Seattle Department of Transportation

RAINIER AVENUE SOUTH SAFETY CORRIDOR

Rainier Pilot Project Evaluation

S Alaska Street to S Kenny Street

Seattle
Department of
Transportation

CONTENTS

PROJECT OVERVIEW

In 2014, the Seattle Department of Transportation (SDOT) launched the Rainier Avenue South Corridor Safety Project to address the frequency and severity of collisions occurring all along this principal arterial street. Engineering, enforcement and educational efforts were employed to achieve the project goals which were to:

- Make Rainier safer for everyone
- Reduce excessive speeding
- Improve conditions for pedestrians
- Maintain efficient transit service
- Improve intersection safety
- Reduce injuries

SDOT studied Rainier and developed design alternatives based on a variety of transportation data, modeling, public input, and neighborhood plans. From November 2014 through July 2015, SDOT and our partners gathered feedback about these design alternatives from residents and businesses in the Rainier Valley.

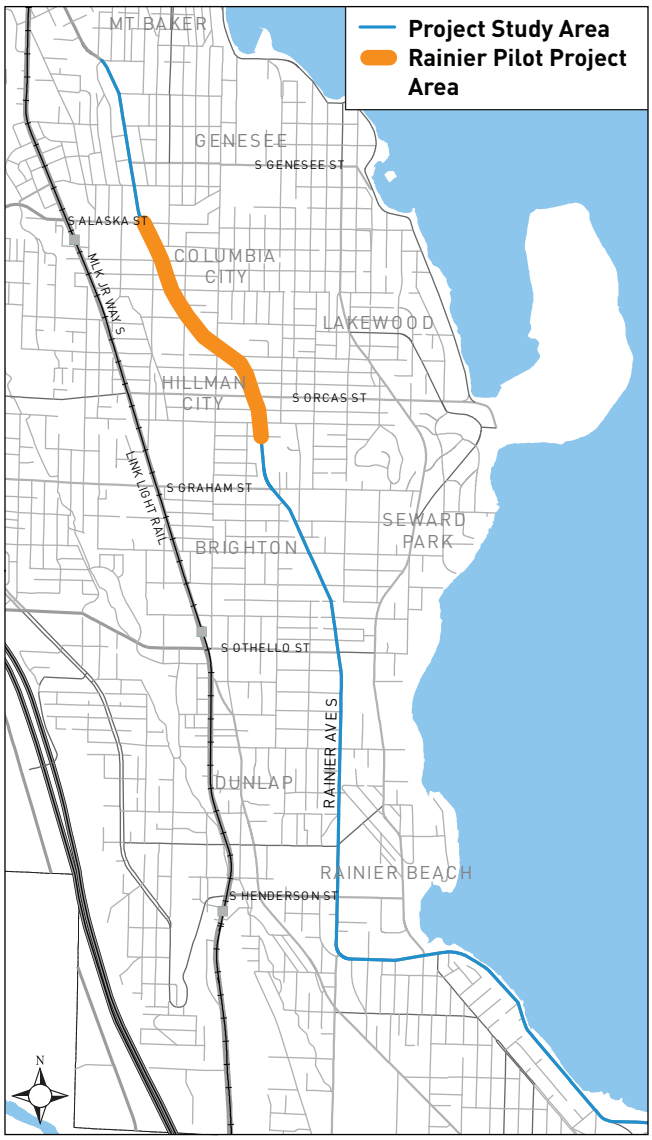
In August 2016, Seattle moved forward with the Rainier Avenue Pilot Project – a multifaceted plan to reduce collisions. Significant street design changes, consisting of a 4-to-3 rechannelization with transit efficiency and pedestrian safety elements, were installed in mid-August and concentrated enforcement efforts began shortly after road work was complete.

Data show that the Rainier Pilot Project improved safety by reducing speeds, improving pedestrian crossings, and improving turning movements at intersections.

The following report provides SDOT's approach to this project including street design changes, enforcement, and a before and after evaluation. Additional information including data, outreach information, project plans and modeling summaries can be found on the project website: www.seattle.gov/transportation/rainieraves.htm

BACKGROUND

Rainier Avenue South runs eight miles long within the City of Seattle to the southeast of the center city. As a principal arterials street, Rainier also facilitates regional transportation for cities southeast of Seattle. The study area for this multi-year project includes the segments of Rainier Avenue South between Martin Luther King Jr Way S and the city limits. Countermeasures deployed during the Rainier Avenue Pilot were installed between S Alaska Street and S Kenny St. See the map for more information



Rainier was previously classified as State Route 167 and was operated in partnership with the Washington State Department of Transportation (WSDOT). On April 1, 1992, Seattle took ownership of Rainier Ave S and the route was decommissioned as a state highway.

Since then, land uses along the corridor evolved significantly to support retail shopping, restaurants, schools, parks, residences and light industrial uses. This array of land uses generates robust volumes of drivers, bicyclists, transit riders, and pedestrians.

While the land uses alongside Rainier have changed, the basic design of the roadway remained the same. As early as 1976 there were public requests for channelization changes on Rainier which were eventually formalized in neighborhood plans. In the late 2000's, SDOT's Southeast Transportation Study (SETS) recommended channelization changes to the roadway and a study was conducted to assess the feasibility of a rechannelization of Rainier between S Alaska Street and S Cloverdale Street (SET recommendation 29, p. 122). The analysis used projected traffic volumes exceeding 30,000 vehicles per day which was projected to induce major delays on the corridor. However, traffic volumes have not increased as anticipated in the study. In fact, average daily traffic volumes on Rainier have remained near 20,000 vehicles per day for the last decade.

In addition, Martin Luther King Jr Way S, a principal arterial street nearly parallel to Rainier, remains underutilized with volumes lower than the roadway's capacity.

SPEED

Speeding has been a long-standing concern on Rainier and speed data confirmed that speeding was an issue on this street. Speed studies showed that 1000 to 2000 vehicles per day would travel the corridor at 40 miles per hour or faster (posted speed limit was 30 mph). Higher speeds increase the likelihood and severity of collisions and numerous studies show that pedestrians hit at 40 miles per hour have a 10 percent chance of surviving.

