

MEMORANDUM

Date: September 21st, 2012
To: Randy Leptien, City of Albany
From: Ryan McClain and Carrie Nielson, Fehr & Peers
Subject: Ohlone Greenway Striping Design Literature Review

WC12-2968

This memorandum reviews available guidance and standards on the striping of shared use paths as it applies to the newly reconstructed Ohlone Greenway within the City of Albany. The Ohlone Greenway travels through the cities of Berkeley, Albany, and El Cerrito, adjacent to and underneath the Bay Area Rapid Transit (BART) aerial structure. As part of the BART seismic retrofit project, the Greenway is being reconstructed throughout the corridor, with a paved width of 14 feet. Originally, BART plans called for a single yellow stripe down the center of the Greenway; however, the Albany Strollers and Rollers community organization has requested that striping separate bicycle and pedestrian lanes on the Greenway be considered. This memorandum covers best practices from relevant American and international design guidelines and manuals and provides recommendations for pathway striping as well as mid-block and intersection crossing treatments for the Ohlone Greenway.

SHARED USE PATH LITERATURE REVIEW

Based on guidance from the City, Fehr & Peers reviewed the following bicycle and pedestrian design guide manuals for current best practices in shared-use pathway design and striping:

- Caltrans 2012 Highway Design Manual (HDM), Chapter 1000
- California Manual on Uniform Traffic Control Devices (MUTCD) 2012, Chapter 9
- American Association of State Highway Officials (AASHTO) *Guide for the Development of Bicycle Facilities*.
- Minnesota Department of Transportation (MnDOT) *Bikeways Facility Design Manual*



- Oregon Bicycle and Pedestrian Design Guide
- Dutch CROW Manual for Bikeway Design

The literature review is summarized in **Table 1**. The table focuses on the criteria for separating bicyclists and pedestrians, how that separation is achieved—whether striped or physically separated, and mid-block and intersection crossing treatments. All of the guides explain that a minimum of 12 to 14 feet is the preferred shared-use pathway width. The Oregon Guide states that a minimum of 16 feet is preferred for a shared-use path in an urban context. The MnDOT Manual explains that 11 feet is the minimum pavement width to allow a bicyclist to pass a pedestrian with oncoming bicycle traffic.

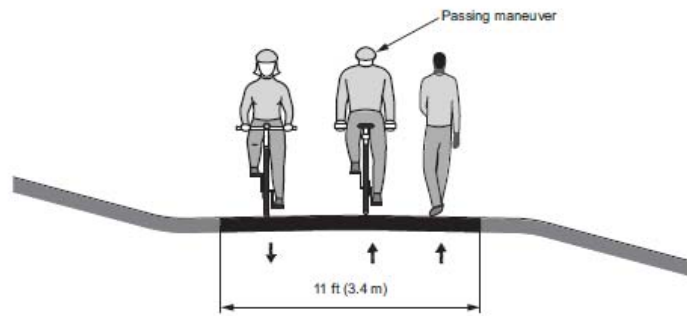
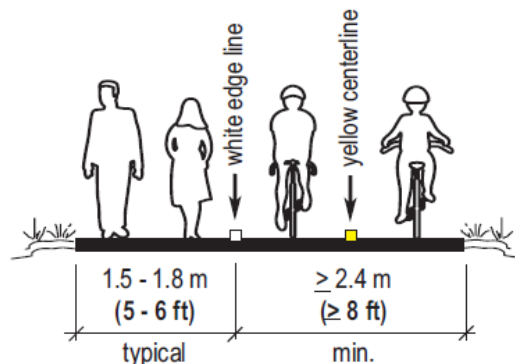


Figure 5-2. Minimum Width Needed to Facilitate Passing on a Shared Use Path

Most guides present two kinds of separation treatments:

1. A striped edgeline between bicyclist and pedestrian space
2. A physical separation between bicyclists and pedestrians, typically unpaved and landscaped

Most of the guides also discuss the option of striping a centerline on the bike portion of the path to indicate directional travel; however, this is not required. The Caltrans HDM indicates a minimum unpaved separation of 5 feet between separate bicycle and pedestrian facilities. However, the California MUTCD indicates that a solid white stripe may be used to separate different types of users on a shared use path. Signage may also be used to supplement the solid white line.



