

# Appendices

## Contents

Appendix A: International Experience and Research

Appendix B: Facilities Not Included In This Paper

Appendix C: Channelizing Islands

Appendix D: Online Video Resources

Appendix E: FHWA Request for Experimentation Process

Appendix F: Sample Striping Plan

Appendix G: Advisory Bike Lane Evaluation Report

Appendix H: Public Outreach Documents

## Appendix A: International Experience and Research

Advisory bicycle lanes are common in the Netherlands, with more than 1,000 road kilometers installed. Installations can also be found in England, Scotland, Ireland, Germany, Denmark, Sweden and Norway. Until 2011, no ABLs were known to exist in North America. This disparity is reflected in the literature with few domestic studies on the facility.

### US Research

Research on advisory bicycle lanes in the US is minimal. Only two official agency reports on the treatment exist, one from Edina, MN and one from Boulder, CO. These were a result of their participation in the FHWA experimentation process.

Both studies found that motorists interacted appropriately with bicyclists and yielded to oncoming motorists with no observed decrease in safety. Boulder observed no speed reduction, while Edina noted a 1-3 mph speed reduction over traditional shared lane markings or no bike lanes.

Domestic studies of delineation are numerous but only one could be found which studied the effect of centerline removal.

### International Research

All cited studies of advisory bike lanes and all cited studies of centerline removal, with the exception of (16) were done outside North America.

All studies (1, 4, 8, 12, 15, 16, 17) on the use of delineation documented the same trend on non-highway roads - higher speeds are correlated with greater delineation. Installation of a centerline and/or edge lines on a roadway increases speeds and removal of those items reduces speeds. One study (8) also found a decrease in crashes which may have been associated with centerline removal.

One study (4) examined the difference between solid edge lines and broken edge lines. This meta-study found that broken lines "provide less visual guidance but a better impression of the speed driven." This study also found that, on roads that were marked only with a centerline, removal of the centerline and addition of dashed ABL markings resulted in a decrease in speed.

All but one of the studies on the installation of advisory bike lanes (2, 4, 5, 7, 9, 10, 11, 13, 14), found reduced motor vehicle speeds and reduced lateral bike-vehicle distance following installation. The reduced bike-vehicle distance was characterized as slight in all cases (on the order of centimeters). One study in Denmark (3) found speed increases following installation of ABLs and other traffic calming measures.

One study found higher expectations of seeing bicyclists on a road with advisory bicycle lanes (6). This was the only study that examined this aspect.

With the exception of the New Zealand study (2), no study observed improper road use.

The study of an ABL installation in New Zealand (2) is worthy of comment because of the fact that the facility was removed within 24 hours of being installed. Removal was prompted by safety concerns and public complaints. There were two safety concerns: 1) the speed reduction

from 100 km/h to 60 km/h that was implemented along with the ABL was not being observed at night and 2) a single event in which a driver stopped suddenly on the shoulder of the ABL; the following car attempted to pass and conflicted with an oncoming car. The decision to remove the facility was strongly influenced by the fact that had it not been removed shortly after incident #2, it would have remained for at least a week before the chance to remove it became available again. The study documenting this trial recommended further trials with more public education/communication. In a personal conversation with Mr. Peter Kortegast, the engineer responsible for the study, Mr. Kortegast disliked the approach of forgoing all education in the area before installing the new facility. Were he to do a similar trial in the future, he would strongly advocate for prior outreach and education.

## Works Cited

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## Appendix B: Facilities Not Included In This Paper

Some ABL and ABL-like facilities were not included as case studies in this work.

What is arguably the first advisory bike lane in the United States still exists and is found on a road that runs underneath the famous Stone Arch Bridge in Minneapolis, MN. This facility uses the same layout as a standard ABL but uses a solid line instead of broken lines. This facility was installed several years before the East 14th Street facility. It is on a street owned by the parks and recreation department and is not under the city's jurisdiction. The street has no centerline, a 2-way center travel lane, and solid lined bike lanes on both sides. The street accesses a trailhead parking lot and a hydropower plant so traffic volumes are low. Without broken lines, this is not an advisory bike lane treatment despite operating like one. This street more closely resembles a long driveway rather than a minor street and has been excluded.

NW Marshall Street, from NW 12th Avenue to NW 14th Avenue in Portland, OR was not included despite it providing a look into what the future of ABLs might bring. Its most notable feature is the use of street surfacing materials to delineate the various lanes of the street. The parking lanes and center travel lane are paved with cobbles, the bike lanes are paved with smooth concrete and the crosswalks at intersections are created from patterned concrete. Without the broken lines, it doesn't technically qualify as an ABL but its intention is the same and it appears to be successfully operating as one.

Summer Street in Somerville, MA could be termed a "half-ABL". The street has a bike lane delineated with a broken line on the uphill-bound side of the street but sharrows marked on the downhill-bound side of the street. Parking is allowed on the downhill side of the street but not on the uphill side. The bike lane is approximately 4 feet wide and is next to the curb. We learned of this facility shortly before publication and did not have the time to fully treat it.

Shaw Road in Gibsons, British Columbia had a half-ABL installed in May, 2017. The street has a bike lane delineated with a broken line on the east side of the street but sharrows marked on the west side of the street with no centerline. On-street parking was removed from the east side of the street but remains on the west side. This configuration was adopted as a way to gain the support of the City government for the project. We learned of this facility shortly before publication and did not have the time to fully treat it.

More information on these facilities is in the spreadsheet of facility information found in the appendices.

It is possible that other ABL installations exist but they were not uncovered by our research.

## Appendix C: Channelizing Islands

The *FHWA Small Town and Rural Multimodal Networks* document explains the factors to consider when designing an ABL. What is not explained is a mechanism to discourage motorists from driving within the bike lane for long distances. This mechanism normally takes the form of islands and comes in two types: hard and soft. These islands are used by European countries but have not been used in North America.

Soft features can be driven over and use a surface similar to mountable aprons in a roundabout. They can be driven over but are designed to deter motorists from doing so. The soft features can be placed across from each other to create a pinch point or they can be staggered, as shown in this picture.



Picture courtesy of Peter Furth.



Picture courtesy of Peter Furth.

Hard features are not designed to be mountable by motor vehicles. They can include traffic calming features to reduce speed as well as requiring vehicles to return to the central lane. Hard features can be placed across from each other as shown or they can be staggered.

Hard features are not looked upon favorably in the American context and approval may be difficult.

Both hard and soft features should provide a minimum clear passage for bicyclists of 4 ft. (1.2 m).

Additional information, examples and a video can be found at

<http://www.northeastern.edu/holland2016sustrans/systematic-safety-2/sustainable-safety-2-van-emmerik-and-nitka/>.

## Appendix D: Online Video Resources

This appendix lists the URLs of ABL-related videos. Some videos show examples of ABLs in action; others are introductory or explanatory in nature.

