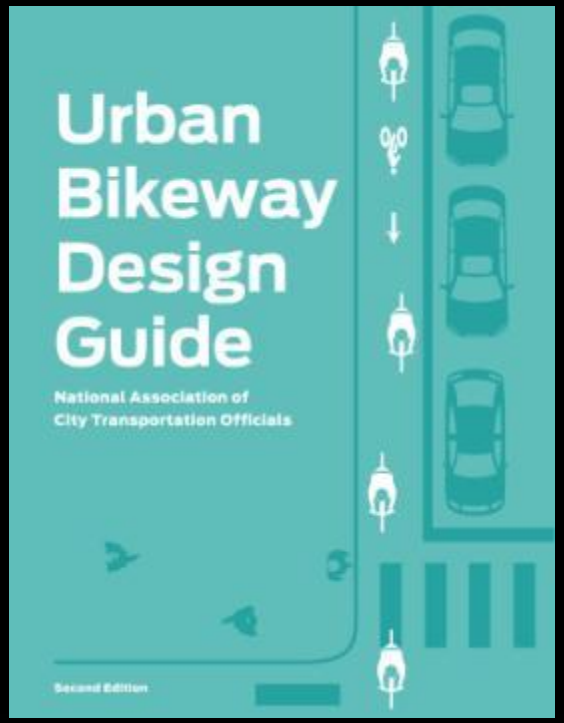


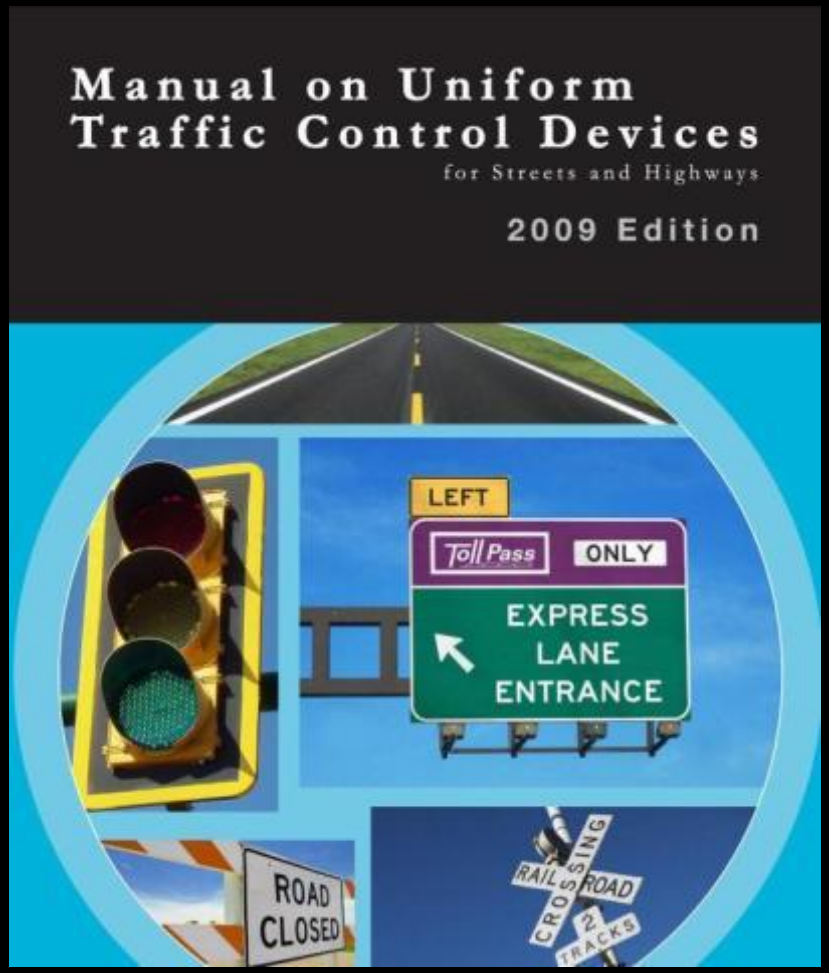
The Urban Bikeway Design Guide

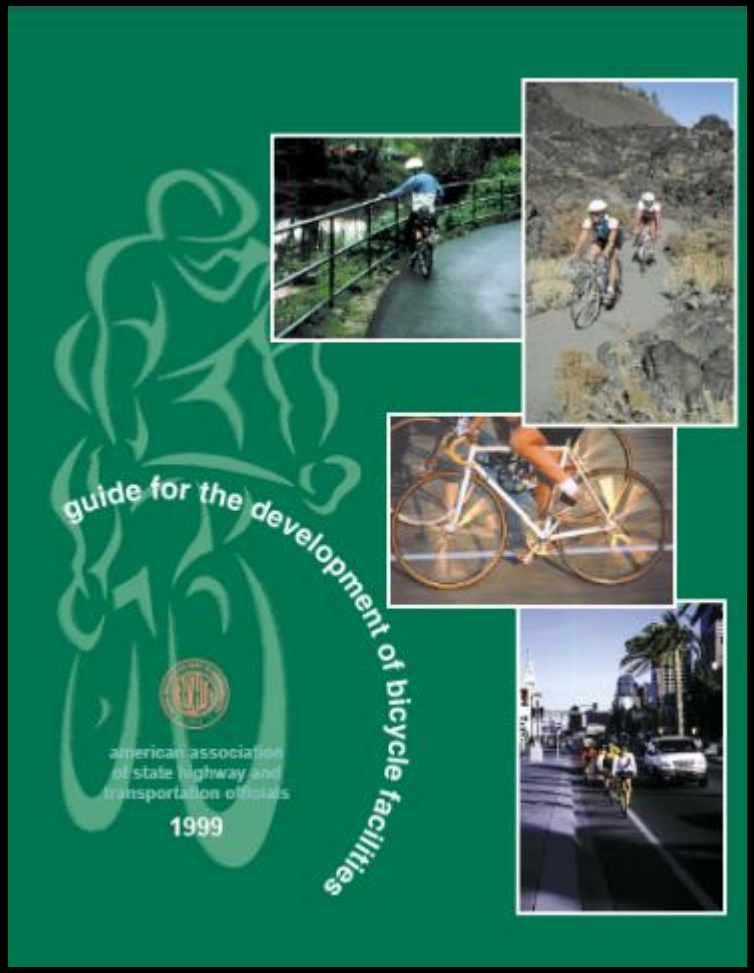
San Mateo Training

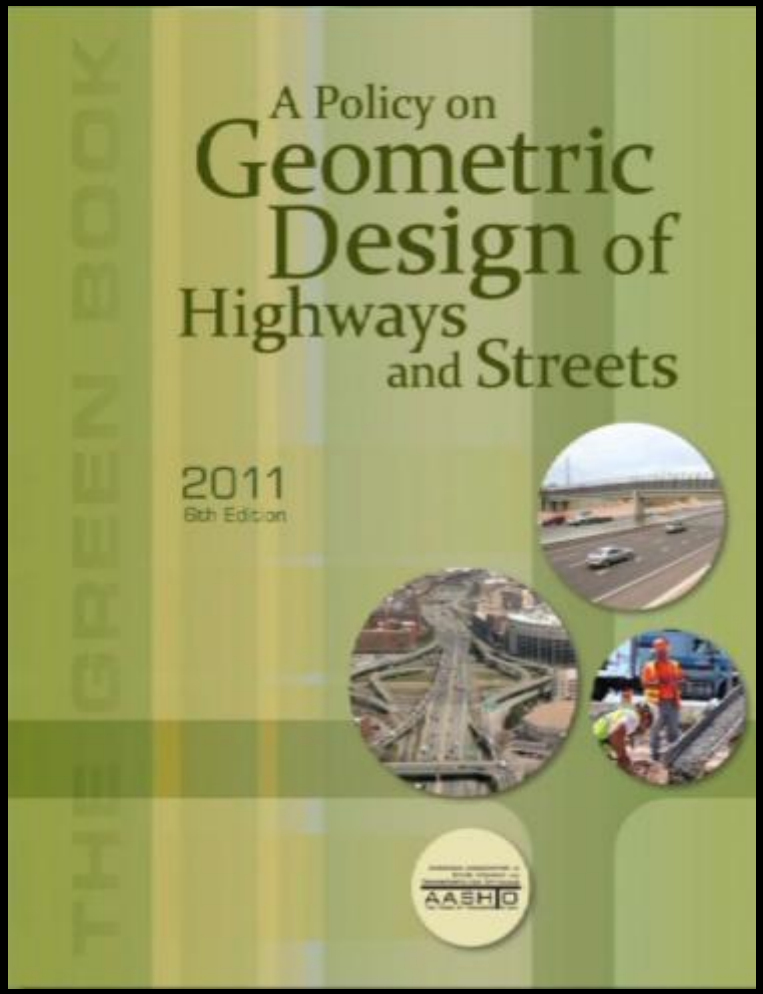
May 14, 2014


163
WATERFORD
ALLOVARDS

The Old Standards







"The bicycle has become an important element for consideration in the highway design process. ***Fortunately, the existing street and highway system provides most of the mileage needed for bicycle travel."***

- *900 pages of guidance*
- *Less than 1 page on bicycles*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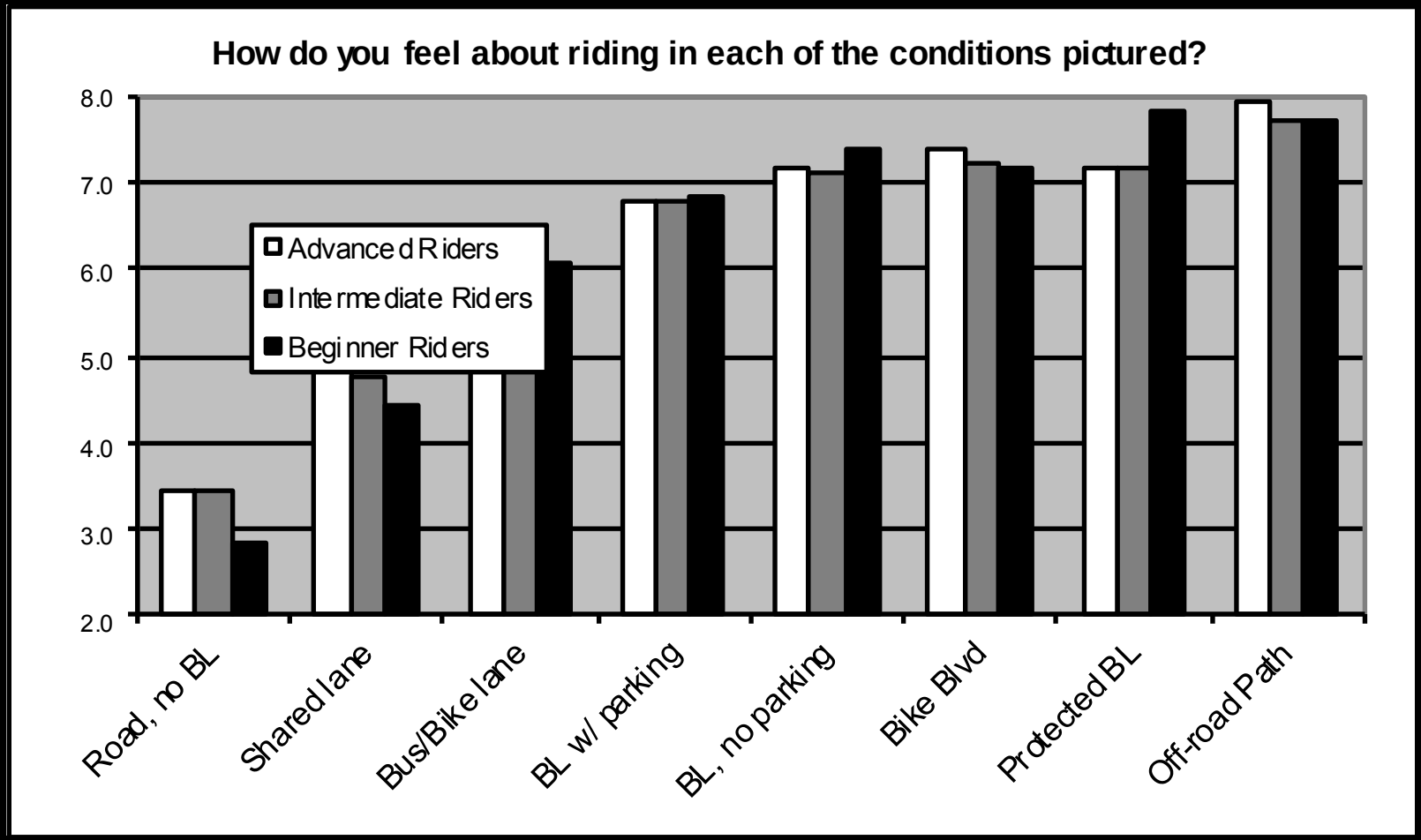
SHARED LANES

