



## City of Sunnyvale

### Department of Transportation and Traffic

### Green Bike Lane Design Standards

On April 15, 2011, the U.S. Department of Transportation Federal Highway Administration issued an MUTCD Interim Approval (IA-14) for the optional use of green colored pavement for bike lanes. According to the MUTCD, colored pavement treatments other than white or yellow are considered aesthetic and not an independent traffic control device. Colored pavement treatments alone do not legally establish a bicycle facility. Therefore, colored pavement treatments for bike lanes must be installed adjacent to bike lane striping. If installed, bicycle striping with or without colored pavement treatments must adhere to the 2014 CA MUTCD design standards.

On August 12, 2011, the California Department of Transportation (CALTRANS) received an approval for the use of green bike lanes on all state highways and local jurisdiction roadways compliant to the terms included in the IA-14 memorandum and the MUTCD. Included in the terms detailed in the MUTCD is:

*An agreement to:*

- 1. Restore the site(s) of the interim approval to a condition that complies with the provisions in this Manual within 3 months following the issuance of a final rule on this traffic control device; and*
- 2. Terminate use of the device or application installed under the interim approval at any time that it determines significant safety concerns are directly or indirectly attributable to the device or application. The FHWA's Office of Transportation Operations has the right to terminate the interim approval at any time if there is an indication of safety concerns.*

In addition, local jurisdictions intending to use the green colored pavement treatment for bike lanes must inform CALTRANS headquarters of the location of the application.

Subsequent to the interim approval of the green bike lanes, many jurisdictions throughout the United States have installed green bike lanes including Washington D.C., Philadelphia, Cambridge, Phoenix, Seattle, and Portland. Also, several California jurisdictions have installed green bike lanes including Los Angeles, San Diego, Davis, and San Francisco. There are also several cities within Santa Clara County that have installed green bike lanes including San Jose, Palo Alto, Mountain View, Santa Clara, and Cupertino.

### Advantages and Disadvantages of Green Bike Lanes

The jurisdictions that are currently using or have considered using green bike lanes have identified similar advantages and disadvantages for their use. The advantages and disadvantages have also been stated by several independent design organizations, advocacy groups, consulting firms, universities, and research teams. Some of the common advantages/disadvantages are listed below:

### Advantages

- Attracts drivers' attention to the bike lane and bicyclists.
- Increases chances of drivers yielding to bicyclists.
- Increases bicyclist comfort in riding in designated bike lane.
- Can provide a continuous facility for bicyclists where bike lane gap exists.
- Discourages illegal parking in bike lanes.
- If used only in conflict areas, increases bicyclist and motorist awareness of potential conflict zones.
- A study<sup>1</sup> done in Vermont with green bike lanes showed:
  - Motorists slow or stop when approaching colored pavement treatments.
  - Bicyclists are more likely to follow bike path if colored pavement treatments are installed.

### Disadvantages

- High installation costs.
- Added maintenance costs to replace or repair treatment (2-3 years).
- Some treatments may increase chances of slipping in wet and rainy conditions.
- Could lose effectiveness if overused.
- Must be removed if not approved as a state standard traffic control device.
- A study<sup>2</sup> done in Vermont with green bike lanes showed:
  - Fewer motorists were found to use a turn signal when crossing the colored bike treatment.
  - Fewer bicyclists turned their head to check for vehicles when entering a vehicle-bicycle conflict zone that was marked with colored pavement treatments.
  - Fewer bicyclists used hand gestures when entering a vehicle-bicycle conflict zone that was marked with colored pavement treatments.
  - Fewer motorists yielded to bicyclists at the colored pavement treatment zones.

### Guidance for Implementation

The FHWA interim approval for green bike lanes states that, "green colored pavement may be used within a bicycle lane or within an extension of a bicycle lane to enhance the conspicuity of the bicycle lane or extension." As such, there has not been a standardized approach developed for the United States or the State of California on where to install green bike lanes. In previous projects, green bike lanes have been installed throughout corridors to promote multi-modal transportation. They have also been used at spot locations where there are:

- Many conflict points between bicyclists and vehicles.
- A high number of vehicle-bicycle collisions.
- High traffic volumes of vehicles and bicyclists.

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<sup>1</sup> Adel W. Sadek, "Effectiveness of a Green, High-Visibility Bike Lane and Crossing Treatment," in TRB 2007 Annual Meeting CD-ROM, pp. 6 – 8.

<sup>2</sup> Ibid.

They have also been used at locations with unique or confusing roadway geometry, such as:

- Long radius roadway curves.
- Adjacent to freeway ramps.
- On approach to a bike box.
- Unclear bicycle paths through intersections due to bike lane offsets.

However, most jurisdictions' typical applications occur at conflict points on approach to or departure from an intersection.

A report titled, "Avoiding Green Lane Ubiquity," by Fehr and Peers discusses the use of green bike lanes. The report indicates that some jurisdictions have overused green bike lanes which have led to a reduction in their effectiveness. The report also points out that miles of uninterrupted green bike lanes will present a financial challenge for any jurisdiction to maintain. The report concludes that green bike lanes should be reserved for locations within a jurisdiction that fall in the top 15 percent of conflict areas based on traffic counts, speed surveys, collision history, or other factors. The suggestion for using 15 percent is based on traffic engineering design standards where the 85<sup>th</sup> percentile is typically used as a basis for design.