An abbreviated version of Peter Furth's introductory video, 0:30

<https://www.youtube.com/watch?v=MzFPI94pXy0>

A video made by advocates in Hanover explaining an ABL and its operation and showing examples of negotiation between various road users, 3:48

<https://vimeo.com/198050122>

Ottawa's video educating the public about operation of an ABL, 0:50

<https://www.youtube.com/watch?v=0zdDlvKXMxY>

A video showing use of a Dutch ABL by different vehicle combinations including a huge bus, 2:53

<https://www.youtube.com/watch?v=L8nwEkBR7NI>

A Dutch video showing an ABL on Hugo de Grootstraat with a 17.5' wide travel lane in which two cars can pass without entering bike lanes; various vehicle combinations shown including a bus, 2:35

[https://www.youtube.com/watch?v=DGMTFm\\_q8aI](https://www.youtube.com/watch?v=DGMTFm_q8aI)

A low-resolution, Dutch video showing a large farm tractor passing a car and cyclists on a rural ABL, 0:23

<https://www.youtube.com/watch?v=VVpkoFWGs50>

A video created by Minneapolis to educate public about various bike facilities (ABLs at 1:02 mark), 4:13

<https://www.youtube.com/watch?v=eeDDYfUP4BU>

## Appendix E: FHWA Request for Experimentation Process

At the time of publication, the FHWA recognized the advisory bike lane treatment as experimental, and encourages agencies to participate in the experimentation process as part of an implementation path. This appendix tries to answer questions an interested agency may have about that process.

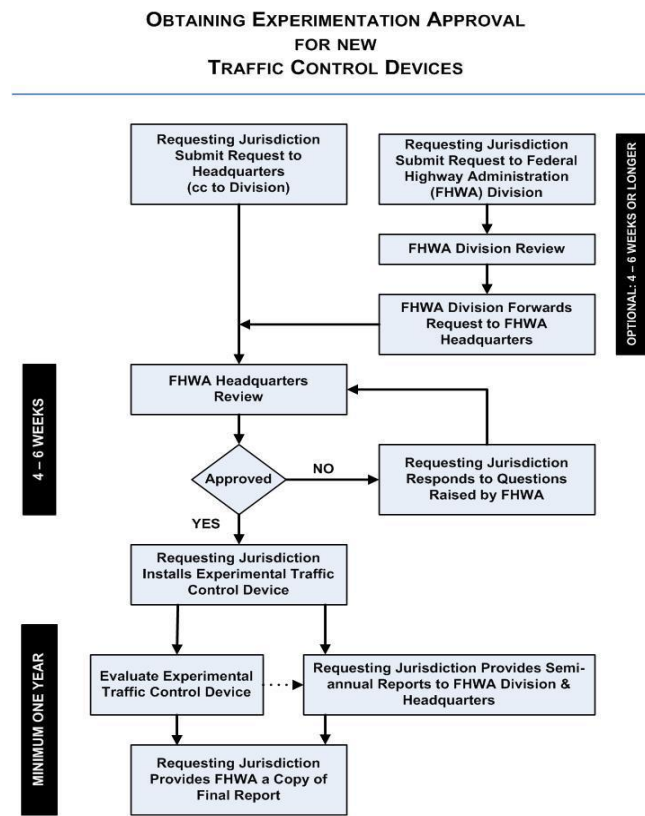
### Q: What is the key website for FHWA experimentation with Advisory Bike Lanes?

A: The FHWA's MUTCD Rulings website calls the treatment **Dashed Bike Lanes** and can be found at [https://www.fhwa.dot.gov/environment/bicycle\\_pedestrian/guidance/mutcd/dashed\\_bike\\_lanes.cfm](https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/dashed_bike_lanes.cfm).

### Q: The process for experimentation seems somewhat long and potentially burdensome. What is the advantage to a State or local jurisdiction for getting FHWA approval and conducting an approved experimentation?

A: Jurisdictions that install new non-MUTCD compliant devices without FHWA experimentation approval expose themselves to considerable potential legal liability for deaths, injuries, or property damage, particularly if a crash occurs that a plaintiff claims was caused by being confused by an unfamiliar non-standard device or application. There is never a total shield from potential liability, but FHWA experimentation approval should significantly reduce it. Also, the data and conclusions from experimentations can support or refute the effectiveness of such devices in improving safety or mobility. Successful experiments often lead to changes in the MUTCD, benefiting all road users in all States.

### Q: What are the steps in the experimentation process?





## **Q: What are the regulations that apply to the experimentation process?**

**A:** The following text was copied from the FHWA website at <http://mutcd.fhwa.dot.gov/condexper.htm>.

## **Experimentations**

If you have an idea for a new traffic control device or a different application of an existing device that will improve road user safety or operation, but the device or application is not compliant with or not included in the MUTCD, it is possible to experiment with the device or its use.

A successful experiment is one where the research results show that the public understands the new device or application, the device or application generally performs as intended, and the device does not cause adverse conditions. The "experimenter" must evaluate conditions both before and after installation of the experimental device and describe the measurements of effectiveness (MOEs) of the safety and operational benefits (e.g., better visibility, reduced congestion).

All requests for experimentation should originate with the State/local highway agency or toll operator responsible for managing the roadway or controlled setting where experiment will take place. That organization forwards the request to the FHWA - with a courtesy copy to the FHWA Division Office. The FHWA must approve the experiment before it begins. Requests may also be forwarded directly to the FHWA Division Office, and the Division Office can submit the request to the FHWA Headquarters Office.

Requests for experimentation approval should be on agency letterhead and should be sent electronically as an attachment (PDF or Word Document) to an e-mail to: [MUTCDofficialrequest@dot.gov](mailto:MUTCDofficialrequest@dot.gov). [Note: if e-mail is not possible, the letter may be sent via postal mail or delivery service to FHWA at 1200 New Jersey Avenue, S.E., HOTO-1, Washington, DC 20590.]

As described in Paragraph 11 of Section 1A.10, all requests should include:

1. A statement of the nature of the problem, including data that justifies the need for a new device or application.
2. A description of the proposed change, how it was developed, and how it deviates from the current MUTCD.
3. Any illustration(s) that enhances understanding of the device or its use.
4. Supporting data that explains how the experimental device was developed, if it has been tried, the adequacy of its performance, and the process by which the device was chosen or applied.
5. A legally binding statement certifying that the concept of the traffic control device is not protected by a patent or copyright (see [MUTCD Section 1A.10](#) for additional details.)
6. The proposed time period and location(s) of the experiment.
7. A detailed research or evaluation plan providing for close monitoring of the experimentation, especially in the early stages of field implementation. The evaluation plan should include before and after studies as well as quantitative data enabling a scientifically sound evaluation of the performance of the device.
8. An agreement to restore the experimental site to a condition that complies with the provisions of the MUTCD within 3 months following completion of the experiment. The agreement must also provide that the sponsoring agency will terminate the experiment at any time if it determines that the experiment directly or indirectly causes significant safety hazards. If the experiment demonstrates an improvement, the device or application may remain in place until an official rulemaking action occurs.
9. An agreement to provide semi-annual progress reports for the duration of the experimentation and a copy of the final results to the FHWA's Office of Transportation Operations within three months of the conclusion of the experiment.

**Q: What design guidelines does the FHWA provide?**

**A:** The FHWA has set out elements which are categorized as required, suggested, recommended, or optional. Many elements (e.g. signage, bike lane markings, minimum center lane width) were specifically excluded by the agencies interviewed for this paper.

