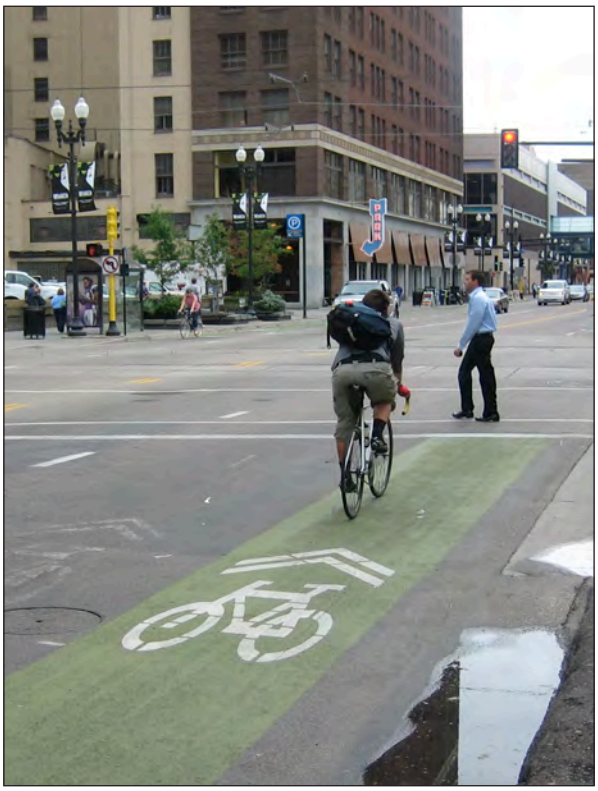
Hennepin Avenue Green Shared Lane Study



City of Minneapolis Department of Public Works
Traffic and Parking Services Division
August 2011

Minneapolis
City of Lakes

Executive Summary

In 2009, a one-mile stretch of Hennepin Avenue in downtown Minneapolis was converted from a one-way with a contraflow bus lane to a two-way street. Bicycle facilities along the corridor were changed from a center two-way bicycle lane to designated shared lanes for bicyclists, buses, and right turning motor vehicles. Shared lane markings and pavement text were utilized to mark the right travel lane. After initial concerns over the visibility and effectiveness of the lane markings, the facility was enhanced to include a solid green background. The 4-ft wide colored background extended the length each block with shared lane markings and text. This design was implemented in August of 2010.

In October of 2010, Public Works staff conducted a study to determine how bicyclists and motorists were interacting while using the shared lanes. Twenty-seven hours of traffic were recorded at 3 locations along Hennepin Avenue: Northbound south of Washington Avenue, northbound south of 4th Street, and southbound south of 7th Street. The locations represented two lane widths (13.5-ft and 18.5-ft shared lanes). In addition, an online survey was administered in July of 2011 to determine public perception of the green lanes, comprehension of the new facility, and changes to travel patterns before and after the changes to Hennepin and parallel corridors. The survey received 494 responses, primarily from bicyclists.

The study concluded the following results:

- Most bicyclists (79-93%) rode in the green lane, however riding varied significantly by lane width.
- Motor vehicles tended to travel to the left of green lane when traveling in the 18.5-ft lanes, but encroached on the green lane when traveling in the 13.5-ft lane. Buses tended to encroach on the green lane for both lane widths.
- Results were inconclusive as to whether motor vehicles and buses were giving a safe passing distance (>3 ft) when overtaking bicyclists.
- Bicyclist volumes on Hennepin Avenue decreased from 1,190 to 990. Survey results indicate that this change can be attributed to new or improved bicycle facilities along parallel corridors.
- The safety of bicyclists improved with the addition of the green lanes. Bicyclist crash rates decreased from 1.03% to 0.4%. Survey results show that approximately one-third of bicyclists feel safer with the addition of the green lanes while another third feel there is no change in their perceived safety.
- When traveling in the right lane on Hennepin, most survey respondents thought a bicyclist should ride in the green lane and most thought that motor vehicles should ride to the left of the green lane. This is similar to the behavior of those traveling in 18.5-ft lanes, however not in 13.5-ft lanes. Survey results show that most survey respondents felt the consistency of where bicyclists ride in the road has improved.
- Most survey respondents expressed dissatisfaction with the changes to Hennepin Avenue, citing lack of adequate space, the desire for a defined or separated facility, and lack of comprehension of the current configuration.

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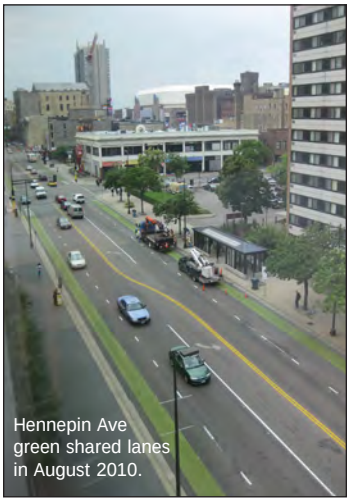
Hennepin Ave green shared lanes in August 2010.

For questions about this report, please contact Simon Blenski at 612-616-7345 or simon.blenski@minneapolismn.gov.

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Project Background

From 1980 to 1994 Hennepin Avenue was a one-way street running north through downtown Minneapolis. In 1994, a two-way bicycle lane was added down the center of Hennepin in addition to a southbound contra-flow bus lane. This was implemented until 2009.

As part of the 2007 Access Minneapolis Plan, several projects were implemented to increase the mobility of downtown travelers. As part of the plan, Hennepin Avenue was converted to a two-way street. Bicycle facilities along Hennepin were changed from center running bicycle lanes to shared lanes for bicyclists, buses, and right turning motor vehicles. Shared lane markings were used to mark the right travel lane in both the north and southbound directions. Following implementation in 2009, approximately 20,000 motor vehicles and 1,000 bicyclists traveled along Hennepin daily. During peak periods, approximately 20-30 buses used the corridor per hour.

After initial concerns over the visibility and effectiveness of the lane markings, the facility was enhanced to include a solid green background. The 4-ft wide colored background extended the length each block and was marked with shared lane markings and text. This experimental design was approved by the Federal Highway Administration and implemented in August of 2010.

Center Bicycle Lanes
(1994-Fall 2009)

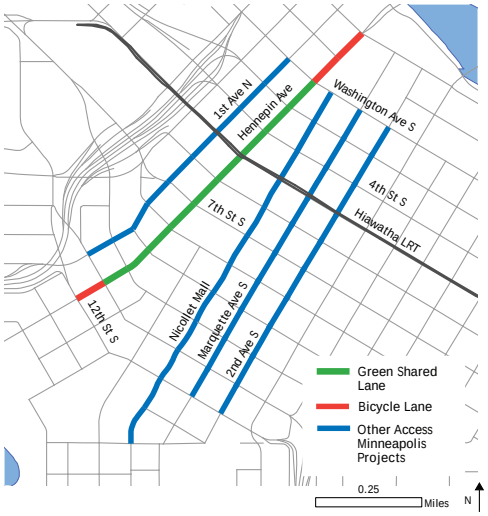
Shared Bicycle, Bus, and Right Turn Lanes
(Fall 2009-Summer 2010)

Green Shared Lane
(Installed Summer 2010)

In addition, bicycle and transit improvements were made to parallel corridors including:

- 1st Avenue North: One to two-way conversion and the addition of a cycle track
- Nicollet Mall: Transit improvements and improved bicycle access during weekday periods
- Marquette/2nd Avenues South: Transit improvements and off peak bicycle access

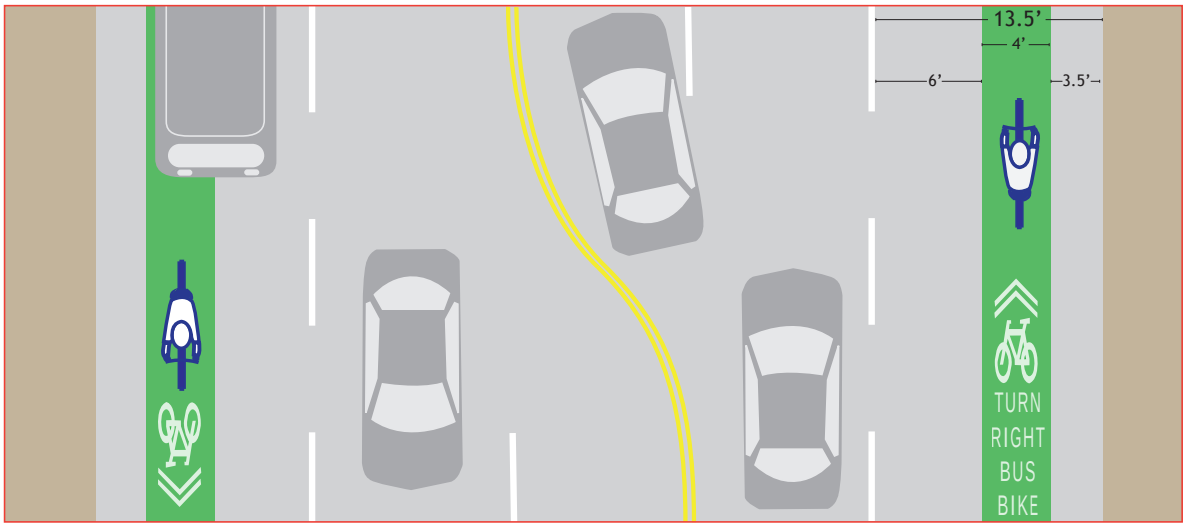
These projects had an overall effect on travel patterns in and through the downtown area. However, this study primarily focused on traffic behavior along Hennepin Avenue, and did not measure the direct influence of projects made to parallel corridors.



The enhanced green shared lanes were installed from Washington Avenue South to 11th Street South. Traditional bicycle lanes extend two blocks north to 1st Street South and one block south to 12th Street South.

Current Corridor Conditions

The current right-of-way of Hennepin Avenue offers two types of one-block cross sections: One with a 13.5-ft shared lane and one with an 18.5-ft shared lane. The roadway width is 59 ft, allowing for two northbound travel lanes and two southbound travel lanes. Along the corridor, there are alternating one-way cross streets so left turn lanes are placed every other block. The width of the roadway remains consistent so blocks with left turn lanes require reduced travel lane widths. To accommodate the left turn lane, the right travel lane is reduced to 13.5 ft.



Hennepin cross section for blocks with a left-turn lane and a 13.5-ft right travel lane. Note that images are not to scale.

For blocks in which there is no left turn lane, the right travel lane is 18.5 ft. Public works staff were especially interested to see if the alternating lane width affected riding or driving position of road users.

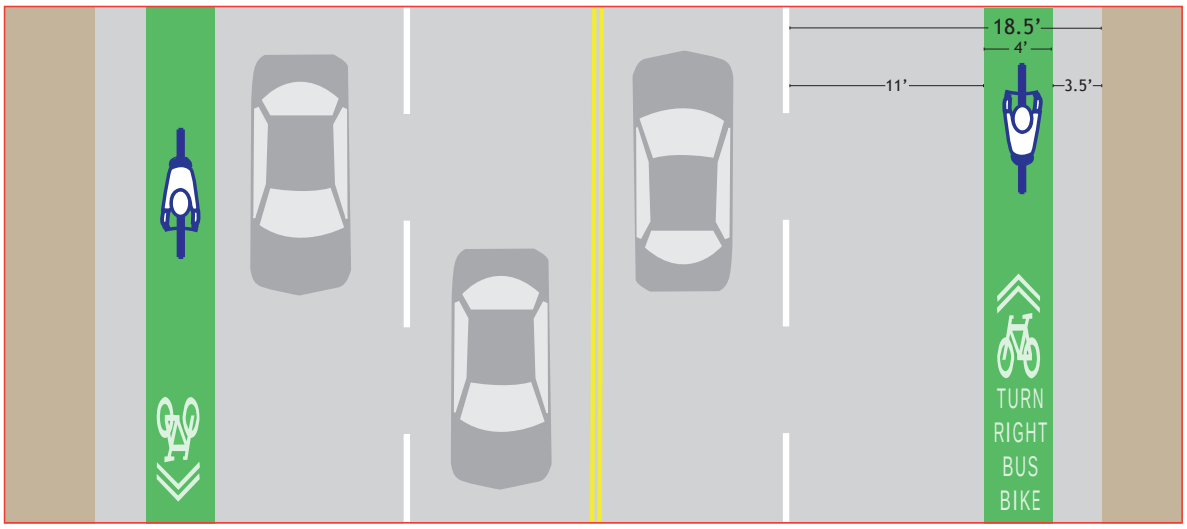


Figure 2: Hennepin cross section for blocks with a left-turn lane and an 18.5-ft right travel lane.

The right travel lane in each direction is a shared lane for bicyclists, buses, and right turning motor vehicles. This lane contains the green shared lane marking. The marking consists of a white bicycle and chevron symbol with a 4-ft wide solid green background that extends the length of

the block . The shared lane includes two bicycle chevron symbols per block, and text at the start of each block that reads “Bike, Bus, Right Turn”. The green colored pavement does not extend through intersections.

In addition to the pavement markings, static signage is present along the corridor and displays messages similar to the pavement text. Variable message signage is also used on overhead message boards installed as part of the Access Minneapolis project. The variable message signs display the same information found on the static signage and pavement text. The effect of the static and variable message signage was not directly measured in this study.

Shared lane pavement text

Shared lane marking

Static Signage

Overhead variable message signage

Research Questions and Methodology

The primary goal of this study is to understand how bicyclists and motorists interact while using the Hennepin Avenue green shared lanes. Specific questions and methodology developed for the study are as follows:

1. Are bicyclists using the green lane and where are they riding?
   Parameters & Methodology: Bicyclist riding position using video analysis
2. Are motor vehicles and buses driving in the green lane and where are they driving?
   Parameters & Methodology: Motor vehicle and bus driving position using video analysis
3. Are motorists and buses giving a safe passing distance (>3 ft) when overtaking bicyclists?
   Parameters & Methodology: Road user driving or riding position using video analysis
4. Does driving or riding behavior vary by lane width?
   Parameters & Methodology: Road user driving or riding position using video analysis
5. Have bicyclist volumes on Hennepin Avenue changed with the addition of green lanes?
   Parameters & Methodology: Daily bicyclist volumes using manual bicyclist counts
6. Has the safety of bicyclists improved with the addition of the green lanes?
   Parameters & Methodology: Bicyclist-motorist crash rates using MN DPS accident reports
7. How do road users comprehend and perceive the green lanes? Does this differ from actual driving or riding behavior?
   Parameters & Methodology: Survey of Downtown Travelers

An effort was also made to analyze intersection behavior to determine if right turning motorists yield to through riding bicyclists. However, this goal was removed after initial observations revealed that driver behavior was impacted by many factors along the corridor. Due to high traffic volumes along Hennepin Avenue, it could not be determined if motorists were yielding for bicyclists, pedestrians, other motor vehicles, or a combination of all three.

Other than bicyclist traffic counts and bicyclist-motor vehicle crash data, it should be noted that before data was not collected for this project due to the quick turnover from the initial shared lanes to the green shared lanes. This is primarily an observational evaluation rather than an evaluation based on defined data parameters.

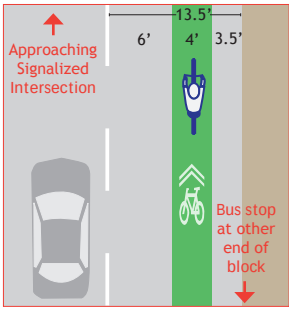
A bicyclist rides along Hennepin north of 5th Street South.

Site Selection

Three locations were selected along Hennepin Avenue to observe activity in the green shared lanes. A fourth location was selected at the south end of the corridor where a traditional bicycle lane was present. This location was not selected for a control, but rather for basic comparison. The locations were selected based on the placement of existing overhead cameras installed on traffic signals. While site selection was generally limited to the location of these existing cameras, panning and zooming allowed for some flexibility with viewing options.