PROTECTED BIKE LANES & SHARED USE PATHS

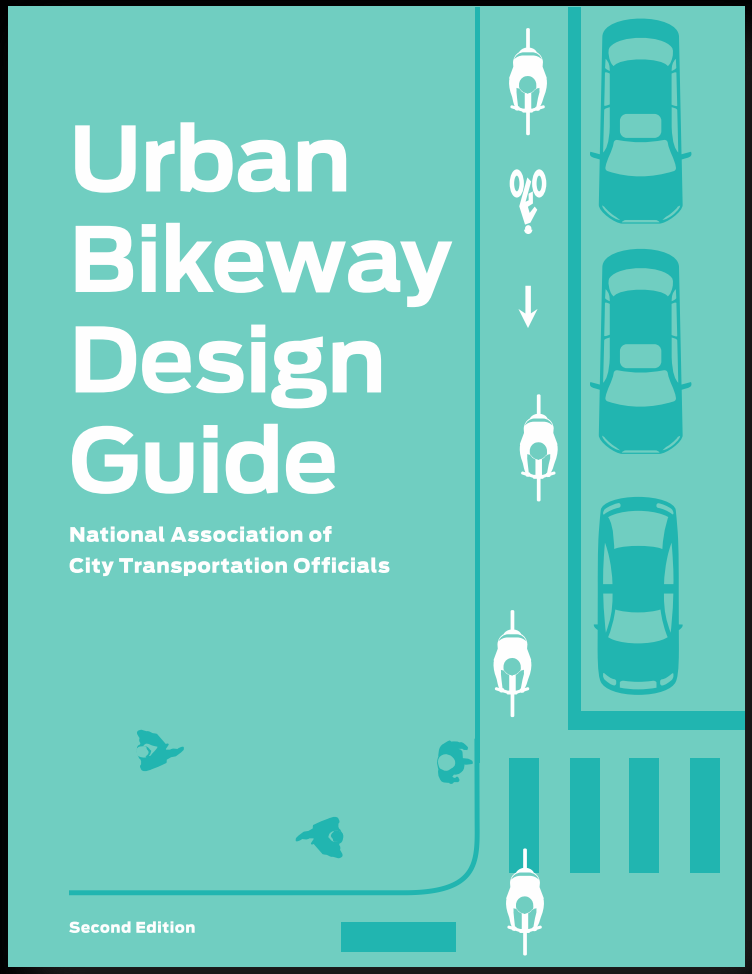
CONVENTIONAL BIKE LANES

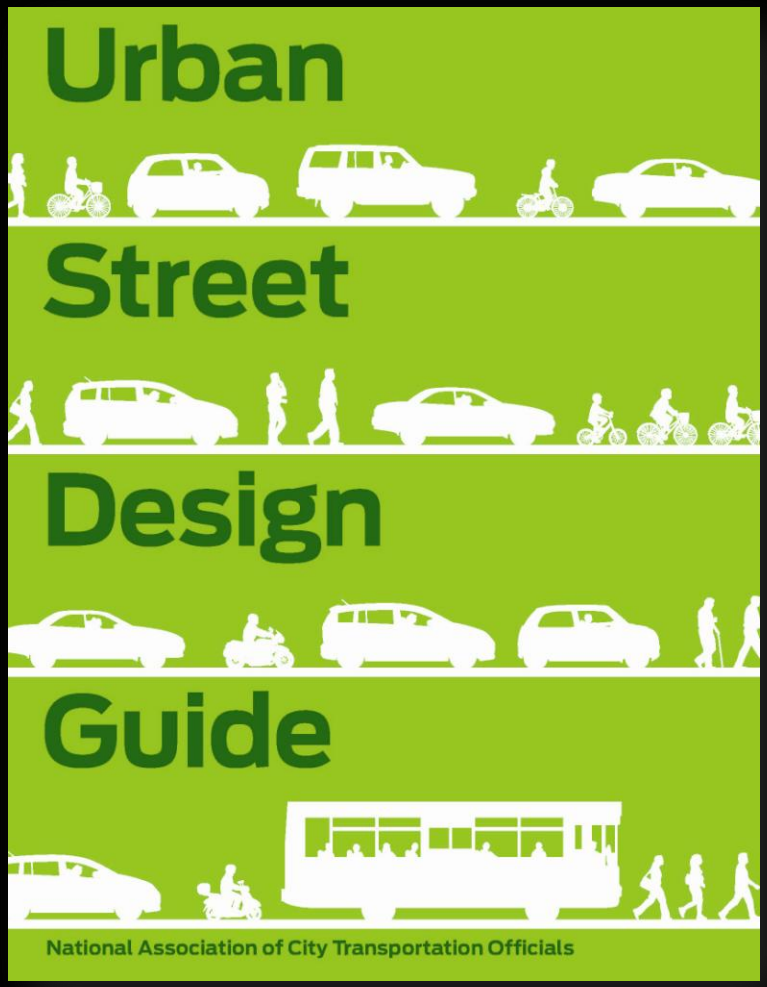
Do you want separation from traffic?



Credit: Nicole Freedman, Boston

Emerging Guidelines





FHWA Status of Existing Bikeway Treatments

Description of Bicycle Facilities	Status in the FHWA's Manual on Uniform Traffic Control Devices (MUTCD)	Are FHWA Experiments in Progress?
Signs and Markings		
Bike Lanes		
Conventional bike lanes	Can be implemented at present time	
Continuation of bike lanes up to intersections	Can be implemented at present time	
Dashed bike lanes through intersections	Can be implemented at present time	
Use of green pavement markings for bike lanes and cycle tracks within intersections	Interim approval has been granted. Requests to use green colored pavement need to comply with the provisions of Paragraphs 14 through 22 of Section 1A.10	Yes
Green bike lanes at conflict points such as heavy turning and merging locations	Interim approval has been granted. Requests to use green colored pavement need to comply with the provisions of Paragraphs 14 through 22 of Section 1A.10	Yes

Protected cycle tracks, both one-way and two-way bicycle facilities are not a traffic control device, so there is no MUTCD restriction on its use.

Cycle Tracks	
Protected cycle tracks, both one-way and two-way bicycle facilities	Not a traffic control device, so no MUTCD restriction on its use
Raised cycle tracks, both one-way and two-way bicycle facilities	Not a traffic control device, so no MUTCD restriction on its use
Merging cycle track users with turn lanes in advance of high volume turn locations, allowing bicyclists to make a through movement at the intersection in order to reduce conflicts with the turning traffic	Can be implemented at present time if signs and pavement markings that are compliant with the MUTCD are used

www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/mutcd_bike.cfm

The Bike Guide: An Overview

The Bike Guide: An Overview

BIKE LANES
- Conventional
- Buffered
- Contra-Flow
- Left-side Bike

CYCLE TRACKS
- One-way
- Two-way
- Raised

INTERSECTIONS
- Cycle Track Intersections

SIGNALS
- Bicycle Signals

SIGNS & MARKINGS
- Shared Lane Markings
- Green Color

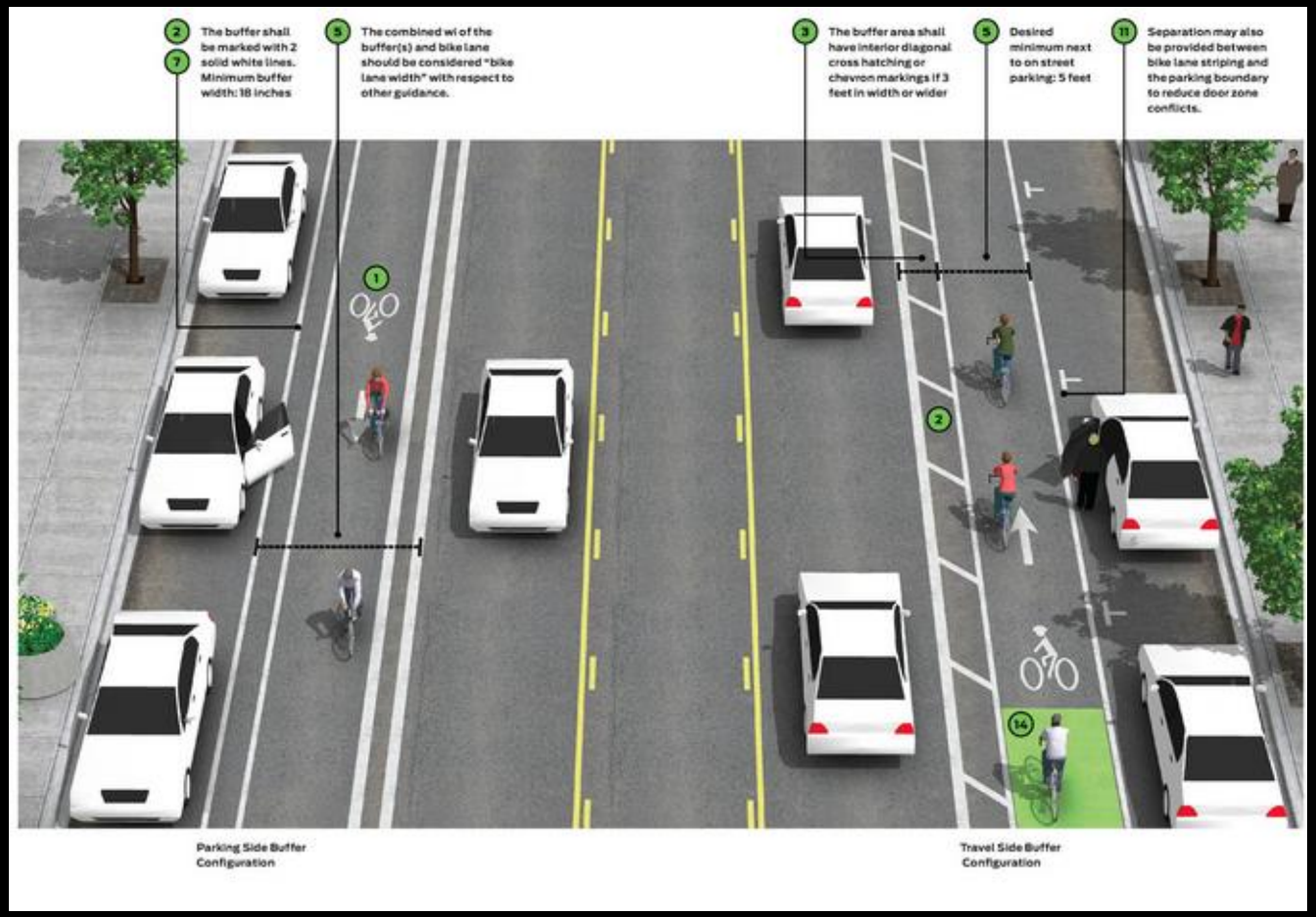
BICYCLE BOULEVARDS

Guide Structure

Required
(Shall)

Recommended
(Should)

Optional
(May)



Defining Success

Comfortable/Safe
Separation is key

Cohesive & Connected
No bike lanes to nowhere

Intuitive
Bicyclists are window shoppers too

Direct
Avoid circuitous routing

Attractive
Commute = Recreation

Design for Every Mode

Bikeway Design = Complete Street Design

Don’t trade the sidewalk for the gutter

Elevation Matters

Avoid cluttered markings

Keep it simple

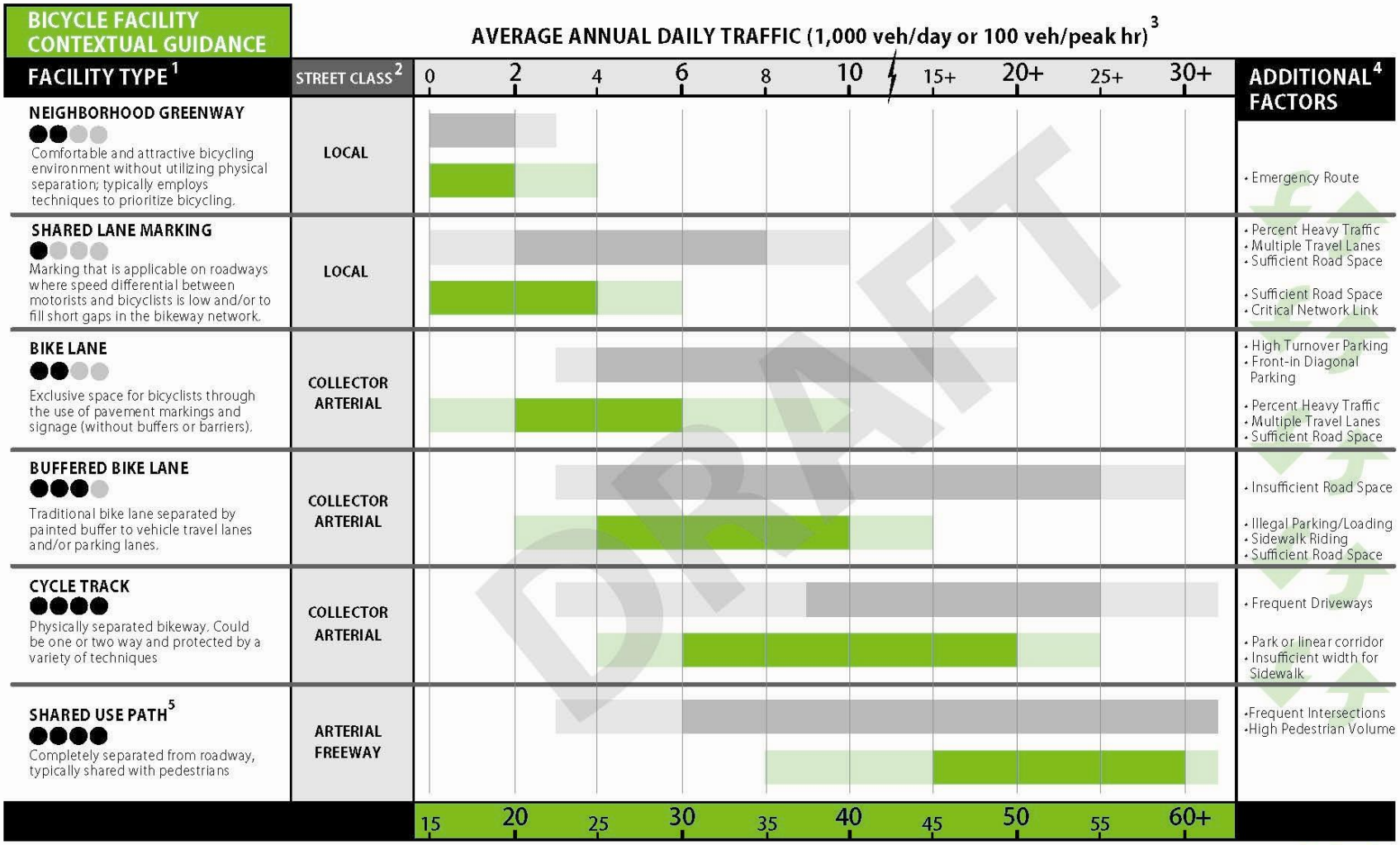
Design for Loading and Maintenance

An Overview of Bikeway Types
in the NACTO Guide

Choosing the Right Facility for the Right Street

Street Classification	Bikeway Type
High Volume, High Intensity Arterial	Shared Use Path Cycle Track
Mixed Use Medium Volume Collector	Cycle Track (Buffered) Bike Lane
Low-volume Residential	Bike Lane Shared Lane Marking

