Seattle Department of Transportation

2nd Ave Protected Bike Lane Demonstration Project

Before and After Study

SDOT
Seattle Department of Transportation


SIGNAL
Spring St 1100

CONTENTS

PROJECT OVERVIEW

The 2nd Avenue Protected Bike Lane (PBL) Demonstration Project installed a two-way PBL on the east side of 2nd Ave between Pike Place Market (Pike St) and Pioneer Square (Yesler Way). This project serves as a model for a planned network of similar facilities throughout downtown Seattle. Protected bike lanes add predictability and improve safety by providing a physical barrier between people biking and people driving. They provide a dedicated, separated space for people of all ages and abilities to ride bikes.

The project was intended to increase bicycle ridership and improve safety for all travelers, while minimizing impacts to travel times for transit and general traffic.

In July and August 2014, the Seattle Department of Transportation (SDOT) solicited feedback from

2nd Ave property owners and business owners concerning their operational needs, with an eye toward limiting impacts to parking and load zones. Signal upgrades and street maintenance started in August 2014, and bike lane installation was complete in September 2014. The project was executed on an accelerated schedule in anticipation of the opening of Pronto! Cycle Share, a bicycle sharing service. We completed the planning, outreach, design, and installation in four months.

The total project cost of $1.5 million was funded through Bicycle Master Plan Implementation funds.

Prior to implementating the PBL, the southbound 2nd Ave bike lane was five feet wide, sitting between a parking lane and a vehicle travel lane.

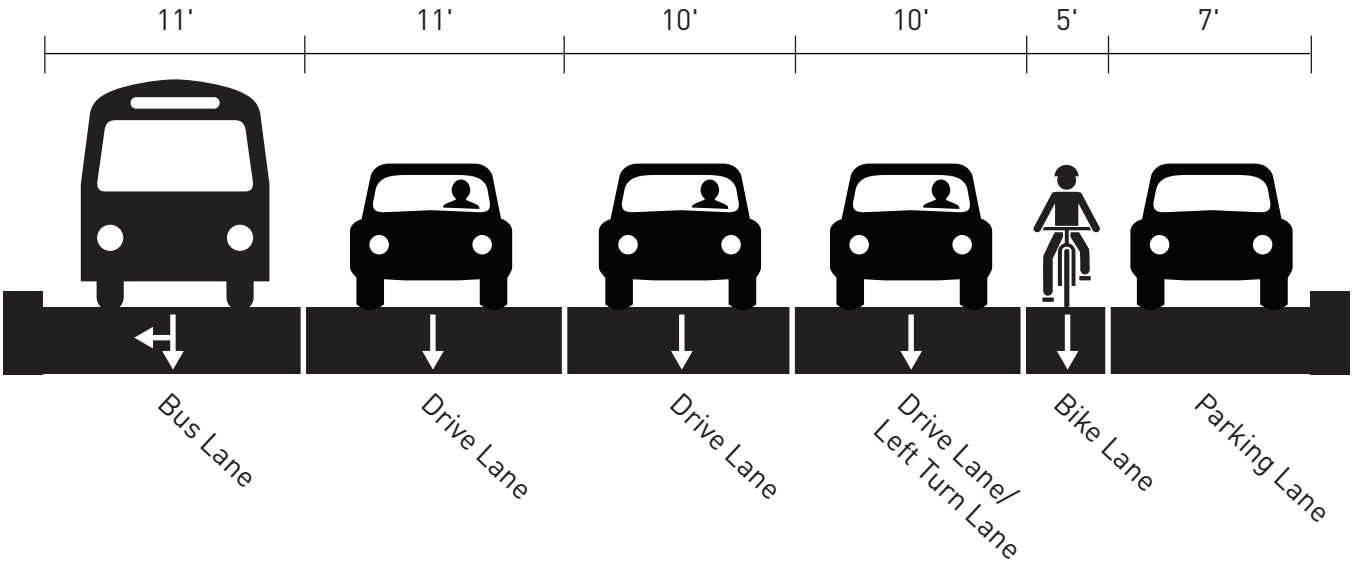
The ten foot wide PBL serves both southbound and northbound bicyclists and is between the curb and a three foot buffer, with the adjacent lane serving left turns and/or parking/loading needs.