Speeds Prior to Pilot Project		
Location	**85th Percentile Speed**	**Average Number of High-End Speeders (10+ mph Over Posted Speed Limit**
S Hudson St	35 mph	611/weekday
42nd Ave S	38 mph	1812/weekday
S Holly St	37 mph	1083/weekday
S Cloverdale St	36 mph	1083/weekday

COLLISIONS

Between January 2011 and October 2014, there were 1243 collisions within the four-mile study area resulting in 630 injuries and two deaths. In the last ten years, 11 people were killed and another 1700 individuals sustained injuries. Compared with other principal arterial roadways in Seattle, Rainier has a per mile crash rate higher than streets that carry more than two times the traffic volume, making it a top candidate for street design modifications.

SDOT's Transportation Operations Center (TOC) monitors Seattle streets and significant incidents. TOC data show that the frequency of collisions and severity of collisions often led to lengthy delays on Rainier. Prior to implementing street design changes, the average time to clear incidents on Rainier was 47 minutes. Prior to the Rainier Pilot Project, collisions contributed to significant delays on the corridor three to ten times per month.

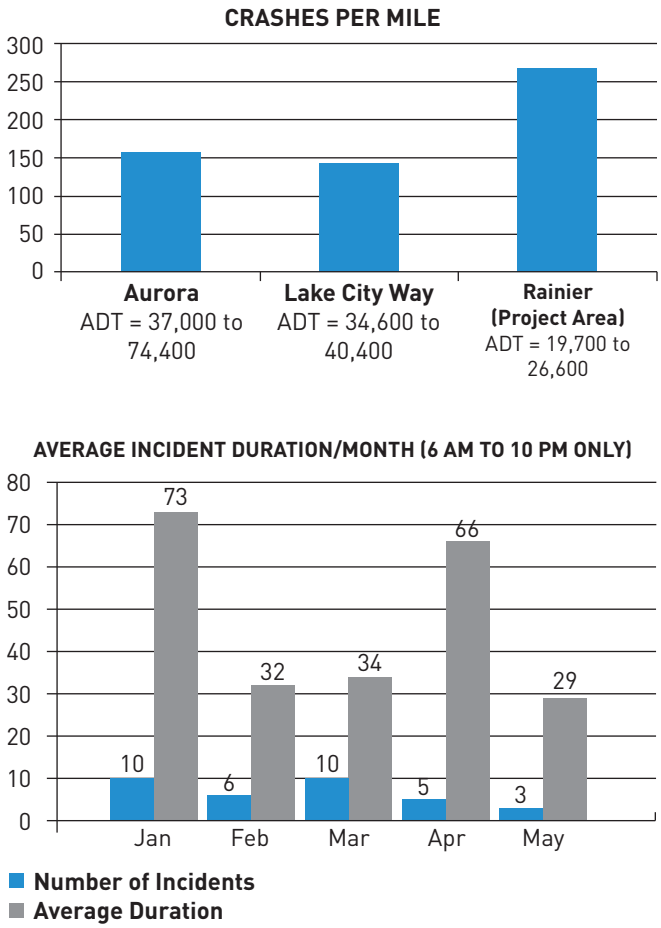


Figure 1 - Rainier Incidents Monitored by SDOT Transportation Operations Center 2015

DATA AND MODELING

SDOT collected an immense amount of data on Rainier and nearby streets to model design concepts and create baseline data. Data collection included:

- Turning movement counts at every intersection during the morning peak hours, off-peak hours, and the evening peak hours
- Pedestrian, bicycle, freight and transit counts
- Floating car travel times (where staff verify model baseline travel times by driving the corridor and recording travel times)
- Transit travel times

Design concepts were assessed using the Vissim dynamic simulation model to better understand the potential impacts of each design. The Vissim model allowed us to consider possible traffic diversion as well as transit and general purpose vehicle travel times. SDOT focused on modeling the peak periods on Rainier when traffic volumes are highest so that we could understand the highest potential delay of each design concept.

All designs were developed to reduce speeds, enhance pedestrian crossings and turning movements, ensure transit efficiency and reduce collisions. Bicycle lanes were considered for this project but were ultimately not installed due to the high frequency of collisions and street design challenges in Columbia City.

Model outputs indicated that the design alternatives would induce delays for general purpose traffic from a minimum of 33 seconds and a maximum of 2 minute and 25 seconds. For transit, model outputs estimated 19 seconds to a maximum of one minute of delay. Modeling also suggested some traffic diversion to Martin Luther King Jr Way S. Anticipated delays and potential diversions were presented to the public during outreach.

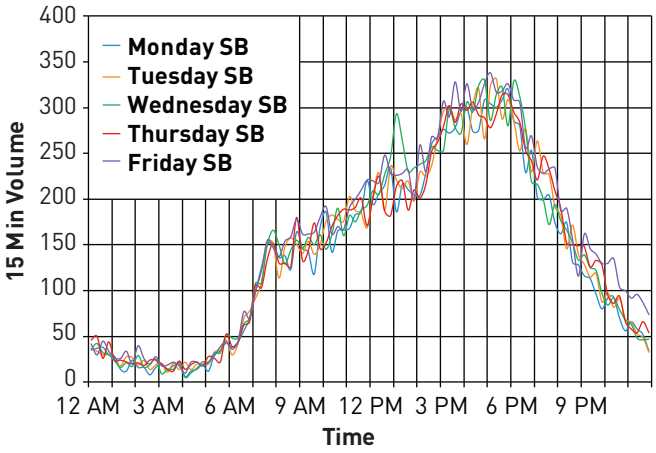


Figure 2 - Southbound Rainier traffic volumes by time of day. Southbound traffic has the highest peak hour volumes on the corridor.