BICYCLE FACILITY CONTEXTUAL GUIDANCE



LEGEND

SEPARATION[6]

- Minimal Separation
- Moderate Separation
- Good Separation
- High Separation

min	VOLUME	max
min	SPEED	max
Acceptable	Desired	Acceptable

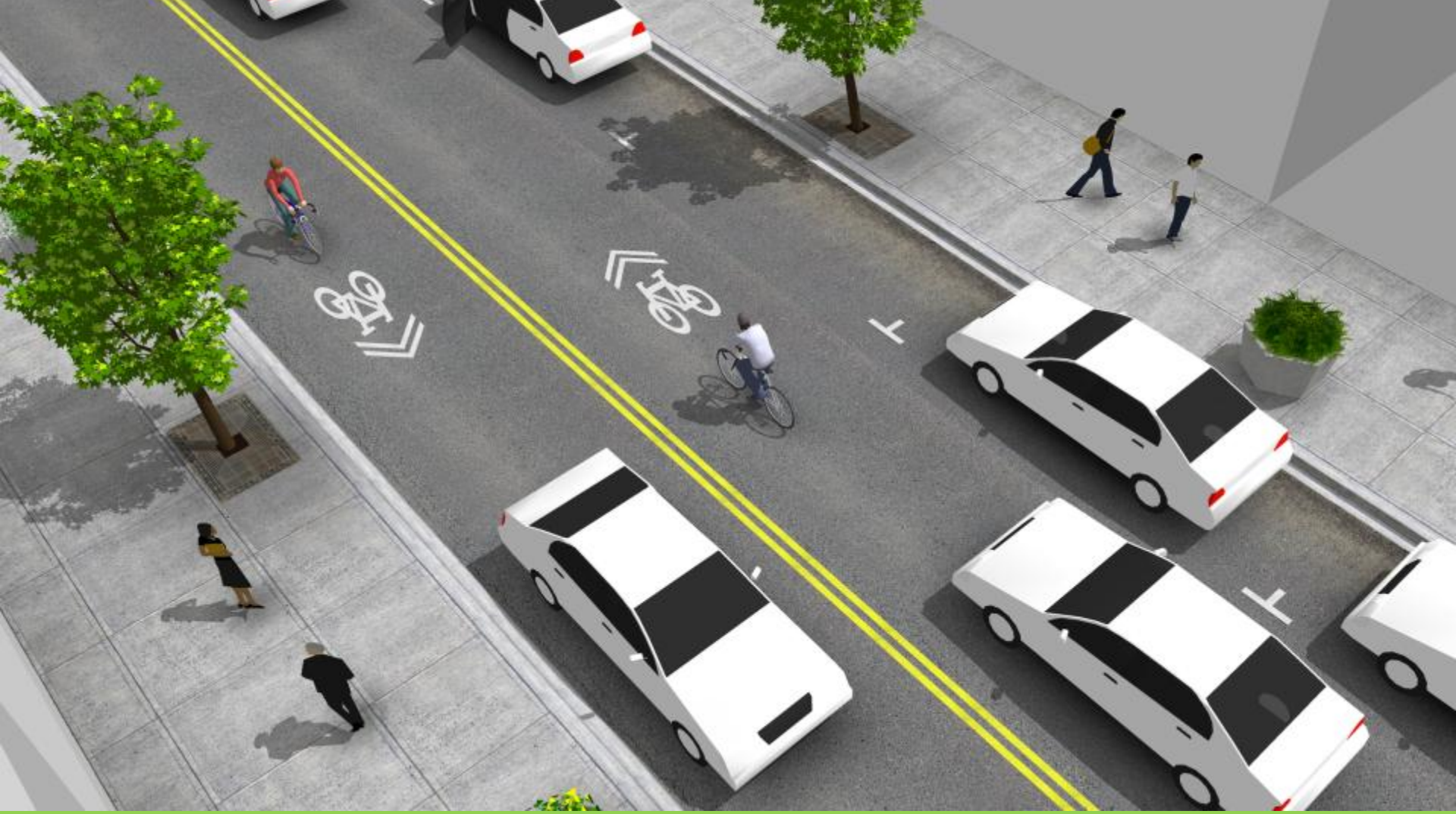
INSTRUCTIONS:

This chart offers guidance as to what types of treatments are recommended depending on street classification, speed, and volume. No matter where bikeway treatments are applied, special care needs to be paid to intersections, driveways, on-street parking, sight distance, and aditional factors.

NOTES:

1. Refers to specific bicycle facilities described in the NACTO Urban Bikeway Design Guide. See http://www.nacto.org for detailed design guidance. Many local roads function just fine as they are due to their low traffic volume and speed.
2. Categories from http://www.fhwa.dot.gov/planning/fcsec2_1.htm. The use of functional classes provides some general context for the cases in which bicycle facilities are most likely to be implemented. Land use and additional factors (see 4) should always take precedence in determining which facility type to select.
3. Urban peak hour factors typically range from 8 to 12 percent of AADT. For the purposes of this chart, the peak hour is assumed to be 10 percent of AADT.
4. Noted additional factors include a selection of considerations that may influence the selection of bicycle facility type where roadway speed/volume values overlap over multiple facilities. Many of the factors that suggest increasing separation are common across multiple facility types like bike lanes, buffered bike lanes and cycle tracks.
5. Design guidance for shared use paths can be found in the AASHTO Guide for the Development of Bicycle Facilities.
6. Increased separation of bicycle facilities from motor vehicle traffic typically results in higher levels of user comfort and appeals to wider skill levels of bicyclists.
7. This chart considers posted speed limit only. The 85th percentile speed may vary, and may change with implementation of a bikeway.

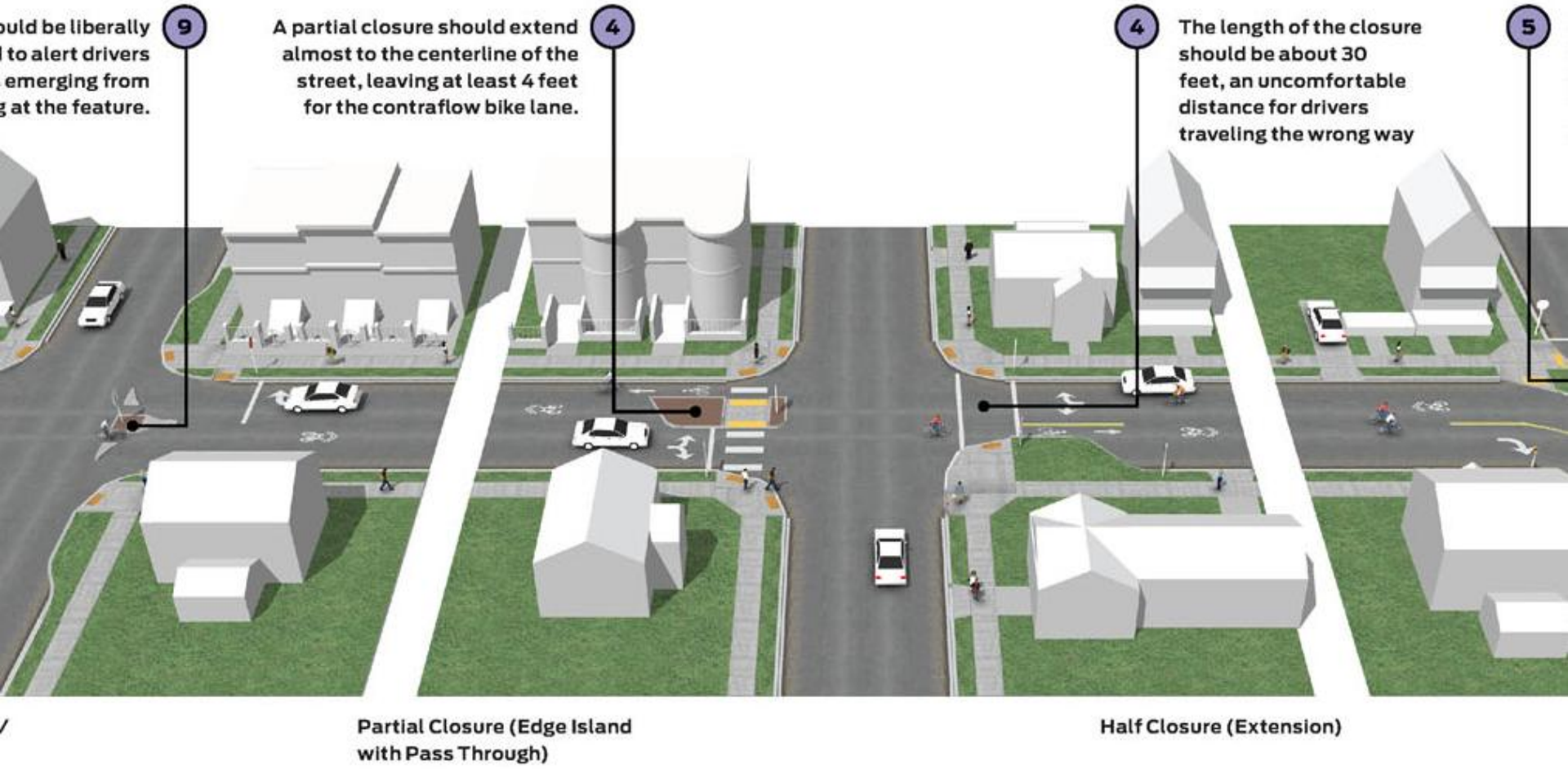
NACTO



Shared Lane Markings

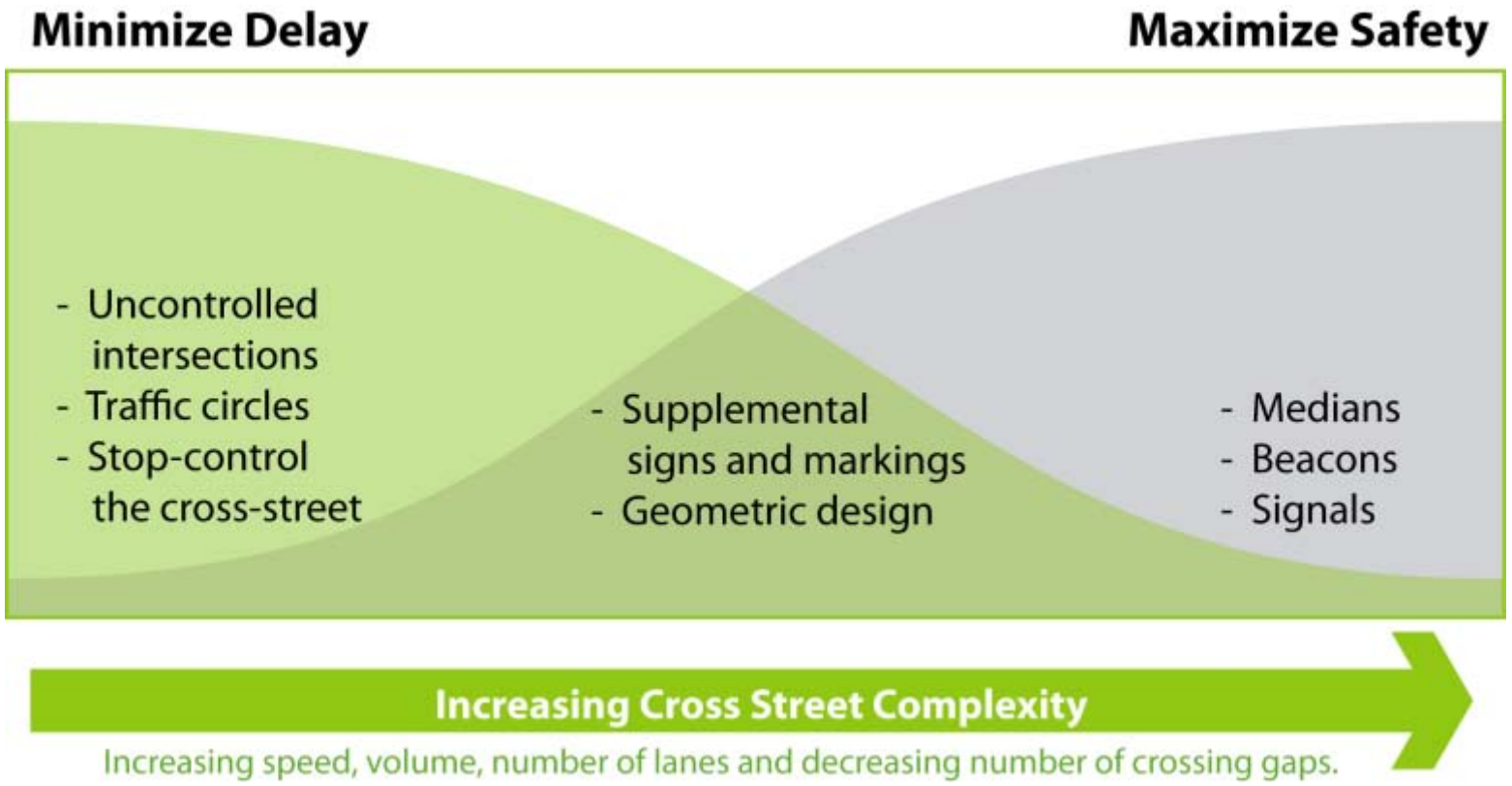
…and we're done!

