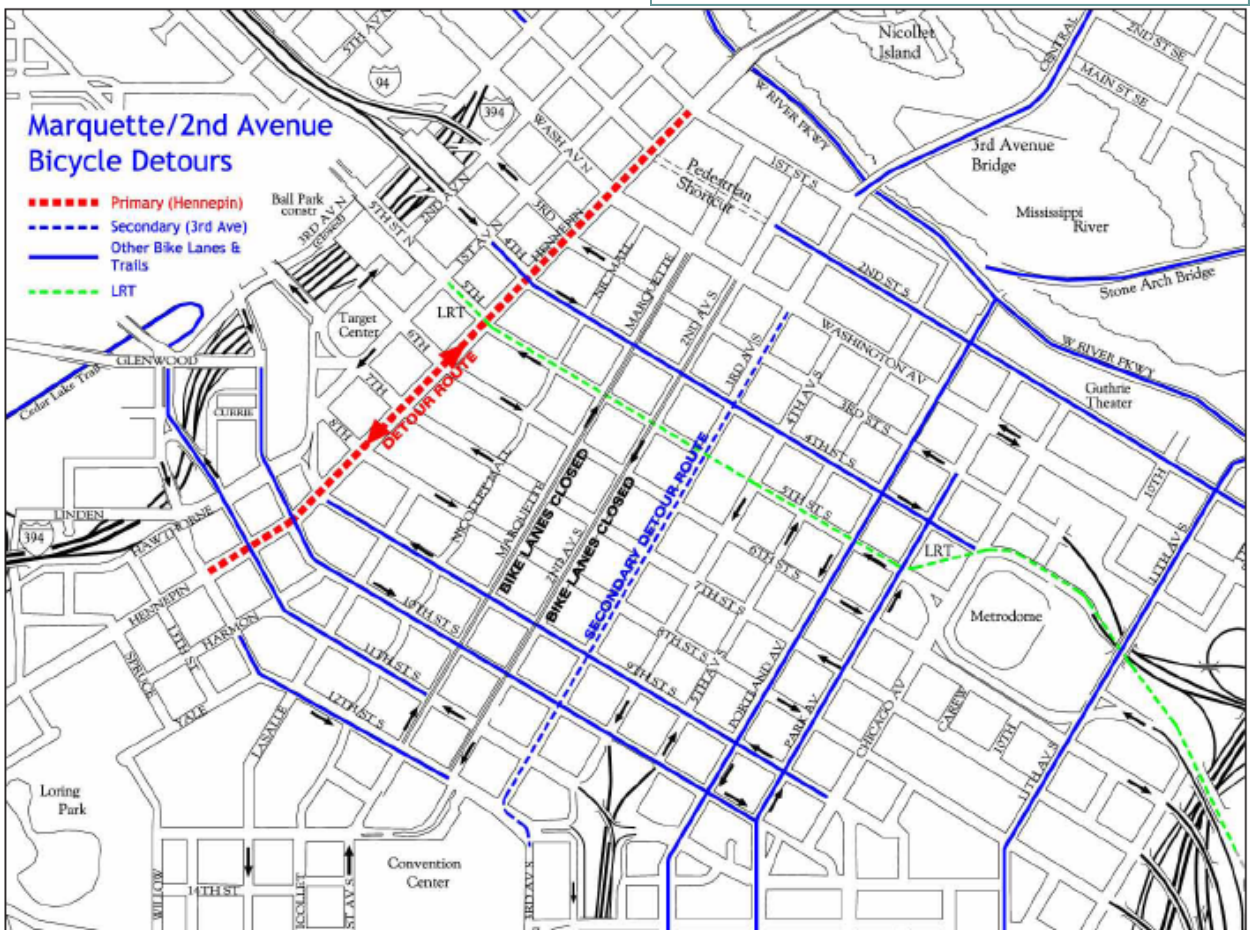
Above: Guide Signs and Plaques for Bicycle Facilities from the 2009 MUTCD.

Guide Signage— Guide signage is intended to provide bicyclists with useful information along bike routes. The MMUTCD states that this type of signage should be placed at given decision points along designated bike routes, including signs to inform bicyclists of bicycle route direction changes and confirmation signs for route direction, distance, and destination. Bicycle Route Guide signs should be repeated at regular intervals so that bicyclists entering from side streets will have an opportunity to know that they are on a bicycle route. Similar guide signing should be used for shared roadways with intermediate signs placed for bicyclist guidance. The signs on the left show all of the guide signs available for use on a bike route.

On-Street Bikeway Design

Bikeway Detours—When a bikeway needs to be closed for more than a few hours it can create serious problems for bicyclists, especially for those who rely on the bicycle network to get around. It is very important that when a bikeway is closed or altered that the public be notified so that bicyclists may choose new routes or plan for added time to their trip. Notification on major projects often includes an announcement on the city bicycling website, in addition to a press release, or e-mail notification to bicyclists. Maps like the one below can also help bicyclists understand the scope of the closure and suggest detour routes.

Replacing Bikeway and Pedestrian Ways:
Minnesota State Statute 160.264
"*Whenever an existing bikeway, pedestrian way, or roadway used by bicycles or pedestrians or the sole access to such is destroyed by any new, reconstructed, or relocated federal, state, or local highway, the road authority responsible shall replace the destroyed facility or access with a comparable facility or access. Replacement is not required where it would be contrary to public safety or when sparsity of population, other available ways or other factors indicate an absence of need for such facility or access.*"



On-Street Bikeway Design

Information and Wayfinding Signage— Signs may be combined or modified to direct a biker to a destination along a bike route. The destination needs to be major destination and can not include private business names.

Above: Example of a Bike Route sign (Chicago).

Above: Unconventional sign placement (Chicago).

Above: Clear and understandable message (Chicago).

Above: Too many signs distract from stop sign (Mpls).

Above: M1-8a sign along a major trail access (Mpls).

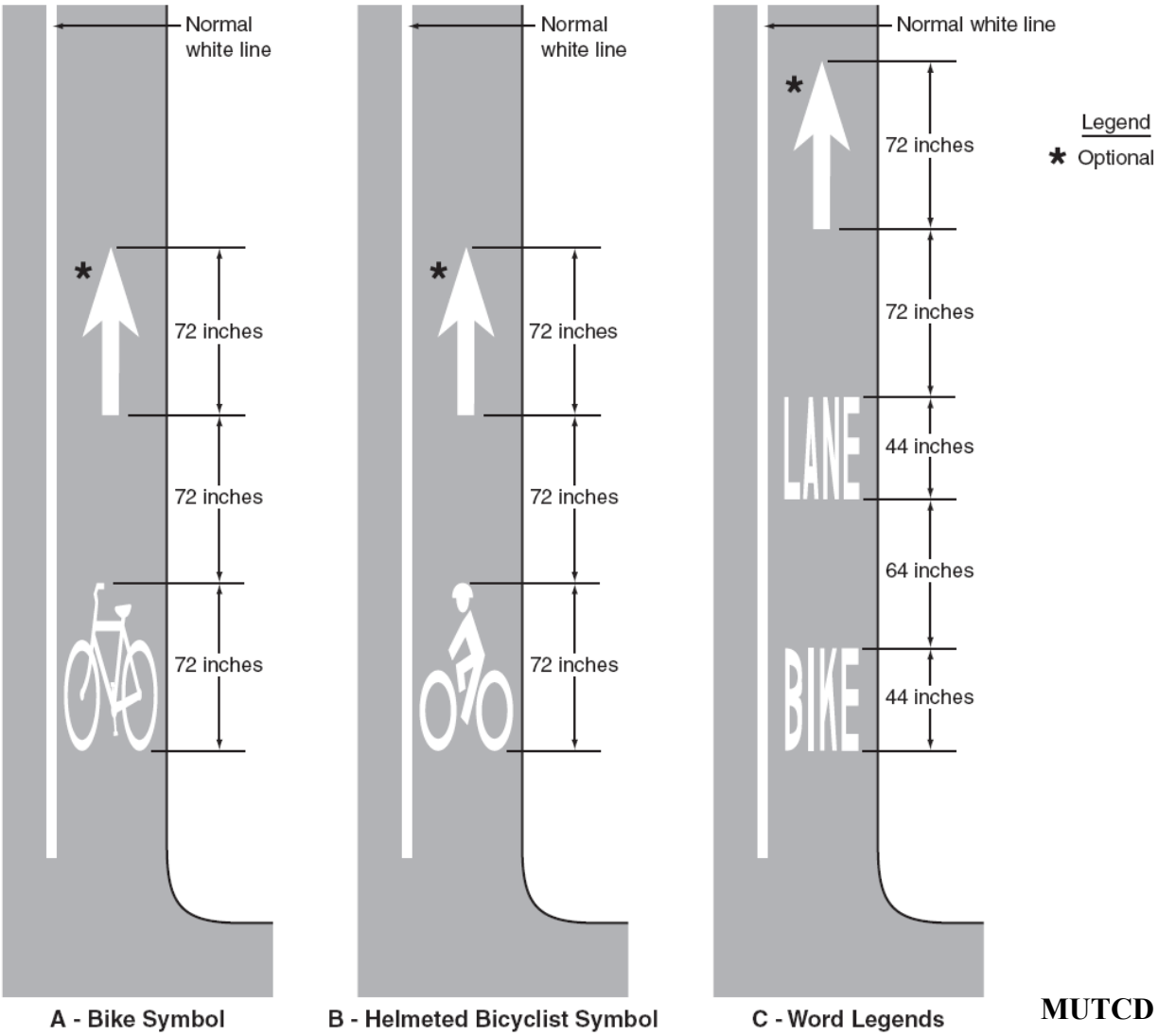
Above: Too many signs is confusing (San Francisco).

Above: Useful sign at a decision point (San Francisco).

On Street Bikeway Design

Above: Examples of bike lane pavement markings.

Pavement Markings—Pavement Markings for bicycle lanes are outlined in the Minnesota Manual of Uniform Traffic Control Devices (MMUTCD) and the dimensions can be seen below. Older versions of the MUTCD have width measurements for pavement markings. The MUTCD requires that longitudinal pavement markings shall be used to define bicycle lanes. If used, bicycle lane word, symbol, and/or arrow markings should be placed at the beginning of a bicycle lane and at periodic intervals along the bicycle lane based on engineering judgment.



A - Bike Symbol | B - Helmeted Bicyclist Symbol | C - Word Legends

MUTCD

On-Street Bikeway Design

Rumble Strips—Rumble strips are repetitive indentations in the roadway that are placed between the driving lane and the shoulder. According to the MnDOT Bicycle Facility Design Manual, continuous or intermittent rumple strips are intended to keep motorists from wandering out of the travel lanes, but are also used to guide motorists in poor driving conditions.

Advantages/Disadvantages: Rumble strips have been shown to wake drivers by creating noise and vibration when driven over. Rumble strips can be milled or rolled into the pavement when still warm. Rumble strips are often difficult to keep free of sand and debris. Most bicyclists do not like to bike over rumble strips so regular breaks are needed along bike routes so that bicyclists can safely and more easily transition from the roadway to the shoulder.

Criteria: Rumble strips should be placed in accordance with the following criteria:

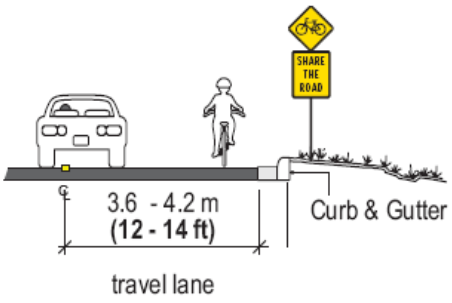
- Rumble strips are not recommended when roadway shoulder widths are 4 feet or less.
- Rumble strips should be installed within 6 inches of the fog line or directly under the fog line.
- Rumble strip width should not exceed 16 inches and are typically 1 foot wide.
- The shoulder width should be 4 feet and preferably 6 feet or wider to allow for safe bicycle riding.
- Rumble strips must be swept or vacuumed on a regular basis so that sand or other debris does not fill in the voids.
- Urban rumble strips may be placed on collector and minor arterial roadways.
- According to AASHTO "Frequent gaps should be provided to allow bicyclists to escape the shoulder to avoid blockages or to turn left. Gaps should be a minimum of 12 feet and spaced every 40 to 60 feet."

MnDOT

Photos: The photos above show rumble strips along highways. These are not recommended for use in urban areas because speeds are lower than in rural/suburban locations and there are more concerns about noise and vibration. Rumble strips are typically used in rural and suburban roadway sections where there are curves and a history of run off the road crashes.Minnesota rumple strips standards vary from 12 to 16 inches wide and are located 4-24 inches from the fog line.

Share the Road Signage—Share the Road Signage is commonly used to inform drivers and bicyclists of their equal responsibility to "share the road". Share the Road signage should be reserved for collector streets and minor arterials up to 10,000 ADT. Share the Road signage is not appropriate for local streets and for major minor arterial routes. Share the Road signage may be used to bridge a gap along a bike route and is often used where there is not enough space to stripe a bike lane. Share the Road signage may also be used at locations where there are documented bicycle crashes or safety concerns.

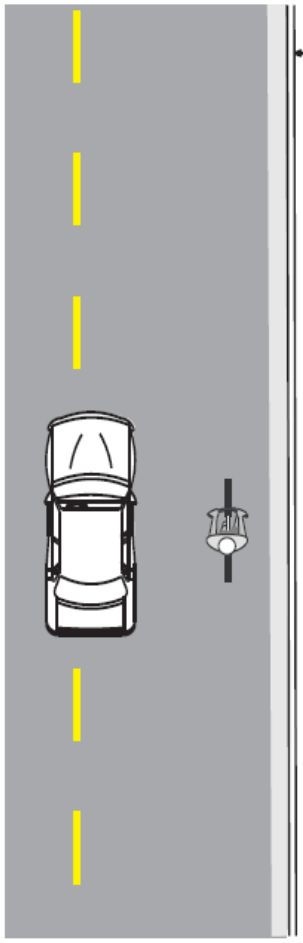
Sign Use: The overuse of Share the Road signage may result in drivers and bikers ignoring the signs. Residents also often complain about sign clutter in the public right-of-way. To avoid this, it is recommended that the maximum spacing of share the road signs along an urban bike route be approximately every 600 feet. This spacing allows one sign for every long block and one for every other short block. It is recommended that a traffic engineering study be completed before installing new signage.



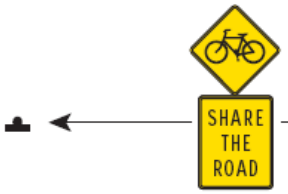
MMUTCD

W11-1
450 x 450 mm
18" x 18"

W16-1
600 x 750 mm
24" x 30"



MnDot Bicycle Facility Design Manual



Optional:

- Install Share the Road signs to warn drivers to watch for bicyclists traveling along the road in rural situations where there is no paved shoulder and a large number of bicycles use the roadway.
- Space signs every 1.6 - 3.2 km **(1 - 2 mi)** and/or on corners, hills, or other places with limited sight distances.

** Not to Scale **

Note:
Application of MN MUTCD Series R7 and/or R8 "NO PARKING" signage may also be appropriate. Check current MN MUTCD for any changes to signs and striping configurations.

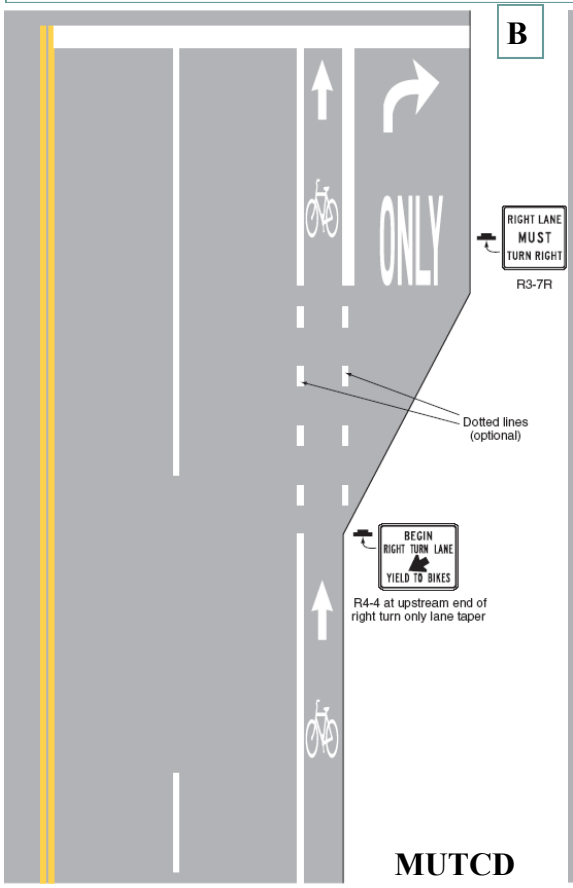
Intersections

Bike Lanes at Intersections—Bicycle lanes at right turn lanes may be handled in one of several different ways. In situation A, the bike lane stops at the intersection, which allows right turning vehicles to enter the bicycle lane. Situation A does not require the outer curb line or the centerline to be adjusted. Situation B is recommended where a roadway can be widened for a right turn lane and Situation C is recommended where parking can be dropped and the centerline adjusted. The bike lane should be placed left of the right turn lane and a transition zone should be marked. Appropriate regulatory signage must accompany the markings.