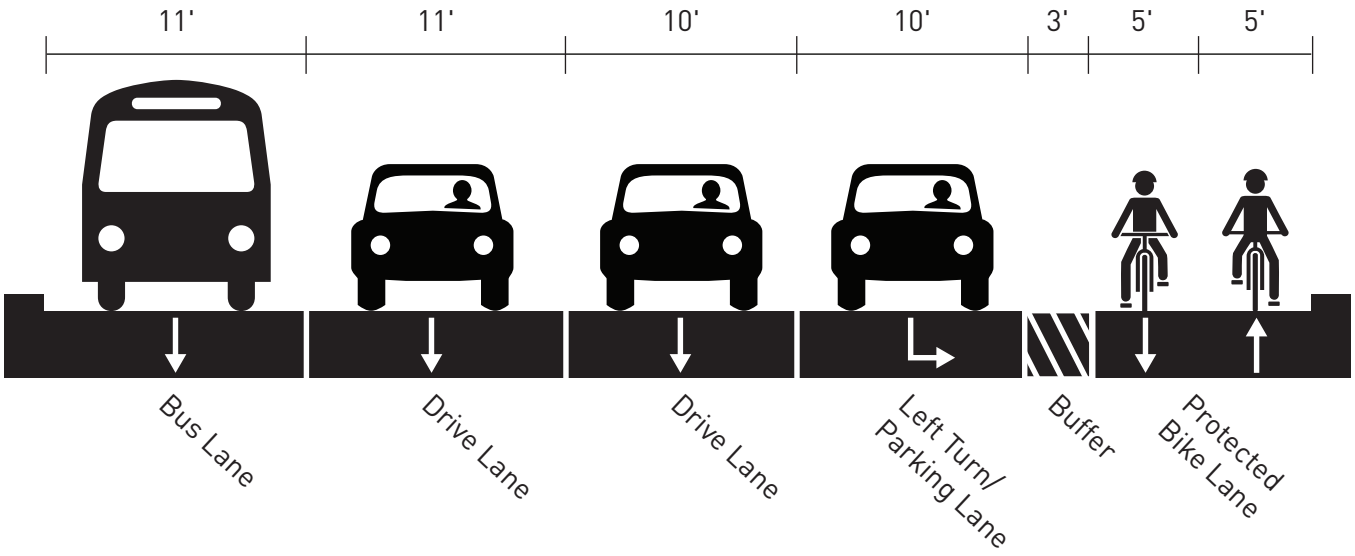
PROJECT ELEMENTS

The project elements provided benefits to everyone who travels along 2nd Ave:

We installed the PBL on the east side of the street to avoid impacts to transit operations, including boardings and alightings. The east side location also allows people who are biking northbound to be closer to the curb and not adjacent to southbound motorists. It is also consistent with the location of the previous one-way bicycle lane.

The PBL was designed as two-way to provide maximum accessibility for bicyclists in an effort to encourage bicyclists to use 2nd Ave versus other





north-south streets (likely 1st or 3rd avenues), and to discourage riding on the sidewalk or riding the wrong way in a one-way PBL. While riding a bike on a sidewalk is legal, it is not ideal. Providing a dedicated space for people biking improves safety for all travelers, whether walking, biking, or driving.

The left turn pockets/curb space management was designed based upon traffic analysis that included left turn volumes by time of day. We struck a balance was struck providing curb space for the loading needs of the adjacent businesses/short term motor vehicle parking and moving traffic.

We designed a three foot wide the physical buffer to provide a space for motorists to enter/exit their vehicles from the adjacent parking and to account for door swing. The buffer included flexible delineator posts to discourage parking encroachment into the buffer. The parking lane, along with the buffer and delineator posts, provided the physical separation that defines a protected bicycle lane.

Traffic signals

The protected bicycle lane included protected left turn lanes at seven of the eleven intersections. We upgraded traffic signals to include both

bicycle signals and vehicular left turn signals at intersections. Separating the bicycle and pedestrian movement from the vehicular left turn movement was a significant safety improvement for people walking and biking. It also provides people who are driving with a dedicated time to turn, separate from pedestrians and people on bicycles traveling through the intersection.

PROJECT TIMELINE

May 6, 2014 – Mayor Murray announces that SDOT will build a protected bike lane on 2nd Ave as a demonstration project during the annual Bike to Work breakfast, hosted by Cascade Bicycle Club

May – September, 2014 – SDOT collects traffic data, designs facility, and conducts outreach to adjacent businesses and communities

September 5-7, 2014 – SDOT crews install 2nd Ave Protected Bike Lane Demonstration Project over one weekend

September 8, 2014 – Grand opening celebration with Mayor Murray, Councilmember Tom Rasmussen, Councilmember Sally Bagshaw, Dick Cantwell (owner of Elysian Bar), Madi Carlson (family biking advocate), and SDOT Director Scott Kubly

September 8-12, 2014 – SDOT staff and Cascade Bicycle Club ambassadors provide one on one education for people on bikes and motorists queuing to make the protected left turn to encourage greater compliance.

Mid-September – November 2014 – SDOT crews make minor modifications to the project based on observations and feedback from community. Modifications included:

- Changing the green ball signals for green through arrows
- Swapping out the "Turn on Green" signs for "No Turn on Red"
- Channelization and sign changes north of Pike St for vehicles and bikes approaching the northern terminus of the new bike lane
- Parking modifications to increase visibility of all travelers at driveways
- Adding signage and pavement legends to increase awareness of pedestrians at crosswalks