The MnDOT Manual recommends an eight foot minimum two-way bikeway with a solid

(c) PAINTED LINES WITH LANE SIGNS



white edgeline separating it from a five to six foot pedestrian space. The Oregon Guide states that such separation should occur on a 16 foot path, with two, five-foot bicycle lanes and a six foot pedestrian space. Where a physically-removed, lateral separation is discussed, the guides suggest that the area should be landscaped to avoid crossover between the two paths and the separation should be three to five feet in width, depending on the source. According to most guides, separation should only occur in areas of "extremely high" use. None of the guides discuss a paved striped buffer treatment.

OHLONE GREENWAY STRIPING AND SIGNAGE RECOMMENDATIONS

Based on the guidelines reviewed above, including the California MUTCD, the City of Albany could consider using a white edgeline stripe to separate bicycle and pedestrian use along the Ohlone Greenway through the City. However, it should be noted that the Ohlone Greenway is a regional trail, connecting multiple East Bay communities. Because this is being repaved in several jurisdictions at the same time, the City of Albany should consider discussing the striping ideas with the City of El Cerrito and the City of Berkeley to maintain regional consistency along this pathway. Many people using the pathway cross into other jurisdictions in a single trip. The understanding and self-enforcement of the white edgeline stripe between bicyclists and pedestrians will likely be most effective if the pattern is consistent across the corridor.

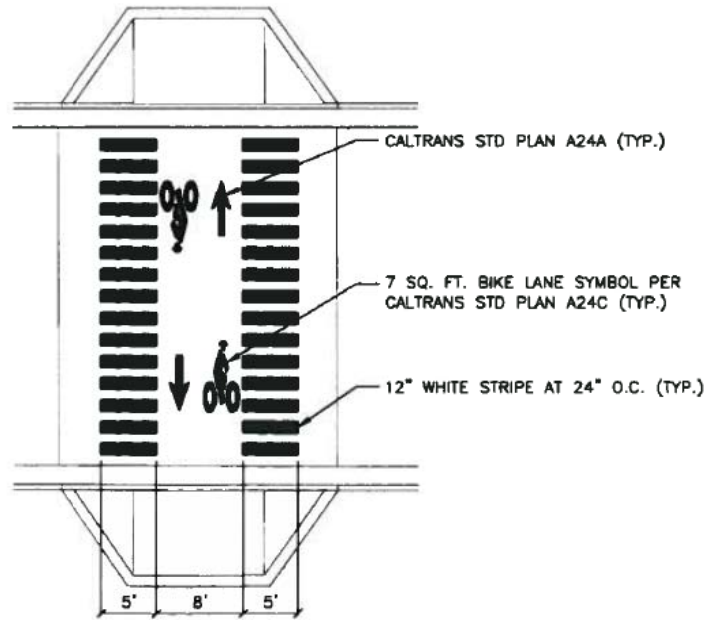
Pathway Striping

Based on the literature review, Fehr & Peers recommends using a solid white edgeline to separate bicyclists and pedestrians in the mid-block pathway condition. Given the 14-foot pavement width, the recommended cross section would be a 9-foot zone for bicyclists and a 5-foot zone for pedestrians. This is shown on **Figure 1**. Pedestrians would likely cross the white edgeline stripe as needed to pass slower moving path users; however, the high volume of bicyclists using the Greenway will help enforce the separate zones. Bicycle pavement legends placed at regular intervals along the path can reinforce the separate zones.



Crosswalk Striping

At intersections and mid-block crossings, a modified “triple-four” crosswalk is recommended. The triple-four crosswalk consists of two 4-foot long high-visibility (continental) stripes with a 4-foot area in between. The modified version of this is shown at right and would consist of two sets of 5-foot high-visibility stripes, two-feet on center. There would be an 8-foot space in between with directional bicycle stencils. This 18-foot crosswalk would be regionally consistent along the path, as it currently proposed for the Greenway crossing in El Cerrito. A similar striping pattern has also been used on path crossings in Berkeley.