A

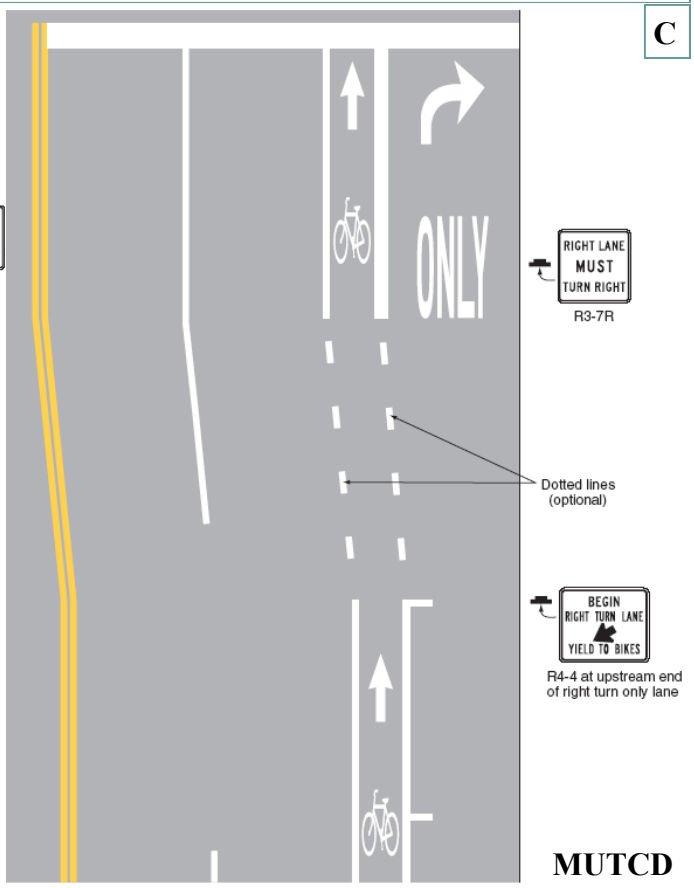
Diagrams: Shown are the various treatments outlined in Chapter 9 of the Minnesota Manual of Uniform Traffic Control Devices (MMUTCD) used to address bicycle lanes at intersections. Intersections with bicycle lanes often require supplemental signage to point out possible conflicts with other modes, including pedestrians, buses, and motor vehicles.

B



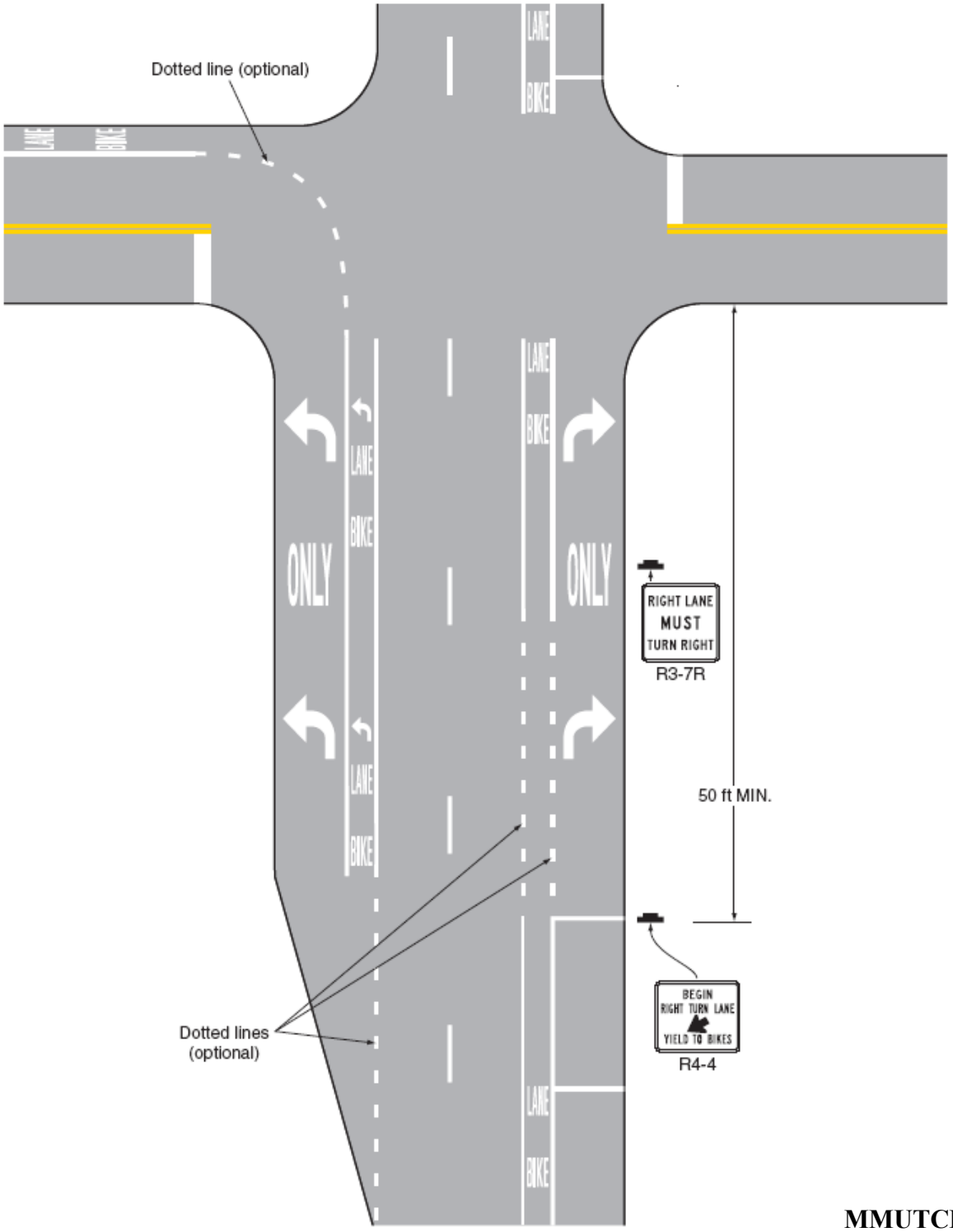
MUTCD

C



MUTCD

Bike Lanes at Intersections—The diagram below shows an example of how to mark a bicycle lane with a left turn area, heavy turn volumes, parking, one-way traffic, or a divided highway.

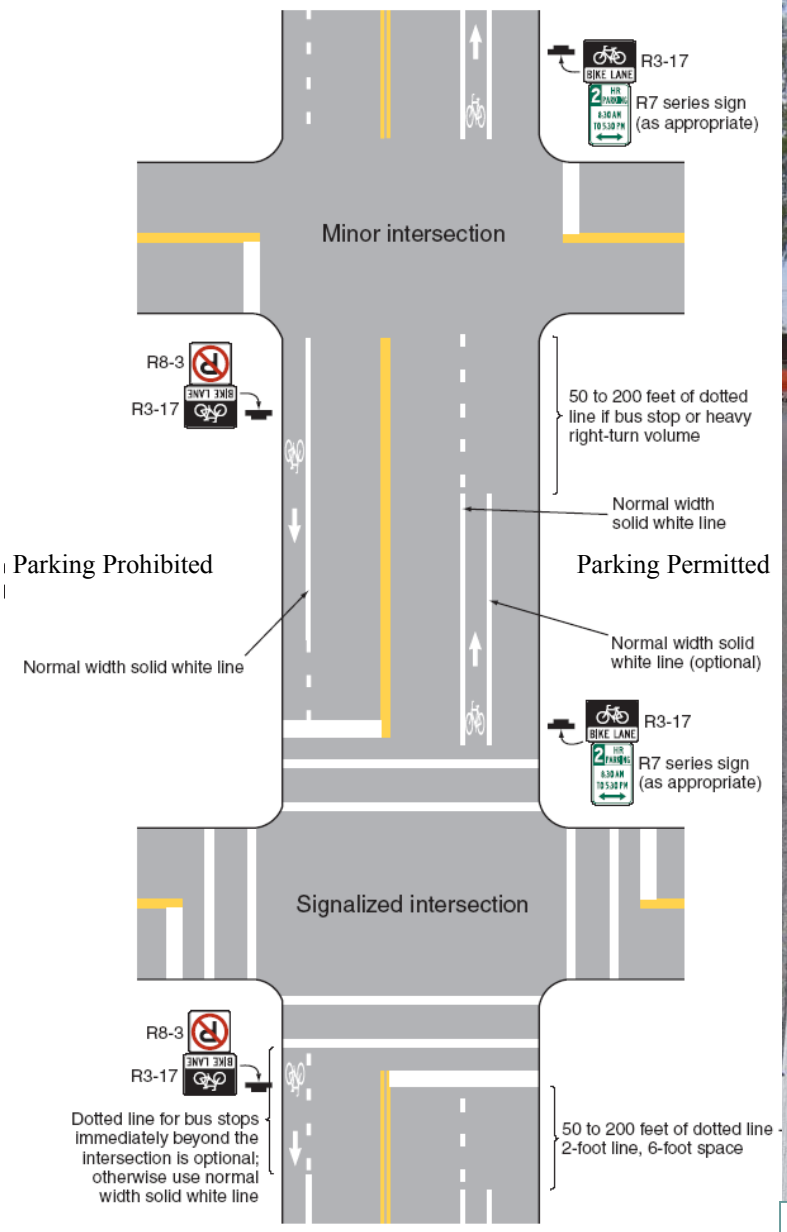


MMUTCD

Intersections

Bike Lanes at Intersections—The diagram below shows an example of pavement markings for bicycle lanes on a two-way street. Where right-of-way is confined, parking may be removed in advance of an intersection and a skip dash installed to allow for a bus stop or right turning vehicles.

Above: 2nd Street South bike lane at an intersection.



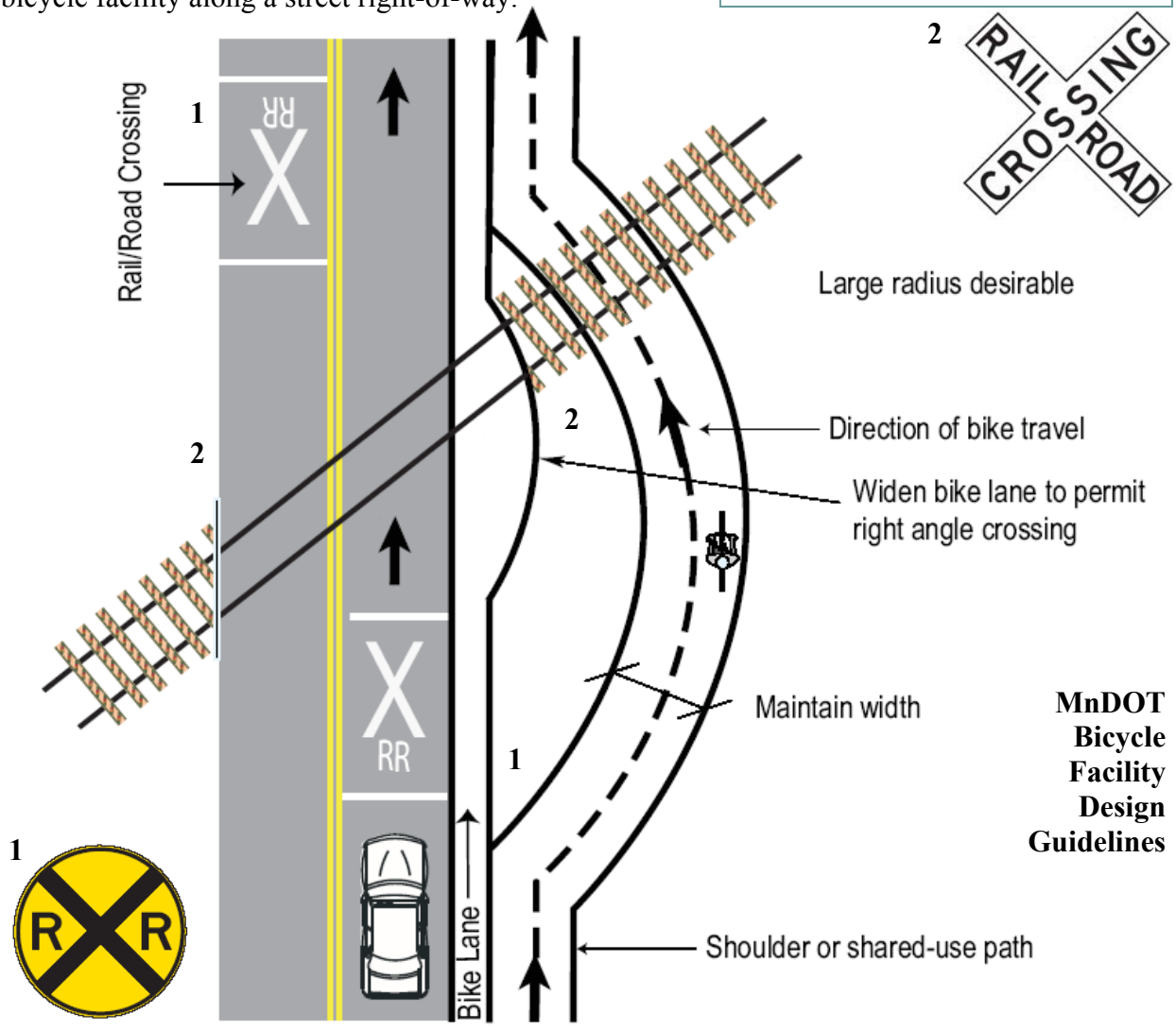
Above: Como Avenue bike lane.

Intersections

Railroad Crossings—On-street bikeways are often located on roadways that cross at-grade railroad tracks. It is important that the crossing be designed to allow bikes to safely cross as close to perpendicular to the tracks as possible. Concrete or rubberized crossings are recommended for crossings along bike routes to minimize the possibility of a bicycle tire getting stuck. Railroad crossbuck and warning signage is required at all railroad crossings. Some at-grade crossings may have a stop sign at the crossbuck and signal and gate arms are often installed at busier intersections. All grade separated railroad crossings should be wide enough to allow for a bicycle facility along a street right-of-way.

Above: Victoria, BC RR Crossing.

Above: Portland, OR LRT Crossing.



MnDOT Bicycle Facility Design Guidelines

Intersections

Railroad Crossings—Bicyclists require a safe and smooth surface at all at-grade railroad crossings with adequate warning devices.

Above: Crossing at the maximum 45 degree angle.

Above: Concrete RR crossing with smooth transition.

Above: Unpaved at-grade RR crossing.

Above: MUTCD recommended RR signage/striping.