BEFORE AND AFTER RESULTS

BICYCLE VOLUMES

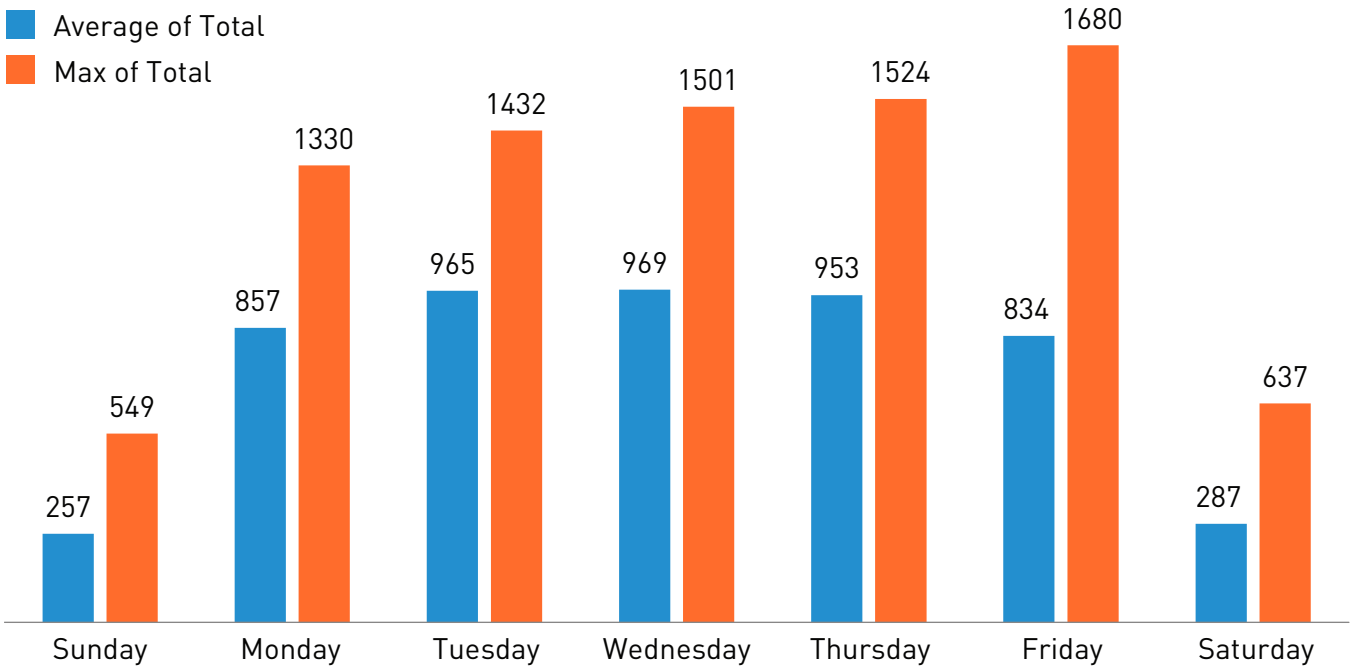
Before the start of construction, we collected bicycle volumes from July 29, 2014 to August 23, 2014. After completing the project, we installed a permanent bike counter on the PBL allowing, allowing for continuous volume tracking. The volumes below are the annual average daily bicycle volume, which includes bicycle counts on the weekends.

	Annual Avg Daily Bicycle Volume
Before	188
After	744
% Change	+296%

Based on the above data, the bicycle volumes on 2nd Ave increased by nearly 300% after the PBL was installed. It is important to recognize that the before count was taken when the facility was one-way southbound. By providing a two-way facility, one could expect the volume to double.

Bicycle volumes on 2nd Ave are significantly greater during the week, which may reflect bicycle commuter demand. This data reflects counts from the permanent counter on the PBL between Madison and Marion streets and averages data from one year of data.

We also conducted before and after counts to quantify whether the PBL changed the number of riders using the sidewalk or travel lanes. There was a 15% reduction in the number of riders using the sidewalk and an early 40% reduction in the number of riding in the general purpose lanes.



BICYCLE SAFETY

We calculated bicycle collision rates before and after installing the PBL. The before period included five years of data (September 5, 2009 to September 4, 2014). The after period was from March 8, 2015 to January 15, 2016. The initial first six months were not included in the data because they were considered an adjustment period during which people were becoming familiar with the facility and how it operated. In addition, we made several improvements during those initial months based upon feedback from users.

In calculating the collision rate, we used the Federal Highway Administration's (FHWA) crash rate calculation to compare before and after data. The collision data shows the bicycle collision rate decreased by 79% overall, and fatal or serious injury collisions decreased by 75%. The two tables below show the values used to measure the collision rates.

All Bicycle Collisions	**Before** September 5, 2009 to September 4, 2014 (5 years)	**After** March 8, 2015 to January 15, 2016 (0.86 years)
Number of collisions	42	6
Bicycle volume (AADV)*	188	744
Years of data	5	0.858
Length of road segment	0.71 miles	0.71 miles
Crash Rate**	**17,241**	**3,627**
% Change	**79% reduction in collision rate**	

Fatal or Serious Injury Collisions	**Before** September 5, 2009 to September 4, 2014 (5 years)	**After** March 8, 2015 to January 15, 2016 (0.86 years)
Number of collisions	35	6
Bicycle volume (AADV)*	188	744
Years of data	5	0.858
Length of road segment	0.71 miles	0.71 miles
Crash Rate**	**14,368**	**3,627**
% Change	**75% reduction in serious collision rate**	

* Bicycle volume is expressed as average annual daily bicycle volume (AADV) – which includes weekends
** FHWA's collision rate is expressed as collisions per 100 million miles of travel. For more information, visit http://safety.fhwa.dot.gov/local_rural/training/fhwasa1109/app_c.cfm

PEDESTRIAN SAFETY

The most significant pedestrian safety improvement involved removing vehicle conflicts on the east crosswalk by restricting left turns on red from southbound 2nd Ave and the westbound left turn from the westbound cross streets. In addition, by restricting the left turn on red, the crosswalks are no longer blocked by motorists trying to make these turns during the red phase, creating a more comfortable crossing for pedestrians.

We reviewed pedestrian collisions to determine if the demonstration project affected pedestrian safety. In the five years prior to the installation of the PBL there were seven pedestrian collisions in the east crosswalks. Since the PBL was installed, there are no reported collisions involving pedestrians and turning motorists in the east crosswalk (for this to occur now the driver would be violating the no left turn on red, or the pedestrian would be jay walking). Due to the relative rarity of pedestrian collisions, a longer period of post PBL data analysis is necessary. As of the writing of this report, there is insufficient data to draw statistical conclusions.

VEHICLE VOLUMES

We collect annual traffic volumes on 2nd Ave between Pike and University streets. To determine if the installation of the PBL caused motorists to divert from 2nd Ave, we compared the average weekday daily traffic (AWDT) volumes from the 5 years before the project to the two years after the project. Counts show traffic volumes increased on 2nd Ave post PBL installation.