On streets with posted 35 mph speeds or faster and motor vehicle volumes higher than 3,000 vpd shared lane markings are not a preferred treatment.



Bicycle Boulevards

Streets formally designated as bicycle boulevards should meet strict targets of fewer than 3,000 motor vehicles per day (1,500 preferred) and an 85th percentile speed of no more than 25 mph (20 mph preferred).



Streets formally designated as bicycle boulevards should meet strict targets of fewer than 3,000 motor vehicles per day (1,500 preferred) and an 85th percentile speed of no more than 25 mph (20 mph preferred).

Volume Management Tools

- Forced Turns
- Diagonal or Full Diverters
- Right-in/Right-out island
- Partial Closure

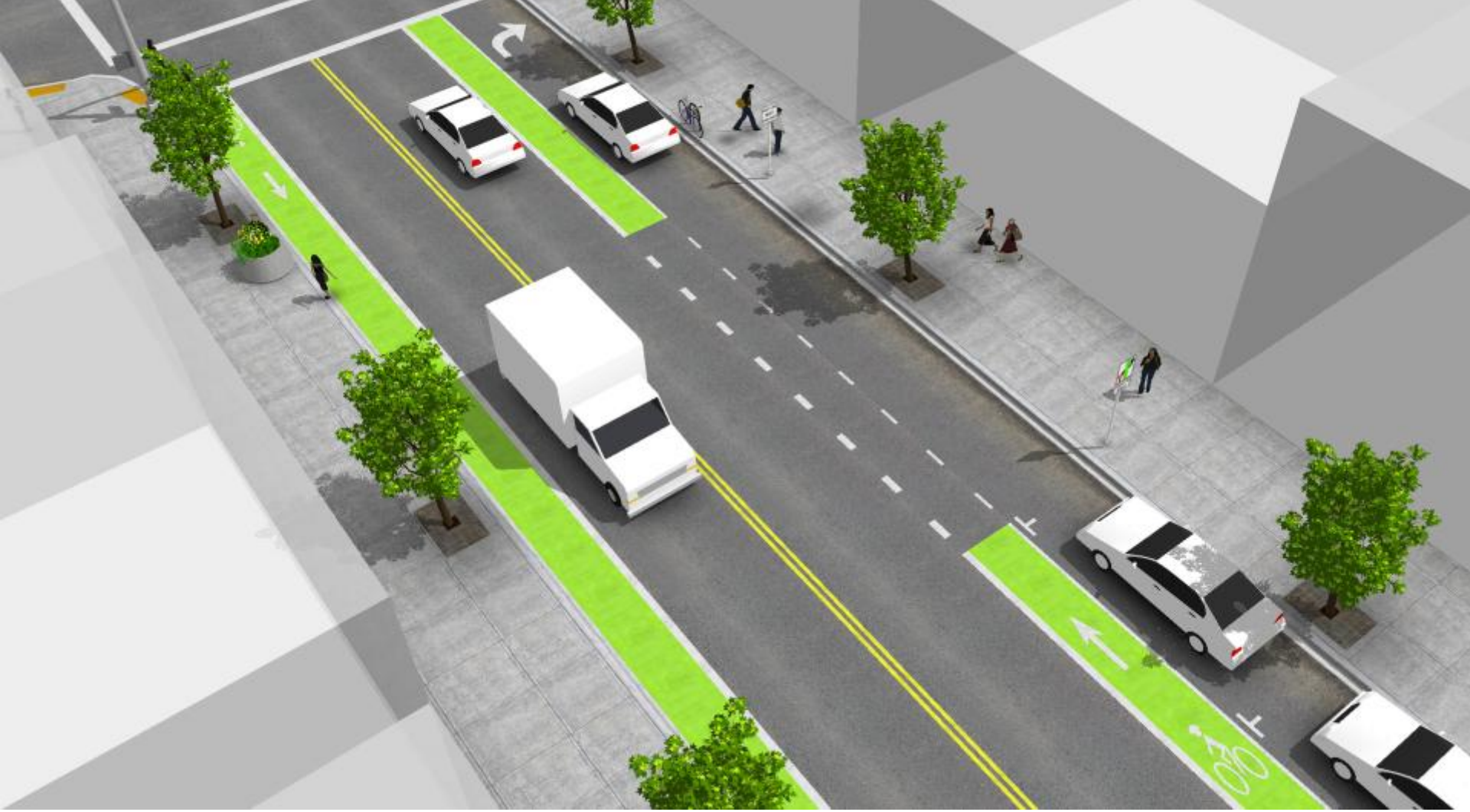
Speed Management Tools

- Speed Humps
- Speed Cushions
- Speed Tables
- Curb extensions
- Neighborhood Traffic Circles
- Chicanes
- Pinchpoints
- Neckdowns
- Center Islands
- Skinny Streets

Bicycle Boulevards

Conventional Bike Lanes

- Wider is better
- 6’ preferred
- Mark through the intersection



Green Bike Lanes

- Choose your material wisely
- Use consistent applications
- Differentiate corridor and conflict green

Left-side Bike Lanes

- Great for transit routes
- Use two-stage turns or bike boxes to facilitate transition from left to right

Buffered Bike Lanes

- 3’ buffer preferred
- Parking-side buffer optional
- Add buffer if you have the width

Contra-Flow Bike Lanes

- Short connections ideal
- Combine with bike signals
- Use physical barrier where appropriate

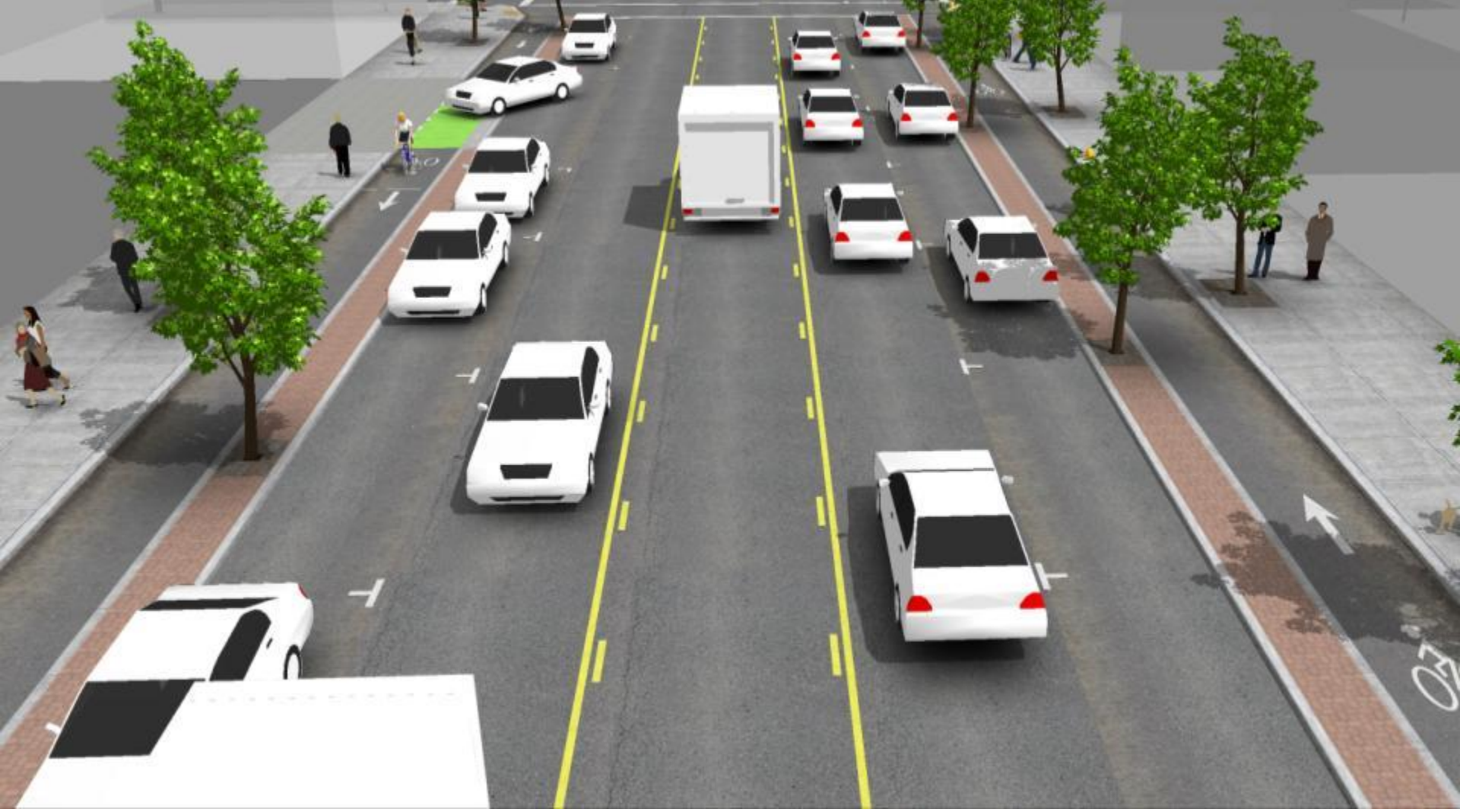
One-way Cycle Track

- Separate using striped buffer, planters, or curbs
- Stakeholder outreach critical
- Pay attention to road's crown

One-way Cycle Track

Austin, TX

- Take advantage of pedestrian benefits
- Wrap around transit stops



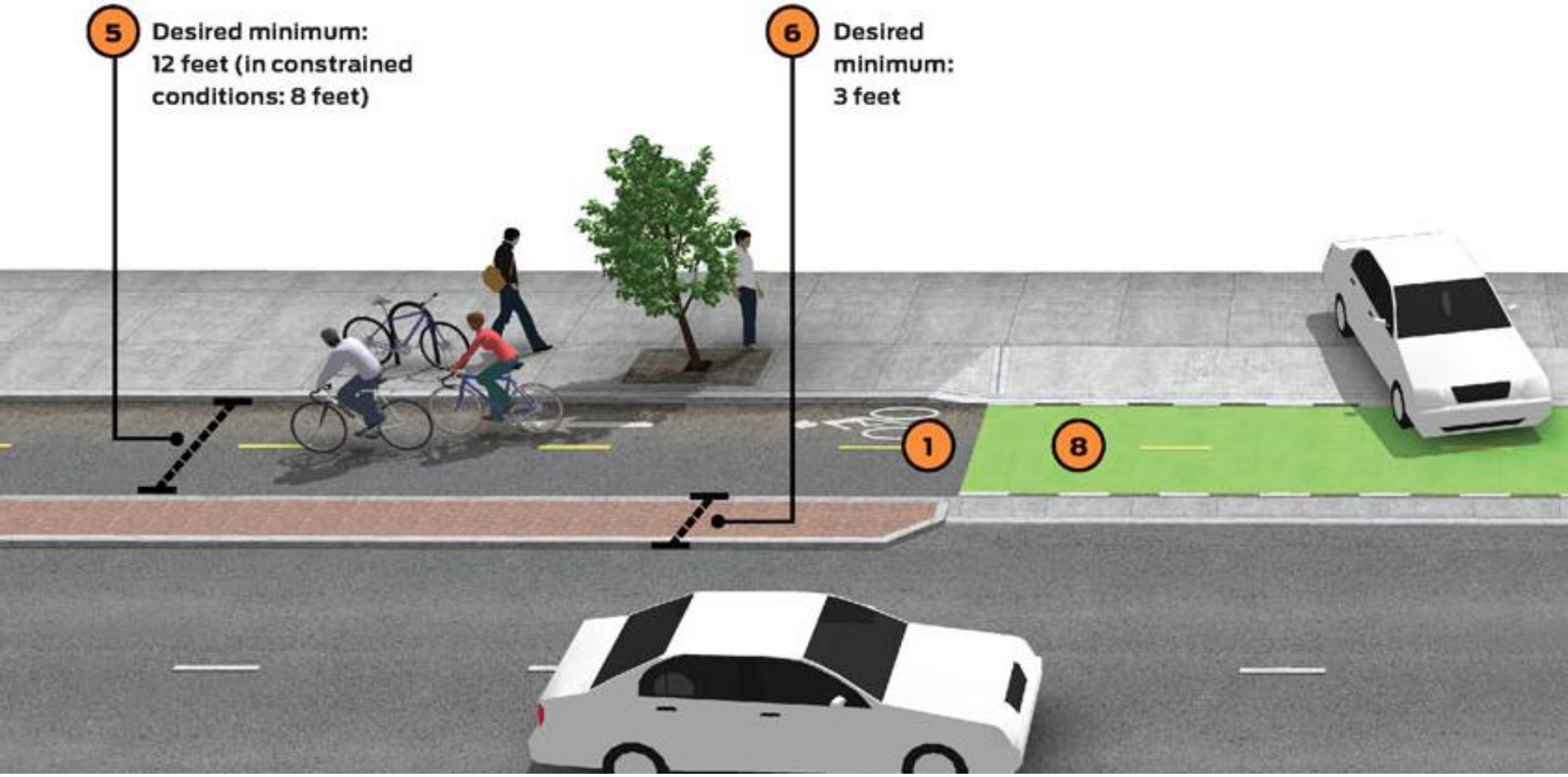
Raised Cycle Track

- Should feel like part of the sidewalk
- Asphalt overlay can be cheaper
- Consider mountable curb