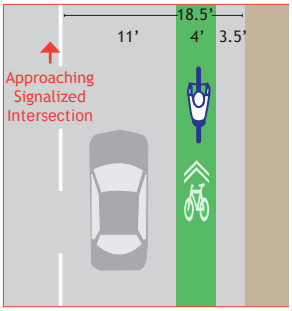
The three green shared lane locations provided the opportunity to observe the effect of the varying lane width, queued traffic and accelerating traffic, and the presence of bus stops.

Hennepin Avenue northbound, south of Washington Avenue



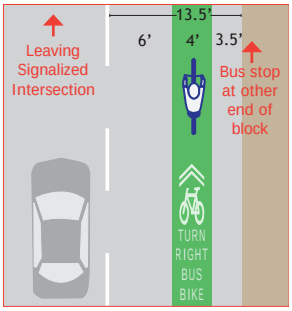
- 13.5-ft shared lane
- Approaching signalized intersection
- Affected by traffic queues stopped at red traffic signal and right turning vehicles
- Bus stop present at opposite end of block

Hennepin Avenue northbound, south of 4th Street



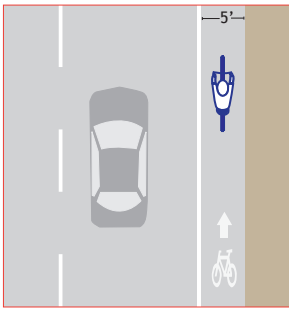
- 18.5-ft shared lane
- Approaching signalized intersection
- Affected by traffic queues stopped at red traffic signal and right turning vehicles
- No bus stop present on block

Hennepin Avenue southbound, south of 7th Street



- 13.5-ft shared lane
- Leaving signalized intersection
- Affected by accelerating traffic and traffic turning left off of 7th Street
- Bus stop present at opposite end of block

Hennepin Avenue northbound, north of 12th Street



- 5-ft traditional bicycle lane
- Used for comparison against the green shared lane location

Site Preparation

To measure the riding position of bicyclists and the driving position of motor vehicles and buses, small hatch marks were painted across the right travel lane in 1-ft intervals. The edges of the green shared lane were also outlined to increase visibility when viewed through the traffic cameras. The hatch marks were selected as a more cost-effective way to replicate the video and image analysis used in similar studies. A review of methodologies used to guide this study can be found in Appendix C.

The hatch mark increments were accurately measured, however the precision of the marks may have flaws due to pavement texture and variation during application. Another consideration to account for is that the facility itself was altered. The addition of the hatch marks may have confused or distracted roadway users and the outline of the green lane could have enhanced the visibility of the green lane. The impact and perception of these markings is unknown to roadway users. However, because the altered space represents a small percentage of the entire length of the corridor, the impact was likely minimal.

Less detailed data was gathered at the 12th Street location so hatch marks and lane markings were not required there.

The prepared observation site south of 4th Street South. Note that prior shared lane markings, although faded, were still visible to the left of the green shared lane.

Recording and Tabulation

Observations were recorded from Monday, October 17 to Thursday, October 20, 2010. Twenty-seven hours of data was collected at the green lane locations. At each site, a morning period (7:30 am-8:30 am), mid-day period (11:00 am – 12:00 pm) and afternoon period (5:00 pm- 6:00 pm) was recorded three times over the course of three days. Recording began during the afternoon period on October 17 and ended after the midday period on October 20. The same recording schedule was done for the comparison location at 12th and Hennepin. In total, 36 hours of footage was recorded.

The Hennepin Avenue and 7th Street location had some technical challenges during recording. There was intermittent static interference with the camera connection. This resulted in about 10-15 minutes of non-viewable footage during each hour of recording. Due to this issue, the number of recorded observations was lower than at the other locations.

The video was viewed by Public Works staff and vehicle location and traffic behaviors were noted. The types of observations tabulated were:

Riding and Driving Position

- Bicyclist riding position: The riding position was tabulated based on the location of the front tire as the bicycle passed over the hatch marks.
- Motor Vehicle and Bus driving position: The driving position was tabulated based on the location of the outside edge of the front passenger's side tire as the vehicle passed over the hatch marks.
- Motorcycles, mopeds, RV's, large trucks, and tour buses were all included within the motor vehicle category. Buses only constituted buses used for public transportation. The majority of these buses were Metro Transit vehicles.

Example of a bicyclist, motor vehicle, and bus passing through the observation site north of 4th Street South.

If two or more vehicles (including a bicycle) were present in the shared lane at the same time, the following traffic behavior was recorded.

- The riding or driving position of each vehicle was tabulated using the above criteria.
- The movement of each vehicle: Whether one was in motion, one was stationary, or the vehicles were traveling in a parallel formation (traveling at relatively the same speed).
- If one vehicle overtook another vehicle within a proximate distance of the hatch marks, it was noted which vehicle overtook the other.

Lastly, the direction of travel for each vehicle was recorded (moving in the designated flow of traffic or traveling the wrong way).

- Bicyclist wrong way riding
- Bus or Motor Vehicle wrong way driving

Tabulation Methodology and Notes

Vehicle positions were estimated using the hatch marks on the roadway and were rounded down to the nearest foot. A datum of zero represented the curb and hatch marks increased in 1-ft increments towards the centerline. For example, a front bicycle tire passing between the fourth and fifth tick mark was recorded as 4 ft. Or, the right edge of a motor vehicle tire passing between the sixth and seventh tick mark was recorded as 6 ft. Due to rounding the margin of error for each observed vehicle may be up to 1 ft.

Only vehicles and traffic movements occurring within the shared lane were tabulated. A vehicle was tabulated if it was either fully or partially traveling in the shared lane. However, if a motor vehicle or bicycle was traveling in the left travel lane or in the left turn lane, they were not included as an observation. No sidewalk activity was tabulated or analyzed as part of this study.

A bicyclist riding through the prepared site south of Washington Avenue.
This bicyclist would have been recorded as riding 4 ft from the curb.

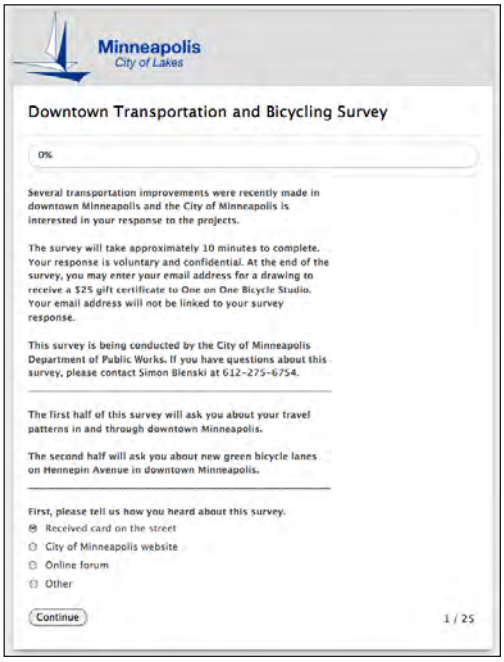
If multiple vehicles overtook the same stationary vehicle, the stationary vehicle was tabulated multiple times in order to be paired with each of the passing vehicles. For example, if two bicyclists overtook the same stationary bus, the bus was tabulated twice. While this double-counted vehicles during the recording process, the proportion of double-counted vehicles to total observations was marginal.

At the comparison location north of 12th Street, only bicyclists were observed. Riding position was only tabulated as "Riding in the bicycle lane" or "Not riding in the bicycle lane." This was used to compare how many bicyclists use the green shared lanes compared to a standard bicycle lane.

Public Survey

Survey Administration

In addition to video collection, a public survey was conducted to understand user comprehension and perception of the green shared lanes. The survey also sought to better understand how the new facility, in addition to other recent changes to downtown transportation infrastructure, have affected the travel patterns of bicyclists and other users. While bicyclists were the primary audience for the survey, it was designed to be completed by all downtown travelers regardless of their primary transportation mode.



The online interface used to conduct the survey.

The survey was administered online through a web-based survey program from July 12-August 5, 2011. The survey was 26 questions long and was designed to be completed in 10 minutes. After completing the survey, participants could enter a drawing to win a $25 gift card to a local bicycle shop. The complete survey text can be found in Appendix B.

Survey Promotion

The survey was actively promoted through the City of Minneapolis website, the Downtown Commuter Connection website, and the local bicycling forum Minneapolis Bike Love. The survey link was quickly disseminated by other parties to Facebook, Twitter, and related bicycling and community blogs.

In addition to promoting the survey online, approximately 800 survey cards were handed out to downtown bicyclists or attached to bicycles parked in or near downtown.

In addition to online promotion approximately 800 survey cards were handed out to downtown bicyclists. Survey cards were handed out at several locations to bicyclists riding in and out of downtown. Cards were also attached as spoke cards on bicycles parked in and around downtown. Another 250 cards were placed at downtown bicycle shops, the Commuter Connection store, and various retail establishments. While bicyclists were the primary target of the survey, cards were also handed out to pedestrians in downtown under the assumption that many of the pedestrians could also be motorists, transit users, and bicyclists.

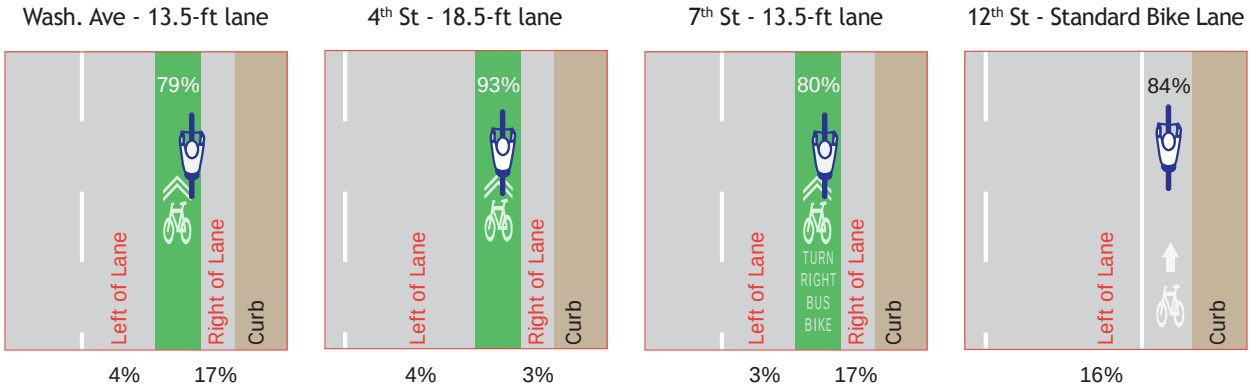
Public Works received 494 valid responses to the survey. The findings are summarized on page 18 and the complete results can be found in Appendix C.

Technical Results: Traffic Behavior

A total of 4,428 observations were tabulated including 3,506 motor vehicles, 480 buses, and 442 bicyclists. The technical results summarizing traffic behavior and video analysis are as follows. Complete data can be found in Appendix A.

Bicyclist Use of Green Shared Lane

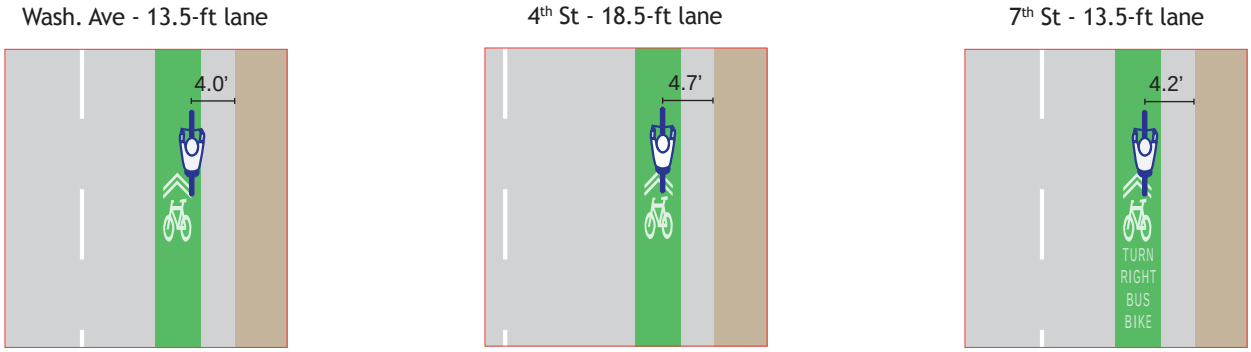
At all three locations, most bicyclists used the green shared lane. At Washington Avenue and 7th Street (13.5-ft shared lanes), 79% and 80% of bicyclists rode in the green lane, respectively. At 4th Street (18.5-ft shared lane), 93% of bicyclists rode in the green lane. Bicyclists riding outside of the green lane, tended to ride to the right of the lane and close to the curb. Comparatively, 84% of bicyclists rode in the bicycle lane at the 12th Street location where a standard bicycle lane was present.



Percentage of Bicyclists Riding in Green Lane and Bicycle Lane

Bicyclist Mean Riding Position

Most bicyclists rode in the green lane or to the right of the lane at all three locations. However, bicyclists rode significantly[1] closer to the curb in the 13.5-ft lanes than in the 18.5-ft lanes.[2] Bicyclists also rode significantly closer to the curb when approaching a signalized intersection than when leaving a signalized intersection.[3]



Bicyclist Mean Riding Distance from Curb

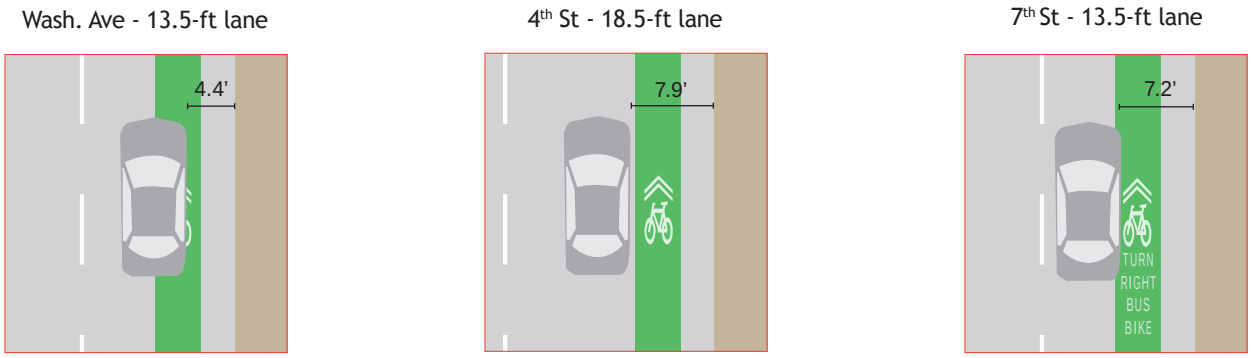
[1] "Significant" indicates that there was a statistically significant difference between the compared means. Significance was determined using a simple t-test. All significant results yielded a p-value<0.05.

[2] The Washington Avenue and 4th Street locations were used when comparing lane width.

[3] The Washington Avenue and 7th Street locations were used when comparing approaching/leaving an intersection.