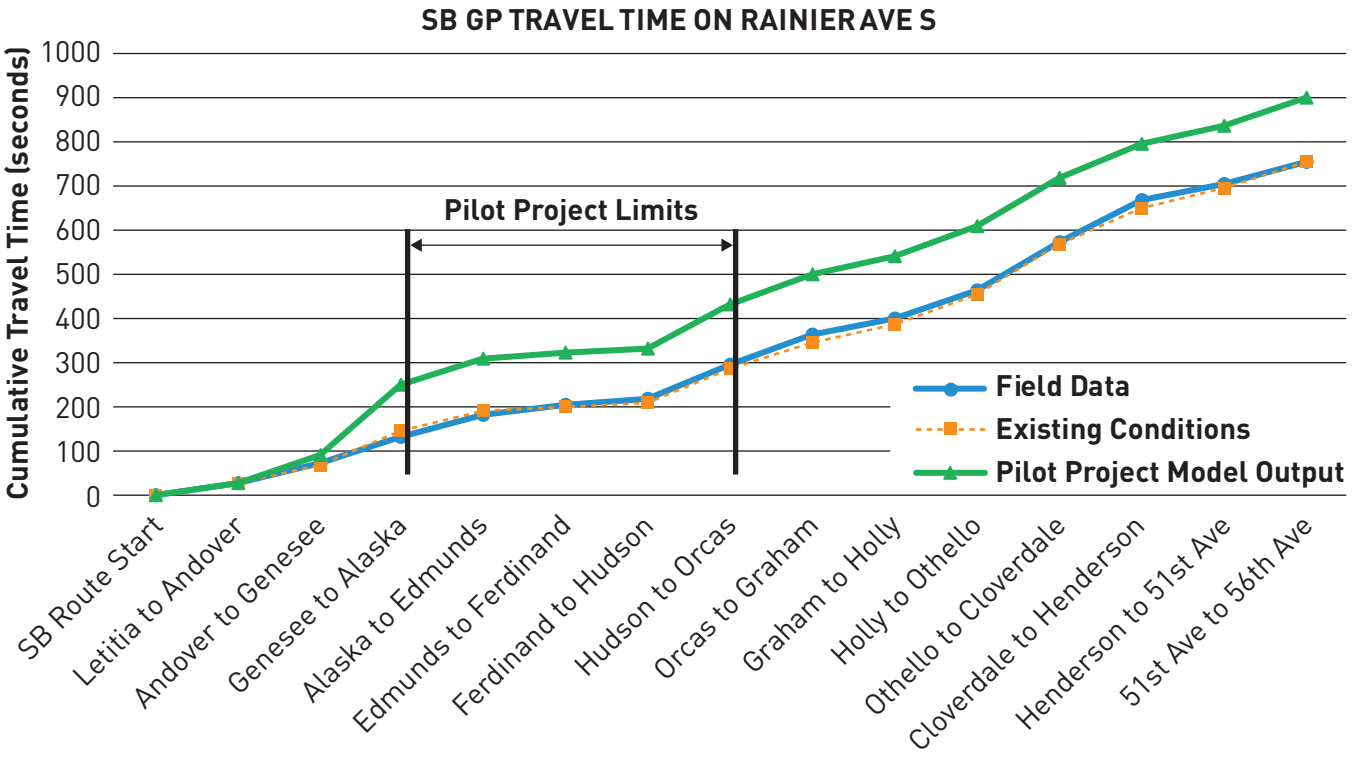


Figure 3 - Southbound General Purpose Travel Time Model Output

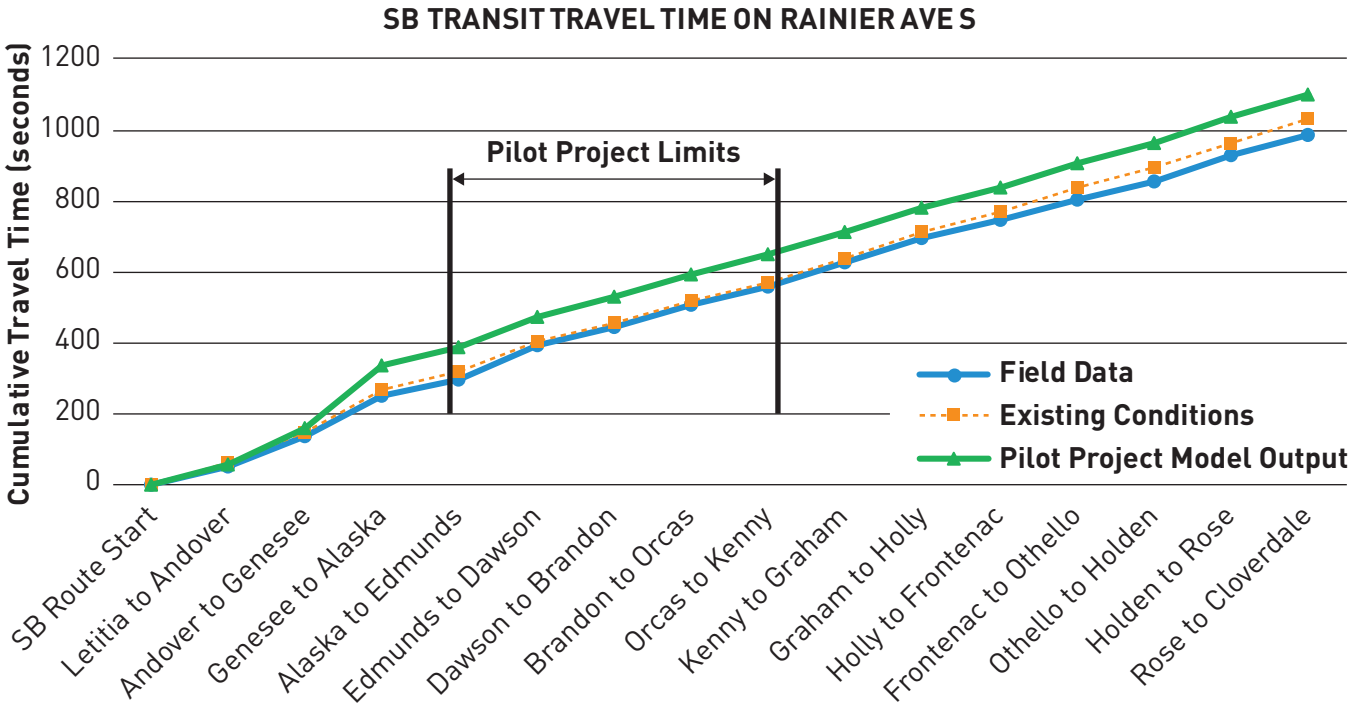


Figure 4 - Southbound Transit Travel Times Model Output

STREET DESIGN MODIFICATIONS AND ENFORCEMENT

After studying the corridor and vetting street design concepts with the public, SDOT implemented the Rainier Pilot Project in August 2015.