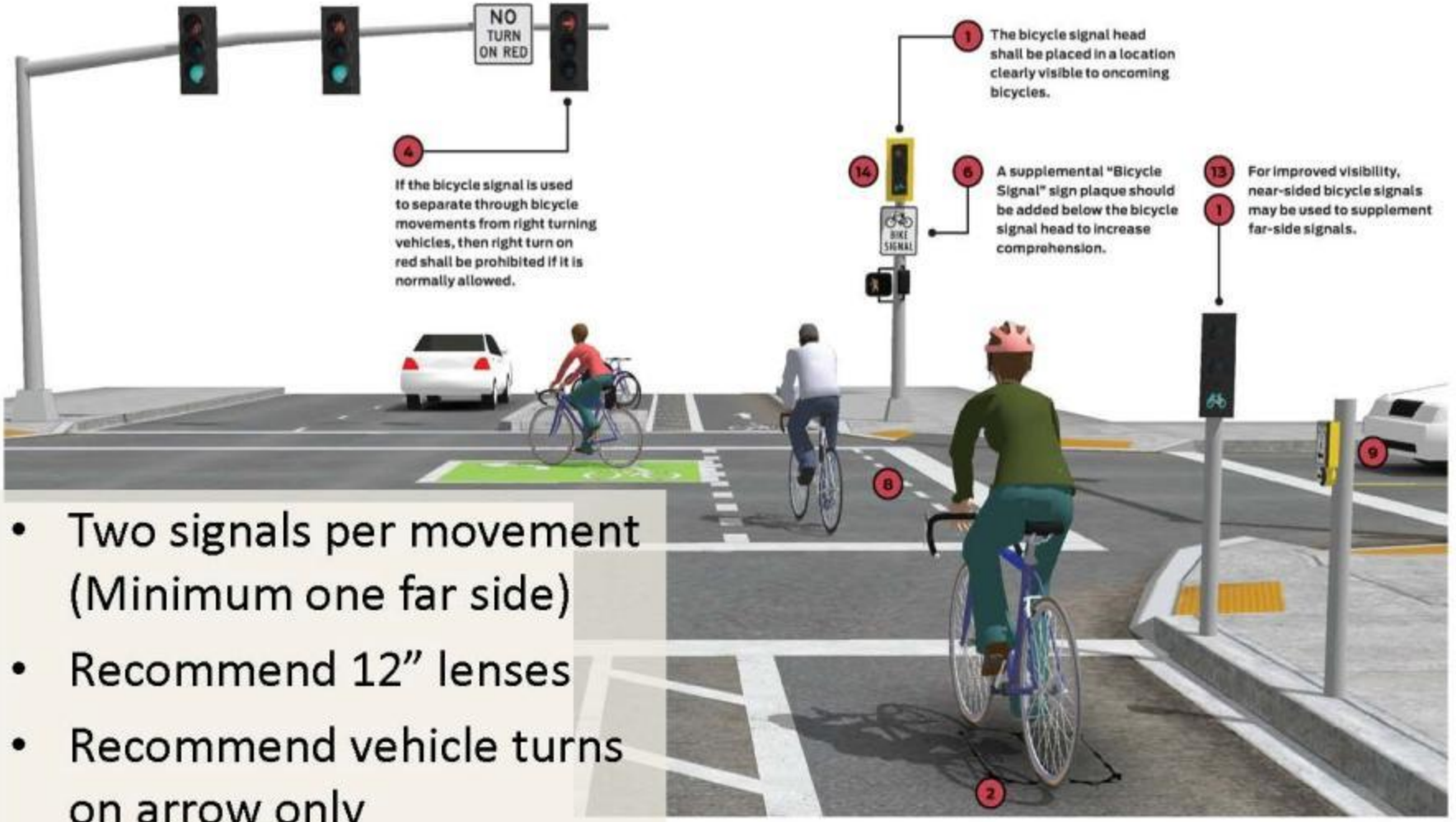
Raised Cycle Track (two-way)

Indianapolis, IN

Two-way Cycle Track


5
Desired minimum:
12 feet (in constrained conditions: 8 feet)
6
Desired minimum:
3 feet
1
8

Cycle Tracks – Signalized Intersection Approach



- Two signals per movement (Minimum one far side)
- Recommend 12” lenses
- Recommend vehicle turns on arrow only

Traffic Signal Phasing

Phase A: Bikes, Thrus and Rights

Traffic Signal Phasing

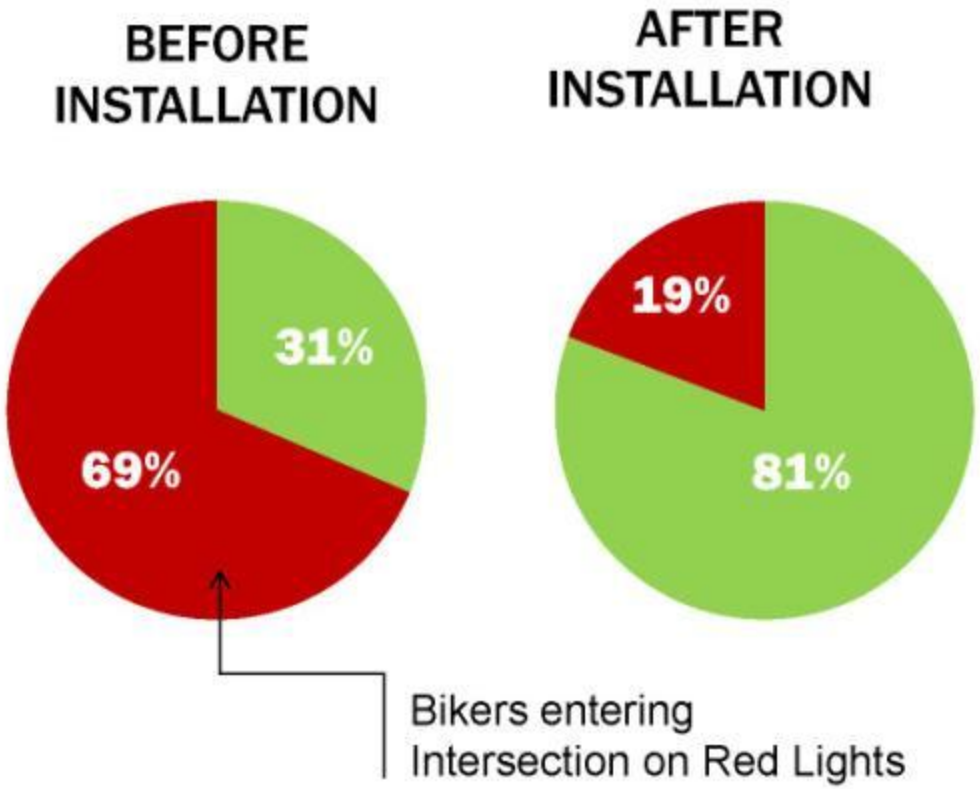
Phase B: Bike Clearance

Traffic Signal Phasing

Traffic Signal Phasing

Phase D: Vehicle Clearance

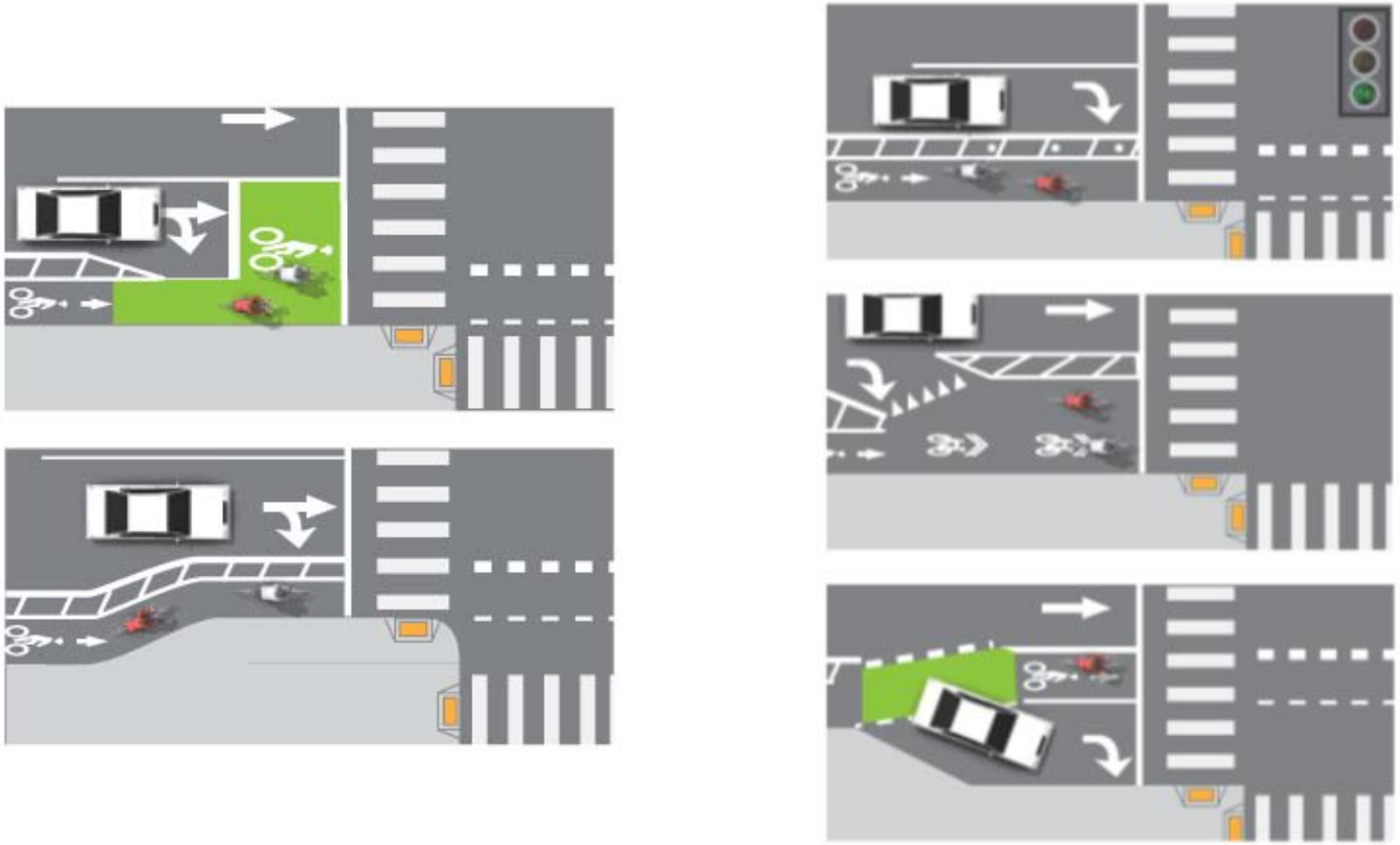
Cyclist Signal Compliance at Red & Green Lights



Mixing Zone

Mixing Zone

New York, NY



Cycle Track Intersection Approach Strategies

Cycle Track Intersection Decision Matrix

Intersection Characteristics	Intersection Treatment
Major Intersection with high turning volumes	Bicycle Signal (Full Separation) or Bikes with Peds
Medium volume intersections	Bicycle Signal, Mixing Zone, or other treatment
Minor Intersections and Driveways	Highlight conflict and ensure good sightlines