VEHICLE SAFETY

We reviewed vehicle collisions before and after the demonstration project was installed and calculated a collision rate using the Federal Highway Administration's (FHWA) crash rate calculation. The collision data shows that the vehicle collision rate has decreased by 6 percent overall, and serious injury collisions decreased by 31 percent. There were no fatal vehicle collisions in the corridor for either the before or after study periods. The table below shows the values used to measure the collision rates.

Type	Before September 5, 2009 to September 4, 2014 (5 years)		After March 8, 2015 to January 15, 2016 (0.86 years)		% Change
	Total	Rate	Total	Rate	
Total	220	1157	40	1086	-6%
Fatal or Serious Injury Collisions	120	631	16	434	**-31%**

COMPLIANCE

An element of the demonstration project that improved safety was the addition of bicycle and left-turn signals at the seven intersections with a left-turn movement along the corridor. Signal phasing allowed for separation of left-turning vehicles from bicycle and pedestrians crossings.

When the PBL first opened, compliance with both the bicycle signal and the left turn signal was mixed. Shortly after opening the PBL, we made two improvements:

1. Changed the traffic signal for the through movement was from a green ball to a green arrow to more clearly define the motorists traffic signal indication
2. Changed the signs from "Turn on Green" to "No Turn on Red" to more clearly provide direction for the left turning motorist

One month after the opening, we recorded video at the intersection of 2nd Ave and University St to measure compliance with the red left-turn arrow and the bicycle signal. Twelve hours of video was recorded, from 6 AM to 6 PM. The video was recorded on two days: October 10, 2014 (one month after the grand opening), and again on August 26, 2015 (nearly one year after the opening). SDOT staff watched the video to calculate the number of violations and the total number of movements.

	Bicycle Signal Compliance			Left Turn Signal Compliance		
	# of Violations	Bike Volume at Intersection	Compliance Rate	# of Violations	Vehicle Left Turn Volume	Compliance Rate
October 10, 2014	60	725	92%	383	2531	85%
August 26, 2015	91	1240	93%	181	2747	93%
% Change			**+1%**			**+8%**

Figure 1: Modified signal with a through arrow instead of green ball (Setember 12, 2014)

Figure 2: New signal configuration right after the grand opening (September 8, 2014)

The data show that people biking had a higher compliance rate shortly after the opening of the PBL (92%), and a year later a slight increase (93%). The more dramatic change was the motorist compliance improved from 85% to 93%. This may reflect that as more motorists are familiar with the facility and how it operates, compliance improves.

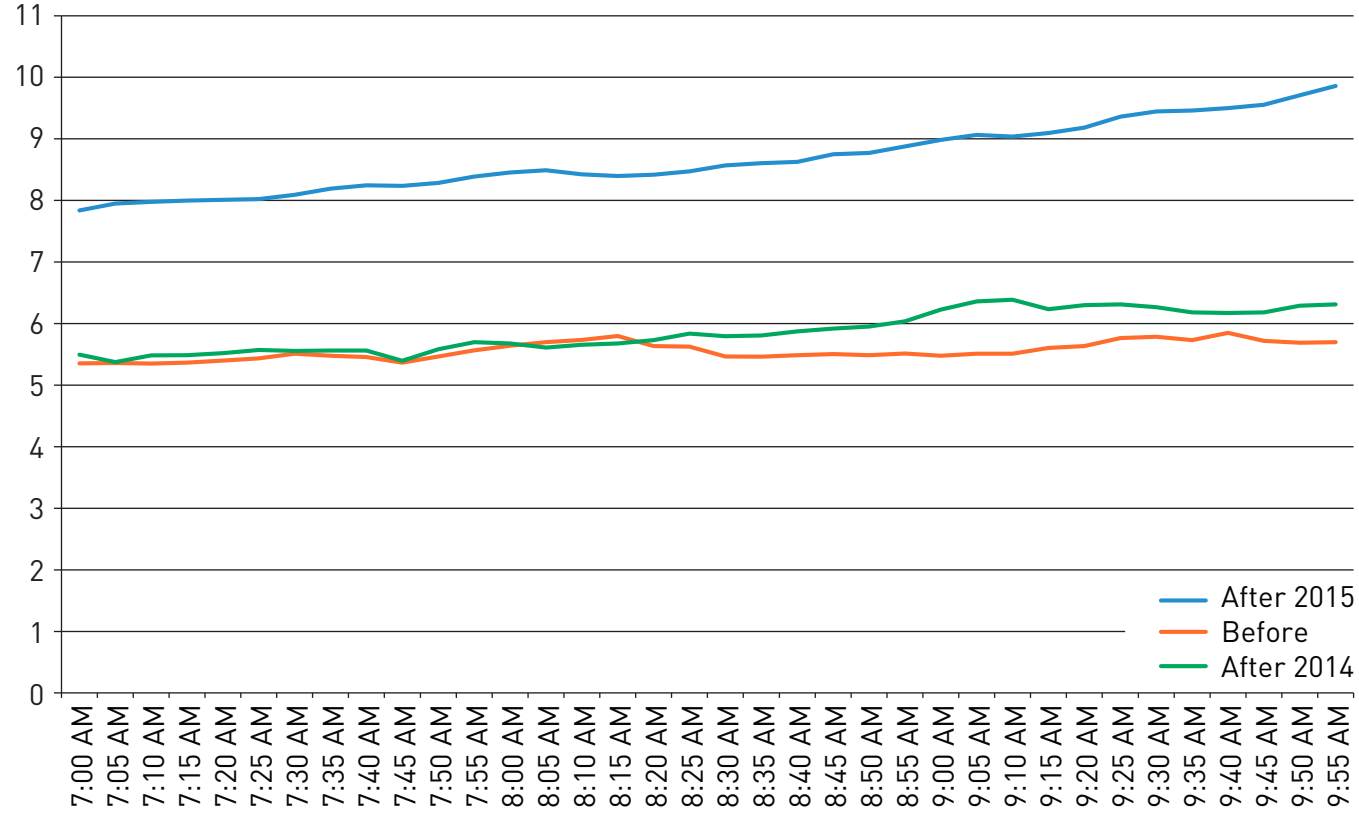
TRAVEL TIMES

We also measured vehicle travel times before the project, in the immediate weeks following implementation, and one year later in 2015. Travel times were measured from Bluetooth readers at Stewart St and James St, which capture the unique Bluetooth identification number from travelers using 2nd Ave at Stewart St, and then the reader at James St looks for matches to calculate the travel time from each individual with a Bluetooth device that passes both readers.