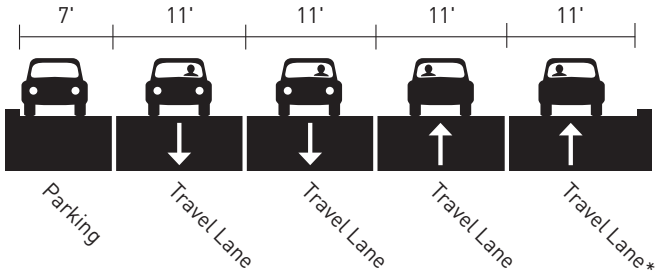
Street design changes focused on a one-mile segment that encompasses the neighborhood commercial districts of Columbia City and Hillman City. Retail, restaurants and convenient access to transit generate heavy volumes of all modes of traffic in this area.

Project plans can be viewed on the project website. The following describes the street design elements and enforcement techniques used for the Rainier Pilot Project:

Rechannelization

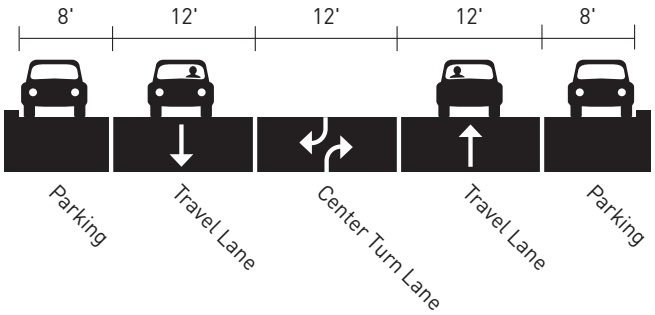
SDOT removed one lane of traffic in each direction and added a center turn lane along most of the corridor. Rechannelization has been proven effective for reducing speeds, high-end speeding (10+ mph over the speed limit) and collisions involving turning movements. This rechannelization reduces the number of lanes pedestrians must cross and provides a center turn lane to enhance left turns and traffic flow efficiency.

TYPICAL CROSS SECTION (EXISTING)



*Parking available at some locations

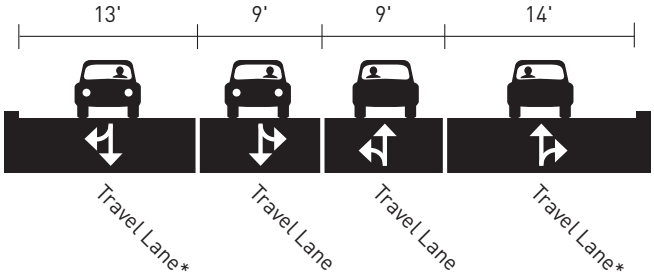
TYPICAL CROSS SECTION (NEW)



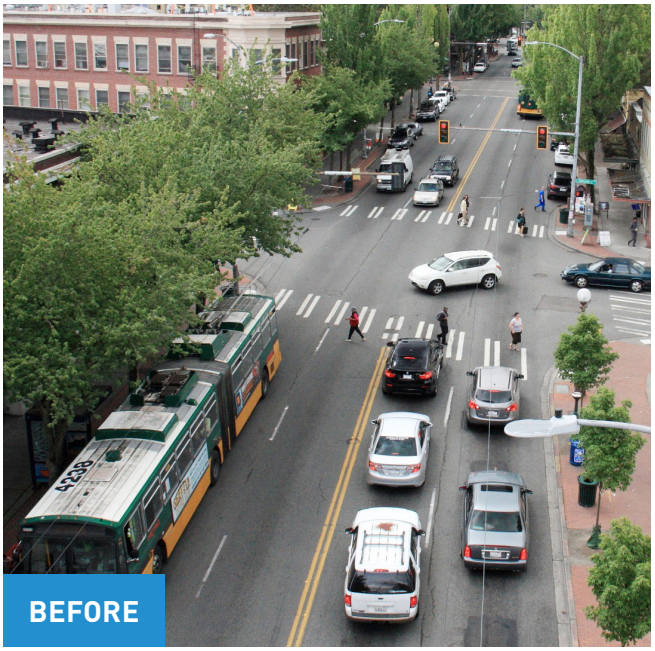
Transit efficiency measures

More than 13,000 people ride transit on Rainier daily and ensuring that transit service remained an attractive travel option was a key goal for this project. A transit queue jump signal and bus and turn lane was installed southbound on Rainier approaching S Edmunds Street to help keep transit moving through the project area. Left turn restrictions were also installed at S Edmunds Street to enhance traffic flow for general purpose traffic entering Columbia City.

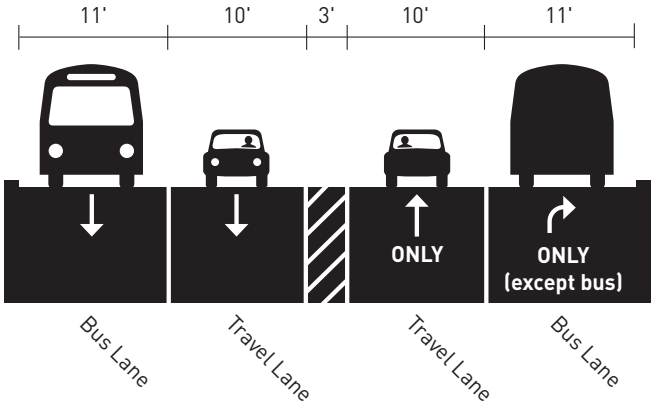
RAINIER AVE S & S EDMUNDS ST (EXISTING)



*Parking available at some locations



RAINIER AVE S & S EDMUNDS ST (NEW)



Signal timing changes

With up to 1100 vehicles travel through Rainier Pilot Project area during the afternoon peak hours, SDOT determined that signal timing changes would be needed to manage traffic flow. The efficiency of the rechannelization design along with longer signal cycles substantially offsets the loss of travel lanes. In addition, a leading pedestrian interval was installed at Rainier and S Ferdinand St to give pedestrians a head start when crossing Rainier.