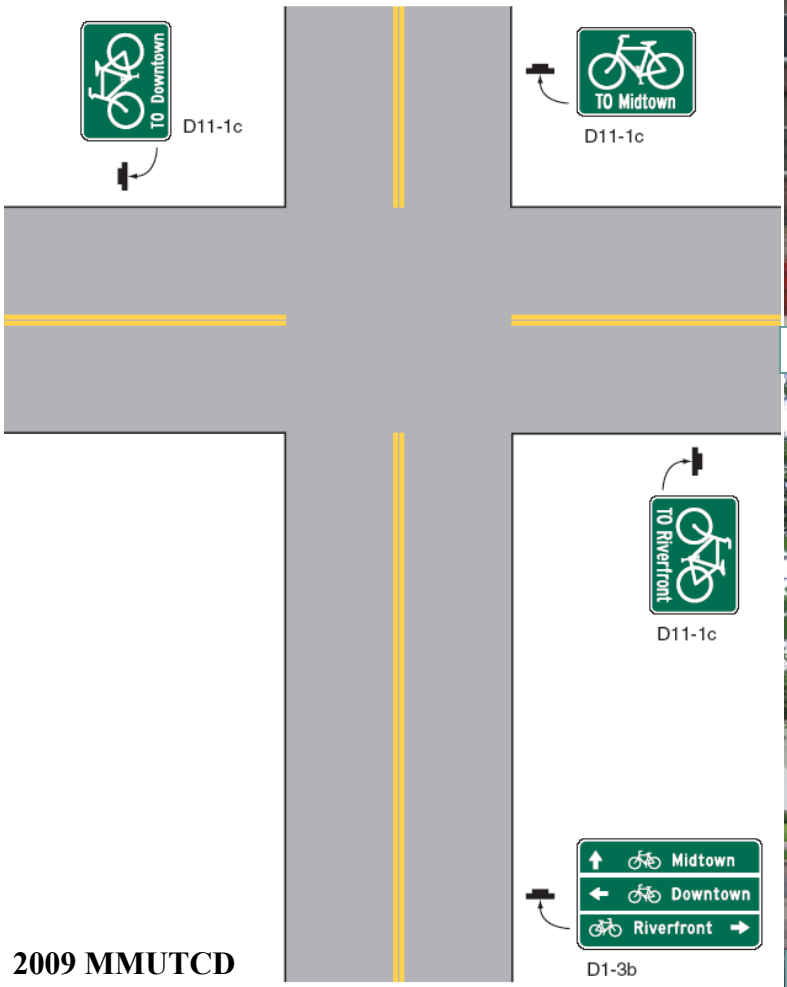
Above: Eroded asphalt RR crossing with flashers.

Above: RR crossing with gate arms

Above: Example of a rubberized at-grade RR crossing.

Intersections

Shared Use Lanes—Below is guidance for intersections.
Warning Signage at Intersections: Signage at intersections where bike lanes are striped to the intersection present a unique safety challenge with turning vehicles. This can be mitigated by placing signage to warn bicyclists about turning vehicles and to indicate to motorists that there is a conflict point with bicycles.
Shared Lanes With Signage at Intersections: Bike Route signage can be useful to bicyclists by providing basic route and destination information. Signed bike routes tend to be more bicycle friendly corridors and provide direct connections to popular destinations. Guidance for shared lanes can be found in the Minnesota Manual on Uniform Traffic Control Devices (MMUTCD).



2009 MMUTCD

Above: Signage approaching 2nd St S.

Above: Signage along Park Ave S.

Above: Signage near the U of M.

Intersections

Signal Detection for Bicycles – There are hundreds of actuated signalized intersections throughout the city. An actuated signal gives priority to the major street at an intersection by staying green until a vehicle approaches on the minor street. Loop detectors or cameras are typically used to detect the vehicles. In most cases the loop detectors or cameras do not pick up bicycles, so more sensitive detection equipment is required. In many cases a special loop detector for bicycles may be installed and signage and pavement markings may be required to show bicyclists where to ride to trip the detector. In some cases a push button pedestal near the curb may also be used. Signal detection may also be used to give signal priority to bicycles. Signal networks may also be coordinated using time-space diagrams to give priority to platoons of bikes traveling at a given speed.

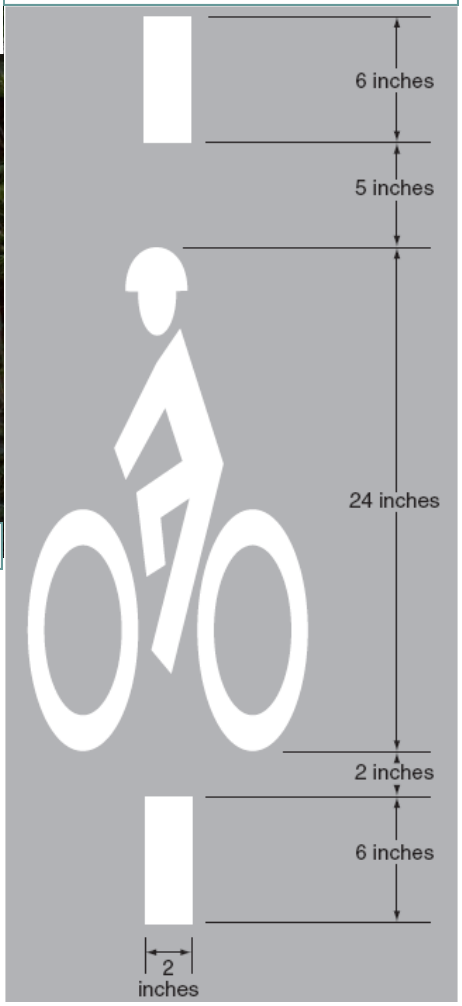
Above: Erlangen, Germany

Above: San Francisco, CA.

Above: Berkeley, CA.

Above: Berkeley, CA.

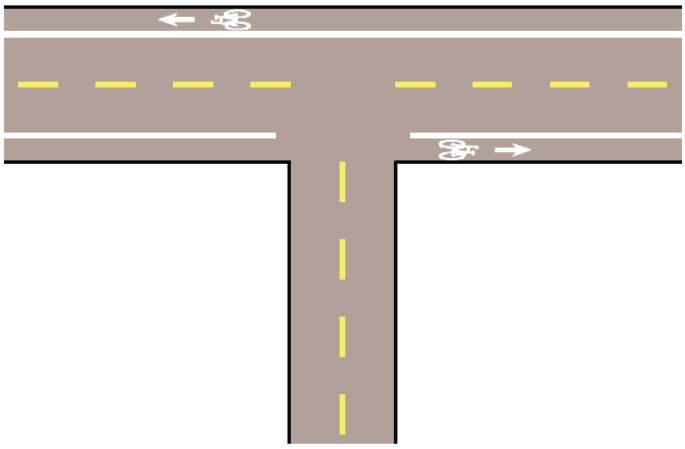
Criteria: Chapter 9 of the Minnesota Manual on Uniform Traffic Control Devices (MMUTCD) states that the pavement marking on the right may be placed on the pavement indicating the optimum position for a bicyclist to actuate the signal. The sign on the left may be installed to supplement the pavement marking. An inductive loop in the pavement allows bicycles to be detected.



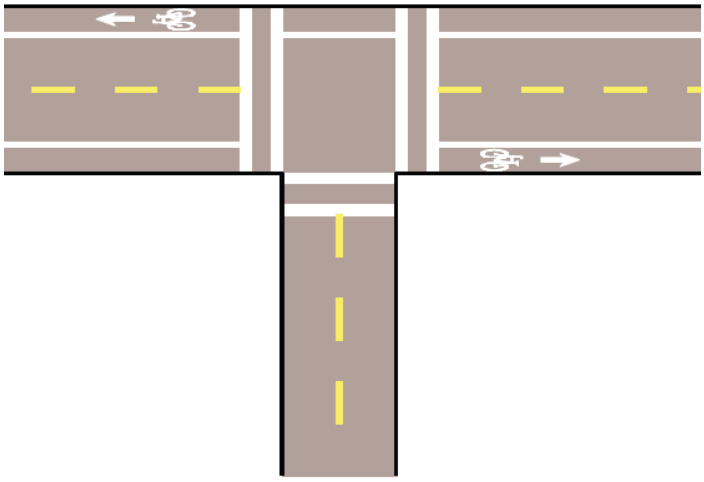
Intersections

T-Intersections—T-Intersections can be striped one of three ways based on several factors. When a T-intersection is controlled by stop signs and no bus stop is present, the top right striping diagram should be followed. When signal control is used at a T-intersection without a bus stop, crosswalks are striped and the middle diagram on the right should be followed. Painted crosswalks may also be found at T-intersections near schools where crossing guards are used. The bottom right diagram should be followed when a bus stop is present at a T-intersection.

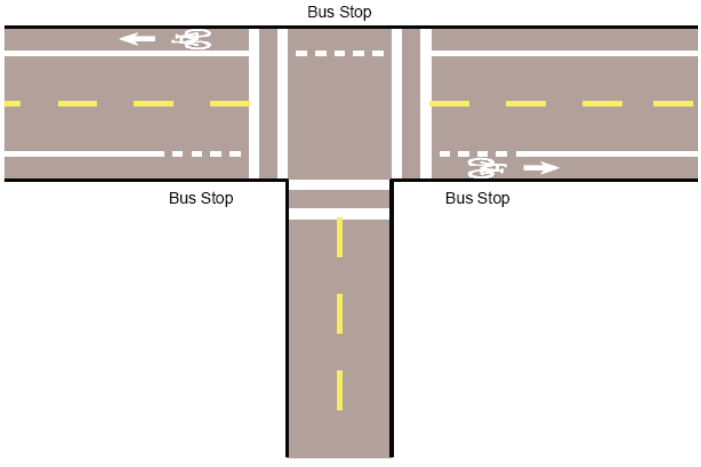
Above: Example of a bike lane in Minneapolis



T-intersection
with no painted crosswalks **AASHTO**



T-intersection
with painted crosswalks
and no bus stops **AASHTO**



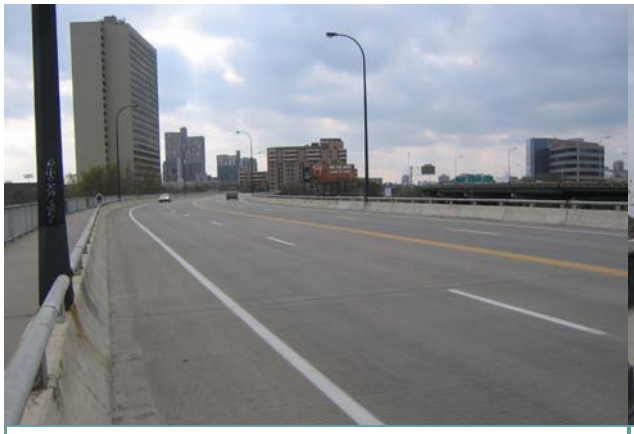
T-intersection
with painted crosswalks
and bus stops **AASHTO**

Road and Bridge Design

Bridge Sidewalks and Shoulders—Roadway bridges are significant investments and are spaced further apart than the street grid. All new roadway bridges should be designed to safely accommodate both bicycles and pedestrians on both sides of the bridge. Special emphasis needs to be placed on river bridges and freeway overpasses/underpasses.

Above: Lake Street Bridge over the Mississippi River.

River Bridge Design: River bridges are typically spaced at greater distances, which can be barriers for bicyclists. All new and renovated river bridges shall have a 6-foot shoulder on both sides of the roadway in addition to an off-street sidewalk on both sides. The minimum recommended sidewalk width is 8 feet with a 2-foot frontage zone on one side and a 2-foot curb/furnishing zone on the other side for a total furnishing zone of 12 feet. If the sidewalk connects to a trail on either end of the bridge the recommended minimum width should be increased to 10 feet for a total of 14 feet of width. Rivers bridges shall be lit and railings must be at least 42 inches in height.



Above: 10th Ave Bridge over the Mississippi River.

Above: Ford Bridge over the Mississippi River.

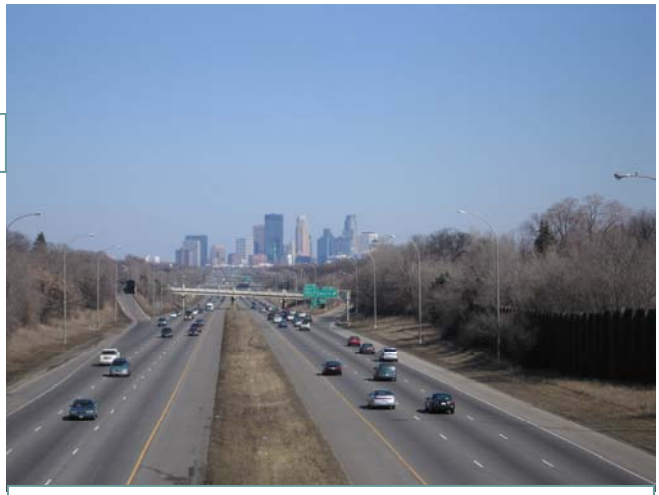
Above: Ford Bridge over the Mississippi River.

Above: 3rd Avenue Bridge over the Mississippi River.

Road and Bridge Design

Bridge Sidewalks and Shoulders—Below is guidance for overpass and underpass design.

Overpass and Underpass Design: Similar to river bridges, all new and renovated bridge overpasses shall have a 6-foot shoulder on both sides of the roadway in addition to an off-street sidewalk on both sides. The minimum recommended sidewalk width is 8 feet with a 2-foot frontage zone on one side and a 2-foot curb/finishing zone on the other side for a total of 12 feet. If the sidewalk connects to a trail on either end of the bridge the recommended minimum width should be increased to 10 feet for a total of 14 feet of width. Bridge overpasses shall be lit and railings must be at least 42 inches in height. Roadways that pass underneath bridges shall be designed to the same widths, and the above bridge should be wide enough to accommodate this cross-section. Wider bridge sidewalks allow for less conflicts between bikers and pedestrians in addition to providing adequate space for snow plowing and snow storage. Wider sidewalk widths should be considered if approaching trail volumes exceed 2,000 users per day.



Above: There are numerous freeway overpasses and underpasses throughout the city. This photo shows the I-35W corridor looking north toward Downtown Minneapolis. As part of the MnDOT crosstown construction project all of the freeway overpasses and underpasses have been reconstructed to modern sidewalk and shoulder design widths.

Through Walk Zone: This zone provides an accessible clear walking space for bicycles and pedestrians. There are no obstructions in this zone.

Curb/Furnishing Zone: The curb and furnishing zones are combined on bridges. This zone provides a buffer between the roadway and the through walk zone, space for temporary snow storage on bridges, and space for signage.

Frontage Zone: This zone reflects the tendency of people to shy away from the edge of the bridge.

Below: An example of a wide sidewalk on a reconstructed bridge (Nicollet Ave S over Minnehaha Creek).

Below: An example of a sidewalk that is too narrow (Diamond Lake Road). This bridge has since been reconstructed as part of the I-35W Crosstown Project.

Road and Bridge Design

Catch Basins — Catch basin placement and design is an important detail that directly impacts bicycle safety. A properly designed catch basin should be entirely located within the gutter pan and catch basin covers should be placed to avoid catching the tires of a bike.

Below/Right: The photos show a properly designed pair of catch basins along 15th Ave SE.

Below: The photos below and to the right are examples of problem catch basins. Placing catch basins in bike lanes should be avoided. In the case below on-street parking was removed on both sides of 42nd Avenue North to allow for bicycle lanes. Catch basin relocation should be considered as part of the project budget for a bike lane striping project. The photo on the right shows a catch basin that caused a bicycle crash at an intersection. Catch basin covers should be turned so that the grates run perpendicular and not parallel to a traveling bicyclist.

NOT RECOMMENDED

NOT RECOMMENDED

Road and Bridge Design

Driveway and Alley Design—On-Street Bikers often need to use driveways or alleys to get to and from their destinations. It is important not to overlook design details associated with alleys and driveways to ensure that bicyclists do not hit abrupt bumps in pavement or catch their tires in pavement grooves (especially with thin road bike tires).

Above: A driveway/alley apron lip should not exceed 1 inch so that bikers will not hit an abrupt surface. The lip should also be tapered like as shown.

Above: A properly designed and installed driveway/ alley apron safe for bicycle use.

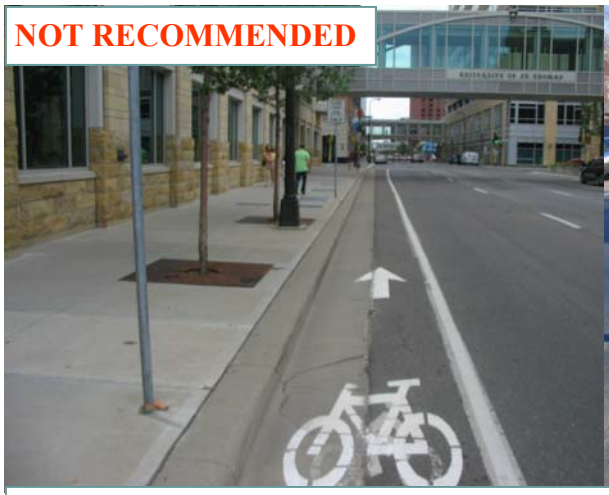
Above: The centerline groove shown here has filled with sand and debris, which can be problematic if a bicycle tire is caught in the groove.