Motor Vehicle Mean Driving Position

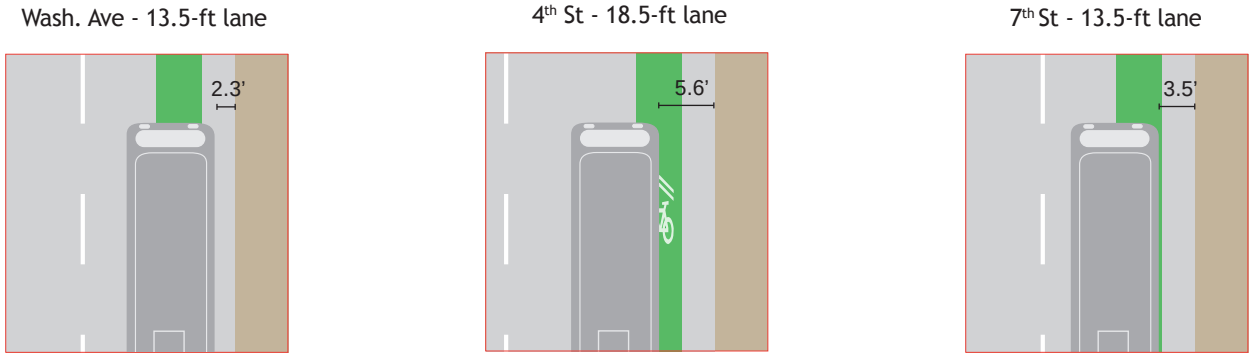
Motor vehicle driving position varied significantly by location. At the Washington Avenue location the mean motor vehicle driving position was 4.4 ft from the curb - causing the vehicle to cover approximately half the green lane. At the 4th Street location the mean riding position was 7.9 ft from the curb - slightly to the left of the green lane. At the 7th Street location, the mean riding position was 7.2 ft from the curb - slightly covering the green lane. Compared to Washington Avenue, the larger mean distance at the 7th Street location was due to the fact that many observed vehicles made wide left turns from 7th Street onto Hennepin Avenue. The mean driving position for through motor vehicles traveling on Hennepin at this location may be closer to the curb.



Motor Vehicle Mean Riding Distance from Curb

Bus Mean Driving Position

Similar to motor vehicles, bus driving position varied significantly by location. Buses tended to drive closer to the curb when traveling in the 13.5-ft lanes than in the 18.5-ft lanes. At the Washington Avenue location the mean bus driving position was 2.3 ft from the curb - causing the vehicle to completely cover the green lane. At the 4th Street location the mean riding position was 5.6 ft from the curb - covering approximately half of the green lane. At the 7th Street location, the mean riding position was 3.5 ft from the curb - completely covering the green lane. While the narrower lane width likely caused buses to drive closer to the curb at the 13.5-ft lane locations, the proximity of bus stops may have contributed to the driving position. At the Washington Avenue and 7th Street locations, a bus stop was present at the opposite end of each of the blocks. The 4th Street location did not have bus stop present on the block.

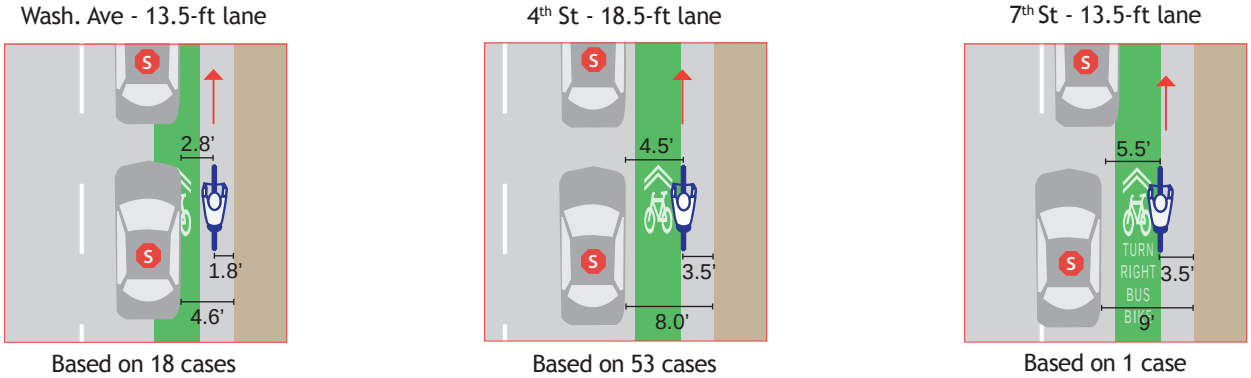


Bus Mean Riding Distance from Curb

Bicyclist-Motor Vehicle Behavior

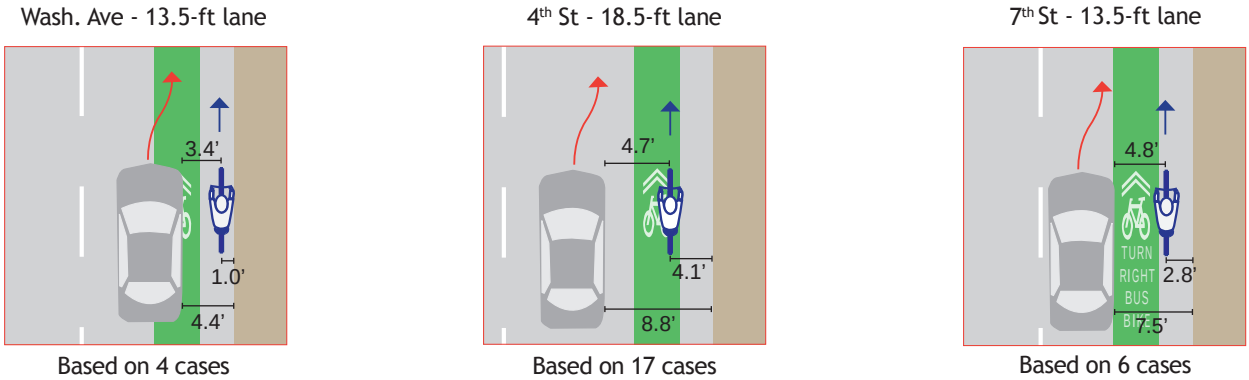
There were 99 observed cases when a bicyclist and motor vehicle were present in the shared lane at the same time. Of those, two types of events occurred most frequently: 1) Bicyclist overtaking a stationary motor vehicle and 2) A motor vehicle overtaking a moving bicyclist.

Bicyclists overtaking stationary motor vehicles occurred most frequently in the afternoon peak period when motor vehicles were queued at red traffic signals. This type of event occurred most often at the 4th Street location (18.5-ft shared lane). The average bicyclist riding position, motor vehicle driving position and passing distance varied by location, although the small sample size did not yield statistically significant results.



Mean passing distance for a bicyclist overtaking a stationary motor vehicle.

Motor vehicles overtaking moving bicyclists occurred less frequently than bicyclists overtaking stationary motor vehicles. This type of event occurred more often in the afternoon peak period than in during the morning or midday periods. Again, the average bicyclist riding position, motor vehicle driving position and passing distance varied by location, although the small sample size did not yield significant results. While it appears that on average, motorists were giving bicyclists a safe passing distance the small sample size and other limitations make the results inconclusive.[1]



Mean passing distance for a motor vehicle overtaking a moving bicyclist.

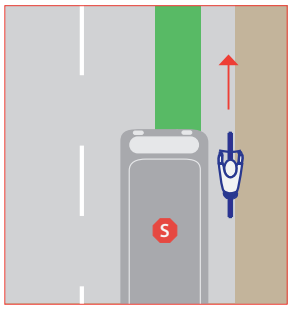
[1] Minnesota law states that motor vehicles overtaking a bicyclist must leave "a safe distance, but in no case less than three feet clearance." (MN Statute 169.18) For this study, 3 ft was used as the threshold for safe passing distance. However, because lateral distance between vehicles was measured from the motor vehicle tire to the front bicycle tire, the effective lateral clearance may be less. A side view mirror on a motor vehicle or bus may extend 6 inches or more past the outside of the passenger's side tire. Also, the AASHTO bicycle facility design manual requires an essential lateral maneuvering space for bicyclists of at least 3 ft. Assuming a bicyclist is positioned symmetrically on a bicycle, an average bicyclist extends 1.5 ft to either side of the front bicycle tire. Incorporating side view mirrors and bicyclists' essential lateral maneuvering space, the observed distance in this study may decrease up to 2 ft.

Bicyclist-Bus Behavior

Out of a total of 442 bicyclists and 480 buses, there were 21 observed cases when a bicyclist and bus were present in the shared lane at the same time. The observations can be separated into two types of events: 1) Bicyclist overtaking a stationary bus and 2) A bus overtaking a moving bicyclist.

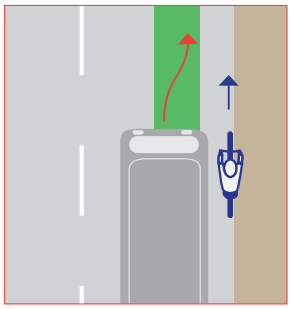
There were 17 cases of bicyclists overtaking stationary buses. Most occurred during the afternoon peak period when buses were queued at red traffic signals. Fifteen cases occurred at the 4th Street location, two at the Washington Avenue location, and none at the 7th Street location. There were four cases of buses overtaking moving bicyclists. For both types of events, the average bicyclist riding position, bus driving position and passing distance varied by location, although the small sample size did not yield significant results.

All locations



Bicyclist overtakes stationary bus - 17 cases.

All locations



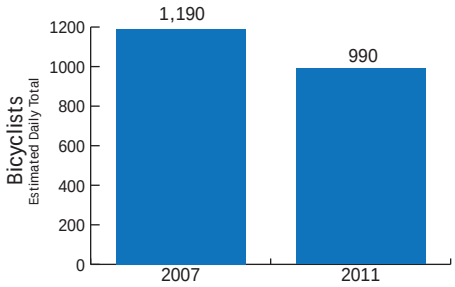
Bus overtakes moving bicyclist - 4 cases.

Wrong-Way Riding and Driving

Of the 442 observed bicyclists, four were observed riding against the flow of traffic. Three of the observed cases were at the 4th Street location and one was at the 7th Street location. No motor vehicles or buses were observed driving against the flow of traffic.

Technical Results: Bicyclist Traffic Volumes

In 2007, an estimated 1,190 bicyclists used Hennepin Avenue when the street was one-way and there were center bicycle lanes. After the one-way to two-way conversion and the addition of the green shared lanes, volumes decreased to 990 in 2011. These estimates are based on 12-hr manual counts conducted at Hennepin Avenue north of 7th Street. Bicyclist counts over a similar period show that bicycling traffic has increased along 1st Avenue N and Nicollet Mall, suggesting that bicyclists may have altered their routes after the street conversion.[1]

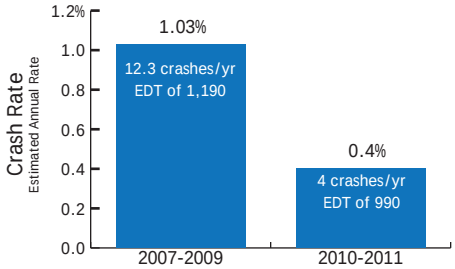


Change in bicyclist volumes 2007-2011. Estimated daily totals base on 12-hr counts at 7th St and Hennepin.

Technical Results: Bicyclist-Motorist Crashes

To determine if the safety of bicyclists improved with the addition of the green lanes, crash data was obtained from Minnesota Department of Public Safety accident reports. Data was analyzed from 3 years before the one-way to two-way conversion (2007-2009) and after the green shared lanes were installed (2011). Only crashes involving a bicyclist and motorist were analyzed. Crash rates along Hennepin Avenue were derived by taking the ratio of reported crashes to estimated daily bicyclists.[2]

It was determined that the crash rate prior to the two-way conversion was 1.03%. This was based on an average of 12.3 crashes per year from 2007-2009 and a bicyclist estimated daily total of 1,190. With the addition of the green lanes, the crash rate decreased to 0.4%. This was based on 4 crashes and a bicyclist estimated daily total of 990. Crash rates representing the shared lanes prior to the addition of the green lanes could not be derived due to the lack of bicyclist count data during that time period.



Change in bicyclist volumes 2007-2011. Estimated daily totals base on 12-hr counts at 7th St and Hennepin.

While the number of crashes and the crash rate decreased with the addition of green lanes, the results are not definitive. Crashes are known to fluctuate from year to year, so examining data over a longer period would be beneficial. Public Works' staff will continue to monitor crashes and the overall safety of the corridor.

[1] *Hennepin and 1st Ave Two-Way Conversion Evaluation Report, July 2010* - www.minneapolismn.gov/hennepinfirst/

[2] Crashes were analyzed along Hennepin Avenue from Washington Avenue to 12th Street, while bicyclist volumes were obtained from counts on Hennepin Avenue north of 7th Street. It is assumed that bicyclist volumes at 7th Street are representative of volumes along the entire study area.

Public Survey Results

A total of 494 valid survey responses were received. Results summarizing the responses of the public survey are found below. A copy of the survey can be found in Appendix B and complete survey results can be found in Appendix C.

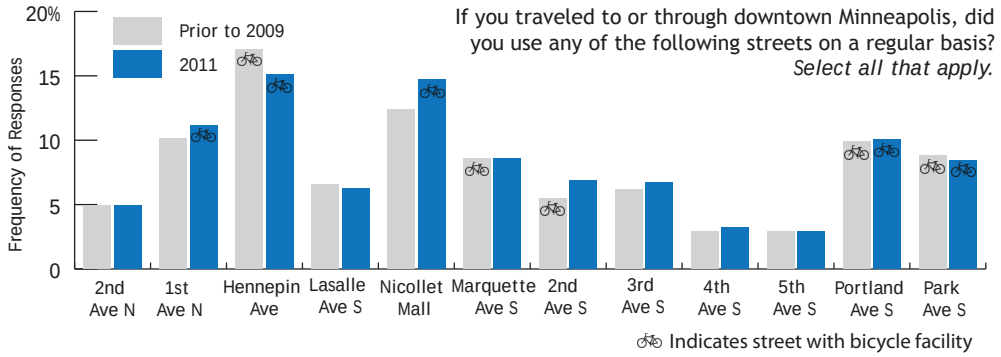
Respondent Personal Attributes

Basic personal information was asked of participants including home zip code, frequency of downtown visits, purpose of downtown visits, and transportation mode choice when traveling to or through downtown Minneapolis. The relevant responses are as follows:

- 82% respondents live in Minneapolis.
- 72% of respondents travel to or through downtown Minneapolis at least twice a week.
- "Entertainment" and "Work" are the most frequently stated purpose of downtown visits.
- 87% of respondents said they use a bicycle as a form of downtown transportation.
- Over 50% of respondents said they use a car or transit for at least some downtown visits.
- 84% of bicyclists indicated they are at least "Somewhat confident" bicycling in downtown traffic.

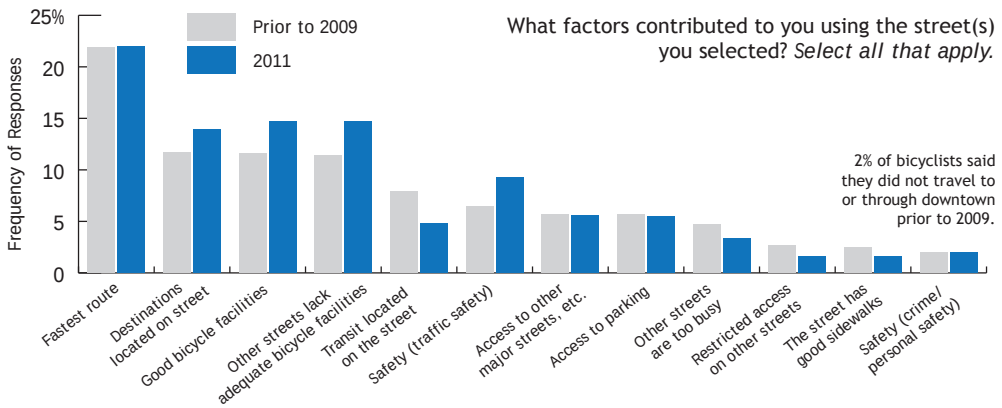
Changes in Bicyclist Travel Patterns

The first half of the survey asked participants about their travel patterns before and after the recent changes to Hennepin Avenue and other north-south streets in downtown. Responses from downtown bicyclists show that prior to 2009, Hennepin Avenue was the primary route to and through downtown, followed by Nicollet Mall and 1st Avenue N. After the changes, a lower percentage of bicyclists used Hennepin Avenue and a greater percentage used Nicollet and 1st Avenue N. Results show that Hennepin Avenue and Nicollet Mall are now equally traveled by respondents who bicycle downtown.[1]



When asked to select the factors that contribute their downtown travel patterns, downtown bicyclists most frequently selected "Fastest route". This was followed by "One of my destinations is located on that street", "Good bicycle facilities", and "Other streets lack adequate bicycle facilities". These factors remained relatively consistent between 2009 and 2011, however the frequency of "Transit is located on this street" decreased and the frequency of "Safety (traffic)" increased.