Signal Cycle Length* (seconds)						
	AM Peak Hour		Off-Peak Hours		PM Peak Hour	
Location	Existing	Proposed	Existing	Proposed	Existing	Proposed
S Edmunds St	60	120	60	60	65	130
S Ferdinand St	60	120	60	60	65	130
S Hudson St	60	120	60	60	65	130
39th Ave S	60	60	60	60	65	65
Brandon St	60	60	60	60	65	65
S Orcas St	60	120	60	60	65	130
S Kenny St	60	60	60	60	65	65

**Signal cycle length is the amount of time you wait when you just arrived to a traffic signal that just turned "red" until it turns "green".*

Left turn signals

Left turn collisions were an issue at the intersection of Rainier and S Orcas Street in Hillman City. In the three years prior to the Pilot project, 63 percent of collisions at this arterial-arterial intersection involved left turns. The rechannelization provided left turn pockets on Rainier and new left turn signals help facilitate left turns.

Speed limit

The speed limit on Rainier was reset using federal guidance set forth in US Limits 2. Taking into account daily volumes of pedestrians, bicyclist and vehicles along with existing street features like driveway openings, the speed limit was adjusted from 30 mph to 25 mph. This is in line with the 25 mph design speed for the project as a whole.

Geometric adjustments

Low cost approaches to safety were used along the corridor. At the intersection of Rainier and S Brandon Street, paint and posts were used to enhance sight lines entering Rainier. This treatment also benefits pedestrians by reducing the street crossing distance.

Enforcement

The Seattle Police Department (SPD) conducted frequent patrols on Rainier Avenue S. Warnings were issued for more than two weeks to allow users to adjust to the new design. SDOT and SPD worked together to focus enforcement efforts on aggressive driving and special emphasis patrols were set up to enforce new turn restrictions.

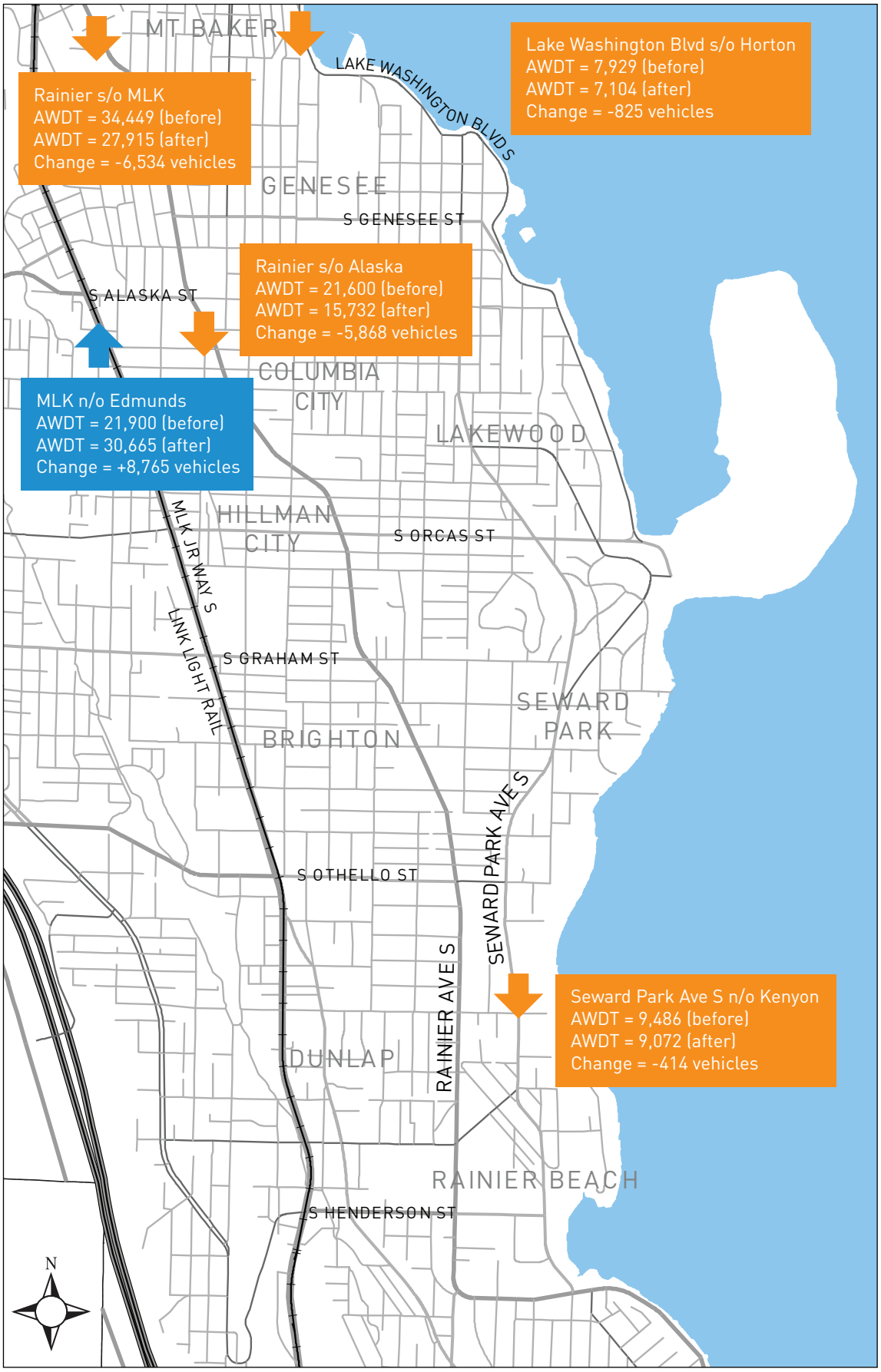
BEFORE AND AFTER RESULTS

The Rainier Pilot Project has enhanced safety on Rainier and travel times for both transit and general traffic have outperformed expectations.