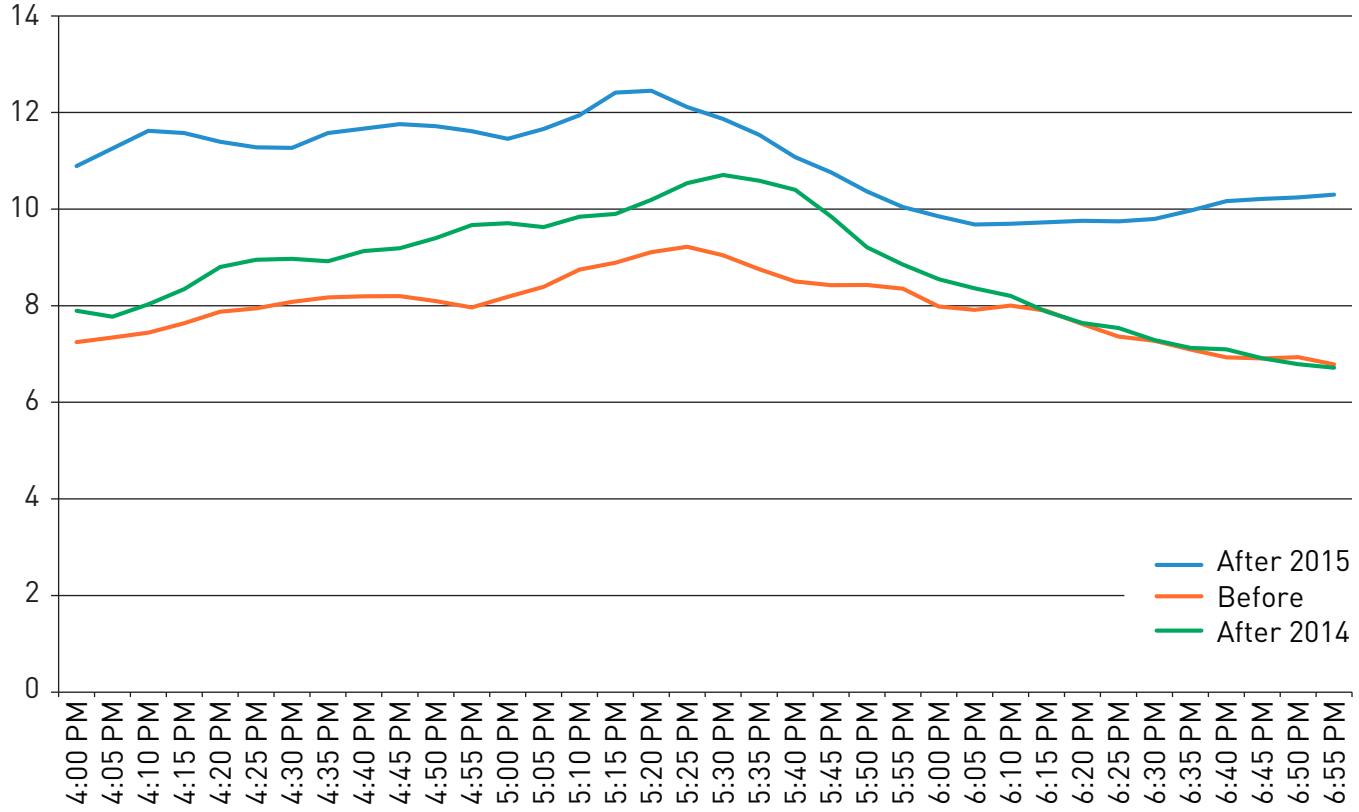
An important caveat is that the data is measuring how long it takes a Bluetooth device to travel from Stewart St to James St. It is measuring this only for travelers going this entire length (which likely eliminates pedestrians, but it does include people in cars, on transit, and riding bicycles). To more accurately measure the general purpose travel lane travel time for this corridor, we plan to conduct travel time runs in vehicles documenting start time at Stewart and end time at James. This could be used to validate the Bluetooth data.

The graphs below show AM and PM peak hours, with a line for the average travel time before the project, immediately after implementation in September 2014, and one year after implementation in August 2015.