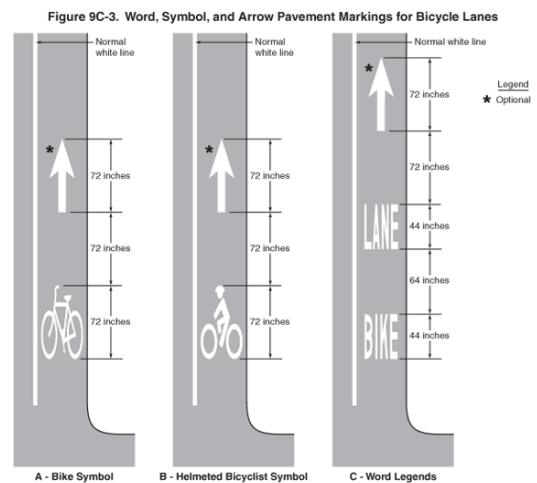
The elements from the FHWA are:

Required - Bike Lane signs and pavement markings

MUTCD R3-17

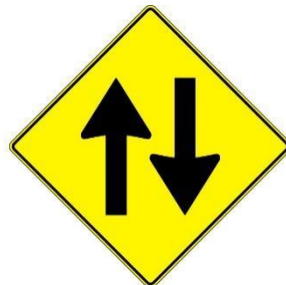


Bicycle Lane markings per MUTCD Section 3D.01



Recommended – Two way traffic signs

MUTCD W6-3



### Suggested - Planning and Design guidelines

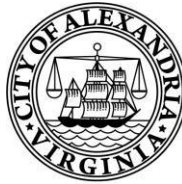
- Traffic volume is less than 6,000 ADT.
- Minimum lateral width of 16 feet of the center space between dashed bicycle lanes.
- The street is not a designated truck or bus route, nor would the street be expected to facilitate these vehicle types to and from other facilities.
- The dashed bicycle lanes (for both directions) are not installed to a street that is interspersed in an overall one-way street network, grid, or area.

### Optional – Green colored pavement

Green colored pavement limited to use at areas of mixing or weaving or as background to pavement markings.

### **Q: What does a request for experimentation approval look like?**

**A:** Paragraph 11 of Section 1A.10 of the MUTCD lists the items included in any request for experimentation approval (see above). Below is the request submitted by the City of Alexandria, VA. It is short, limited to one facility type, applies to a single roadway, and is succinct.



DEPARTMENT OF TRANSPORTATION  
AND ENVIRONMENTAL SERVICES  
P.O. Box 178 - City Hall  
Alexandria, Virginia 22313  
703-746-4025

[alexandriava.gov](http://alexandriava.gov)

July 11, 2014

Mr. Kevin Dunn  
Office of Transportation Operations (HOTO)  
Federal Highway Administration, Mail Stop: E84-402  
1200 New Jersey Avenue, S.E.  
Washington, DC 20590

[Kevin.Dunn@dot.gov](mailto:Kevin.Dunn@dot.gov)

Dear Mr. Dunn,

The City of Alexandria has a Complete Streets policy and has established a citywide bicycle network master plan. Both have goals to enhance the bicycle infrastructure to help manage and balance transportation mobility and safety for all users. To implement these goals, the City has been installing bicycle lanes, bicycle parking, and has deployed bicycle sharing stations (as part of the Capital Bikeshare program). The City is requesting permission to experiment with a variation of the standard longitudinal markings for a bicycle lane. This strategy is meant to convey a permissive message in a low speed environment and would consist of replacing the inside solid line defining the bicycle lane to a modified dotted line pattern, also known as Advisory Bike Lane. A new Bikeshare station will be installed along the proposed roadway this summer, and the roadway is approximately one mile from the Braddock Road Metro Station where Bikeshare already exists. Additionally, a number of requests for traffic calming have been submitted to the City for this corridor, which currently has no centerline and a 14' wide lane in each direction.

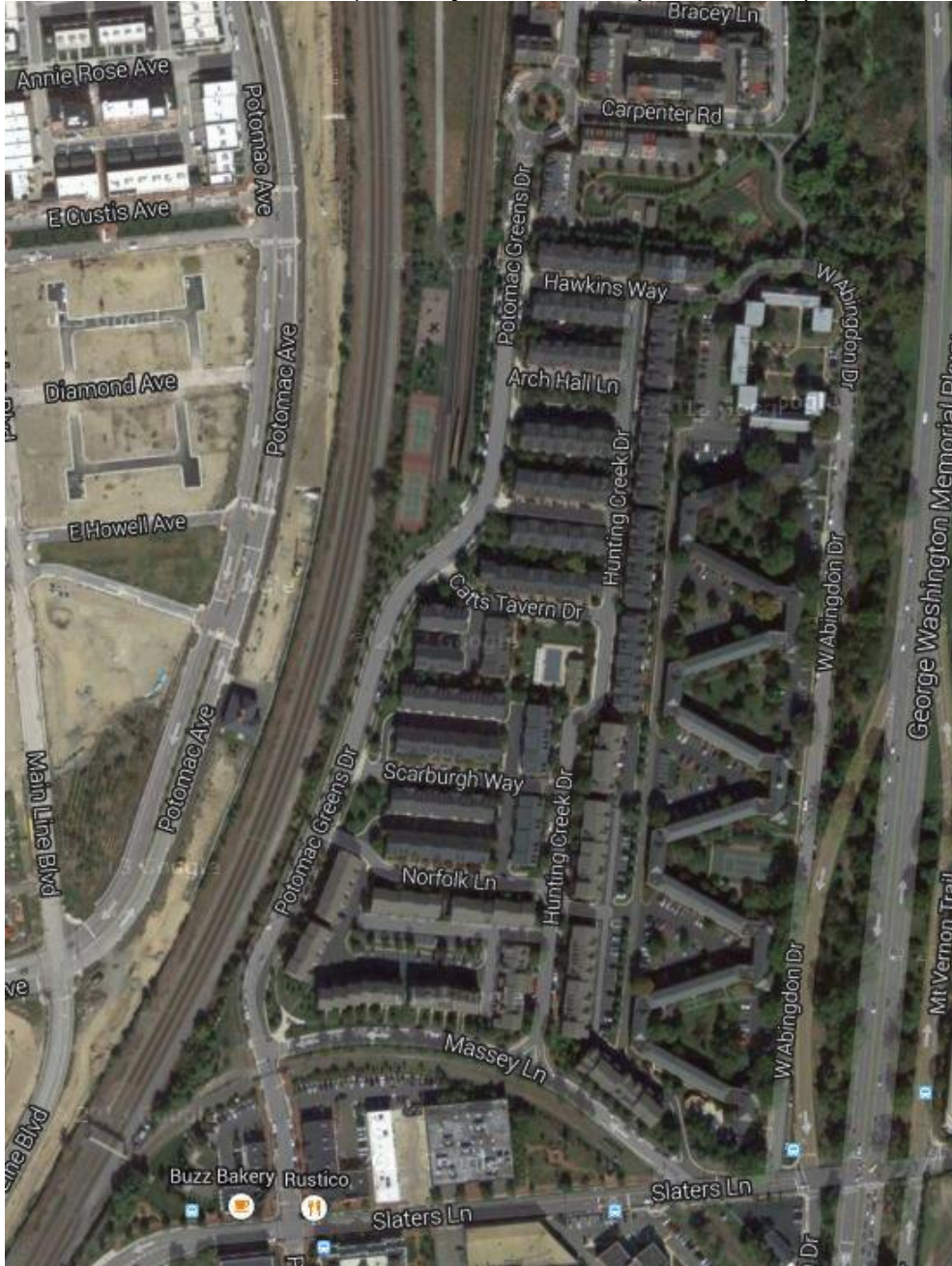
While sharrows are an alternative to the advisory bike lane, the visibility and conspicuity of sharrows is a concern. Due to the width of the proposed corridor, a standard bike lane is not possible. The advisory bike lane is intended to convey the message that the bike lane is preferred for bicycle use.