[1] Due to the nature of the survey questions, these travel patterns are not exclusive to bicyclists and may reflect trips made by modes other than by bicycle.



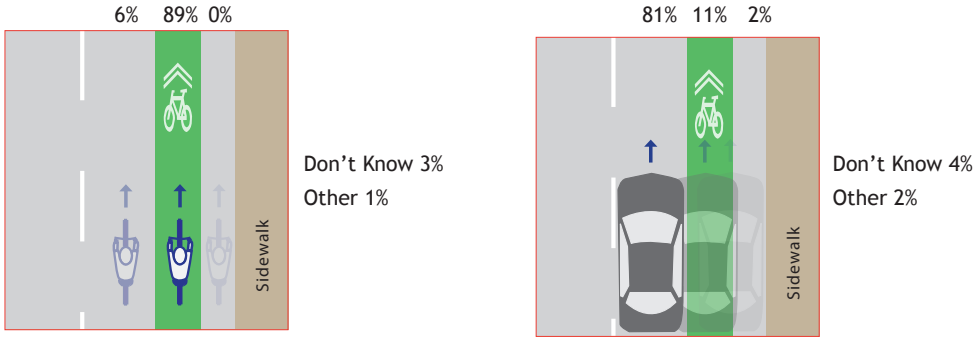
Respondents whose travel patterns changed were asked to elaborate on the changes. Nearly all respondents' travel patterns changed at least somewhat and 199 respondents chose to elaborate on those changes. While answers varied due to work, home, or personal changes, most responses expressed either satisfaction or dissatisfaction with changes to downtown bicycling facilities as primary factors in their changes. The most frequently mentioned responses are as follows.

Please briefly explain why you altered your travel patterns.

Rank	Response	Freq.
1	Dissatisfied with Hennepin Ave changes	67
2	Dissatisfied with 1st Ave N changes	38
3	Satisfied with Nicollet Mall changes	38
4	Satisfied with 1st Ave N changes	26
5	Satisfied with overall changes	25
6	Satisfied with Marquette/2nd Ave S changes	17
7	Satisfied with Cedar Lake Trail extension	15
8	Satisfied with Hennepin Ave changes	14
9	Dissatisfied with Nicollet Mall changes	12
10	Bus Route Changed (neutral response)	10

Comprehension and Perception of the Green Shared Lanes

The second half of the survey asked participants about the green shared lanes on Hennepin Avenue. Most (82%) respondents had seen the green shared lanes so it assumed that most responses are based on experience, rather than presumption. When asked to select where a bicyclist should ride when traveling in the shared lane, 89% of all respondents said in the green lane. Six percent said to the left of the green lane, no respondents said to the right, 3% said they did not know, and 2% said another position. When asked to select where a motorist should drive when traveling in the shared lane 81% said to the left of the green lane. Eleven percent said on the green lane, 2% said to the right, 4% said they did not know, and 2% said another position.



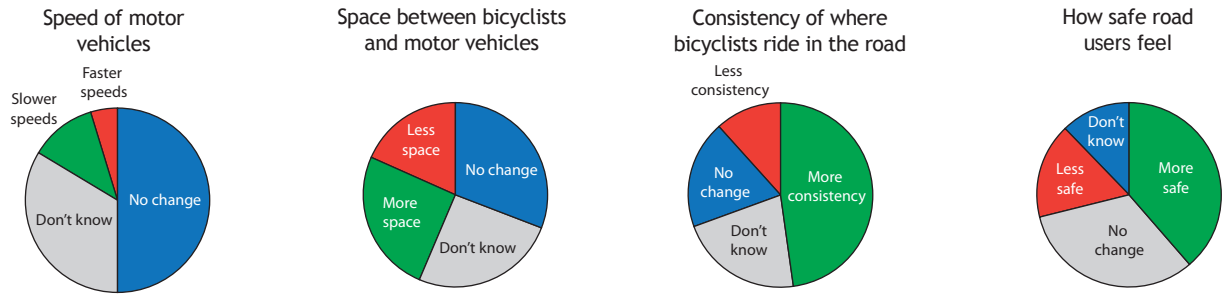
Survey results for bicyclist riding and motor vehicle driving position.

Participants were then asked what the purpose of the green shared lanes was. "Improve the safety of bicyclists" was most frequently selected followed by "Show bicyclists where to ride" and then "Show motorists where to drive". When asked if the green shared lanes had another purpose, responses varied, but most frequently mentioned that is was to increase the visibility of bicyclists on the roadway.

Participants were also asked about their perception of the green shared lanes and if the facility has changed or not changed actual or perceived behavior. The questions were designed to be a general comparison, rather than compare the green shared lanes directly to another bicycle facility such as a standard bicycle lane. This was an attempt to eliminate any direct bias against a particular type of facility or associated street.

When asked if the speed of motor vehicles changed with the addition of the green lanes, most respondents thought there was no change, or did not know. With respect to the space between bicyclists and motor vehicles, responses were almost equally split between less space, more space, no change, and did not know. However, respondents tended to think the green lane improved the consistency of where bicyclists ride in the road. Lastly, nearly 40% of respondents thought the green lanes made them feel more safe, while about 30% thought there was no change in their perceived safety.

Respondents perceived change in:



Specific Comments on the Green Shared Lanes

At the end of the survey, respondents were asked to provide any additional comments about the green shared lanes. A total of 259 respondents provided 458 comments which were aggregated into topics or themes. The most frequently mentioned themes are as follows.

Please provide any additional comments you have about the green bicycle lanes on Hennepin Avenue.

Rank	Comment or Theme	Freq.
1	Lack of adequate space/desire separated facility	73
2	Lack of comprehension/education is needed	69
3	Enforcement of right turn lane	60
4	Paint fades quickly/general lack of visibility	36
5	Safety concerns (general)	33
6	Overall a good idea/satisfied	32
7	Motorists do not provide a safe passing distance	17
8	Difficult to share lane with buses	16
9	Motorist behavior/aggressive driving	16
10	Pavement quality is poor	15

Below are representative examples of some of the most frequently mentioned topics.

Reaction to overall changes

"There are several decent [bicycle route] options [through downtown] , although I don't find any of them ideal."

Paint fades quickly/general lack of visibility

"The green color doesn't seem the best choice to me - it seems faded or dirty already, and I wonder how visible the color is at night."

Lack of adequate space/desire separated facility

"I think the green lanes have a lot of potential, but the biggest reason I feel uncomfortable in them is that they essentially make me switch between sharing [the lane] and taking the lane after every block."

"Due to the volume and speed of traffic on Hennepin, I think it's important to maintain other choices for cyclists who are less confident."

Lack of comprehension/education is needed

"I feel that drivers don't understand/know about the green bike lanes, and because it doesn't look like a regular bike lane, the drivers tend to not be as nice towards bikers in the green bike lanes."

"I think there needs to be more communication about what the green lanes are and how they are to be used. When I drive north on Hennepin Avenue...I don't know where I'm supposed to be driving. I'm not sure where I am supposed to bicycle, either."

Conclusions

The following conclusions can be made about the recent changes to Hennepin Avenue and the implementation of the green shared lanes:

1. Are bicyclists using the green lane and where are they riding?

   Yes/Varies: Most bicyclists (79-93%) rode in the green lane. Bicyclists rode closer to the curb while riding in the 13.5-ft shared lanes than while riding in the 18.5-ft lanes.

2. Are motor vehicles and buses driving in the green lane and where are they driving?

   Varies/Varies: On average, motor vehicles traveled to the left of green lane when traveling in the 18.5-ft lanes, but encroached on the green lane when traveling in the 13.5-ft lane. Buses tended to encroach on the green lane for both lane widths.

3. Are motorists and buses giving a safe passing distance (>3 ft) when overtaking bicyclists?

   Inconclusive: There were a limited number of observations involving a motor vehicle or bus overtaking a bicyclists. Due to the small sample size, conclusions could not be made.

4. Does driving or riding behavior vary by lane width?

   Yes: Significant differences between the 13.5-ft and 18.5-ft shared lanes were observed for all vehicles.

5. Have bicyclist volumes on Hennepin Avenue changed with the addition of green lanes?

   Yes: Estimated daily bicyclist volumes on Hennepin Avenue decreased from 1,190 to 990. Survey results indicate that this change can be attributed to new or improved bicycle facilities along parallel corridors. Despite this decrease in bicyclist traffic, results show that Hennepin Avenue remains a primary bicycle route through downtown.

6. Has the safety of bicyclists improved with the addition of the green lanes?

   Yes: Bicyclist crash rates decreased from 1.03% to 0.4%; however, continued monitoring is needed to determine the long-term safety of the facility. Survey results show that approximately one-third of bicyclists feel more safe with the addition of the green lanes while another third feel there is no change in their perceived safety.

7. How to road users perceive the green lanes and does this differ from actual driving or riding behavior?

   Varies: When traveling in the right lane on Hennepin, most survey respondents think a bicyclist should ride in the green lane and most think that motor vehicles should ride to the left of the green lane. This is similar to the behavior of those traveling in 18.5-ft lanes, however not in 13.5-ft lanes. Survey respondents indicated that a lack of adequate space, the desire for a defined or separated facility, and lack of comprehension are primary reasons for their dissatisfaction with the changes to Hennepin Avenue.

Recommendations and Future Considerations

Due to its access to a primary river crossing and other destinations, Hennepin Avenue will continue to be a busy street for bicycle traffic. While parallel streets will continue to attract certain bicyclists based on preference, future refinements and plans should assume that Hennepin will be a primary bicycling route through downtown Minneapolis.

Public Works staff are pleased to see that most bicyclists are riding in the green lane. Safety along the corridor is improving and observed conflicts are minimal. However, high volumes of motor vehicles and frequent bus traffic continue to pose concerns for bicyclists of all abilities. While crash rates have decreased, opportunities remain to increase the perceived safety for all users.

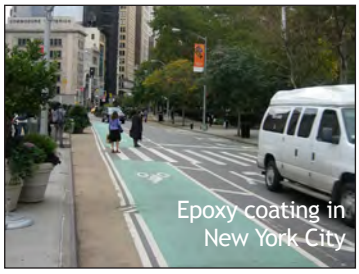
Below are two short-term recommendations one long-term consideration to include in future plans.

1. Increase the Visibility and Lifespan of the Green Lanes

Pursue more permanent colored pavement treatment options like thermoplastic, epoxy, or crushed glass cutlets. This would decrease maintenance costs and increase visibility of the facility; therefore improving the overall effectiveness. Examples can now be found in several U.S. cities including Portland, OR and New York City. Preliminary research and possible plans for implementation are outlined in the Appendix.

Fading paint

Thermoplastic coating in Portland, OR


Epoxy coating in New York City

2. Increase Comprehension

Develop temporary on-street signage that clearly outlines the intention of the green shared lanes and includes simple instructions for users of all modes. In addition, update the City's website to include further information about Hennepin Avenue and the recent changes. A similar education campaign could be applied to other new and experimental bicycle projects. Examples include campaigns like the "Portland Loves Cycling" and "Get Behind the Box" campaigns in Portland, OR.

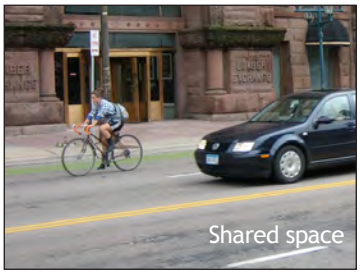
Lack of comprehension

Portland, OR

Portland, OR

3. Consider Separated Right-of-Way

While the current street width and high traffic volumes may preclude a separated right-of-way for bicyclists, further improvements could be made. For the length of the corridor, the green lanes could be shifted adjacent to the curb, similar to a normal bike lane. On blocks where the lane width is wide enough, a concrete divider could be constructed to create a permanent cycle track. On narrow blocks, the green lane could still be present, but separated by a dashed white line instead of a concrete divider. The alternating facilities could be coordinated with bus stops and right turning movements to ensure normal traffic movements are still allowed. Examples of separated facilities include Prospect Park West in New York City, University Ave in Madison, and one block of the S Marquette Avenue transit lanes in Minneapolis.


Shared space

Concrete divider in New York City

Concrete divider in Madison

Concrete divider on S Marquette Ave in Minneapolis

Appendix A: Complete Technical Results

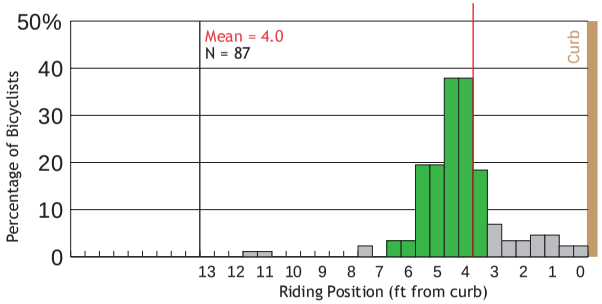
Distribution of Bicyclist Riding Position

Observations when single vehicle present in green shared lane

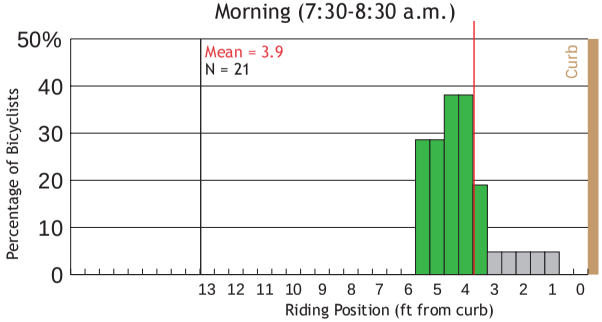
Riding poistion was aggregated to the nearest foot for all positions except near the borders of the green lane where riding position was aggregated to the nearest half foot (3.5 ft and 7.5 ft).

Washington Avenue - 13.5-ft lane

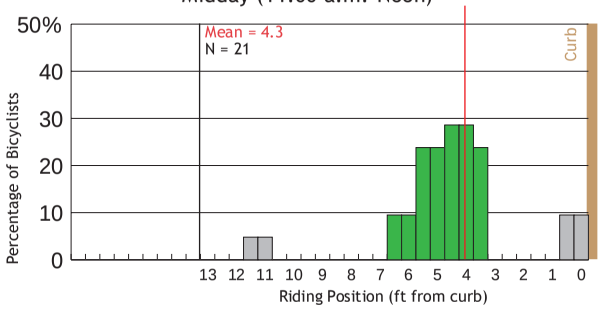
All Time Periods



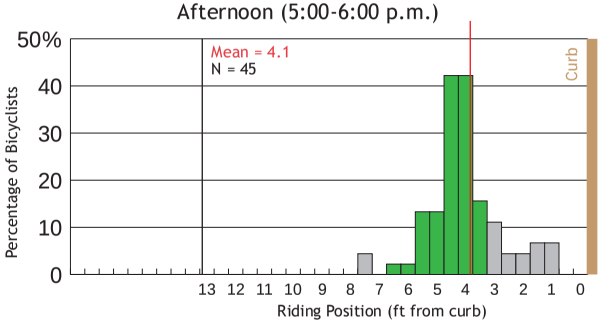
Morning (7:30-8:30 a.m.)