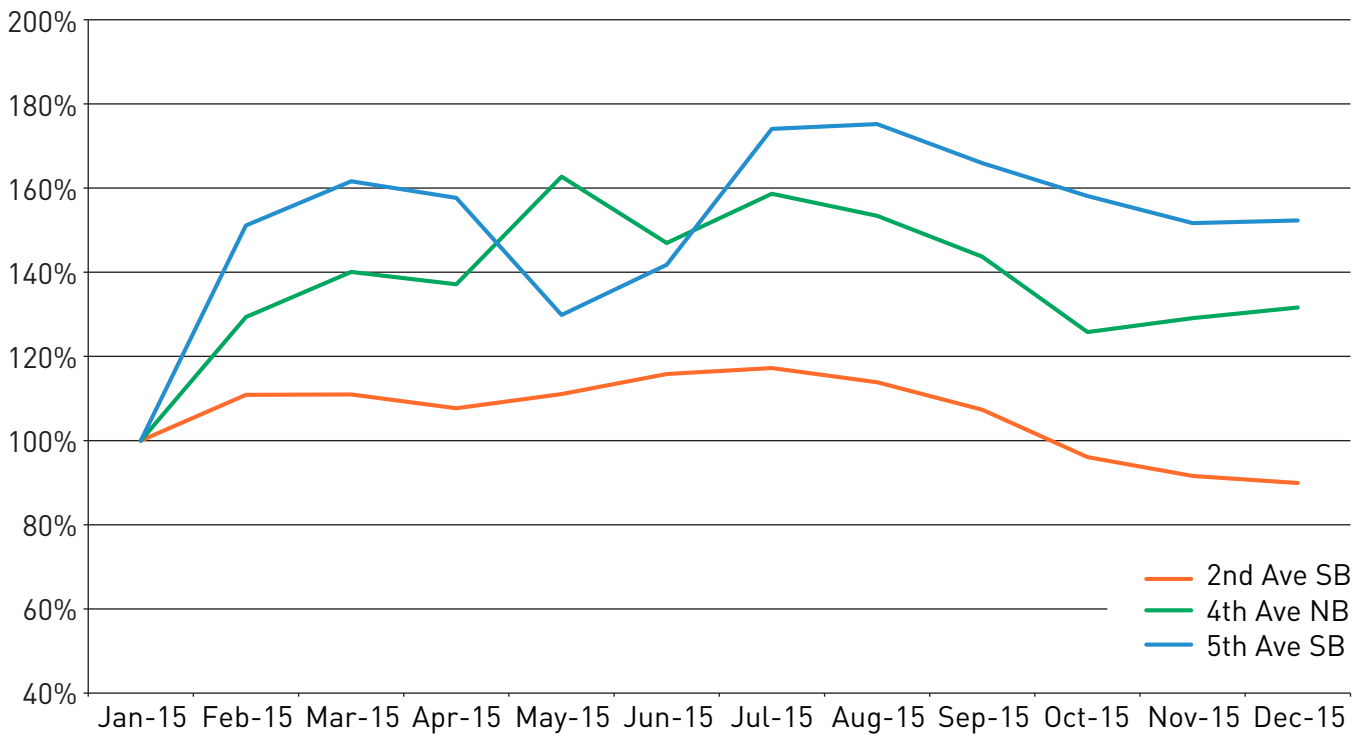
AM TRAVEL TIMES



PM TRAVEL TIMES



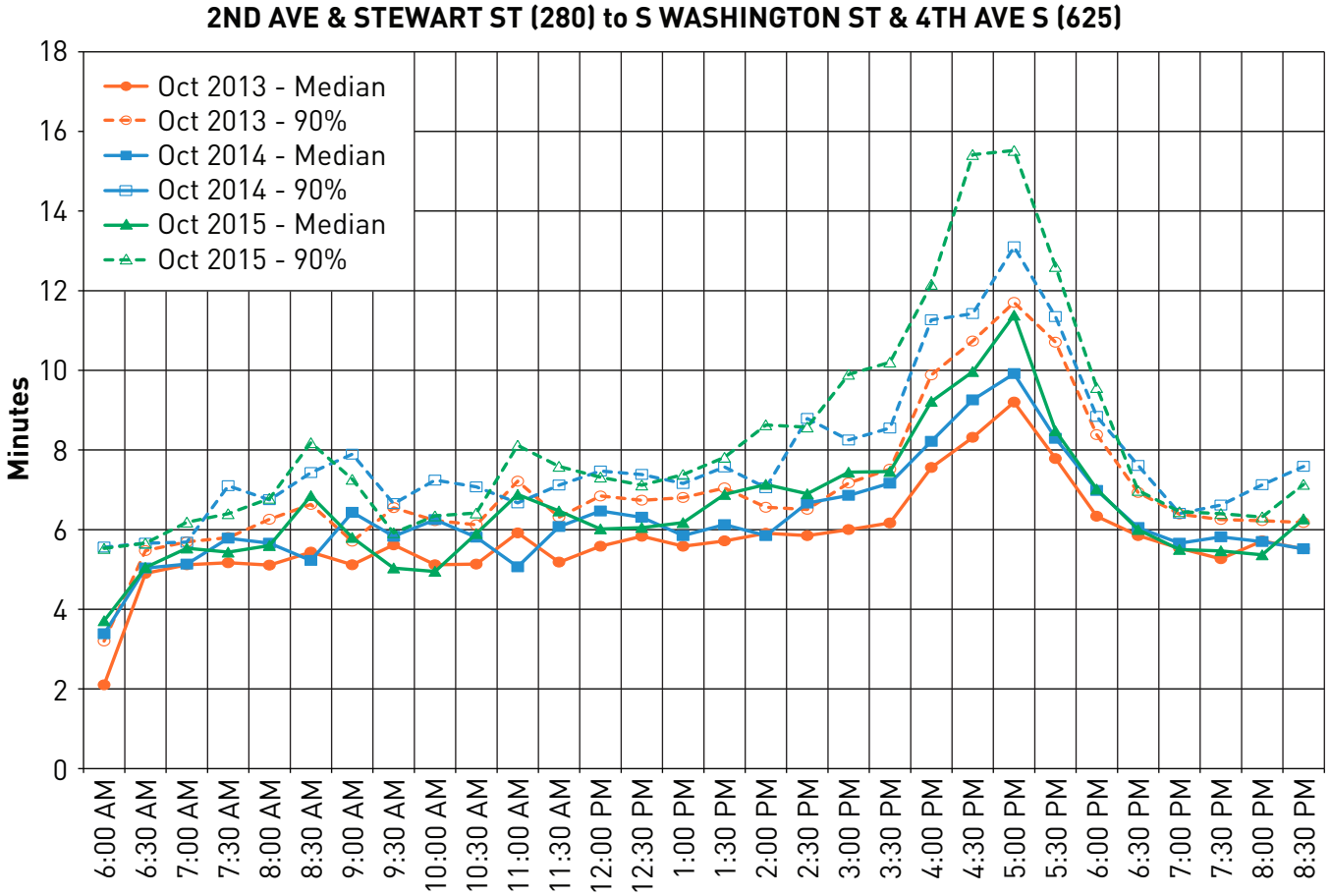
The data show that travel times did not increase immediately after the implementation of the PBL. However, one year later, the data show a more pronounced increase in travel times along the corridor. It is unclear if this is related to the PBL. Travel time data from other parallel streets suggests that the increase in travel time is not unique to Second Ave.

