OTIS
Office of Transportation, Infrastructure, & Sustainability
CITY OF PHILADELPHIA

Memorandum

Date: July 2020

Re: Washington Avenue Analysis – Summary of Findings

Statement of Purpose

This document provides a summary of traffic analysis performed on Washington Avenue as part of the 2019-2020 Washington Avenue Repaving and Safety project; the attached technical appendix provides detailed information on the analysis results.

Project Overview

The City of Philadelphia has been working with a multitude of partners to plan for the future of Washington Avenue since Spring 2013. We have studied parking, loading, traffic operations, driving behavior, and reached out to hundreds of stakeholders.

The City is repaving Washington Avenue in 2021. Repaving is a chance to change the design of the roadway and make it safer for people walking, driving, riding transit, and biking. We can also make sure parking and loading on Washington Avenue work well for local businesses and neighbors. This project responds to what we have heard from the community since 2013 and gives us the opportunity to:

- Create a smoother street
- Create safer and shorter pedestrian crossings
- Improve parking and loading operations
- Reduce illegal parking such as double parking
- Decrease weaving, speeding, and aggressive driving
- Keep people bicycling safer by separating them from moving traffic
- Preserve space for trucks and buses to turn
- Design travel lanes that match the changing corridor

List of Studies and Analysis

The City of Philadelphia is committed to making informed design decisions based upon appropriate engineering analysis and community input. The City of Philadelphia completed the following traffic analysis and studies as part of the Washington Avenue design process:

1. We gathered data on existing traffic conditions to see how traffic is currently operating on Washington Avenue.
2. We observed how people are actually using Washington Avenue today using an Origin-Destination study. Specifically, we wanted to know if people were using Washington Avenue to travel all the way across town, for only a few blocks, or some combination .
3. We modeled multiple different roadway options to make sure that nothing we proposed would add significant travel time for people driving .
4. We analyzed how existing parking and loading on Washington Avenue is working (or not working) and how double-parking and median parking impact traffic flow along Washington Avenue.
5. We looked at what might happen to streets like Christian and Ellsworth due to changes on Washington Avenue . We wanted to make sure that the proposed layouts would not add significant traffic to nearby neighborhood streets that act as parallel routes for Washington Avenue.

Existing Travel Time

The City of Philadelphia collected traffic counts along Washington Avenue in April 2019 for traffic analysis. Because we know that Washington Avenue is a used throughout the week , we took weekday counts and Saturday and Sunday counts. Right now, Washington Avenue is busiest during the weekday evening rush hour, so we used that as our test – anything that worked during the weekday evening rush hour should work the rest of the time because that's when traffic is the highest on Washington Avenue.

We also looked at how long it takes to drive along Washington Avenue today from 4th Street to Grays Ferry Avenue (which are the limits of the project). We wanted to know how long it takes right now so we could make sure we weren't making the drive significantly longer with any of the options we were looking at. We did this on weekdays and the weekend. Here is what we found:

- Today, during the weekday morning rush hour, it takes about 8.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
- Today, during the weekday evening rush hour, it takes about 8.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
- Today, on Saturdays, the roadway is busiest between 10am and 2pm. During these hours, it takes between 8 and 10 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.

These average travel times translate to an average of 21 seconds a block to travel along Washington Avenue during the busiest times of the day on weekdays and weekends. We used 21 second per block travel time as a baseline for evaluating impacts of the three options for the future.

Future Travel Time

We used the morning and evening peak hours - when things are already the slowest - to evaluate the maximum potential impact of all three roadway design options on Washington Avenue. Essentially, we looked at the worst-case scenario.

Any changes that we make to Washington Avenue will include traffic signal optimization. This is a fancy way of saying that all the lights will be re-timed to create a smoother, more consistent driving experience. Right now, someone driving along Washington Avenue will likely get through two green lights before they reach a red light and have to stop. This creates a kind of stop-and-go traffic flow that can be frustrating to some drivers, and cause people to try to "beat the light" by driving quickly or erratically. With signal re-timing, traffic lights will have a more even flow, so drivers will have longer stretches of green lights before they reach a red. These changes will be coordinated with the traffic signal at Broad Street to create a consistent traffic flow across all of Washington Avenue and keep that intersection working well for drivers.

We also know that changes in the number of lanes on Washington Avenue will result in some cars that use it today diverting to other streets. In our models, we assumed that 10% of existing traffic will switch from Washington Avenue if the 3-lane option is implemented; 5% of existing traffic will switch from Washington Avenue if the mixed cross-section is implemented, and 0% of existing traffic will switch from Washington Avenue if the4-lane cross-section is implemented. (For a detailed explanation of what these diversions would mean for streets like Christian and Ellsworth, please see the "Parallel Route Analysis" section in this document.)

Here is what we found:

- **Option A: 3-lane cross-section[1]**
    - In the morning, it will take about 8.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
    - In the evening, it will take between 8 and 9.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
    - *This is an average travel time of 21.5 seconds a block, which is an increase of only 0.5 seconds per block.*
- **Option B: 4-lane cross-section[2]**
    - In the morning, it will take about 10 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
    - In the evening, it will take between 9.5 and 10.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.

[1] Travel time analysis for the 3-lane Cross Section assumes that 10% of vehicles that use Washington Avenue today will divert to other streets after the roadway is reconfigured. For anticipated impacts on nearby neighborhood streets, see the "Parallel Route Analysis" section of this document.
[2] Travel time analysis for the 4-lane Cross Section assumes none of the vehicles that use Washington Avenue today will divert to other streets after the roadway is reconfigured. If some vehicles do diver, these travel times will probably be a little faster.

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    - *This is an average travel time of 25 seconds a block, which is an increase of only 4 seconds per block.*
- **Option C: mixed cross-section[3]**
    - In the morning, it will it will take about 9.5 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
    - In the evening, it will take between 9 and 11 minutes for a car to travel between Grays Ferry Avenue and 4th Street in either direction.
    - *This is an average travel time of 24.5 seconds a block, which is an increase of only 3.5 seconds per block.*

It's important to remember that these are the rush-hour numbers. During the rest of the day, travel time should remain the same, or even decrease because of the signal optimization and the parking and loading changes that are planned no matter what layout is chosen.

Origin/Destination Analysis

An Original/Destination analysis shows how people driving actually use Washington Avenue. Where do they turn onto Washington Avenue? How long do they drive along Washington Avenue? How far do people go out of their way to use Washington Avenue? Do they go all the way from the Delaware River to Grays Ferry Avenue, or do they only drive on Washington Avenue for a few blocks? In short, it looks at how Washington Avenue is actually being used by the people who drive on it.

The analysis shows that most of the cars that drive along Washington Avenue come from either northbound Grays Ferry Avenue or southbound Christopher Columbus Boulevard, which isn't very surprising. What is surprising, though, is how many of those people leave Washington Avenue before Broad Street:

- **In the mornings:**
    - Half of the eastbound cars that come to Washington Avenue from Grays Ferry Avenue leave Washington before Broad Street.
    - Half of the westbound cars that come to Washington Avenue from Columbus Boulevard leave Washington Avenue before 5th Street.
- **In the evenings:**
    - Half of the eastbound cars that come to Washington Avenue from Grays Ferry Avenue leave Washington before 15th Street.
    - Half of the westbound cars that come to Washington Avenue from Columbus Boulevard leave Washington Avenue before 7th Street.

[3] Travel time analysis for the Mixed Cross Section assumes that 5% of vehicles that use Washington Avenue today will divert to other streets after the roadway is reconfigured. For anticipated impacts on nearby neighborhood streets, see the "Parallel Route Analysis" section of this document.

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It turns out that only 5% to 10% of people who use Washington Avenue use it as a cross-town corridor. In fact, most people are only using Washington Avenue for a few blocks at a time. That's why understanding the travel time per block was so important.

Parallel Route Analysis

As we mentioned in the "Future Travel Times" section, above, the travel time models we looked at assume that some drivers who use Washington Avenue today will choose to drive on other streets after the roadway is reconfigured:

- Travel time estimates for the 3-lane cross section assume that 10% of drivers will use other roads.
- Travel time estimates for the mixed cross-section assume that 5% of drivers will use other roads.
- Travel estimates for the 4-lane cross section assume that everyone who uses Washington Avenue today will continue to use it (in other words – that 0% of drivers will chose different roads).

A lot of the people we spoke to leading up to this project asked whether reducing the number of vehicle travel lanes on Washington Avenue would mean more traffic on neighborhood streets, particularly Christian and Ellsworth streets. We wanted to make sure we understood the potential impacts of diversions , so we modeled them.

We decided to look at what would happen if 10% of all the cars on Washington Avenue during rush hour decided to use Christian Street and Ellsworth Street on the same day at the same time. Because Philadelphia's street grid provides multiple route options, it's very unlikely that this scenario would occur in real life – people will likely choose different streets to get where they're going. For example, someone could choose to take Bainbridge Street instead of Christian Street to go east or west in the same general area.

Additionally, Washington is the largest arterial between Center City and Snyder Avenue. People will that currently divert significant distances to travel east-west might choose to stay on closer crosstown routes. But because neighbors indicated that Christian and Ellsworth Streets are the closest parallel routes to Washington Avenue, we took a look at what would happen if all of the diverted cars shifted to those two streets. .

We needed to understand how Christian and Ellsworth Streets currently function to understand the impact a 10% diversion from Washington Avenue would have, so we took traffic counts at multiple locations on both streets. Right now, Ellsworth Street is only using about 44% of its capacity, and Carpenter Street is using between 58% and 76% of its capacity. That means that both roadways can handle additional traffic without becoming gridlocked.

When we take 10% of Washington Avenue's peak hour traffic and moved it to Christian and Ellsworth Streets, Ellsworth ends up using 54% of its available capacity, and Christian ends up using between 71% and 93%. That 93% is only located at the intersection of Christian Street and Grays Ferry Avenue, where cars would have to wait an additional 8.6 seconds before getting through the intersection.

So, even in the worst-case scenario - imagining that 10% of Washington Avenue's peak-hour traffic moved to Christian or Ellsworth Streets on the same day at the same time - there should be pretty minimal impacts on those parallel routes. The only intersection that had any real change was at Christian Street and Grays Ferry Avenue, and even there that change was only 8 additional seconds at the intersection, which is still under its full capacity.

Conclusion

The City is repaving Washington Avenue in 2021. Repaving is a chance to change the design of the roadway and make it safer for people walking, driving, riding transit, and biking. We can also make sure parking and loading on Washington Avenue works well for local businesses and neighbors.

The City of Philadelphia is committed to making informed design decisions based upon appropriate engineering analysis and community input. This project responds to what we have heard from the community since 2013 and aims to address the many safety and functional concerns of businesses, neighbors, and other Washington Avenue users.

Through data collection, traffic analysis, and study, the City of Philadelphia developed three possible roadway configurations for Washington Avenue between Grays Ferry Avenue and Columbus Boulevard: a 3-lane cross-section, a 4-lane cross-section, and a mixed cross-section. The City of Philadelphia performed extensive analysis to understand the impacts of each of these three options, including existing traffic conditions, existing parking and loading, where people are coming from and going to, how travel time along Washington Avenue will change, and impacts to nearby parallel streets.

Each option has its strengths, and each has its drawbacks. Fundamentally, we believe that any of the three concepts presented to the public will address many (if not all) of the issues currently present on Washington Avenue, with minimal negative impacts on travel time, and with positive impacts on safety, parking and loading operations, and overall corridor function.

Notes on the Technical Appendices

The Technical Appendices included with this summary memo include studies and analysis dating back to 2017. In some cases, the information contained in these appendices does not reflect current analysis. In some cases, recommendations contained in these analyses were investigated but not pursued by the city. The following list notes some of these instances. Notes pointing out instances such as these have also been added to the Appendices themselves where appropriate.

TA-1 Washington Avenue West Side Parking and Loading Study

- *Potentially personal vehicle identification data has been removed from some photographs in this document.*

TA-2 Washington Avenue East Side Parking and Loading Study

- *Potentially personal vehicle identification data has been removed from some photographs in this document.*

TA-3 Washington Avenue Traffic Study Report

- *The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.*

TA-4 Washington Avenue OD & Parallel Route Analysis Memo

- *None*

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TA-1
Washington Avenue West Side Parking and Loading Study

Notes

Potentially personal vehicle identification data has been removed from some photographs in this document.

CITY OF PHILADELPHIA

WASHINGTON AVENUE PARKING & LOADING STUDY

13TH STREET TO GRAYS FERRY AVENUE

TASK 2 – PARKING ANALYSIS MEMORANDUM

AUGUST 2019

Submitted to:
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APPENDICES

TASK 2 – PARKING ANALYSIS

1.1 INTRODUCTION

The purpose of the Washington Avenue Parking and Loading Study is to provide the City of Philadelphia with the information needed to make data-driven planning and engineering decisions for the Washington Avenue corridor in South Philadelphia. Washington Avenue has a diverse mix of commercial, industrial, and residential uses that create significant demand for on-street parking and loading operations. This current effort covers the western portion of Washington Avenue between Grays Ferry Avenue and 13th Street, using similar methodology to a companion study performed in 2016 for the east side of Washington Avenue between 13th Street and 5th Street.

This memo summarizes findings from ***Task 2 – Parking Analysis***. The purpose of this task was to (a) collect on-street parking and loading data along Washington Avenue between 13th Street and Grays Ferry Avenue and (b) analyze this data to determine operational characteristics including occupancy, turnover/duration, and instances of illegal parking activity. Results from this task will support the development of parking and loading reorganization recommendations, which is the 4th task listed below:

- **Task 1** – Inventory of Existing On-street Regulations
- **Task 2** – Parking Analysis
- **Task 3** – Operational Impact Analysis
- **Task 4** – Parking & Loading Reorganization Recommendations

1.2 OBSERVATIONAL METHODOLOGY

The Task 1 inventory of existing on-street regulations identified approximately 270 on-street parking spaces along Washington Ave between 13th Street and Grays Ferry Avenue, with an additional 86 spaces dedicated to loading operations. The curbside (i.e. on-street) parking supply along both sides of Washington Avenue is **regulated** by several types of signs establishing *No Stopping, No Parking, 1-Hour Parking*, and *Loading Only* zones. Outside of these zones, the on-street parking supply is **unregulated** with no parking meters or time/day restrictions, which means someone can essentially park as long as they want. Since on-street parking spaces are not striped within the study area, the number of spaces along each block face was estimated based on the length of the block and the observed number of vehicles parking along the block.

WSP staff conducted site visits in May of 2019 to collect parking data along both sides of Washington Avenue between 13th Street and Grays Ferry Avenue. Prior to the site visits, WSP developed field sheets based on the Task 1 inventory of existing spaces. The data collection effort consisted of a 12-hour collection period (7:00 AM to 7:00 PM) on Wednesday, Thursday, and Saturday along with an 8-hour collection period (8:00 AM to 4:00 PM) on Sunday. These periods were selected in consultation with the City to cover the highest periods of activity in the corridor. The specific times and dates were also selected to avoid any non-representative periods (i.e. schools not in session, traffic lane closures, inclement weather, etc.). *Figure 1* summarizes the data collection schedule:

Figure 1 - Data Collection Schedule

DAY & DATE	START	END TIME	DURATION	WEATHER
Wednesday, 5/1/19	7:00 AM	7:00 PM	12 hrs	Cloudy, 50 - 60 deg.
Thursday, 5/2/19	7:00 AM	7:00 PM	12 hrs	Partly Cloudy, 65 – 80 deg.
Saturday, 5/4/19	7:00 AM	7:00 PM	12 hrs	Partly Cloudy, 65 – 75 deg.
Sunday, 5/19/19	8:00 AM	4:00 PM	8 hrs	Partly Cloudy, 75-85 deg.

The parking data collection methodology consisted of walking loops of the corridor every hour to record vehicle license plates for both regulated and unregulated on-street parking spaces and tally instances of illegal parking activity including double parking, median parking, and sidewalk parking. License plate data for curbside activity was collected at hourly intervals for use in calculating occupancy and turnover/duration metrics.

1.3 PARKING/LOADING OPERATIONAL CHARACTERISTICS

The collected parking data was input into a spreadsheet format and analyzed to determine operational characteristics including occupancy, duration/turnover, and instances of illegal parking activity. Key results from the parking analysis are summarized in this section, while detailed graphs and tables are included as attachments.

1.3.1 OCCUPANCY

Occupancy is calculated by dividing the number of occupied spaces by the number of total spaces at each hourly interval. Average occupancy rates were summarized for each parking area and block face by day of the week, and then aggregated to determine an average occupancy for the corridor. Only parking and loading spaces were included in the corridor occupancy calculations (restricted spaces were not).

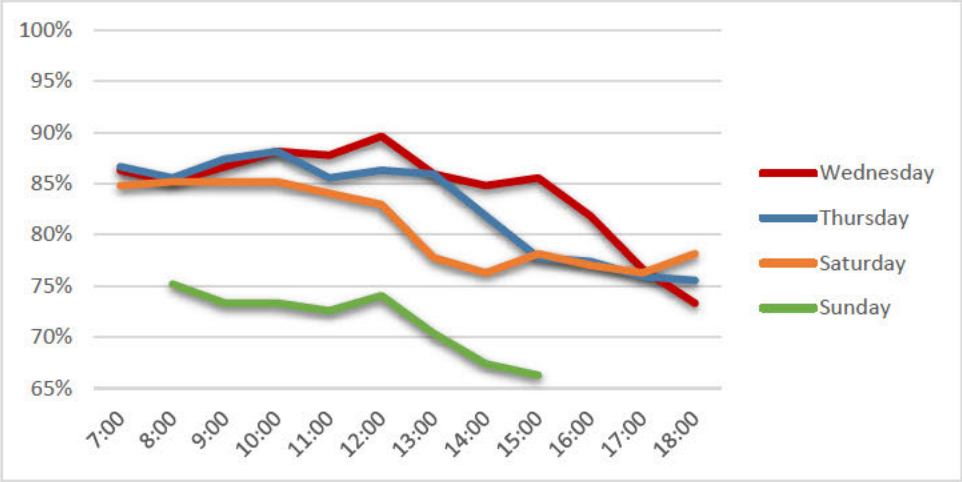
Detailed occupancy calculations were performed on a block-by-block basis for each of the two categories (parking and loading). Graphs showing occupancy by block are included as *Appendix A-1*. Occupancy rates for parking spots were highest between 13th and 20th Street, with many blocks hovering at or above 90% throughout the day (i.e. the 1300, 1400, 1600, 1800, 1900 blocks). Parking occupancy was significantly lower for the blocks east of 21st Street, particularly on weekends and later in the day, where it approached 50% on several blocks. Occupancy rates for loading zones varied widely across the corridor and were highly dependent on the use and activity of adjacent businesses. A summary of occupancy trends by day and time is provided below.

ON-STREET PARKING SPACES

Figure 2 shows average occupancy across the corridor for on-street parking spaces. On the two weekdays, occupancy was highest (85-90%) during the middle of the day and lowest (at or below 75%) at the end of the collection period. On Saturday, occupancy was highest in the morning hours (85%) and declined slightly through the day to a low of 75%. This may be related to vehicles parking overnight on Friday and then leaving spots during the afternoon. Occupancy on Sunday was lowest of all the days, ranging from a high of 75% in the morning to just over 65% in the afternoon. When

compared with results from the previous study east of Broad, average occupancies for the western side of Washington Avenue are significantly lower than the eastern side, particularly on weekends.

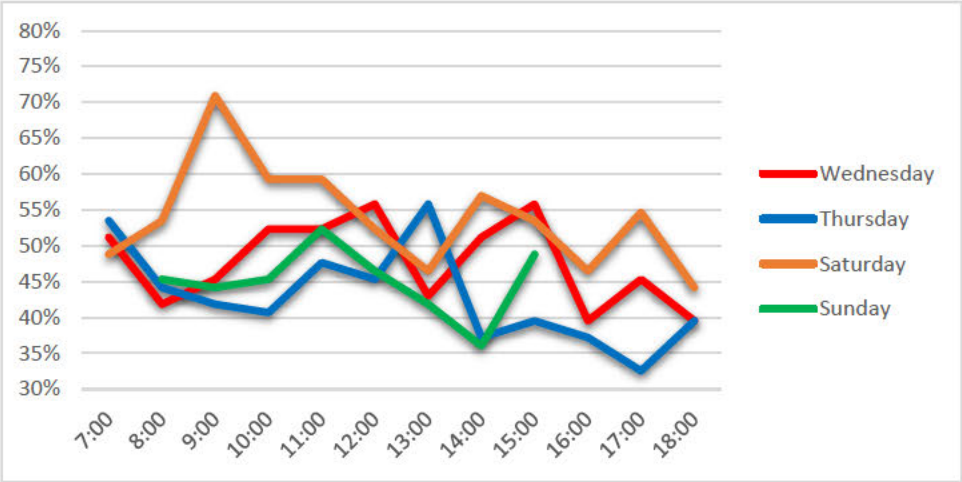
Figure 2 - Average Occupancy for Parking Spaces (Corridor)



LOADING ZONE SPACES

Figure 3 shows average occupancy across the corridor for on-street loading zone spaces. Compared to the on-street parking spaces, average occupancies for loading zone spaces were: (a) significantly lower, which could be expected given the transitory nature of regulated loading areas, and (b) varied more sharply throughout the day. On the two weekdays, occupancy was highest (55%) at the beginning of the collection period as well as the middle of the day, and lowest (at or below 40%) after 3:00 pm. On Saturday, there was a pronounced peak in occupancy (70%) at 9:00 am which decreased to 55% or lower through the remainder of the day. The occupancy on Sunday varied from a high of 50% at 11:00 am to a low of 35% at 2:00 pm.

Figure 3 - Average Occupancy for Loading Spaces (Corridor)



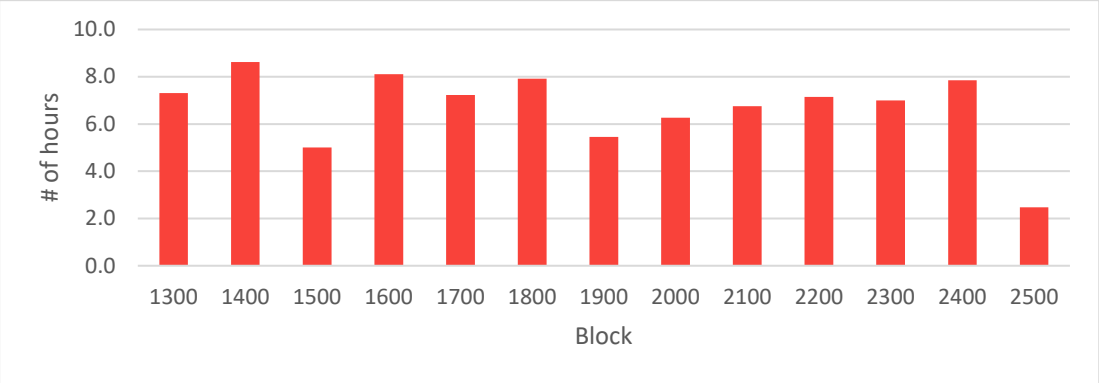
1.3.2 DURATION & TURNOVER

Duration is the observed length of time (in hours) that a vehicle occupies a parking space. Turnover refers to the number of vehicles that occupy a given parking space over the collection period and is inversely related to duration. *Appendix A-2* includes detailed tables showing average durations and turnover by block and parking type for the full collection period. As might be expected, these metrics varied significantly by parking type and location.

ON-STREET PARKING SPACES

Figure 4 provides a summary of average durations and turnover for unregulated on-street parking spaces. Durations ranged from 2.5 to 8.6 hours with an average of 6.9 hours. However, the 2500 block was a notable outlier, likely due to its isolated location west of the overpass. Most of the remaining blocks had an average duration between 6-8 hours, which is very high for a mixed-use corridor and confirms that many vehicles are parking most or all the day in the same spot. Thus, the turnover on these blocks – between 1-2 cars per day – was very low

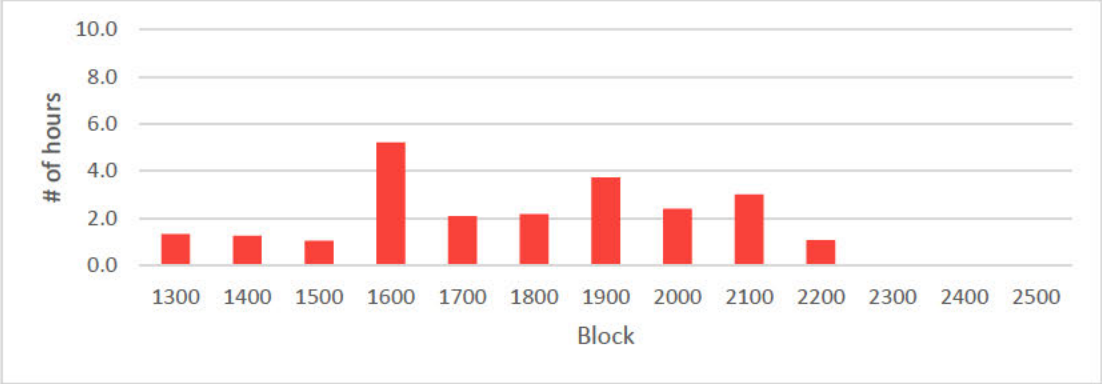
Figure 4 – Average Duration by Block (Parking Spaces)



LOADING ZONE SPACES

Figure 5 provides a summary of average durations and turnovers for loading zone spaces. Durations varied from 1.0 to 5.2 hours with an average of 2.5 hours. The 1600 and 1900 blocks were notable outliers, with high average durations due to multiple loading spots that were occupied the entire collection period. Aside from these blocks, average durations were between 1-3 hours with many blocks having durations near the 1-hour minimum that can be recorded using hourly parking data collection. Corresponding average turnovers were as high as 4-5 vehicles for some blocks, and would be higher if occupancy rates had been higher. This indicates that the regulated loading zones along Washington Avenue are working fairly well and encouraging turnover where they are used and enforced. For example, the newly-implemented loading zone on the north side of the 1400 block (in front of Target) had some spaces that turned over 8 to 10 cars over the collection period.

Figure 5 – Average Duration by Block (Loading Spaces)



1.3.3 ILLEGAL PARKING ACTIVITY

Three types of illegal parking activity were recorded during the data collection effort: (1) parking in an active lane (i.e. double parking), (2) parking in the center median, and (3) parking on the sidewalk. These activities are shown and quantified on a series of diagrams that are included as *Appendix A-3*. The diagrams also include photos highlighting the most prominent locations where these activities were observed. Illegal parking activity was often spread between multiple locations along the block; however, listed below are specific locations where double parking, median parking, and sidewalk parking were observed regularly:

BLOCK	DESCRIPTION
1300	○ Double parking in front of The Rock School and Philly Marble & Tile ○ Head-in parking frequently blocks sidewalk at AOK Auto Body
1500	○ Frequent median parking on this block ○ Construction activity at Kerr's Building Materials results in double parking & sidewalk parking
1700	○ Double parking in front of Little Shepards Learning Center/Bury the Hatchet ○ Sidewalk parking in front of Family Dollar
1800	○ Very frequent median parking and some double parking in front of Chick's restaurant
1900	○ Occasional median parking on this block ○ Occasional sidewalk parking and double parking in front of Roma and Billows Electric Supply
2000	○ Occasional median parking on this block ○ Frequent sidewalk parking and double parking in front of Caliber Collision
2100	○ Frequent median parking on this block ○ Occasional sidewalk parking in front of Ivan Supply
2300	○ Regular double parking along the north side of the block
2400	○ Occasional median parking on this block ○ Occasional sidewalk parking and double parking in front of KX Auto

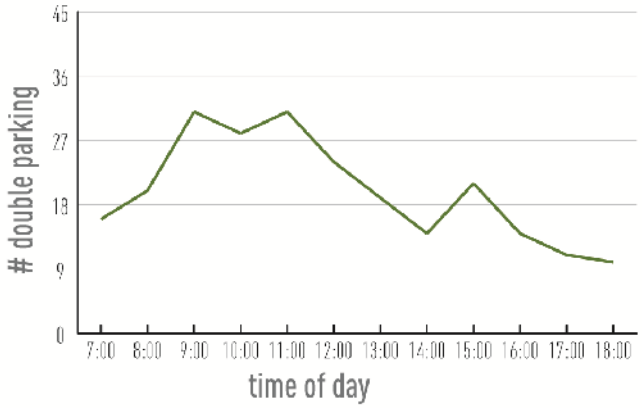
Figure 6 shows the number of double parked vehicles by time of day over the entire collection period, with each block shown as a separate row, while *Figure 7* and *Figure 8* show the same information for median and sidewalk parked vehicles. Graphs showing illegal parking activity for each of the collection days are included as *Appendix A-4*. License plate data was not collected for illegally parked vehicles; therefore, any observations related to parking durations for double, median, and sidewalk parking are qualitative based on field observations.

DOUBLE PARKING

Double parking along the corridor was most prevalent on the 1300, 1700, 1900, 2000, 2300, and 2400 blocks. In general, double parking was spread evenly across the day. On most blocks, particularly those near the middle of the corridor, activity was highest between 9:00 am and 3:00 pm with peaks occurring around 9:00 am and 11:00 am. This coincides with the operating hours of the primarily construction-related businesses generating the double parking. The observed duration for double parked vehicles was almost always under an hour, often as short as 15 minutes.

Figure 6A – Correlation Matrix of Double Parked Vehicles (All Days)

Figure 6B – Sum of Double Parked Vehicles by Time of Day (All Days)



MEDIAN PARKING

Median parking along the corridor was most prevalent on the 1500, 1800, 1900, 2000, 2100, and 2400 blocks and was concentrated between 7:00 am and 2:00 pm. An exception is the 1800 block, which has the highest prevalence of median parking due to Chick's restaurant. Median parking on this block increased throughout the day and was highest at the end of the collection period. The observed duration for median parked vehicles was also much higher than double parked vehicles, with some vehicles parking for multiple hours.

Figure 7A – Correlation Matrix of Median Parked Vehicles (All Days)

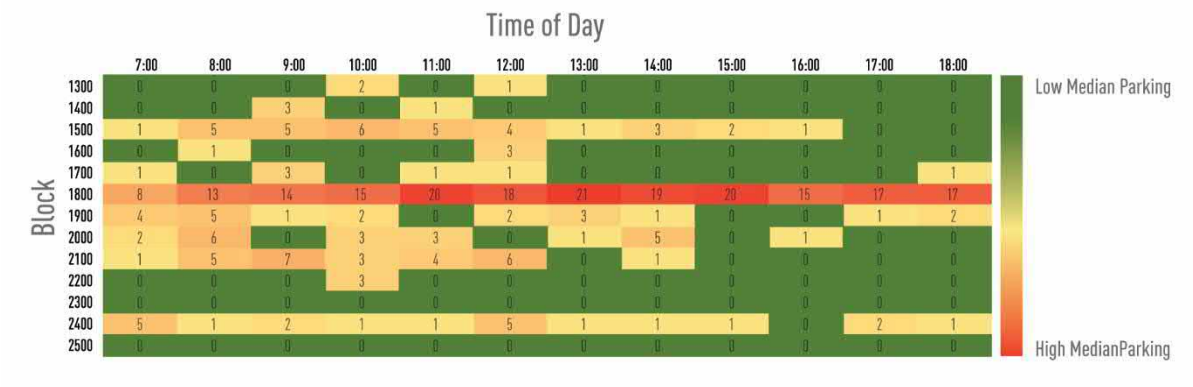
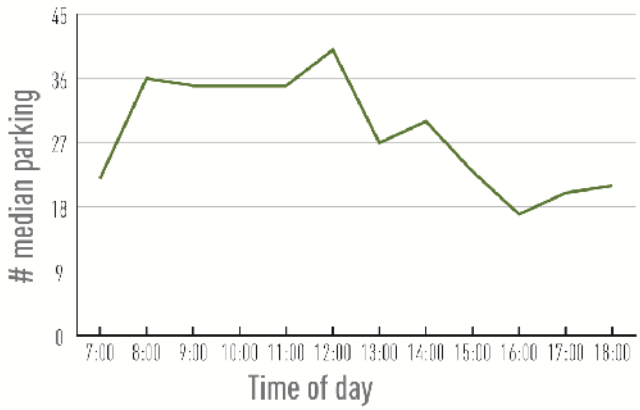


Figure 7B – Sum of Median Parked Vehicles by Time of Day (All Days)



SIDEWALK PARKING

Sidewalk parking was concentrated on the 1300, 1700, and 2000 blocks. Sidewalk parking was much more prevalent on weekdays than on weekends, and was heaviest between 9:00 am and 2:00 pm. This coincides with the operating hours of the primarily auto and construction-related businesses generating the sidewalk parking. Vehicles parking on the sidewalk during weekdays often stayed in the same location for multiple hours or even the entire collection period.

Figure 8A – Correlation Matrix of Sidewalk Parked Vehicles (All Days)

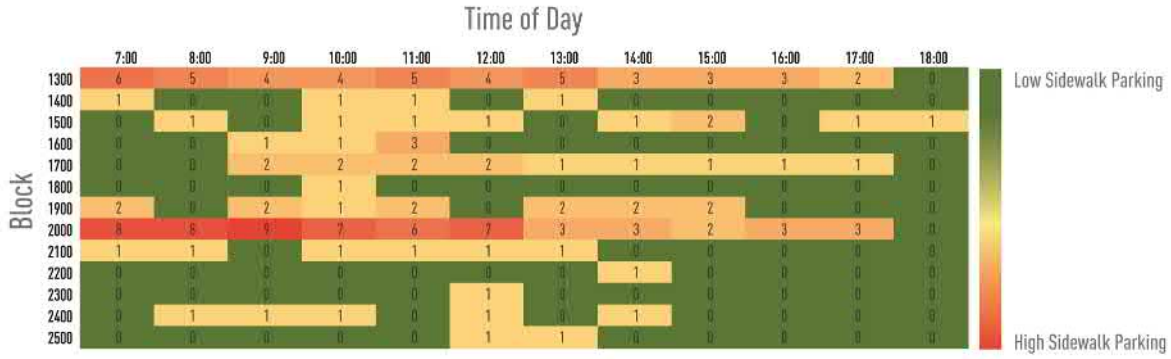
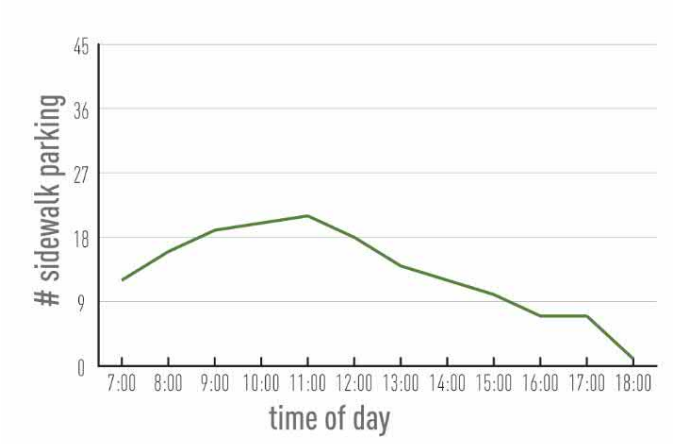


Figure 8B – Sum of Sidewalk Parked Vehicles by Time of Day (All Days)



1.4 SUMMARY OF FINDINGS

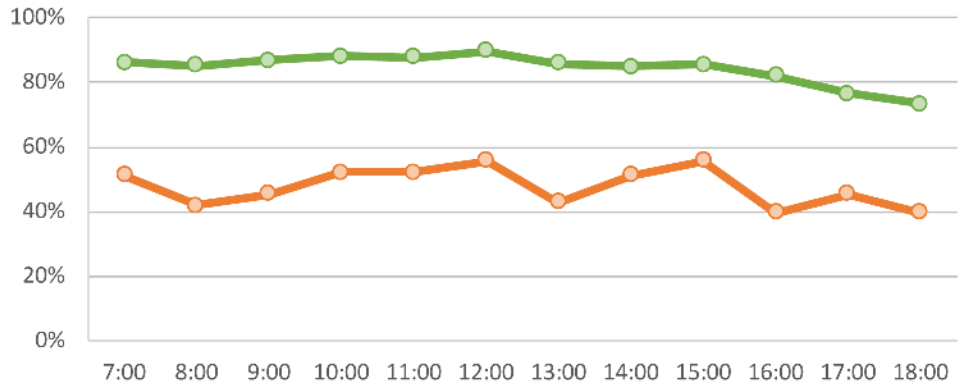
Analysis of parking data collected along Washington Avenue between 13th Street and Grays Ferry Avenue shows a significant difference between parking and loading usage. While the unregulated on-street parking supply is characterized by medium-to-high occupancy rates, long average durations, and low turnover, the loading zone spaces have lower occupancy rates, shorter average durations, and higher turnover. Specific findings are outlined below:

- **Average occupancy rates for on-street parking spaces** were between 75-90% on all days except Sunday, where they ranged between 65-75%.
    - On both weekdays and weekends, occupancy was highest between 7:00 am and 1:00 pm and then declined steadily through the day.
- Compared to parking spaces, **average occupancy rates for loading zone spaces** were: (a) significantly lower, which could be expected given the transitory nature of regulated loading areas, and (b) varied more sharply throughout the day (between 30-70% depending on the block).
    - On weekdays, occupancy was highest (55%) at the beginning of the collection period as well as the middle of the day, and lowest (at or below 40%) after 3:00 pm.
- When compared with results from the previous study east of Broad, average occupancies for parking spaces on the western side of Washington Avenue are significantly lower than the eastern side, particularly on weekends.
- The **average duration for parking spaces** was 6.9 hours, with a low of 2.5 hours on the 2500 block and a high of 8.6 hours on the 1400 block. Many vehicles occupied parking spaces for the entire 12-hour weekday collection period.
- The **average duration for loading spaces** was 2.5 hours, with durations at or near 1 hour on the 1300, 1400, 1500, and 2200 blocks. This indicates that the regulated loading zones along Washington Avenue are working fairly well and encouraging turnover where they are used and enforced.
- **Double parking** along the corridor was most prevalent on the 1300, 1700, 1900, 2000, 2300, and 2400 blocks. On most blocks, activity was highest between 9:00 am and 3:00 pm with peaks occurring around 9:00 am and 11:00 am. The observed duration for double parked vehicles was almost always under an hour, often as short as 15 minutes.
- **Median parking** along the corridor was most prevalent on the 1500, 1800, 1900, 2000, 2100, 2400 blocks. The 1800 block had by far the highest prevalence of median parking. Median parking on most blocks was concentrated between 7:00 am and 2:00 pm.
- **Sidewalk parking** was concentrated on the 1300, 1700, and 2000 blocks. Sidewalk parking was much more prevalent on weekdays than on weekends, and was heaviest between 9:00 am and 2:00 pm. Vehicles parking on the sidewalk during weekdays often stayed in the same location for multiple hours or even the entire collection period.