### **City of Sunnyvale Minimum Requirements for Green Bike Lanes**

For most jurisdictions, the evaluation to install green bike lanes at a particular location has been done on a case-by-case basis. Most agencies have not established a minimum threshold to warrant the installation of green bike lanes. The use of green bike lanes seems to occur through an evaluation of vehicle and bicycle volumes, collision history analysis, and engineering judgment. However, the Florida Department of Transportation had established minimum requirements in 2012, and updated in 2016, to warrant the installation of green bike lanes. Based on the Florida DOT set of criteria and an analysis of information on the installation and use of green bike lanes from various jurisdictions, organizations, and research firms, the following guidelines have been established to aid in the determination of where green bike lanes should be installed within the City of Sunnyvale:

**The City of Sunnyvale will permit the installation of green bike lanes on a roadway at conflict points if BOTH of the following conditions are met:**

1. A traffic conflict area exists at one of the following locations:
  - a. The bike lane crosses a right turn lane,
  - b. Traffic in a channelized right turn lane crosses a bike lane, or
  - c. The bike lane is adjacent to a dedicated bus bay.
2. A need for this treatment is demonstrated by either of the following:
  - a. Any of the four minimum thresholds exist as shown in Table 1, or
  - b. The City has observed and documented conflicts (failure of the motor vehicle to yield to the bicyclist) between cyclists and motor vehicles at an average rate of two per peak hour. The documentation for conflicts shall include observations from a minimum of three separate data collection periods, conducted on

different days in a one month period, and include at least one weekday and one weekend count period during peak bicycle travel times. Each period should be at least 2 hours in duration. Peak times vary by surrounding land use, but are typically:

Weekday, 7:00 AM to 9:00 AM

Weekday, 5:00 PM to 7:00 PM

Saturday, 8:00 AM to 2:00 PM

**The City of Sunnyvale will permit the installation of green bike lanes on a corridor if BOTH of the following conditions are met:**

1. A bike lane exists for a minimum of ½ mile on a roadway segment with at least a 35 MPH posted speed limit.
2. A need for this treatment is demonstrated by either of the two minimum thresholds as shown in Table 2.

Table 1  
Minimum Thresholds for the Installation of Green Bike Lane Pavement Treatments at Conflict Points

Number of Lanes	A. Roadway AADT <sup>1</sup>		B. Roadway Hourly Volume <sup>2</sup>		C. Intersection Approach Volume		D. Safety
	Traffic Volume (AADT)		Traffic Volume (DDHV)		Peak Hour	Peak Hour	Vehicle-Bicycle Collisions at Intersection (3-Yr Period)
	Vehicles	Bicycles	Vehicles	Bicycles	Right Turns	Bicycles	
1	8300	125	600	15	90	10	3
2	16000	125	1150	15	90	10	3
3	25000	125	1800	15	90	10	3

Notes:

1. AADT - Annual Average Daily Traffic (vehicles/day). Roadway AADT based on bi-directional volume.
2. DDHV - Directional Design Hourly Volume (vehicles/hour). Roadway DDHV based on volume in peak direction.

Table 2  
Minimum Thresholds for the Installation of Green Bike Lane Pavement Treatments on a Corridor

Roadway Speed	Number of Lanes	A. Roadway AADT <sup>1</sup>		B. Safety <sup>2</sup>
		Traffic Volume (AADT)		Vehicle-Bicycle Collisions Mid-block (3-Yr Period)
		Vehicles	Bicycles	
≥35 MPH	1	9000	125	7
	2	17600	125	7
	3	27500	125	7

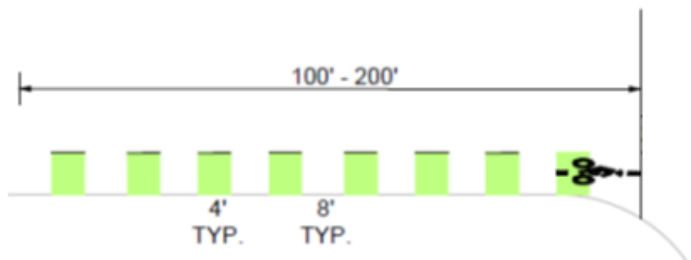
Notes:

1. AADT - Annual Average Daily Traffic (vehicles/day). Roadway AADT based on bi-directional volume.
2. Vehicle-bicycle collisions occurring mid-block (excluding intersection collisions) per 1/2 mile segment.