Above: Alley centerlines are designed to drain water, however poorly designed grooves can create serious problems for bicycle tires, especially road bikes.

Road and Bridge Design

Gutter Pan Design — When designing bicycle facilities, care must be taken to consider how the bike lane is placed relative to the gutter pan. In many places throughout the city, poured gutter pans have been integrated into the bike lane. However, in other situations the bike lane has been striped with half of the bike lane in the gutter pan and the other half on the roadway surface. This poor practice results in bicyclists traveling along a roadway seam.

NOT RECOMMENDED



Above: When a corridor is re-striped to include a bike lane it is important to place the full 5-foot or 6-foot lane outside of the 2-foot gutter pan. The photo on the left shows a substandard bike lane along 10th St S. The photo on the right shows a correctly striped bike lane on 40th St S. Shown in the upper right is University Ave SE.

Above: An innovative 5-foot poured curbside concrete bike lane may be pursued in locations where there are space constraints. The gutter pan is then saw cut to create smooth joints for bicyclists. The photos above are from the reconstruction of Richfield Road. University Avenue SE was the first project in the city to have this treatment.

Road and Bridge Design

Manholes — If at all practical, manholes should be placed outside of bike lanes to create a smooth ride for bikers. If a manhole is unavoidable in the bike lane, special care should be taken to minimize any bumps or dips near the manhole. Pavement markings should not be placed on manholes. Manholes are portals for maintenance workers to gain access to the sanitary and stormwater systems. On occasion utility trucks need to be placed near the manhole for maintenance purposes. Placing the manhole outside of the bike lane eliminates the need to close the bike lane for maintenance.

Photos: The top right photo shows a bike lane free of manholes and other obstructions. The rest of the photos are examples of bike lanes with manholes in the travel zone, which should be avoided.

NOT RECOMMENDED

NOT RECOMMENDED

NOT RECOMMENDED

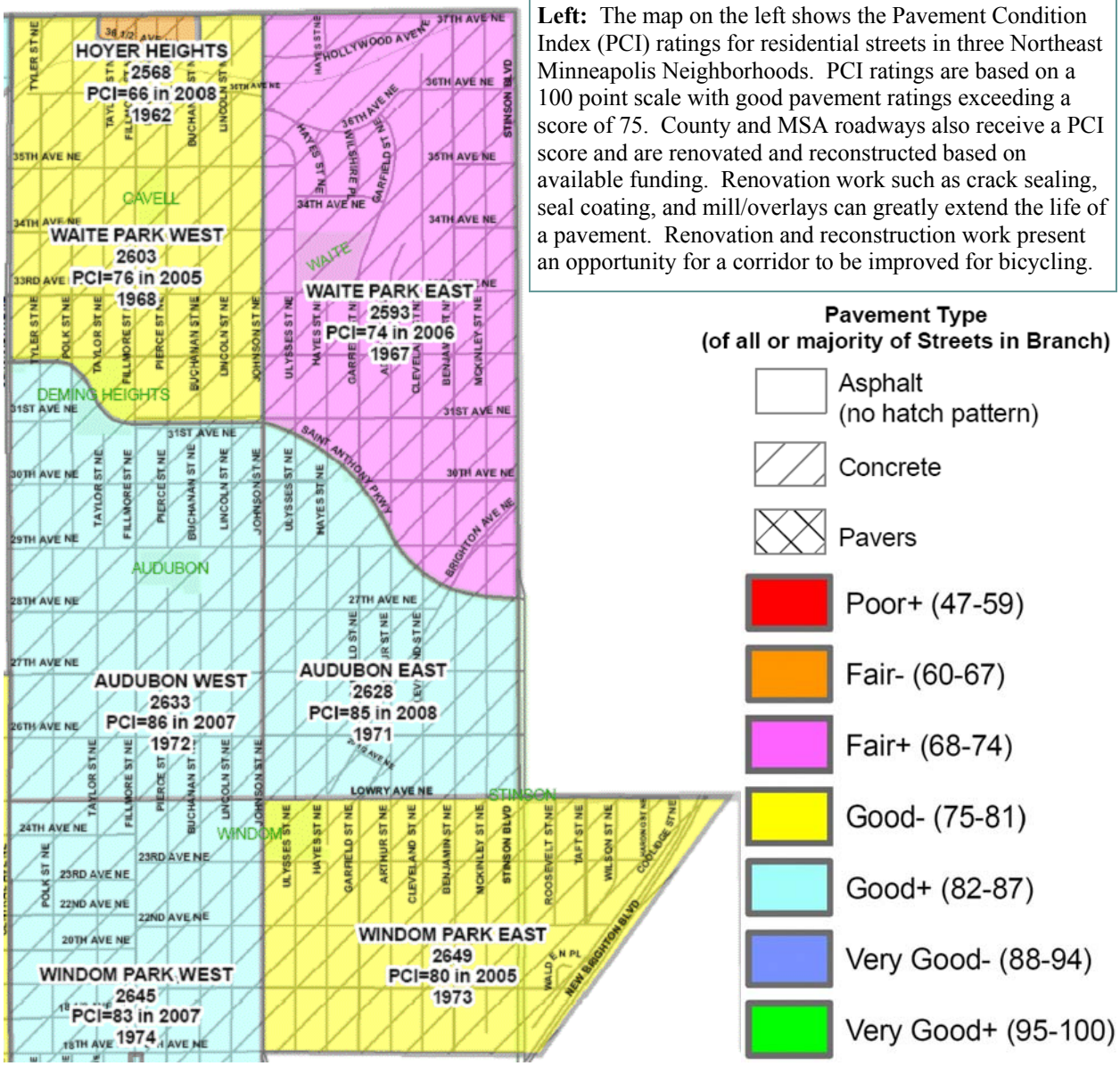
NOT RECOMMENDED

Road and Bridge Design

Pavement Condition — Pavement condition is an important consideration for bicycling. Poor pavement quality can not only inhibit bicycling, but can also create bicycle crashes, which is one reason why efforts should be made to renovate and reconstruct roadways on a timely basis. All pavement renovation and reconstruction projects along dedicated bicycle routes shall consider bicycle accommodations.

Above: The reconstruction of 15th Ave SE allowed for new bike lanes as part of the project.

Left: The map on the left shows the Pavement Condition Index (PCI) ratings for residential streets in three Northeast Minneapolis Neighborhoods. PCI ratings are based on a 100 point scale with good pavement ratings exceeding a score of 75. County and MSA roadways also receive a PCI score and are renovated and reconstructed based on available funding. Renovation work such as crack sealing, seal coating, and mill/overlays can greatly extend the life of a pavement. Renovation and reconstruction work present an opportunity for a corridor to be improved for bicycling.



Road and Bridge Design

Pavement Condition—The photos show examples of poor pavement conditions along bike routes throughout the city, creating a bumpy and potentially dangerous bike ride.

Above: Bumps can catch bicyclists off-guard

Above: Very poor pavement condition

Above: Properly patched pavement; but no sealcoat

Above: Patchwork of pavement creates ridges for bikers

Above: Jagged saw cuts can catch a bike tire

Above: Dip in roadway will be felt on a bike

Above: Ponding can create slippery conditions

Road and Bridge Design Considerations

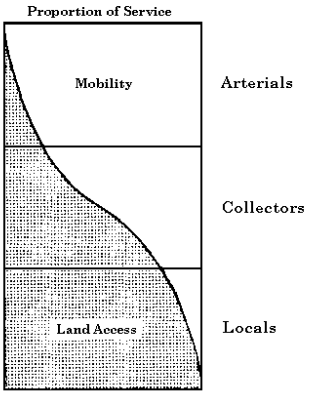
Roadway Functional Classification— Roadway Functional Classification is a term that is used to define a roadway network hierarchy ranging from local streets with low speeds and high land use access to principal arterials (freeways) with higher speeds and few access points to adjacent land uses. Arterials are spaced further apart than local streets and are designed to accommodate higher traffic volumes with longer trips in mind. Collector streets are designed to distribute vehicles from local streets to minor arterials. Most minor arterial roadways are located along commercial and employment nodes and are spaced about a mile apart within the city. Since Downtown Minneapolis is a regional destination, there are a number of principal arterials (including freeways) that converge in this area.

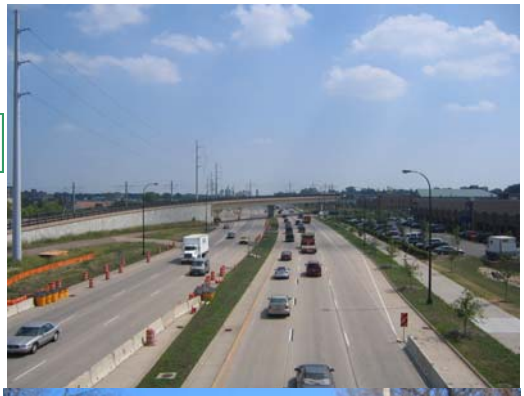
Roadway functional classification directly relates to what type of bicycle facility (if any) should be installed on a given roadway. In Minnesota bicycles are prohibited from riding on freeways, but are permitted on all other roadways regardless if there are bicycle facilities present. To encourage biking and to remove barriers for bicyclists a number of design treatments are used systematically throughout the city. Typically higher speed minor arterials with high traffic volumes require a higher degree of separation between motor vehicles and bikes than collectors and local streets.

Right: Shown is a chart from the AASHTO Green Book that represents the fundamental basis for roadway functional classification. As access to adjacent land uses increase, mobility decreases. For instance local streets may have several driveways per mile whereas a freeway may only have one access point over several miles. As mobility increases so do speed and traffic volumes. The type of bicycle facility is highly dependant on the functional classification of a roadway.

Figure II-4

Relationship of functionally Classified Systems in Serving Traffic Mobility and Land Access





Above (from top to bottom):
Hiawatha Avenue: Principal Arterial
Franklin Avenue: Minor Arterial
East 42nd Street: Collector Street
Thomas Avenue South: Local Street

Road and Bridge Design Considerations

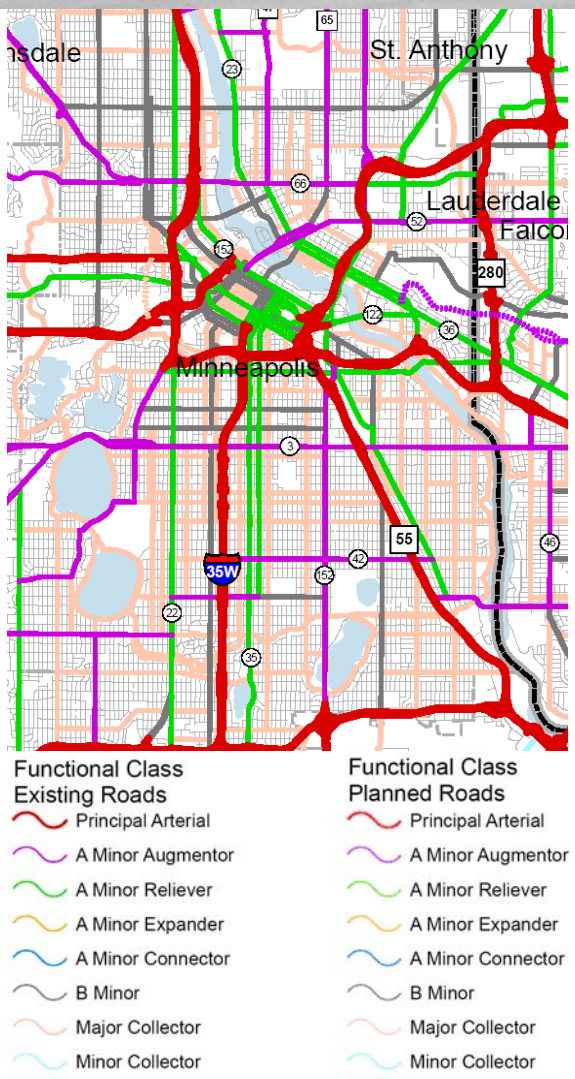
Roadway Functional Classification— Collector and minor arterial streets are designated into three categories to denote jurisdictional responsibility, which governs street design and roadway funding.

Trunk Highways (TH): TH routes are MnDOT owned minor arterial and principal arterial routes that are funded with state dollars and must meet state standards.

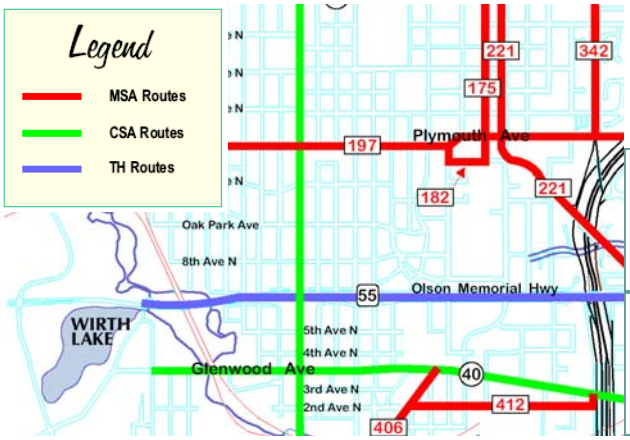
County State Aid Routes (CSA): CSA routes are County owned minor arterial corridors that receive county, state, and city funds and must be designed to county state-aid standards.

Municipal State Aid Routes (MSA): MSA routes are typically city owned collector and lower order minor arterial corridors that receive state funding and must be designed to municipal state-aid standards.

Bicycle facilities are permitted on most MSA, CSA, and TH routes, but must be designed and maintained to meet the jurisdictional standard. The Hennepin County Transportation Policy Plan defines bicycle accommodations as a 6-foot bicycle lane on CSA routes. TH and MSA routes must be designed to meet the standards defined in the MnDOT Bikeway Facility Design Guidelines in addition to state MSA statutes.



Above: Above is the Metropolitan Council Roadway Functional Classification Map. Roadway Functional Classification is directly linked to Jurisdictional Street Designations.



Left: Typically higher order roadways that serve a more regional purpose are owned and maintained by MnDOT or Hennepin County while local streets and collector streets are primarily a city responsibility.

Road and Bridge Design Considerations

MSA Standards—New or reconstruction projects for urban MSA roadways must meet or exceed the minimum dimensions indicated in the following chart.

Functional Classification and Projected Traffic Volume	Design Speed (mph)	Lane Width (feet)	Curb Reaction Distance (feet)	Parking Lane Width (feet)
Collectors or Locals with ADT less than 10,000	30-40	(B) 11	2	8
	Over 40	12	2	10
Collectors or Locals with ADT greater than or equal to 10,000 and Arterials	30-40	(B) 11	(C) 4	10
	Over 40	12	(C) 4	(D) 10

A) One-way turn lanes must be at least ten feet wide, except 11 feet is required if the design speed is over 40 mph.
B) Wherever possible, lane widths of 12 feet, rather than 11 feet, should be used.
C) May be reduced to two feet if there are four or more traffic lanes and on one-way streets.
D) No parking is allowed for six or more traffic lanes or when the posted speed limit exceeds 45 mph.
E) Curb reaction must be provided only where parking is not provided.

One-way streets must have at least two through-traffic lanes.

When a median is included in the design of the two-way roadway, a one-foot reaction distance to the median is required on either side of the median. Minimum median width is four feet.

Urban design roadways must be a minimum nine tons structural design, or ten tons if needed for system continuity. Phased projects must be constructed to attain design strength within three years of completion of final grading.

Roadways not on the state-aid system are not subject to the minimum structural design strength requirements.

The minimum curb-to-curb width of a new bridge must be the required street width, but in no case less than required per Minnesota Statutes, section 165.04. HS 25 loading with AASHTO Standard Specifications or HL-93 loading with load and resistance factor design (LRFD) is required for new or reconstructed bridges and a minimum of HS 18 loading is required for all rehabilitated bridges. Where the new bridge approach roadway includes elements for the accommodation of pedestrians or bicycles, the new bridge width must also provide for pedestrians or bicycles unless pedestrians or bicycles are otherwise accommodated.

For ADT lass than 150, the widths of bridges to remain must be at least the sum of the lanes. For ADT greater than or equal to 150, the widths of bridges to remain must be at least the sum of the lanes plus half the sum of the shoulders, parking lane, and curb reaction distance.