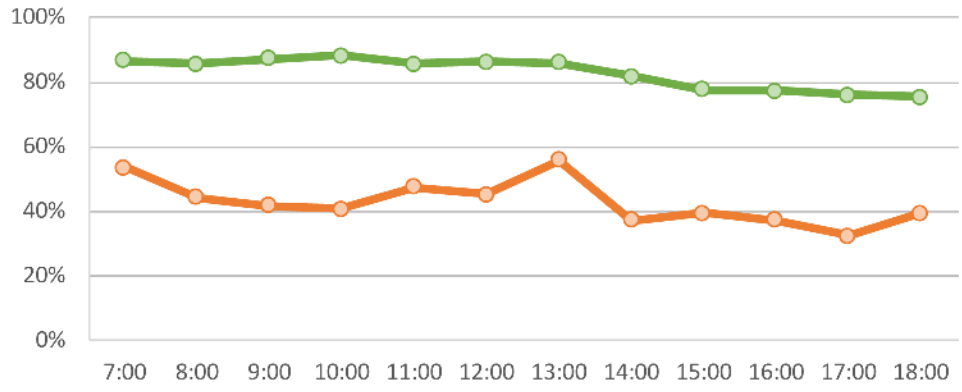
Appendix

A-1 OCCUPANCY GRAPHS

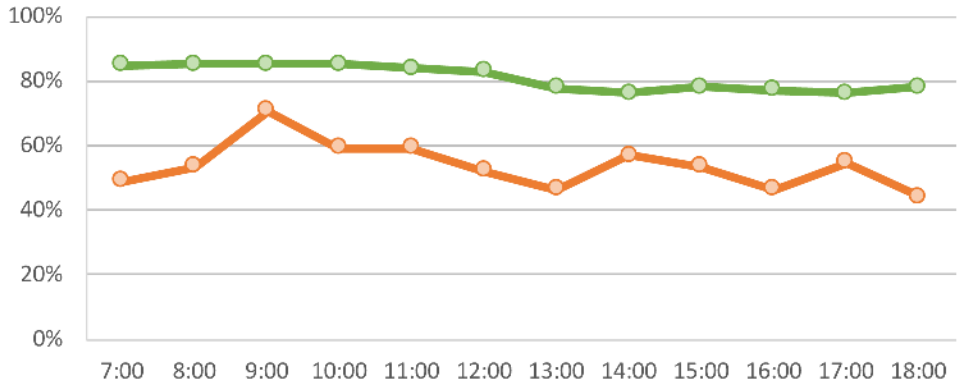
Entire Corridor (by Day)