David Vega-Barachowitz
Director, Designing Cities Initiative
david@nacto.org

THE NACTO URBAN BIKEWAY DESIGN GUIDE

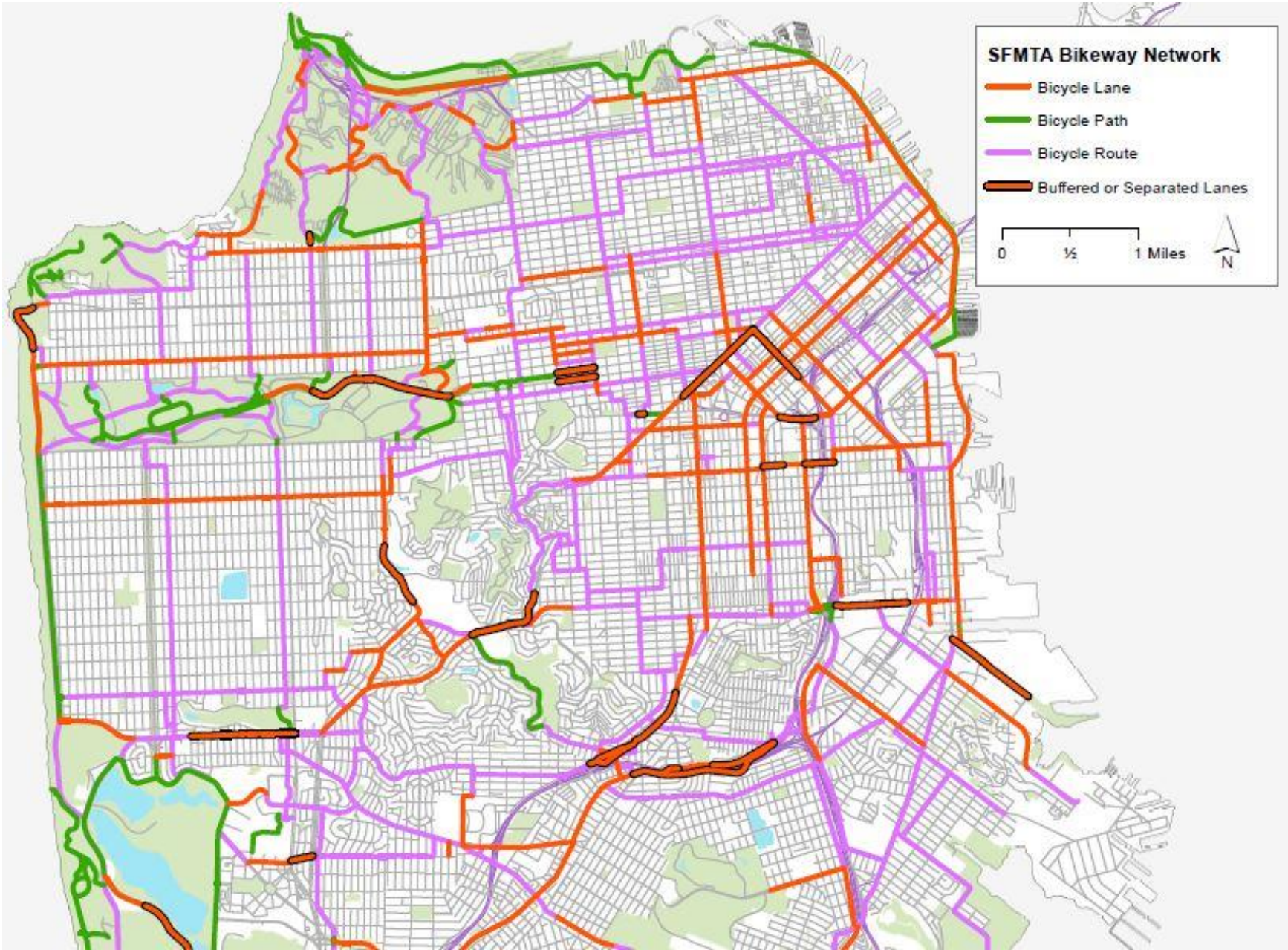
SAN MATEO TRAINING

May 14, 2014

Application of the Guide on San Francisco Bikeways

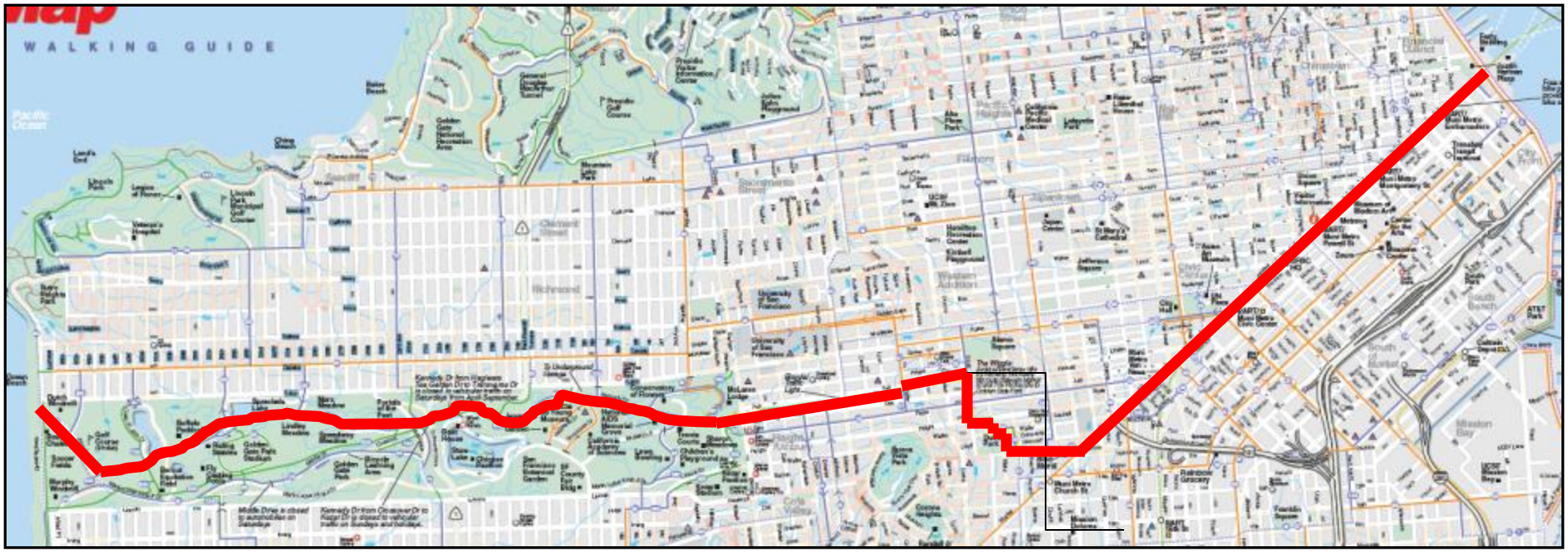
SFMTA
Municipal
Transportation
Agency

SF Bike Route Network



SFMTA Municipal Transportation Agency

“Bay to Beach” Crosstown Route



Goal of continuous, cross-town routes with few/no gaps

Central Portion of Bay to Beach Route

Oak Street and Fell Street Cycle Tracks

- from Scott Street to Baker Street
- directly connects existing east-west bike routes

Fell St: Remove Parking for Cycletrack

NACTO Guidance on Cycle Tracks

Required | Recommended | Optional

Recommended Features

The minimum desired width for a cycle track should be 5 feet. In areas with high bicyclist volumes or uphill sections, the minimum desired width should be 7 feet to allow for bicyclists passing each other.

+ Click for more information

Three feet is the desired width for a parking buffer to allow for passenger loading and to

Green Bike Box with Signal Work

Task: Improve left turn into cycletrack

Tools: Bike Box and Leading, Protected Left Turn Phase

NACTO Guidance on Bike Boxes

Required Features

A box formed by transverse lines shall be used to hold queuing bicyclists, typically 10 to 16 feet deep. Deeper boxes show less encroachment by motor vehicles.[44]

Stop lines shall be used to indicate the point behind which motor vehicles are required to stop in compliance with a traffic control signal. See MUTCD 3B.16.[45]

Pavement markings shall be used and centered between the crosswalk line and the stop line to designate the space as a bike box. The marking may be a Bike Symbol (MUTCD 9C-3A) or Helmeted Bicyclist Symbol (MUTCD 9C-3B).

Inclines that permit right turns on red signal indications, a "No Turn on Red" sign shall be installed overhead to prevent vehicles from entering the Bike Box.

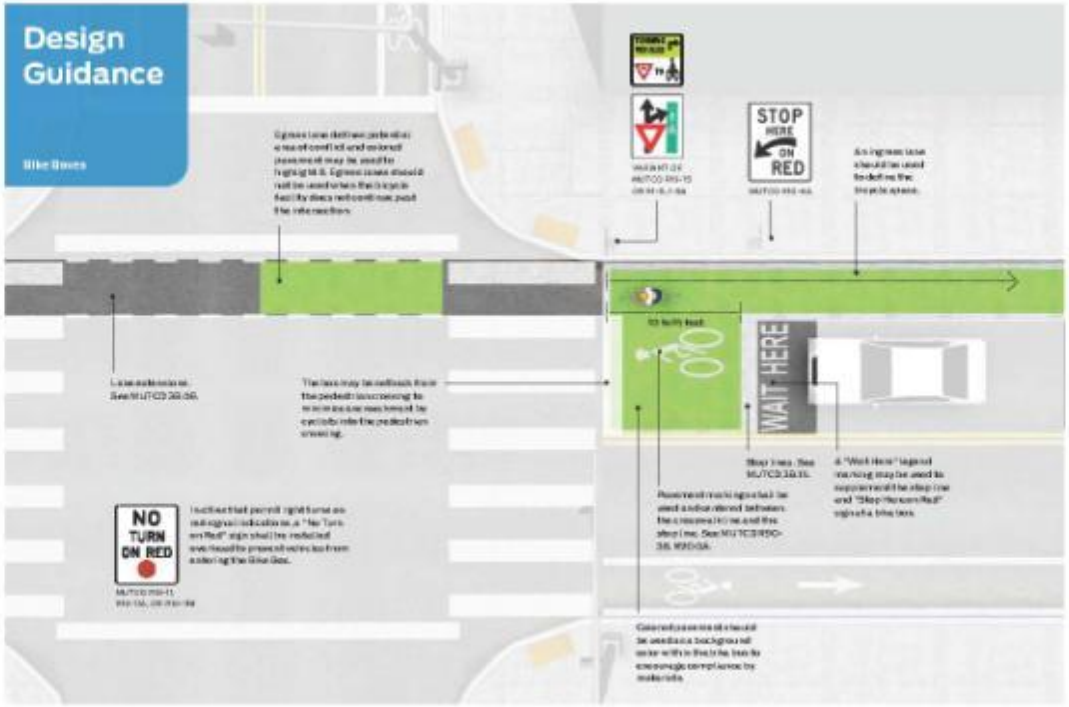
Recommended Features

A "Stop Here on Red" sign should be post-mounted at the stop line to reinforce observance of the stop line.[46]

Additional signs may be used to clarify signal control. Among the signs that may be used for this purpose are "Bikes Stop Here on Red" on a supplemental "Except Bicycles" plaque in conjunction with R10-6 to indicate the bicyclist stop line.[47]

Colored pavement should be used as a background color within the bike box to encourage compliance by motorists.[48]

An ingress zone should be used to define the bicycle space. Colored pavement may be used. When color is used, length shall be 25 to 50 feet to guarantee bicycle access to the box.[49]



All vehicles that encroached at control sites went into the pedestrian crossing, compared with 12% at [bike box] sites, indicating that [a bike box] can provide a buffer zone that discourages vehicles from blocking the pedestrian crossing.

An egress zone should be used to clearly define the potential area of conflict between motorists and bicyclists in the intersection when intersection is operating on a green signal indication. Refer to intersection crossing markings in this guide. Colorado pavement or other markings may be used to define the potential area of conflict. An egress zone should not be used when there is no complimentary bicycle facility on or near on the far side of the intersection.[50]

A "Yield to Bikes" sign should be post-mounted in advance of and in conjunction with an egress zone to reinforce that bicyclists have the right-of-way going through the intersection.[51]

Optional Features

A "Wait Here" legend marking may be used to supplement the stop line and "Stop Here on Red" sign at a bike box.[52]

Stop lines may be placed up to 7 feet in advance of the bike box space to limit encroachment by motor vehicles.

The box may be setback from the pedestrian crossing to minimize encroachment by cyclists into the pedestrian crossing.

Bike boxes may extend across multiple travel lanes to facilitate bicyclist left turn positioning. A two-stage turn queue box may be an alternative approach to facilitate left turns where there are multiple vehicle through lanes.[53]

Bike boxes may be combined with an exclusive bicycle signal phase or leading bicycle interval through the use of bicycle signal heads to allow clearance of the bicycle queue prior to the green indication for motorists.[54]

Guidance on Bike Boxes

REPORTS ↓

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Bicycle Storage Area and Advanced Bicycle Stop Lines. (2009).

Advanced Stop Line Variations Research Study. (2005).

Behaviour at Cycle Advanced Stop Lines. (2005).

See all items

A box formed by transverse lines shall be used to hold queuing bicyclists, typically 10-16 feet deep. Deeper boxes show less encroachment by motor vehicles.