Speeds

Speeds have been reduced within the project area. The most substantial speed reductions occurred in Columbia City at S Hudson Street. Speeds remain higher than the posted speed limit between Columbia City and Hillman City and additional street design changes in Phase 2 of the project will address this issue.

Speeds at S 42nd Street			
50th Percentile Speeds			
	2015 (30 mph speed limit)	**2016 (25 mph speed limit)**	**Change**
Northbound	33.4%	28.0%	-16.2%
Southbound	33.5%	30.0%	-10.4%
Speeders (Percent speeding)			
Northbound	84.1%	40.0%	-52.4%
Southbound	82.4%	59.3%	-28.0%
Top End Speeders (Drivers exceeding 40 mph)			
Northbound	4.1%	0.8%	-80.5%
Southbound	6.2%	1.7%	-72.6%


MT BAKER
LAKE WASHINGTON BLVD S
Lake Washington Blvd s/o Horton
AWDT = 7,929 (before)
AWDT = 7,104 (after)
Change = -825 vehicles
Rainier s/o MLK
AWDT = 34,449 (before)
AWDT = 27,915 (after)
Change = -6,534 vehicles
GENESEE
S GENESEE ST
Rainier s/o Alaska
AWDT = 21,600 (before)
AWDT = 15,732 (after)
Change = -5,868 vehicles
S ALASKA ST
COLUMBIA CITY
MLK n/o Edmunds
AWDT = 21,900 (before)
AWDT = 30,665 (after)
Change = +8,765 vehicles
LAKEWOOD
HILLMAN CITY
S ORCAS ST
MLK JR WAY S
LINK LIGHT RAIL
S GRAHAM ST
SEWARD PARK
BRIGHTON
SEWARD PARK AVE S
S OTHELLO ST
RAINIER AVE S
Seward Park Ave S n/o Kenyon
AWDT = 9,486 (before)
AWDT = 9,072 (after)
Change = -414 vehicles
DUNLAP
RAINIER BEACH
S HENDERSON ST
N

Volume

SDOT continually monitors volumes on Rainier and streets in close vicinity to Rainier. Traffic volumes on Rainier within the project area remain within historical norms. As anticipated, some diversion from Rainier to MLK Jr Way S is occurring. SDOT has documented a 5870 vehicle per day decrease in daily traffic on Rainier and a 8765 vehicle increase in daily traffic on MLK. This diversion is accepted as positive since MLK is under-capacity and better suited for freight traffic and through travel.

Volumes on nearby arterials like Seward Park Ave S and Lake Washington Blvd have not significantly changed. SDOT has not found evidence of significant cut-through traffic on intersecting non-arterial streets.

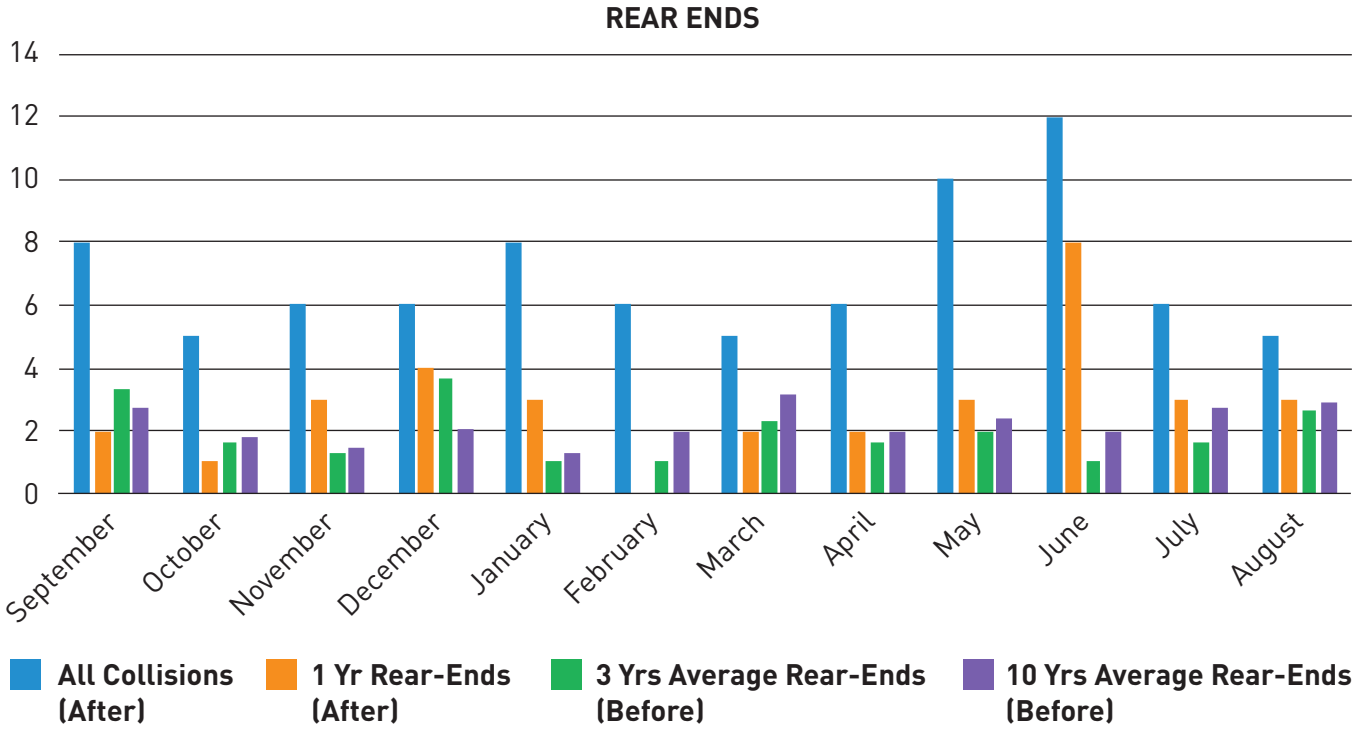
Collisions

Collisions have decreased 15 percent overall with injury collisions down 30 percent and pedestrian and bicycle collisions down 40 percent. There have been zero serious collisions since the project was implemented. This is in contrast to the national trend of increasing serious injury and fatal collisions.