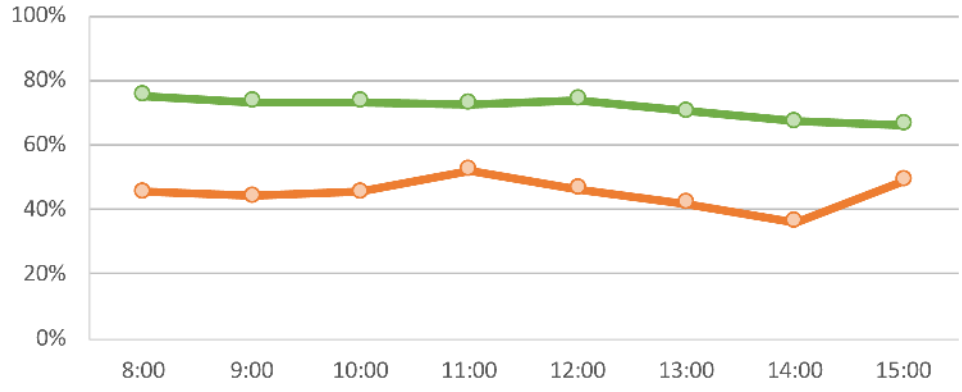
Wednesday
05/01/2019



Thursday
05/02/2019



Saturday
05/04/2019



Sunday
05/19/2019

Block-by-Block

Wednesday 05/01/2019

1300 Block

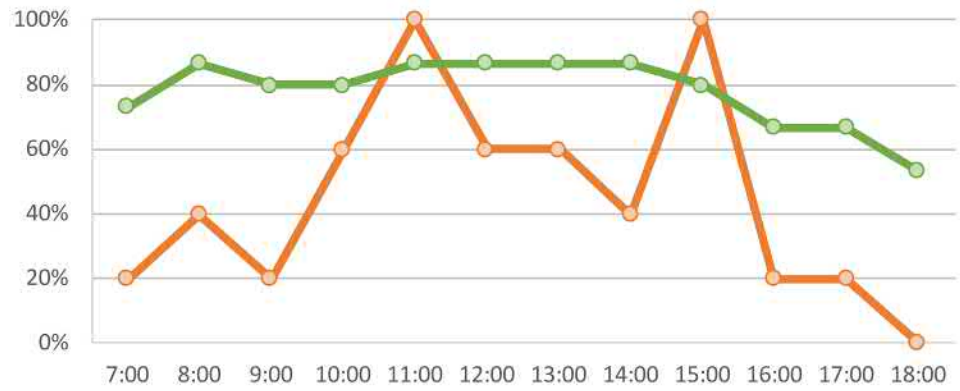
Parking spots: 38

Loading spots: 1

1400 Block

Parking spots: 16

Loading spots: 17



1500 Block

Parking spots: 15

Loading spots: 5

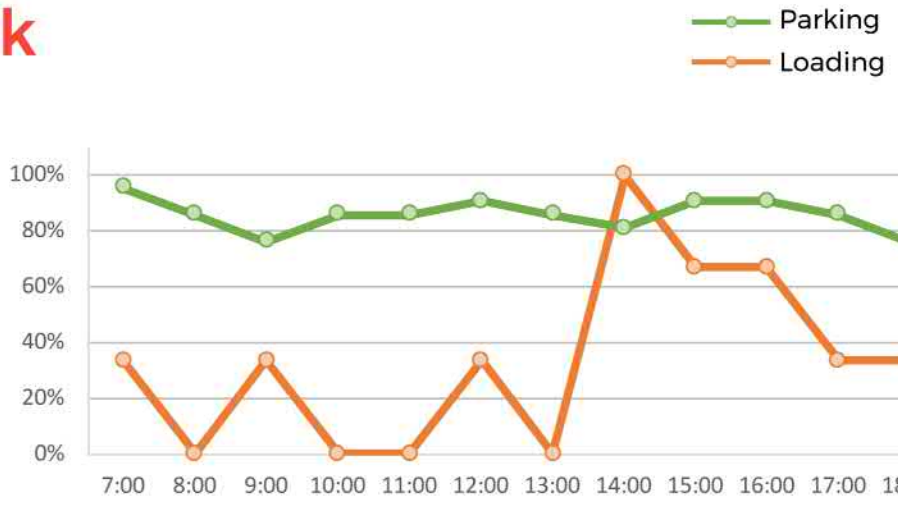
1600 Block

Parking spots: 11

Loading spots: 14

Block-by-Block

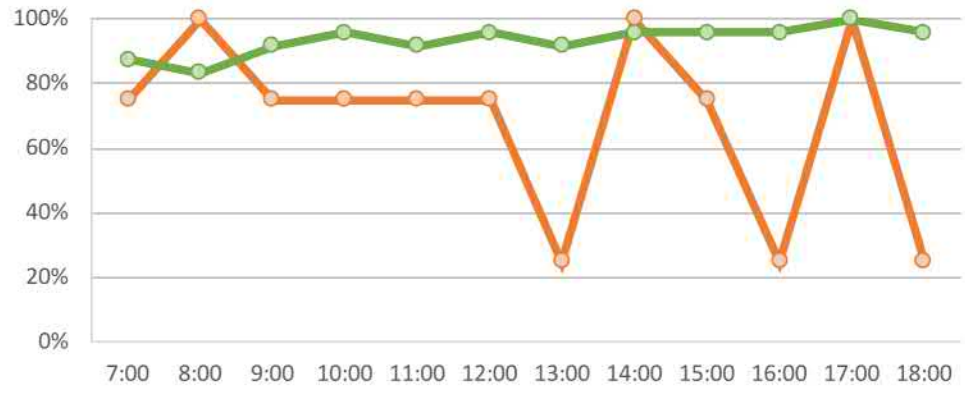
Wednesday 05/01/2019



1700 Block

Parking spots: 21

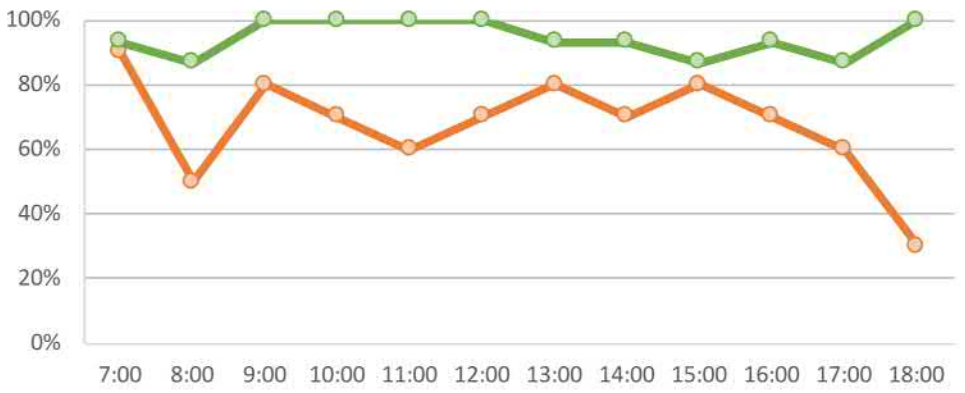
Loading spots: 3



1800 Block

Parking spots: 24

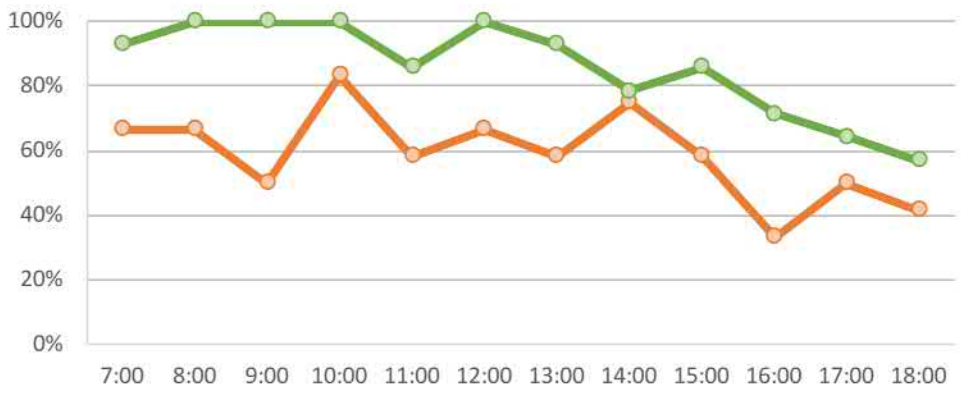
Loading spots: 4



1900 Block

Parking spots: 15

Loading spots: 10



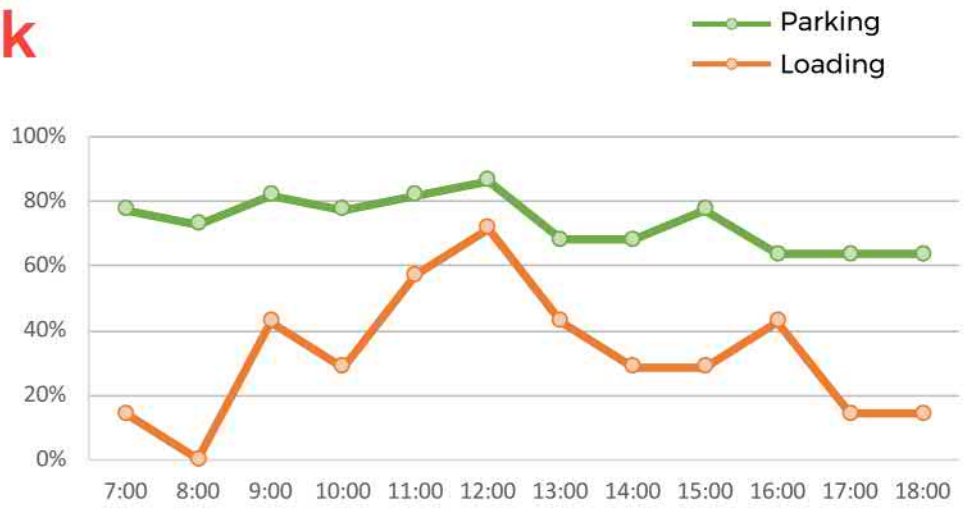
2000 Block

Parking spots: 14

Loading spots: 12

Block-by-Block

Wednesday 05/01/2019



2100 Block

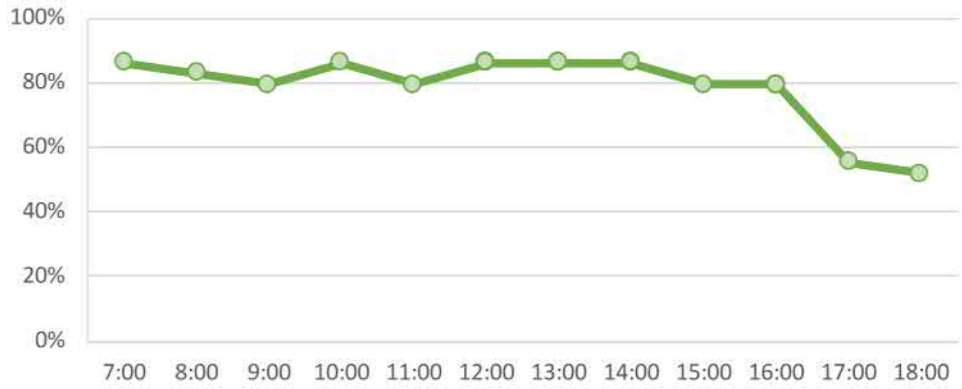
Parking spots: 22

Loading spots: 7

2200 Block

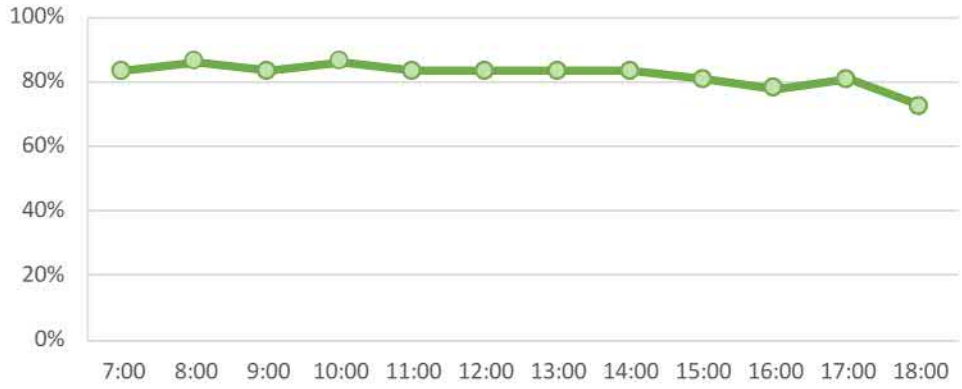
Parking spots: 17

Loading spots: 13



2300 Block

Parking spots: 29



2400 Block

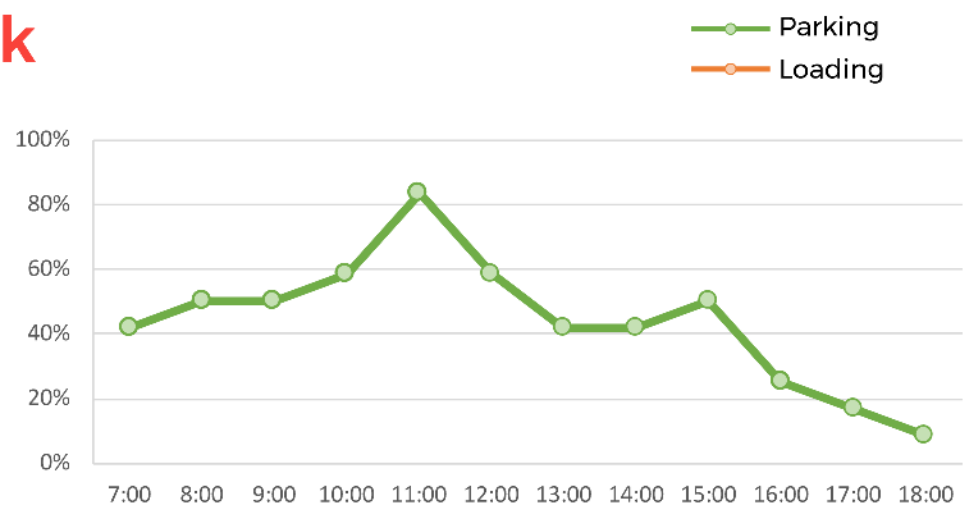
Parking spots: 36

Block-by-Block

Wednesday 05/01/2019

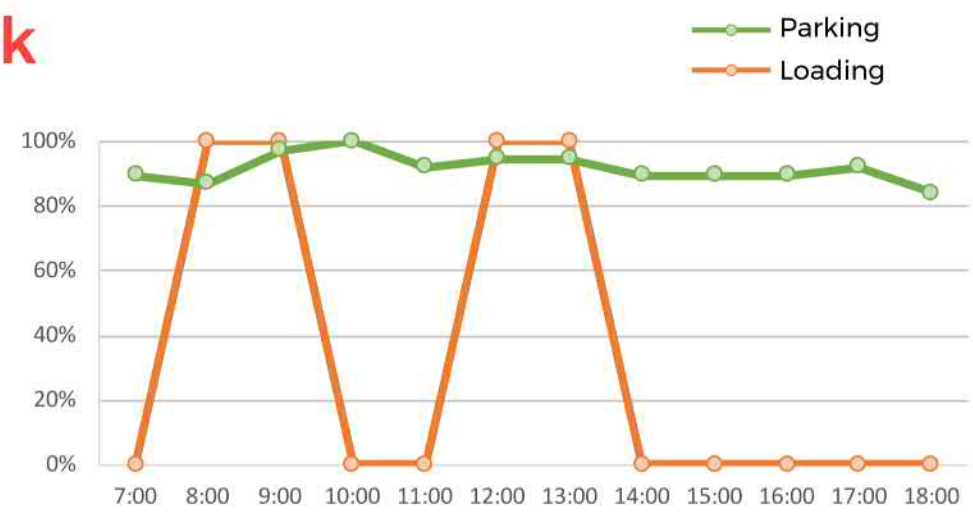
2500 Block

Parking spots: 12



Block-by-Block

Thursday 05/02/2019



1300 Block

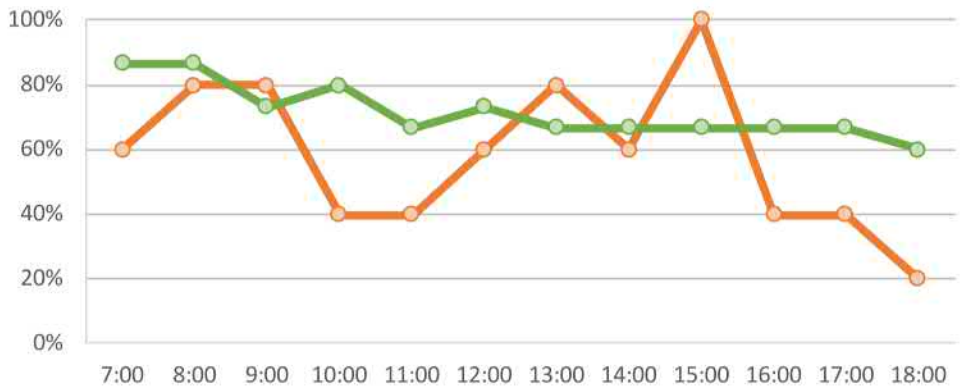
Parking spots: 38

Loading spots: 1

1400 Block

Parking spots: 16

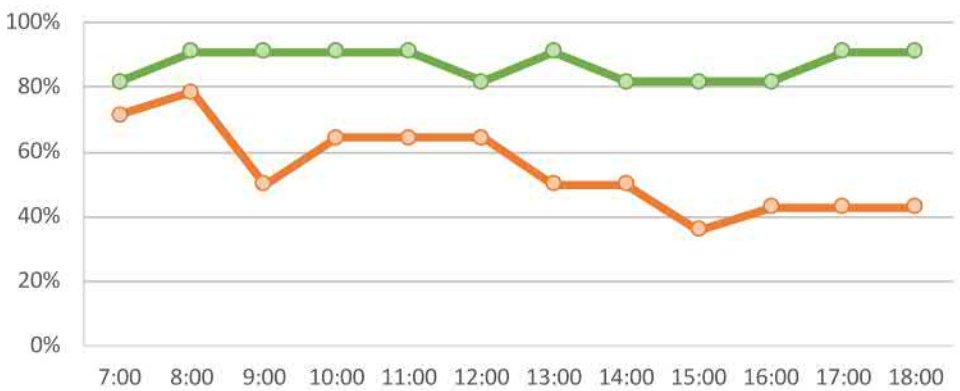
Loading spots: 17



1500 Block

Parking spots: 15

Loading spots: 5



1600 Block

Parking spots: 11

Loading spots: 14

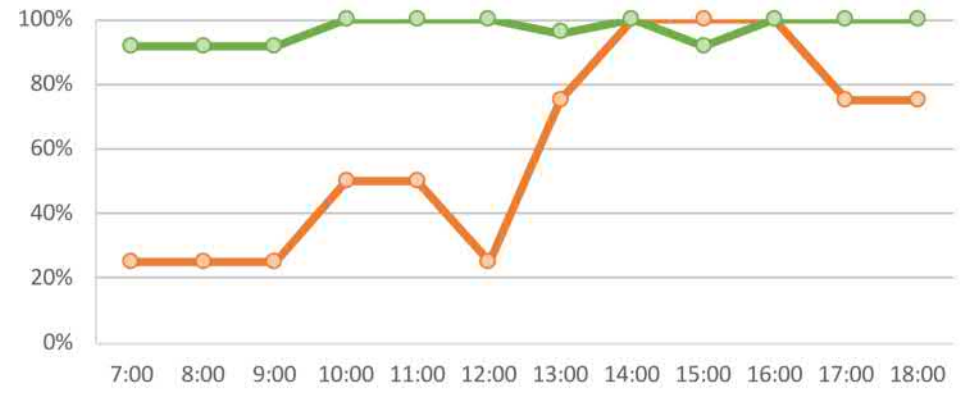
Block-by-Block

Thursday 05/02/2019

1700 Block

Parking spots: 21

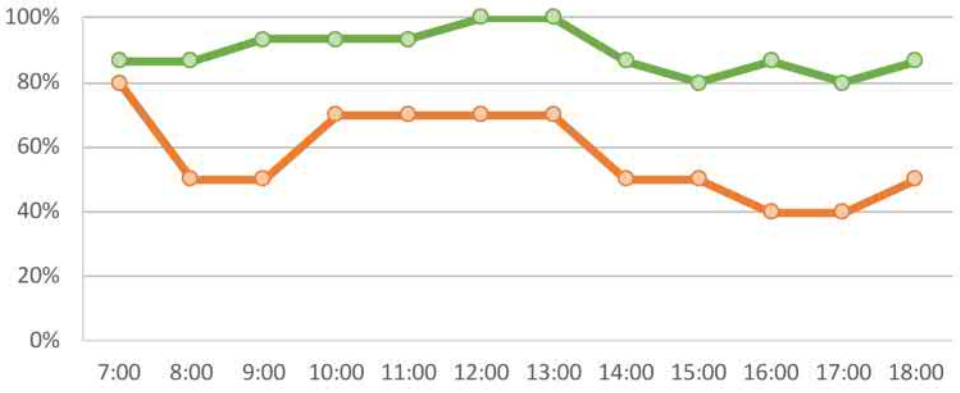
Loading spots: 3



1800 Block

Parking spots: 24

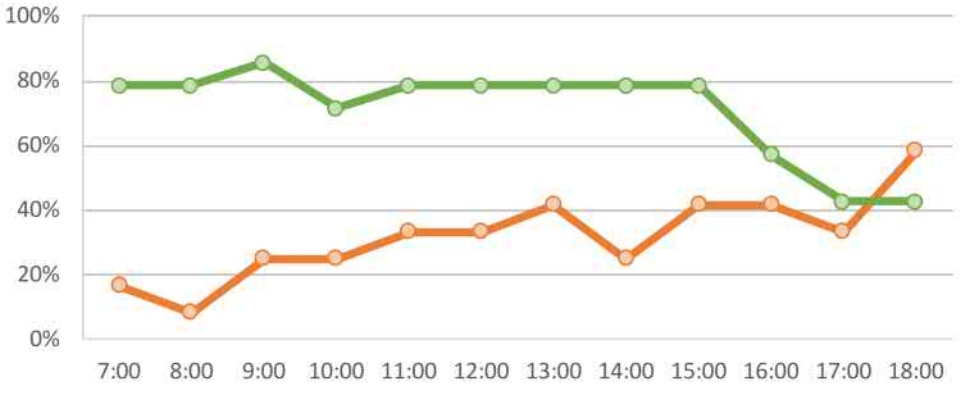
Loading spots: 4



1900 Block

Parking spots: 15

Loading spots: 10



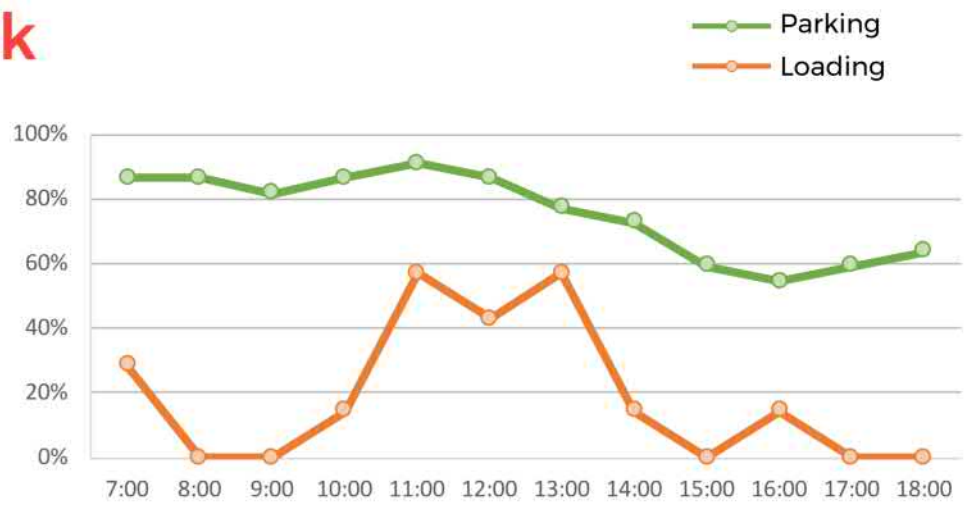
2000 Block

Parking spots: 14

Loading spots: 12

Block-by-Block

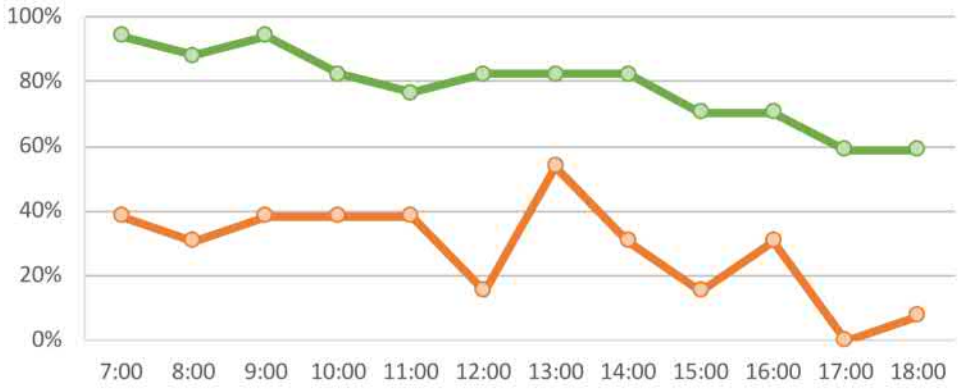
Thursday 05/03/2019



2100 Block

Parking spots: 22

Loading spots: 7



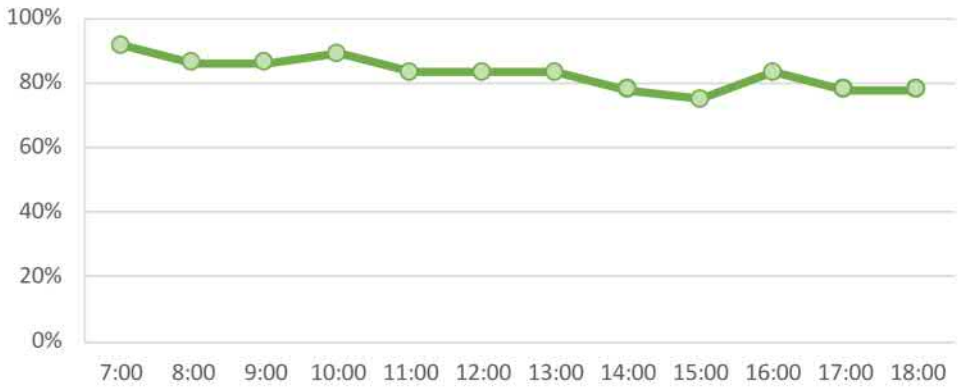
2200 Block

Parking spots: 17

Loading spots: 13

2300 Block

Parking spots: 29



2400 Block

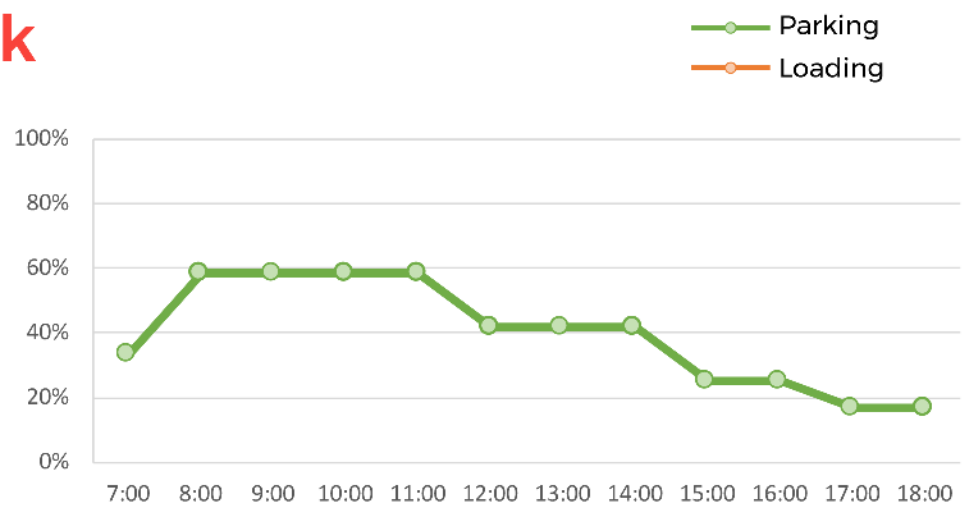
Parking spots: 36

Block-by-Block

Thursday 05/03/2019

2500 Block

Parking spots: 12



Block-by-Block

Saturday 05/04/2019

1300 Block

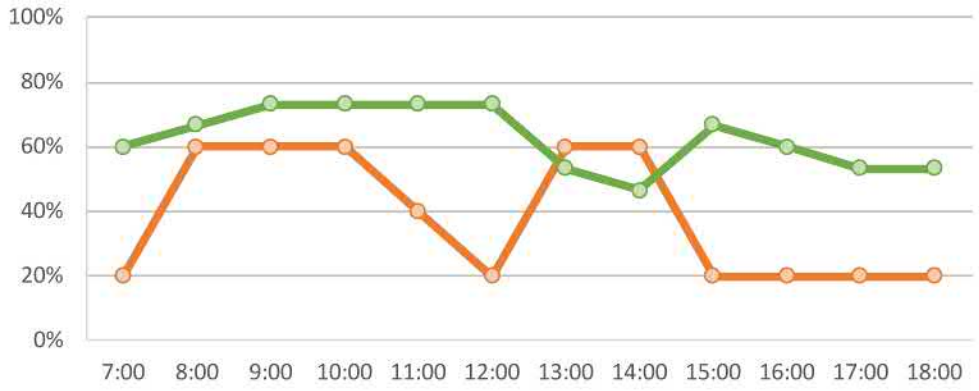
Parking spots: 38

Loading spots: 1

1400 Block

Parking spots : 16

Loading spots: 17



1500 Block

Parking spots: 15

Loading spots: 5

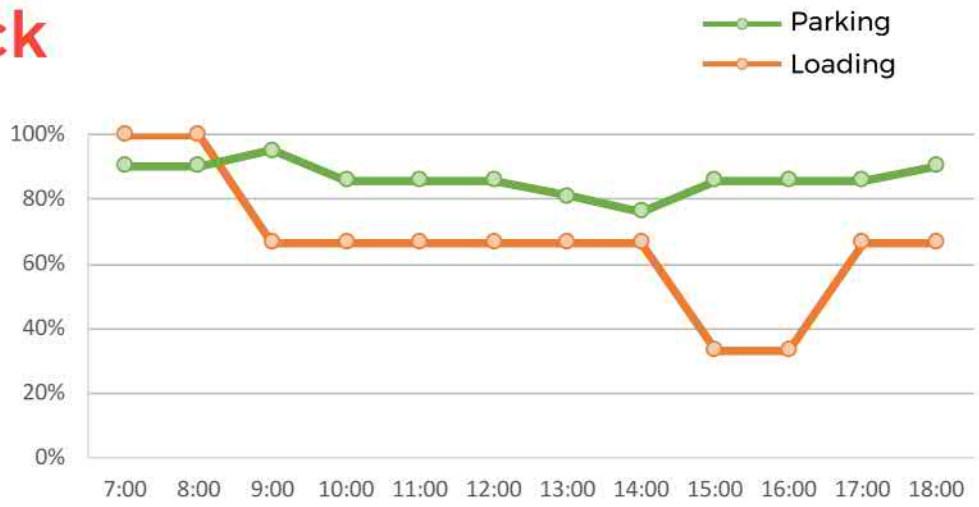
1600 Block

Parking spots: 11

Loading spots: 14

Block-by-Block

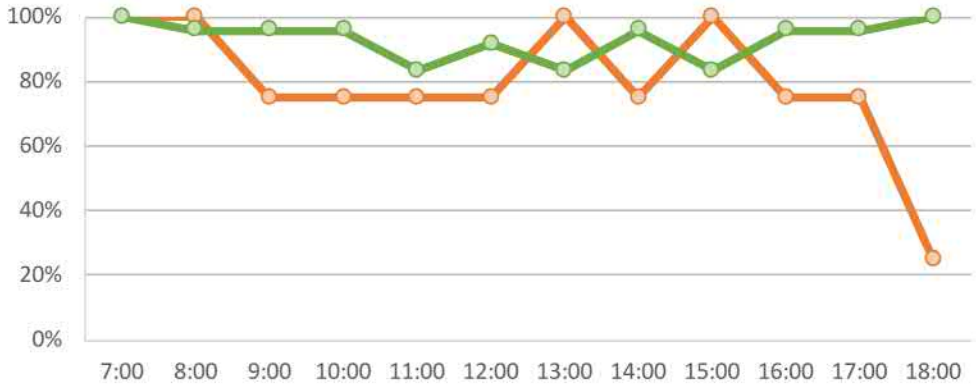
Saturday 05/04/2019



1700 Block

Parking spots: 21

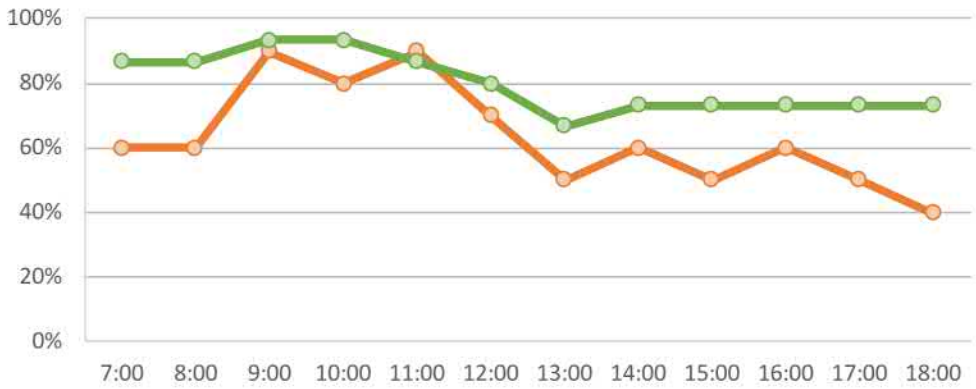
Loading spots: 3



1800 Block

Parking spots : 24

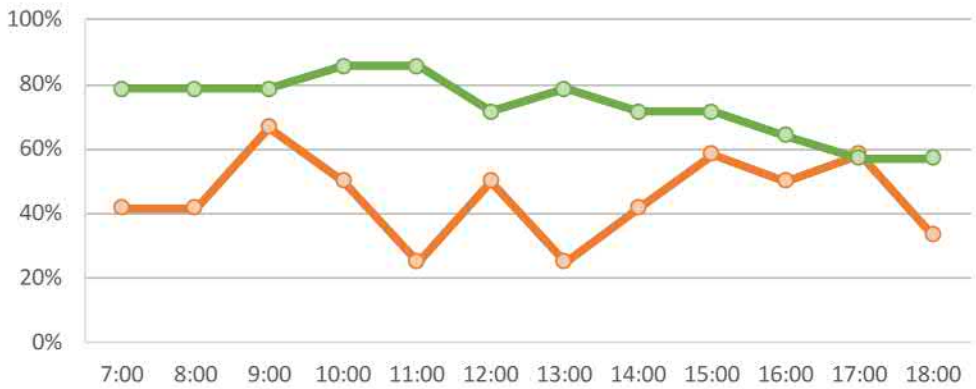
Loading spots: 4



1900 Block

Parking spots: 15

Loading spots: 10



2000 Block

Parking spots: 14

Loading spots: 12

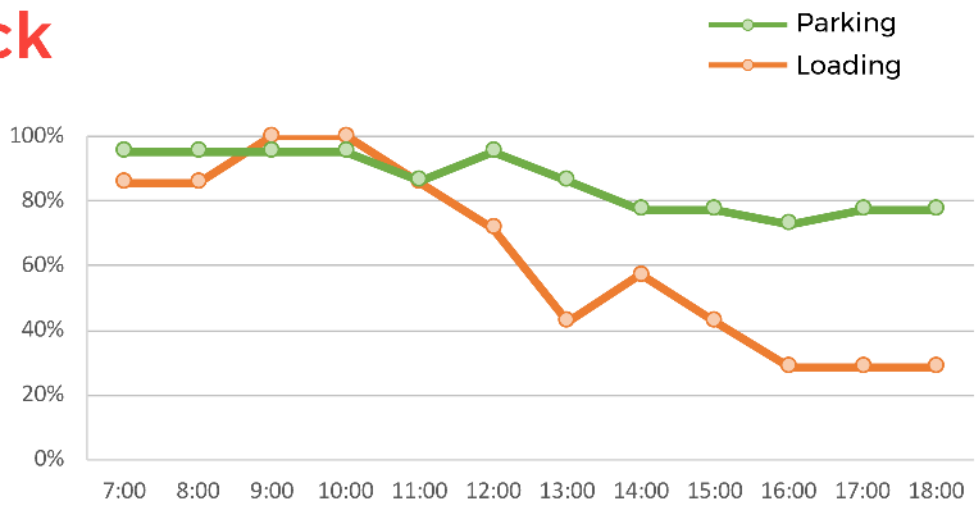
Block-by-Block

Saturday 05/04/2019

2100 Block

Parking spots: 22

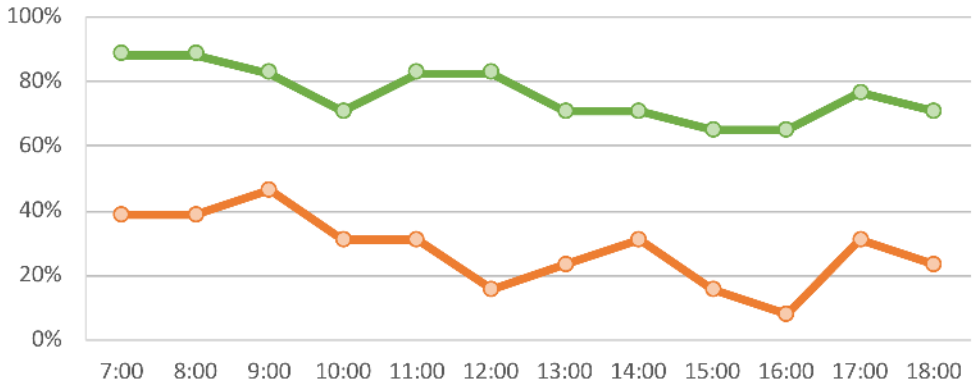
Loading spots: 7



2200 Block

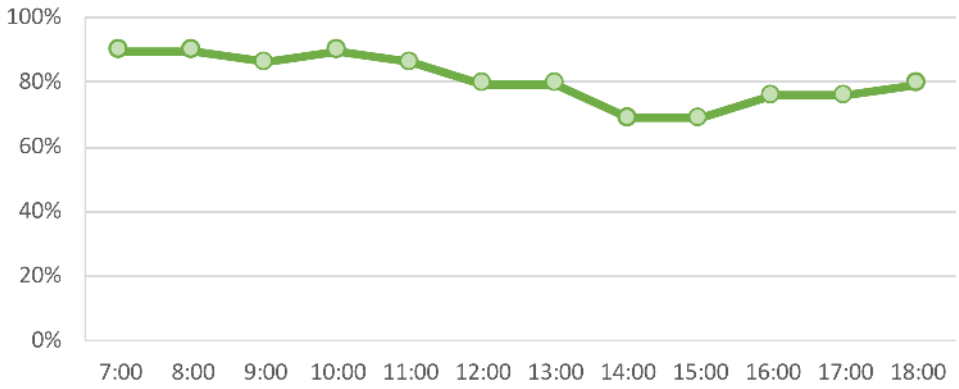
Parking spots : 17

Loading spots: 13



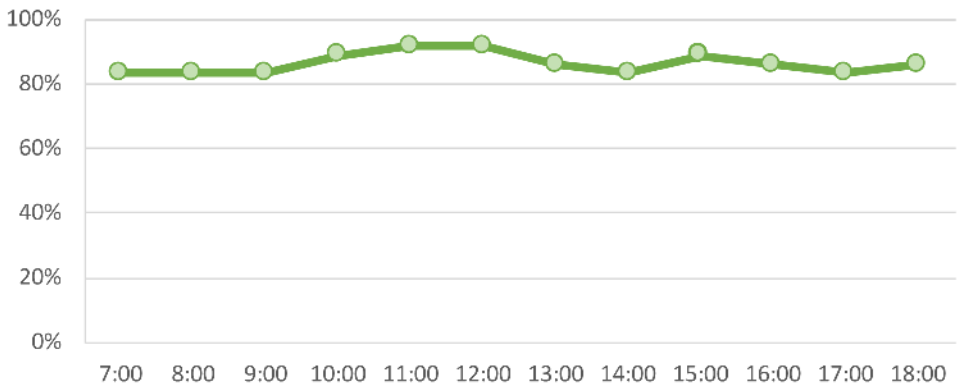
2300 Block

Parking spots: 29



2400 Block

Parking spots: 36

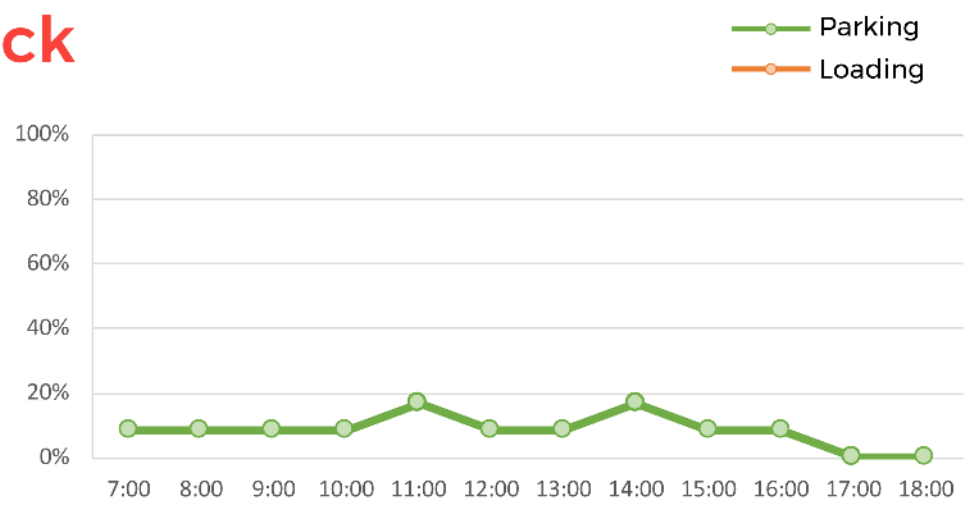


Block-by-Block

Saturday 05/04/2019

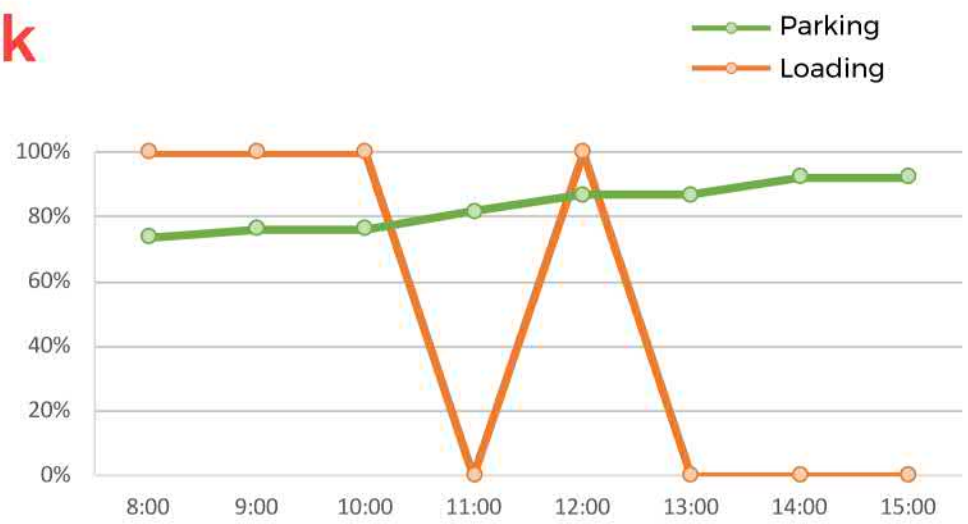
2500 Block

Parking spots: 12



Block-by-Block

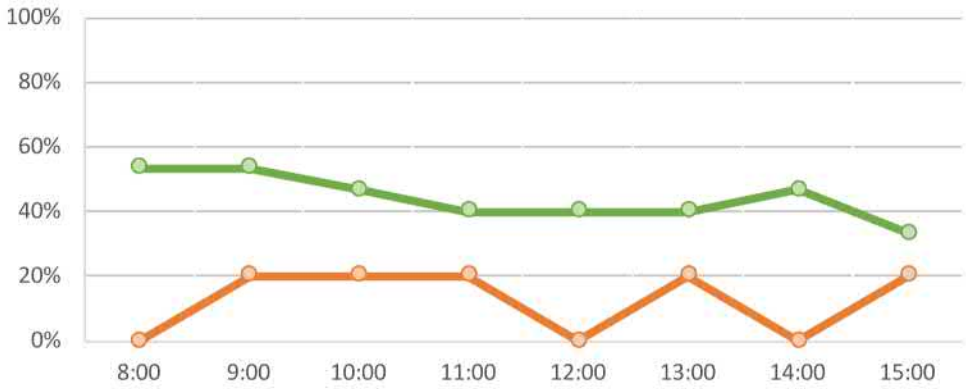
Sunday 05/19/2019



1300 Block

Parking spots: 38

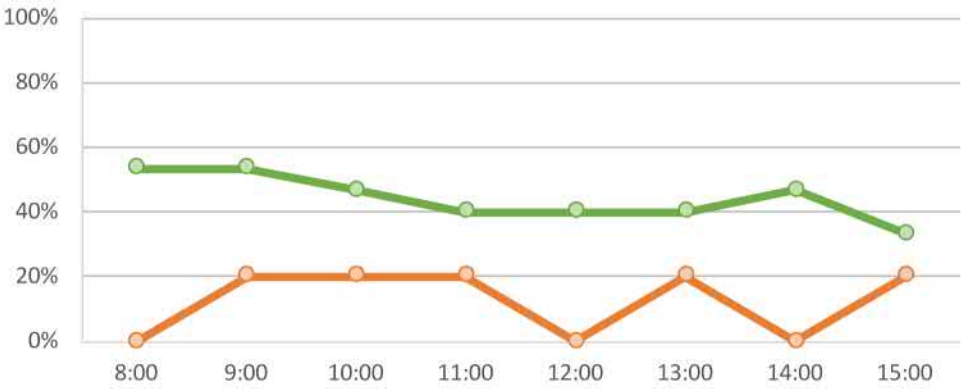
Loading spots: 1



1400 Block

Parking spots : 16

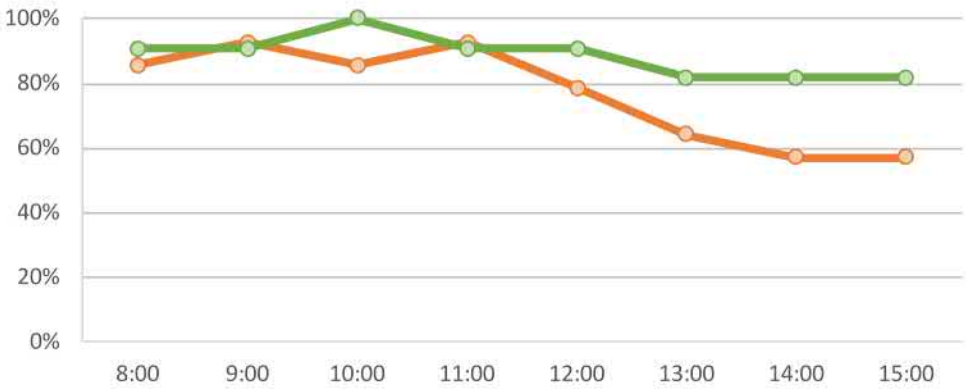
Loading spots: 17



1500 Block

Parking spots: 15

Loading spots: 5



1600 Block

Parking spots: 11

Loading spots: 14

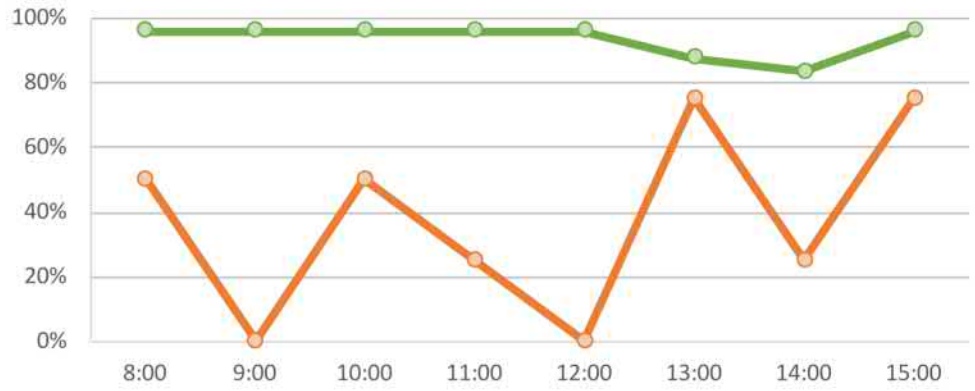
Block-by-Block

Sunday 05/19/2019

1700 Block

Parking spots: 21

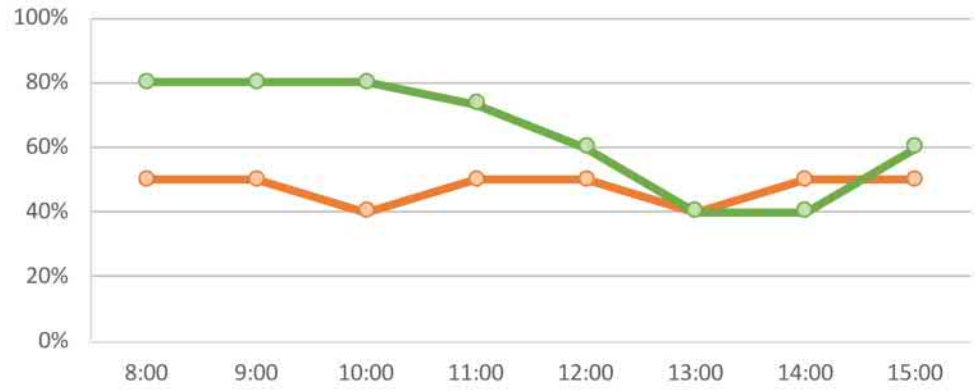
Loading spots: 3



1800 Block

Parking spots: 24

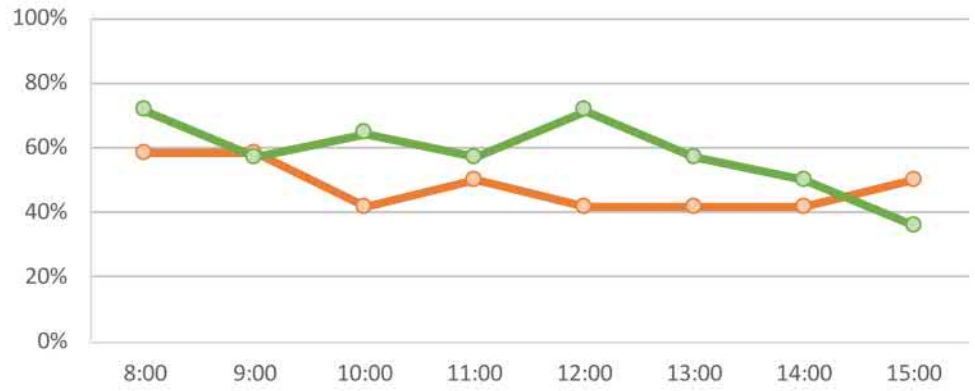
Loading spots: 4



1900 Block

Parking spots: 15

Loading spots: 10



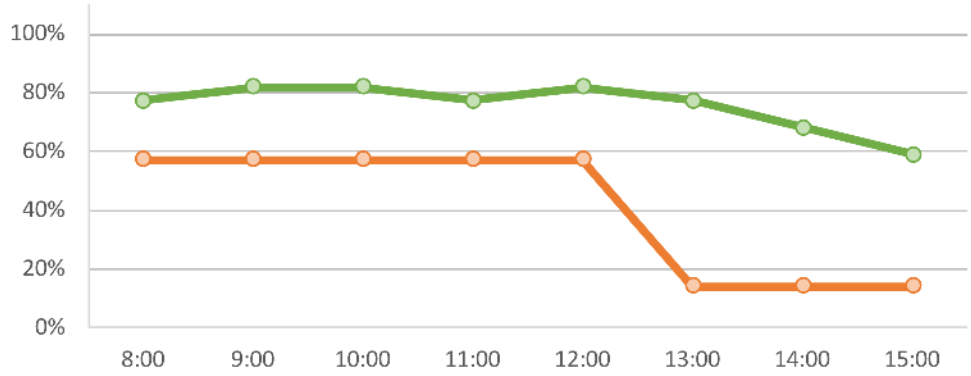
2000 Block

Parking spots: 14

Loading spots: 12

Block-by-Block

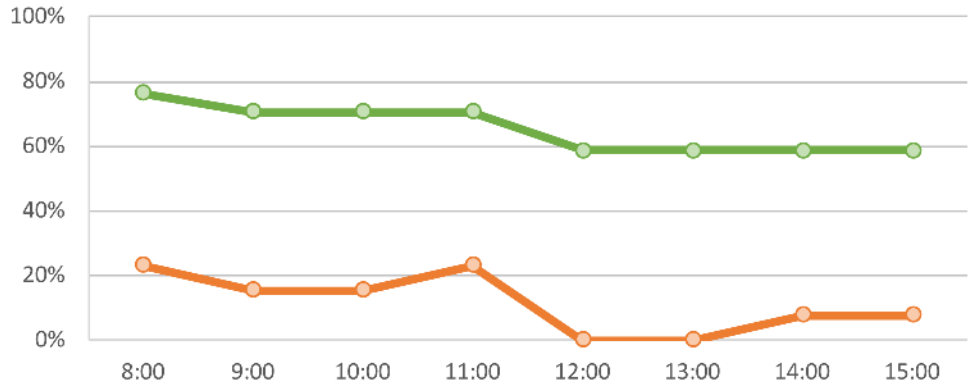
Sunday 05/19/2019



2100 Block

Parking spots: 22

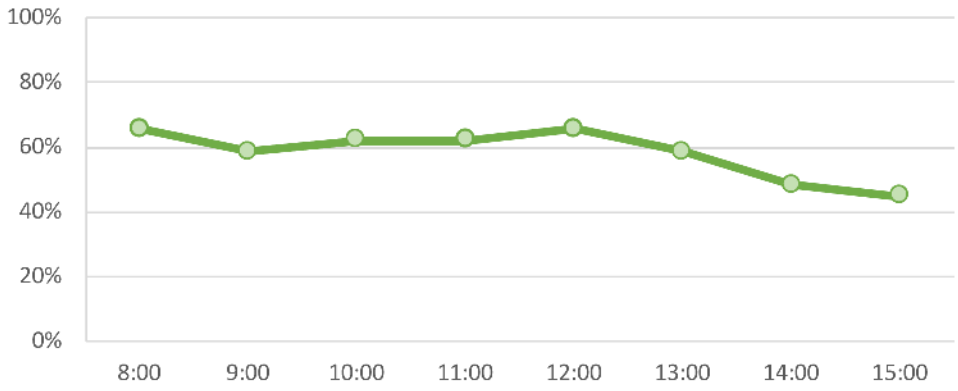
Loading spots: 7



2200 Block

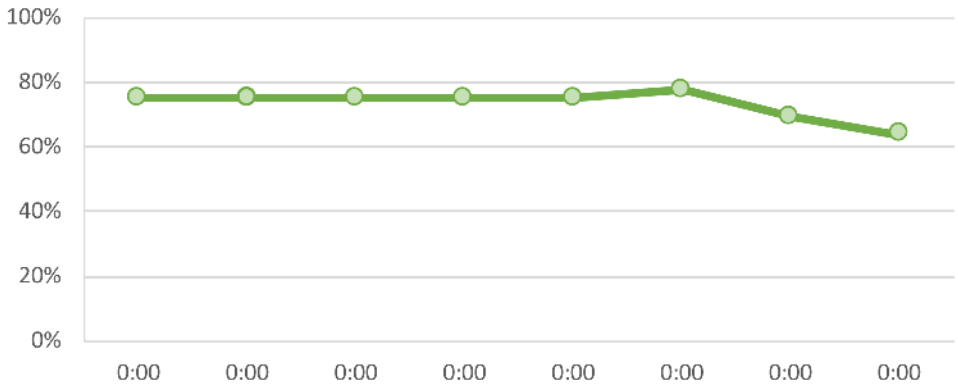
Parking spots: 17

Loading spots: 13



2300 Block

Parking spots: 29



2400 Block

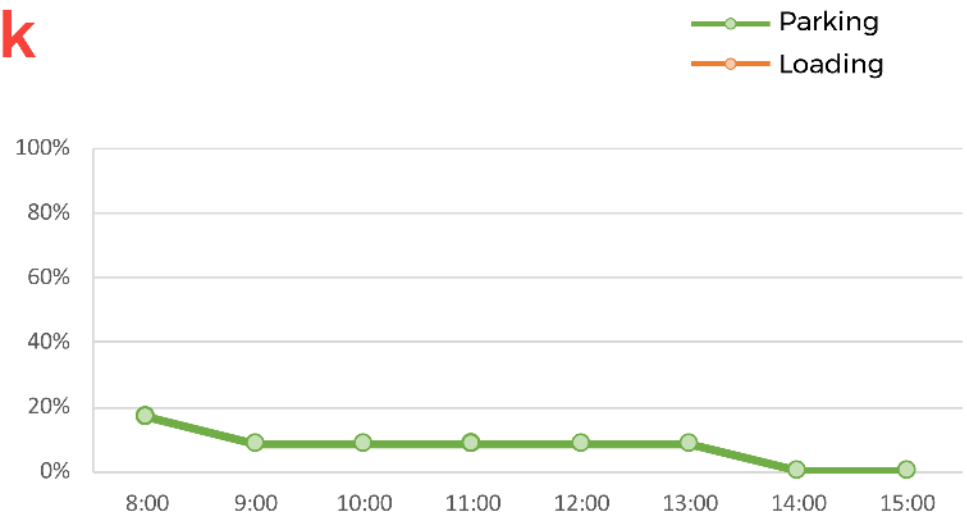
Parking spots: 36

Block-by-Block

Sunday 05/19/2019

2500 Block

Parking spots: 12



A-2 DURATION/ TURNOVER TABLES

Duration

Parking

Block	Spaces	Average Duration (hours)
1300	38	7.3
1400	16	8.6
1500	15	5.0
1600	11	8.1
1700	21	7.2
1800	24	7.9
1900	15	5.4
2000	14	6.3
2100	22	6.8
2200	17	7.1
2300	29	7.0
2400	36	7.8
2500	12	2.5
Corridor	**270**	**6.9**

Loading

Block	Spaces	Average Duration (hours)
1300	1	1.3
1400	17	1.3
1500	5	1.0
1600	14	5.2
1700	3	2.1
1800	4	2.2
1900	10	3.7
2000	12	2.4
2100	7	3.0
2200	13	1.1
2300	0	0.0
2400	0	0.0
2500	0	0.0
Corridor	**86**	**2.5**

Turnover

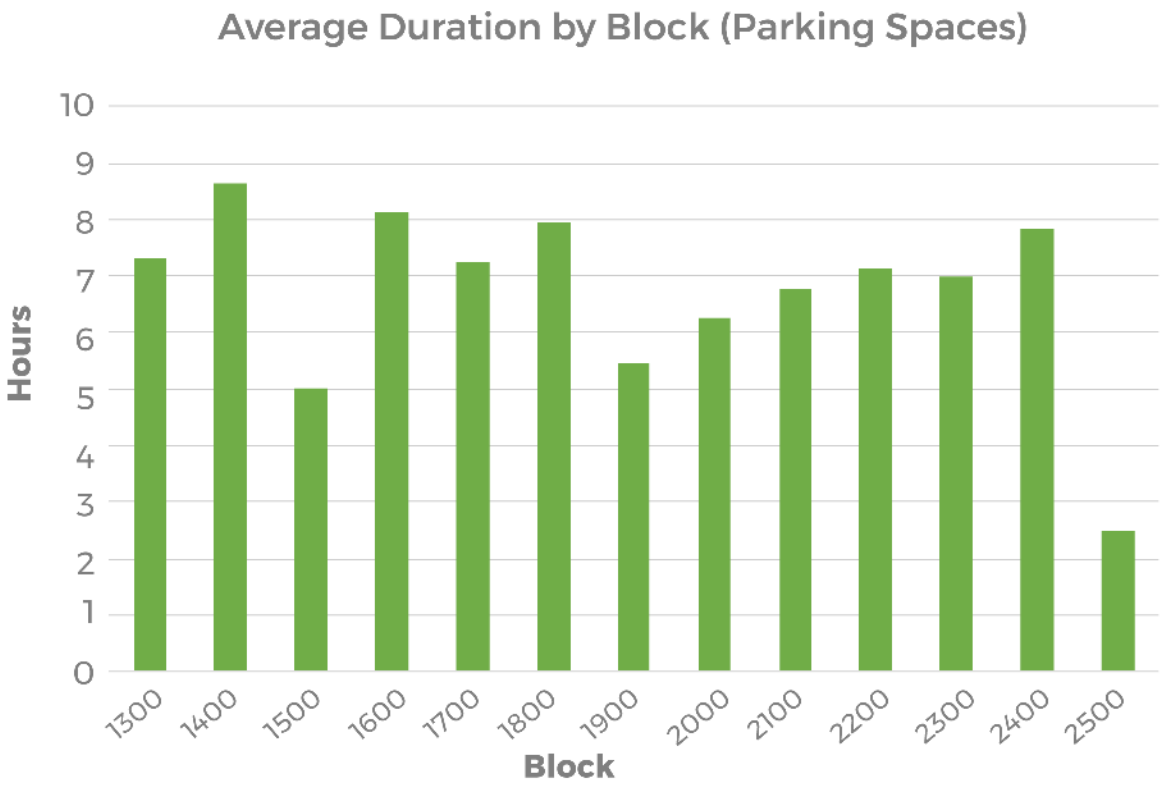
Parking

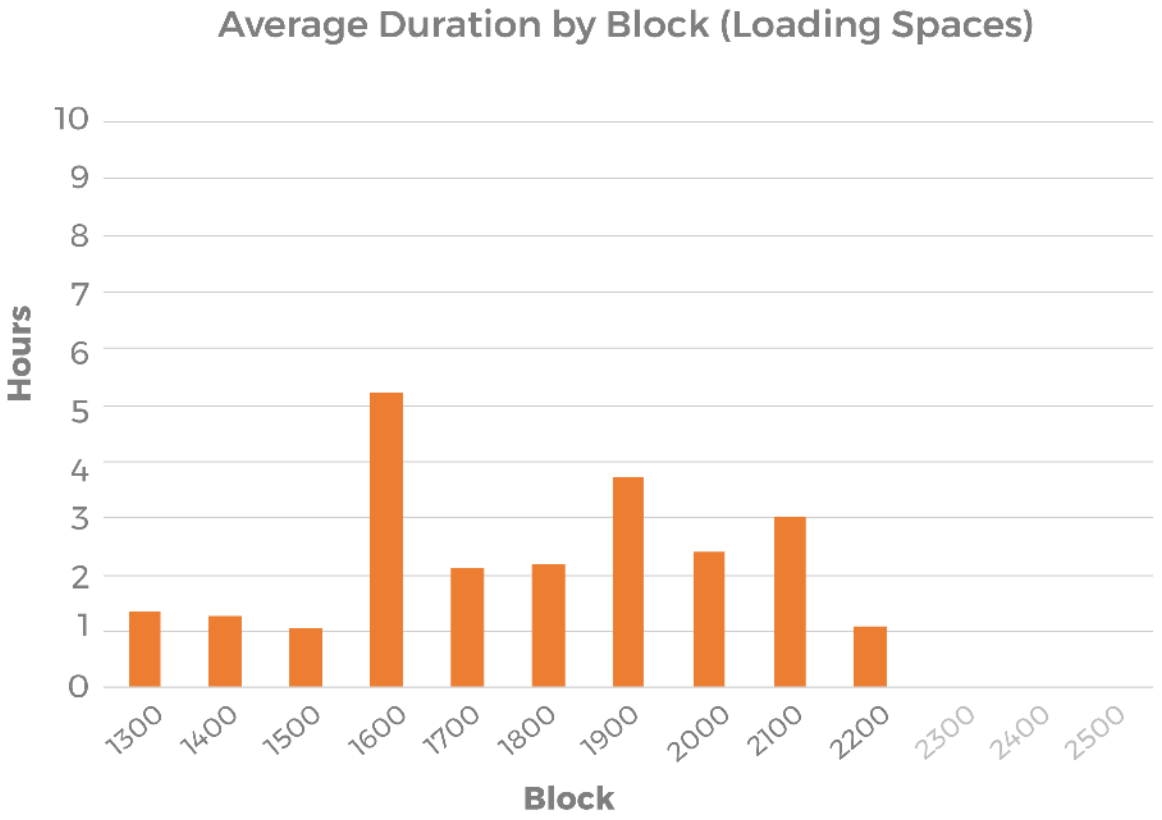
Block	Spaces	Average Turnover (# of cars)
1300	38	1.7
1400	16	1.4
1500	15	1.7
1600	11	1.5
1700	21	1.7
1800	24	1.9
1900	15	2.1
2000	14	1.6
2100	22	1.6
2200	17	1.3
2300	29	1.4
2400	36	1.3
2500	12	0.7
Corridor	**270**	**1.5**

Loading

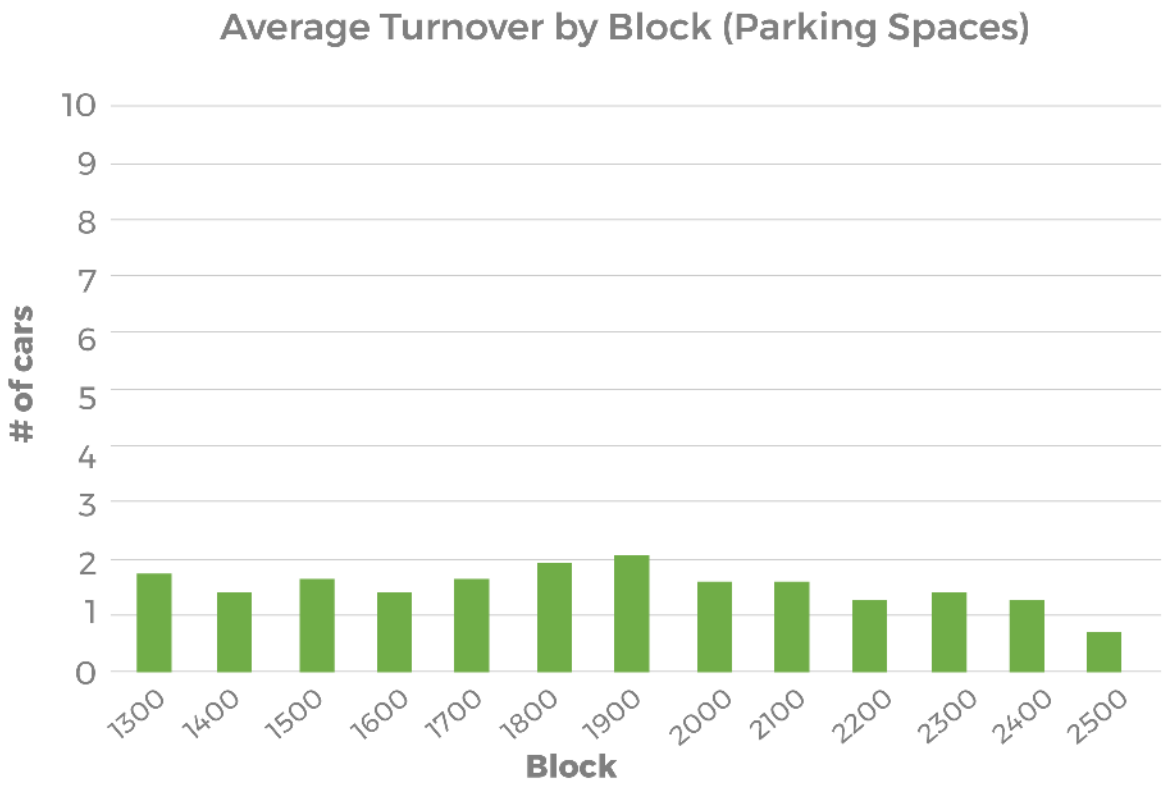
Block	Spaces	Average Turnover (# of cars)
1300	1	3.5
1400	17	4.4
1500	5	3.8
1600	14	1.9
1700	3	3.3
1800	4	3.7
1900	10	2.7
2000	12	2.7
2100	7	1.8
2200	13	1.8
2300	0	0.0
2400	0	0.0
2500	0	0.0
Corridor	**86**	**2.8**

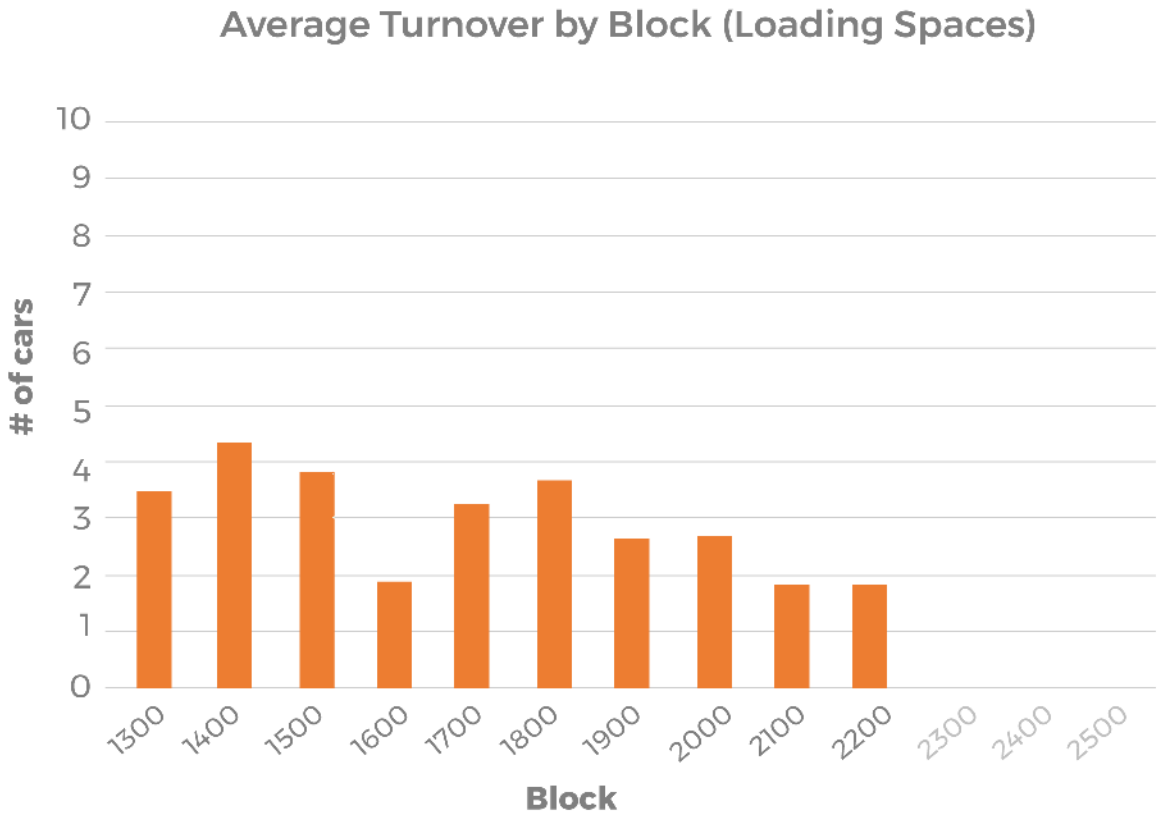
Average Duration





Average Turnover





Appendix

A-3 DIAGRAMS OF OBSERVED ACTIVITY

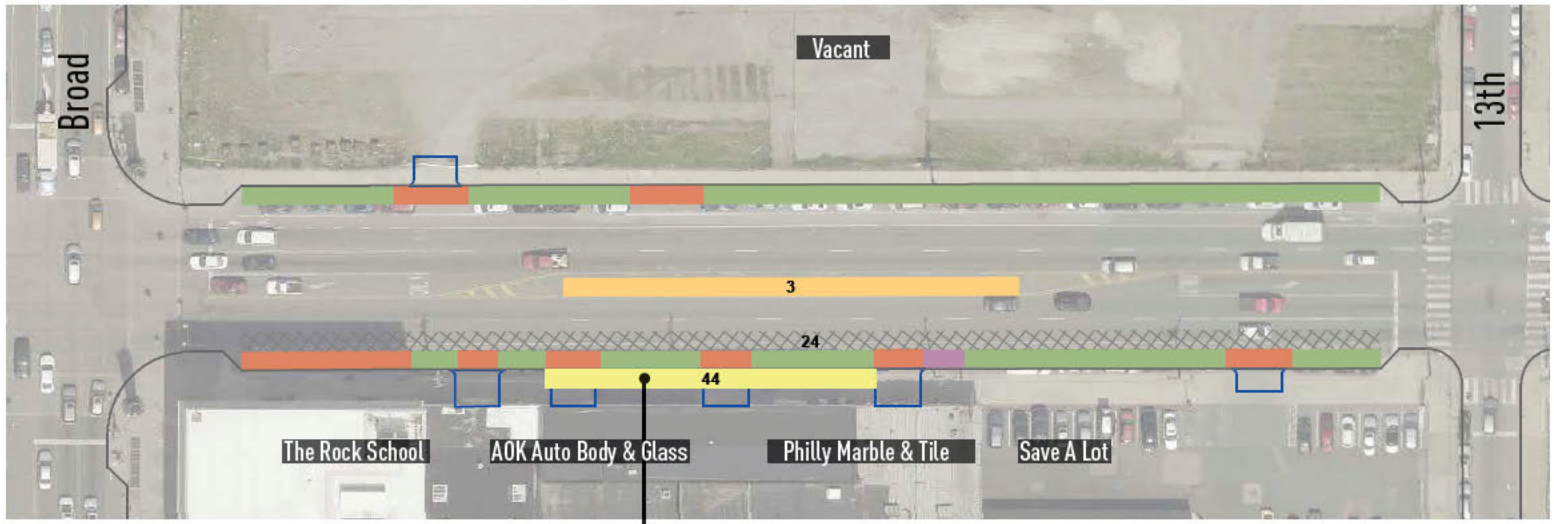
13th St - Broad St

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

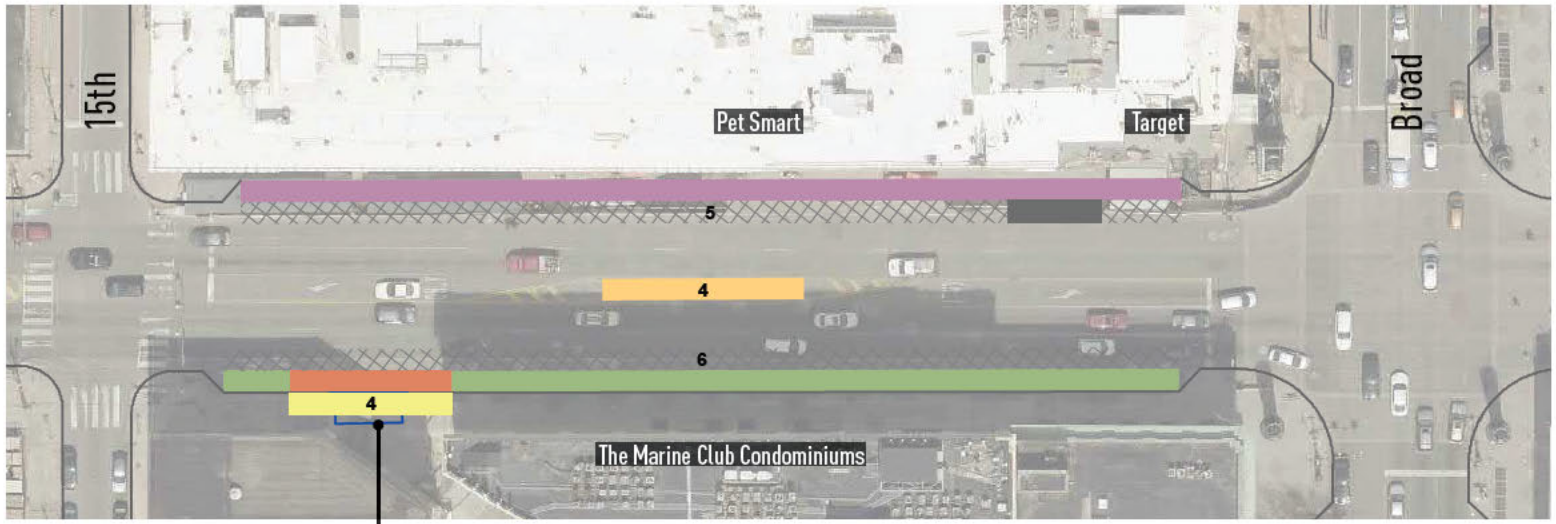
Broad St - 15th

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

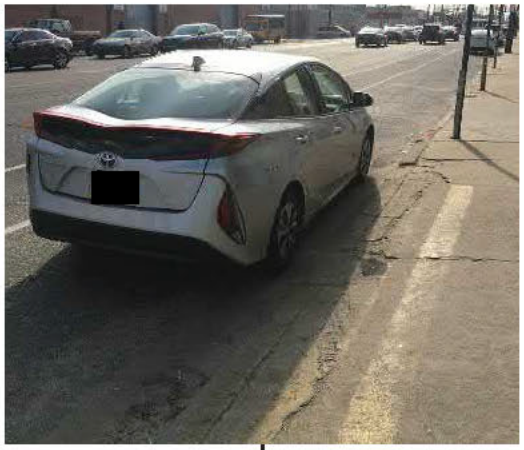
15th St - 16th St

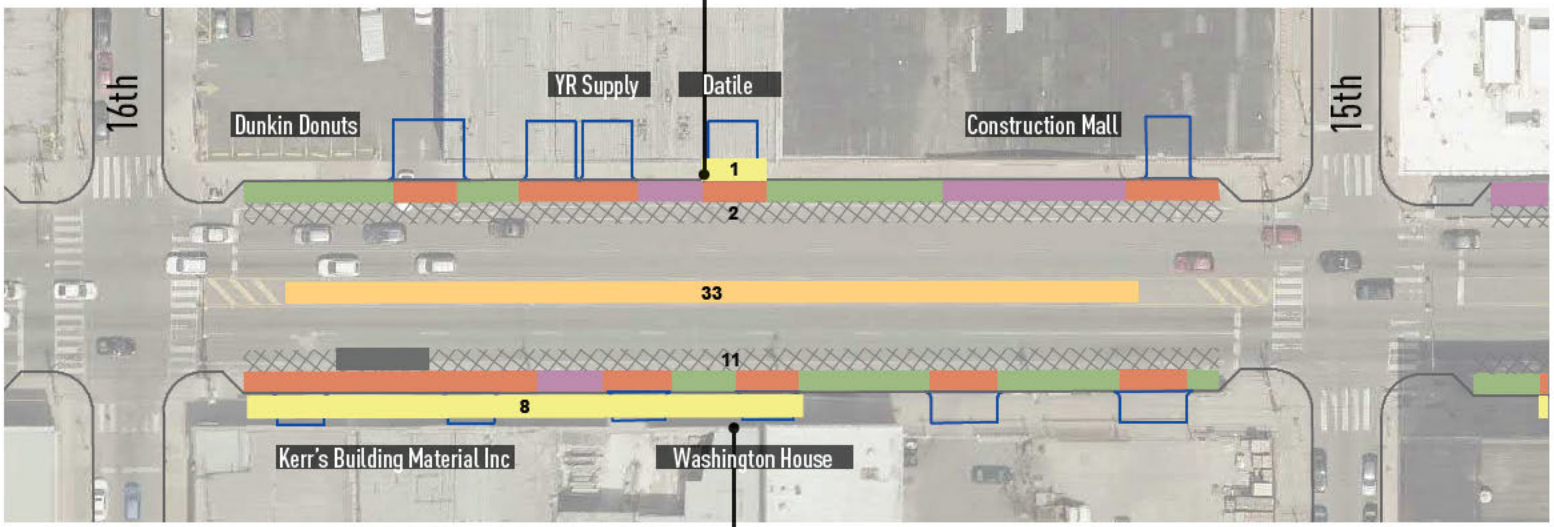
Diagram of Observed Activity

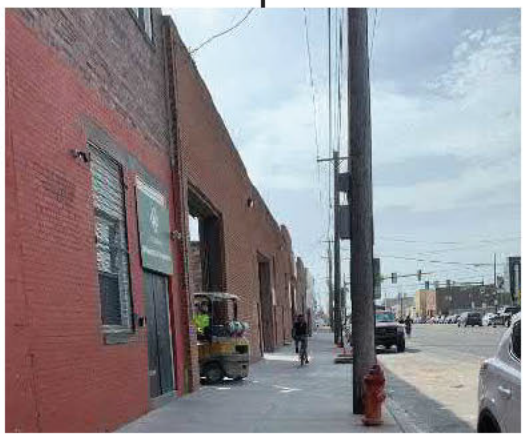
DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*