Midday (11:00 a.m.-Noon)

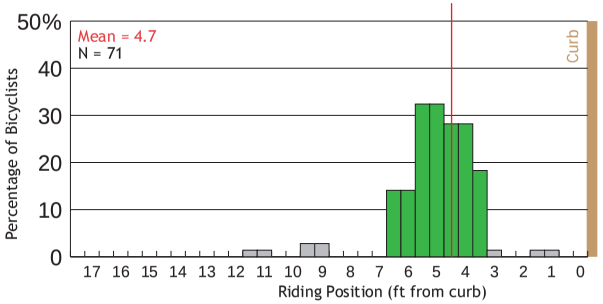


Afternoon (5:00-6:00 p.m.)



4th Street - 18.5-ft lane

All Time Periods



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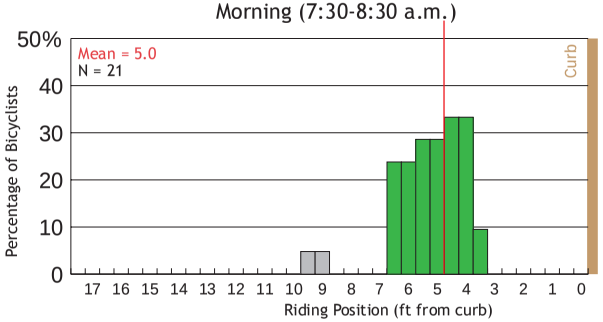

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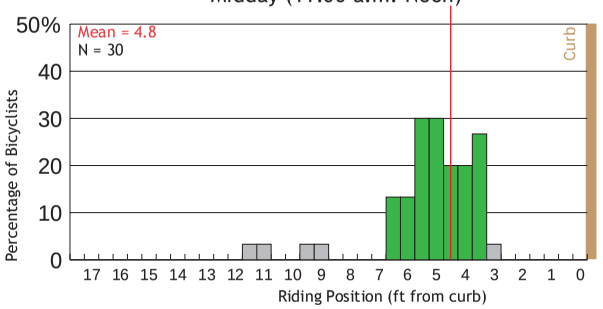
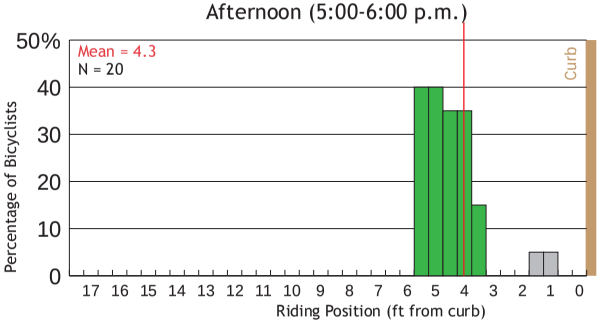
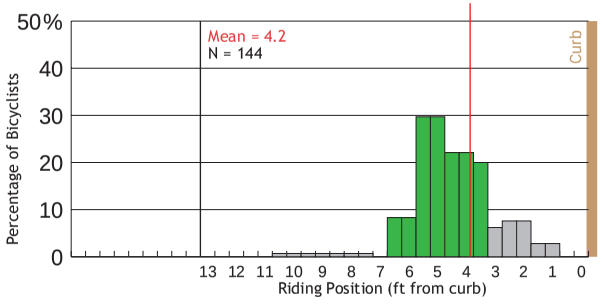


Afternoon (5:00-6:00 p.m.)

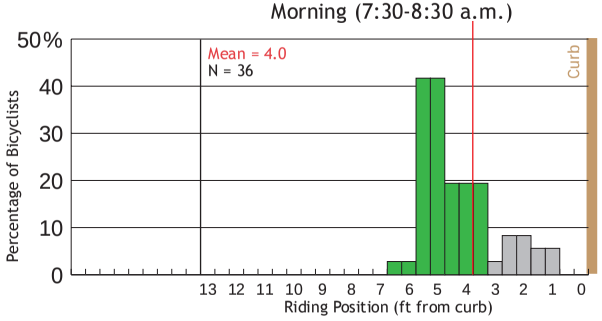


7th Street - 13.5-ft lane

All Time Periods



Morning (7:30-8:30 a.m.)



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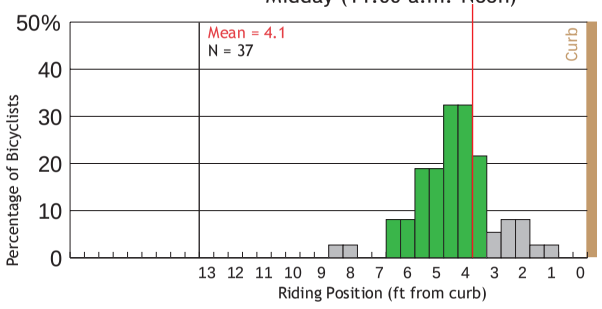

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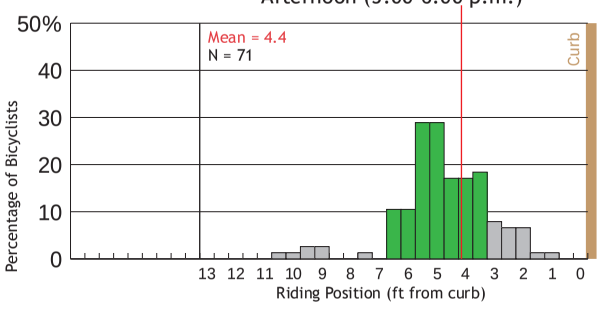


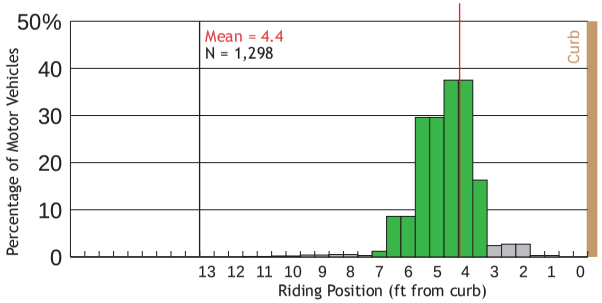
Distribution of Motor Vehicle Driving Position

Observations when single vehicle present in green shared lane

Riding poistion was aggregated to the nearest foot for all positions except near the borders of the green lane where riding position was aggregated to the nearest half foot (3.5 ft and 7.5 ft).

Washington Avenue - 13.5-ft lane

All Time Periods



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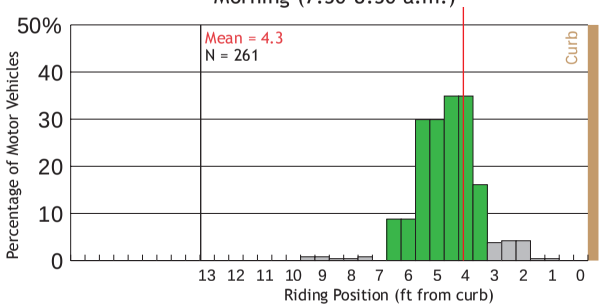
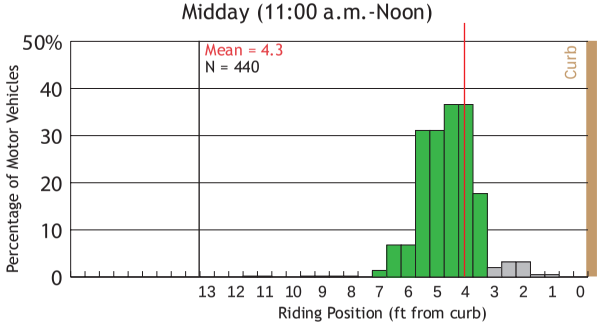


Midday (11:00 a.m.-Noon)



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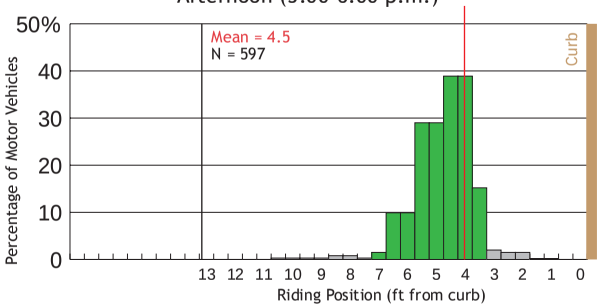
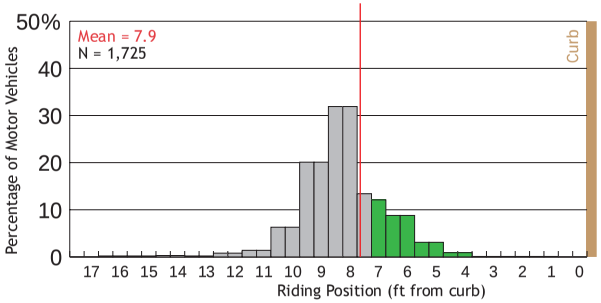


4th Street - 18.5-ft lane

All Time Periods



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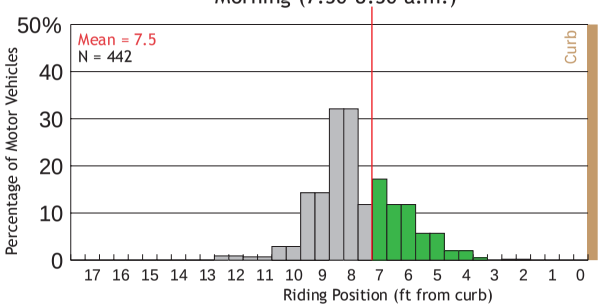
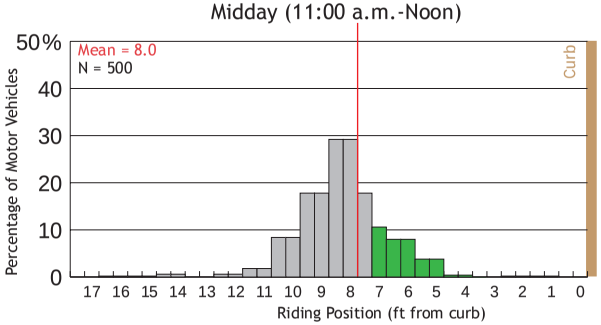
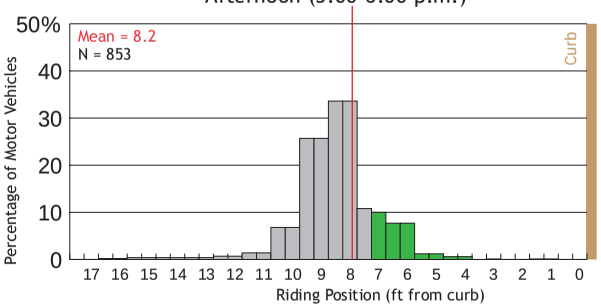


Midday (11:00 a.m.-Noon)

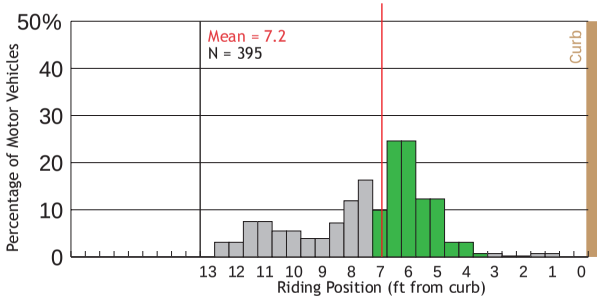


Afternoon (5:00-6:00 p.m.)

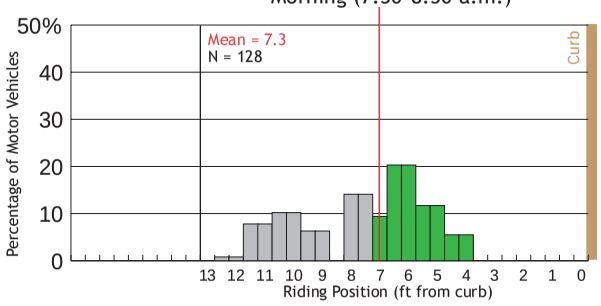


7th Street - 13.5-ft lane

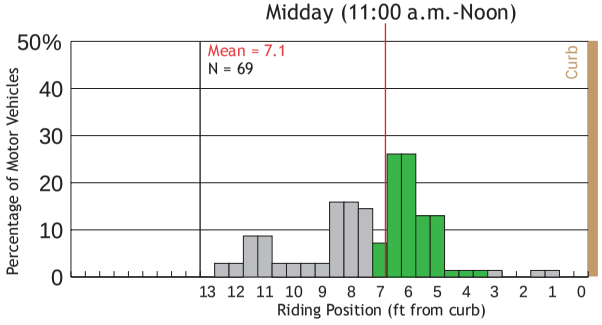
All Time Periods



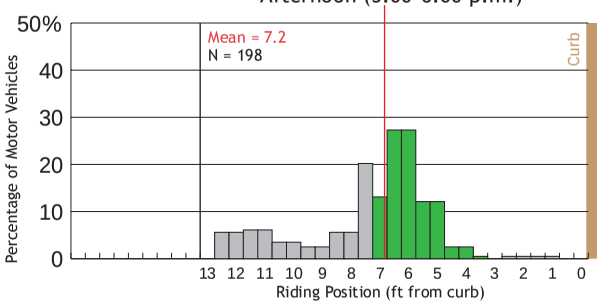
Morning (7:30-8:30 a.m.)



Midday (11:00 a.m.-Noon)



Afternoon (5:00-6:00 p.m.)



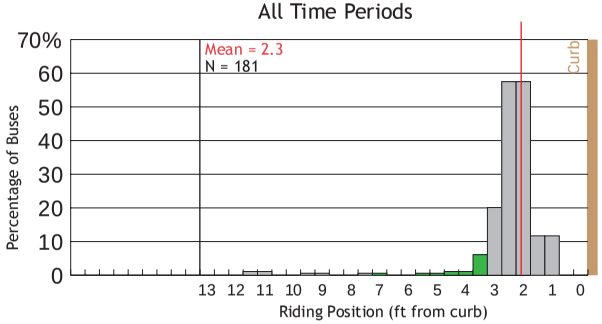
Distribution of Bus Driving Position

Observations when single vehicle present in green shared lane

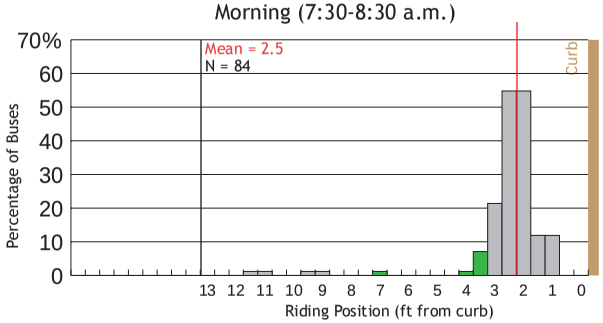
Riding poistion was aggregated to the nearest foot for all positions except near the borders of the green lane where riding position was aggregated to the nearest half foot (3.5 ft and 7.5 ft).

Washington Avenue - 13.5-ft lane

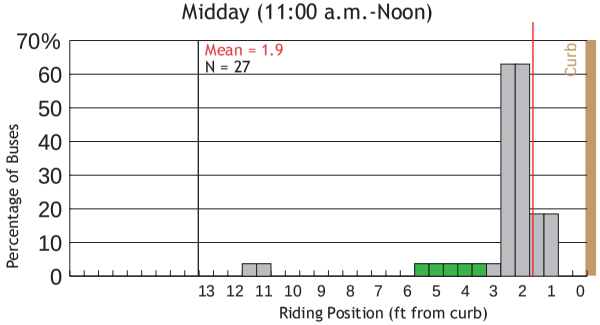
All Time Periods



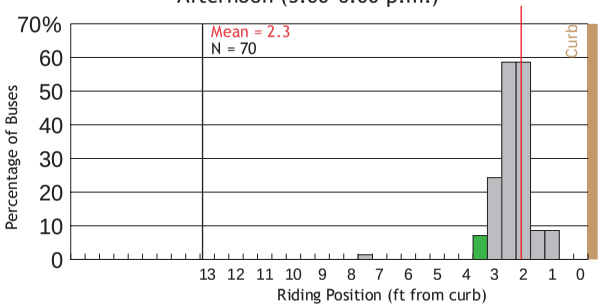
Morning (7:30-8:30 a.m.)