## Request for Permission to Experiment – Advisory Bike Lanes

## A. Purpose for Experiment

The purpose of the experiment to install advisory bike lanes along one corridor:

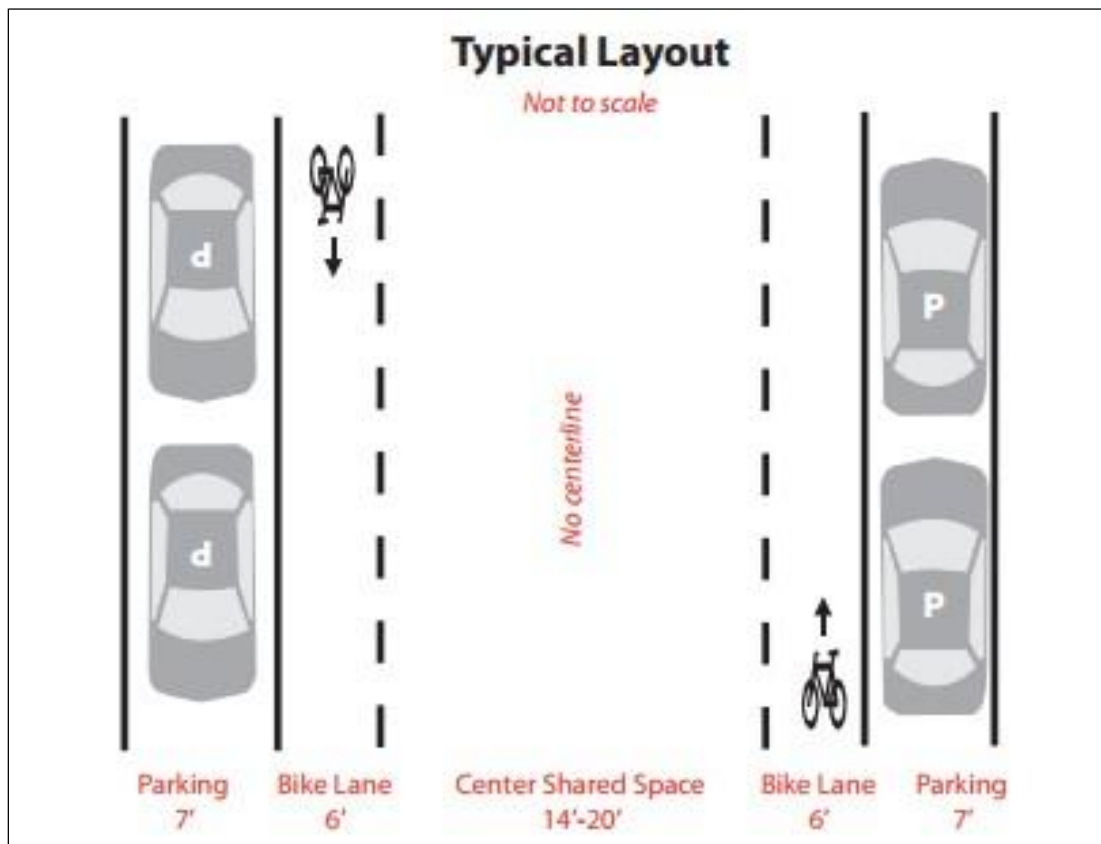
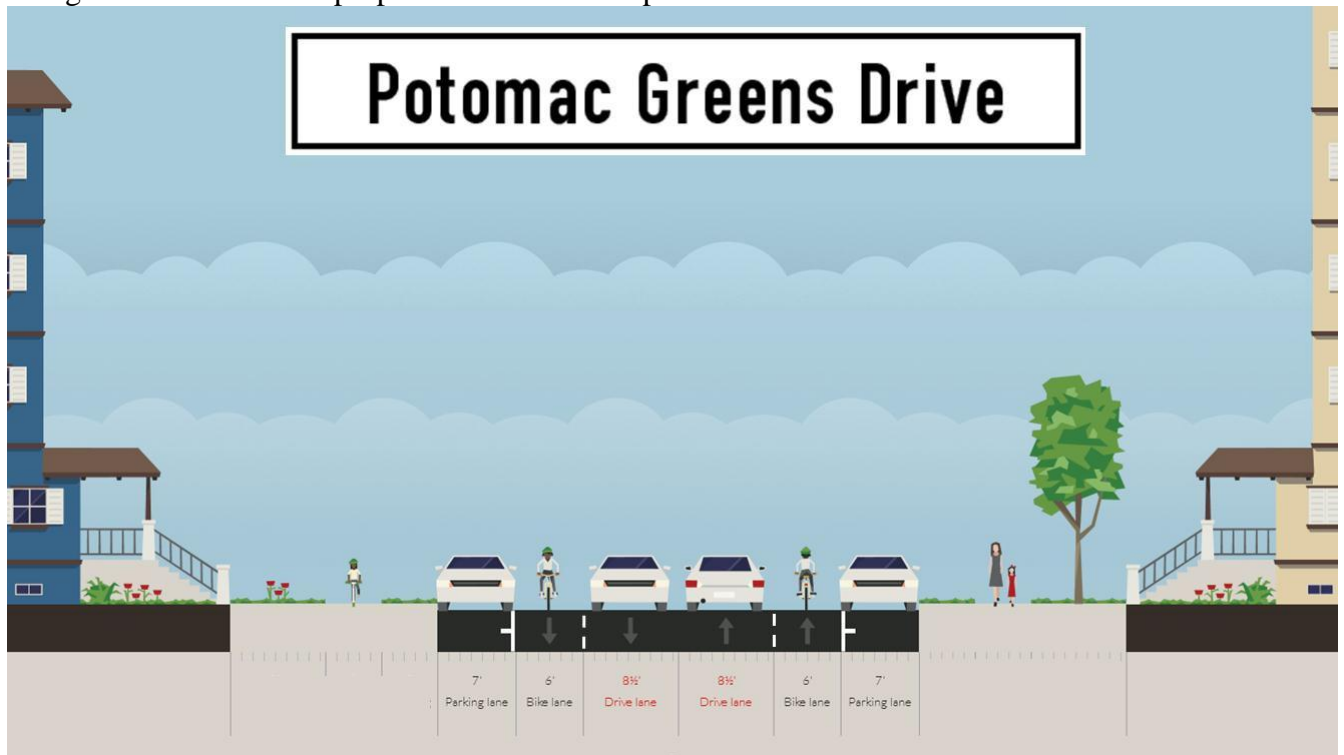
1. Potomac Greens Drive (Massey Lane to Carpenter Road):



Source: Google Maps

## B. Illustrations

Design documents of the proposed bike lanes are provided below.