Washington Avenue
Parking and Loading Study

City of Philadelphia

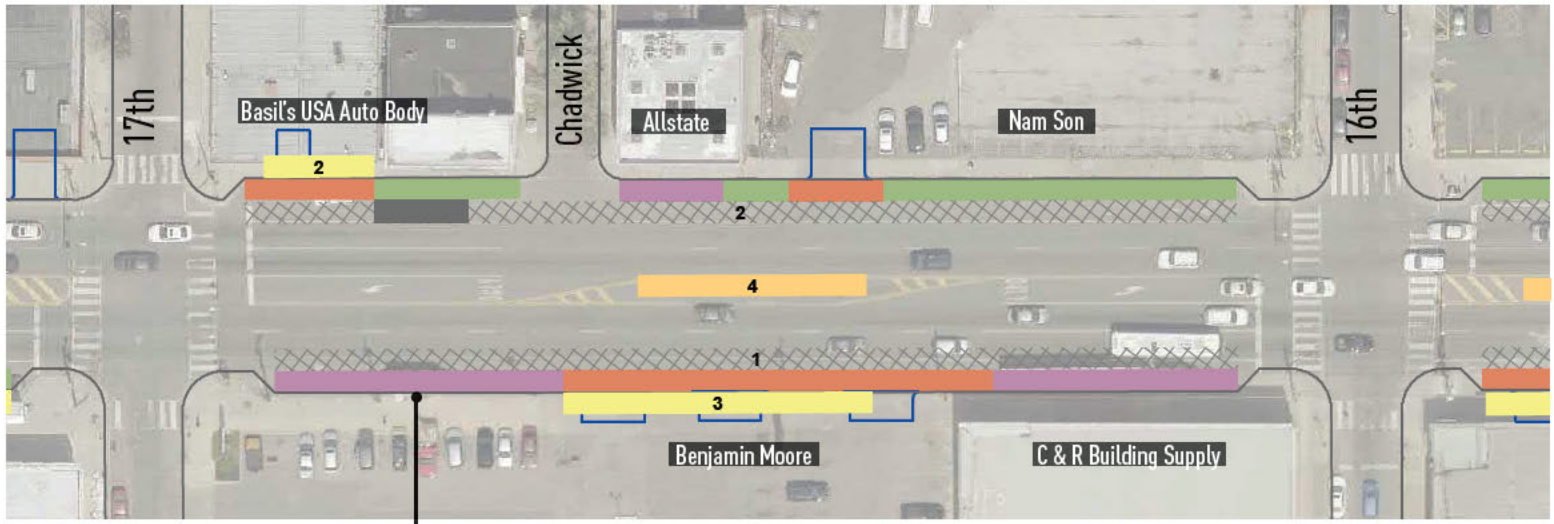
16th St - 17th St

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

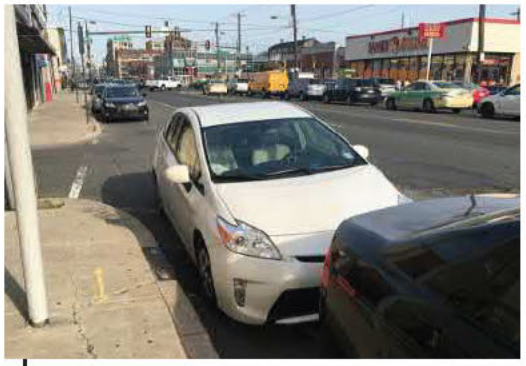
17th St - 18th St

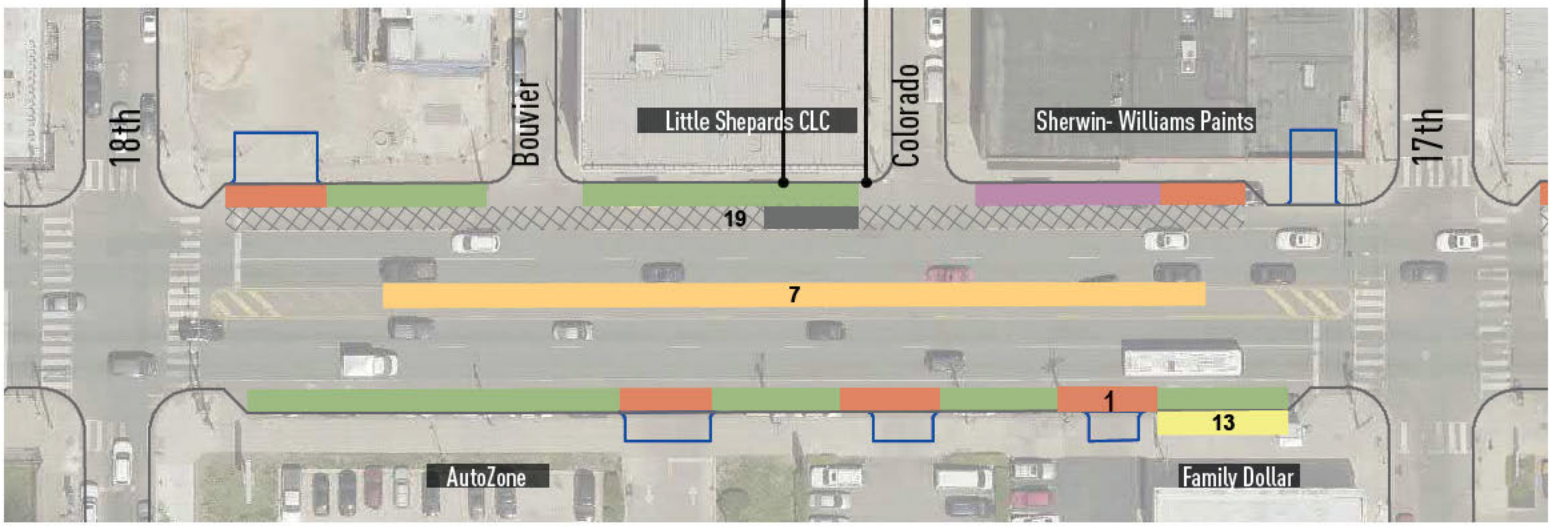
Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*





Washington Avenue
Parking and Loading Study

City of Philadelphia

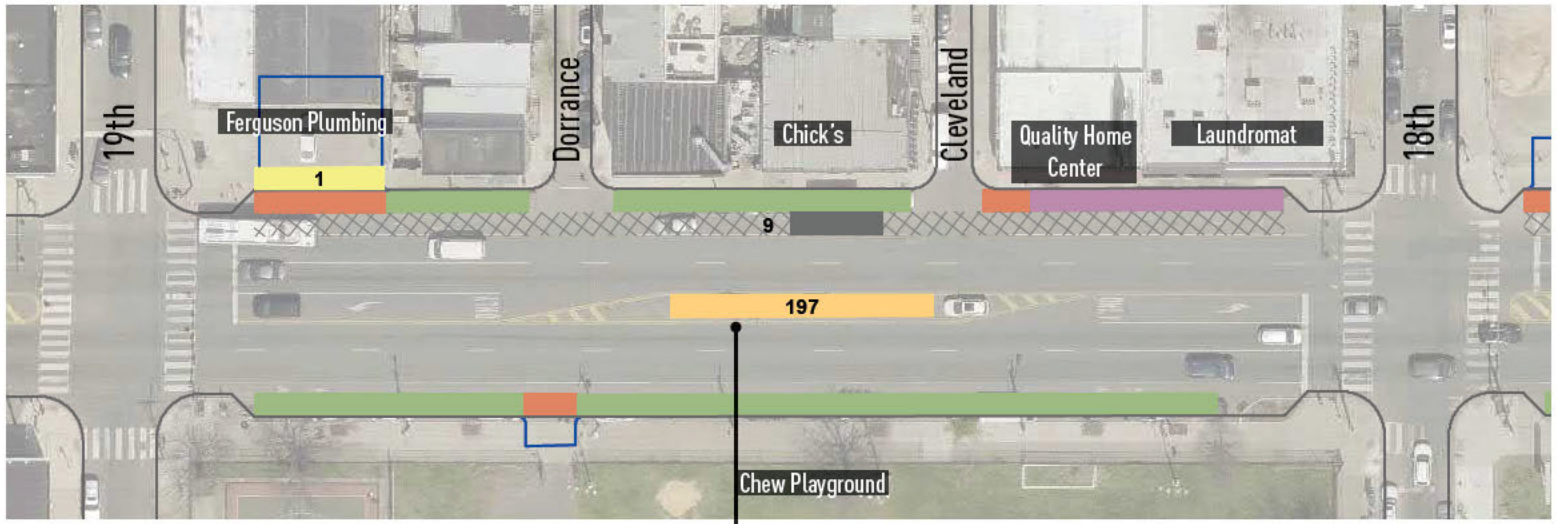
18th St - 19th St

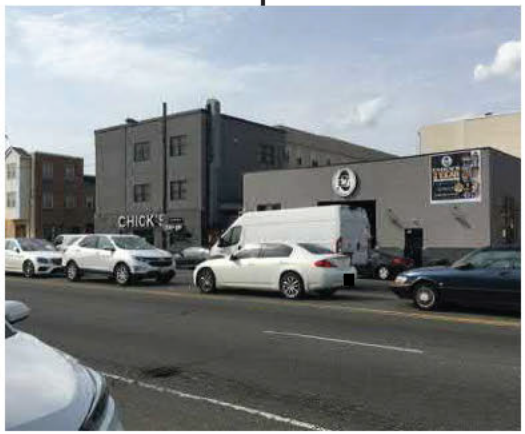
Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*





Washington Avenue
Parking and Loading Study

City of Philadelphia

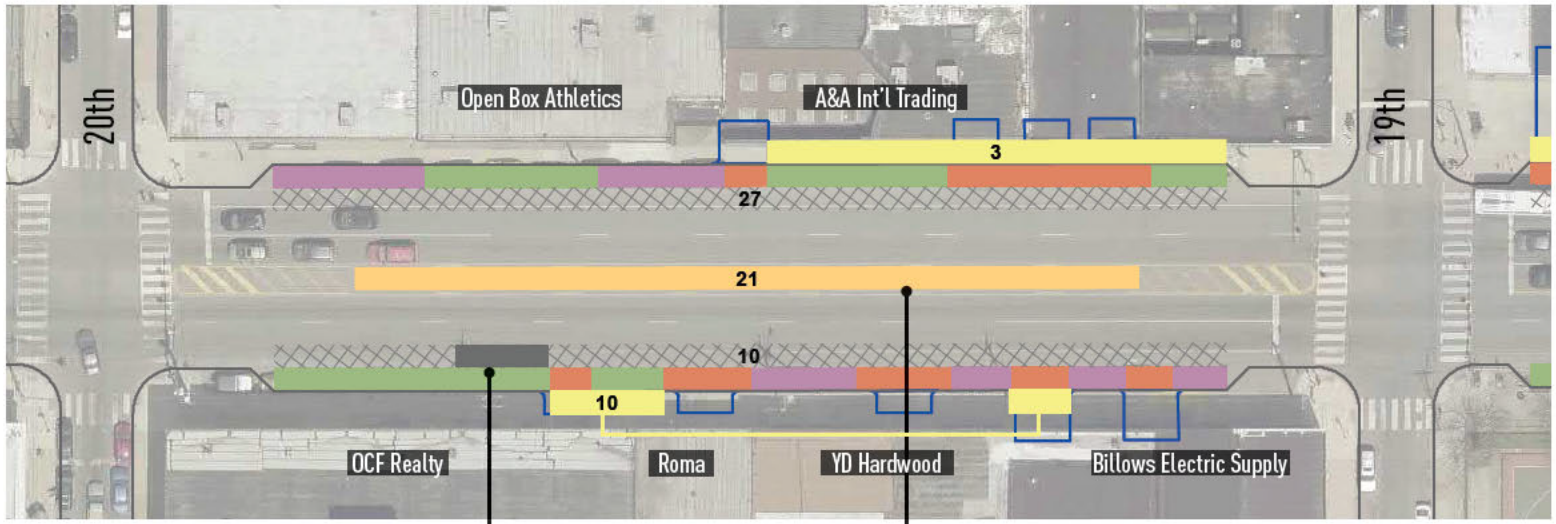
19th St - 20th St

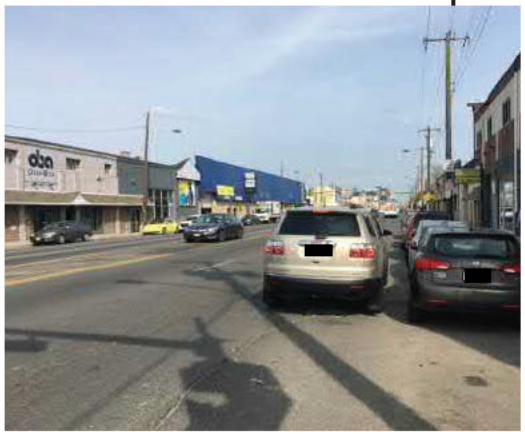
Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*





Washington Avenue
Parking and Loading Study

City of Philadelphia

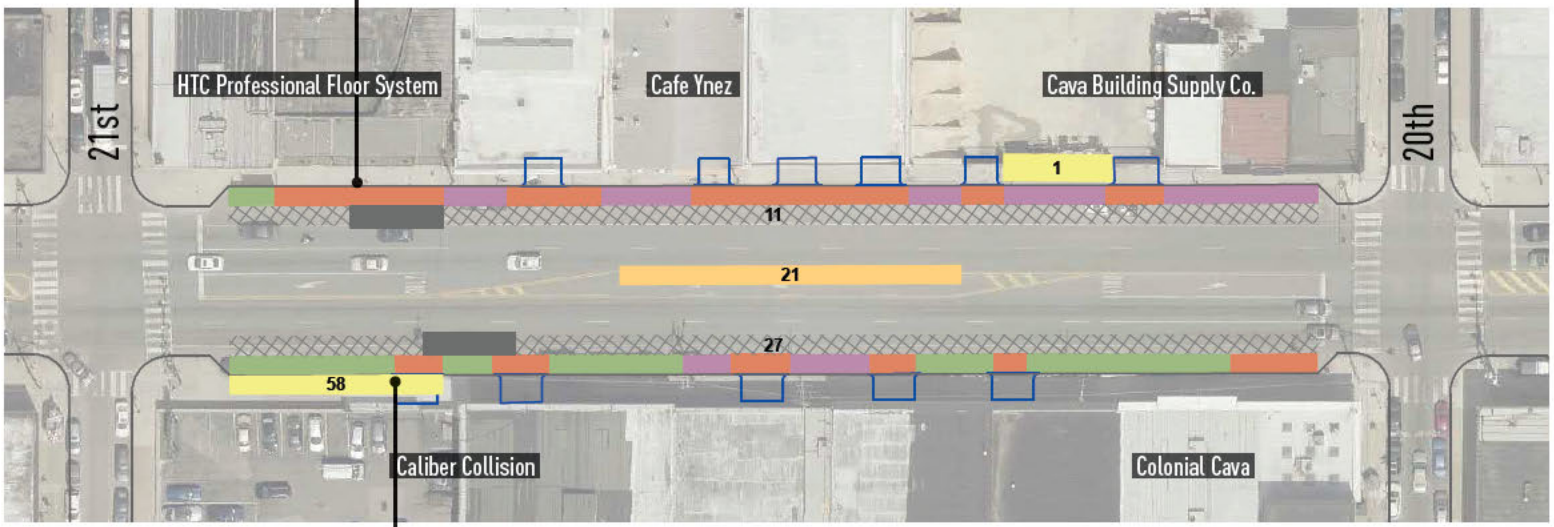
20th St - 21th St

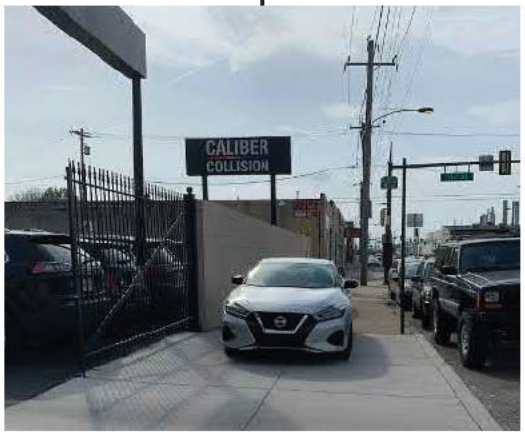
Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*





Washington Avenue
Parking and Loading Study

City of Philadelphia

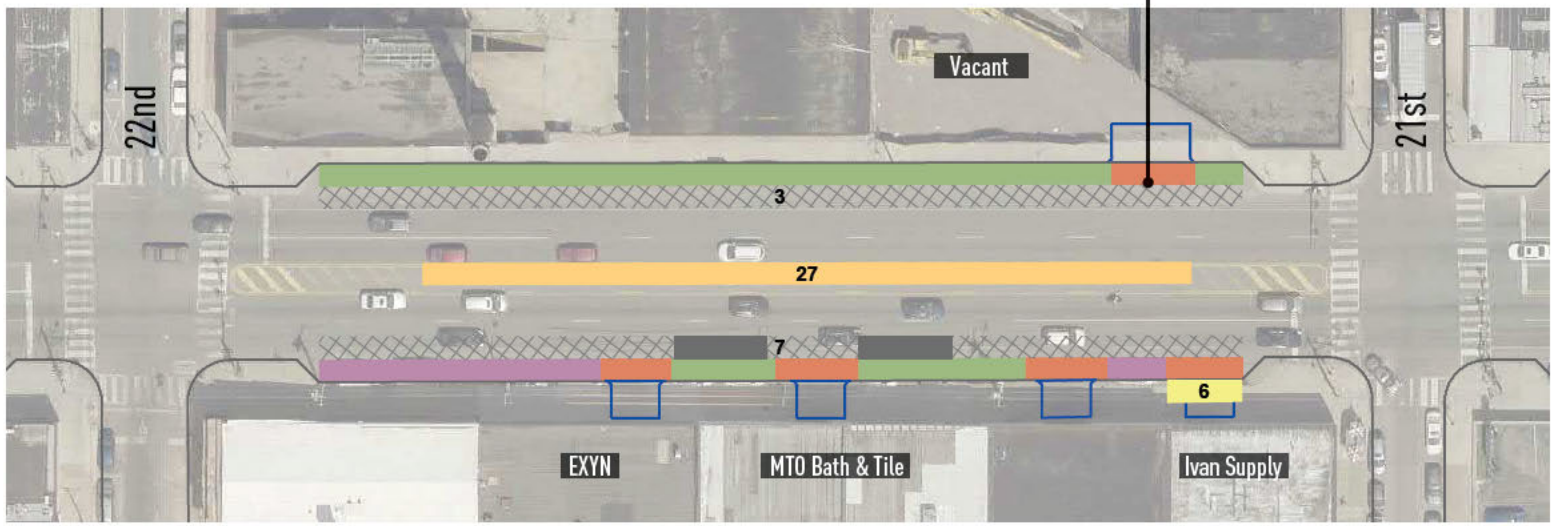
21st St - 22nd St

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

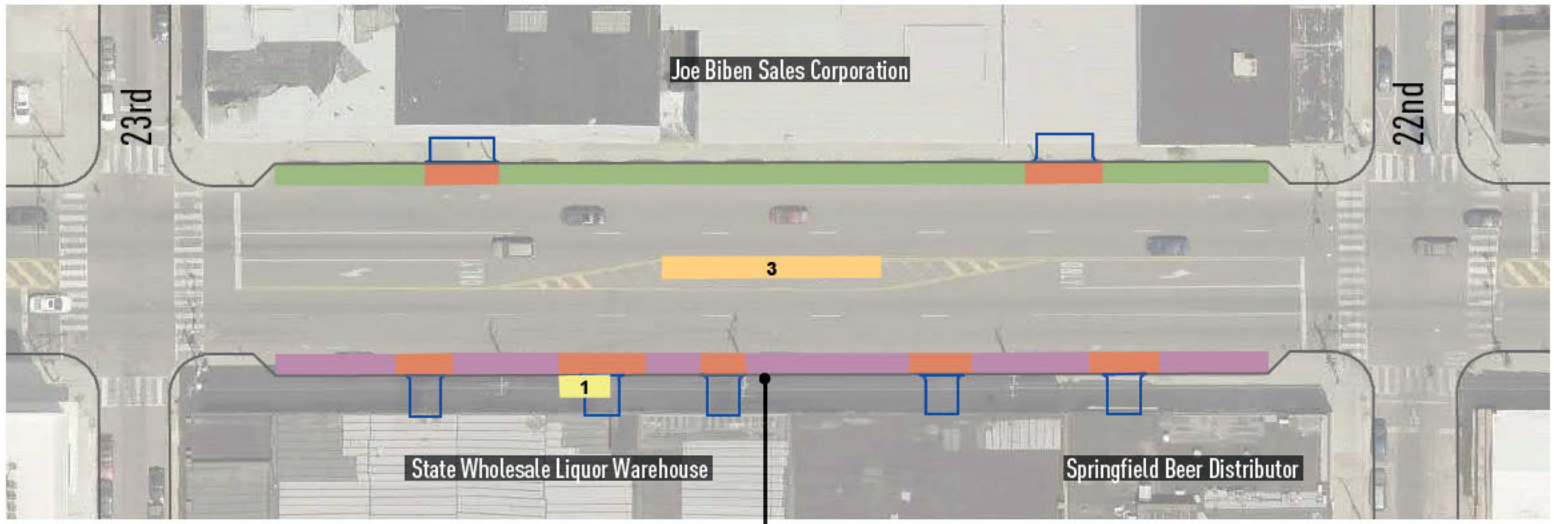
22nd St - 23rd St

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

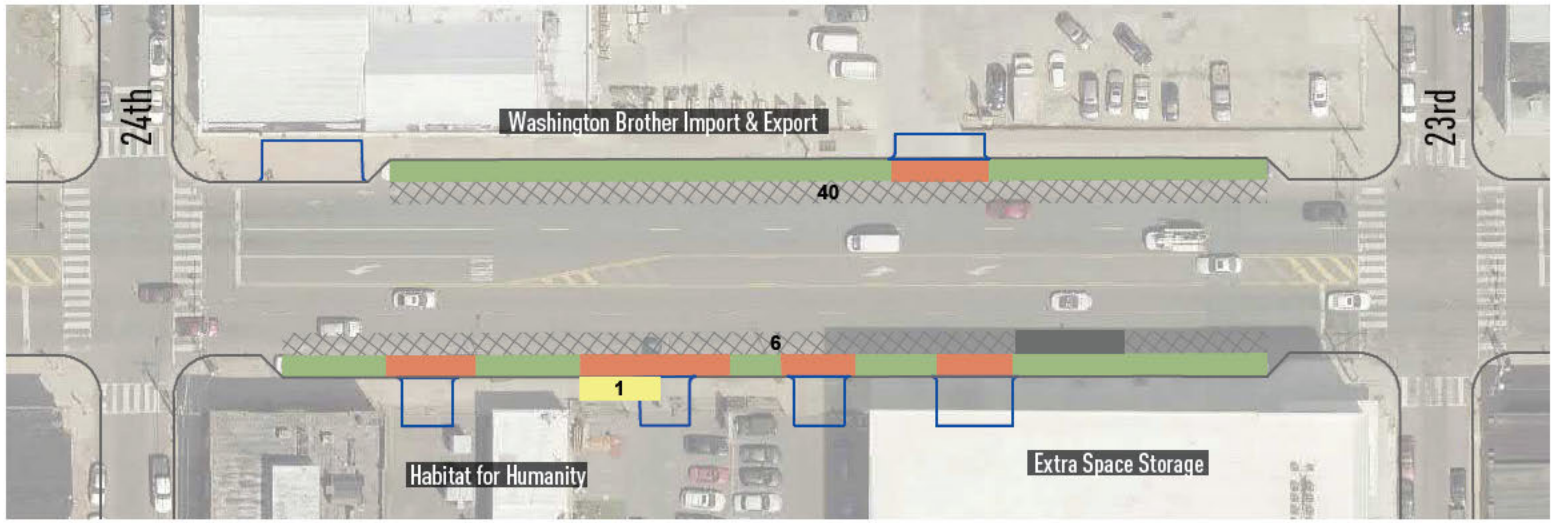
23rd St - 24th St

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*



Washington Avenue
Parking and Loading Study

City of Philadelphia

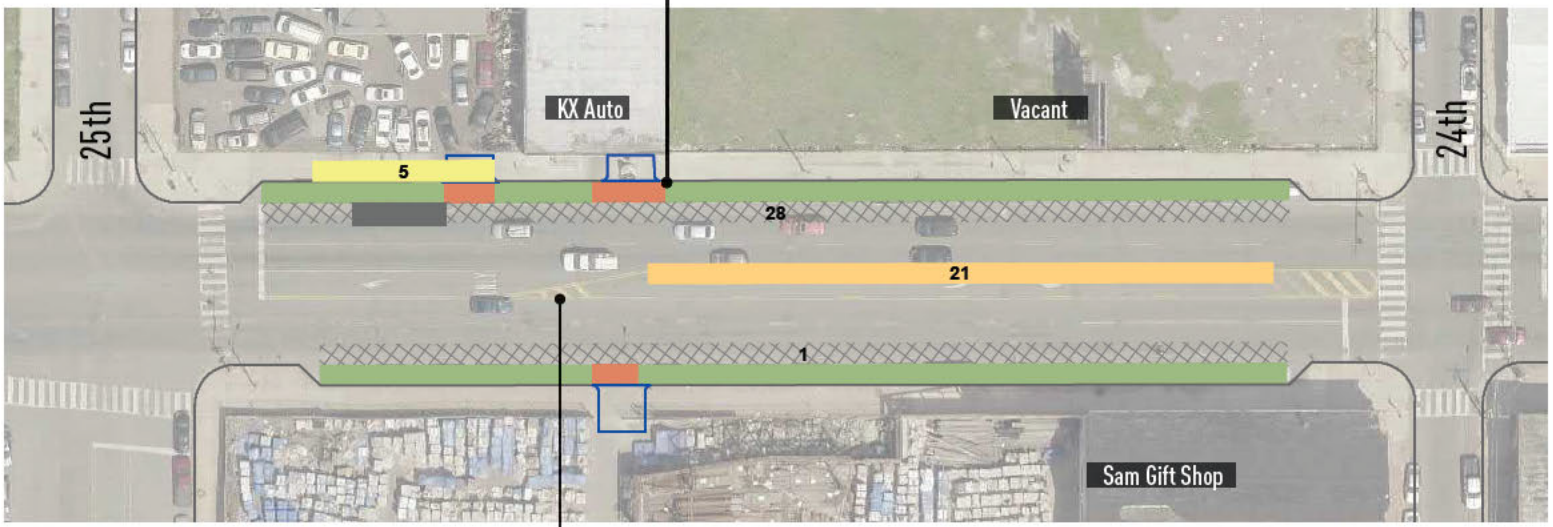
24th St - 25th St

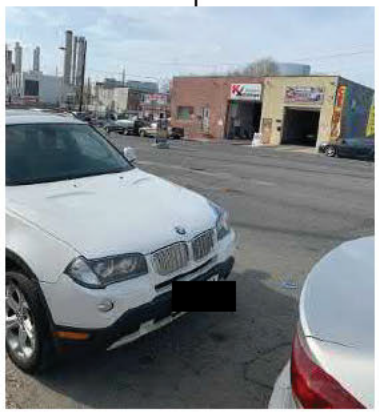
Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*





Washington Avenue
Parking and Loading Study

City of Philadelphia

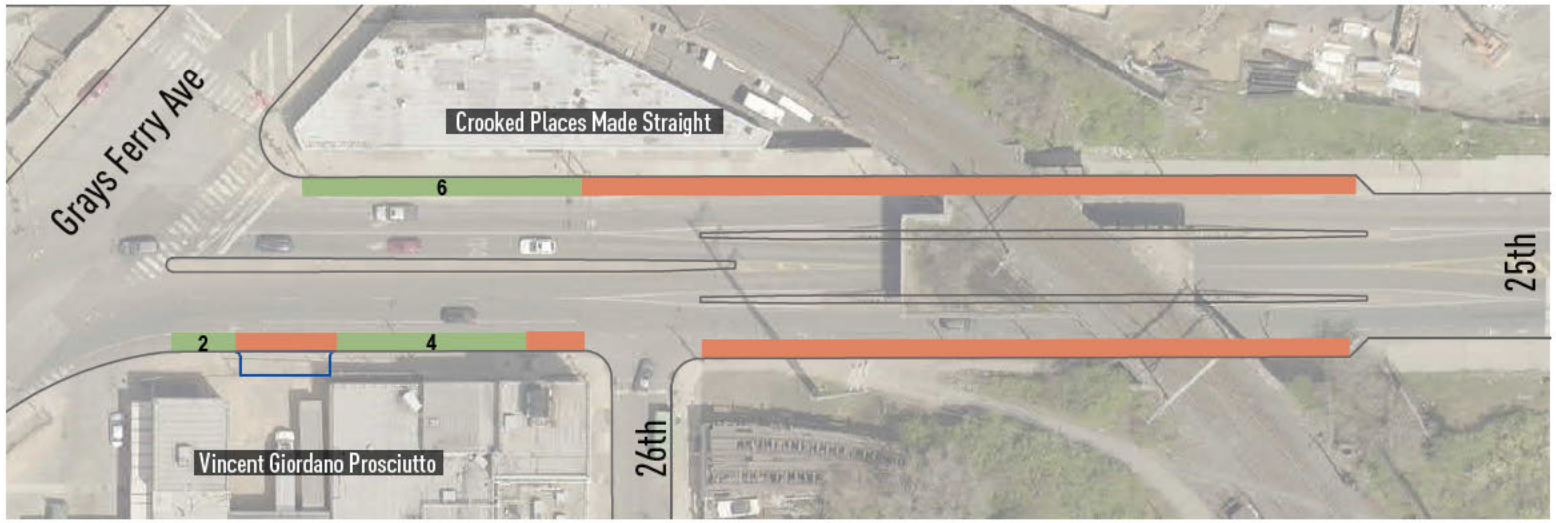
25th St - Grays Ferry Ave

Diagram of Observed Activity

DRAFT - August

- Parking Zone
- Loading Zone
- Restricted
- Driveway
- Median Parking*
- Double Parking* (Occasional)
- Double Parking (Regular)
- Sidewalk Parking*

** Numbers shown on diagrams represent the # of vehicles observed over the 44-hour collection period*

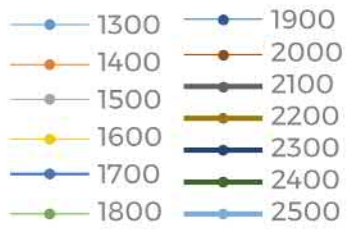


Washington Avenue
Parking and Loading Study

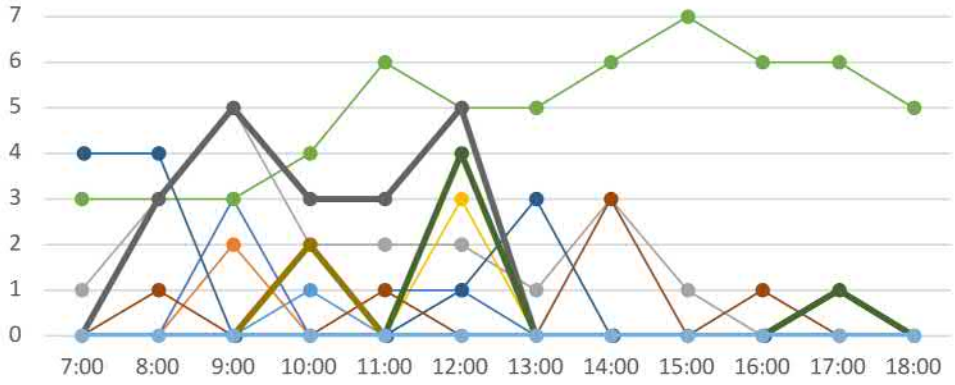
City of Philadelphia

A-4 ILLEGAL PARKING ACTIVITY GRAPHS

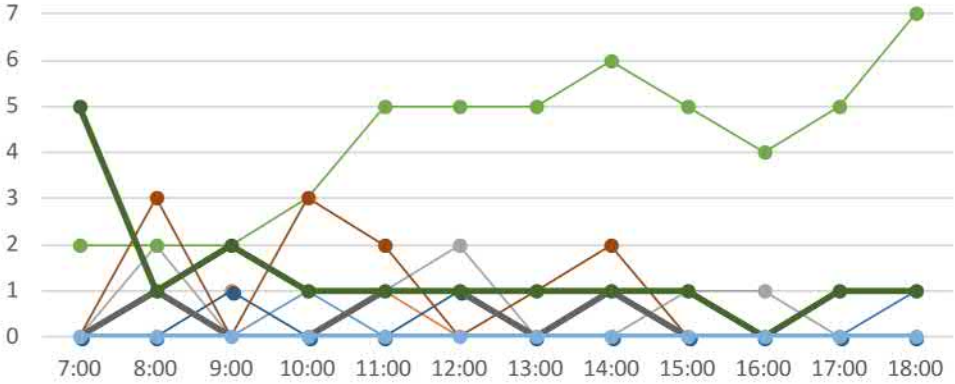
Median Parking (by block)



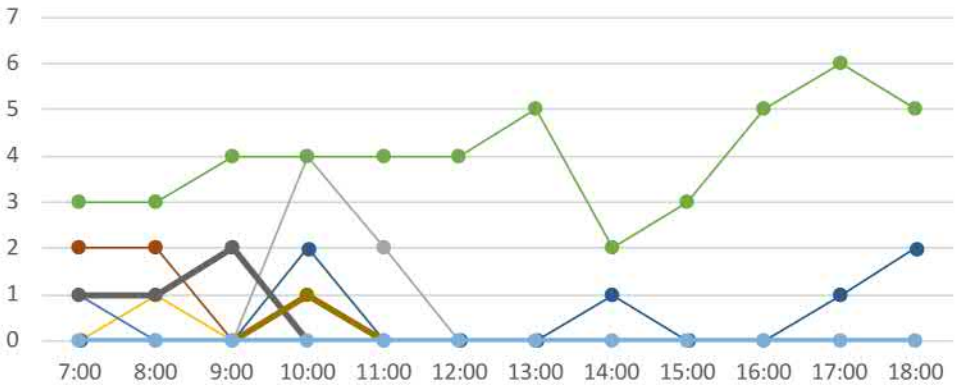
Wednesday
05/01/2019



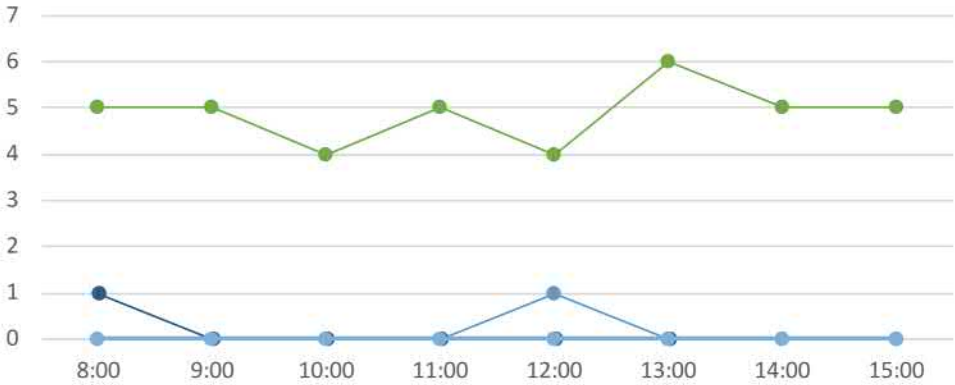
Thursday
05/02/2019



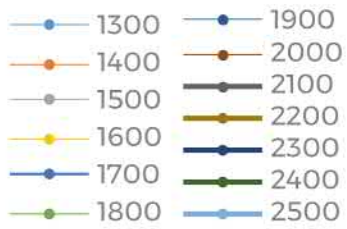
Saturday
05/04/2019



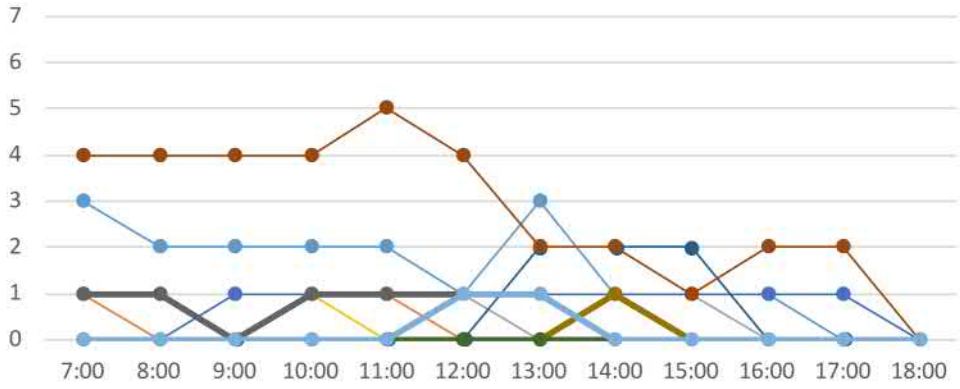
Sunday
05/19/2019



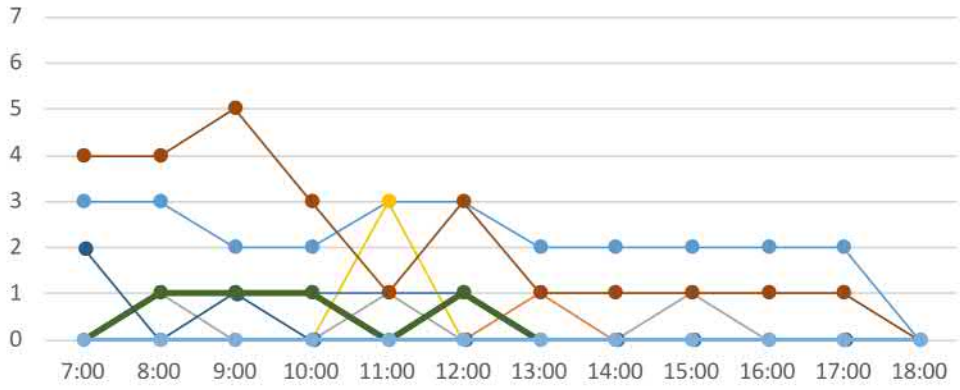
Sidewalk Parking (by block)