Midday (11:00 a.m.-Noon)

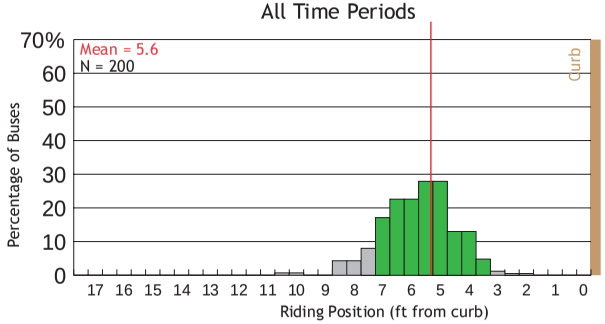


Afternoon (5:00-6:00 p.m.)



4th Street - 18.5-ft lane

All Time Periods



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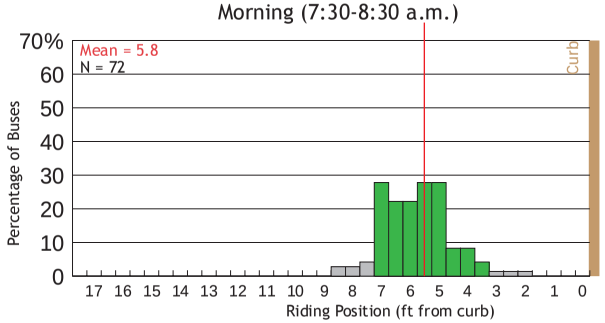
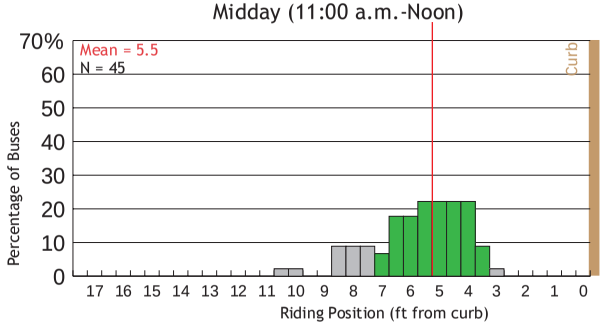
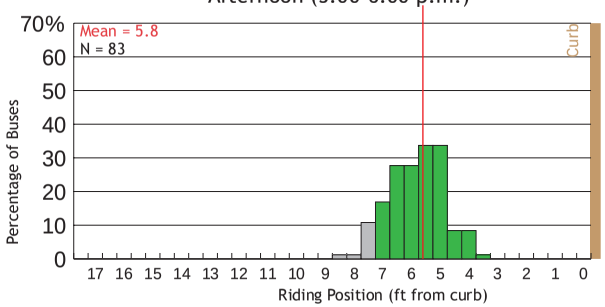


Midday (11:00 a.m.-Noon)

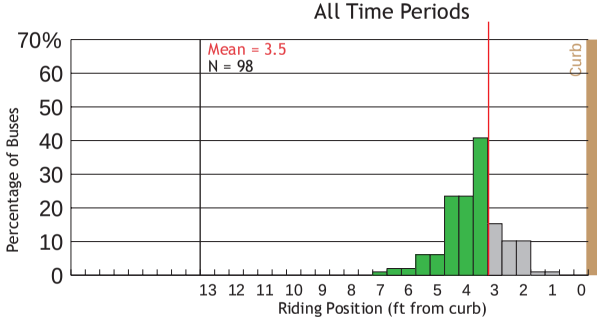


Afternoon (5:00-6:00 p.m.)

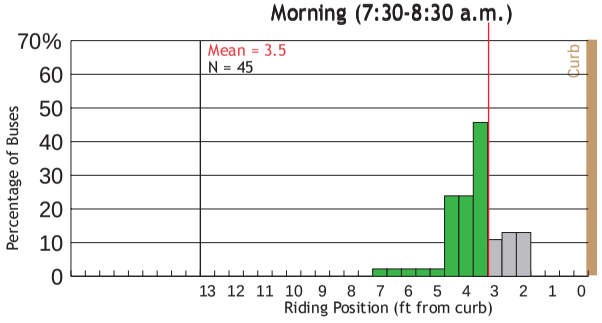


7th Street - 13.5-ft lane

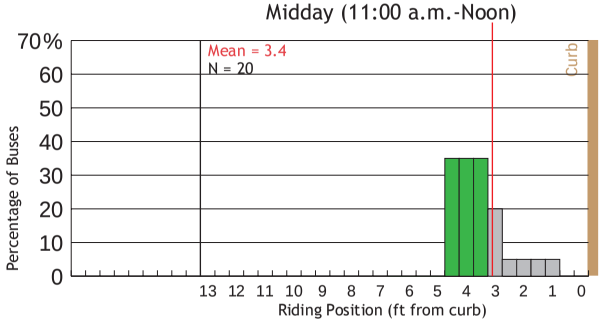
All Time Periods



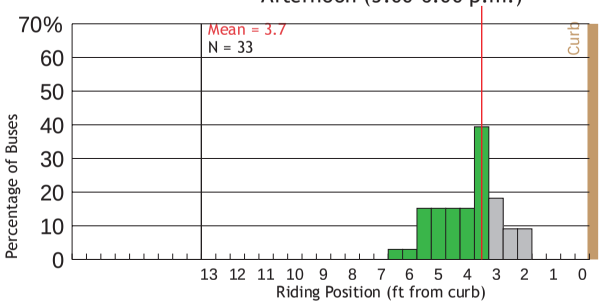
Morning (7:30-8:30 a.m.)



Midday (11:00 a.m.-Noon)



Afternoon (5:00-6:00 p.m.)



Vehicle Position and Passing Distance

Observations when two vehicles present in green shared lane

Location	Time	Vehicle 1			Vehicle 2			Which Overtakes?	Passing Distance (ft)	Vehicles Parallel?
		Type	Position	Stationary?	Type	Position	Green lane			
Washington	AM	MV	5	Yes	Bike	3	Yes	Bike	2	No
Washington	Mid	MV	3.5	No	Bike	0	Yes	MV	3.5	Yes
Washington	Mid	MV	4	No	Bike	1	No	MV	3	Yes
Washington	Mid	MV	5	Yes	Bike	1	No	Bike	4	No
Washington	PM	Bike	5	Yes	Bike	3	Yes	Bike	2	No
Washington	PM	Bike	9	No	Bike	3.5	No	Bike	5.5	Yes
Washington	PM	Bike	10	No	Bike	3.5	No	Bike	6.5	Yes
Washington	PM	Bus	2	Yes	Bike	0	No	Bike	2	No
Washington	PM	Bus	3.5	Yes	Bike	1	Yes	Bike	2.5	No
Washington	PM	MV	3	Yes	Bike	1	No	Bike	2	No
Washington	PM	MV	3.5	Yes	Bike	0	Yes	Bike	3.5	No
Washington	PM	MV	3.5	Yes	Bike	1	No	Bike	2.5	No
Washington	PM	MV	4	Yes	Bike	0	Yes	Bike	4	No
Washington	PM	MV	4	Yes	Bike	1	Yes	Bike	3	No
Washington	PM	MV	4	Yes	Bike	1	No	Bike	3	No
Washington	PM	MV	4	No	Bike	2	Yes	MV	2	No
Washington	PM	MV	4	Yes	Bike	2	Yes	Bike	2	No
Washington	PM	MV	5	Yes	Bike	0	Yes	Bike	5	No
Washington	PM	MV	5	Yes	Bike	2	Yes	Bike	3	No
Washington	PM	MV	5	Yes	Bike	2	Yes	Bike	3	No
Washington	PM	MV	5	Yes	Bike	3	Yes	Bike	2	No
Washington	PM	MV	5	Yes	Bike	3	Yes	Bike	2	No
Washington	PM	MV	5	Yes	Bike	3	Yes	Bike	2	No
Washington	PM	MV	5	Yes	Bike	3.5	No	Bike	1.5	No
Washington	PM	MV	5	Yes	Bike	3.5	No	Bike	1.5	No
Washington	PM	MV	6	No	Bike	1	Yes	MV	5	Yes
Washington	PM	MV	6	Yes	Bike	2	Yes	Bike	4	No
4th	AM	Bus	6	Yes	Bike	2	No	Bike	4	No
4th	AM	Bus	6	No	Bike	3.5	Yes	Bus	2.5	Yes
4th	AM	Bus	7	Yes	Bike	3.5	Yes	Bike	6	No
4th	AM	Bus	8	No	Bike	2	Yes	Bus	6	Yes
4th	AM	MV	7	No	Bike	5	Yes	MV	2	Yes
4th	AM	MV	7.5	Yes	Bike	3.5	Yes	Bike	4	No
4th	AM	MV	8	No	Bike	3	Yes	MV	5	Yes
4th	AM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	AM	MV	8	Yes	Bike	3.5	No	Bike	4.5	No
4th	AM	MV	8	No	Bike	5	Yes	Bike	3	No
4th	AM	MV	9	Yes	Bike	3.5	Yes	Bike	5.5	No
4th	AM	MV	9	No	Bike	4	Yes	MV	5	No
4th	AM	MV	10	Yes	Bike	3	Yes	Bike	8	No
4th	Mid	Bus	10	No	Bike	3.5	Yes	Bus	6.5	No
4th	Mid	MV	8	No	Bike	3.5	Yes	MV	4.5	Yes

Vehicle Position and Passing Distance

Observations when two vehicles present in green shared lane

Location	Time	Vehicle 1			Vehicle 2			Which Overtakes?	Passing Distance (ft)	Vehicles Parallel?
		Type	Position	Stationary?	Type	Position	Green lane			
4th	Mid	MV	9	No	Bike	4	No	MV	5	Yes
4th	Mid	MV	9	No	Bike	4	No	MV	5	No
4th	Mid	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	Mid	MV	10	No	Bike	4	No	MV	6	Yes
4th	Mid	MV	10	No	Bike	5	Yes	MV	5	Yes
4th	PM	Bus	4	Yes	Bike	2	Yes	Bike	2	No
4th	PM	Bus	5	No	Bike	1	Yes	Bike	4	No
4th	PM	Bus	5	Yes	Bike	2	Yes	Bike	3	No
4th	PM	Bus	6	Yes	Bike	1	Yes	Bike	5	No
4th	PM	Bus	6	Yes	Bike	2	No	Bike	4	No
4th	PM	Bus	7	Yes	Bike	1	Yes	Bike	6	No
4th	PM	Bus	7	Yes	Bike	1	Yes	Bike	6	No
4th	PM	Bus	7	Yes	Bike	2	Yes	Bike	5	No
4th	PM	Bus	7	Yes	Bike	2	Yes	Bike	5	No
4th	PM	Bus	7	Yes	Bike	2	Yes	Bike	5	No
4th	PM	Bus	7	Yes	Bike	2	Yes	Bike	5	No
4th	PM	Bus	7	Yes	Bike	3.5	Yes	Bike	3.5	No
4th	PM	Bus	7.5	Yes	Bike	3.5	Yes	Bike	4	No
4th	PM	MV	6	Yes	Bike	0	Yes	Bike	6	No
4th	PM	MV	6	Yes	Bike	1	Yes	Bike	5	No
4th	PM	MV	6	Yes	Bike	3	Yes	Bike	3	No
4th	PM	MV	6	Yes	Bike	3	No	Bike	3	No
4th	PM	MV	6	Yes	Bike	3.5	Yes	Bike	4	No
4th	PM	MV	6	Yes	Bike	3.5	No	Bike	2.5	No
4th	PM	MV	7	Yes	Bike	1	Yes	Bike	6	No
4th	PM	MV	7	Yes	Bike	2	No	Bike	5	No
4th	PM	MV	7	Yes	Bike	3.5	No	Bike	3.5	No
4th	PM	MV	7	Yes	Bike	3.5	No	Bike	3.5	No
4th	PM	MV	7.5	Yes	Bike	3.5	Yes	Bike	4	No
4th	PM	MV	7.5	Yes	Bike	4	Yes	Bike	3.5	No
4th	PM	MV	7.5	Yes	Bike	4	Yes	Bike	3.5	No
4th	PM	MV	8	Yes	Bike	2	Yes	Bike	6	No
4th	PM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	No	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	No	Bike	5	No
4th	PM	MV	8	Yes	Bike	3	Yes	Bike	5	No
4th	PM	MV	8	Yes	Bike	3.5	Yes	Bike	4.5	No
4th	PM	MV	8	Yes	Bike	3.5	Yes	Bike	4.5	No
4th	PM	MV	8	Yes	Bike	3.5	Yes	Bike	4.5	No
4th	PM	MV	8	Yes	Bike	3.5	Yes	Bike	4.5	No
4th	PM	MV	8	No	Bike	3.5	Yes	MV	4.5	Yes

Vehicle Position and Passing Distance

Observations when two vehicles present in green shared lane

Location	Time	Vehicle 1			Vehicle 2			Which Overtakes?	Passing Distance (ft)	Vehicles Parallel?
		Type	Position	Stationary?	Type	Position	Green lane			
4th	PM	MV	8	Yes	Bike	4	Yes	Bike	4	No
4th	PM	MV	8	Yes	Bike	4	Yes	Bike	4	No
4th	PM	MV	8	No	Bike	4	Yes	Bike	4	No
4th	PM	MV	8	Yes	Bike	5	Yes	Bike	3	No
4th	PM	MV	8	No	Bike	5	Yes	MV	3	Yes
4th	PM	MV	8	No	Bike	5	Yes	MV	3	Yes
4th	PM	MV	8	Yes	Bike	5	Yes	Bike	3	No
4th	PM	MV	9	No	Bike	2	Yes	MV	7	Yes
4th	PM	MV	9	Yes	Bike	2	Yes	Bike	7	No
4th	PM	MV	9	Yes	Bike	2	No	MV	7	No
4th	PM	MV	9	Yes	Bike	3.5	No	Bike	5.5	No
4th	PM	MV	9	Yes	Bike	3.5	No	Bike	5.5	No
4th	PM	MV	9	No	Bike	3.5	No	Bike	5.5	No
4th	PM	MV	9	No	Bike	3.5	Yes	Bike	5.5	No
4th	PM	MV	9	Yes	Bike	4	Yes	Bike	5	No
4th	PM	MV	9	Yes	Bike	4	Yes	Bike	5	No
4th	PM	MV	9	Yes	Bike	4	No	Bike	5	No
4th	PM	MV	9	Yes	Bike	4	Yes	Bike	5	No
4th	PM	MV	9	No	Bike	4	Yes	MV	5	Yes
4th	PM	MV	9	No	Bike	4	No	MV	5	Yes
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	Yes	Bike	5	Yes	Bike	4	No
4th	PM	MV	9	No	Bike	5	No	Bike	4	No
4th	PM	MV	10	No	Bike	5	No	MV	5	Yes
4th	PM	MV	10	No	Bike	6	Yes	MV	4	Yes
7th	AM	MV	9	No	Bike	3.5	Yes	Bike	5.5	No
7th	PM	Bike	5	No	Bike	2	Yes	Bike	3	Yes
7th	PM	Bike	7	No	Bike	2	Yes	Bike	5	Yes
7th	PM	Bike	7	No	Bike	3.5	Yes	Bike	3.5	No
7th	PM	Bike	9	No	Bike	4	No	Bike	5	No
7th	PM	Bus	3.5	No	Bike	1	Yes	Bus	2.5	No
7th	PM	MV	6	No	Bike	1	No	MV	5	No
7th	PM	MV	7	No	Bike	4	Yes	MV	3	Yes
7th	PM	MV	7.5	No	Bike	2	Yes	MV	5.5	Yes
7th	PM	MV	7.5	No	Bike	2	No	MV	5.5	No
7th	PM	MV	8	No	Bike	3.5	Yes	MV	4.5	No
7th	PM	MV	9	No	Bike	4	Yes	MV	5	No

Appendix B: Public Survey

Downtown Transportation and Bicycling Survey

Several transportation improvements were recently made in downtown Minneapolis and the City of Minneapolis is interested in your response to the projects.