Intersection Considerations

At intersections, the edgeline stripe should stop approximately 25 feet prior to the intersection. This will allow for a mixing zone to occur prior to intersections and mid-block crosswalks. Bicyclists typically navigate to the middle of the curb ramp, where they will have to negotiate with the surrounding walking and biking traffic. Ending the stripe prior to intersection will reiterate the idea that dedicated space has ended and path



R9-7



users are entering a “mixing zone” through which all users must carefully navigate. Where the edgeline stripe begins and ends, modal pavement legends and corresponding signage should indicate proper use of the two sides of the path. A modified R9-7 sign is appropriate in this case.

Use of Bollards and Driveway Condition

The BART drawings show bollards at most path crossings as well as a series of bollards where the path crosses a driveway in Berkeley. All of the guides reviewed no longer recommend the use of bollards on shared-use paths. Many of the guides explicitly discourage their use, as they create vertical objects that are easily clipped by bicycle handlebars or trailers and may be cumbersome to negotiate for those with strollers or in wheelchairs. The guides say to only use bollards if there is a demonstrated compliance issues with automobiles entering the path.

Fehr & Peers recommends not installing and possibly removing bollards that have been placed at the entrances to the pathways or at driveway crossings. In order to alert bicyclists to oncoming traffic and to encourage them to slow down in these zones, Fehr & Peers recommends striping a series of 6” white stripes, two-feet on center, perpendicular to the pathway. New York City Department of Transportation (NYCDOT) has recently used this striping pattern to slow bicyclists as they approach crosswalks on separated bikeways in Brooklyn. This treatment could also be considered prior to unsignalized mid-block crossings and could be combined with advanced yield markers, as appropriate.

NEXT STEPS

Based on the findings of the literature review and comments received from the City, Fehr & Peers will prepare a set of 90 percent design drawings that reflect current best practices and that provide regional consistency along the Ohlone Greenway as feasible.

ATTACHMENTS:

Table 1 – Shared Use Path Literature Review

Figure 1 – Ohlone Greenway Recommended Striping Through Albany

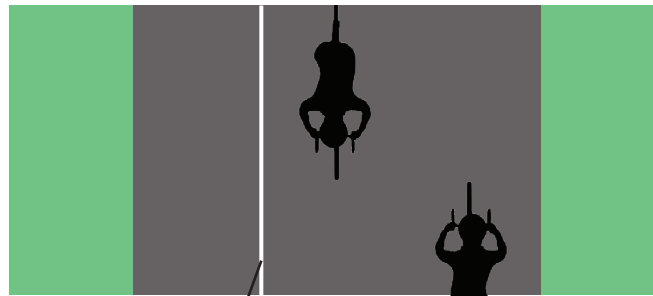
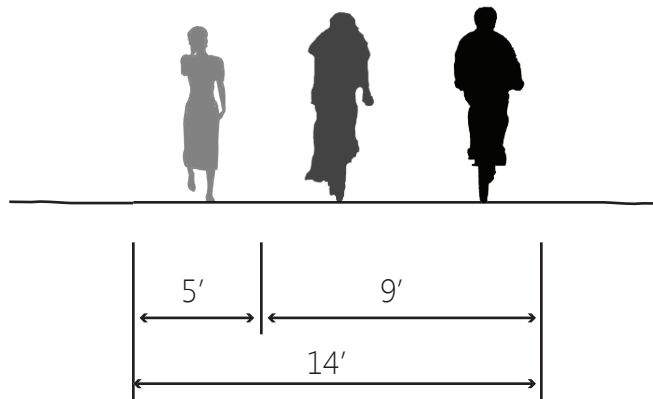
TABLE 1 SHARED USE PATH LITERATURE REVIEW