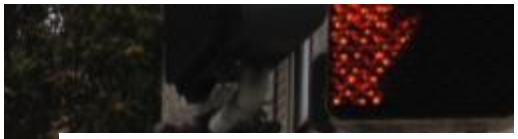
+ Click for more information

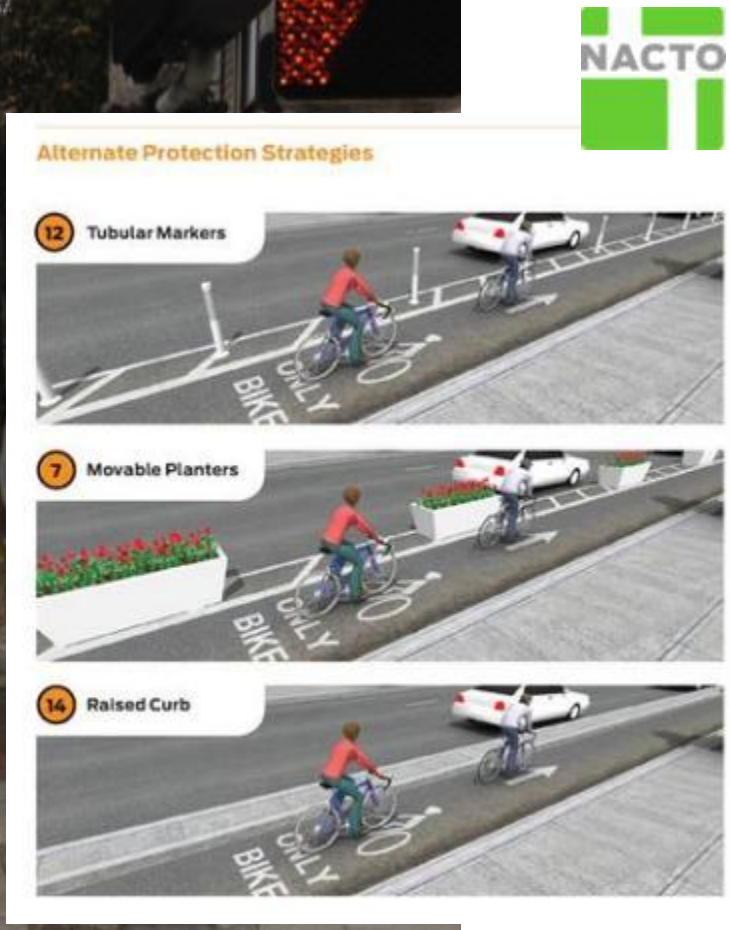
In cities that permit right turns on red signal indications, a "No Turn on Red" sign shall be installed overhead to prevent vehicles from entering the Bike Box.

+ Click for more information

Entry to Cycle Track

Separate bikeway from traffic stream





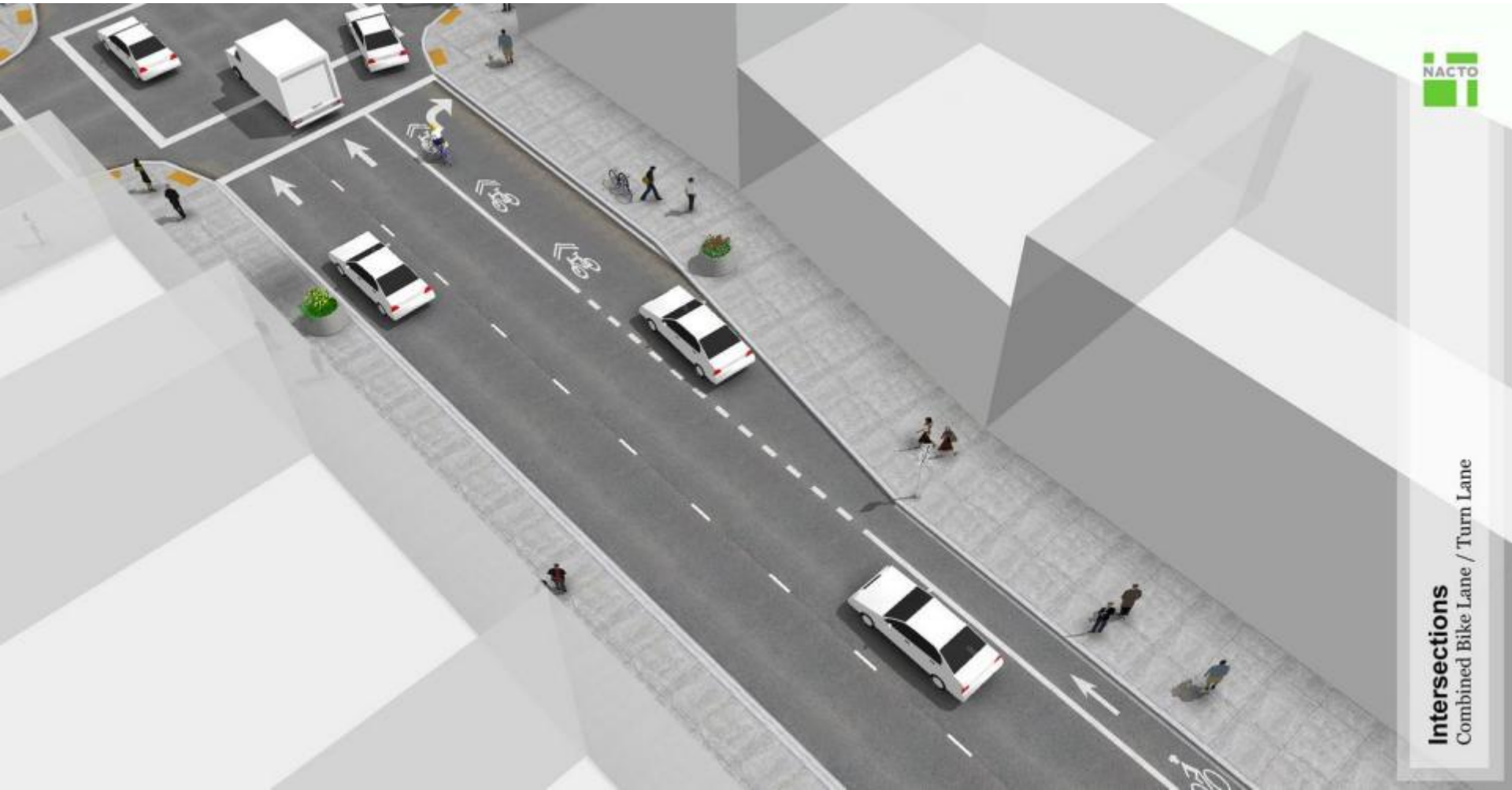
Painted Buffer, Delineators, Green, and Planters (future)

Combined Turn Lane w Sharrows

Handle an intersection with relatively few right turns

Combine Turn Lane, Bike Box and Bike Signal Head Start

Combined Turn Lane Design using Sharrows



Bike Box with Bike Signal “Head Start”

Box and Signal gets cyclists ahead of traffic and reduces right hook potential at next intersection

Design Guidance

Combined Bike Lane/ Turn Lane

Guidance for conventional bicycle lanes and intersection crossing markings may also apply. When configured as a mixing zone for a cycle track, additional guidance for a cycle track intersection approach may also apply.

Required Features

1. Some form of bicycle marking shall be used to clarify bicyclist positioning within the combined lane.

Recommended Features

2. Within the combined lane, the bicycle area width should be 4 feet minimum.

3. Width of combined lane should be 9 feet minimum, 13 feet maximum. A full bicycle through lane can be accommodated if the vehicle right turn only lane can be made 14 feet or wider.

4. A dotted 4 inch line and bicycle lane marking should be used to bicyclist positioning within the combined lane without excluding cars from the suggested bicycle area.

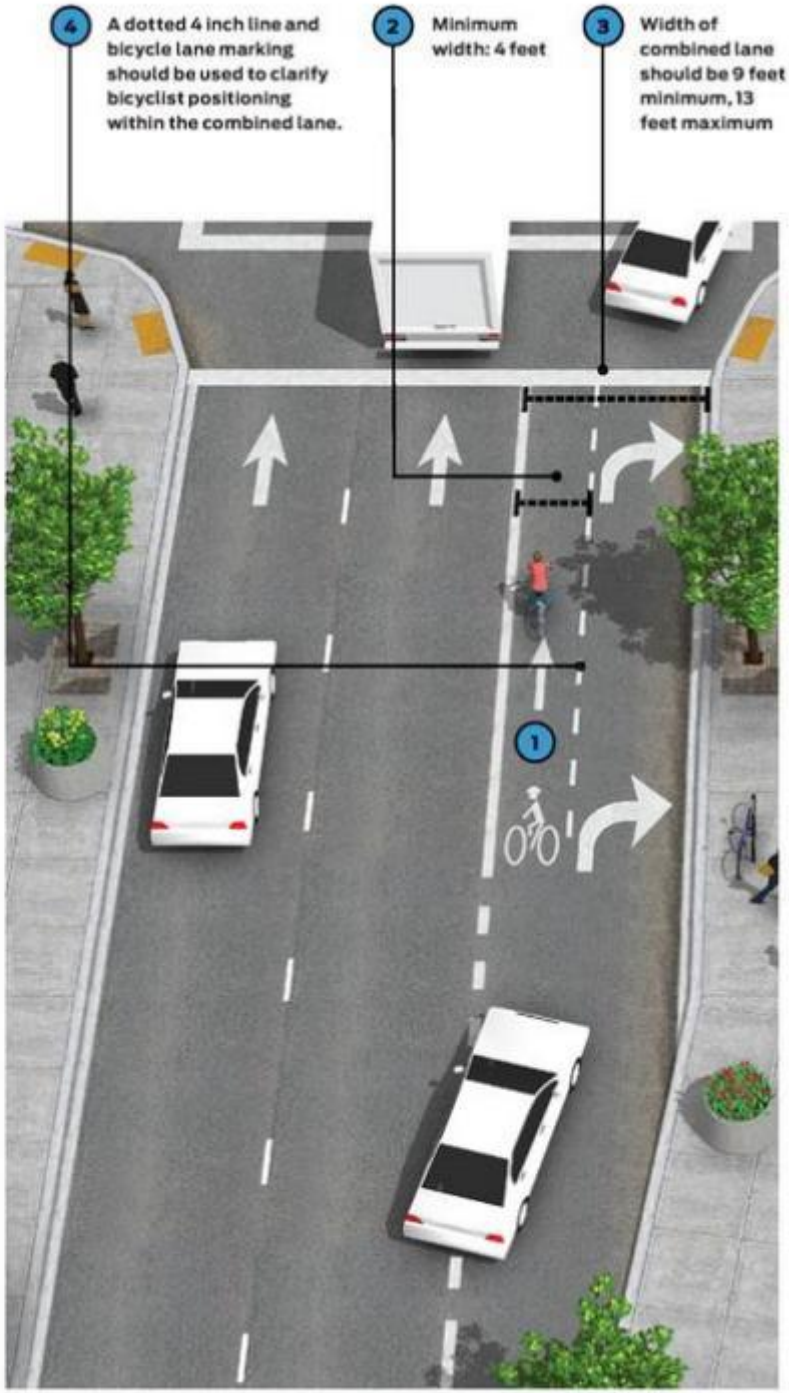
5. If the right lane is signed for "Right Turn Only," or if a sign is otherwise needed to make it legal for through bicyclists to use a right turn lane, signage should be installed in advance alerting the start of the combined turn lane.

6. If configured as a mixing zone on a cycle track corridor, the following features are recommended:

- A Turning Vehicles Yield to Bikes (modified R10-15) sign should be used in advance of the mixing zone.
- A yield line should be used in advance of the mixing zone.
- The transition to the mixing zone should begin a minimum of 70 feet in advance of the intersection. Mixing zones that are shorter in length and begin abruptly encourage slower vehicle speed.

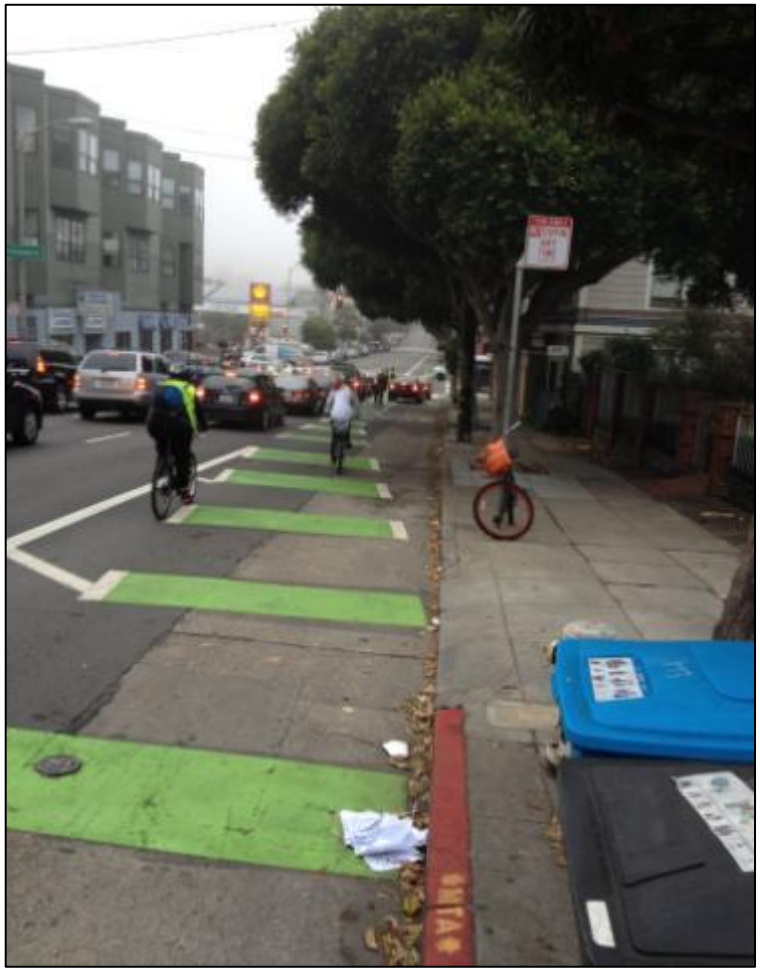
Optional Features

7. A shared lane marking (MUTCD figure 9C-9) may be used as an alternative to dotted striping to clarify bicyclist position within the combined lane.