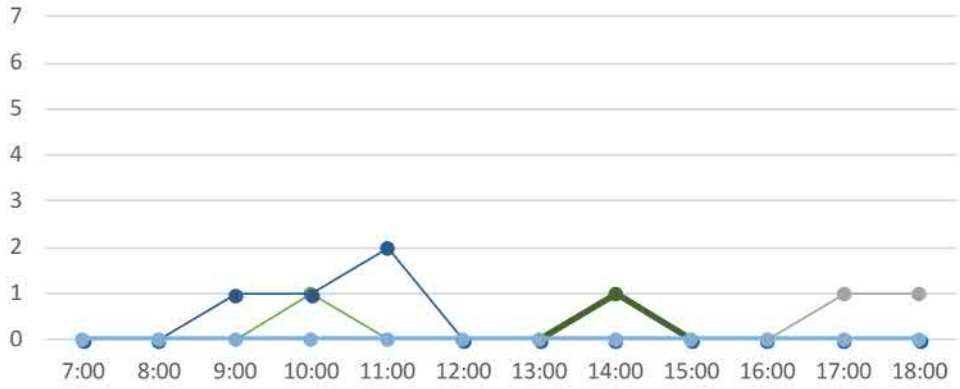
Wednesday
05/01/2019



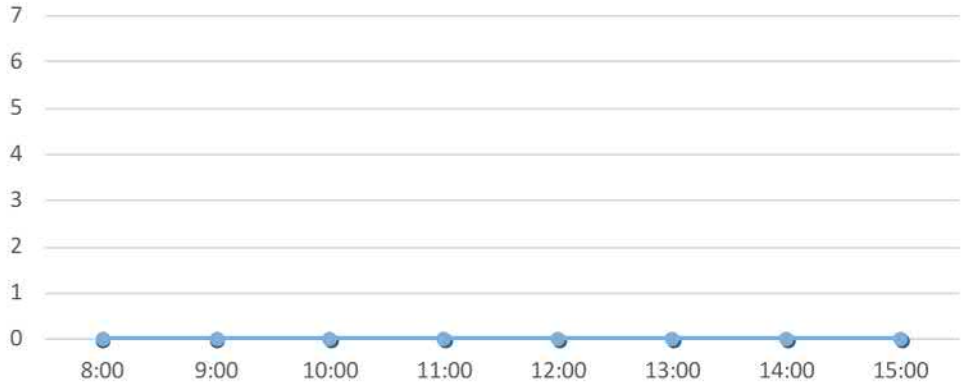
Thursday
05/02/2019



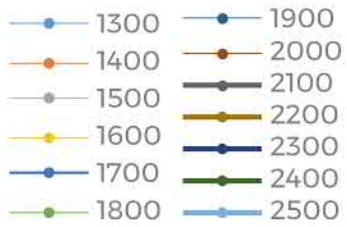
Saturday
05/04/2019



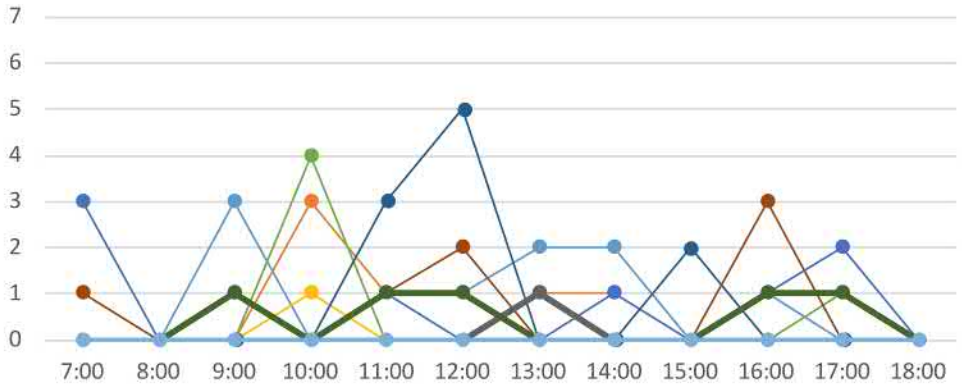
Sunday
05/19/2019



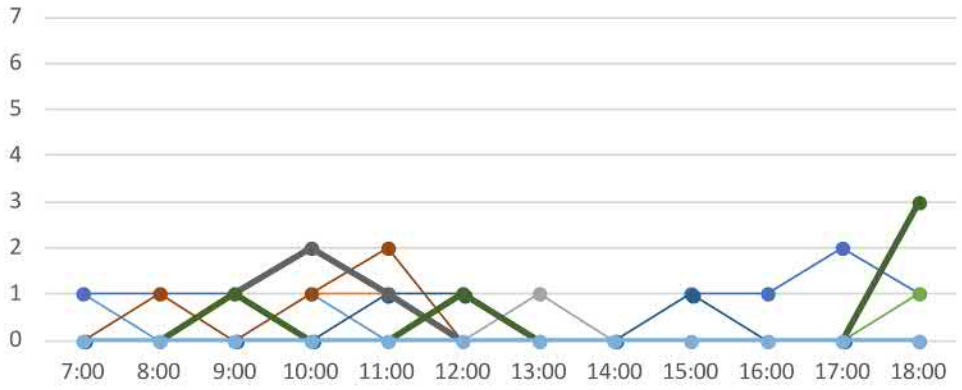
Double Parking (by block)



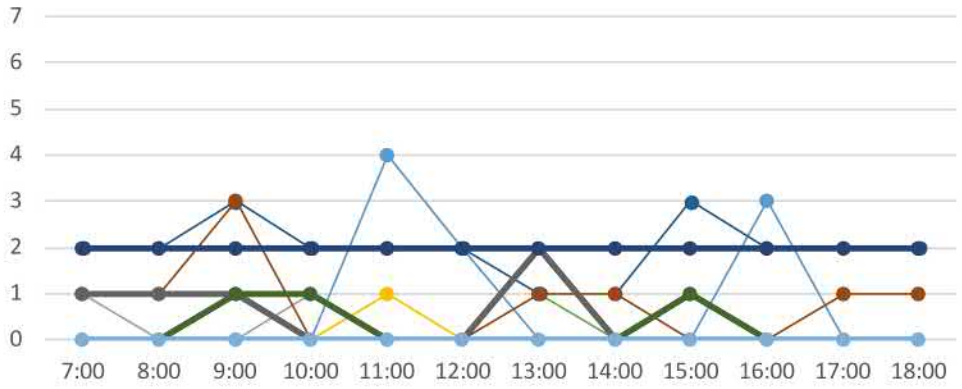
Wednesday
05/01/2019



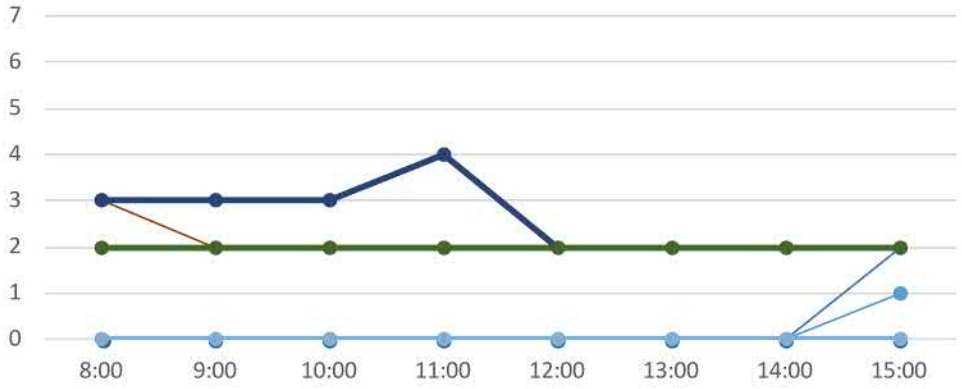
Thursday
05/02/2019



Saturday
05/04/2019



Sunday
05/19/2019



OTIS
Office of Transportation, Infrastructure, & Sustainability
CITY OF PHILADELPHIA

TA-2
Washington Avenue East Side Parking and Loading Study

Notes

Potentially personal vehicle identification data has been removed from some photographs in this document.

URBAN ENGINEERS
530 Walnut Street
Philadelphia, PA 19106
215.922.8080

MEMORANDUM

Date: January 5, 2017

To: Ema Yamamoto, EIT, AICP, City of Philadelphia

From: John Federico, PE, PP, AICP, Urban Engineers, Inc.

CC: Kelley Yemen, AICP, City of Philadelphia
Silvia Scheuermann, PE, Urban Engineers, Inc.
Erika Rush, PP, AICP, Urban Engineers, Inc.
Orla Pease, PE, PTOE, Urban Engineers, Inc.

Re: **Task 2 – Identify & Map Parking/Loading Behavior – Summary Memo**
Washington Avenue Parking Inventory & Loading Zone Operations Study

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Introduction

The purpose of the *Washington Avenue Parking Inventory and Loading Zone Operations Study* is to provide the City of Philadelphia Department of Streets with the information needed to make data-driven planning and engineering decisions for the Washington Avenue corridor east of Broad Street in South Philadelphia. This section of Washington Avenue has a diverse mix of commercial, industrial, and residential uses that create significant demand for on-street parking and loading/unloading operations.

This study consists of three tasks. This memo summarizes the results of ***Task 2 – Identify & Map Parking/Loading Behavior***. The purpose of this task was to (A) collect data related to on-street parking and loading along Washington Avenue between 5th Street and 13th Street and (B) analyze that data to determine operational characteristics including occupancy, turnover/duration, and instances of illegal parking behavior such as double-parking and median parking.

Observational Methodology

The Task 1 inventory of existing parking conditions identified approximately 226 parallel parking spaces along Washington Ave between 5th and Broad Streets, with an additional eight spaces dedicated to loading operations and two reserved (disabled) spaces. The on-street parking supply along both sides of Washington Avenue within the study limits is **regulated** by a limited number of *Reserved (Disabled) Parking* and *Loading Only* zones. The *Loading Only* zones extend from 8 AM to 7 PM and have a 30-minute time limit. Outside of these zones, the on-street parking supply is **unregulated** with no parking meters or time restrictions, which means someone can essentially park as long as they want. Since on-street parking spaces are not striped within the study area, the number of spaces along each block face was estimated based on the length of the block and the observed number of vehicles parking along the block. The number of **restricted (illegal)** spaces were also estimated.

Urban conducted site visits during the week of December 5th-12th to collect parking data along both sides of Washington Avenue between 5th Street and 13th Street. Prior to the site visits, Urban developed field sheets based on the Task 1 inventory of existing spaces. The data collection effort consisted of a 16-hour collection period (5:00 AM to 9:00 PM) on Wednesday, Thursday, and Saturday along with an 8-hour collection period (8:00 AM to 4:00 PM) on Sunday. These periods were selected in consultation with the City to cover the highest periods of activity in

the corridor. The specific times and dates were also selected to avoid any non-representative periods (i.e. schools not in session, traffic lane closures, inclement weather, etc.). **Table 1** summarizes the data collection schedule:

Table 1 – Data Collection Schedule

Day & Date	Start Time	End Time	Duration	Weather
Wednesday, 12/7/16	5:00 AM	9:00 PM	16 hrs	Cloudy/Light Rain, 40 - 48 deg.
Thursday, 12/8/16	5:00 AM	9:00 PM	16 hrs	Partly Cloudy, 37 – 44 deg.
Saturday, 12/10/16	5:00 AM	9:00 PM	16 hrs	Clear, 30 – 36 deg.
Sunday, 12/11/16	8:00 AM	4:00 PM	8 hrs	Overcast, 30 deg.

The parking data collection methodology consisted of conducting walking loops of the corridor every hour to record vehicle license plates for both regulated and unregulated on-street parking spaces and tally instances of illegal parking behaviors such as double-parking, median parking, or parking in restricted locations. License plate data was collected at regular intervals for use in calculating occupancy (i.e. number of spaces open) and turnover/duration.

Summary of Parking/Loading Operational Characteristics

The collected parking data was input into a spreadsheet format and analyzed to determine operational characteristics including occupancy, duration/turnover, and instances of illegal behavior. This data was also attached to the GIS shapefile created for Task 1, and areas of illegal behavior were added to the dataset to create a new shapefile (the GIS and spreadsheets will be provided to the City separate from this memo). Key results from the parking analysis are summarized in this section, while detailed tables and graphs are included as attachments.

OCCUPANCY

Occupancy is calculated by dividing the number of occupied spaces by the number of total spaces at each hourly interval. Average occupancy rates were summarized for each parking area and block face by day of the week, and then aggregated to determine an average occupancy for the corridor. Only unregulated on-street parking spaces were included in the corridor occupancy calculations (regulated and restricted spaces were not).

Figure 1 shows the average occupancy across the corridor for each of the collection days (Tuesday, Wednesday, Saturday, and Sunday). Average occupancies were very high across the corridor and exceeded 90% on each day. On the two weekdays, occupancy was lowest (near or at 90%) during the beginning (8:00 AM) and end (5:00 PM) of the workday and highest during the middle of the day. On Saturday and Sunday, the average occupancy and was highest in the morning hours and declined slightly through the day, but was above 95% for most of the day.

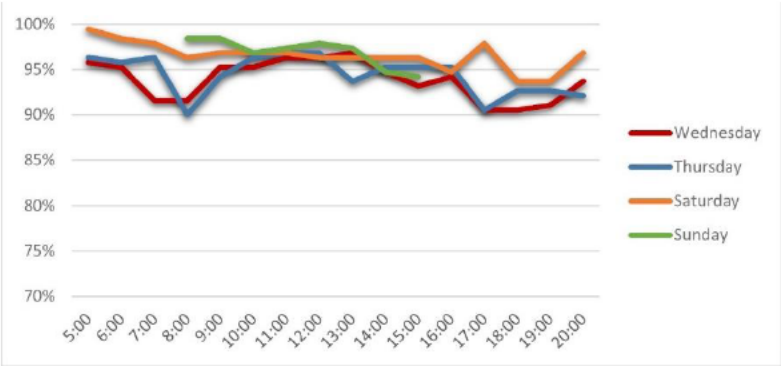


Figure 1 – Average Occupancy for Entire Corridor

Detailed occupancy calculations were also performed on a block-by-block basis for two sets of data: (1) the unregulated on-street parking supply, and (2) the entire on-street parking supply, including unregulated, regulated, and restricted spaces. Graphs showing occupancy by block are included as **Attachment #1**. Occupancy rates were somewhat lower for the blocks at each end of the corridor (500, 600, 1100, and 1200 blocks) – particularly during the 8:00 AM and 5:00 PM hours on weekdays and Saturday – and highest on the 900 and 1000 blocks.

DURATION & TURNOVER

Duration is the observed length of time (in hours) that a vehicle occupies a parking space. Average durations were summarized for each parking area and block face over the full collection period, and were also categorized by parking type – loading zone spaces, unregulated spaces, and restricted spaces. **Attachment #2** includes detailed tables showing average durations and turnover for the full collection period by both block and parking type.

Durations varied significantly in different areas and on different blocks. The average duration for loading zone spaces varied from 1.8 to 10.5 hours; however, this was based on a very small sample size - only four loading zone spaces are designated between 5th Street and 13th Street. For the unregulated on-street parking spaces, the average duration ranged from a low of 6.2 hours on the 800 block to a high of 11.6 hours on the 900 block. In contrast, the average duration for restricted spaces was under 3.5 hours on all blocks. The lower duration for restricted spaces is intuitive because these are not legal parking spaces. **Table 2** and **Figure 2** provide a summary of average durations by block.

Block	Spaces	Average Duration
500	34	6.3
600	38	9.0
700	28	6.4
800	33	5.6
900	38	9.0
1000	22	7.1
1100	29	7.2
1200	29	8.0
Corridor	**251**	**7.4**

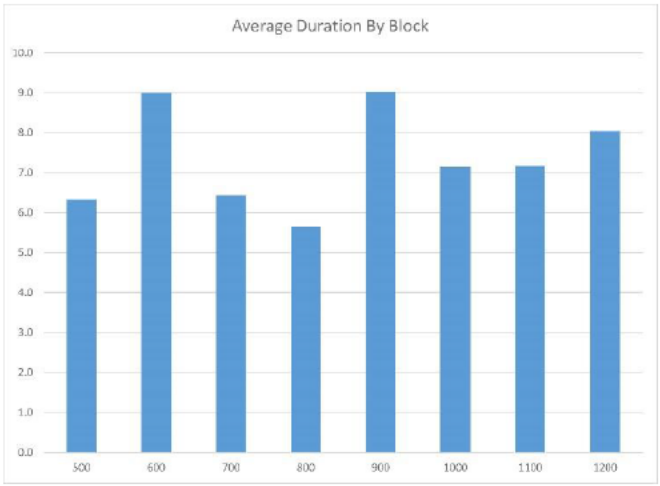


Table 2/Figure 2 – Average Duration by Block

Turnover is the number of different vehicles that occupy a given parking space over the collection period, and is the inverse of the duration. Similar to duration, the average turnover rates were summarized for each parking area and block face over the full collection period, and were also categorized by parking type. **Table 3** and **Figure 3** provide a summary of average durations by block. Overnight turnover was also evaluated for consecutive days in the data collection period (Wednesday/Thursday and Saturday/Sunday). The data shows that 74% of vehicles at 9:00 PM on Wednesday were in the same spot on Thursday morning at 5:00 AM. Likewise, 73% of vehicles at 9:00 PM on Saturday were in the same spot on Sunday morning at 8:00 AM.

Block	Spaces	Average Turnover
500	34	2.6
600	38	1.9
700	28	1.8
800	33	1.4
900	38	2.0
1000	22	2.0
1100	29	1.3
1200	29	1.3
Corridor	**251**	**1.8**

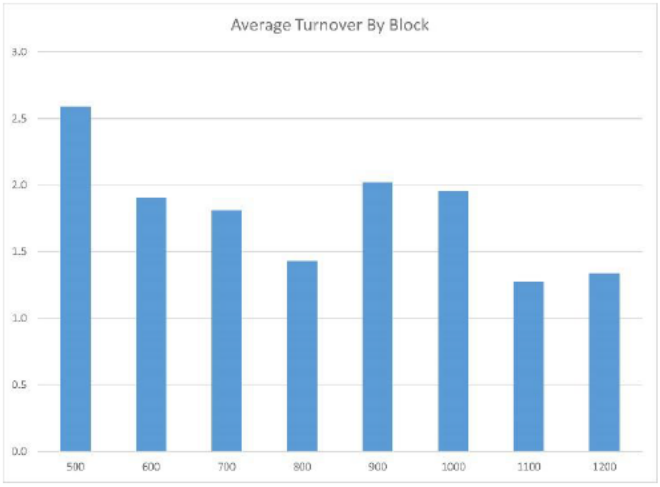


Table 3/Figure 3 – Average Turnover by Block

ILLEGAL PARKING BEHAVIOR

Four types of illegal parking were recorded during the parking data collection: (1) parking in the active lane (i.e. double parking), (2) parking in the center median (median parking), (3) parking in restricted areas such as driveways and fire hydrants, and (4) parking on the sidewalk. These behaviors are shown and quantified on a series of figures that are included as **Attachment #3.** The figures also include photos highlighting the most prominent locations where illegal parking/loading was observed. Illegal parking activity typically occurred at various locations along a block face; however, there were a few specific areas where double parking, median parking, and sidewalk parking occurred regularly. These include:

- Double parking for loading/unloading at Giordano's Produce and Anastasi Seafood (800 block)
- Double parking and median parking for access to Philly Soft Pretzel (800 block)
- Double parking at the bump-out in front of Golden Donuts (900 block)
- Head-in parking blocking sidewalk at Nigro's Auto (900 block) and CK Auto Image (700 block)
- Vehicles parked on sidewalk in front of Mid-City Tire & Auto (700 block)

The average duration for double and median parked vehicles was almost always under an hour, and often as short as 15 minutes or less. The same was true for vehicles parking in restricted areas. On the other hand, vehicles were typically parked on the sidewalk for most or all of the collection period.

Figures 4 shows the number of double parked vehicles by time of day for the entire collection period, with each block shown as a separate line, while **Figure 5** shows the same for median parked vehicles. For almost all blocks, the number of vehicles double parking and median parking was highest between the hours of 9:00 AM and 3:00 PM, and decreased significantly in the early morning and late afternoon/evening hours. Graphs showing illegal parking activity for each day are included as **Attachment #4.**

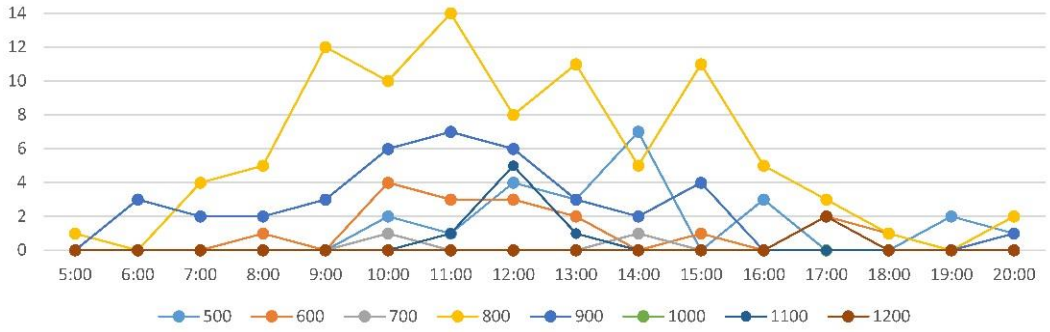


Figure 4 – Number of Double Parked Vehicles by Block (for all days)

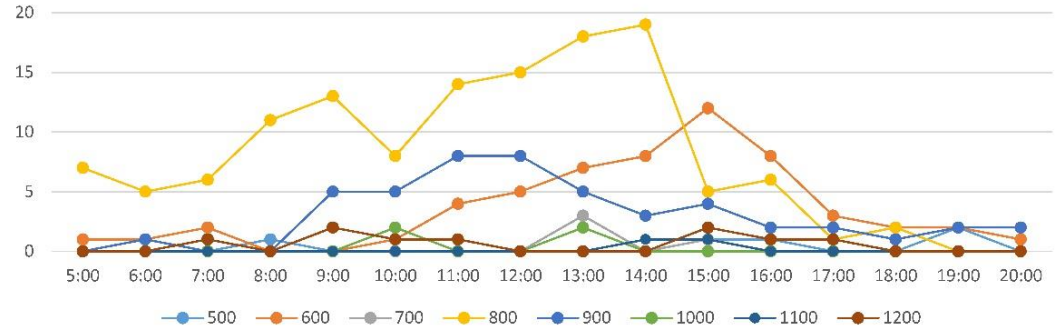


Figure 5 – Number of Median Parked Vehicles by Block (for all days)

SUMMARY

Analysis for this study shows that the on-street parking along the Washington Avenue is generally characterized by high occupancy rates with long average durations and very low turnover. Specific findings include:

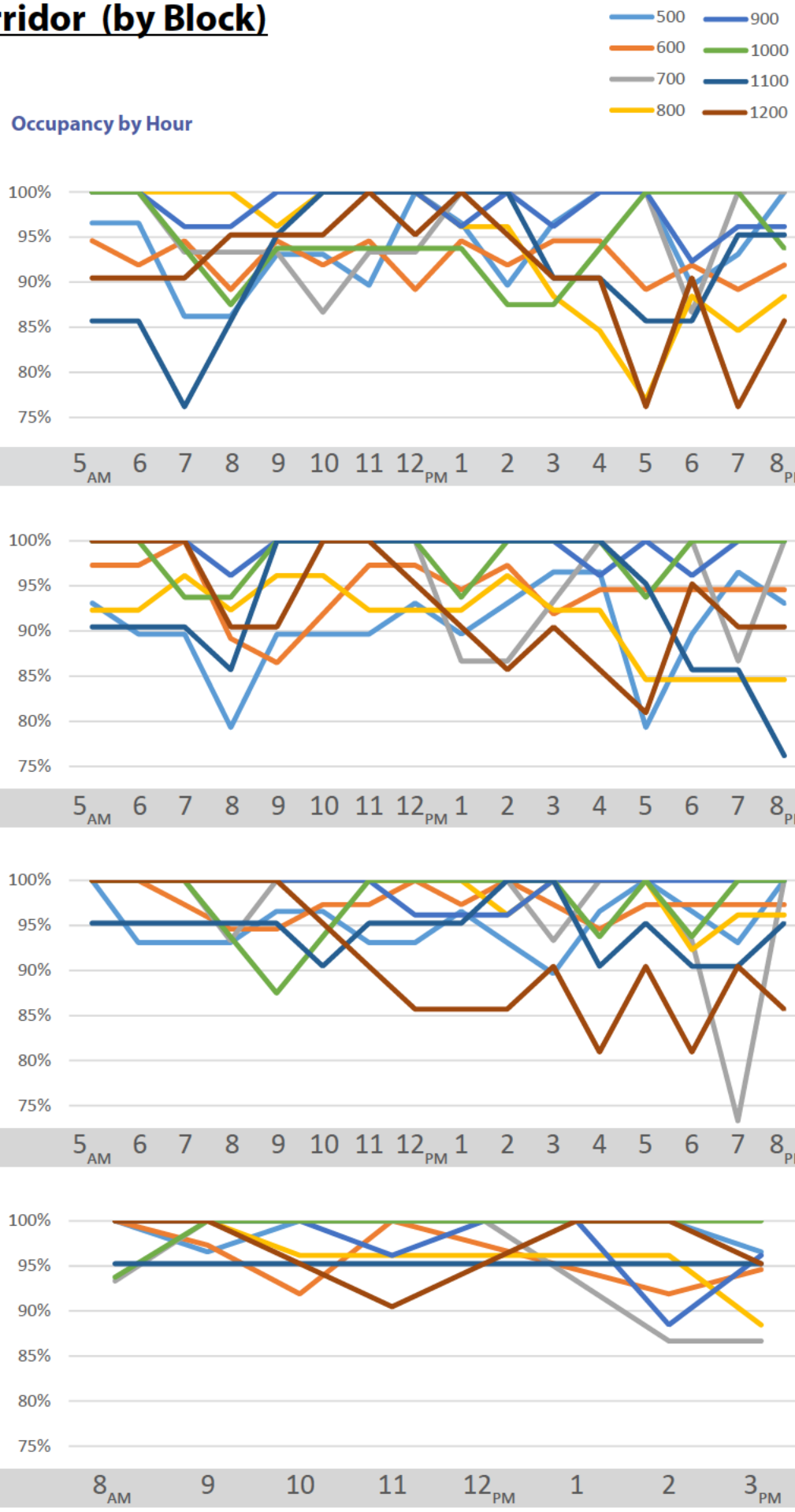
- **Average occupancy rates** exceeded 90% on each of the four collection days
- On **weekdays**, occupancy was lowest during the beginning (8:00 AM) and end (5:00 PM) of the workday and highest during the middle of the day
- On **weekends**, occupancy was highest in the morning hours and declined steadily through the day
- The average duration for **unregulated on-street parking spaces** ranged from a low of 6.2 hours on the 800 block to a high of 11.6 hours on the 900 block
- The average duration for **restricted spaces** (parking in front of driveways, fire hydrants, etc.) was under 3.5 hours for all blocks
- Many vehicles occupied unregulated spaces for the entire 16 hour collection period, which resulted in the long average durations with little turnover.
- The average duration for vehicles **double parking, median parking, or parking in restricted spaces** was almost always under an hour, and often as short as 15 minutes or less. The number of vehicles double parking and median parking was highest between the hours of 9:00 AM and 3:00 PM, and decreased significantly in the early morning and late afternoon/evening hours.
- Regarding **overnight parking**, the data shows that 74% of vehicles at 9:00 PM on Wednesday were in the same spot on Thursday morning at 5:00 AM. Likewise, 73% of vehicles at 9:00 PM on Saturday were in the same spot on Sunday morning at 8:00 AM.

ATTACHMENT #1

Occupancy Graphs

Entire Corridor (by Day)

Entire Corridor (by Block)



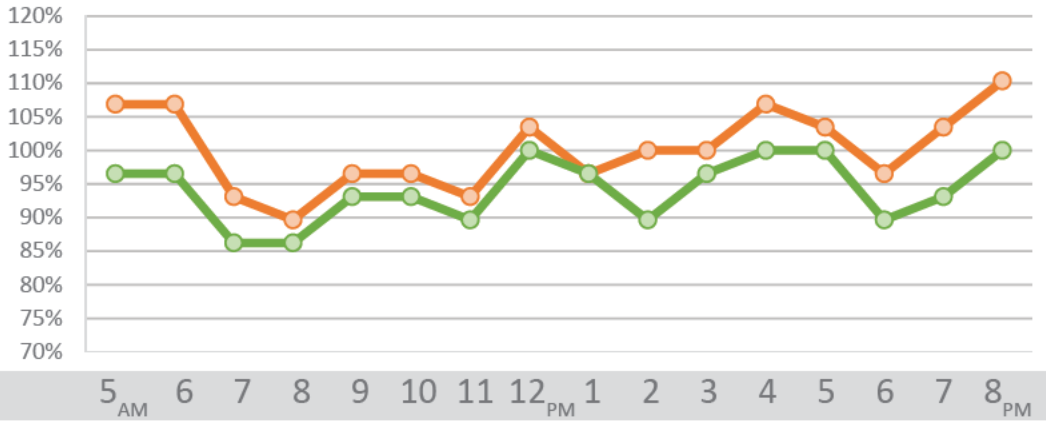
Block-by-Block (Wednesday, 12/7/16)

All Parking Unregulated Parking

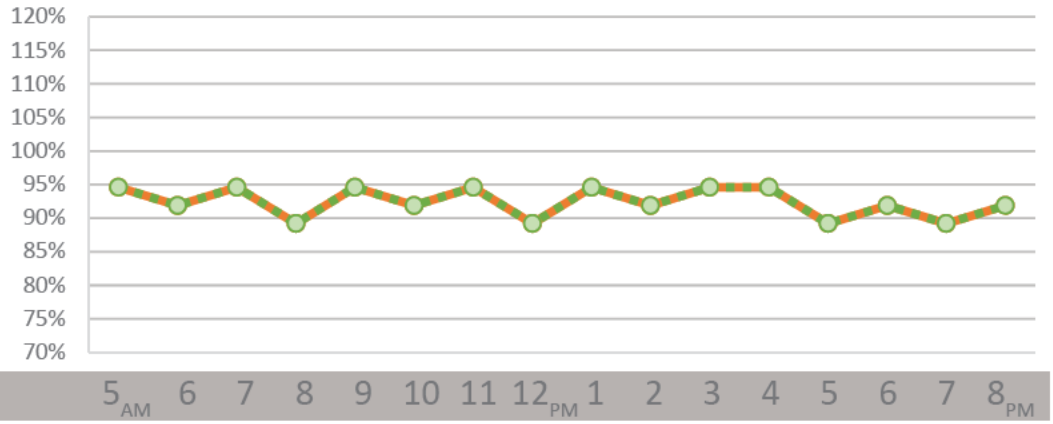
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

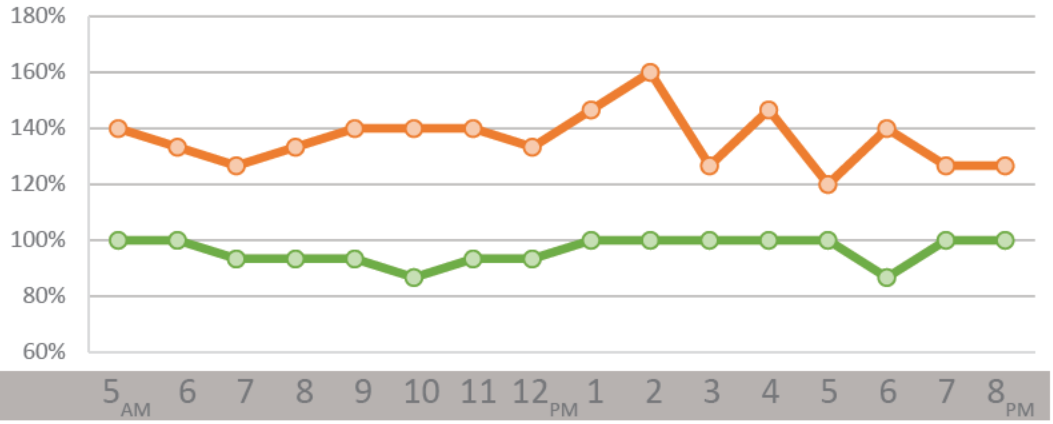
500 Block



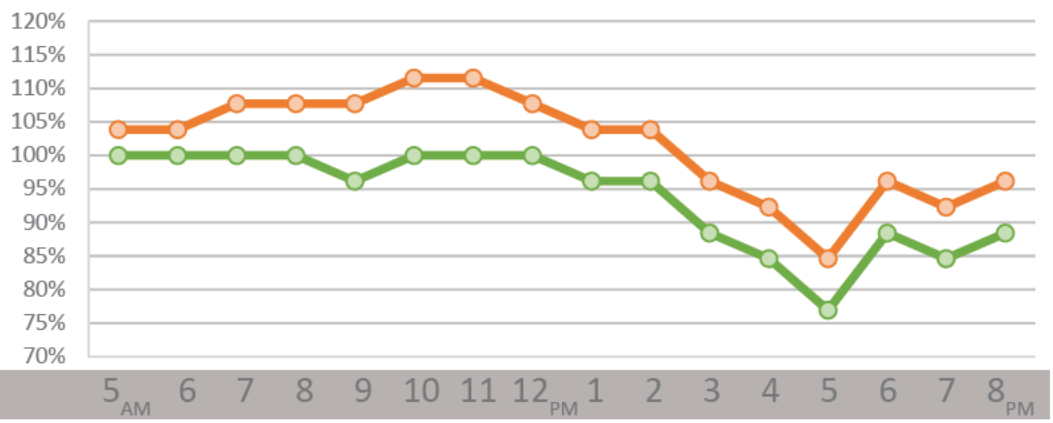
600 Block



700 Block



800 Block



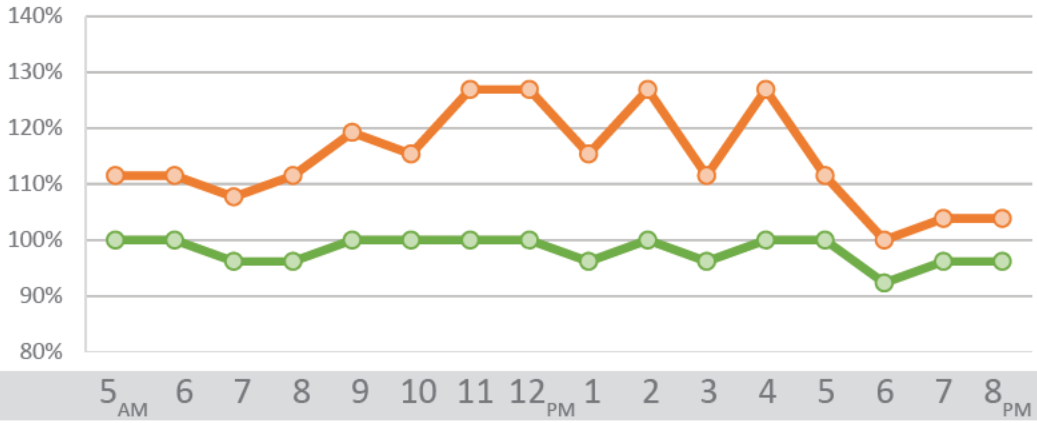
Block-by-Block (Wednesday, 12/7/16)

All Parking Unregulated Parking

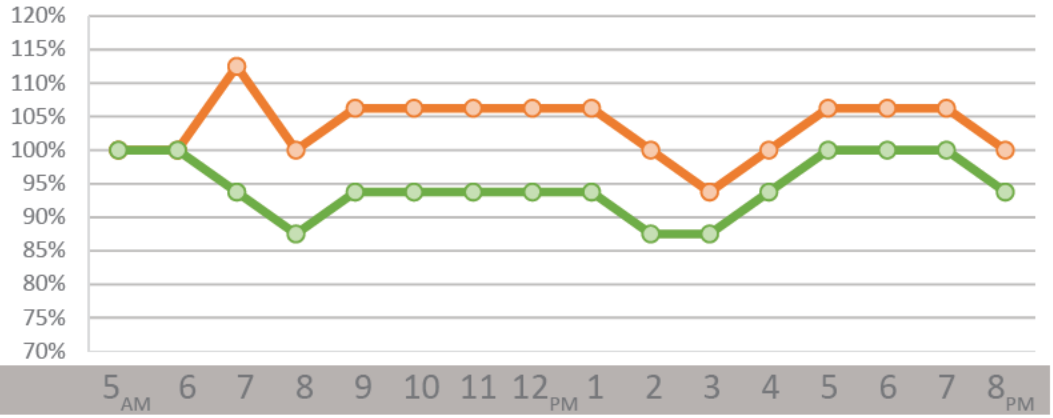
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