The survey will take approximately 10 minutes to complete. Your response is voluntary and confidential. At the end of the survey, you may enter your email address for a drawing to receive a $25 gift certificate to One on One Bicycle Studio. Your email address will not be linked to your survey response.

The first half of this survey will ask you about your travel patterns in and through downtown. The second half will ask you about new green bicycle lanes on Hennepin Avenue in downtown.

This survey is being conducted by the City of Minneapolis Department of Public Works. If you have questions about this survey, please contact Simon Blenski at 612-275-6754.

1. First, please tell us how you heard about this survey.

- o Received card on the street
- o City of Minneapolis website
- o Online forum
- o Other

2. In the past 3 months: How often did you travel to or through downtown Minneapolis?

- o 5 or more times a week
- o 2-4 times a week
- o Once a week
- o 2-3 times a month
- o Once a month
- o Less than once a month
- o Never

3. In the past 3 months: If you traveled to or through downtown Minneapolis, what was the purpose of your visit? *Please select all that apply.*

- o Work
- o Delivery
- o Entertainment (music, theater, sports)
- o Eat or drink
- o Run errands
- o Appointment
- o Visit friends or family
- o I live downtown
- o Just passing through
- o Other
- o I have not visited downtown Minneapolis in the past 3 months

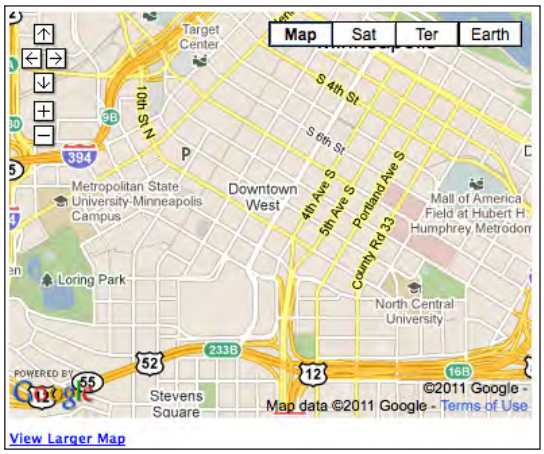
4. In the past 3 months: When traveling to or through downtown Minneapolis, what form of transportation did you use? *Please select all that apply.*

- Walking
- Bicycle
- Transit (Bus or Train)
- Car or Truck
- Other
- I have not visited downtown Minneapolis in the past 3 months

5. If you selected "Bicycle", please indicate your level of confidence when riding in downtown traffic.

- Very confident
- Somewhat confident
- Not very confident
- Not confident at all
- Don't know
- I did not select "Bicycle" in the previous question.

6. In the past 3 months: If you traveled to or through downtown Minneapolis, did you use any of the following streets on a regular basis? *Please use the map for reference and select all streets that apply.*



- 2nd Avenue North
- 1st Avenue North
- Hennepin Avenue
- Lasalle Avenue
- Nicollet Mall
- Marquette Avenue South
- 2nd Avenue South
- 3rd Avenue South
- 4th Avenue South
- 5th Avenue South
- Portland Avenue South
- Park Avenue South
- I have not used any of these streets on a regular basis
- I have not visited downtown Minneapolis in the past 3 months

7. What factors contributed to you using the street(s) you selected? *Please select all that apply.*

- Fastest route
- Safety (traffic safety)
- Safety (crime/personal safety)
- Restricted access on other streets
- Other streets are too busy
- Has good access to other major streets, highways, or interstates
- The street has good sidewalks
- The street has good bicycle facilities such as bike lanes
- Other streets lack adequate bicycle facilities such as bike lanes
- Transit is located/travels on the street
- One of my destinations is located on this street

- One of my destinations is located on another street, but access to parking is available on this street
- I did not select any of the streets listed in the previous question
- I have not visited downtown Minneapolis in the past 3 months

8. Over the past 2-3 years, several infrastructure and transportation projects were implemented in downtown Minneapolis. Are you aware of any of the following projects? *Please select all that apply.*

- Marquette/2nd Avenue
- South Transit Improvements
- Nicollet Mall Transit Improvements
- Nicollet Mall Increased Bicycle Access
- Hennepin Avenue one-way to two-way Conversion
- Hennepin Avenue Green Bicycle Lanes
- 1st Avenue North one-way to two-way Conversion
- 1st Avenue North Bicycle Lanes
- Minnesota Twin's Baseball Stadium
- Hiawatha Light Rail Extension
- I have not noticed any of these projects

9. Most of the preceding projects were implemented in 2009. Prior to 2009: How often did you travel to or through downtown Minneapolis?

- 5 or more times a week
- 2-4 times a week
- Once a week
- 2-3 times a month
- Once a month
- Less than once a month
- Never

10. Prior to 2009: If you traveled to or through downtown Minneapolis, what was the purpose of your visit? *Please select all that apply.*

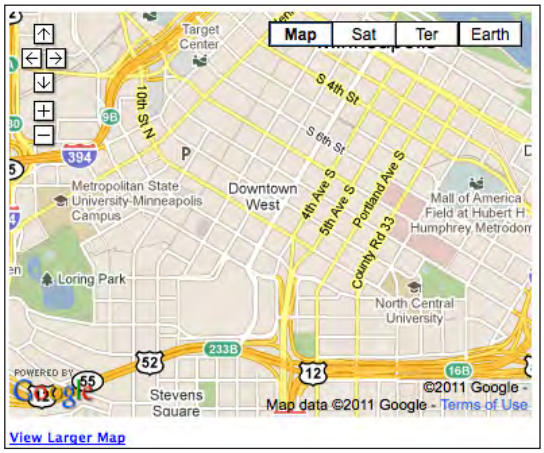
- Work Delivery
- Entertainment (music, theater, sports)
- Eat or drink
- Run errands
- Appointment
- Visit friends or family
- I lived downtown
- Just passing through
- Other
- I never visited downtown Minneapolis prior to 2009

11. Prior to 2009: When traveling to or through downtown Minneapolis, what form of transportation did you use? *Please select all that apply.*

- Walking
- Bicycle
- Transit (Bus or Train)

- Car or Truck
- Other
- I never visited downtown Minneapolis prior to 2009

12. Prior to 2009: If you traveled to or through downtown Minneapolis, did you use any of the following streets on a regular basis? *Please use the map for reference and select all streets that apply.*



- 2nd Avenue North
- 1st Avenue North
- Hennepin Avenue
- Lasalle Avenue
- Nicollet Mall
- Marquette Avenue South
- 2nd Avenue South
- 3rd Avenue South
- 4th Avenue South
- 5th Avenue South
- Portland Avenue South
- Park Avenue South
- I have not used any of these streets on a regular basis
- I have not visited downtown Minneapolis in the past 3 months
- I never visited downtown Minneapolis prior to 2009

13. What factors contributed to you using the street(s) you selected? *Please select all that apply.*

- Fastest route
- Safety (traffic safety)
- Safety (crime/personal safety)
- Restricted access on other streets
- Other streets are too busy
- Has good access to other major streets, highways, or interstates
- The street has good sidewalks
- The street has good bicycle facilities such as bike lanes
- Other streets lack adequate bicycle facilities such as bike lanes
- Transit is located/travels on the street
- One of my destinations is located on this street
- One of my destinations is located on another street, but access to parking is available on this street
- I did not select any of the streets listed in the previous question
- I never visited downtown Minneapolis prior to 2009

14. Since 2009, have any of the following infrastructure or transportation projects caused you to alter your travel patterns? *Please select all that apply.*

- Marquette/2nd Avenue South Transit Improvements
- Nicollet Mall Transit Improvements
- Nicollet Mall Increased Bicycle Access
- Hennepin Avenue one-way to two-way Conversion
- Hennepin Avenue Green Bicycle Lanes
- 1st Avenue North one-way to two-way Conversion

- 1st Avenue North Bicycle Lanes
- Minnesota Twin's Baseball Stadium
- Hiawatha Light Rail Extension
- I have not noticed any of these projects
- I never visited downtown Minneapolis prior to 2009

15. If you selected any of the projects above, please briefly explain why you altered your travel patterns.

_____

_____

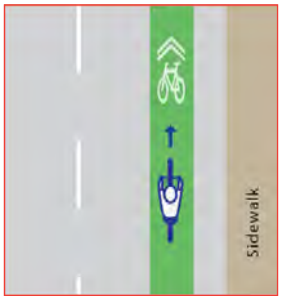
The remaining questions of this survey will ask you about new green bicycle lanes on Hennepin Avenue.

Please answer the questions even if you are not a regular bicyclist in downtown.

16. Have you noticed the green bicycle lanes on Hennepin Avenue? *The picture below is an example of the green bicycle lanes along Hennepin Avenue.*

- Yes
- No
- Don't Know

17. The green bicycle lanes are also shared lanes - designed to accommodate bicyclists, buses, and right turning motor vehicles. If a bicyclist is traveling in the right travel lane on Hennepin Avenue, where should he or she ride?



- Other
- Don't Know

18. If a motorist is traveling in the right travel lane on Hennepin Avenue, where should he or she drive?

- Other
- Don't Know

19. What is the purpose of the green bicycle lane? *Please select all that apply.*

- Show bicyclists where to ride
- Show bus drivers where to drive
- Show motorists where to drive
- Improve safety of bicyclists
- Improve safety of bus riders
- Improve safety of motorists
- Other
- Don't Know

20. If you selected "Other", please explain what you think the purpose of the green bicycle lane is.

_____

_____

21. Do you feel that the green shared lanes have resulted in:

- Slower speeds for motor vehicles and buses
- Faster speeds for motor vehicles and buses
- No change in the speeds of motor vehicles and buses
- Don't know

22. Do you feel that the green shared lanes have resulted in:

- More space between bicyclists and passing vehicles
- Less space between bicyclists and passing vehicles
- No change in the space between bicyclists and passing vehicles
- Don't know

23. Do you feel that the green shared lanes have resulted in:

- More consistency in where bicyclists ride in the road
- Less consistency in where bicyclists ride in the road
- No change in the consistency in where bicyclists ride in the road
- Don't know

24. Do the green shared lanes make you feel:

- o Make you feel more safe
- o Make you feel less safe
- o Make no difference in how safe you feel
- o Don't know

25. Please provide any additional comments you have about the green bicycle lanes on Hennepin Avenue.

_____

_____

26. Please enter the zip code of your current home address.

_____

This is the end of the survey.

Thank you for participating!

If you would like to be entered into a drawing to receive a $25 gift card to One on One Bicycle Studio, please enter your email address. Your email address will not be linked to your survey response. Your contact information will only be used to reach you if you are the recipient of the prize.

_____

Appendix C: Complete Public Survey Results

A total of 494 valid survey responses were received. Not all respondents answered each question and many questions allowed for multiple selections or written responses. The following results represent all responses for each question.

1. Please tell us how you heard about this survey.

Response	Freq.
Online forum	211
Other	150
Received card on the street	122
City of Minneapolis website	11
Total	**494**

2. In the past 3 months: How often did you travel to or through downtown Minneapolis?

Response	Freq.
5 or more times a week	246
2-4 times a week	103
2-3 times a month	55
Once a week	51
Less than once a month	17
Once a month	11
Never	2
Total	**485**

3. In the past 3 months: If you traveled to or through downtown Minneapolis, what was the purpose of your visit? *Please select all that apply.*

Response	Freq.
Entertainment (music, theater, sports)	318
Work	311
Eat or drink	290
Just passing through	229
Run errands	222
Visit friends or family	117
Appointment	101
Other	55
I live downtown	24
Delivery	16
I have not visited downtown Minneapolis in the past 3 months	1
Total	**1684**

4. In the past 3 months: When traveling to or through downtown Minneapolis, what form of transportation did you use? *Please select all that apply.*

Response	Freq.
Bicycle	432
Transit (Bus or Train)	266
Car or Truck	260
Walking	225

Response	Freq.
Other	6
I have not visited downtown Minneapolis in the past 3 months	0
Total	**1189**

5. If you selected “Bicycle”, please indicate your level of confidence when riding in downtown traffic.

Response	Freq.
Very confident	229
Somewhat confident	164
Not very confident	34
I did not select "Bicycle" in the previous question.	34
Not confident at all	9
Don't know	1
Total	**471**

6. In the past 3 months: If you traveled to or through downtown Minneapolis, did you use any of the following streets on a regular basis? *Please use the map for reference and select all streets that apply.*

Response	Freq.
Hennepin Avenue	317
Nicollet Mall	303
1st Avenue North	229
Portland Avenue South	204
Marquette Avenue South	179
Park Avenue South	171
2nd Avenue South	142
3rd Avenue South	141
Lasalle Avenue	131
2nd Avenue North	104
4th Avenue South	69
5th Avenue South	63
I have not used any of these streets on a regular basis	25
I have not visited downtown Minneapolis in the past 3 months	0
Total	**2078**

7. What factors contributed to you using the street(s) you selected? *Please select all that apply.*

Response	Freq.
Fastest route	376
One of my destinations is located on this street	242
Safety (traffic safety)	239
The street has good bicycle facilities such as bike lanes	238
Other streets lack adequate bicycle facilities such as bike lanes	151
Has good access to other major streets, highways, or interstates	100
Other streets are too busy	94
Transit is located/travels on the street	91
Restricted access on other streets	59
Safety (crime/personal safety)	33
One of my destinations is located on another street, but access to parking is available on this street	32
The street has good sidewalks	29

Response	Freq.
I did not select any of the streets listed in the previous question	17
I have not visited downtown Minneapolis in the past 3 months	0
Total	**1701**

8. Over the past 2-3 years, several infrastructure and transportation projects were implemented in downtown Minneapolis. Are you aware of any of the following projects? *Please select all that apply.*

Response	Freq.
Minnesota Twin's Baseball Stadium	388
Hiawatha Light Rail Extension	352
Hennepin Avenue one-way to two-way Conversion	352
Hennepin Avenue Green Bicycle Lanes	350
1st Avenue North one-way to two-way Conversion	303
1st Avenue North Bicycle Lanes	298
Nicollet Mall Increased Bicycle Access	277
Marquette/2nd Avenue South Transit Improvements	244
Nicollet Mall Transit Improvements	231
I have not noticed any of these projects	13
Total	**2808**

9. Most of the preceding projects were implemented in 2009. Prior to 2009: How often did you travel to or through downtown Minneapolis?