### **C. Supporting Data for Advisory Bike Lanes**

Advisory bike lane experiments have been successfully implemented in cities across the United States. The City of Alexandria contacted some of these cities to get insight into the success and failures they have had with advisory bike lanes. We learned that successful advisory bike lanes have the following characteristics:

- High parking demand
- Traffic volume less than 6,000 ADT, preferably less than 4,000 ADT
- Minimum of 14-16 feet between advisory lane stripes
- Wider center space if the street is a bus route
- Best if not installed near one way streets to avoid confusion

Potomac Greens Drive meets all of these criteria. The volumes on the street are currently less than 2,000 ADV with 85<sup>th</sup> percentile speeds around 26.5mph. The street is not a bus route and is not near one way streets. It was recommended that we install yellow diamond two-way signs at the start of corridor, which we plan on include.

### **D. Patent or Copyright**

The City of Alexandria is not aware of any patent or copyright protecting the concept of the Advisory Bike Lanes.

### **E. Time Period**

- Potomac Greens Drive – 2 years

### **F. Community Outreach and Evaluation Plan**

Prior to the installation of the advisory bike lanes, pamphlets would be delivered to all residents of the community explaining how to use the new facilities. The City will also provide a website dedicated to education for advisory bike lanes in addition to a project page for the proposed corridor. The City will also provide education messages through their email distribution system and social media outlets such as Facebook and Twitter. Prior to the installation, there will be a public forum for input from residents and where staff can present the project and answer questions. A meeting will also be held with the homeowners associations in this area.

The evaluation process will be guided by Section 1A.10 of the 2009 MUTCD. “Before” and “after” studies will be performed to assess the performance of the experimental device. Bike lanes or shared lane markings do not exist on either of the facilities identified to receive the experimental treatment. As such, the evaluation process will be primarily focused on their performance after implementation. Bicyclists and motorist behavior will be observed by staff and volunteers along the subject streets after the application of the experimental devices.

Variables to be studied and recorded in the field will be:

- Bicycle and vehicular volumes (before and after)
- Vehicular speeds (before and after)
- Intersection crash data for the entire roadway (before and after)
- Observations along the corridor (after only)

Where do bicyclists tend to ride? Does this vary by the presence of parked vehicles or oncoming vehicles?

- Where do motorists tend to drive? Does this vary by the presence of



bicycles or oncoming vehicles?

Are motorists yielding to bicyclists before merging into the advisory bike lane? When a motorist overtakes a bicyclist, are they leaving a safe passing distance?

- Do the advisory bike lanes and lack of centerline appear to create conflicts among bicyclists and motorists?  
Are bicyclists using the treatment as intended?
- Are motorists using the treatment as intended?
- Survey of users (after only)  
Do bicyclists feel safer with the addition of the advisory bike lanes?
- Do motorists understand the purpose of the advisory bike lanes?

Observations will be made once a year after implementation

### **G. Agreements**

If it is determined that this proposed change does not meet the goals outlined within this document, the City will restore the sites of the experiment to a condition that complies with the provisions in the MUTCD within 3 months following the end of the time period of the experiment. Should significant safety concerns arise that are directly or indirectly attributable to the experimentation, the City of Alexandria agrees to terminate the experiment and restore the sites to their original conditions.

### **H. Submissions to FHWA**

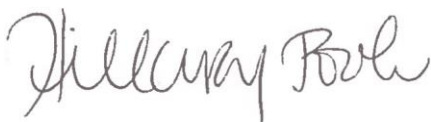
Semi-annual progress reports will be provided throughout the experimentation and a copy of the final results of the experimentation will be provided to the FHWA's Office of Transportation Operations within three months following completion of the experimentation.

### **I. Conclusion**

These advisory bike lanes are important to implement in order to create a safe and comprehensive bicycle network for the residents and visitors.

Please follow up with us directly regarding this request. Thank you.

Sincerely,



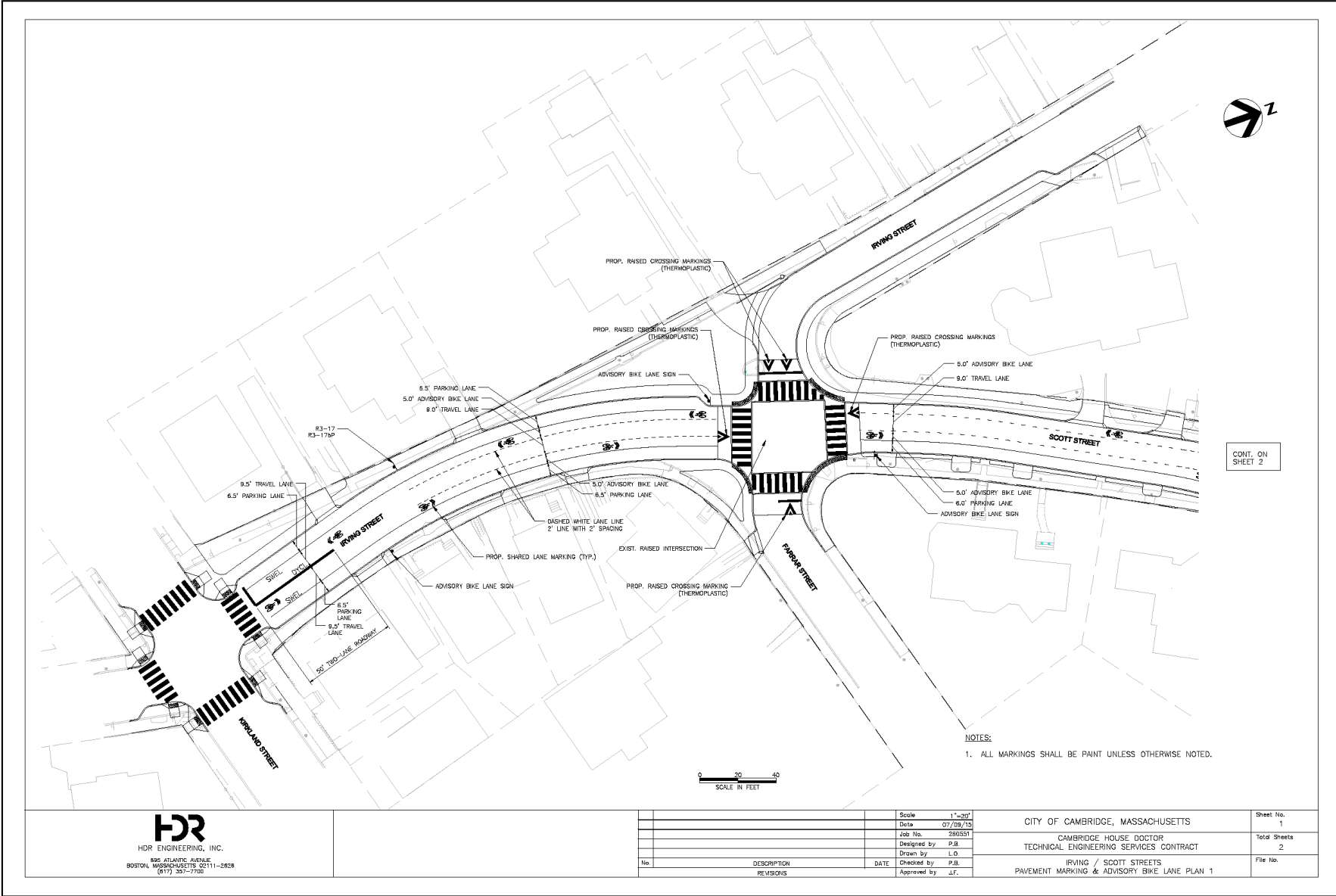
Hillary Poole, Complete Streets  
Coordinator Transportation Planning  
Division  
[Hillary.Poole@AlexandriaVA.gov](mailto:Hillary.Poole@AlexandriaVA.gov)



703-746-4017

Appendix F: Sample Striping Plan

This is one page of the Cambridge street striping plans for their ABL. It shows two intersections. One intersection is treated with 50 feet of centerline while another is left without. What is not shown is continuation of the bike lane markings through an intersection with a minor street using dashed lines.