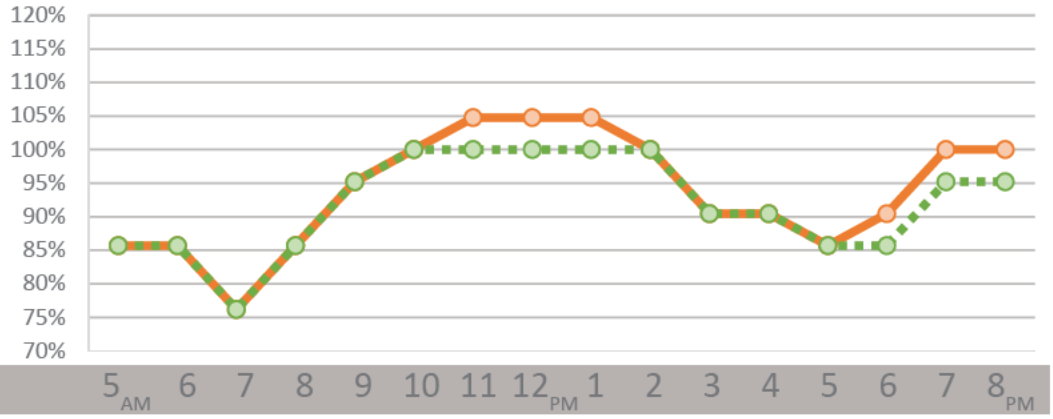
900 Block



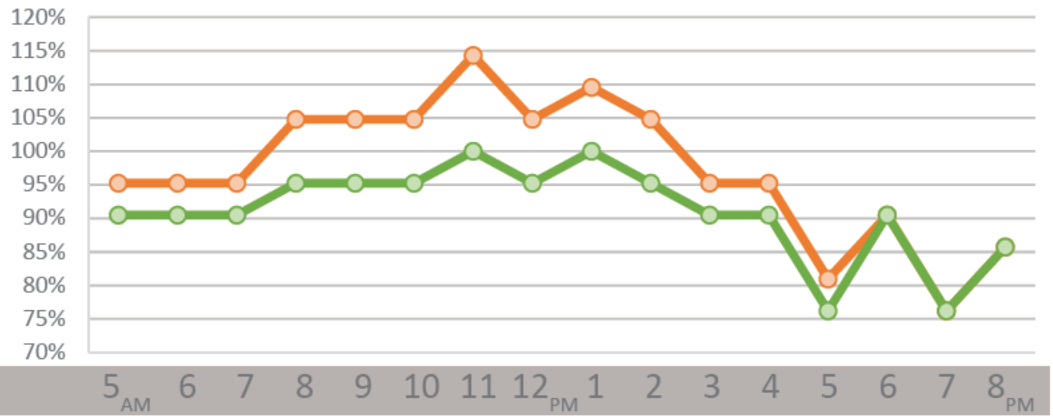
1000 Block



1100 Block



1200 Block



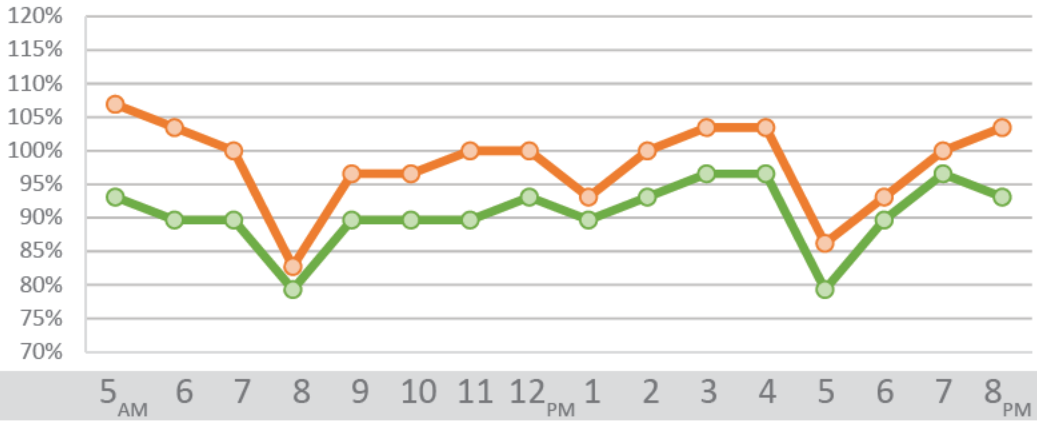
Block-by-Block (Thursday, 12/8/16)

All Parking Unregulated Parking

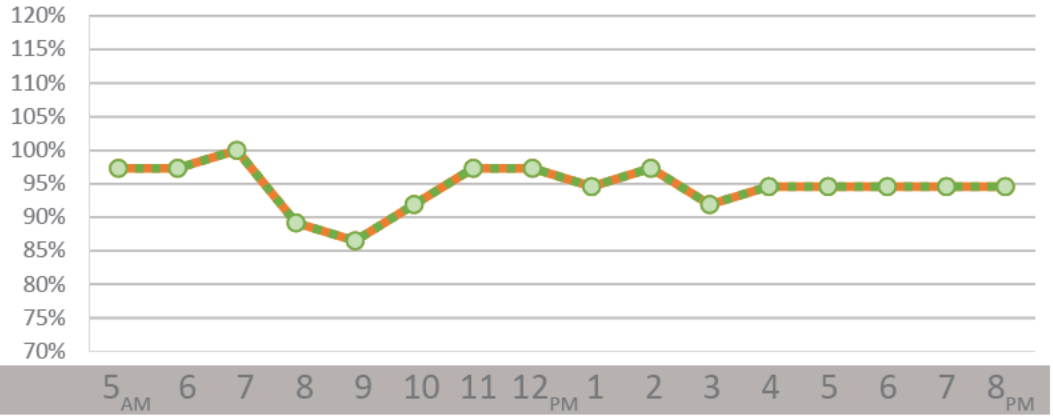
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

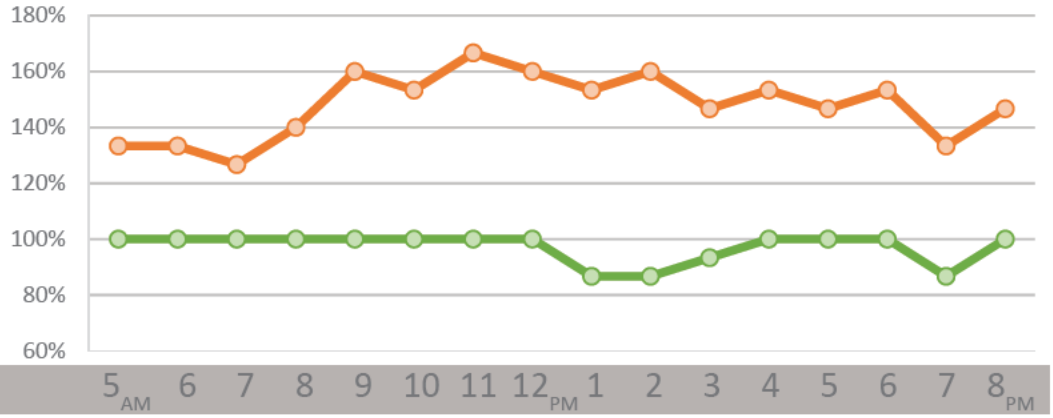
500 Block



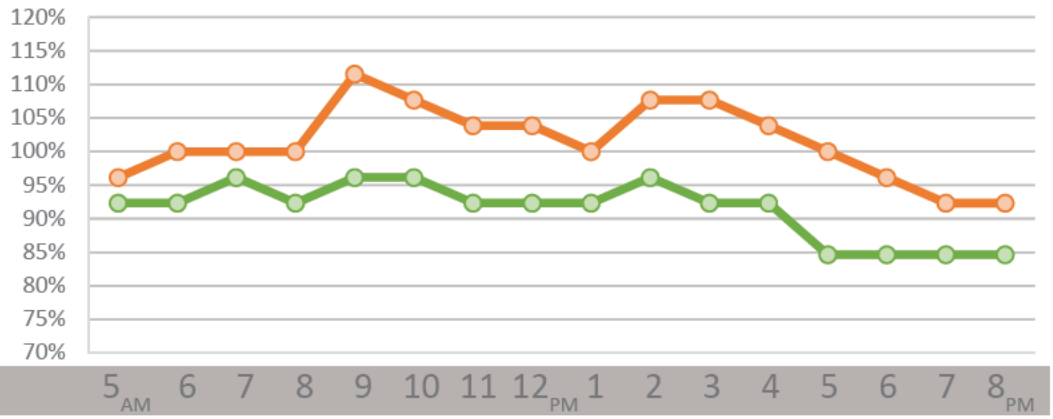
600 Block



700 Block



800 Block



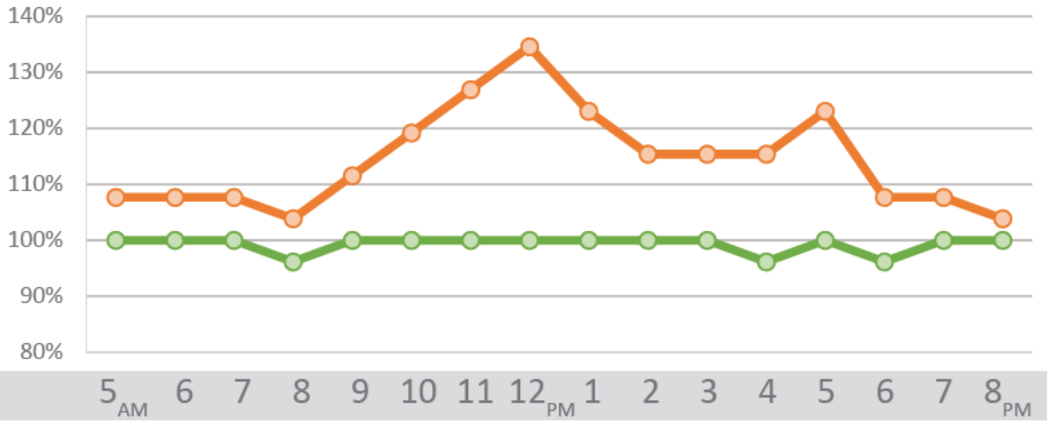
Block-by-Block (Thursday, 12/8/16)

All Parking Unregulated Parking

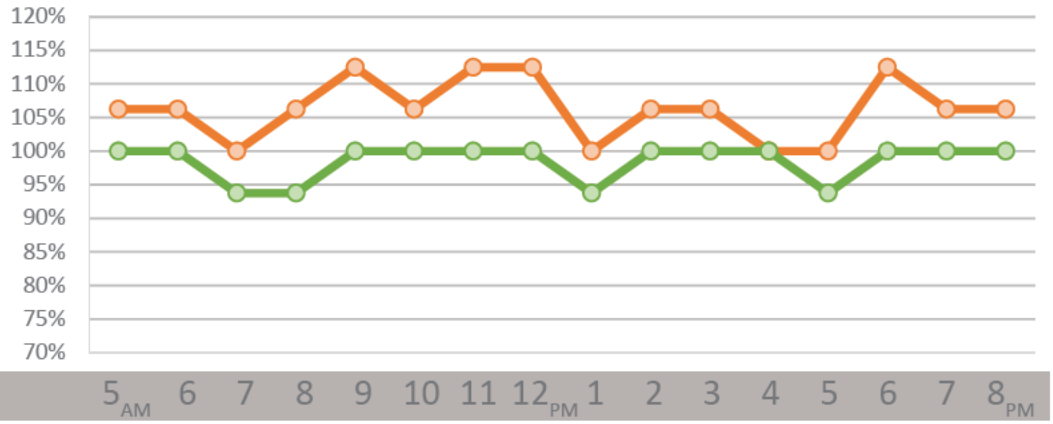
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

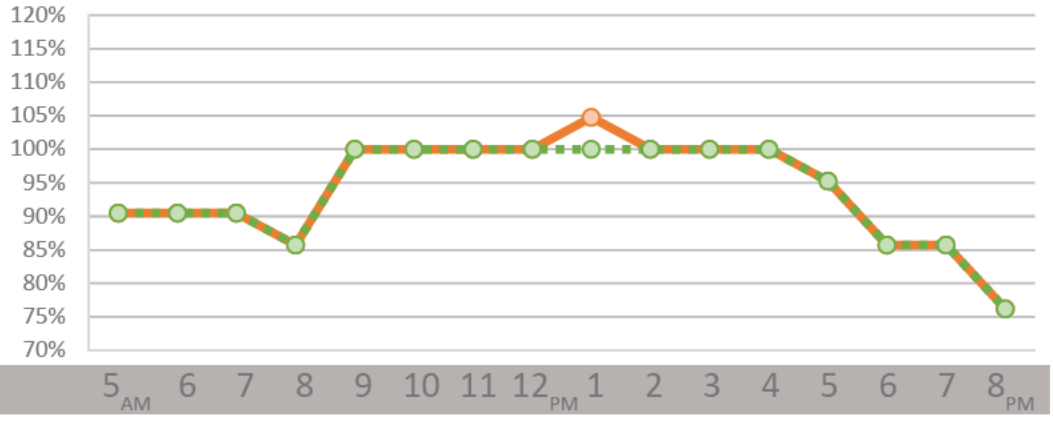
900 Block



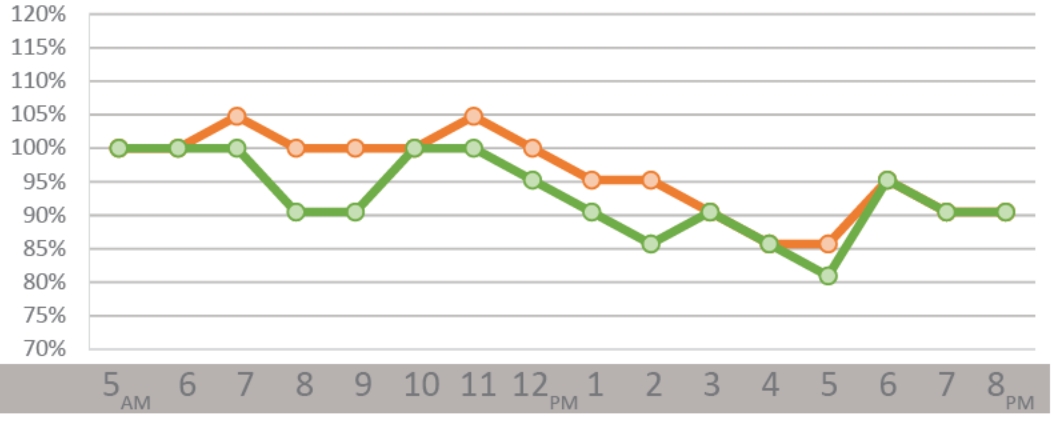
1000 Block



1100 Block



1200 Block



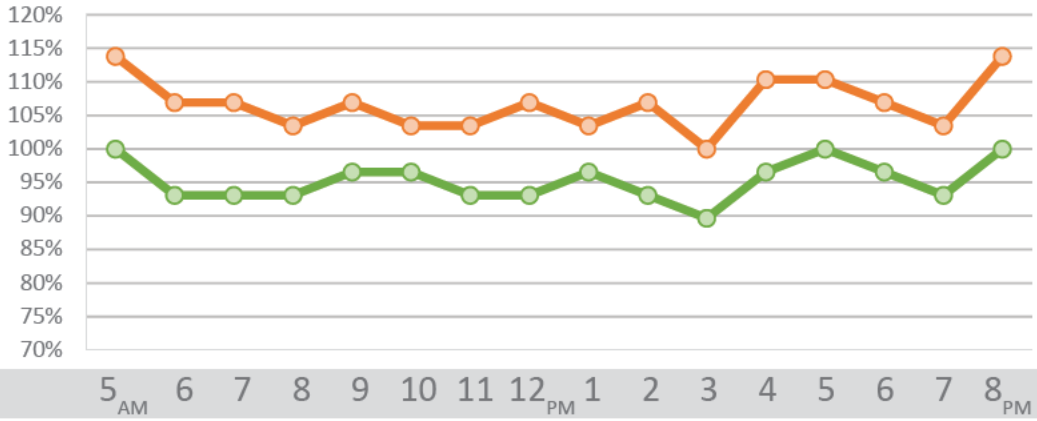
Block-by-Block (Saturday, 12/10/16)

All Parking Unregulated Parking

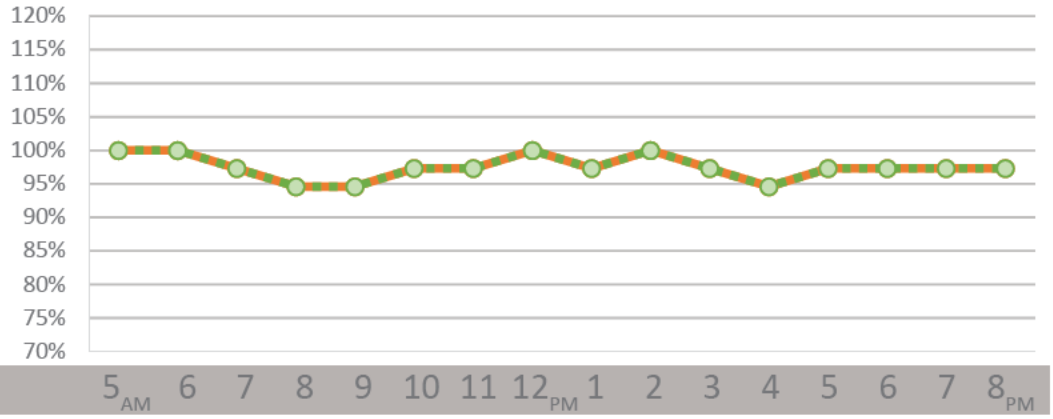
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

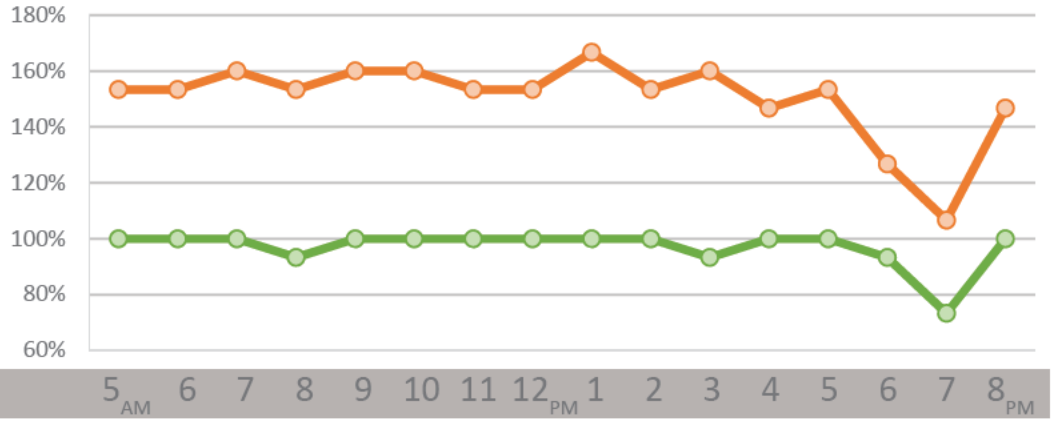
500 Block



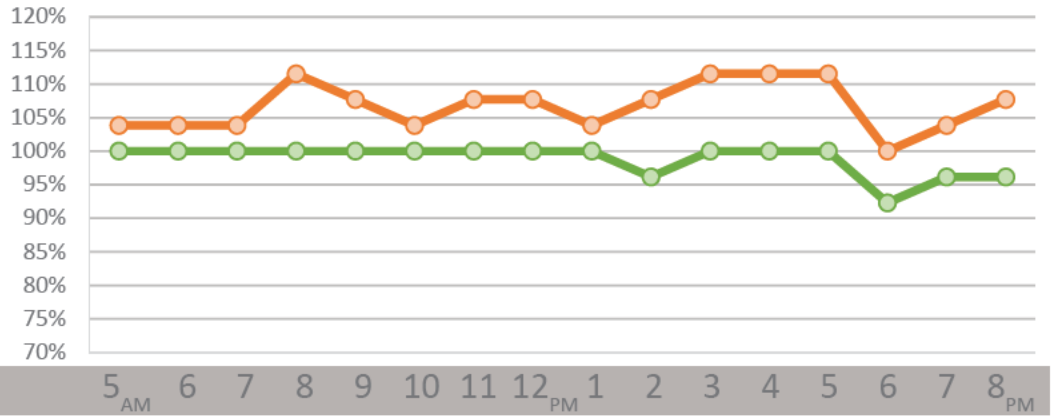
600 Block



700 Block



800 Block



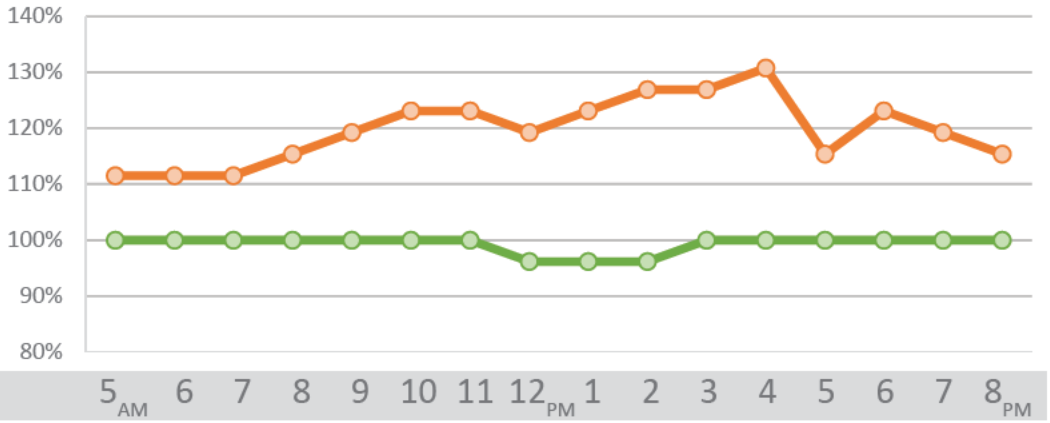
Block-by-Block (Saturday, 12/10/16)

All Parking Unregulated Parking

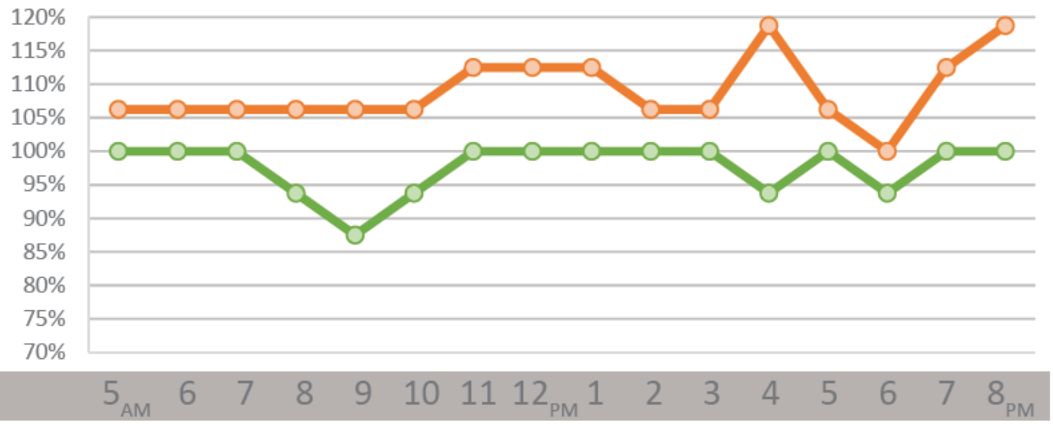
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

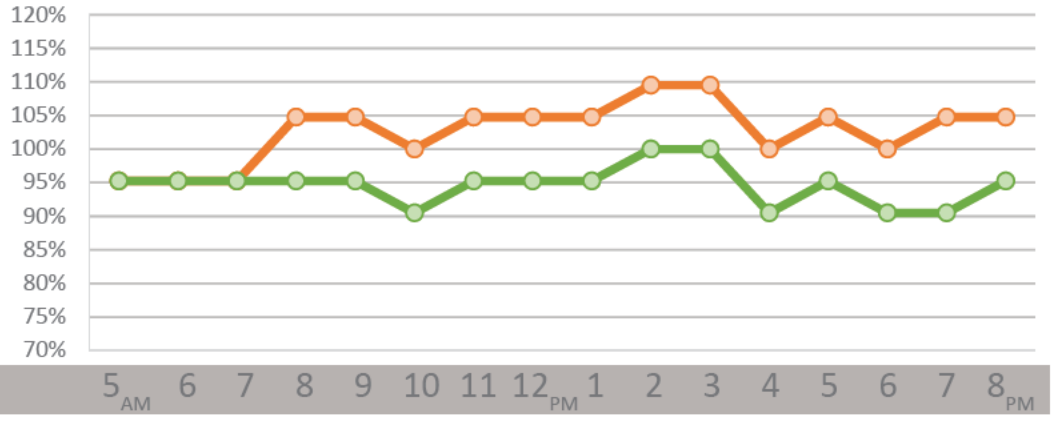
900 Block



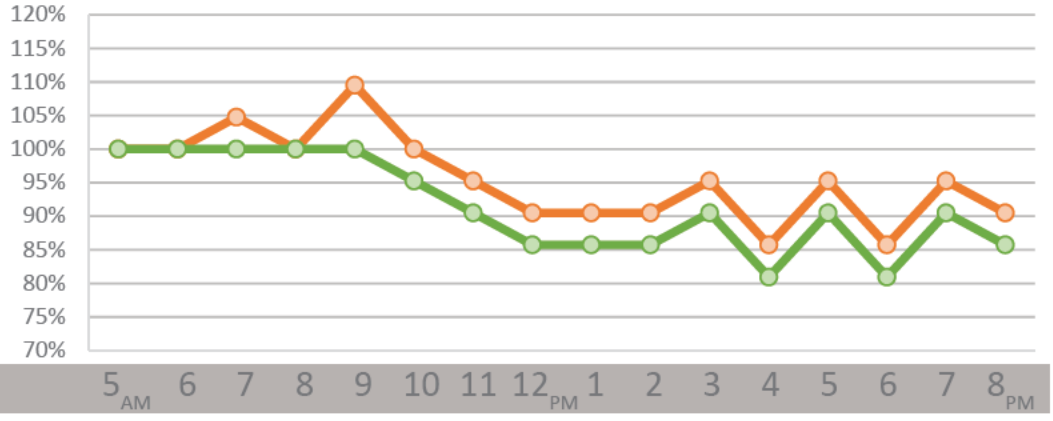
1000 Block



1100 Block



1200 Block



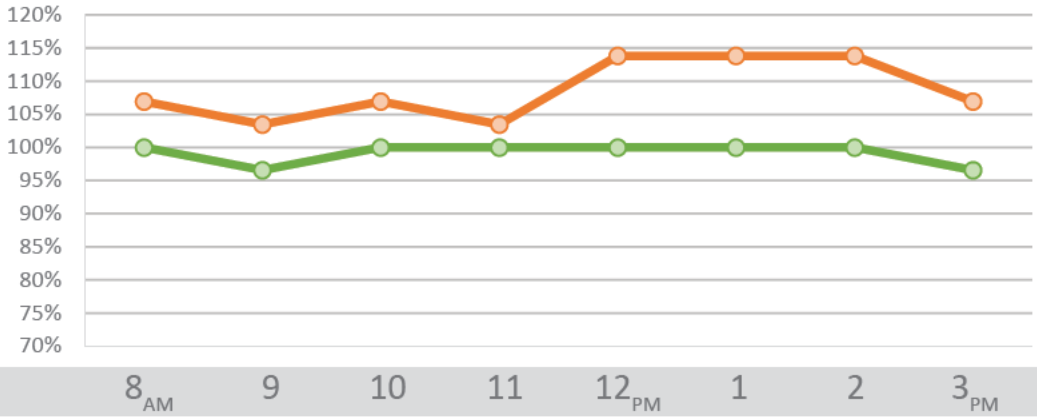
Block-by-Block (Sunday, 12/11/16)

All Parking Unregulated Parking

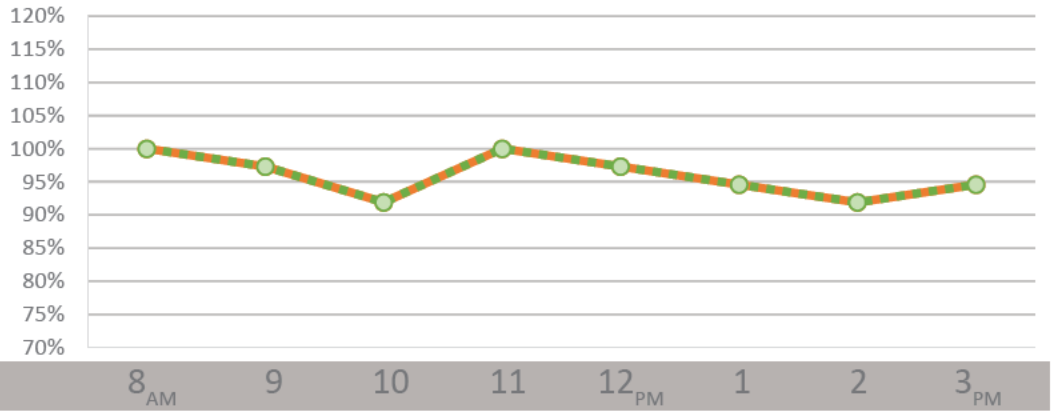
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

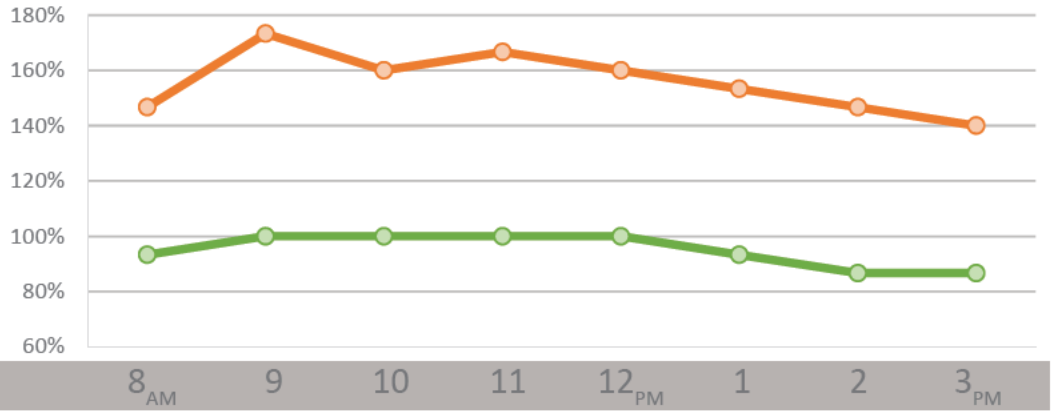
500 Block



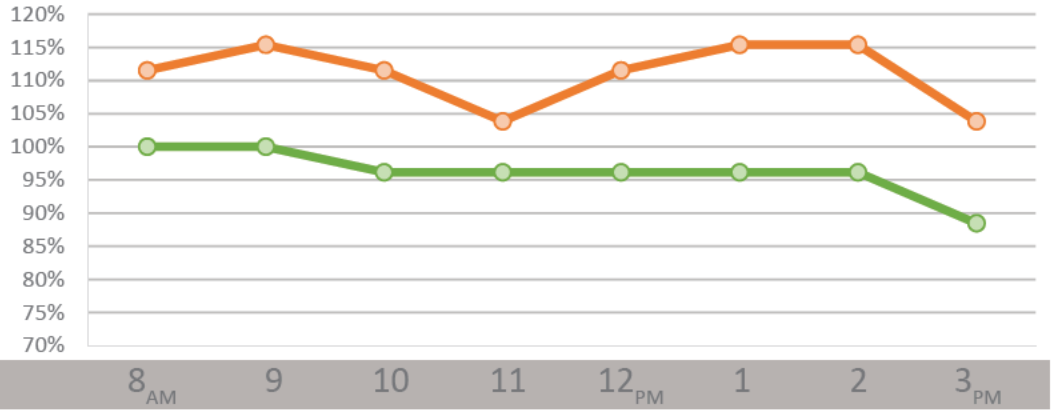
600 Block



700 Block



800 Block



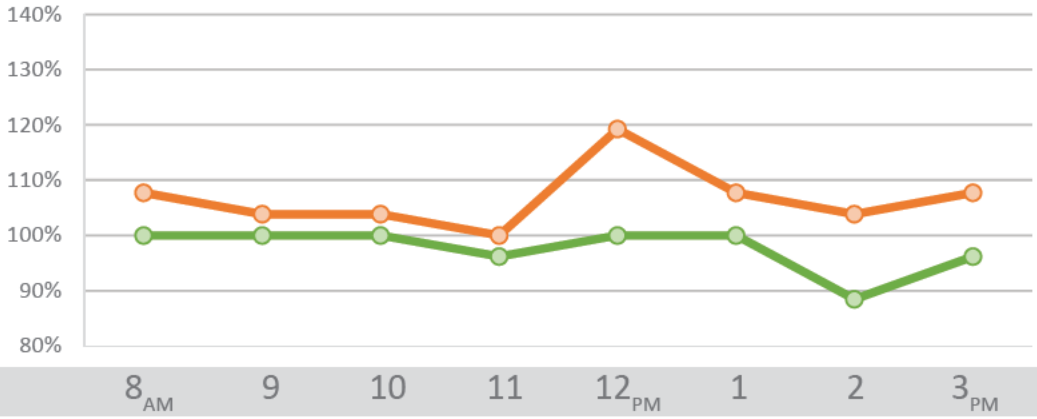
Block-by-Block (Sunday, 12/11/16)

All Parking Unregulated Parking

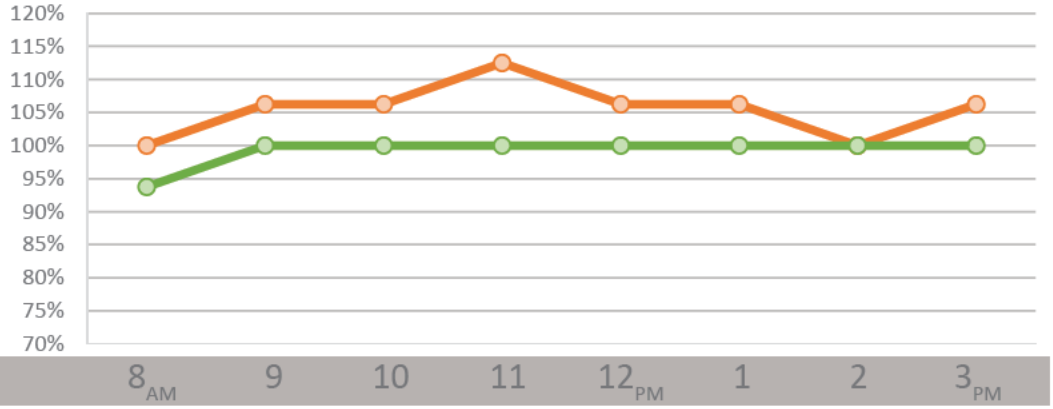
Please note that the scale for the y-axis varies due to large variations in the number of illegally parked vehicles

Occupancy by Hour

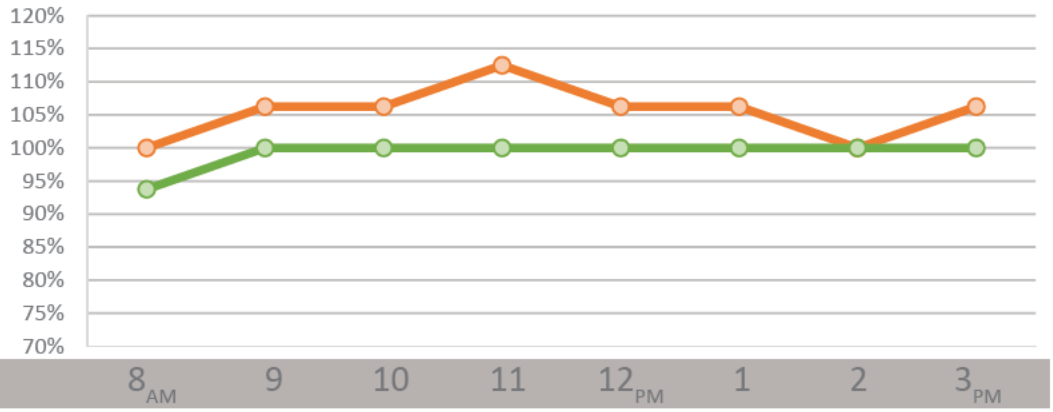
900 Block



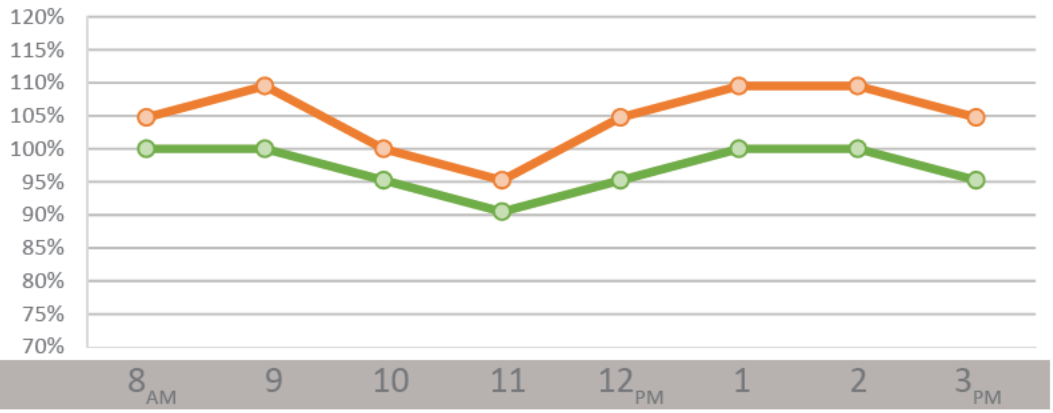
1000 Block



1100 Block



1200 Block



ATTACHMENT #2

Duration/Turnover Tables

Average Duration (Hours)
By Block and Parking Type

Block & Type	Spaces	Average Duration
500	**34**	**6.3**
Loading	2	1.8
Unregulated	29	7.2
Restricted	3	1.4
600	**38**	**9.0**
Unregulated	37	9.3
Restricted	1	0.0
700	**28**	**6.4**
Unregulated	15	9.1
Restricted	13	3.3
800	**33**	**5.6**
Unregulated	26	6.2
Restricted	7	3.4
900	**38**	**9.0**
Disabled	2	9.6
Unregulated	26	11.6
Restricted	10	2.4
1000	**22**	**7.1**
Loading	2	10.5
Unregulated	16	8.4
Restricted	4	0.5
1100	**29**	**7.2**
Unregulated	21	9.8
Restricted	8	0.2
1200	**29**	**8.0**
Unregulated	21	10.1
Restricted	8	2.6
Corridor	**251**	**7.4**

Average Turnover (# Vehicles)
By Block and Parking Type

Block & Type	Spaces	Average Turnover
500	**34**	**2.6**
Loading	2	4.3
Unregulated	29	2.5
Restricted	3	2.3
600	**38**	**1.9**
Unregulated	37	2.0
Restricted	1	0.0
700	**28**	**1.8**
Unregulated	15	1.6
Restricted	13	2.0
800	**33**	**1.4**
Unregulated	26	1.5
Restricted	7	1.2
900	**38**	**2.0**
Disabled	2	2.8
Unregulated	26	2.1
Restricted	10	1.6
1000	**22**	**2.0**
Loading	2	2.4
Unregulated	16	2.3
Restricted	4	0.4
1100	**29**	**1.3**
Unregulated	21	1.5
Restricted	8	0.7
1200	**29**	**1.3**
Unregulated	21	1.6
Restricted	8	0.6
Corridor	**251**	**1.8**

ATTACHMENT #3

Diagrams of Observed Activity

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

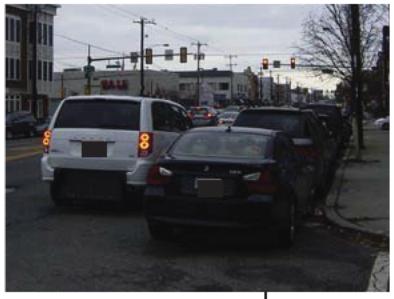
5th Street to 6th Street

Legend

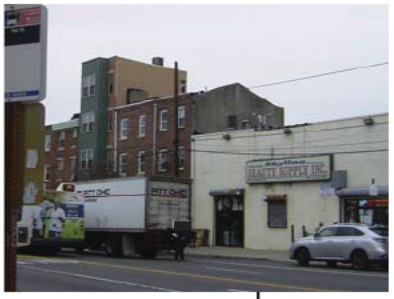
- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