Clearance of 1.5 feet from the face of the curb to fixed objects must be provided when the posted speed is 40 to 45 mph. A ten-foot clear recovery area measured from the driving lane must be provided when the posted speed exceeds 45 mph.

For volumes greater than 15,000 projected ADT, at least four through-traffic lanes are required. Additional average daily traffic may be allowed if a capacity analysis demonstrates that level of service D or better is achieved at the higher traffic volume. If the capacity analysis demonstrates that additional lanes are required only during peak traffic hours, then each additional driving lane may be used as a parking lane during nonpeak hours.

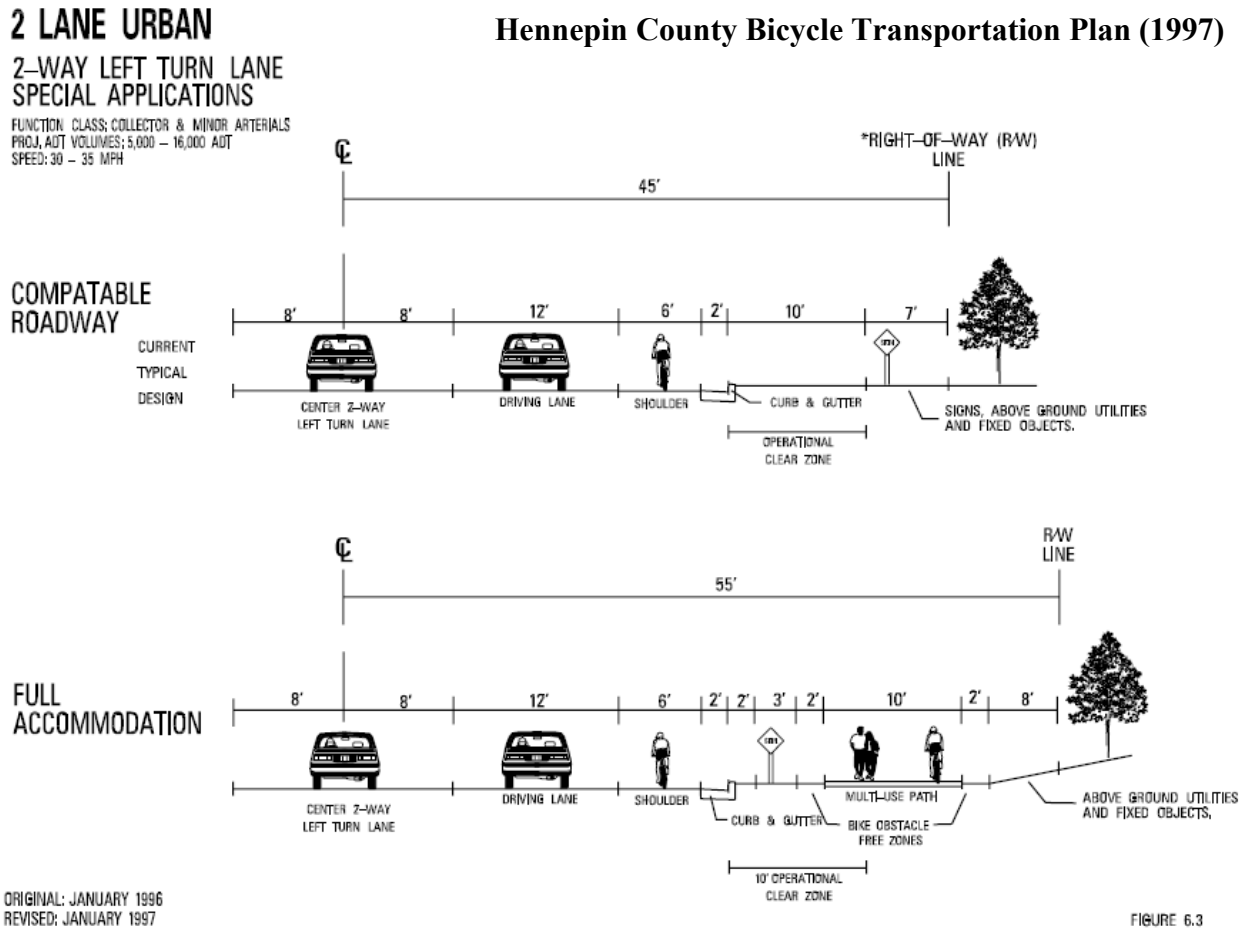
Road and Bridge Design Considerations

County State Aid (CSA) Standards—County State Aid (CSA) routes tend to be minor arterials with high volumes and higher speeds. In Minneapolis most CSA routes are 30 mph, however volumes on county roads are typically between 10,000 and 20,000 vehicles per day. Because of the volumes of vehicles (including trucks) on CSA routes, bicycle lanes along CSA must be 6 feet wide. 5-foot wide curbside bike lanes have also been allowed on some CSA routes using a 60-inch monolithic gutter pan. Share the Road signage or Bicycle Route signage is not allowed on CSA roadways, however approved bicycle wayfinding signage is permitted along designated county bike routes. It is very difficult to achieve full accommodation within the city because county right-of-way is limited to 80 feet in most locations.

Above: Lowry Avenue North is an example of a County State Aid 2-lane roadway that is compatible for bicycles. Lowry Avenue North was reconstructed with bicycle lanes.

Diagram Below: The diagram below shows two cross section that reflect a 2-lane urban compatible roadway (with a 6-foot shoulder or bike lane) and a 2-lane urban roadway with full bicycle accommodation (a 6-foot shoulder or bike lane and a 10-foot multi-use trail).

Hennepin County Bicycle Transportation Plan (1997)



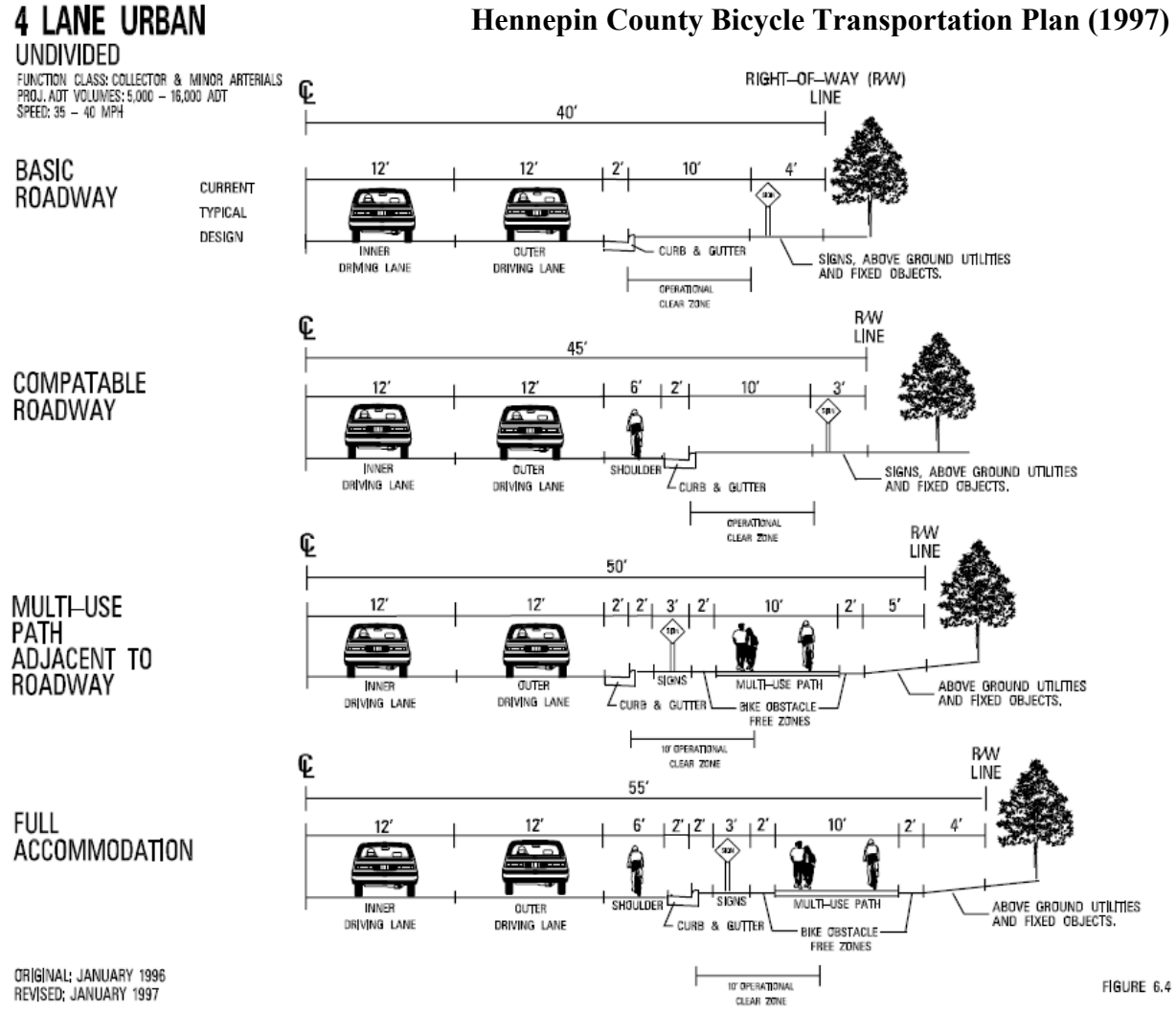
Road and Bridge Design Considerations

County State Aid (CSA) Standards—Most County State Aid (CSA) roadways require four moving lanes of traffic to function properly and to maintain a reasonable level-of-service. Most county right-of-ways in the city are 80 feet in width, which can make it difficult to meet all of the needs in a given corridor.

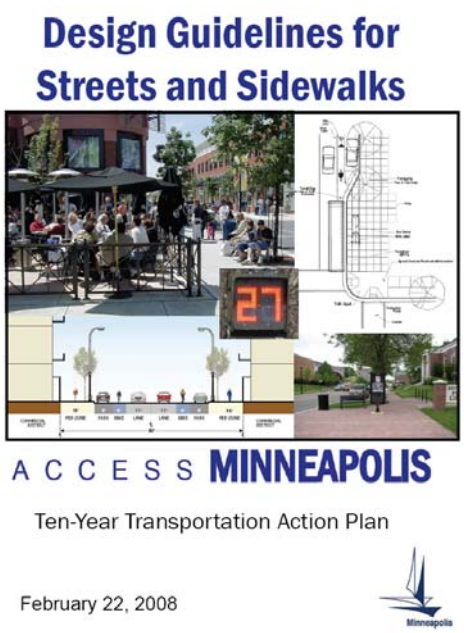
Above: The Ford Bridge is an excellent example of an urban four lane urban undivided roadway with full accommodation. The bridge includes two moving lanes of traffic in each direction in addition to a pair of 6-foot bike lanes and 10-foot multi-use trails on both sides of the roadway.

Below: The diagram below shows several cross section that reflect 4-lane urban roadway scenarios including a compatible roadway with a 6-foot bikeway, a multi-use path adjacent to a roadway, and full accommodation with both and on-street and off-street bicycle facilities.

Hennepin County Bicycle Transportation Plan (1997)



Road and Bridge Design Considerations



Street Typology—As part of the *Access Minneapolis Transportation Action Plan,* the City of Minneapolis Public Works Department developed the *Access Minneapolis Design Guidelines for Streets and Sidewalks* to foster the practice of providing complete streets that support and encourage walking, bicycling and transit use while promoting safe operations for all users. The document is intended to be a resource to staff and stakeholders in the street design decision-making process.

The City's policy, as adopted in the 2009 *Access Minneapolis Citywide Transportation Action Plan*, is to use these guidelines for all infrastructure and development projects. While the guidelines do not apply directly to county or state roadways, the document is intended to be the basis for City of Minneapolis input into county and state roadway improvement projects.

The document recommends that if a bicycle facility is in the Minneapolis Bicycle Master Plan, then bicycle facilities should be provided on the target street or on a parallel street serving the same travel shed.

Above: Bicyclist riding near Minnehaha Park.

Road and Bridge Design Considerations

Right-of-Way Constraints and Variances— Variances to MSA and CSA standards may be considered in situations where a bike lane is required due to safety concerns, lack of a nearby bikeway, or if high bicycle use is present. Variances should be limited to situations where there are no other logical options for accommodating bicycles in a given corridor or travelshed. In tight corridors tough choices must be made as to whether parking, traffic capacity, sidewalk width, green space, or bike lanes are most important. Variances should be seen as a last resort when all other options to accommodate bicycles have been exhausted. Since MSA and CSA variances are not granted by the City of Minneapolis there is no guarantee that a variance request will be granted. A considerable amount of research was done as part of the Bicycle Master Plan process to ensure that on-street routes minimize conflicts with potential bike lanes. Identified routes within the Bicycle Master Plan have attempted to balance the needs of freight, transit, vehicle parking, vehicle capacity, pedestrian needs, green space and bicycle needs. Network planning is needed to ensure that a mode that is not fully accommodated on a given street could be accommodated on a parallel street.

Below: Central Avenue Northeast.

Below: Fremont Avenue North.

Below: Glenwood Avenue North.

Below: Monroe Avenue Northeast.

Below: 1st Avenue North.

Above: Shown are examples of corridors identified for future bicycle facilities with ROW constraints.

Road and Bridge Design Considerations

Right-of-Way Constraints and Variances— Below are examples of constrained roadways.

Above: Osseo Rd is a CSA route with 11,900 vehicles per day and no sidewalks. Adding bike lanes to this corridor would require lane reductions resulting in a level-of-service reduction.

Above: Minnehaha Avenue between Franklin Avenue and E 26th Street is a wide two-way MSA street with one lane in each direction. The roadway is wide enough to add bicycle lanes between the driving and parking lanes without impacting parking or level-of-service.

Above: Nicollet Avenue is an MSA route with 9,400 vehicles per day north of Diamond Lake Road. The roadway is 50-foot wide with a 66-foot ROW and there is enough space for bicycle lanes, parking on both sides and two moving lanes. Level-of service constraints and community priorities have resulted in the addition of a turn lanes in lieu of bike lanes. Parking at business nodes is needed for economic vitality and therefore the community has opted for parking instead of bike lanes along this corridor. Since buildings are at the edge of the right-of-way line and sidewalks are narrow, securing additional street width would require buildings to be removed at enormous cost. Since the corridor is a designated truck route and primary transit route, lane widths must conform to MSA standards. This is a typical case where choices between priorities must be made and variances are not appropriate.

Above: Como Avenue was reconstructed with bicycle lanes in each direction. Since the roadway was not wide enough to support one moving lane in each direction in addition to parking on both sides while adding a bike lane, a decision was made to remove parking on the north side of the corridor and to create a westbound curb bike lane. Parking was preserved on the south side of the corridor and an eastbound bike lane was added between the parking lane and traffic lane. All lane widths meet MSA requirements.

Road and Bridge Design Considerations

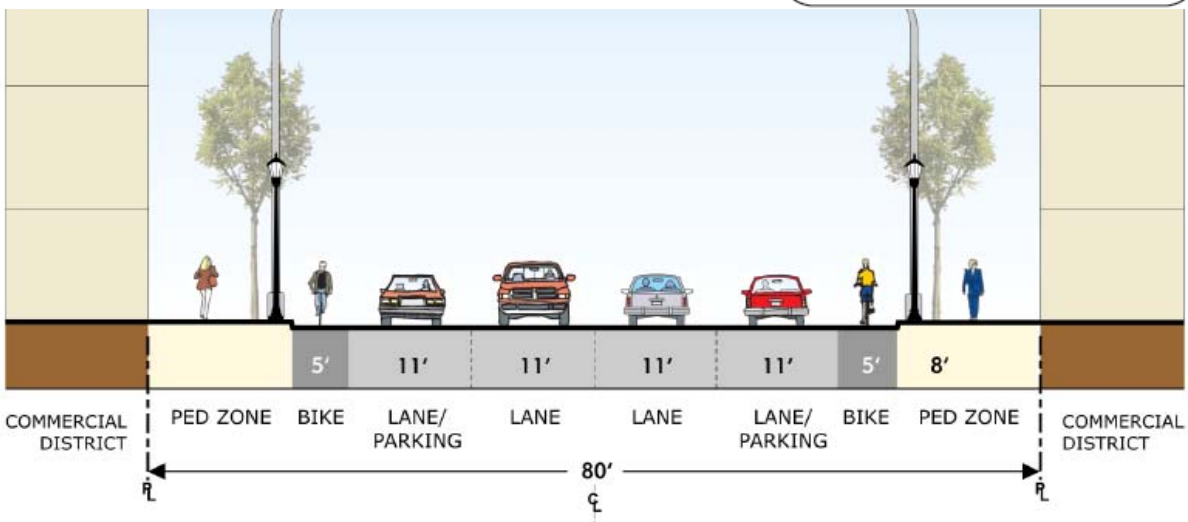
Lane Conversions—Lane Conversions involve the removal of traffic lanes to accommodate bicycle lanes. Depending on the number of traffic lanes, roadway widths, need for parking, and level-of-service (based on signal spacing, left turn volumes, overall traffic volumes, and signal phasing), four-lane roadways may be converted to a three-lane section. Parking is often removed on both sides of a roadway to accommodate bike lanes, however in some cases lanes may be shifted to preserve parking on one side of the road. In some cases, turn lanes may be removed to facilitate a bike lane, but a traffic study should be completed to determine if removal of the turn lane will reduce the level of service at an intersection.