## **Appendix G: Advisory Bike Lane Evaluation Report**

This appendix contains the evaluation report submitted by Boulder for the Harvard Lane facility as part of the FHWA experimentation process. Some formatting changes may have occurred during insertion of the report into this appendix.



## MEMORANDUM

**To:** Bruce Friedman  
Office of Transportation Operations  
Federal Highway Administration

**From:** David “DK” Kemp  
City of Boulder

**Date:** June 13, 2016

**Project:** Harvard Dashed Bike Lane – FHWA RTE 9(09)-70

**Subject:** FHWA Right to Experiment Final Report

### Harvard Dashed Bike Lane Experiment Overview

In the fall of 2014 the City of Boulder received permission from the Federal Highway Administration (FHWA) to experiment with Dashed Bicycle Lanes (DBLs) on Harvard Lane. <http://mutcd.fhwa.dot.gov/reqdetails.asp?id=1315>. The City of Boulder proceeded with installation of the DBLs in the fall of 2014 after receiving permission from FHWA to experiment. The DBLs were installed for 0.3 miles on Harvard Lane between Dartmouth Avenue and the Bear Creek Greenway multi-use path at Table Mesa Drive (see Figure 1). The DBLs were installed as approved by FHWA with experimental longitudinal markings for an on-street bicycle lane. Evaluation of the DBLs has occurred over the last year based on the approved performance measures from FHWA. This included community feedback, field observations, and “before” and “after” comparison of the performance objectives. This memo summarizes the results of three data collection efforts: before the installation in October 2014, 6 months after installation in April 2015, and one year after installation in October 2015. The key findings that are supported by the technical data at the end of this memorandum follow:

- DBLs resulted in fewer people riding bicycles in the center of the road
- People driving vehicles yielded to other people driving and riding bicycles
- DBLs did not change total crashes, travel speeds or demographics

Figure 1: Harvard Lane DBL from Dartmouth to the Bear Creek Multi-use Path



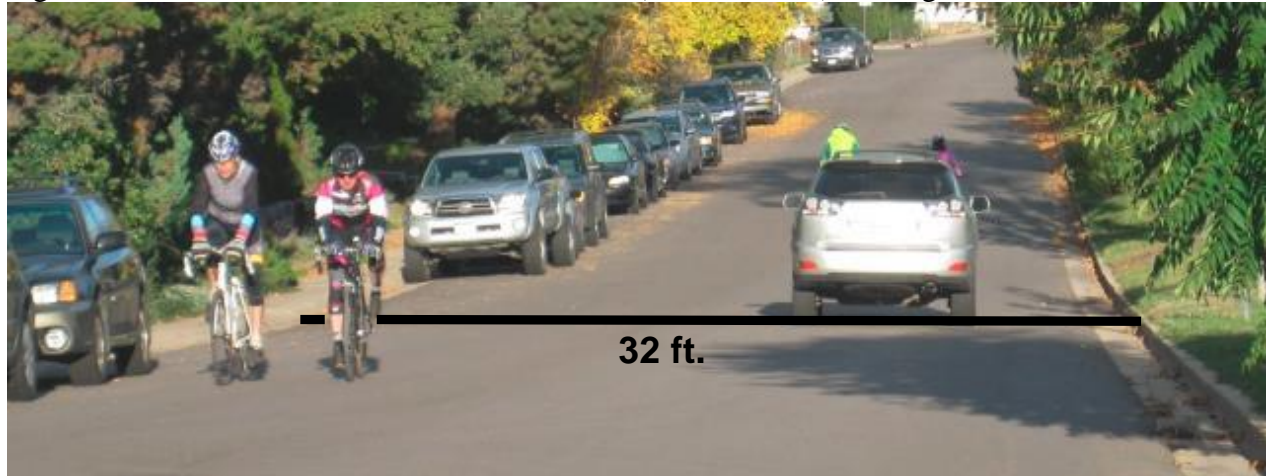
## Harvard Lane Before Conditions

Harvard Lane is a low volume residential street that provides a critical link in Boulder's bicycle network. The roadway is bounded on the north end by Dartmouth Avenue and on the southern end by Table Mesa Drive. The average weekday daily traffic on Harvard Lane is approximately 350 motor vehicles and 400 people on bicycles. The motor vehicle traffic is primarily local residential traffic, as northbound access for motor vehicles to Dartmouth Avenue is restricted. People on bicycles are allowed to ride northbound past Dartmouth Avenue. Harvard Lane is a popular connection for people riding bicycles between south Boulder, the University of Colorado and downtown Boulder. The south end of Harvard Lane also provides access to the east-west Bear Creek Greenway multi-use path. The corridor is relatively flat from the north end to Dover Drive. South of Dover Drive is a 4.8% uphill grade in the southbound direction.



Prior to the DBLs installation, Harvard Lane had a 32 feet wide curb-to-curb dimension and was a signed bicycle route (Figure 2). On-street parking was available along the west side of the street, serving the adjacent single and multi-family residential land uses. Parking was restricted along the east side of the street. There is an uphill grade on Harvard Lane in the southbound direction.

Figure 2: Harvard Lane before DBL installation (October 2014) looking northbound



## Why Demonstrate with a DBL?

Prior to the DBLs, people riding bicycles often used the full roadway width when riding on Harvard Lane. In some areas people were riding bicycles in the opposing travel lane to access the Bear Creek Trail located at the south end of the corridor. The DBLs were requested and installed to understand changes in people's driving and riding behaviours. The performance measures were established to document changes in all roadway user's safety and understand if DBL reduces possible roadway conflicts. In addition, the experiment would aid FHWA and the City of Boulder in determining if DBLs are a cost-effective and safe for use on similar roadways.