URBAN ENGINEERS

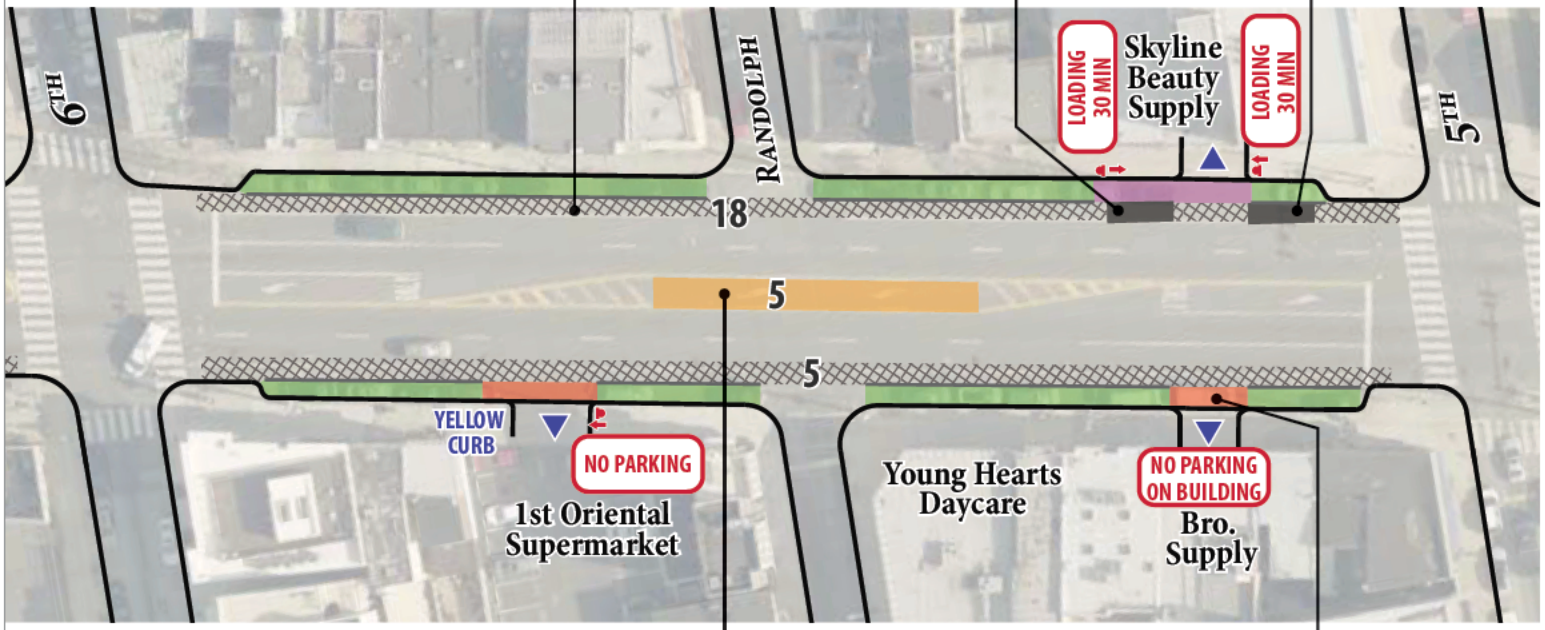
DRAFT – December 2016



Occasional double parking



Regular double parking



Occasional median use (loading/parking)

Parking in front of driveway to Bro. Supply

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

Washington Avenue
Parking and Loading Study

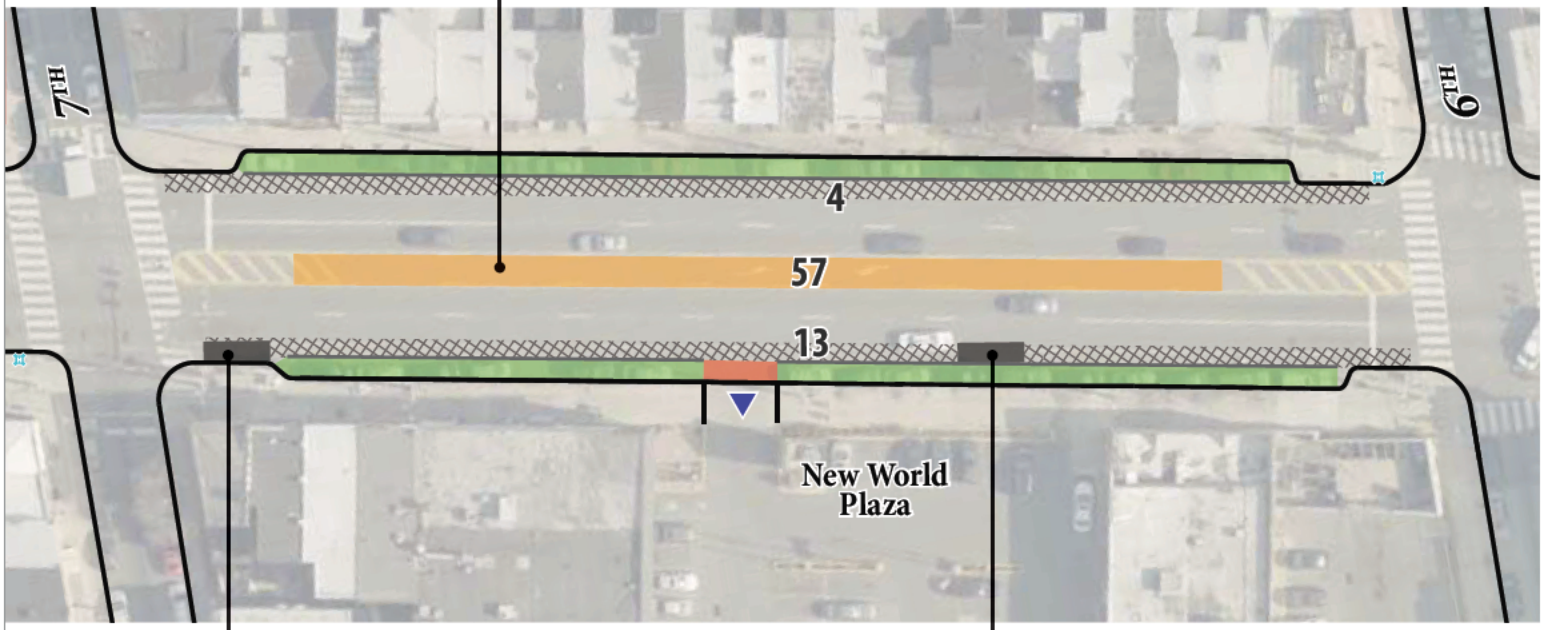
Diagram of Observed Activity

6th Street to 7th Street

Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

Regular median parking



Regular short-term parking in front of bump-out

Regular double parking/loading

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

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Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

7th Street to 8th Street

Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

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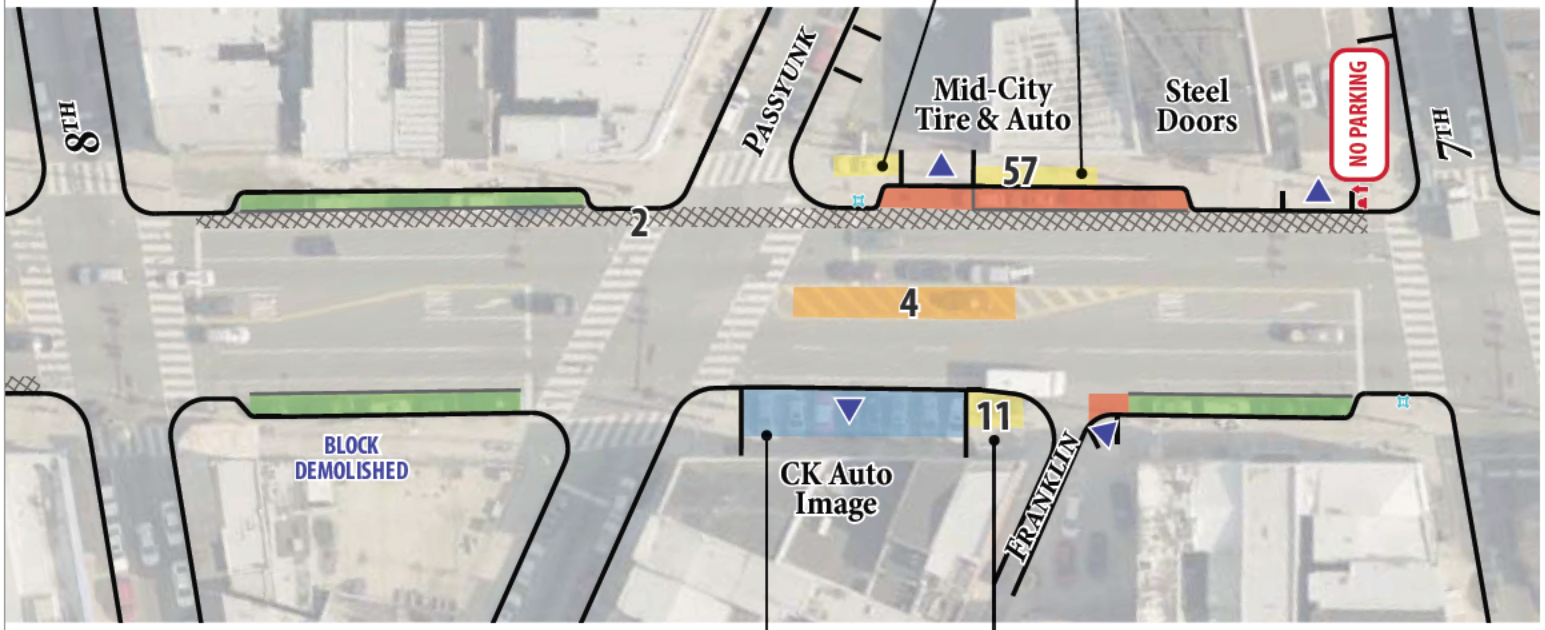
Regular parking on sidewalk (occurred during 43% of observed hours)



Head-in parking with frequent turnover

Occasional parking on sidewalk (occured during 20% of observed hours)

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

8th Street to 9th Street

Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

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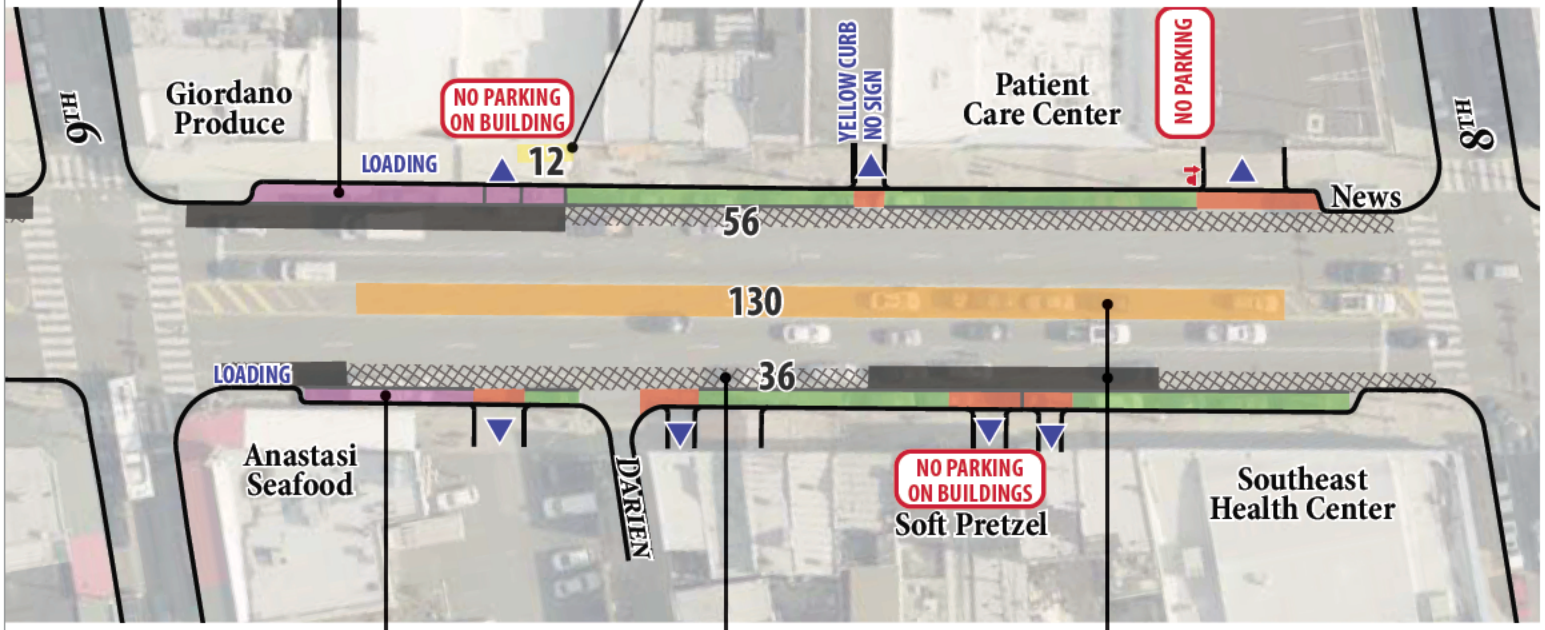
Parking in front of Giordano's used primarily for loading with regular double parking

Sidewalk parking (occurred during 21% of observed hours)



Parking in front of Anastasi's used for loading

Crates/pallets used to reserve spaces

Regular double (and median) parking in front of Soft Pretzel

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

9th Street to 10th Street

Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

URBAN ENGINEERS

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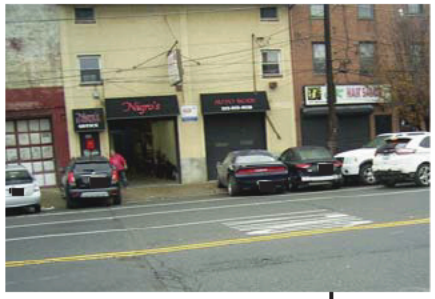
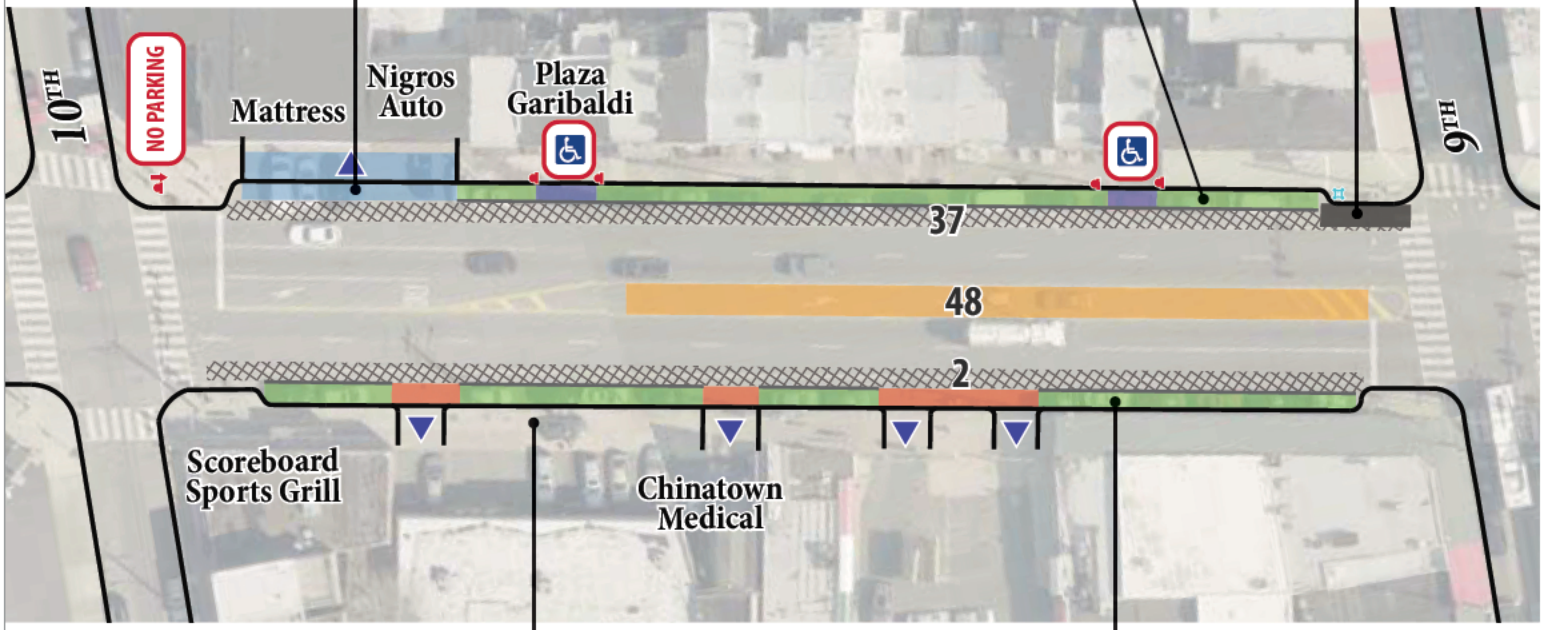
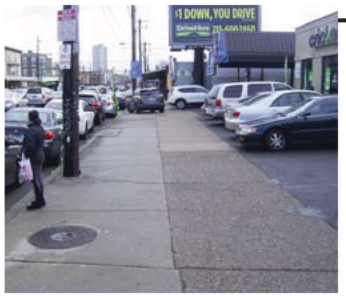
Head-in parking in front of Garage & Mattress Store

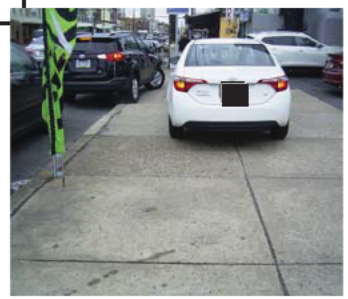


Cones used to reserve spaces

Regular parking in front of bump-out at Golden Donuts







Vehicles drive on sidewalk to access off-street spaces

Cones used to reserve spaces

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

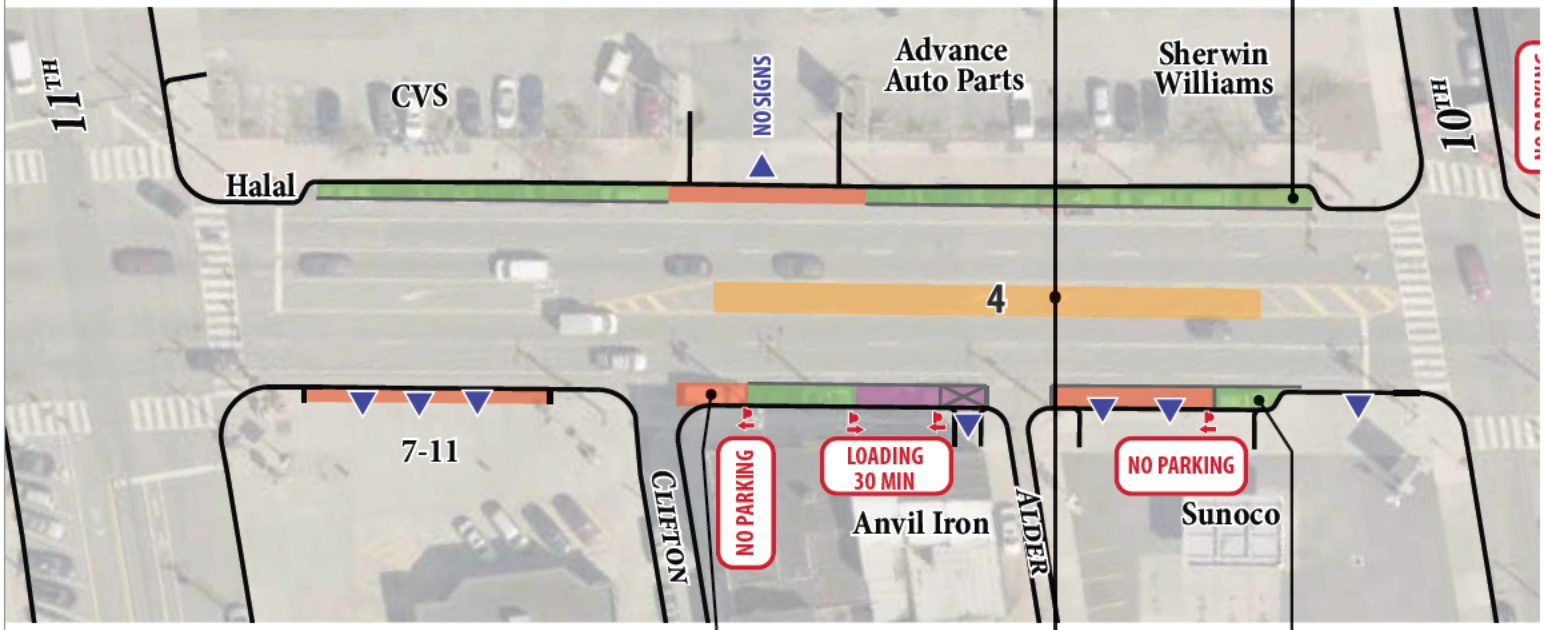
10th Street to 11th Street

Legend

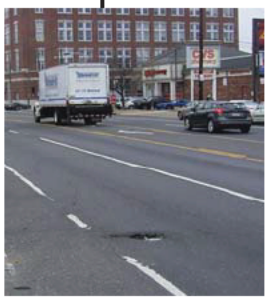
- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

Occasional median parking

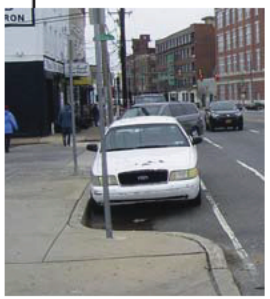
Food truck regularly uses corner space



Example of parking in no parking zone



Occasional median parking



Long-term parking in this space

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

DRAFT – December 2016

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

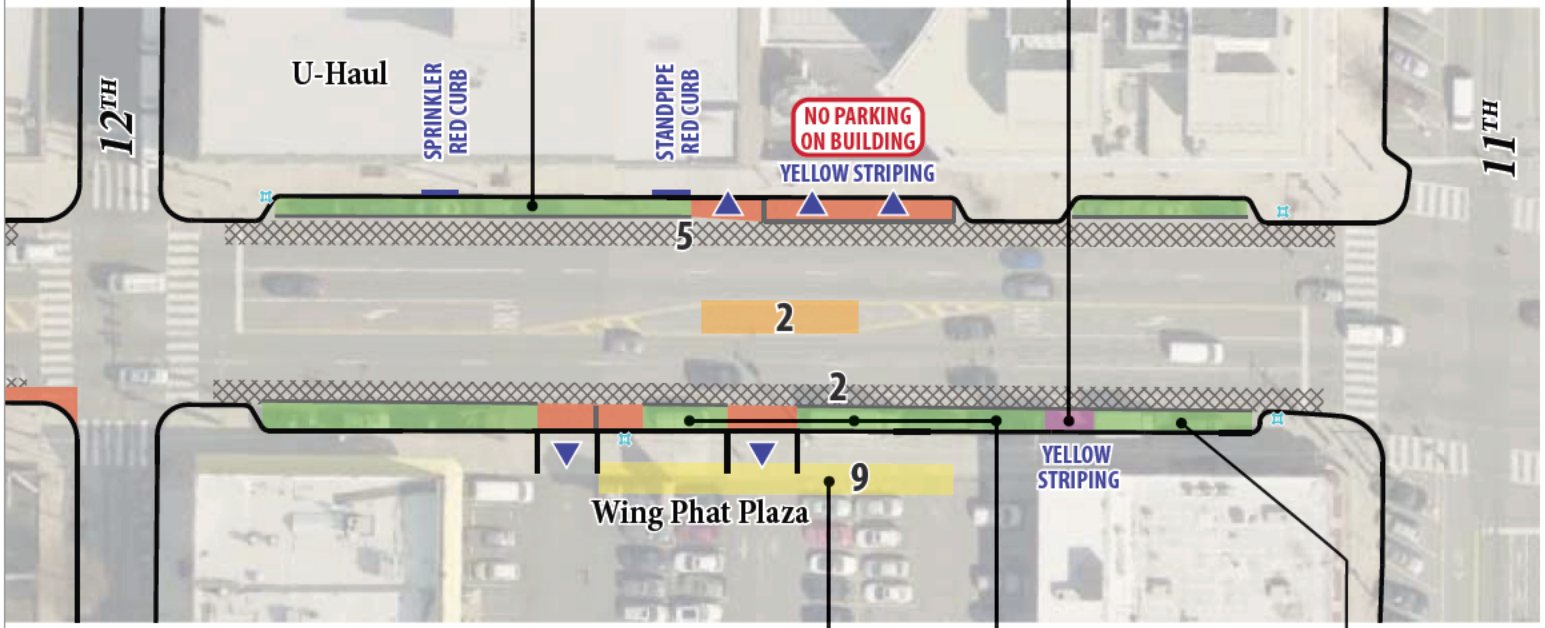
11th Street to 12th Street

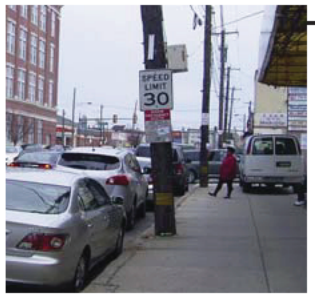
Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

Spaces are regularly used by U-Haul vehicles

Loading from striped area





Occasional parking on sidewalk on weekends (occurred during 16% of observed hours)

Long-term van and truck parking in these spaces

DRAFT – December 2016

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

Washington Avenue
Parking and Loading Study

Diagram of Observed Activity

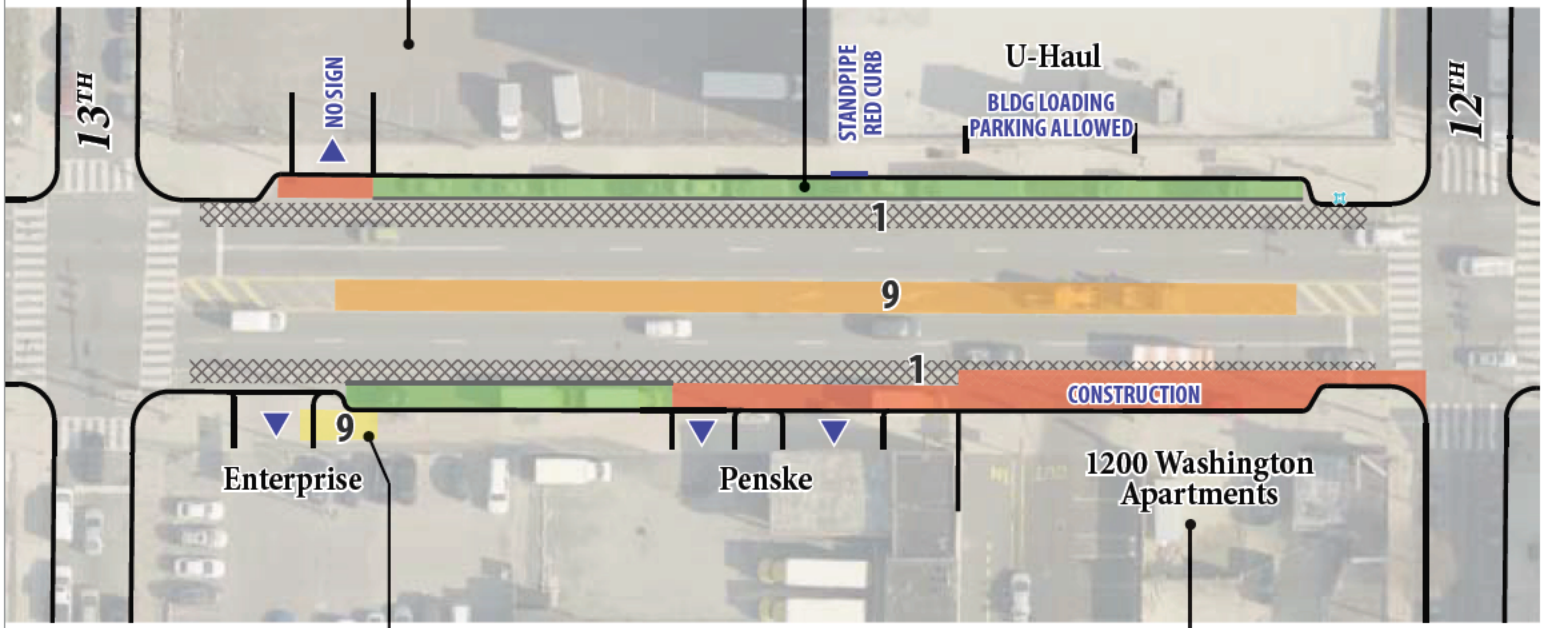
12th Street to 13th Street

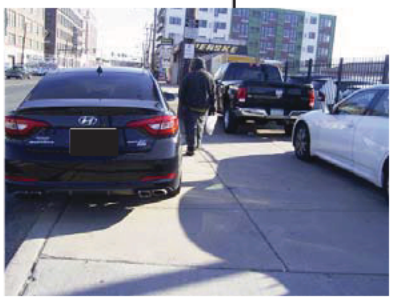
Legend

- Unregulated Parking
- Loading Zone
- Disabled Parking
- Restricted Parking
- Head-In Parking
- Median Parking *
- Double Parking: *Occasional* *
- Double Parking: *Regular*
- Sidewalk Parking *
- Driveway
- Hydrant
- Parking Sign

Off-street parking lot frequently underutilized

Spaces are regularly used by U-Haul vehicles





Occasional parking on sidewalk (occurred during 16% of observed hours)

Construction disrupts parking in this area

* ***Numbers*** *shown on diagrams represent the # of vehicles observed over the 56-hour collection period*

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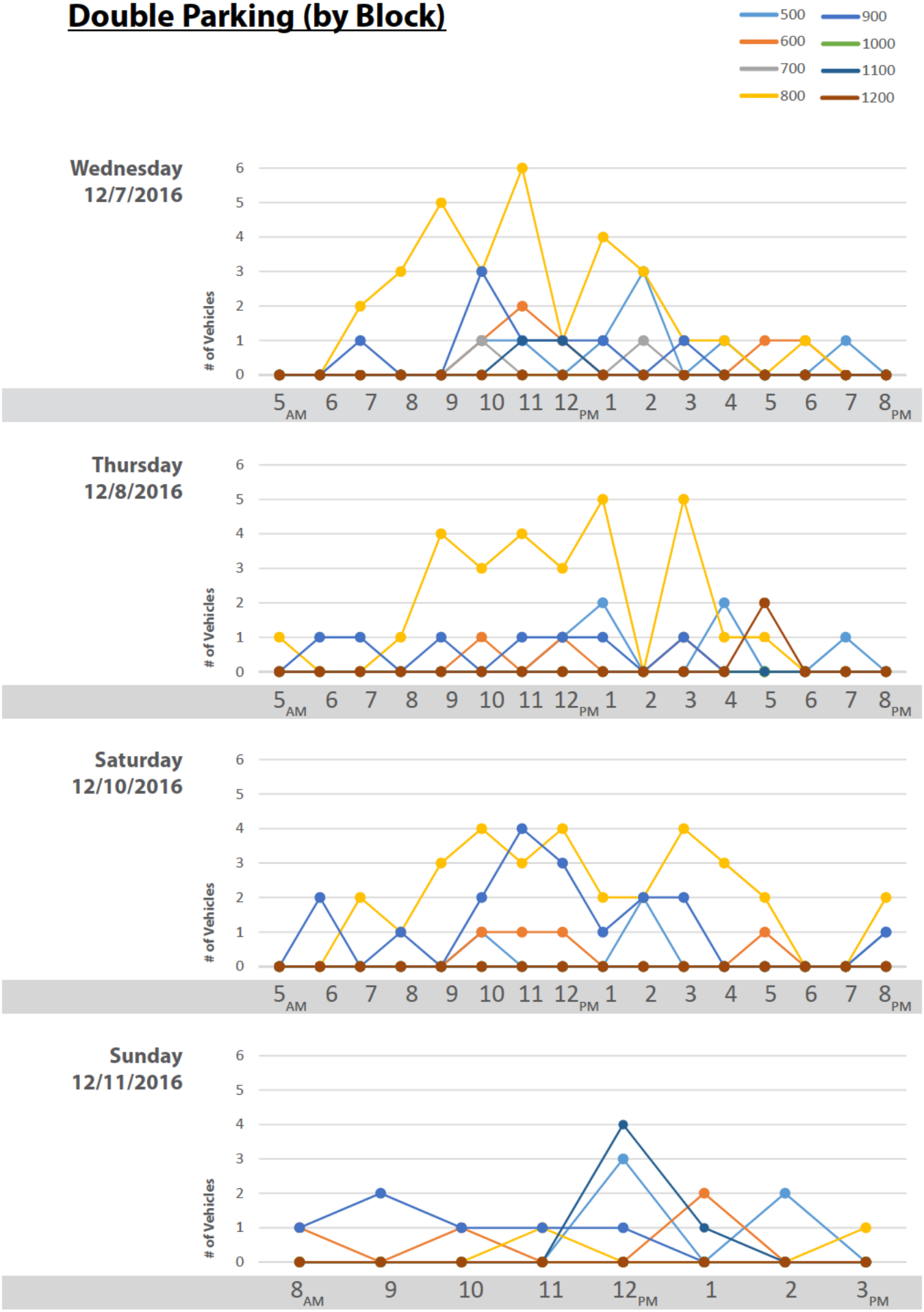
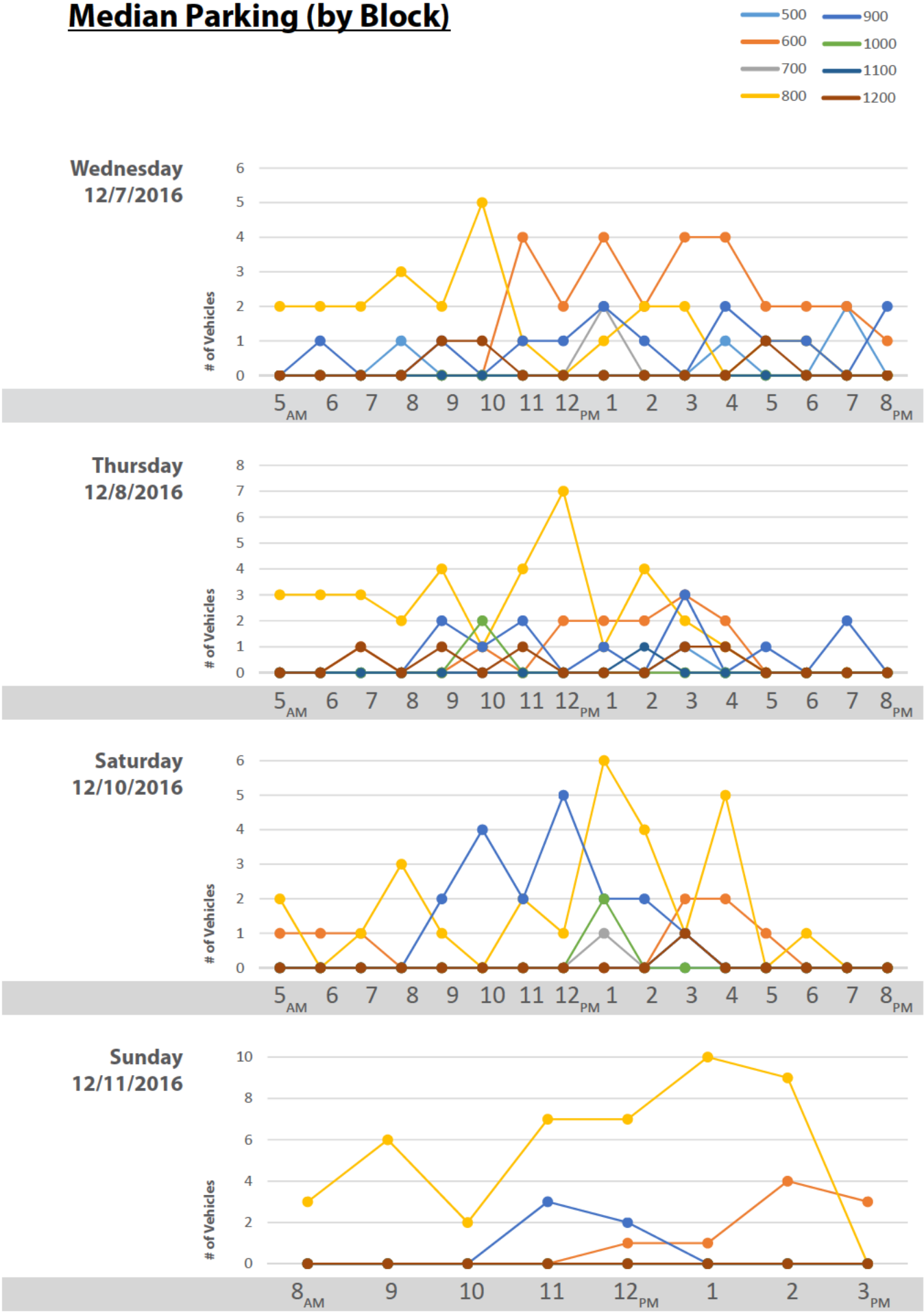
ATTACHMENT #4

Double/Median/Sidewalk Parking Graphs

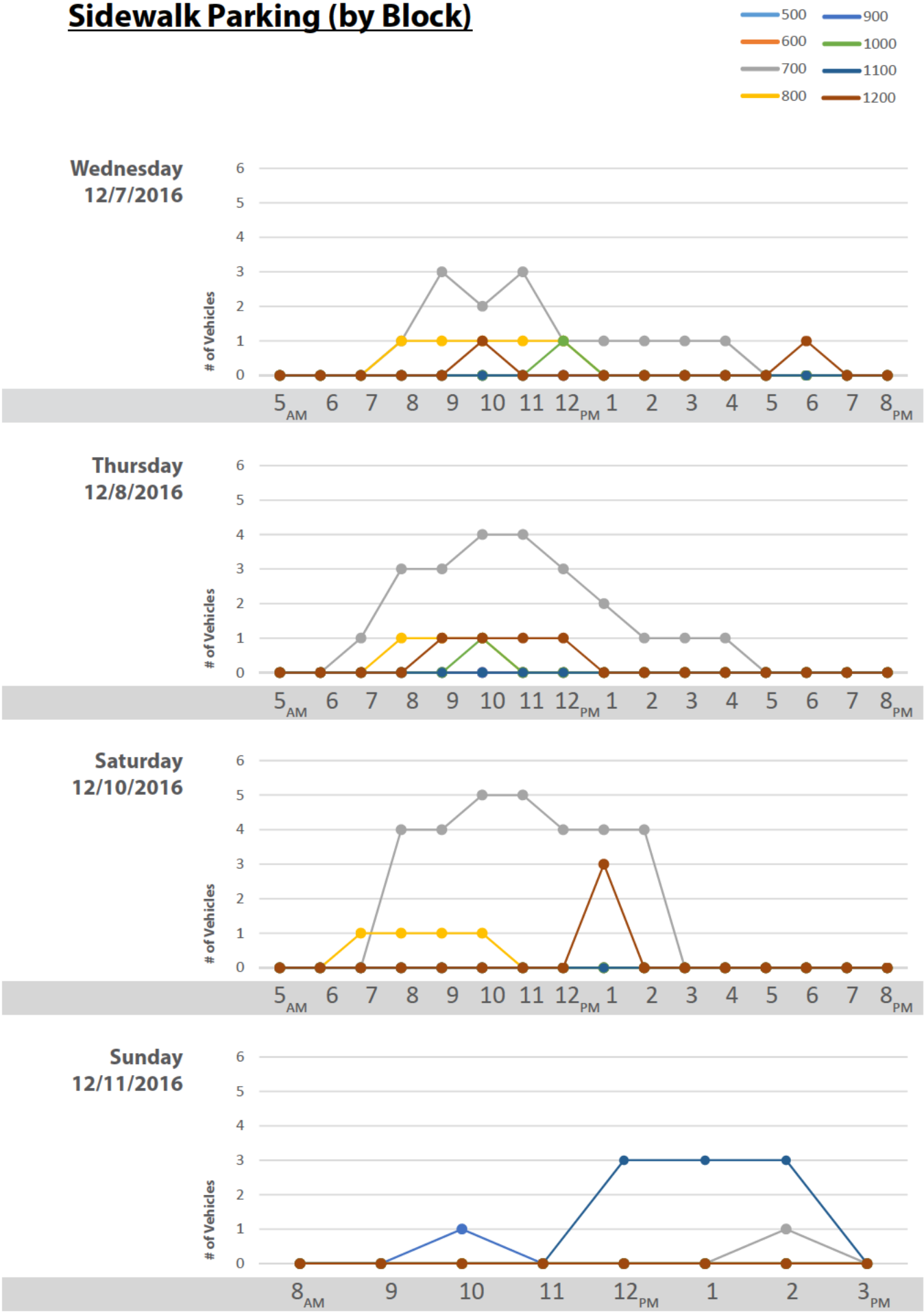
Double Parking (by Block)



Median Parking (by Block)



Sidewalk Parking (by Block)



OTIS
Office of Transportation, Infrastructure, & Sustainability
CITY OF PHILADELPHIA

TA-3
Washington Avenue Traffic Study report

Notes

The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

WASHINGTON AVENUE
TRAFFIC STUDY
CITY OF PHILADELPHIA

DATE: JANUARY 2020

WSP.COM

JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

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TABLES

FIGURES

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APPENDICES

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1 INTRODUCTION

1.1 BACKGROUND

In March 2015, the City of Philadelphia Department of Streets completed the Washington Avenue Selective Road Diet Study along the Washington Avenue corridor in Philadelphia, PA. The purpose of the 2015 study was to evaluate the feasibility of a Selective Road Diet from five lanes to three lanes along sections of Washington Avenue between Grays Ferry Avenue and Front Street. The road diet concept was originally proposed in 2013 with the goal of increasing safety, defining clear areas for different travel modes, improving parking and loading operations, and providing continuous bicycle lanes along the corridor. The 2015 study concluded that the Selective Road Diet concept best satisfied the above objectives, and recommended an increase in cycle length from 60 to 65 seconds along the entire corridor to minimize negative impacts to traffic operations.