	MnDOT Manual	AASHTO Guide	Caltrans HDM and California MUTCD	Oregon Manual	CROW Manual
Standard Pavement Width	8', 10', or 12' depending on bicyclist and pedestrian volumes	<ul style="list-style-type: none"> • Minimum 10', typically 10'-14' depending on volumes and types of users • 11' to 14' where 30% of users are pedestrians and over 300 total users in peak hour 	<ul style="list-style-type: none"> • Minimum 8', 10' preferred • 12' or more recommended when significant bicyclist and pedestrian use is expected 	<ul style="list-style-type: none"> • Minimum 8' • 10' acceptable in rural areas • 12' or more in higher-volume, mixed-use urban areas 	
Bicyclist/Pedestrian Separation Criteria	<ul style="list-style-type: none"> • Potential for conflicts during peak periods • Peak daily pedestrian and bicycle user volume is greater than 2,000 individuals/day • Peak hour bicycle traffic is >100/hour • Pedestrian and bicycle traffic both occur at high volumes • Combination of use by fast and/or long-distance bicyclists as well as less skilled bicyclists and pedestrians 	<ul style="list-style-type: none"> • "Extremely heavy" pathway volumes • Separation only on minimum path width of 15' with 10' for bicycle traffic and 5' for pedestrians • Pedestrians will often walk in "bicycle only" area when bikes not present • Pedestrians on side of path with view, as appropriate 	"significant pedestrian use"	<ul style="list-style-type: none"> • "Very high use" by pedestrians and bicyclists, separate with striping • With "exceptionally high use by both bicyclists and pedestrians", separate paths for cyclists and pedestrians are recommended 	<ul style="list-style-type: none"> • If <100 pedestrian per hour per meter of path width, shared-use path does not need further separation • If 100-160 pedestrians per hour per meter of path width, "visual separation", such as an edgeline stripe is sufficient
Striping Guidelines	<ul style="list-style-type: none"> • 5 – 6' pedestrian space and 8' or more for bicyclist space • White edgeline between pedestrian and bicycle space • Yellow centerline between directional bike traffic 	<ul style="list-style-type: none"> • Can use centerline as needed in complex areas or not at all • If striping, use double centerline where no passing allowed; broken where passing allowed 	<ul style="list-style-type: none"> • A centerline marking is particularly beneficial where there is heavy use, on curves with restricted sight distance; and, where the path is unlighted and nighttime riding is expected • A solid white line may be used to separate different types of users 	Minimum 16' path for using striping to divided bicyclist and pedestrian space: 5' in each direction for bikes, 6' for pedestrians	

Clear Zone	<ul style="list-style-type: none"> • 2' graded shoulder on each side • Additional 1' from the shoulder to vertical elements 	3-5' graded shoulder, minimum 2'	2' graded clear zone	3' graded clear zone on both sides	
Buffer Between Separated Bike and Ped Facilities	Discuss an option for a minimum 3' landscaped median	Indicates possibility of physical separating bicyclists & pedestrians based on considerations of width of separation, anticipated level of compliance, and origins & destinations of users	If adjacent pedestrian walkway exists, must be separated by minimum of 5' unpaved material	Create two physically separated paths with "exceptionally high use"	Create two physically separated path if greater than 200 pedestrians per meter of path width
Intersection Treatments	<ul style="list-style-type: none"> • Split path into 5' section with low landscaping to allow emergency access, preferable to bollards • If using single bollard, situate in middle of path 	<ul style="list-style-type: none"> • Bollard use not recommended unless documented unauthorized use by autos 	<ul style="list-style-type: none"> • Bollard or gates only when other measures have failed • 5' minimum between obstacles • 10-30' back from intersection 	<ul style="list-style-type: none"> • Path crossing minor street should have right-of-way • Signalize major street crossings where path users cannot find acceptable gaps in traffic 	
Mid-Block Crossing Treatments	<ul style="list-style-type: none"> • Place "STOP AHEAD" or "YIELD AHEAD" signs 140' before crossing • Locate 250' from nearest intersection • Consider raised crossing, flashing beacons, and/or continental striping 	<ul style="list-style-type: none"> • Consider installing "YIELD" signs for roadway traffic or path to encourage caution without being overly and unrealistically restrictive 	<ul style="list-style-type: none"> • Use "YIELD" or "STOP" signs or traffic signals with bicyclist actuation to control mid-block crossing 	<ul style="list-style-type: none"> • Bicyclists unlikely to obey "STOP" or "YIELD" signage at minor crossing 	

Sources: Minnesota DOT Bikeways Facility Design Manual (2007); AASHTO Guide for the Development of Bicycle Facility, 4th Ed. (2012); 2012 Caltrans Highway Design Manual, Chapter 1000; 2012 California Manual on Uniform Traffic Control Devices, Chapter 9; Oregon Bicycle & Pedestrian Design Guide (1995); CROW Design Manual for Bicycle Traffic (2007).

Ohlone Greenway Proposed Striping



4" Solid White Edgeline, Typ.



NOT TO SCALE