Collisions on Rainier Avenue S between S Alaska St and S Kenny St			
Collision Type	**Before Redesign 9/1/2005 - 8/31/2015 (average over 10 years)***	**After Redesign 9/1/2015 -**	**% Change Before and After Redesign (10 years)**
Total Collisions	95	80	-15%
Angles	12.2	10	-18%
Cycles	0.6	0	-100%
Head On	1.8	0	-100%
Left Turn	13.7	7	-49%
Other	9.5	10	+5%
Parked Car	13.1	9	-31%
Pedestrian	3.3	3	-9%
Rear Ended	26.5	33	+25%
Right Turn	0.8	1	+25%
Sideswipe	13.0	7	-46%
Total number of serious injury collisions	9	0	-100%
Total number of fatal collisions	1	0	

Rear-end collisions occasionally increase after rechannelization as drivers adjust to the new conditions and SDOT expects fewer rear-end crashes moving forward. The chart below shows that rear-end crashes peaked in June:

SDOT also anticipates further reductions in the number of left turn collisions. While left turns signals were installed on Rainier at Orcas and for northbound left turning vehicles at Edmunds, the left turn phases were not introduced until four months after implementation to allow engineers to observe roadway operations.



Travel times

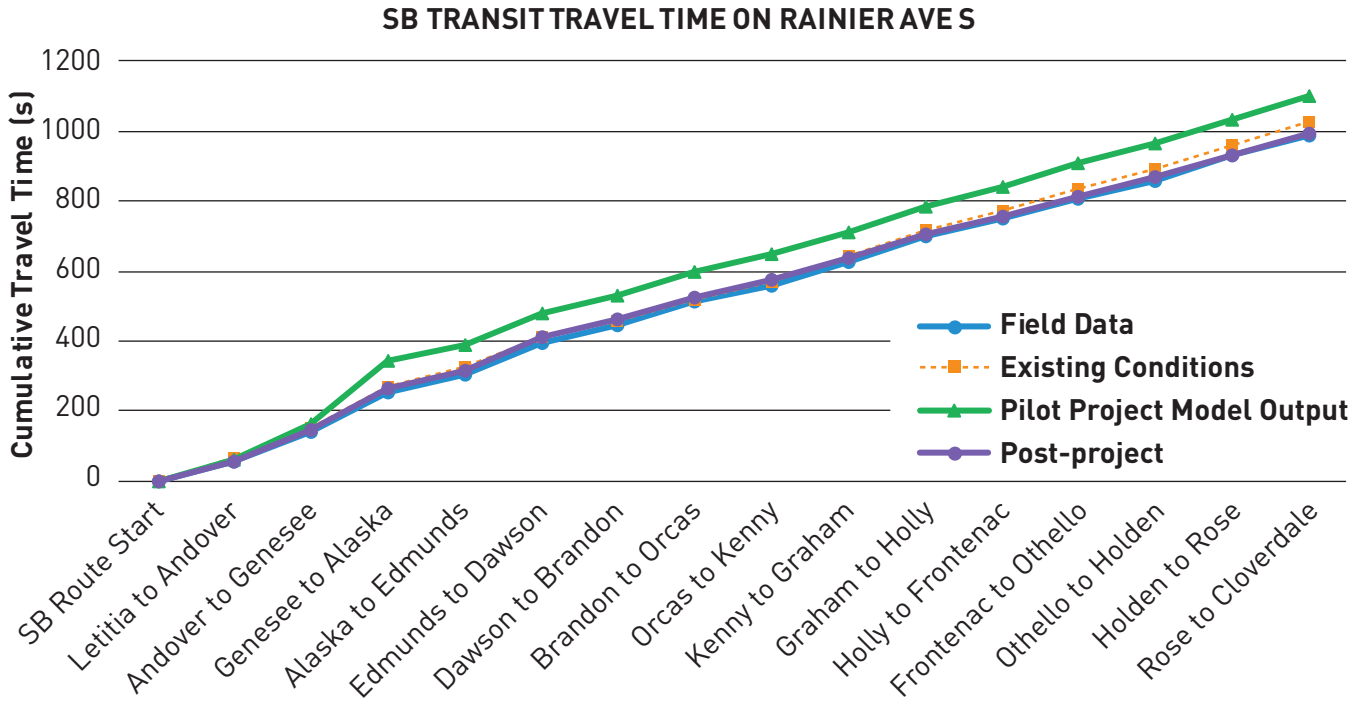
Travel times were collected for both transit and vehicles using the general traffic lanes. The existing and post travel times along Rainier Ave S between Letitia and Seward Park Ave S are:

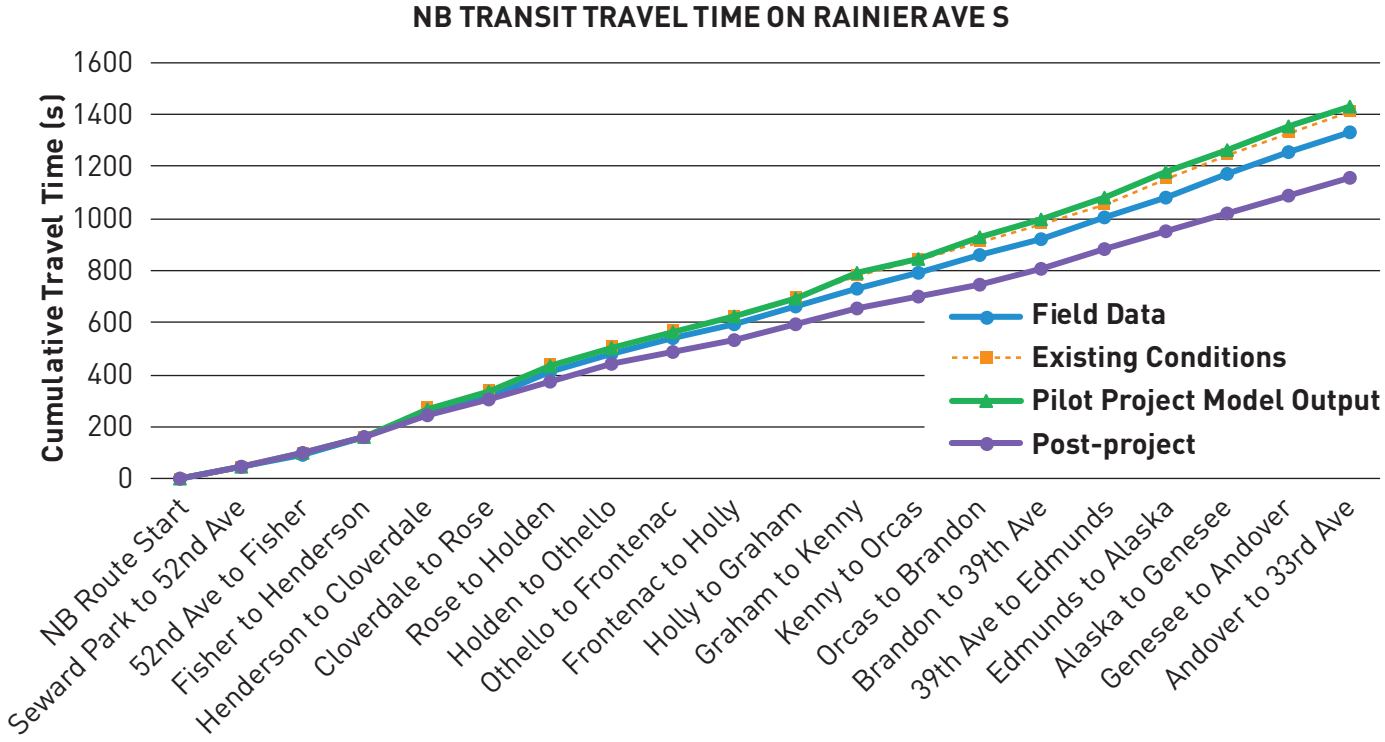
Transit Travel Times (PM Peak)		
	Prior to Redesign	Post Redesign
Northbound	19:32	16:31 (improvement)
Southbound	15:34	15:36 (no change)

Transit

Thanks to the installation of bus and turn lanes (also known as BAT lanes) and a transit queue jump signal at Edmunds, transit travel times were not significantly impacted. Average transit travel times for both northbound and southbound buses improved during afternoon peak hours. During the PM peak commute, southbound buses are traveling the corridor about a minute faster. Transit travel times during the morning peak hours increased slightly.

Maintaining efficient transit service was a primary goal of this project since more than 13,000 people ride King County Metro's Route 7 on Rainier daily.


SB TRANSIT TRAVEL TIME ON RAINIER AVE S
Cumulative Travel Time (s)
1200
1000
800
600
400
200
0
Field Data
Existing Conditions
Pilot Project Model Output
Post-project
SB Route Start
Letitia to Andover
Andover to Genesee
Genesee to Alaska
Alaska to Edmunds
Edmunds to Dawson
Dawson to Brandon
Brandon to Orcas
Orcas to Kenny
Kenny to Graham
Graham to Holly
Holly to Frontenac
Frontenac to Othello
Othello to Holden
Holden to Rose
Rose to Cloverdale


NB TRANSIT TRAVEL TIME ON RAINIER AVE S
Cumulative Travel Time (s)
1600
1400
1200
1000
800
600
400
200
0
Field Data
Existing Conditions
Pilot Project Model Output
Post-project
NB Route Start
Seward Park to 52nd Ave
52nd Ave to Fisher
Fisher to Henderson
Henderson to Cloverdale
Cloverdale to Rose
Rose to Holden
Holden to Othello
Othello to Frontenac
Frontenac to Holly
Holly to Graham
Graham to Kenny
Kenny to Orcas
Orcas to Brandon
Brandon to 39th Ave
39th Ave to Edmunds
Edmunds to Alaska
Alaska to Genesee
Genesee to Andover
Andover to 33rd Ave

General Traffic

During outreach, we anticipated that the street re-design would add 1 to 2 minutes of delay for general purpose traffic depending on the time of day with a maximum delay of 2.5 minutes during afternoon peak hour traffic. Preliminary data show that northbound travel times during the afternoon peak commute increased by 1 minute and southbound travel times increased by an average 1 minute and 21 seconds.

Passenger Vehicle Travel Times (Rainier Ave S between S Alaska St and S Henderson St) PM Peak			
	Prior to Redesign	Post Redesign	Delay
Northbound	7 mins 52 secs	8 mins 47 secs	+54 secs
Southbound	9 mins 39 secs	10 mins 59 secs	+1 min 21 secs

NEXT STEPS

The Rainier Pilot Project demonstrates that the redesigned Rainier works better for everyone. In 2016 and 2017, SDOT will design safety enhancements for the southern segment of the street – from Hillman City to Rainier Beach – with implementation scheduled for 2018 (sooner if possible).

In the meantime, we will continue to collect data and monitor the corridor. We will also continue to alter the street design within the pilot project area to provide additional safety enhancements. SDOT recently completed installing two new crosswalks with rapid flashing beacons on Rainier in the Hillman City neighborhood. We are also exploring traffic calming for the intersecting non-arterial streets and traffic flow enhancements on the non-arterial streets within Columbia City.

"There's less speeding, fewer backups when turning, less chaos when walking, and just less fear! Our neighborhood feels more connected."

—Joya Iverson, Owner – Tin Umbrella Coffee Shop in Hillman City

New crosswalk with rapid flashing beacons at Rainier and Mead

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