Combined Turn Lane with Bike Box

Handle an intersection with moderate right turns



Bike box and combined turn lane w 9’ turn lane and 4’ through bike lane

Combined Turn Lane design w color

Colored Bike Facility Benefits

- Promotes the multi-modal nature of a corridor.
- Increases the visibility of bicyclists.
- Discourages illegal parking in the bike lane.
  + Click for more information
- When used in conflict areas, raises motorist and bicyclist awareness to potential areas of conflict.
  + Click for more information
- Increases bicyclist comfort though clearly delineated space.
  + Click for more information
- Increases motorist yielding behavior.
  + Click for more information
- Helps reduce bicycle conflicts with turning motorists.
  + Click for more information

SFMTA
Municipal
Transportation
Agency

Combined Turn Lane with Bike Box

Combined Turn Lane with Bike Box

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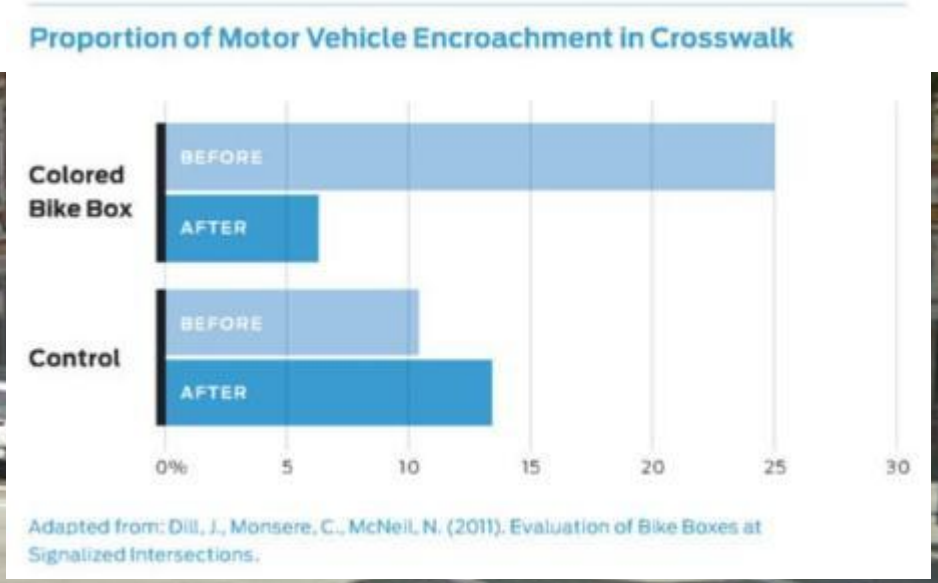
Combined Turn Lane with Bike Box

Colored Bike Box to Left Turn Bike Lane

Reduce encroachment by motorists



Add green for visibility

Left Turn Bike Lane w Protected Turn Phase

Handle two left turns in three blocks by cyclists

NACTO Guidance on Left Side Bike Lane

Signal Separation using Bike Signal

Reduce conflicts between path users and heavy turn movements

Two Stage Turn Queue Area: “Jug Handle” turn

Improve challenging left turns for cyclists across three lanes and tracks

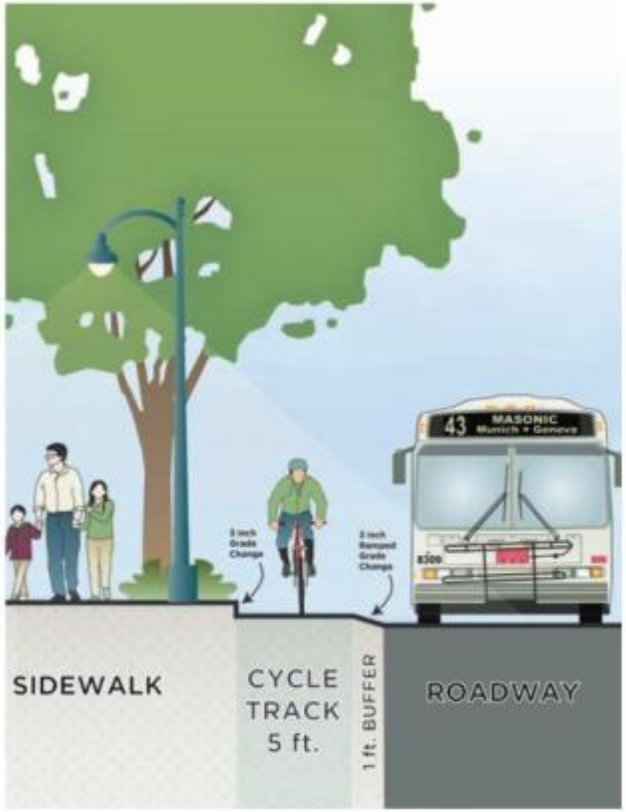
SFMTA
Municipal
Transportation
Agency

Two Stage Turn Queue Area with Bike Signal

JFK Drive: Parking Separated Cycle Track

Masonic Ave Raised Cycletrack

Safe and Comfortable Cycling on an Arterial w Transit



Section showing typical cycle track layout

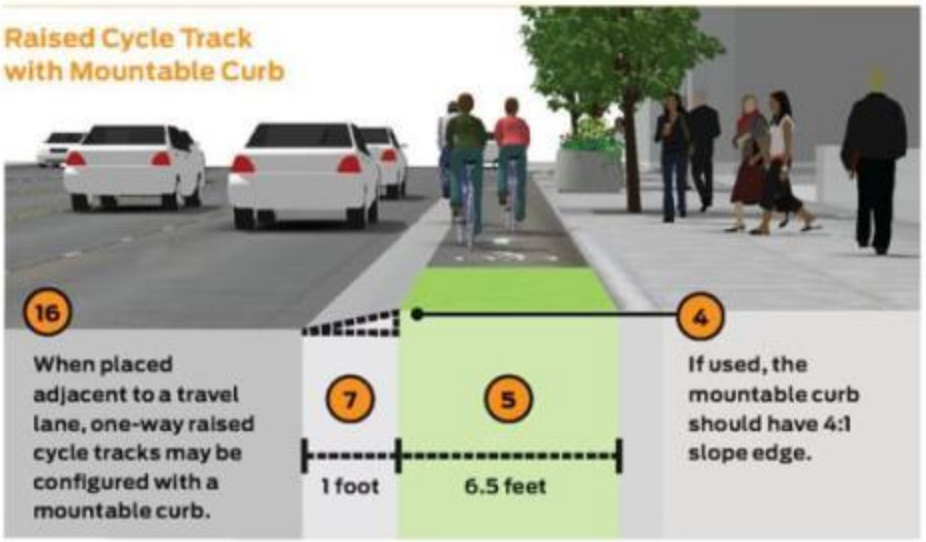
Proposed "Bus Bulb Plaza" seeks to reduce conflict between bikes and buses at bus stops

Raised Cycle Track Guidance

If used, the mountable curb should have 4:1 slope edge without any seams or lips to interfere with bike tires to allow for safe entry and exit of the roadway. This curb should not be considered a ridable surface when determining cycle track width.

Masonic Ave and Market St

Vertical separation between the roadway and the cycle track should be between 1 and 6 inches. Higher separation values discourage illegal parking.



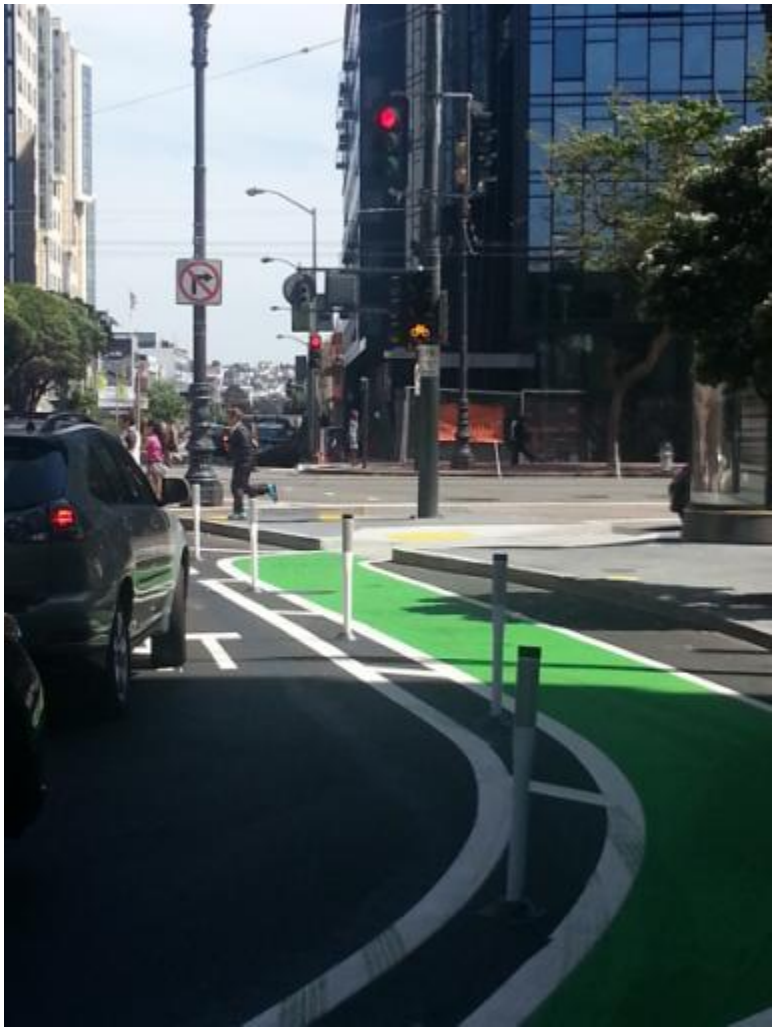
Vertical separation between the cycle track and the sidewalk should be between zero (flush with the sidewalk surface) and 5 inches. A separation of 3 inches or greater discourage conflicts with pedestrians.

Polk Street Contraflow Lane

Improve Connectivity along One-Way Arterial

Polk Street Contraflow Lane

Improve connection between median bikeway and intersecting bikeways



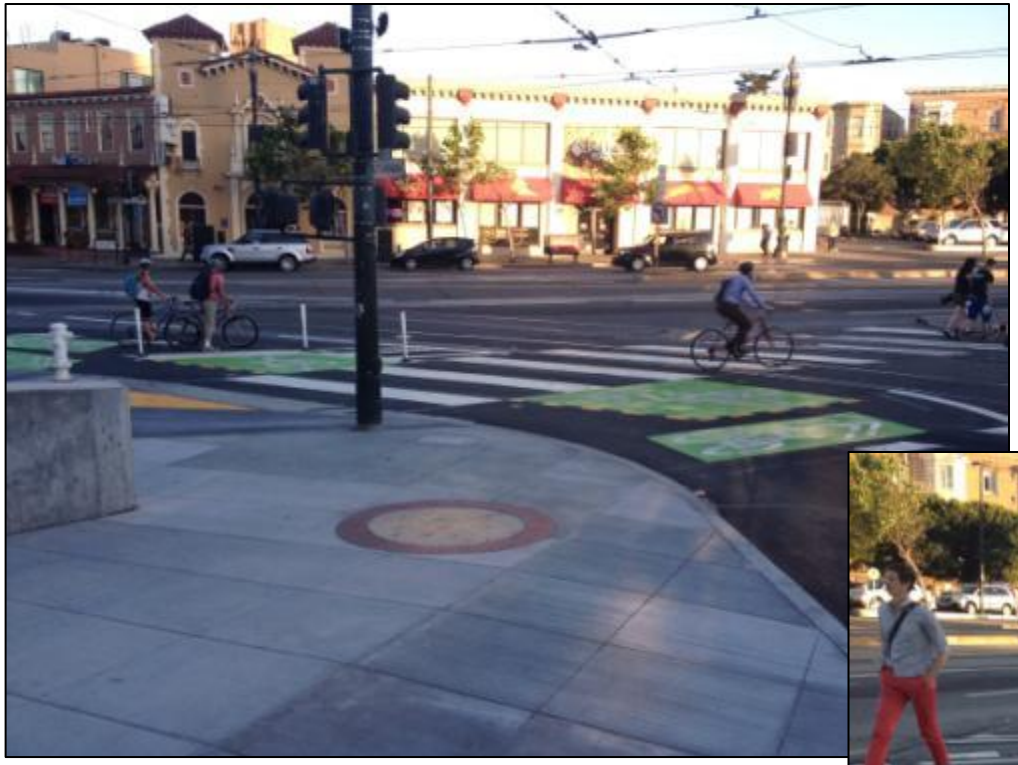
Bike channel, bike signal, and two-stage turn box

Polk Street Contraflow Lane

Get people to contraflow lane where left turns are prohibited

Two-stage turn box and bike signal

Market and Duboce



Connect a two-way path with one-way bike lanes

Intersection Crossing Markings and Bike Boxes

Traditional Manuals vs NACTO Guide

With the right tools, you can address so many more challenges!

or

And Get Great Results!!

Contact: Mike Sallaberry, mike.sallaberry@sfmta.com