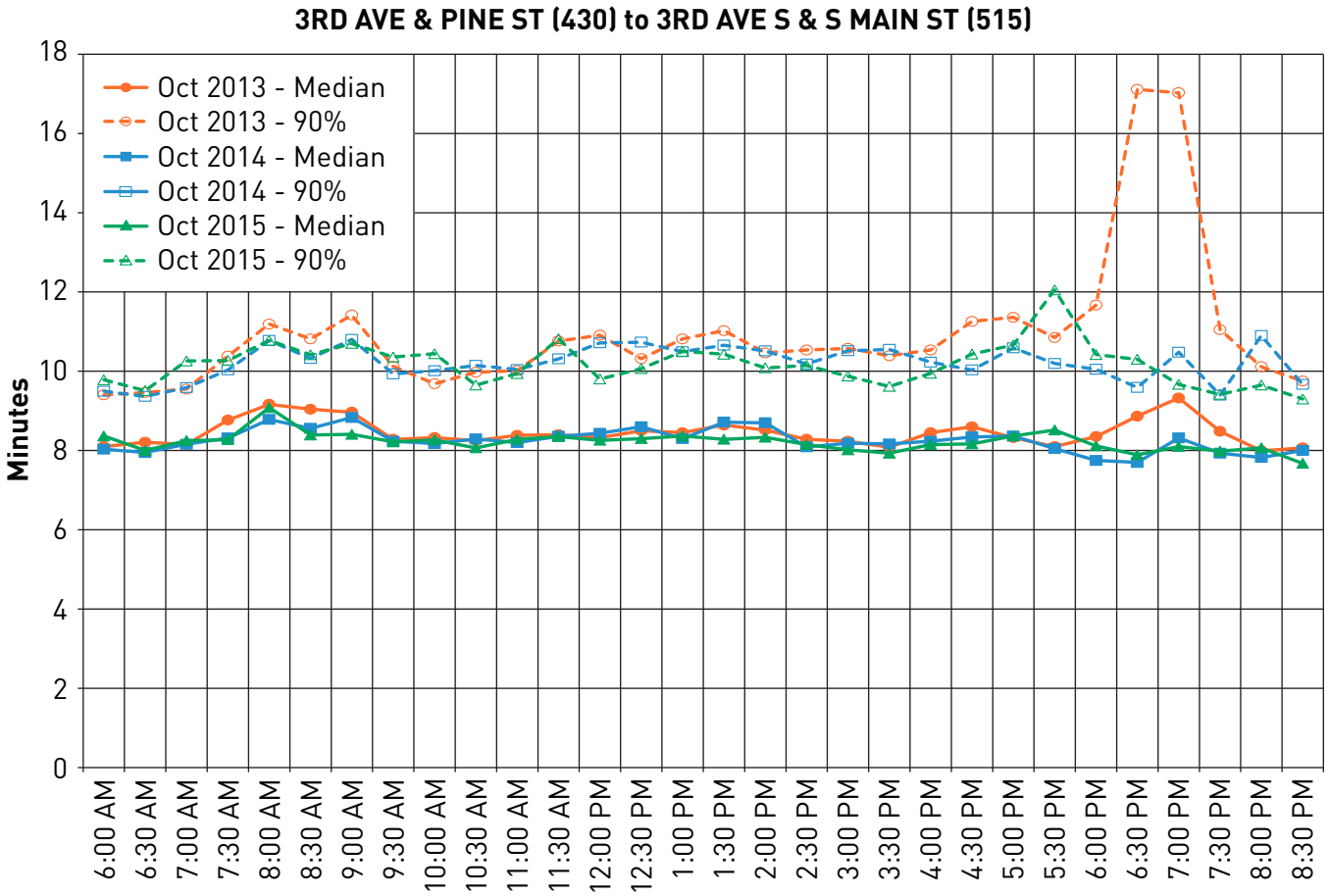


KING COUNTY METRO TRANSIT TRAVEL TIMES

King County Metro staff compared data from July and August 2014 (before) and post September 8, 2014 (after). The result is that the September 2014 period has slight higher median and 90th percentile travel times at most times during the day compared to the before period. In most cases, the difference is less than one minute.