Response	Freq.
5 or more times a week	220
2-4 times a week	67
2-3 times a month	45
Never	45
Once a week	42
Once a month	25
Less than once a month	17
Total	**461**

10. Prior to 2009: If you traveled to or through downtown Minneapolis, what was the purpose of your visit? *Please select all that apply.*

Response	Freq.
Entertainment (music, theater, sports)	279
Work	245
Eat or drink	236
Just passing through	196
Run errands	169
Appointment	87
Visit friends or family	86
I never visited downtown Minneapolis prior to 2009	37
Other	34
Total	**1408**

11. Prior to 2009: When traveling to or through downtown Minneapolis, what form of transportation did you use? *Please select all that apply.*

Response	Freq.
Bicycle	298
Car or Truck	261
Transit (Bus or Train)	251
Walking	186
I never visited downtown Minneapolis prior to 2009	36
Other	2
Total	**1034**

12. Prior to 2009: If you traveled to or through downtown Minneapolis, did you use any of the following streets on a regular basis? *Please use the map for reference and select all streets that apply.*

Response	Freq.
Hennepin Avenue	290
Nicollet Mall	210
1st Avenue North	173
Portland Avenue South	171
Park Avenue South	150
Marquette Avenue South	143
Lasalle Avenue	112
3rd Avenue South	103
2nd Avenue South	91
2nd Avenue North	82
5th Avenue South	50
4th Avenue South	48
I did not use any of these streets on a regular basis	38
I never visited downtown Minneapolis prior to 2009	37
Total	**1698**

13. What factors contributed to you using the street(s) you selected? *Please select all that apply.*

Response	Freq.
Fastest route	305
One of my destinations is located on this street	171
The street has good bicycle facilities such as bike lanes	155
Safety (traffic safety)	154
Transit is located/travels on the street	114
Other streets lack adequate bicycle facilities such as bike lanes	90
Has good access to other major streets, highways, or interstates	80
Other streets are too busy	76
Restricted access on other streets	65
The street has good sidewalks	37
One of my destinations is located on another street, but access to parking is available on this street	35
I never visited downtown Minneapolis prior to 2009	35
I have not visited downtown Minneapolis in the past 3 months	28
Safety (crime/personal safety)	27
I did not select any of the streets listed in the previous question	18
Total	**1390**

15. Since 2009, have any of the following infrastructure or transportation projects caused you to alter your travel patterns? *Please select all that apply.*

Response	Freq.
Hennepin Avenue one-way to two-way Conversion	169
Hennepin Avenue Green Bicycle Lanes	151
Nicollet Mall Increased Bicycle Access	139
1st Avenue North one-way to two-way Conversion	133
1st Avenue North Bicycle Lanes	127
Marquette/2nd Avenue South Transit Improvements	110
Minnesota Twin's Baseball Stadium	99
Hiawatha Light Rail Extension	73
Nicollet Mall Transit Improvements	64
I never visited downtown Minneapolis prior to 2009	28
I have not noticed any of these projects	24
Total	**1117**

If you selected any of the projects above, please briefly explain why you altered your travel patterns.

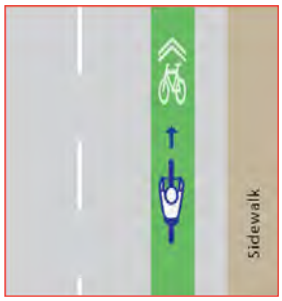
Response	Freq.
Dissatisfied with Hennepin Ave changes	67
Dissatisfied with 1st Ave N changes	38
Satisfied with Nicollet Mall changes	38
Satisfied with 1st Ave N changes	26
Satisfied with Overall changes	25
Satisfied with Marquette/2nd Ave S changes	17
Satisfied with Cedar Lake Trail extension	15
Satisfied with Hennepin Ave changes	14
Dissatisfied with Nicollet Mall changes	12
Bus Route Changed (neutral response)	10
Dissatisfied with overall changes	7
Dissatisfied with Marquette/2nd Ave S changes	4
Total	**273**

16. Have you noticed the green bicycle lanes on Hennepin Avenue?

Response	Freq.
Yes	348
No	67
Don't Know	7
Total	**422**

17. If a bicyclist is traveling in the right travel lane on Hennepin Avenue, where should he or she ride?

27



375

0

Don't know: 13
Other: 6
Total: 421

18. If a motorist is traveling in the right travel lane on Hennepin Avenue, where should he or she drive?

339

47

8

Don't know: 17
Other: 9
Total: 420

19. What is the purpose of the green bicycle lane? *Please select all that apply.*

Response	Freq.
Improve safety of bicyclists	357
Show bicyclists where to ride	270
Show motorists where to drive	159
Improve safety of motorists	100
Show bus drivers where to drive	74
Improve safety of bus riders	73
Other	48
Don't Know	23
Total	**1118**

20. If you selected "Other", please explain what you think the purpose of the green bicycle lane is.

Responses varied. The most frequent response was related to increased visibility of bicyclists on the roadway.

21. Do you feel that the green shared lanes have resulted in:

Response	Freq.
No change in the speeds of motor vehicles and buses	211
Don't know	141
Slower speeds for motor vehicles and buses	49
Faster speeds for motor vehicles and buses	19
Total	**420**

22. Do you feel that the green shared lanes have resulted in:

Response	Freq.
No change in the space between bicyclists and passing vehicles	130
Don't know	107
More space between bicyclists and passing vehicles	106
Less space between bicyclists and passing vehicles	77
Total	**420**

23. Do you feel that the green shared lanes have resulted in:

Response	Freq.
More consistency in where bicyclists ride in the road	200
Don't know	90
No change in the consistency in where bicyclists ride in the road	79
Less consistency in where bicyclists ride in the road	48
Total	**417**

24. Do the green shared lanes make you feel:

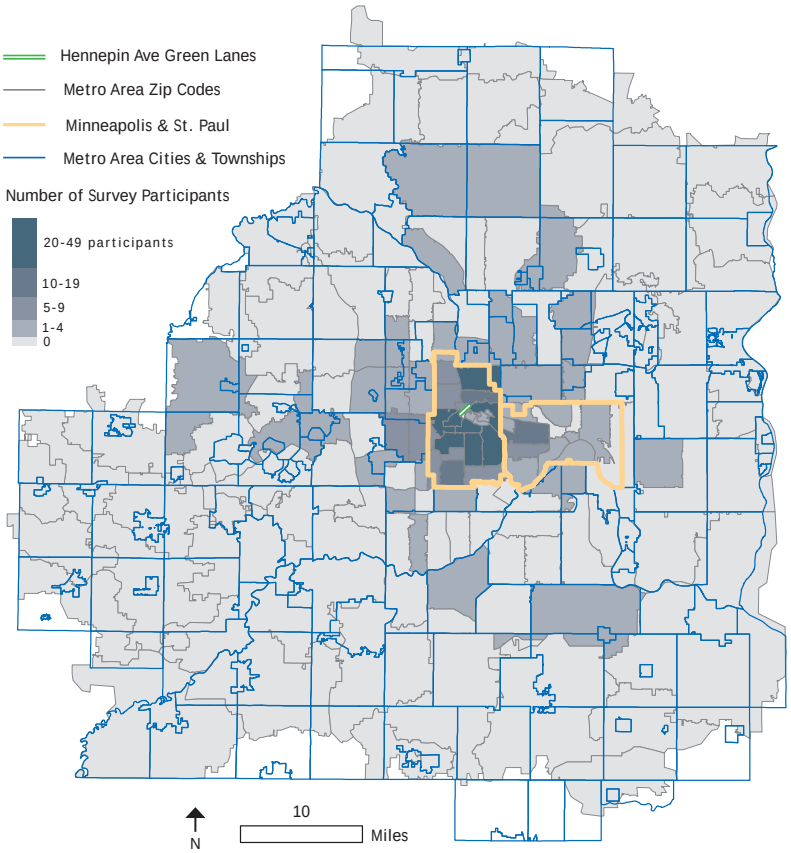
Response	Freq.
Make you feel more safe	162
Make no difference in how safe you feel	137
Make you feel less safe	69
Don't know	51
Total	**419**

25. Please provide any additional comments you have about the green bicycle lanes on Hennepin Avenue.

Response	Freq.
Lack of adequate space/desire separated facility	73
Lack of comprehension/education is needed	69
Enforcement of right turn lane	60
Paint fades quickly/general lack of visibility	36
Safety concerns (general)	33
Overall a good idea/satisfied	32
Motorists do not provide a safe passing distance	17
Difficult to share lane with buses	16
Motorist behavior/aggressive driving	16
Pavement quality is poor	15
Improve signage/pavement message	15
Green color is ineffective	12
Lane is slick when wet	9
Should be applied on other streets	9
Lane widths are inconsistent	8
Green lane placement	8
Increases visibility of bicyclists	7
Lane is difficult to see at night/in the winter	6
Force bicyclists to ride in lane	5
Intersections should be painted	3
Green color is effective	3
Motorists drive to fast along Hennepin	2
Bike boxes should be installed as part of the facility	2
There is now better separation between motorists and bicyclists	2
Total	**415**

26. Please enter the zip code of your current home address.

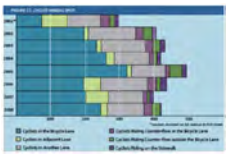
Survey Participants by Zip Code of Home Address
Twin Cities 7-County Metro Area



412 participants provided a valid zip code. One participant provided a zip code that was outside the Twin Cities Metro.

Appendix D: Review of Evaluation Methodologies

A number of U.S. municipalities have conducted evaluations of bicycle lanes, colored pavement markings, and shared lane markings. Evaluations and research methods from the following locations were reviewed as part of the Hennepin Avenue Green Shared Lane Study.

Location	Year	Facility	Resources	Observation Method	Evaluation Parameters
Lake County, FL	1998	Red shoulder along 2-lane highway	katana.hsrc.unc.edu/cms/downloads/Evaluation_RedShoulders.pdf	Video & image analysis	• Lateral distance between motor vehicles and bicyclists • Motorist encroachment
Portland, OR	1999	Blue conflict areas	nacto.org/wp-content/uploads/2011/01/Portlands-Blue-Bike-Lanes.pdf	Video	• Motor vehicle-bicyclist conflicts • Motor vehicle and bicyclist driving and riding behavior
San Francisco, CA	2004	Shared lane markings, “sharrows”	nacto.org/wp-content/uploads/2010/08/San-Franciscos-Shared-Lane-Pavement-Markings-Improving-Bicycle-Safety.pdf	Video & image analysis	• Lateral distance between motor vehicles and bicyclists • Motorist encroachment
St. Petersburg, FL	2008	Green conflict area	nacto.org/wp-content/uploads/2011/01/Evaluation_of_Green_Bike_Lane_Weaving.pdf	Video	• Motor vehicle-bicyclist conflicts • Motor vehicle and bicyclist driving and riding behavior
New York City, NY 	2009	Bike lanes	www.nyc.gov/html/dcp/pdf/transportation/bike_facilities_profile_full.pdf	Manual field observations	• Bicyclist riding position on roadway and in bicycle lanes

Appendix E: Paint Surface Wear

The green lanes were initially painted in August of 2010 with a standard latex road paint with no glass beads. The roadway was resurfaced one year prior using a seal coating method. After one winter season, the lanes experienced significant wear and were almost completely worn in some areas. Bus traffic, plowing, deicing, and freeze-thaw cycles were likely contributing factors to the rapid depreciation of the paint surface and deterioration of the roadway surface.

August 2010

May 2011

August 2010

May 2011

August 2010

May 2011

Appendix F: Review of Colored Surface Treatments

Due to significant wear of the green lanes, Public Works staff are reviewing alternative material options that can be more visible and more cost effective in the long-term. Many cities are implementing colored pavement markings that utilize thermoplastic sheets or an epoxy coating. The following table outlines several cases and resources currently implemented in U.S. cities.

Location	Facility	Resources	Material	F & I	Experience
Austin, TX	Green conflict areas, bike boxes, green lanes	nacto.org/wp-content/uploads/2010/08/Austin-Effects-of-Colored-Lane-Markings-on-Bicyclist-and-Motorist-Behavior-at-Conflict-Areas.pdf	Thermoplastic	$5/sf to furnish $7-8/ft to install	• Quality of pavement is a contributing factor to quick deterioration of thermoplastic • High volume of bus traffic may have contributed to deterioration
Boston, MA	Green shared lanes	Nicole Freedman, Bicycle & Pedestrian, Coordinator, Boston	Epoxy-modified, acrylic, waterborne coating	$4.44/sf to furnish and install	• No significant issues after one winter season
Long Beach, CA	Green shared lanes	nacto.org/wp-content/uploads/2010/08/Second-Street-Sharrows-and-Green-Lane-in-the-City-of-Long-Beach.pdf Charles Gandy, Mobility Coordinator, Long Beach	Aviation tarmac paint	$5,000 for project	• Paint placed on newly surfaced road slurry seal • Surface does not get slippery • No reflective material
Madison, WI	Bike boxes	Steve Grob, Sign Operations Supervisor, Madison	Resin with small aggregate colored glass cutlets	$5.50-6.60/sf to furnish and install	• Surface must be cleaned and dried before application • Installed in spring and will monitor performance during winter
New York City, NY	Green conflict area, bike boxes, green lanes	nacto.org/wp-content/uploads/2011/03/evaluation-of-solid-green-bicycle-lanes-to-increase-compliance-and-bicycle-safety.pdf	Epoxy-modified, acrylic, waterborne coating	$5/sf to furnish and install	• Surface not slippery when wet (0.5 friction factor) • Shows up well at night under street lamps • Lifespan may be 3-5 years
Portland, OR	Green conflict areas, bike boxes, green lanes	otrec.us/main/document.php?doc_id=1559	Thermoplastic	$5/sf to furnish $7-8/ft to install	• Wear is evident after 2-3 years, but surface is still highly visible • Surface not slippery (.75 friction factor - average asphalt is .81)
Salt Lake City, UT	Green shared lanes	www.slcgov.com/transportation/BicycleTraffic/GreenLanes.htm Becka Roolf, Bicycle & Pedestrian Coordinator, Salt Lake City	Acrylic emulsion coating with epoxy cross links	$5/sf to furnish and install	• Lifespan on existing concrete is 6 months • Lifespan on new asphalt may be 4-5 years • Wear likely due to traffic and plowing

Appendix G: Testing and Application of Materials

Hennepin Alternatives

Based on the research outlined in Appendix F, Public Works is pursuing alternative colored pavement treatments for Hennepin Avenue.

Epoxy coating used in New York City.

Two materials are being considered for the green shared lanes: 1) An epoxy modified, acrylic, waterborne coating, and 2) Crushed glass cutlets and resin. The epoxy product has tested well in both New York City and Boston and the crushed glass cutlet treatment is currently being tested in Madison. Both products offer more vivid hues of green than the current paint and yield a higher contrast to the color and texture of the pavement.

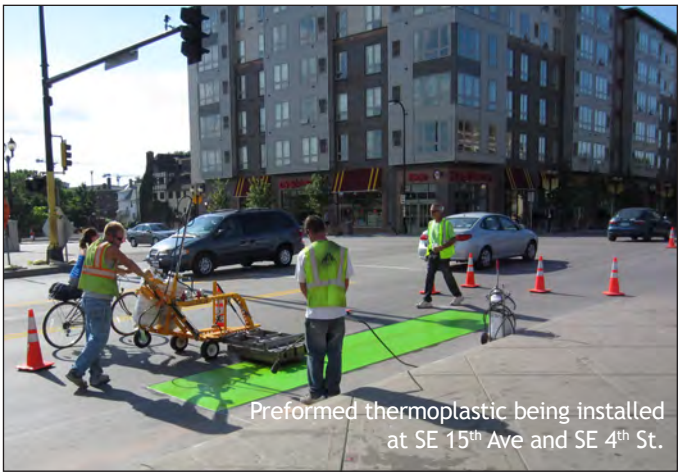
Due to challenges related to winter maintenance, pavement condition, and high bus volumes, Public Works wants to ensure the materials test well locally before making decisions about the entire corridor. A portion of Hennepin between 6th and 7th Streets is being proposed to test the two products. One product would be tested on each side of the block, allowing staff to observe the effect of right turning vehicles on the materials.

Crushed glass cutlets being installed in Madison.

To anticipate plowing during winter months, the proposed test site would either be shot blasted or ground down, depending on vendor specifications. This would provide a recessed grove for the material and would mitigate the effect of plow blades. A tentative testing schedule would start in spring of 2012.

Other Colored Bicycle Facilities in Minneapolis

In addition to the work along Hennepin Avenue, colored pavement options are being tested at other locations in Minneapolis. In September of 2011, Public Works installed three green conflict areas on SE 15th Ave at SE University Ave, SE 4th St, and SE 5th St. Preformed thermoplastic is used to highlight conflict areas at these intersections. While both the material and purpose of the facility differs from the Hennepin Avenue shared lanes, the site will also be monitored closely as Minneapolis expands its bicycling infrastructure.


Preformed thermoplastic being installed at SE 15th Ave and SE 4th St.