## Dashed Bike Lane Installation

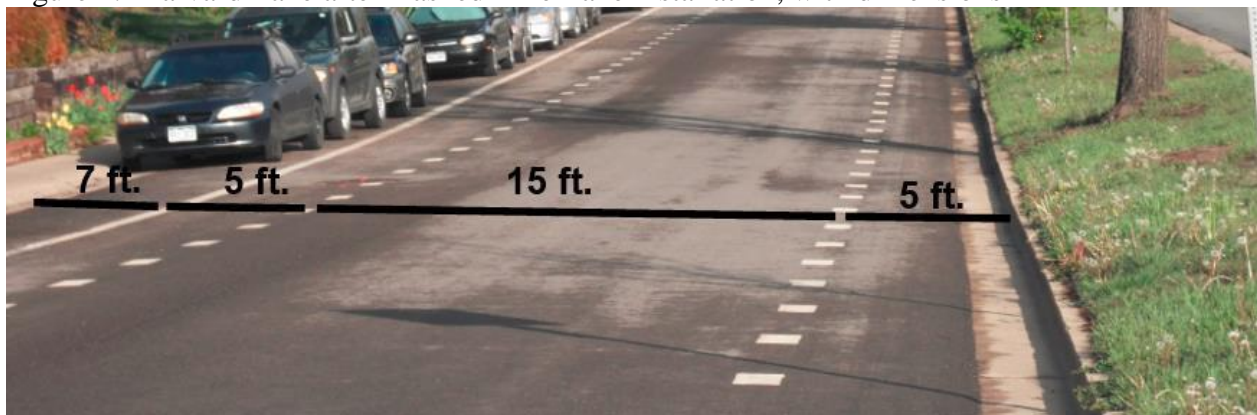
The DBLs were installed along Harvard Lane in mid-October of 2014 along the 0.3 miles of roadway (see Figure 3). The installation of DBLs did not require the reconstruction of Harvard Lane, only new pavement markings. A solid line delineating the parking lane was striped at 7 ft. from the west curb. A dashed line pattern was striped 5 ft. east of the solid parking line, designating the 5 ft. bike lane. An additional dashed line pattern was striped 5 ft. west of the east curb, leaving a 15 ft. bi-directional travel lane (see Figure 4). The 32-foot curb-to-curb dimension and on-street parking on the west side of the street were not altered.

Figure 3: Harvard DBL installation (October 2014)



The DBLs require sharing conditions between bicycles and motor vehicles. The dashed markings are meant to convey a permissive message to bicyclists and motor vehicle operators, allowing motorists to encroach into the bike lane when encountering an oncoming motor vehicle. When motor vehicles approach each other with a bicycle present, motorists are still expected to yield right of way to bicyclists.

Figure 4: Harvard Lane after Dashed Bike Lane installation, with dimensions



## Technical Results of DBL Field Observations

The project team collected 9 hours of video of people riding and driving in the corridor. This included video recording and field observations of vehicle and bicycle location in the roadway, volume and speed, bicyclist demographics, and bicyclist-vehicle and vehicle-vehicle interactions. The following section summarizes the observation periods:

- Before data on Tuesday, October 14, 2014 from 7:30 a.m. to 9:00 a.m. and from 4:00 p.m. to 5:30 p.m. The weather was sunny and ranged from 50-60 degrees.
- The first after data was collected on Wednesday, April 28, 2015 from 7:30 a.m. to 9:00 a.m. and 4:00 p.m. to 5:30 p.m. The weather was sunny and ranged from 50-60 degrees.
- A second round of after data was collected on Wednesday, October 15, 2015 from 7:30 a.m. to 9:00 a.m. and 4:00 p.m. to 5:30 p.m. The weather was cloudy and 40 degrees.

Figure 5: Sample video from the interactions on Harvard DBL (April 2015)



Table 1 summarizes the 9 hours of data collection in 2014 and 2015. It is important to note that people riding bicycles represent 80% of the AM and PM peak traffic on Harvard Lane during a typical weekday.

Table 1: Total Vehicles Observed During Before and After Harvard Data Collection

	Bicyclists	Motor Vehicles	Total
Before (October 2014)	274	51	325
After (April 2015)	239	76	315
After (October 2015)	207	42	249
<b>Total Observations</b>	<b>720</b>	<b>169</b>	<b>889</b>

### Changes in Bicycle Riding Location with the DBL

In video summaries and field data collected after the installation of the DBLs, the riding position of people riding bicycles was observed much like a street with standard on-street bicycle lanes. Prior to the DBLs, 73% of bicyclists were observed riding in the travel lane and 27% in the DBL area. After the DBLs were installed, 43% of all bicyclists were observed riding in the travel lane and 57% were observed riding in the DBLs. This represents a shift of 30% of bicyclists from the travel lane to the DBL.

Table 2: Bicycle Riding Location in Roadway

	Travel Lane Area	Dashed Bike Lane Area
Before (October 2014)	73%	27%
After (April 2015)	46%	54%
After (October 2015)	43%	57%



### Elevation and Utility Cover Influences on Bicycle Riding Location with the DBL

Video summaries collected after the DBLs were installed showed that people riding bicycles southbound (uphill) changed their position from the travel lane to the DBL. People riding southbound (uphill) are adjacent to parked vehicles. People riding northbound (downhill) also had changes in riding position. In the northbound direction, bicyclists ride downhill and adjacent to the curb. The higher percentage of northbound bicyclists riding in the travel lane as compared to the southbound bicyclists may be influenced by the faster downhill speeds and the 1.5 foot gutter pan and portions of 2 utility covers located within the southbound DBL.

Table 3: Southbound (uphill) Riding Location

	Travel Lane Area	Dashed Bike Lane Area
Before (October 2014)	60%	40%
After (April 2015)	5%	95%
After (October 2015)	4%	96%

Table 4: Northbound (downhill) Riding Location

	Travel Lane Area	Dashed Bike Lane Area
Before (October 2014)	85%	15%
After (April 2015)	81%	19%
After (October 2015)	65%	35%

### Motor Vehicle Yielding Behavior

A total of 118 motor vehicles were observed driving on Harvard Lane after the installation of the DBLs. The following provides a summary of the yielding interactions and behaviour of the 118 observations.

- In 53% of the observations of motor vehicles driving on the roadway, no other motor vehicle or cyclist was present. All but one of these motor vehicles were observed driving in the travel lane.
- In 32% of the observations, a motor vehicle was observed passing a cyclist.
  - In 13% of the observations, the motor vehicle and person riding a bike were traveling in the same direction.
  - In 19% of the observations the motor vehicle and person riding a bicycle were traveling in opposite directions.
  - In every case the motor vehicle maintained at least 4 feet of distance between the vehicle and bike.
- In 10% of the observations, two motor vehicles were observed passing one another without a cyclist present. In every case, the northbound vehicle yielded to the southbound vehicle by moving into the DBL zone. The predominant northbound motor vehicle yielding behavior may reflect a desire by southbound vehicles to avoid the “door area” of the adjacent parked vehicles.
- In 5% of these observations, two motor vehicles were observed passing one another with a cyclist present. In 5 out of the 6 observations, the motor vehicle traveling in the same direction as the cyclist was yielded to by the motor vehicle traveling in the opposite

direction, which moved into the DBL where no cyclist was present. In one case, the motor vehicle traveling in the same direction as the cyclist yielded to the oncoming vehicle by slowing down and moving into the DBL behind the cyclist.

### Collisions and Safety

The project team collected prior police reports of collisions and tracked crashes along Harvard Lane during the DBL experiment. There were four collisions reported on Harvard Lane between 2009 and the October 2014 before the installation of the DBLs. Three of the collisions were motor vehicle-motor vehicle collisions and one was a motor vehicle-bicycle collision. None of the collisions before the DBL resulted in serious injuries or fatalities. Between November 2014 and March 2016 there was one collision that involved a motor vehicle hitting an unattended parked car. The collision rate before the DBL was 0.68 per year and the collision rate during the DBL experiment was 0.70 per year. There were no collisions involving bicyclists during the DBL experiment. There were no injuries or fatalities during the DBL experiment.