Above: Signage in Minneapolis.

Below: Example of a road diet in Portland, OR.

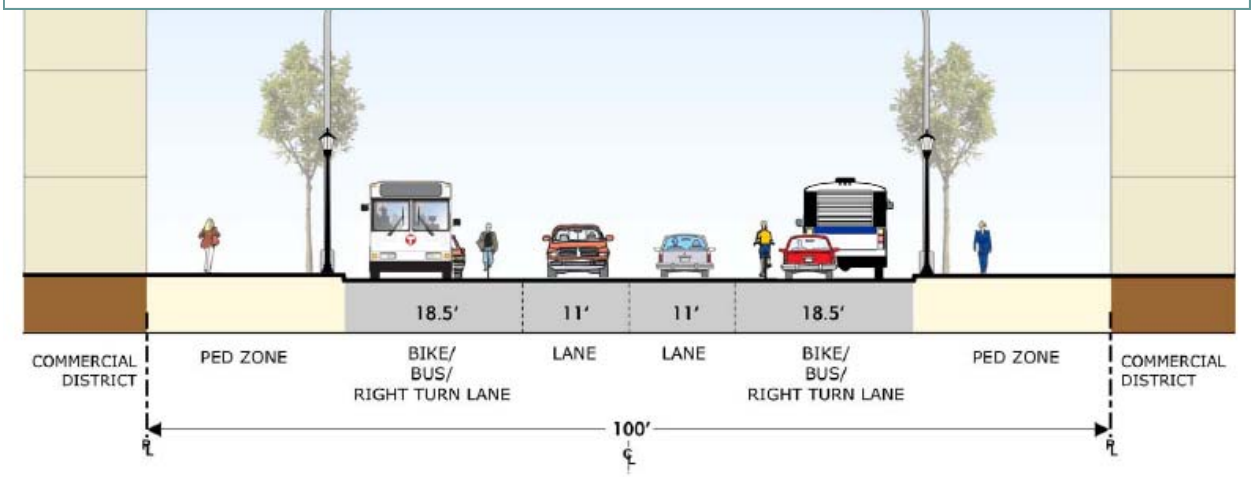
Road and Bridge Design Considerations

One-Way/Two-Way Conversions—Converting a roadway from a one-way to a two-way or from a two-way to a one-way may present an opportunity to add bicycle lanes. In most cases these situations involve a pair of roadways. As with any roadway reconfiguration, traffic capacity needs and parking needs will greatly factor into whether a conversion is appropriate. Below are examples of how bicycle lanes were accommodated by either creating a one-way pair from two-way streets or by creating a pair of two-way streets from a one-way pair.



Above: The diagram above shows how 1st Avenue North was converted from a one-way street with three southbound moving lanes to two moving lanes (4 during peak hours) and two bike lanes. Parking was removed during peak hours to accomplish this cross section.

Below: Hennepin Avenue was also converted to a two-way street but has a much different cross section.



Road and Bridge Design Considerations

One-Way/Two Way Conversions—Examples

Above: The 35th Street West and 36th Street West corridors work well as one-way pairs to accommodate freeway entrance/exit traffic, however bike lanes do not fit with existing parking. Converting the pair into two-way streets will not create bike lanes unless parking is removed.

Above: The 1st Ave NE and E Hennepin Ave corridors are currently one-way pairs. Converting these corridors into two-way streets could be examined in the future. The Bicycle Master Plan recommends bicycle lanes along both of these corridors.

Right: 40th Street East was examined as part of the RiverLake Greenway design process to become a one-way street with a two-way bike lane. This idea was abandoned in favor of a bicycle boulevard. There was also no desire to convert a parallel street into a one-way.

Above: The Blaisdell bike lane has a substandard width much of the way. With parking removed on one side on both 1st Ave S and Blaisdell Ave, a pair of standard bike lanes (one NB and one SB between the two) can be installed following MSA rules.

Above: The University Ave SE and 4th Ave SE corridors work well as a one way pair to handle large volumes of event traffic. With parking prohibited, each corridor has enough space for a one-way bike lane.

Traffic Calming Treatments—Identify the Problem

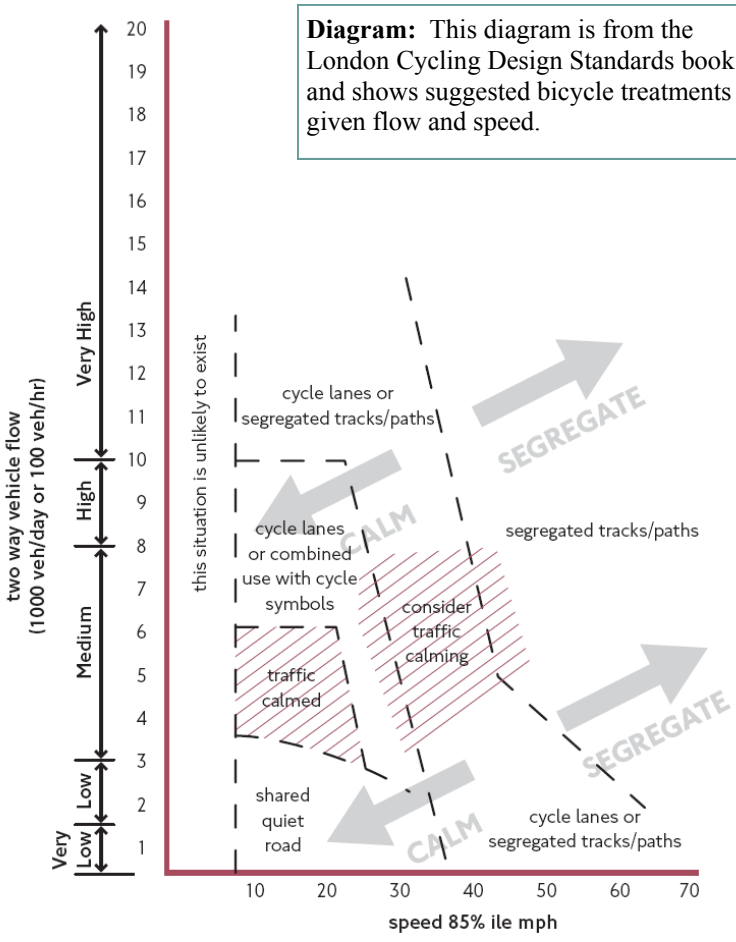
1) Identify the Problem—In many places traffic calming may not be the appropriate solution for a given problem. In some situations the problem is only perceived and traffic calming may not be required. To determine the need for traffic calming, the problem (ie. speeding , cut through traffic, etc.) must be clearly identified and proven with data. Traffic counts and speed data is useful information in making this determination. It is important to look at adjacent land uses, topography, drainage, and roadway functional classification before installing traffic calming devices.

Traffic Calming: According to the Institute of Transportation Engineers, *"Traffic Calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users. Traffic Calming goals may include increasing the quality of life, incorporating the preferences and requirements of the people using the area, creating safe and attractive streets, helping to reduce the negative effects of motor vehicles on the environment, and promoting pedestrian, cycle, and transit use. Traffic Calming objectives include achieving slow speeds for motor vehicles, reducing collision frequency and severity, increasing the safety and perception of safety for non-motorized users of the street(s), reducing the need for police enforcement, enhancing the street environment, encouraging water infiltration into the ground, increasing access for all modes of transportation, and reducing cut-through motor vehicle traffic."*

Traffic Calming Treatments—Develop Countermeasures

2) Develop Countermeasures—Once a problem has been identified and documented, there are a number of traffic calming tools that can be used to solve a specific problem. Typically devices such as cul-de-sacs and diverters are used to mitigate cut through traffic and speed humps, raised crosswalk, and curb extensions are used to slow vehicles. It is important not to forget the importance of education and enforcement in any traffic calming effort. This document will address some of the more basic traffic calming devices and how they relate to bicycling and bicycle facilities.

Diagram: This diagram is from the London Cycling Design Standards book and shows suggested bicycle treatments given flow and speed.



Traffic Calming Treatments

Chicanes— A chicane is a serpentine curve on a collector or local roadway used to slow vehicles. A chicane may be accomplished with striping or with curb and signage treatments. Chicanes are often designed to improve the aesthetics of a given corridor and can be designed to accommodate bike lanes.

Advantages/Disadvantages: Chicanes are primarily designed to slow vehicles. Curb extensions or medians used to create chicanes are often landscaped and can help beatify a neighborhood. Bike lanes may be striped as part of the roadway design, however vehicles often cut corners and can meander into the bike lane. Incorrectly designed chicanes can present visibility challenges and may result in additional crashes. Chicanes may present maintenance challenges, especially for snow plow drivers and street sweepers. Emergency vehicles may also have difficulties if the chicane curve radius is too small.

Criteria: Chicane installation must adhere to the following criteria:

- Chicanes should not be placed on minor arterial roadways (including MSA routes) or roadways with speed limits that exceed 35 mph
- Chicanes should not impede visibility.
- Manitenance costs and impacts need to be considered before installing a chicane.
- Chicanes must be signed and striped correctly to avoid crashes and to achieve the desired speed reduction.
- Bicycle lanes may be placed on the right side of a roadway through a chicane. A 6-foot bike lane is recommended to allow for greater separation from a motor vehicle.
- Colored bicycle lanes may be used at chicanes to improve bicycle visibility.

Above: A chicane on a Toronto street.

Above: A chicane on a local German street.

Above: The Nicollet Mall is a chicaned roadway.

Above: Lombard Street in San Francisco.

Traffic Calming Treatments

Crosswalk Enhancements— Crosswalks are typically intended for pedestrians, however some bicyclists choose to ride on sidewalks and often use pedestrian crosswalks. Unless a trail approaches an intersection, crosswalk design and crosswalk enhancements should be based on pedestrian needs and not designed specifically for bicycle use. Midblock trail crossings are addressed as part of the City of Minneapolis Midblock Trail Crossing Policy.

Most intersections in Minneapolis involving local streets do not have striped crosswalks. Striped crosswalks are permitted at signalized intersections and typically consist of two solid parallel white lines. In rare cases when the crossing distance is long or there are very high volumes, a zebra crosswalk may be used. Non-signalized intersections that are school patrolled may also be eligible for a striped crosswalk.

Crosswalk enhancements may include zebra crosswalks, crosswalk bollards, flashing warning signs, enhanced pavement markings, and lighted crosswalks.

Above: Mid-block paddle along 21st Avenue.

Above: Mid-block flasher in Minneapolis.

Above: Crosswalk at Midtown Greenway at 26th St.

Above: Crosswalk at Edina City Hall.

Traffic Calming Treatments

Cul-de-Sacs— Cul-de-sacs are places for vehicles to turn around at the ends of local dead end streets. In a grid system cul-de-sacs have been installed at select locations to address speeding and cut through traffic. Cul-de-sacs that are installed for this purpose should allow for bicycles and pedestrians to proceed through the cul-de-sac. This can be accomplished with special curb ramps Bicycle boulevards are often placed on roadways with cul-de-sacs to deter through traffic.

Above: This cul-de-sac in NE Minneapolis provides for safe and convenient bicycle access to NE Park. There is a curb cut in the center of the cul-de-sac.

Above: Snow storage can be an issue for cul-de-sacs with a cut through for bicycles. Paths through cul-de-sacs require basic maintenance.

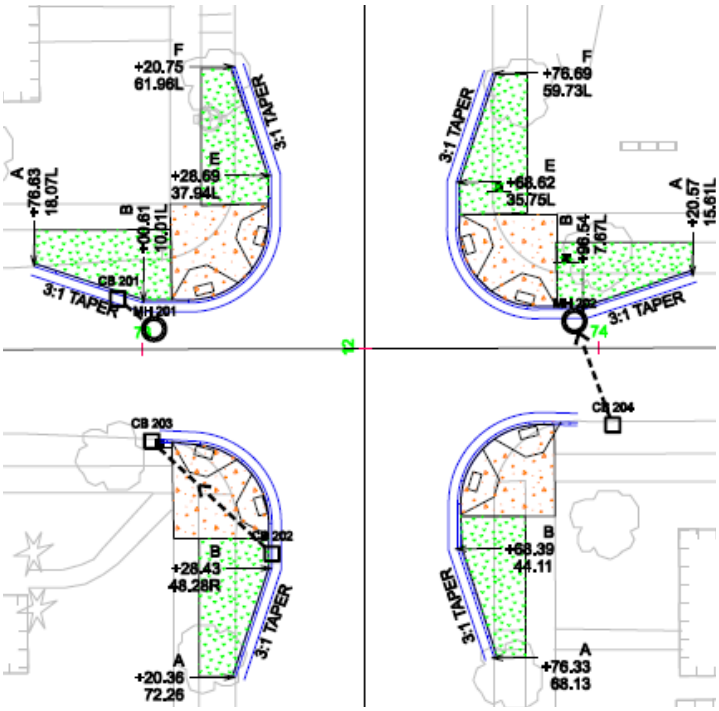
Above: This cul-de-sac in South Minneapolis was installed without provisions for bicycles and could be easily retrofitted with a curb cut on both sides.

Above: Example of a cul-de-sac in NE Minneapolis with a connection to a pedestrian bridge.

Above: Bollards may be spaced to prevent vehicles from going through while allowing bicycles.

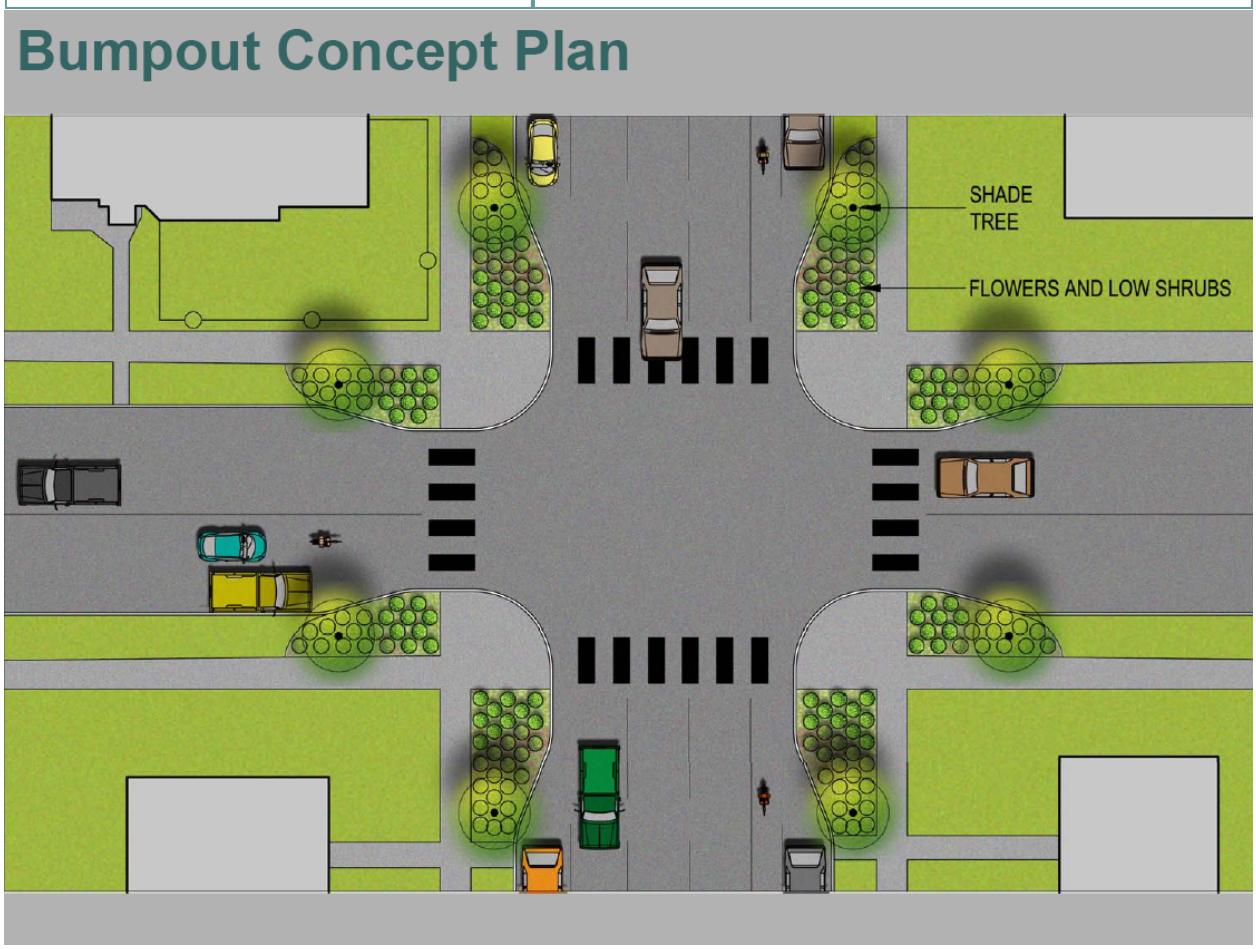
Traffic Calming Accommodations

Curb Extension Design—Often called "chokers", curb extensions are used to slow traffic and to reduce the distance a pedestrian needs to cross a roadway. In many cases, catch basins and manholes need to be relocated in addition to new pedestrian aprons, and curb and gutter relocation. Bump-outs should not protrude more than the width of the parking lane, especially on MSA routes where trucks are turning. Numerous bump-outs have been successfully installed throughout the city.