### Typical Design Installations

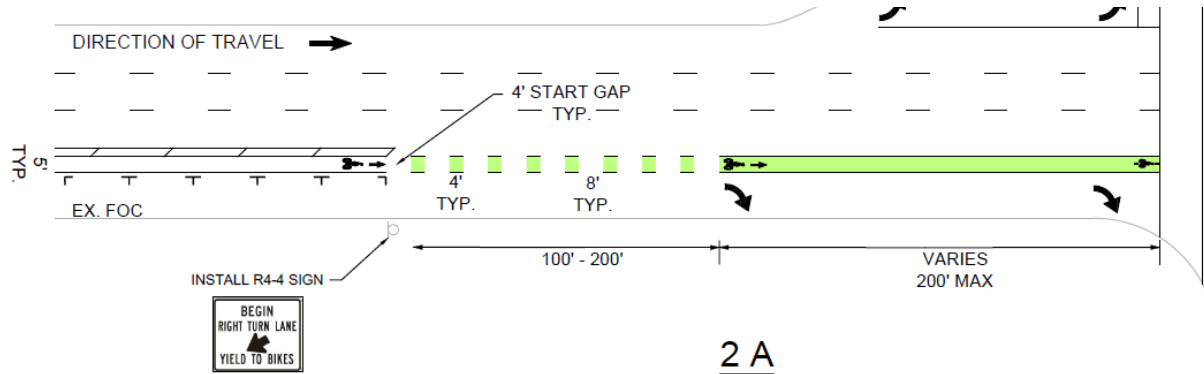
If warranted and approved by the City of Sunnyvale, green bike lanes shall be installed at spot locations or as continuous treatments throughout roadway corridors. The material shall be made of High Friction Surface Treatment (HFST) and be compliant to the specifications detailed in IA-14 and the 2014 CA MUTCD. Refer to the National Association of City Transportation Officials (NACTO) for design guidance of green bike pavement treatments. The following are design examples from other jurisdictions that can also be used as guidance for design:

#### Right Turn Vehicles Merge into Bike Lane



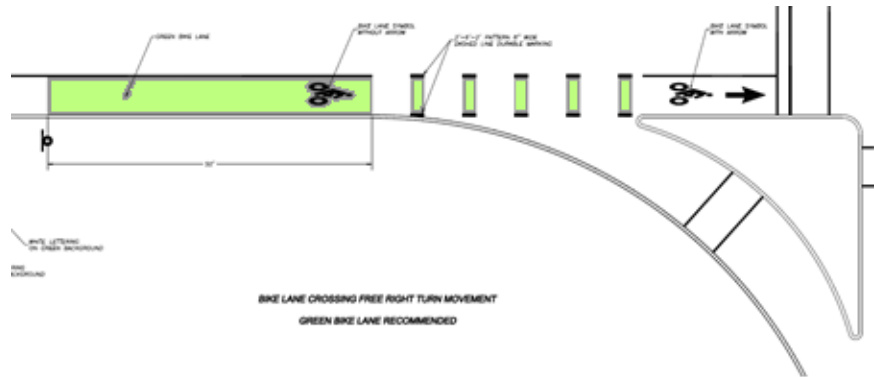
Source: City of San Jose

#### Parking Lane Becomes Right Turn Lane



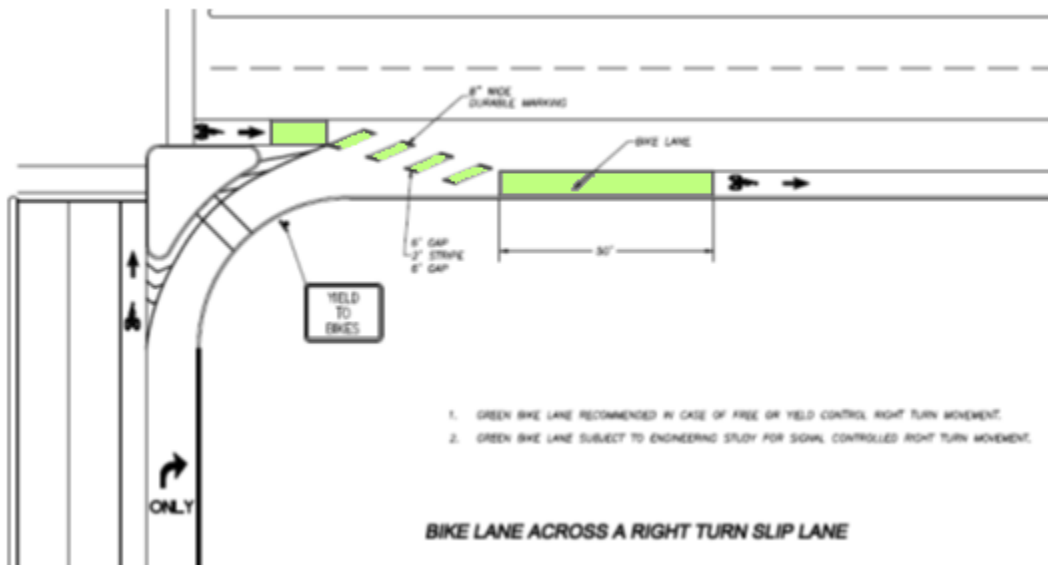
Source: City of San Jose

Right Turns Cross Bike Lane at a “Pork Chop” Island



Source: Clark County, Washington

Bike Lane Crosses Free Right Turn Lane at Departure



Source: Clark County, Washington

## Reference List

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