### Motor Vehicle and Bicyclist Speeds

The project team collected speed data on Harvard Lane before and after the DBL installation. The installation of the DBL did not change motor vehicle or bicyclist speed during the peak travel periods. The speed limit along Harvard Lane is 25 mph. The results are listed below.

Table 5: Motor Vehicle Average Speed (Speed Limit = 25 mph)

	Avg. Speed	85 <sup>th</sup> Percentile
Before (10/14)	25 mph	29 mph
After (average 4/15 & 10/15)	24 mph	31 mph

Table 6: Bicycle Average Speed

	Average Northbound Speed	85 <sup>th</sup> Percentile Northbound	Average Southbound Speed	85 <sup>th</sup> Percentile Southbound
Before (10/14)	18 mph	21 mph	12 mph	16 mph
After (average 4/15 & 10/15)	19 mph	23 mph	12 mph	15 mph

### Demographics of People Riding Bikes

The gender of people riding bicycles was evaluated in the before and after condition based on bicycle types, clothing, accessories, and conversations in the field. The results are listed below.

Table 7: Gender of People Riding Bikes on Harvard

	Noted as Male Riding Bicycle	Noted as Female Riding Bicycle
Before (October 2014)	78%	22%
After (April 2015)	77%	23%
After (October 2015)	83%	17%

### Community Input Obtained Through the Course of the Experiment

The following comments were obtained during the experiment at a Transportation Open House in November 2015 and through an online survey form. Community input regarding the dashed bike lane facility has been mixed. Some people favor the facility and others did not see any value added.

- Harvard Lane did not feel like it needed work. I don't think the lanes as painted are adequate. Without the lane markings, I felt more comfortable riding where I felt most comfortable in the lane.
- I ride this a few times a month. The marked lines were nice but didn't add that much to what is basically a very safe and easy street to ride on.
- Think the dashed bike lanes would be a great opportunity to install a contra flow bike lane on Grant Street from College to Baseline Rd.
- This would be a great tool to use on Grant Street as a contra-flow climbing lane as an alternative to 9th street which is busy and dangerous.
- Good, inexpensive, easy- probably helps a little although I haven't had a problem riding here.
- This should be favored by motorists as it keeps us bikes from being all over the road.
- 2 words: Continue it! Please!
- Impressive results. Sounds like a win-win. Expand!
- Sounds like a great idea.
- This at least acknowledges bike rider potential and driver mindfulness.
- Make bike lane wider. It's too narrow as it stands.
- North bound lane too narrow to dodge uneven spots, so I find myself veering into traffic lanes several times along the route. Can it be widened?
- Like the lanes but they need to be wider. A separated bike path would be optimal. Better snow removal is essential.
- Are there bike symbols indicating where bikes belong?
- The Harvard lanes are I think are less great and I don't see a real improvement to the biking conditions. If anything it sends a message to bike to get over to the side of the road. Due to manhole covers and overgrown vegetation this doesn't work that well. Riding over manhole covers at night is surprising and uncomfortable. On this street with the low traffic volumes I like to ride side by side. If faster moving cars approach from the back they simply drive around. Again this treatment sends a message that cyclist should ride single file. I think sharrows on this section would work better.

### Next Steps

The City of Boulder staff recommends maintaining the Dashed Bike Lanes on Harvard Lane. Staff may consider other options for the corridor during future assessments of the City's transportation network. Staff will consider the experimental Dashed Bike Lane treatment for other locations if applicable.

## Appendix H: Public Outreach Documents

This appendix contains selected examples of public outreach material from the contacted agencies. The first is from Cambridge, MA. The second is from Edina, MN. The online video resources listed above may also be useful for public education.

### **NOTICE for Scott Street/Irving Neighborhood 10/31/16 Installation of Advisory Bike Lane Pavement Markings**

The reconstruction of Irving Street from Kirkland Street to Scott Street and Scott Street from Irving Street to Bryant Street was substantially completed fall 2014.

The temporary pavement markings installed in 2014 have worn away and the City is preparing to install new markings that will include a trial of a facility called an advisory bicycle lane. City staff held a community meeting on June 24, 2015 to discuss this concept with neighbors; the goals of the markings are to increase safety for bicyclists and further reduce vehicle speeds. The City will evaluate how the street is working over the next few months, monitoring before permanent markings are installed. Below is a photo rendering of how the pavement markings will generally look, as well as the accompanying sign. **The line striping work is scheduled for November 8, 2016 starting at 8 PM, weather permitting.**



#### **Advisory Bike Lanes**

Advisory bike lanes are used on streets that are too narrow for dedicated bike lanes. Advisory bike lanes look like dedicated bike lanes, except a dashed line is used in place of a solid bike lane stripe. A dashed line signals to drivers that they may drive in the bike lane space when a bicyclist is not present. Advisory bike lanes do not narrow the travel lanes or reduce the amount of roadway space that can be used by motor vehicles. Advisory lanes bring greater awareness to the roadway as shared space and can help to reduce vehicle speeds and improve roadway safety.

For more information on how to travel on a street with priority bicycle lanes please visit:

<http://www.cambridgema.gov/CDD/Transportation/bikesincambridge/biketoolbox>  
<https://www.youtube.com/watch?v=MzFP194pXy0>

For more information regarding this project contact Juan Avendano, [javendano@cambridgema.gov](mailto:javendano@cambridgema.gov), at 617/349-4655.

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Advisory bike lanes do not narrow the travel lanes or reduce the amount of roadway space that can be used by motor vehicles.

Advisory lanes bring greater awareness to the roadway as shared space and can help to reduce vehicle speeds and improve roadway safety.

Advisory bike lanes can be found on Wooddale Avenue, between W. 50th Street and Valley View Road, and on W. 54th Street, between France Avenue and Minnehaha Boulevard.

### When you drive:

- Drive as you would on any road without a center stripe, staying to the right of oncoming traffic.
- It is OK to drive in the advisory lane when a bicycle is not present.
- If a bicycle is in the advisory lane, move to the left, fully into the center area, to pass.
- If there is oncoming traffic in the center area, hang back behind the bicyclist until it is safe to pass.
- When passing, state law requires motorists to leave at least three feet of distance between their vehicle and the bicyclist.

### When you bike:

- Watch for motorists driving in or merging into the advisory lane.
- Always use caution and assume that turning or merging motor vehicles may not see you.
- When leaving the bike lane (such as to make a left turn) look behind you and signal your intentions.



*Advisory bike lanes look like dedicated bike lanes, except a dashed line is used in place of a solid bike lane stripe.*



*Motorists may drive in the advisory bike lane when a cyclist is not present. To pass a cyclist, move fully into the center area when safe.*

### Are advisory bike lanes experimental?

Experimentation is a formal process by which the Federal Highway Administration evaluates the safety and efficacy of new traffic control devices. Devices that are shown to be safe, to perform as intended, and to be understood by the general public are eligible to be considered for inclusion in a future edition of the Manual of Uniform Traffic Control Devices, the publication that governs the use of traffic control devices on public streets and highways.

Advisory bike lanes are currently being evaluated in Minneapolis and Edina.

For more information, please call the Edina Engineering Department, 952-826-0371.