Below: Curb extensions are ideal places for landscaping.

Above: Curb extensions or "bumpouts" may be designed to protrude into one or both legs of an intersection.



Traffic Calming Treatments

Curb Extension Design—Details below:

Curb Extension Placement: Curb extensions or bump-outs are typically installed at intersections to calm traffic, reduce pedestrian crossing distances, and to provide additional green space.

Curb Extension Design: Curb extensions need to be customized to the proposed location based on topography, roadway widths, and functional classification. Curb Extensions typically protrude 8-10 feet when parking is present. The bike lane should be placed outside of the gutter pan and should be striped to the crosswalk. Pavement markings should be placed at the beginning of the intersection.

Curb Extension Aprons: Pedestrian Aprons at Curb Extensions require special attention. Minimum radii should be calculated based on the largest vehicle type that will frequently turn the corner. Curb radii at a signalized crossing or at the intersection of two minor arterials should be greater than the intersections of minor arterials and local streets. Typical radii range from 15 to 30 feet.

Catch Basins: Catch basin placement is a critical component of curb extension design. Catch basins must be placed to optimize rainwater collection but may present design challenges, especially if a corner is retrofitted. These retrofits can often be costly and difficult to achieve. In some cases it is best not to install a curb extension unless significant underground stormwater system retrofits also occur.

Traffic Calming Treatments

Curb Extension Design—Design details are below:

Parking: One reason to install a curb extension is that it forces motor vehicles to park away from an intersection. This improves visibility at an intersection.

Plantings: Curb extensions may result in the creation of additional space for plantings. Plantings must not exceed 3 feet in height in order to maintain good visibility. A maintenance agreement should also be in place with the adjacent property owner or with a gardening club to ensure that the plantings will be maintained. The City of Minneapolis does not maintain curb extension plantings.

Delineators for Plowing: Curb extensions should be constructed with a 5:1 taper to allow for proper snow plowing. Curb extensions are difficult to plow around and curb delineators are required at both ends of the curb extension tapers so that plow drivers can approximate the curb line. Delineators should be located approximately 18 inches behind the curb line.

Driveways: In some locations, private driveways need to be maintained where curb extensions are proposed. In most situations the curb extension may be altered to keep the driveway apron in place. This can be accomplished by either shortening the curb extension or by increasing the taper angle. A curb extension may also be lengthened to allow for a driveway to be extended. The new driveway apron must keep the sidewalk level.

Traffic Calming Treatments

Curb Extension Design—Design details are below:

Curb Extensions—Curb extensions may be installed at intersections or at mid-block locations to constrict traffic and to provide shorter pedestrian crossings.

Above: Most corners can be retrofitted to allow for curb extensions. Much of the expense to retrofit a corner is based on whether a catch basin or other utilities must be relocated.

ITE

Left: Innovative curb extensions may be adjusted to allow bikes. This treatment may be difficult to plow and many bikers will not ride over the bump. In the case below the curb extension is much more gradual, however parked vehicles may still be a problem.

Above: Innovative curb extension in Montreal.

Traffic Calming Treatments

Diverters—Traffic diverters are common throughout the Como, Fulton, Jordan, and Lyndale neighborhoods. Designed to divert traffic along the local street grid, traffic diverters are intended to calm traffic and keep regional trips off local streets. Where a diverter disrupts a bike route or a bicycle boulevard, special accommodations can be made to allow bicycles through the diverter without allowing motor vehicles. Bollards may be used to physically prevent motor vehicles from cutting through the diverter in addition to "No Motor Vehicles" signage combined with enforcement.

Photos: The photos on the right show a variety of diverter treatments. The photos on the left show two locations where opportunities exist to add bike facilities.

Above: Diverter in Cologne, Germany.

Above: Diverter in Nijmegen, Netherlands.

Above: Diverter at 17th and Rollins in Minneapolis.

Above: Diverter at 18th and Elm in Minneapolis.

Above: Diverter at 33rd and Penn in Minneapolis.

Above: Diverter in Berkeley, CA.

Traffic Calming Accommodations

Education—Education is a key component of the Minneapolis Bicycle Program and is an important factor in traffic calming. Infrastructure projects alone will not calm traffic; it also takes education and enforcement initiatives to get the desired result. There are dozens of ways to educate residents, drivers, and bicyclists about biking.

The photos shown are just a few examples of education initiatives throughout the city.

Above: Lawn signs get the point across. Slower roadway speeds make a safer and more livable street. Slower speeds also reduce the risk of severe injuries.

Above: Bicycle giveaways like the one shown can be used as a reward in a bicycle education curriculum.

Above: The Minneapolis Safe Routes program includes both education and infrastructure projects.

Above: Teaching kids how to safely ride a bike pays dividends. Instilling good riding habits reduces crashes.

Above: Events like Bike in at the Bell have been great places to educate the public about bicycle issues.

Traffic Calming Treatments

Enforcement and Speed Reduction— Both enforcement and speed reduction are equally important traffic calming tools. Enforcement: Traffic enforcement is an effective traffic calming measure that can be used to slow motor vehicles speeds, making a bike route safer. Speed wagons are an effective tool that have been used throughout the city to educate drivers and are often used prior to enforcement at a given location. Care should be taken so that speed wagons are not directly placed in bicycle lanes or in the direct flow of bicyclists. It is also important that enforcement be uniform so that both motorists and bikes are treated equally. Speed Reduction: Lowering the speed limit may result in a safer bicycle route, however it may not be appropriate on certain types of roadways. Currently most roadways throughout the city have a speed limit of 30 mph. School zones may be posted at 25 mph. A speed study and a letter from the State Transportation Commissioner may be required to change a speed limit. State statute does permit lowering the speed limit to 25 mph in the presence of a bikeway. However, reducing speed limits on collector and minor arterial streets may result in decreased mobility and reduced level-of-service for vehicles. Lowering speeds on bicycle boulevard corridors in combination with enforcement should result in a safer, more attractive route for bicyclists. Speed reduction is often one of the primary goals when implementing traffic calming devices, however there is mixed evidence as to which treatment is the most effective. Due to the cost of physical improvements it is wise to look at added enforcement or reducing posted speeds first.

Above: Minneapolis speed wagon.

Above: Minneapolis City Hall.

Above: Minneapolis City Hall.

Traffic Calming Treatments

Speed Humps— Speed humps are found throughout the city along many local streets. Speed humps are placed in pairs and have been shown to reduce traffic speeds within 300 feet of the speed hump. Speed humps may not be installed along MSA or CSA routes, which are also truck routes.

Advantages/Disadvantages: Speed humps located along bike routes often present a challenge to bicyclists and maintenance vehicles. In places where parking is prohibited, speed humps may be shortened in width to allow for bicycles to pass to the right. Most bicyclists traveling at slow speeds have little trouble passing over a speed hump, however their use should be discouraged along a bike route.

Criteria: Speed hump installation must adhere to the following criteria:

- Speed humps may not be installed along MSA or CSA routes, which are typically collector and minor arterial streets that are also truck routes.
- Speed humps must be installed by petition in accordance with the Cities Traffic Calming Policy. All speed humps must be constructed to meet the uniform city design standard.
- Speed humps are placed in pairs and must be properly signed and marked.
- Speed humps must be placed on a level surface and are not appropriate on roadways that exceed 5% grades.
- Speed humps are not appropriate along local streets with more than 500 bicyclists per day. Alternate traffic calming measures should be considered along these corridors.
- Cycle track by-passes may be installed at locations where there is adequate boulevard space. Bicycle curb aprons should be installed within 50 feet of each side of the speed hump.

Above: Examples of speed hump treatments.

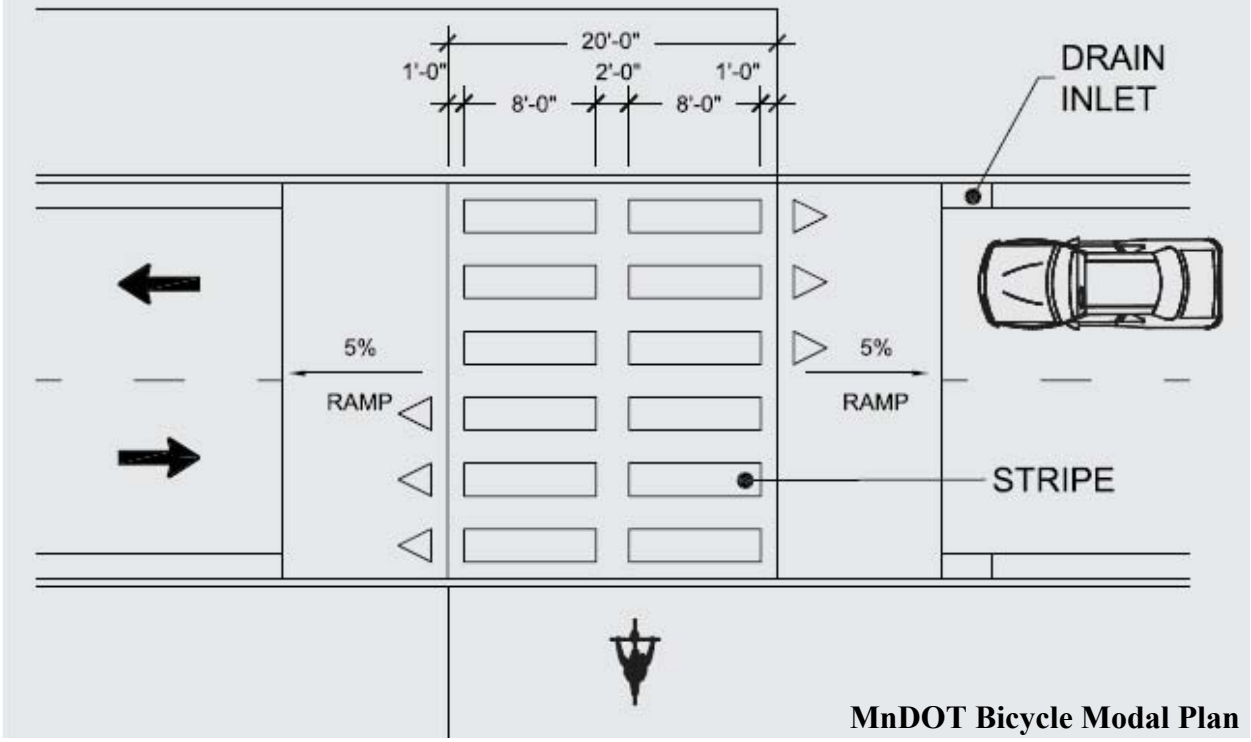
Traffic Calming Treatments

Raised Crosswalks/Speed Tables—Below is guidance pertaining to both.

Raised Crosswalks: Raised crosswalks (speed table) in combination with signage and pavement markings may be used at midblock trail crossings to improve visibility and safety. Raised crosswalks can be difficult to maintain and are not recommended for major streets.

Above/Below: Examples of a raised midblock crosswalk. Raised crosswalk and speed tables are not allowed on MSA or CSA routes.

Standard Speed Table:



MnDOT Bicycle Modal Plan

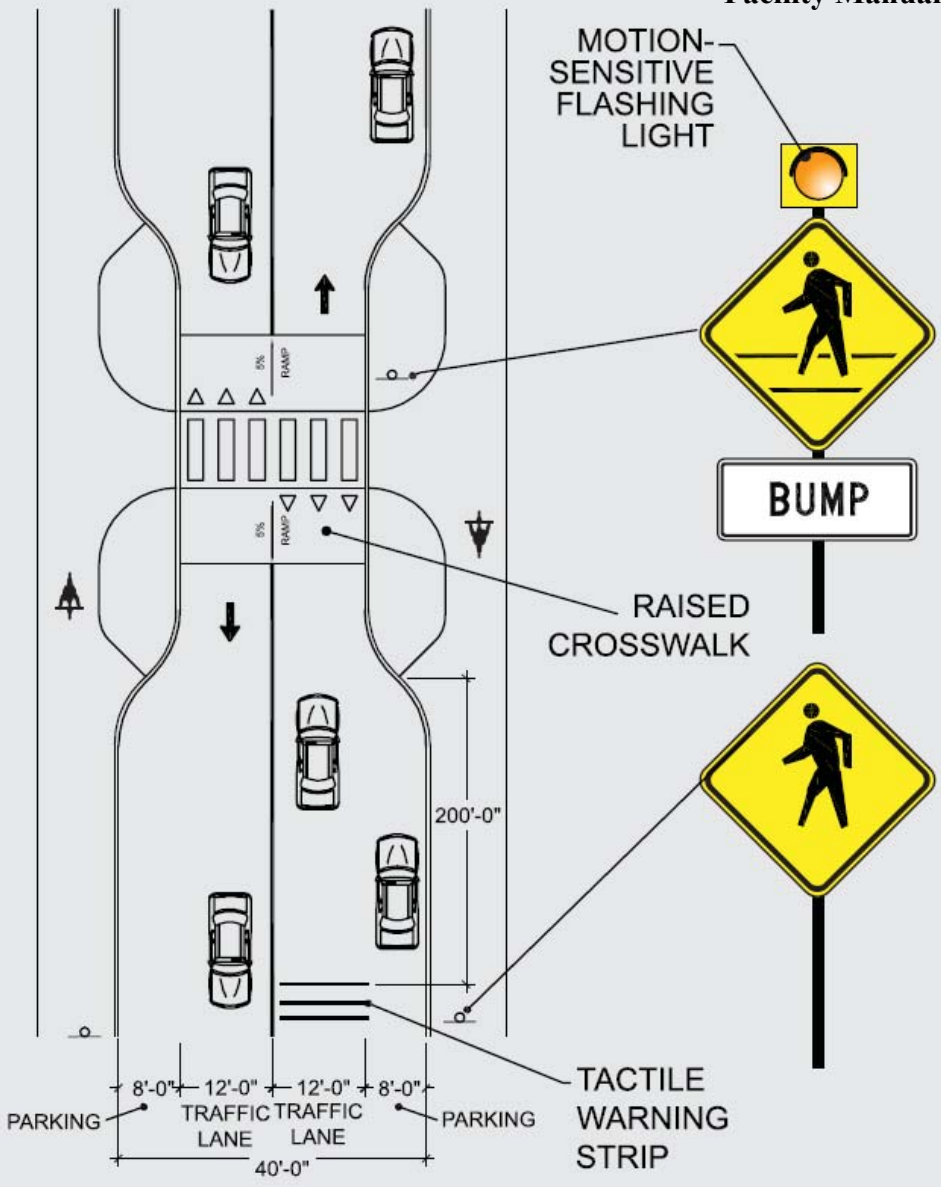
Traffic Calming Treatments

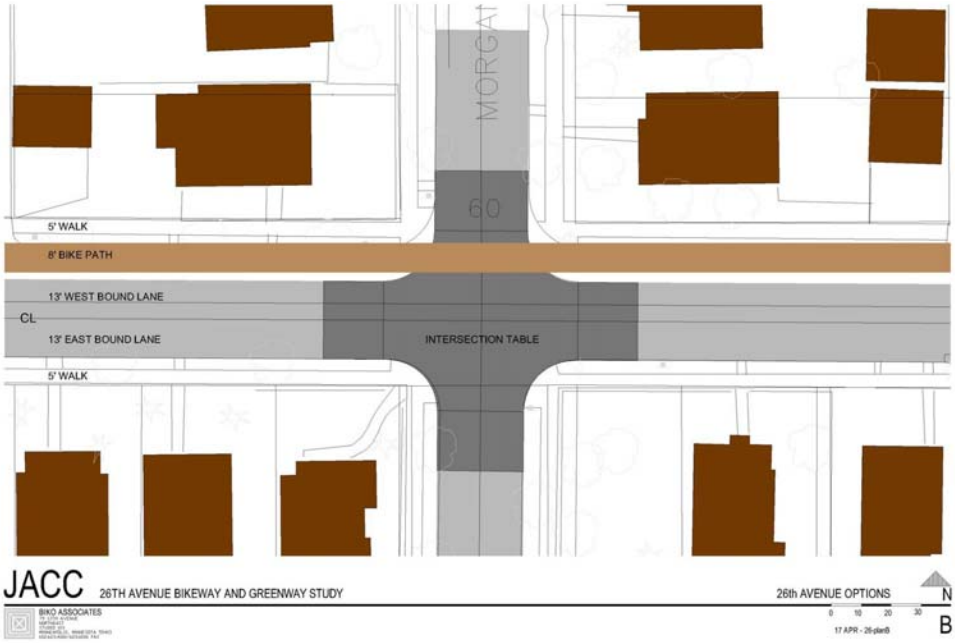
Raised Crosswalks/Speed Tables—Raised crosswalks may improve the visibility of pedestrians and bicyclists and can be installed using several types of pavement styles. Raised crosswalks are seldom installed throughout the city due to winter maintenance concerns.

Above: East River Parkway.

Right: Curb extensions may be used in conjunction with raised crosswalks. This protects the crosswalk from parking vehicles and decreases the crossing distance for pedestrians and bicyclists. The curb extensions also provide a choking effect, which slows motor vehicles down and provides better visibility at the crossing. This treatment must be properly signed and marked, with warning signage in advance of the crossing. An engineering study that examines the maintenance costs and challenges is recommended before installing this treatment. The diagram is from the 2007 MnDOT Bicycle Facility Design Manual.

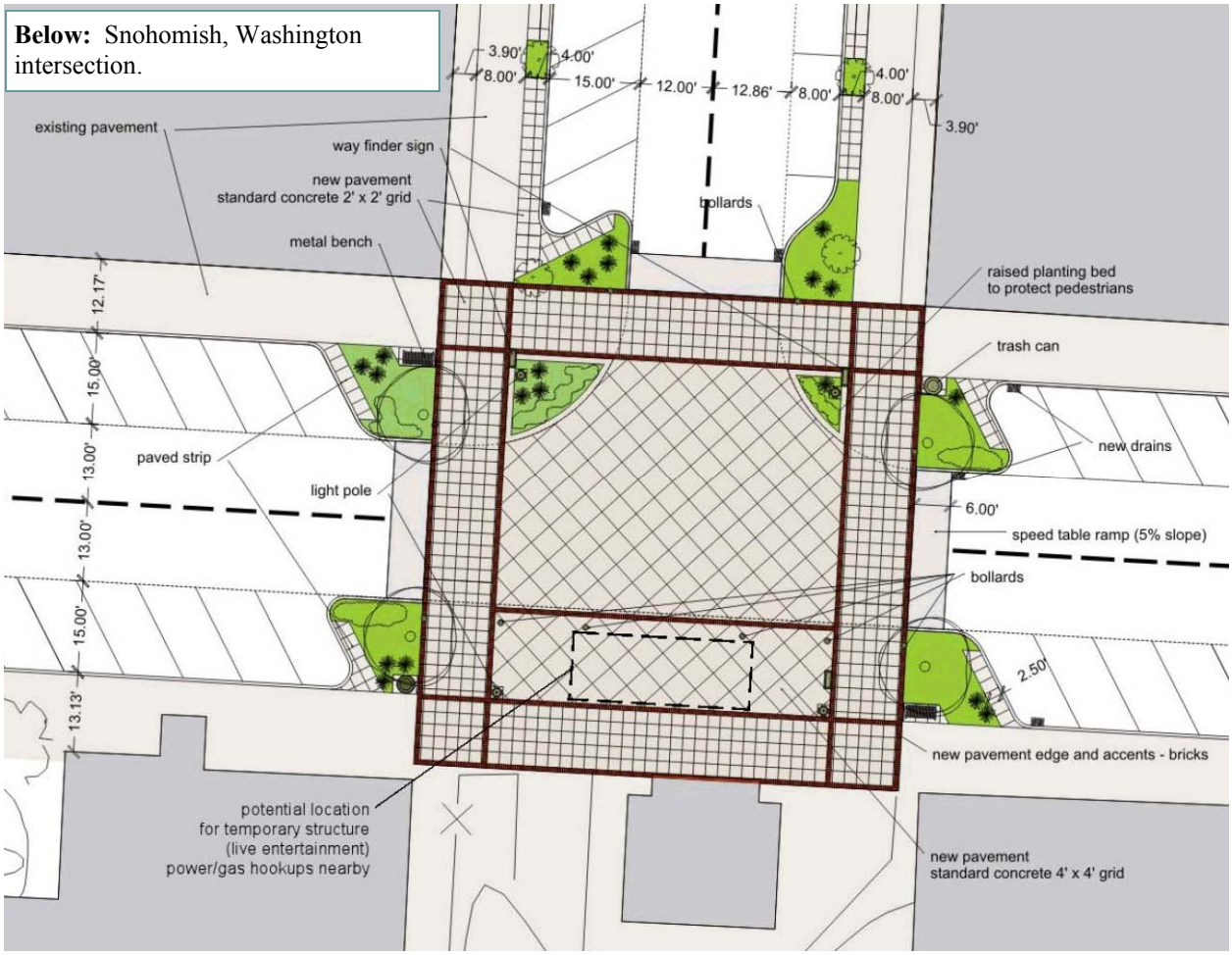
MnDOT Bicycle Facility Manual





Raised Intersections— Raised Intersections may be used as a traffic calming device to slow vehicles and make an intersection more visible. Raised intersections may be used to elevate a roadway to keep an off-street trail crossing at the same elevation, but are not permitted on MSA, CSA, and TH routes.

Below: Snohomish, Washington intersection.

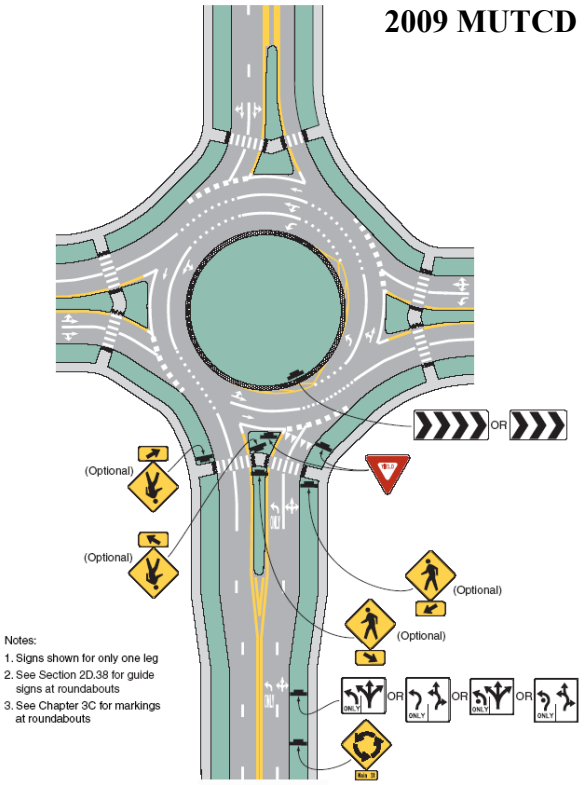


Traffic Calming Treatments

Roadway Roundabouts—According to AASHTO, there are two ways to accommodate bicycles in roundabouts:

1) In mixed flow with vehicular traffic.
2) Along separate bicycle paths.

When a bike lane approaches a roundabout, the bike lane should be dropped 35 to 65 ft ahead of the roundabout and bicyclists are expected to share the road with traffic. Multi-use and separated trails may also be built along the outside diameter when bicycle and pedestrian use is high. Bicycle lanes along the outside diameter of roundabouts is not recommended.



Below: Roadway roundabout in Overland Park, Kansas. The photo and diagram show a two-lane roundabout. The pavement markings at this intersection are not to standards.

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Traffic Calming Treatments

Roadway Roundabouts—Accommodating bicycles at roadway roundabouts can often be challenging. Bicycle lanes are not recommended in roundabout layouts, however trail facilities may be integrated into a roundabout design. There is considerably more guidance in Chapter 2 and Chapter 3 of the Minnesota Manual on Uniform Traffic Control Devices.

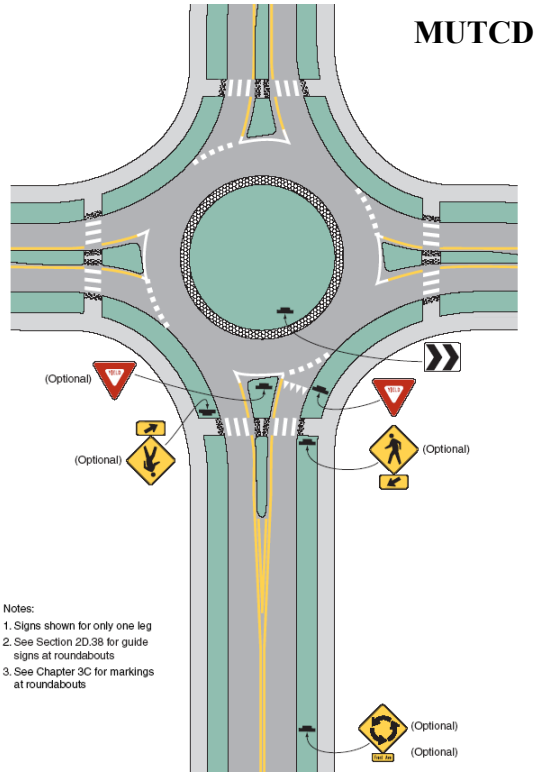
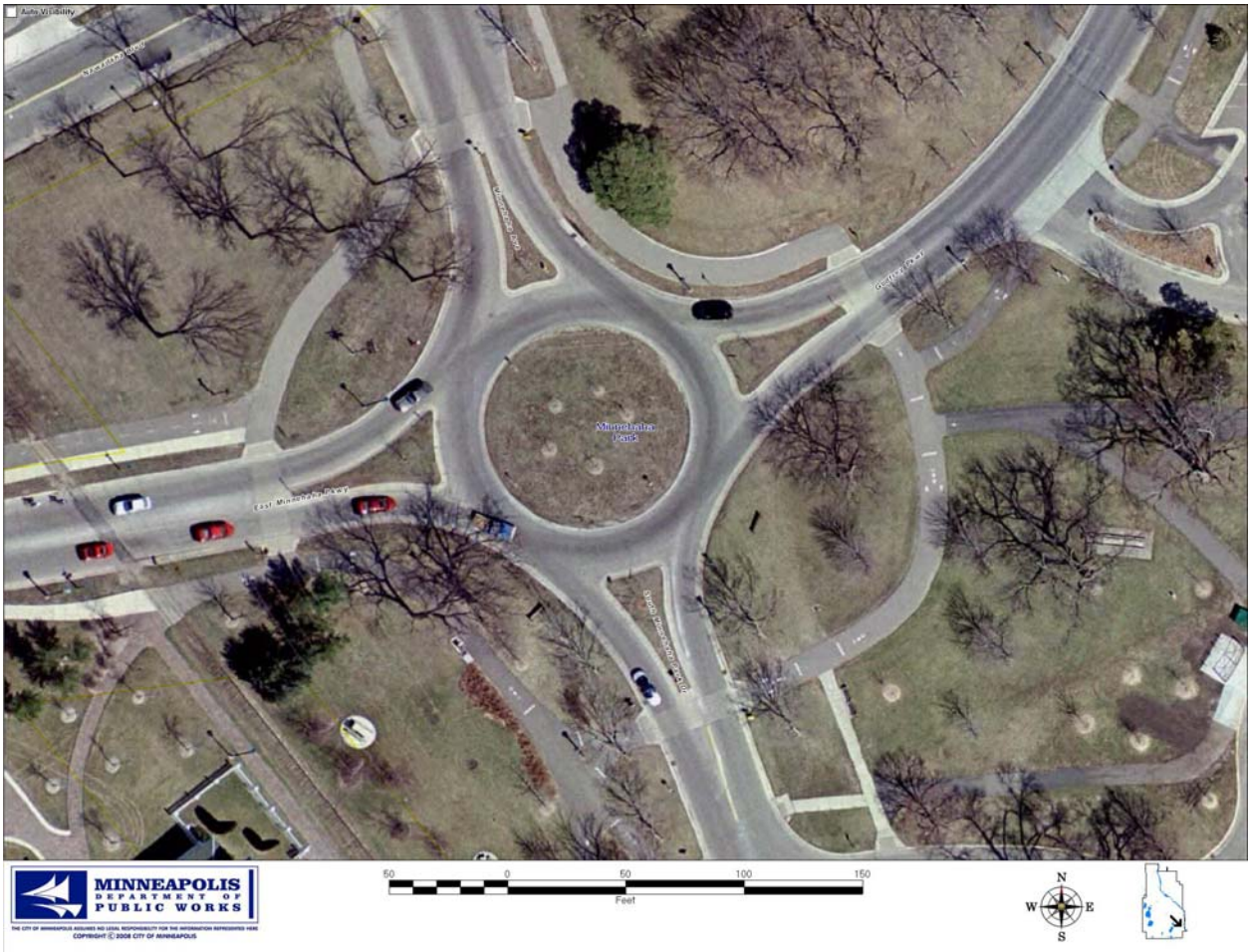


Photo: Roadway roundabout at the intersection of Minnehaha Avenue and Minnehaha Parkway in South Minneapolis. The aerial photo and diagram show a one-lane roundabout. The aerial photo shows how an off-street trail can be accommodated at a roundabout. This trail is part of the Minneapolis Grand Round system and has a significant amount of bicycle and pedestrian use.



Traffic Calming Treatments

Traffic Circles—Traffic circles are a circular structure that is placed in an existing intersection to slow traffic and discourage truck traffic. Traffic circles can be landscaped to beautify neighborhoods and to prevent vehicles from driving through, however their success is mixed. The city instituted a traffic circle program years ago with several traffic circle installations. Due to citizen complaints and high maintenance costs all but two of the original traffic circles have been removed.

Unlike modern roundabouts, traffic circles utilize existing right-of-way at an intersection, which makes traffic circles much smaller and cheaper than modern roundabouts. Roundabouts also require vehicles to yield at an intersection, where traffic circles keep existing stop sign control in place. Turning vehicles must follow a clockwise movement around a roundabout, however left turning vehicles may cut in front of a traffic circle to make the movement. Roundabouts also are normally placed at very busy intersections including collector and minor arterial streets, whereas traffic circles should only be placed at the intersection of two local streets.

Traffic circles have little benefit to bicycles as a stand alone treatment. However when coupled with a bicycle boulevard or a signed bike route, traffic circles may be strategically placed along a corridor to deter trucks from using the route and to slow traffic, making it a safer bike route. Traffic circles may reduce visibility at an intersection and it is not recommended that a cut-through for bicycles be created as part of the traffic circle installation.

Photos: The photos above show a traffic circle located in the Linden Hills Neighborhood.