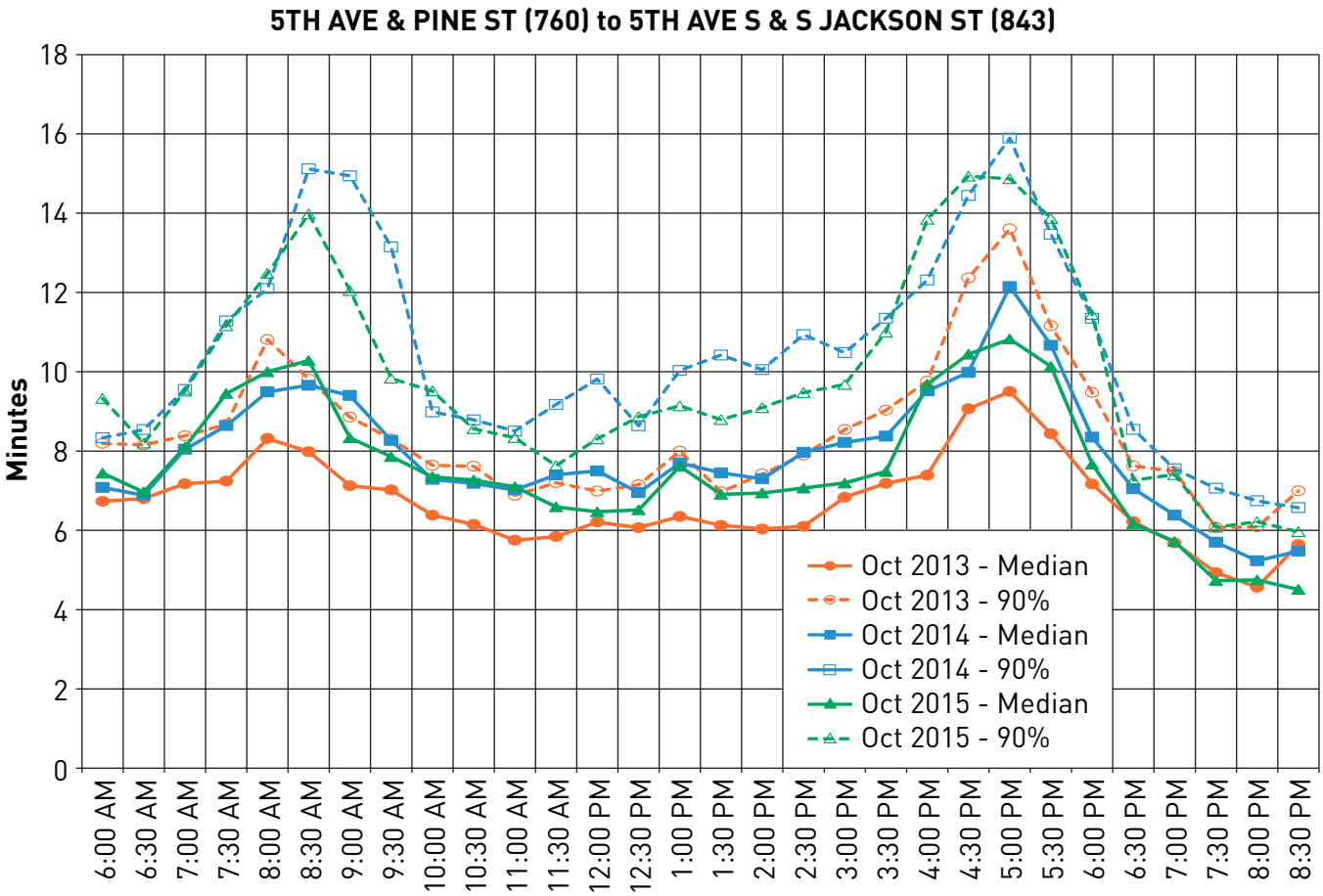
Their analysis also compared 2nd Ave travel times with southbound travel times for 3rd and 5th avenues between October 2013 and September 2014 to see if the slight increase in travel times on 2nd Ave were part of an overall increase in transit travel times in the center city. The results were mixed, with 3rd Ave showing very similar travel times, but 5th Ave showing similar increase in travel times to what 2nd Ave experienced.




3RD AVE & PINE ST (430) to 3RD AVE S & S MAIN ST (515)
Minutes
Oct 2013 - Median
Oct 2013 - 90%
Oct 2014 - Median
Oct 2014 - 90%
Oct 2015 - Median
Oct 2015 - 90%
0
2
4
6
8
10
12
14
16
18
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 AM
12:00 PM
12:30 PM
1:00 PM
1:30 PM
2:00 PM
2:30 PM
3:00 PM
3:30 PM
4:00 PM
4:30 PM
5:00 PM
5:30 PM
6:00 PM
6:30 PM
7:00 PM
7:30 PM
8:00 PM
8:30 PM


LEFT TURN ON ONLY
Metropolitan Grill
ONE WAY


2nd Ave Protected Bicycle Lane Demonstration Project
SIGNAL
NO STOPS


5TH AVE & PINE ST (760) to 5TH AVE S & S JACKSON ST (843)
Minutes
0
2
4
6
8
10
12
14
16
18
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
11:30 AM
12:00 PM
12:30 PM
1:00 PM
1:30 PM
2:00 PM
2:30 PM
3:00 PM
3:30 PM
4:00 PM
4:30 PM
5:00 PM
5:30 PM
6:00 PM
6:30 PM
7:00 PM
7:30 PM
8:00 PM
8:30 PM
Oct 2013 - Median
Oct 2013 - 90%
Oct 2014 - Median
Oct 2014 - 90%
Oct 2015 - Median
Oct 2015 - 90%

NEXT STEPS

2nd Ave is functioning as a demonstration project as expected and we're continuing to make improvements. This summer (2016) we will be making additional upgrades that will include placing the traffic signal heads over the individual lanes, and raising driveways and passenger loading zones at a total of four locations to increase awareness of potential conflicts and slow people driving and biking.

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