1.2 PURPOSE OF STUDY

The main purpose of the Washington Avenue Traffic Study is to re-evaluate the feasibility of the Selective Road Diet Concept for the Washington Avenue corridor based on updated 2019 traffic information. The road diet concept considered in this study evaluated the same cross sections explored in the 2015 study:

- A 3-lane cross section west of 16th Street
- A 5-lane cross section between 16th Street and 13th Street
- A transitional 4-lane section between 13th Street and 12th Street
- A 3-lane cross section between 12th Street and 5th Street
- A transitional 4-lane section between 5th Street and 4th Street
- A 5-lane cross section between 4th Street and Front Street

In addition, this study analyzed potential retiming options along the corridor with the existing lane configuration geometry and included a detailed crash analysis along the corridor.

1.3 PROJECT LOCATION / STUDY AREA

The Washington Avenue corridor is approximately 2.3 miles long and extends between Front Street to the east and Grays Ferry Avenue to the west. The location of the corridor is shown in Figure 1. The roadway cross section along the corridor consists of the following:

- Two travel lanes in each direction
- Center left turn lane (except between 25th Street and Grays Ferry Avenue)
- Bicycle lanes in each direction, except between 7th Street and 11th Street (Share the Road)
- On-street parking in each direction

The Washington Avenue corridor has a posted speed limit of 30 mph, while all intersecting side-streets have posted speed limits of 25 mph. The 28 signalized intersections along Washington Avenue are listed below with their functional classification:

- Front Street – Urban Collector
- 2nd Street – Local Roadway
- Moyamensing Avenue – Local Roadway

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- 3rd Street – Local Roadway
- 4th Street – Local Roadway
- 5th Street – Urban Collector
- 6th Street – Urban Collector
- 7th Street – Urban Collector (north leg)
- Passyunk Avenue – Urban Collector (south leg)
- 8th Street – Local Roadway
- 9th Street – Local Roadway
- 10th Street – Local Roadway
- 11th Street – Minor Arterial
- 12th Street – Minor Arterial
- 13th Street – Local Roadway
- Broad Street (SR 0611) – Principal Arterial
- 15th Street – Minor Arterial
- 16th Street – Minor Arterial
- 17th Street – Local Roadway
- 18th Street – Local Roadway
- 19th Street – Local Roadway
- 20th Street – Local Roadway
- 21st Street – Minor Arterial
- 22nd Street – Minor Arterial
- 23rd Street – Local Roadway
- 24th Street – Local Roadway
- 25th Street – Local Roadway
- Grays Ferry Avenue – Principal Arterial south of Washington Avenue; Minor Arterial north of Washington Avenue.

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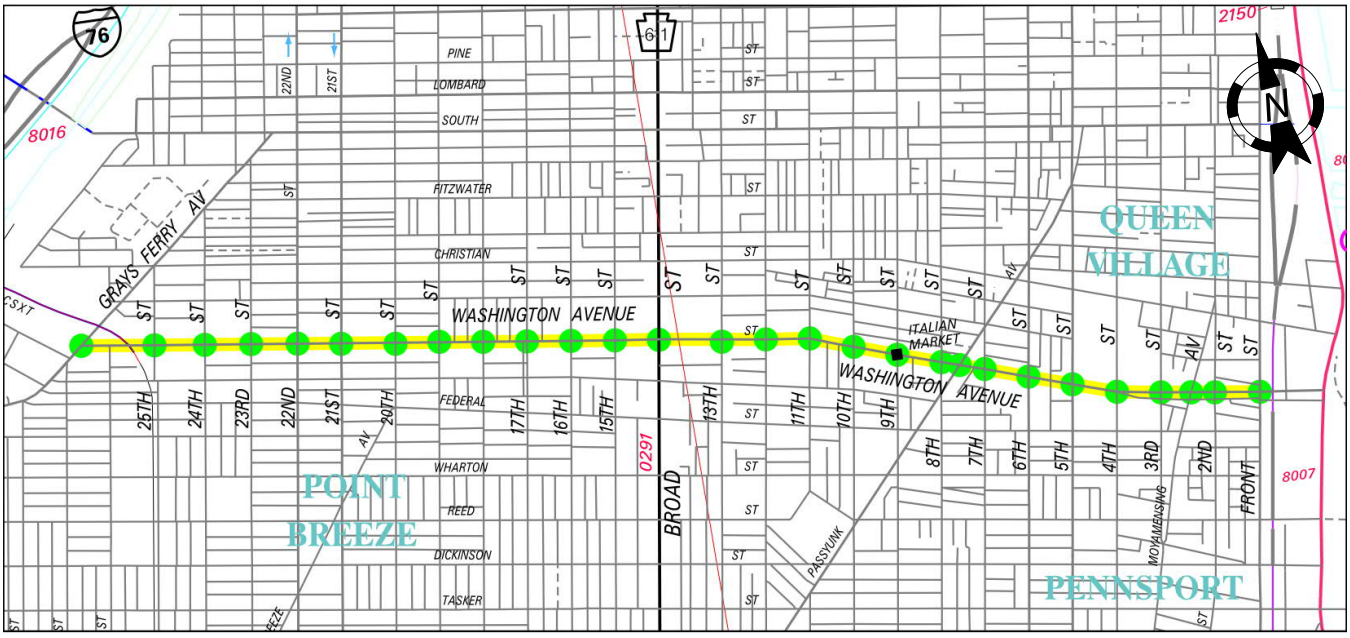

Figure 1 – Traffic Analysis Project Study Area

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The Southeastern Pennsylvania Transportation Authority (SEPTA) provides the following bus service through and along the corridor:

- Route 2 (20th – Johnston to Pulaski-Hunting Park or Wayne Junction) – Route traverses northbound on 16th Street and southbound on 17th Street in study area.
- Route 4 (Broad – Pattison to Fern Rock Transportation Center) – Route traverses northbound and southbound along Broad Street (SR 0611) in study area.
- Route 7 (Pier 70 to 33rd – Dauphin) – Route traverses northbound on 22nd Street and southbound on 23rd Street in study area.
- Route 12 (Columbus – Dock to 50th – Woodland) – Route traverses eastbound and westbound along Grays Ferry Avenue in the study area.
- Route 17 (Penns Landing to 20th – Johnston and Broad – Pattison) – Route traverses southbound on 19th Street and northbound on 20th Street in the study area.
- Route 27 (Broad – Carpenter to Plymouth Meeting Mall) – Route traverses northbound and southbound along Broad Street (SR 0611) and southbound along 15th Street in the study area.
- Route 32 (Broad – Carpenter to Ridge – Lyceum) - Route traverses northbound and southbound along Broad Street (SR 0611) and southbound along 15th Street in the study area.
- Route 45 (Broad – Oregon to Center City) – Route traverses northbound along 11th Street and southbound along 12th Street in the study area.
- Route 47 (Whitman Plaza to 5th – Godfrey) – Route traverses northbound along 7th Street and southbound along 8th Street in the study area.
- Route 47M (Whitman Plaza to 7th – Spring Garden via 9th Street) – Route traverses northbound along 9th street only in the study area.
- Route 57 (Whitman Plaza to Rising Sun – Olney or Fern Rock Transportation Center) – Route traverses northbound along 3rd Street (south of Washington Avenue), southbound along 4th Street (north of Washington Avenue), Washington Avenue between 3rd & 4th Streets and Moyamensing Avenue south of Washington Avenue in the study area.
- Route 64 (50th – Parkside to Pier 70) – Route traverses eastbound and westbound along Washington Avenue in the study area.

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2 DATA COLLECTION

2.1 TRAFFIC VOLUMES

2.1.1 EXISTING VOLUMES

Updated 2019 traffic volumes were obtained at the 24 signalized intersections between 4th Street and Grays Ferry Avenue (where cross sections of the roadway are expected to be modified with the Selective Road Diet Concept) during the following timeframes:

- Weekday traffic counts - Collected on Thursday April 11, 2019
  - AM Peak: 7 - 9 AM
  - PM Peak: 4 - 6 PM
- Weekend traffic counts – Collected on the following dates (10 AM – 2 PM):
  - Saturday, April 13, 2019 → Utilized as Weekend Peak
  - Sunday, April 14, 2019

Traffic data collected at each intersection included:

- Turning movement counts
- Classification (passenger cars, buses, trucks)
- Bicycles
- Pedestrians by crossing
- Right turns on red (RTOR)

The following system peak hours were determined and utilized in the traffic analyses:

- Weekday AM peak hour: 7:45 – 8:45 AM
- Weekday PM peak hour: 5:00 – 6:00 PM
- Weekend Saturday peak hour: 12:30 – 1:30 PM

Existing 2019 traffic volume figures along the corridor are included in Appendix A.

A comparison between the DVRPC 2017 traffic counts and the 2019 traffic counts shows they are relatively close in value and thus provides validation on the traffic volume used in this study. Volume graphs per direction for each peak hour along Washington Avenue are provided for comparison. The ADT along Washington Avenue (2017 DVRPC) is 23,162 vehicles. The Federal Highway Administration's (FHWA) 2014 *Road Diet Informational Guide* advises that roadways with ADTs of 20,000 vpd or less may be good candidates for a Road Diet and should be evaluated for feasibility. The guide notes that some agencies have had success with Road Diets at higher traffic volumes. The weekday PM peak hour is the critical peak for analysis purposes. The weekday AM, PM, and weekend Saturday intersection peak hour traffic volumes are provided in Figures 3, 4, and 5 respectively.

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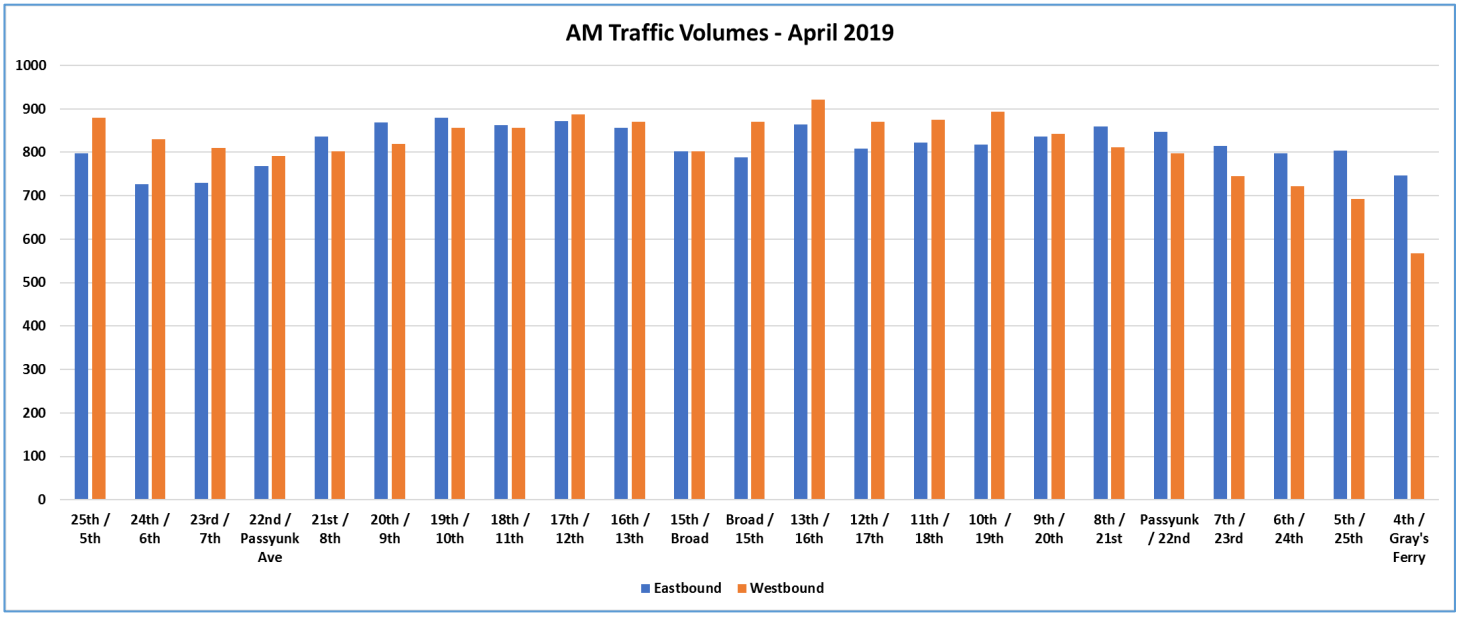

Figure 3 – Washington Avenue Weekday AM Peak Hour Traffic Volumes

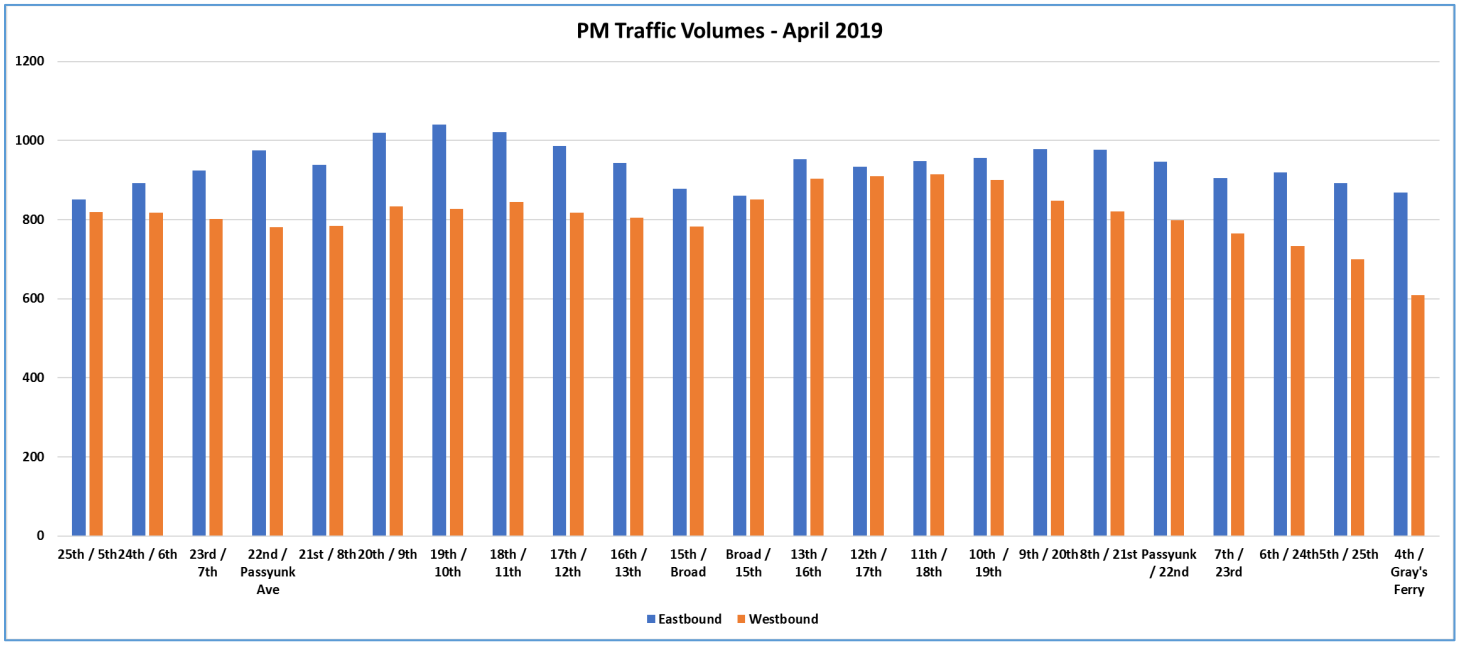

Figure 4 – Washington Avenue Weekday PM Peak Hour Traffic Volumes

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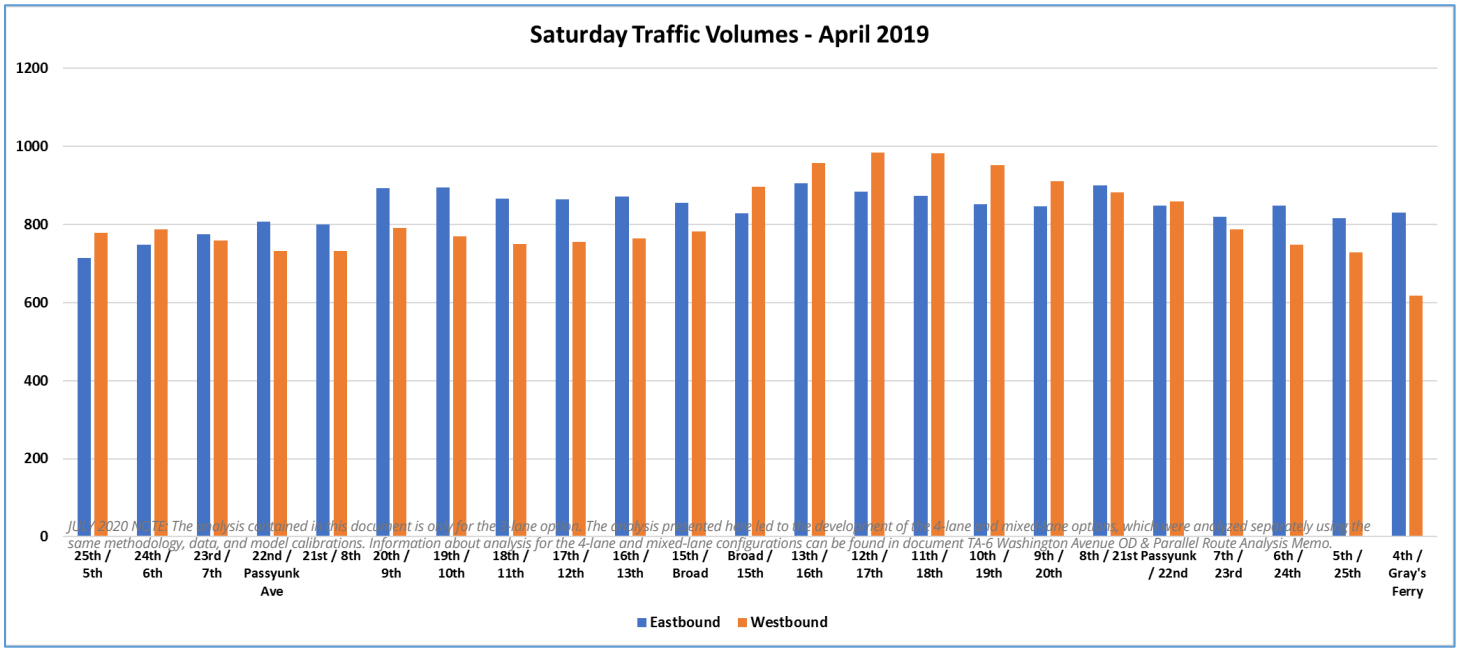

Figure 5 – Washington Avenue Weekend Saturday Peak Hour Traffic Volumes

2.1.2 FUTURE VOLUMES

The City of Philadelphia provided guidance regarding background growth and potential committed developments along the Washington Avenue corridor for inclusion into future volume projections. Based on PennDOT's Growth Factors for August 2018 to July 2019, a growth factor of 0% is shown for Philadelphia Urban Non-Interstate Roadways. The City of Philadelphia mentioned that they are not aware of any proposed or anticipated site developments along the corridor that would substantiate an increase of vehicular traffic. Therefore, the existing volumes were utilized for both the existing and future condition models.

2.2 TRAVEL TIME RUNS

Existing 2019 travel time runs were conducted along the Washington Avenue corridor from 4th Street to Grays Ferry Avenue (24 study signalized intersections) for both the eastbound and westbound directions to calibrate the existing condition Synchro models during the following time periods:

- Weekday travel time runs – (AM Peak: 7 – 9 AM; PM Peak: 4 – 6 PM)
  - Tuesday, April 23, 2019
  - Wednesday, April 24, 2019
- Weekend travel time runs – (10 AM – 2 PM)
  - Saturday, April 13, 2019
  - Sunday, April 14, 2019

Travel time runs were completed in accordance with the Institute of Transportation Engineer's (ITE) Manual of Transportation Engineering, utilizing the latest Tru-Traffic software (Version 10.0) via GPS units. Runs were conducted alternatively in the right and left lanes of each direction. If a lane was blocked due to a double-parked vehicle or loading bus, the driver waited until a safe opportunity to pass and then reentered the departed lane. If a motorist slowed down to yield to a pedestrian while turning, the driver stayed in the same travel lane.

After completion of the travel time runs, all GPS data points were verified in Tru-Traffic and subsequently used to calculate the average travel time (including delay) between each intersection. This data was used to calibrate the Synchro and SimTraffic models.

2.3 CORRIDOR OBSERVATIONS

A field view along the corridor was conducted to verify lane configurations, signal timings (compared to provided Signal Work Orders), operations, etc. along the corridor. The following observations were noted:

- Parking and loading maneuvers were field collected and utilized in the traffic analysis.
    - Double parking issues included the following locations:
        - Between 8th and 9th Streets in both directions (Italian Market)
        - Between Broad and 13th Streets in the eastbound direction (The Rock School for Dance Education)
        - Between 16th and 15th Street in the eastbound direction (near Marble Works)
- No Turn on Red signs are no longer provided at the following intersection approaches to Washington Avenue (a comparison was conducted between 2012 and 2017 in Google Earth Street View and field verified):
    - NB 9th Street
    - NB 16th Street
    - SB 19th Street
    - NB 21st Street
    - NB 23rd Street
    - SB 24th Street
- Broad Street & Washington Avenue (90 second cycle length):
    - Existing Conditions - Permitted left turn phasing with lead pedestrian intervals (LPI) provided during traffic data collection and travel time runs.
    - Future Conditions – Signal timing and equipment upgrade to protected/permitted left turn phasing with the LPI's removed. This improvement was implemented in May 2019.
- Motorists turning right from Gray's Ferry Avenue to Washington Avenue generally failed to yield to pedestrians in the crosswalk. Consideration should be given to reducing the wide sweeping radius.
- Median parking appears to be tolerated between 19th Street and 18th Street, which is the block with Chick's restaurant. This restricts the sight distance for vehicles accessing to and from Dorrance Street and S. Cleveland Street. Pedestrians were observed crossing outside the crosswalk from behind parked vehicles.
- The Rock School for Dance Education uses cones to block off their No Parking zone. Accordingly, parents stop and load in the eastbound bike and travel lane. This introduces significant delay to the Broad Street intersection. The Rock School for Dance Education has a parking lot on the northeast corner of 13th Street and Washington Avenue that is underutilized.

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3 CRASH DATA & ANALYSIS

3.1 METHODOLOGY

The most recent five-year crash history (2013 through 2017) was evaluated from PennDOT's CDART system along Washington Avenue from 4th Street to Grays Ferry Avenue (limits of the potential Selective Road Diet Concept). This analysis included each intersection and midblock location along the corridor. The initial analysis was focused on the entire corridor. Each signalized intersection was ranked by total crashes, and then the top ten highest crash intersections were identified. Analyses include the preparation of:

- Written summary sheet, and
- Tabulation sheet outlining crashes (yearly totals, illumination, road surface, weather, collision type, severity, and driving actions).

3.2 OVERALL CRASH ANALYSIS

The overall crash analysis of Washington Avenue consisted of tabulating yearly statistics and totaling for the five-year period from 2013 to 2017. This tabulation showed each of the 24 signalized intersections and midblock locations between them. There were 187 crashes that occurred along Washington Avenue during this five-year period. The data for this crash analysis included all reportable crashes that occurred within 100 feet of each intersection. Crashes outside of this intersection criteria were included in the midblock tabulations. There were ***three fatal crashes*** along the corridor, each occurring at the following intersections:

- Washington Avenue & Broad Street – Washington Avenue westbound and Broad Street southbound angle fatality.
- Washington Avenue & 15th Street – 15th Street southbound left turning bus pedestrian fatality.
- Washington Avenue & 24th Street – Washington Avenue eastbound multi-vehicle pedestrian fatality.

In addition, there were a high number of bicycle and pedestrian crashes along the corridor:

- ***32 crashes involving pedestrians (17%)***
- ***45 crashes involving bicycles (24%)***

****Pedestrians and bicycles combined for 10% of the roadway users; however, they account for 41% of all crashes.***

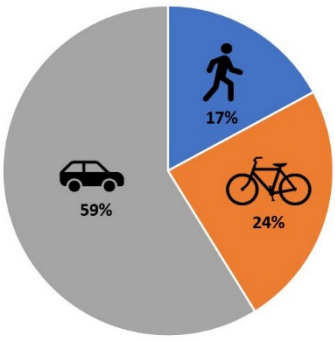

Table 1 shows the total crashes along Washington Avenue.

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Table 1 – Total Roadway Crashes Comparison

Crash Location		Year					
Intersection**	**Midblock Location**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
	3rd to 4th	0	0	0	0	1	1
4th & Washington		2	3	2	0	1	8
	4th to 5th	0	0	0	1	0	1
5th & Washington		0	0	1	0	1	2
	5th to Randolph	0	0	1	0	0	1
Randolph & Washington		1	2	0	0	0	3
6th & Washington		0	1	0	4	0	5
	6th to 7th	0	1	1	0	3	5
7th & Washington		1	1	0	0	0	2
Passyunk & Washington		0	0	0	1	0	1
	7th to 8th	0	1	0	0	0	1
8th & Washington		1	1	2	1	1	6
	8th to 9th	0	1	0	2	1	4
9th & Washington		0	1	1	1	0	3
	9th to 10th	0	0	0	1	1	2
10th & Washington		0	2	0	1	1	4
	10th to 11th	0	1	2	1	0	4
11th & Washington		0	2	2	1	2	7
	11th to 12th	0	0	0	3	0	3
12th & Washington		0	0	0	1	2	3
	12th to 13th	1	1	0	1	0	3
13th & Washington		2	3	2	3	3	13
	13th to Broad	0	0	1	1	0	2
Washington & Broad (SR291)		5	4	4	4	4	21
	Broad to 15th	0	1	0	0	1	2
15th & Washington		1	2	0	1	3	7
	15th to 16th	0	0	1	2	1	4
16th & Washington		1	1	1	1	1	5
	16th to 17th	0	0	0	1	0	1
17th & Washington		1	1	1	1	3	7
	17th to 18th	0	0	1	0	1	2
18th & Washington		1	0	0	0	0	1
	18th to 19th	0	0	2	0	0	2
19th & Washington		0	1	0	2	0	3
20th & Washington		0	0	1	0	1	2
	20th to 21st	1	1	0	1	1	4
21st & Washington		1	1	0	0	1	3
	21st to 22nd	0	1	1	0	0	2
22nd & Washington		2	1	1	2	1	7
	22nd to 23rd	0	1	0	0	0	1

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Crash Location		Year					
Intersection**	**Midblock Location**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
23rd & Washington		0	0	1	2	1	4
24th & Washington		1	0	3	1	1	6
	24th to 25th	0	0	0	1	0	1
25th & Washington		0	1	1	4	2	8
	25th to Gray's Ferry	0	1	0	1	1	3
Gray's Ferry & Washington		1	2	1	2	1	7
Total		**23**	**40**	**34**	**49**	**41**	**187**

** - Includes crashes within 100 feet of intersection

3.3 TOP 10 CRASH INTERSECTION ANALYSES

From the overall crash analysis, the top ten highest crash signalized intersections were determined. These intersections account for 48.7 percent of all crashes along the Washington Avenue corridor. Table 2 enumerates the results.

Table 2 – Top 10 Crash Intersections for Washington Avenue (2013 – 2017)

Crash Location	Year					
Intersection	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**
Broad Street (SR 291)	5	4	4	4	4	21
13th Street	2	3	2	3	3	13
4th Street	2	3	2	0	1	8
25th Street	0	1	1	4	2	8
11th Street	0	2	2	1	2	7
15th Street	1	2	0	1	3	7
17th Street	1	1	1	1	3	7
22nd Street	2	1	1	2	1	7
Gray's Ferry Avenue	1	2	1	2	1	7
8th Street	1	1	2	1	1	6
Total	**15**	**20**	**16**	**19**	**21**	**91**

A corridor wide crash total heat map was developed and illustrated in Figure 6. Detailed descriptions of the Top 10 crash intersections are outlined in the next section of the report.

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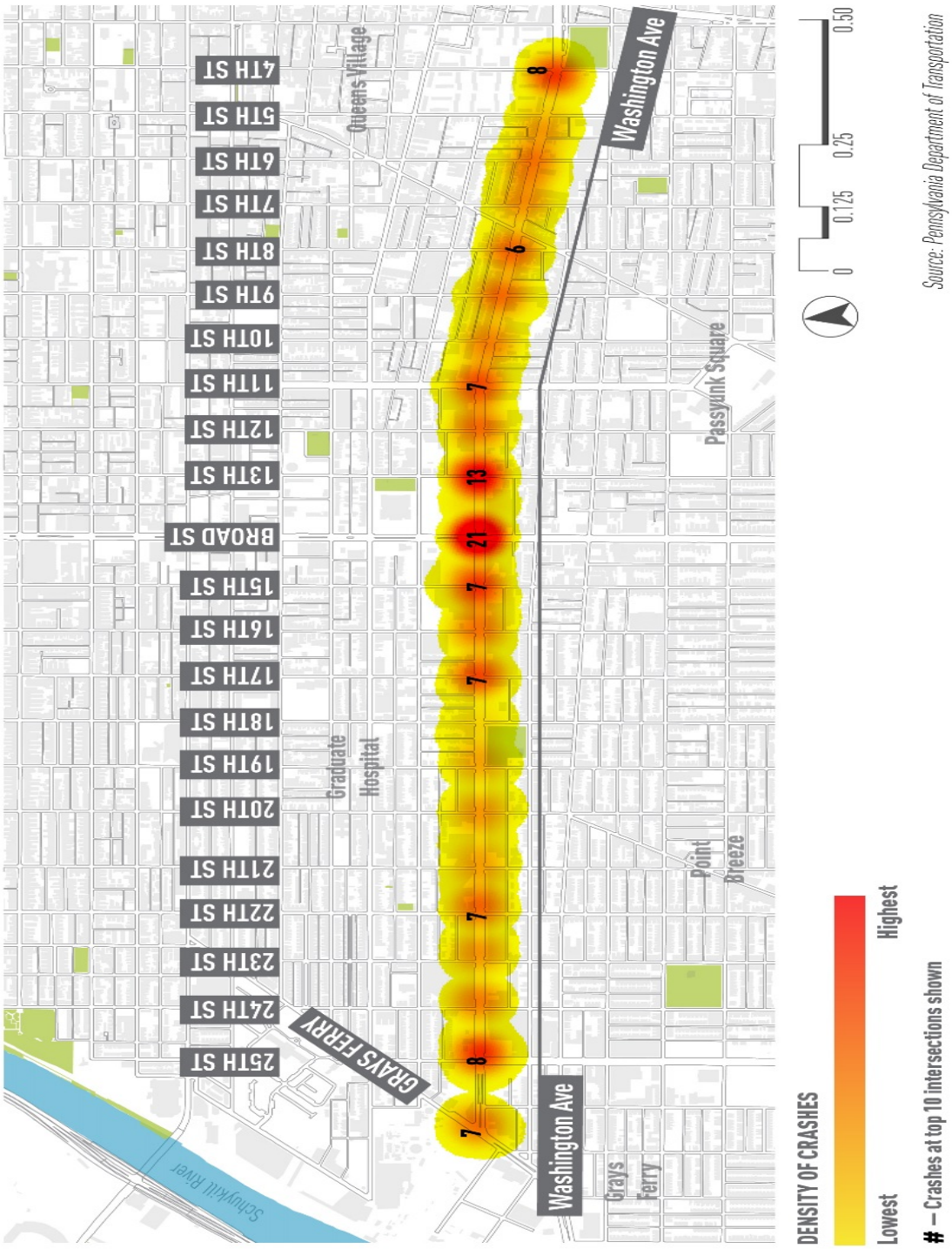

Figure 6 – Washington Avenue Heat Map

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3.3.1 NO. 1 – WASHINGTON AVENUE AND BROAD STREET (SR 0611)

Washington Avenue has two travel lanes and separate left turn lanes in each direction with bike lanes and parking along both sides of the roadway (no bus zones). Broad Street (SR 0611) has two travel lanes, separate left turn lanes in each direction with no bike lanes, and has parking on both sides of the street with a signed bus zone on the northbound approach. The phasing at this intersection was recently modified from permitted only left turn phasing with leading pedestrian intervals (LPI) to protected only left turn phasing with the LPI removed. Overhead street lighting is present on all four corners of the intersection. The Rock School of Dance is located on the southeast corner while Target is located on the northwest corner. The data revealed that a total of 21 reported motor vehicle collisions occurred within the five-year period (4.2 crashes per year). A crash summary is provided in Table 3.

Table 3 – Crash Data Summary: Washington Avenue & Broad Street

Year	Total
2013	5
2014	4
2015	4
2016	4
2017	4
Grand Total	**21**

Illumination	Total
Daylight	12
Dusk	1
Street Light	8
Grand Total	**21**

Road Surface	Total
Dry	20
Other	1
Grand Total	**21**

Weather	Total
Clear	21
Grand Total	**21**

Collision Type	Total
Angle	13
Pedestrian	2
Rear-End	5
Same Direction Sideswipe	1
Grand Total	**21**

Severity	Total
Possible Injury	8
Suspected Minor Injury	5
Suspected Serious Injury	1
Unknown If Injured	1
Unknown Severity	5
Fatal	1
Grand Total	**21**

Driving Actions	Total
Driving wrong side of road	1
Failure to Respond to TCD	1
Improper/Careless Turn	6
No contributing action	1
Other	4
Unknown	6
Other	1
Running Red Light	1
Grand Total	**21**

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3.3.2 NO. 2 – WASHINGTON AVENUE AND 13TH STREET

Washington Avenue has two travel lanes and a separate left turn lane for the eastbound approach with bike lanes and parking along both sides of the roadway (no bus zones). 13th Street is one-way northbound (single lane) with parking on both sides of the roadway and signed for No Thru Trucks. No pedestrian signal heads are provided for crossing 13th Street. Overhead street lighting is present on the northwest and southeast corners. The data revealed that a total of 13 reported motor vehicle collisions occurred within the five-year period (2.6 crashes per year). A crash summary is provided in Table 4.

Table 4 – Crash Data Summary: Washington Avenue & 13th Street

Year	Total
2013	2
2014	3
2015	2
2016	3
2017	3
Grand Total	**13**

Collision Type	Total
Angle	7
Non-Collision	1
Pedestrian	3
Rear-End	2
Grand Total	**13**

Illumination	Total
Street Light	4
Daylight	9
Grand Total	**13**

Severity	Total
Possible Injury	8
Property Damage Only	2
Suspected Minor Injury	2
Unknown Severity	1
Grand Total	**13**

Road Surface	Total
Dry	9
Wet	4
Grand Total	**13**

Driving Actions	Total
Unknown	3
Running Red Light	3
No contributing action	1
Improper/Careless Turn	2
Tailgating	2
Failure to Respond to TCD	1
Improper Entrance to Highway	1
Grand Total	**13**

Weather	Total
Clear	9
Rain	3
Other	1
Grand Total	**13**

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3.3.3 NO. 3 – WASHINGTON AVENUE AND 4TH STREET

Washington Avenue has two travel lanes and a separate left turn lane for the westbound approach. Bike lanes on both sides of the roadway are present on the west leg while a bike lane is provided on the east leg for the westbound direction with sharrows provided for the eastbound direction. No bus zones are provided. On-street parking is allowed on the west leg of the intersection (both sides) and on the east leg of the intersection (north side). 4th Street is one-way southbound (single lane) with parking on both sides of the roadway. No pedestrian signal heads are provided for crossing 4th Street. Overhead street lighting is present on the northeast, southwest, and northwest corners. Sack's Playground is located on the southwest quadrant while Jefferson Square is located on the southeast quadrant of the intersection. The data revealed that a total of 8 reported motor vehicle collisions occurred within the five-year period (1.6 crashes per year). A crash summary is provided in Table 5.

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Table 5 – Crash Data Summary: Washington Avenue & 4th Street

Year	Total
2013	2
2014	3
2015	2
2017	1
Grand Total	**8**

Collision Type	Total
Angle	6
Head-On	1
Pedestrian	1
Grand Total	**8**

Illumination	Total
Daylight	6
Street Light	2
Grand Total	**8**

Severity	Total
Property Damage Only	2
Unknown Severity	2
Possible Injury	2
Suspected Minor Injury	2
Grand Total	**8**

Road Surface	Total
Dry	6
Wet	2
Grand Total	**8**

Driving Actions	Total
Unknown	1
Driver was distracted	1
Improper/Careless Turn	3
No contributing action	2
Running Red Light	1
Grand Total	**8**

Row Labels	Total
Clear	6
Rain	2
Grand Total	**8**

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3.3.4 NO. 4 – WASHINGTON AVENUE AND 25TH STREET

Washington Avenue has two travel lanes and a separate left turn lane for the westbound approach with bike lanes along both sides of the roadway (no bus zones). On-street parking is allowed on both sides of the east leg of the intersection. 25th Street is one-way (single lane) northbound north of the intersection and signed for No Thru Trucks while south of the intersection is two-way with a separate right turn lane. Parking is allowed on both sides of 25th Street. Pedestrian signal heads are provided for crossing all four legs of the intersection. Overhead street lighting is present on the southeast and northwest corners. The data revealed that a total of 8 reported motor vehicle collisions occurred within the five-year period (1.6 crashes per year). A crash summary is provided in Table 6.

Table 6 – Crash Data Summary: Washington Avenue & 25th Street

Year	Total
2014	1
2015	1
2016	4
2017	2
Grand Total	**8**

Collision Type	Total
Angle	1
Pedestrian	1
Head-On	1
Rear-End	4
Opposite Direction Sideswipe	1
Grand Total	**8**

Illumination	Total
Daylight	5
Street Light	2
Dark	1
Grand Total	**8**

Severity	Total
Unknown Severity	3
Possible Injury	2
Property Damage Only	2
Suspected Minor Injury	1
Grand Total	**8**

Road Surface	Total
Dry	6
Wet	2
Grand Total	**8**

Driving Actions	Total
Unknown	4
Driver was distracted	2
No contributing action	1
Driving wrong side of road	1
Grand Total	**8**

Weather	Total
Clear	7
Rain	1
Grand Total	**8**

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3.3.5 NO. 5 – WASHINGTON AVENUE AND 11TH STREET

Washington Avenue has two travel lanes and separate left turn lanes in each direction with bike lanes and parking along both sides of the roadway (no bus zones). 11th Street is a two-way (single lane) roadway with angle parking allowed on both sides. There is a bike lane provided northbound while sharrows are striped for southbound 11th Street. Pedestrian signal heads are provided for crossing all four legs of the intersection. Overhead street lighting is present on the northeast, southeast, and northwest corners. Wing Phat Vietnamese Plaza is located on the southwest quadrant of the intersection. The data revealed that a total of 7 reported motor vehicle collisions occurred within the five-year period (1.4 crashes per year). A crash summary is provided in Table 7.

Table 7 – Crash Data Summary: Washington Avenue & 11th Street

Year	Total
2014	2
2015	2
2016	1
2017	2
Grand Total	**7**

Collision Type	Total
Angle	4
Pedestrian	2
Rear-End	1
Grand Total	**7**

Illumination	Total
Street Light	3
Daylight	4
Grand Total	**7**

Severity	Total
Possible Injury	5
Unknown Severity	1
Suspected Minor Injury	1
Grand Total	**7**

Road Surface	Total
Dry	6
Wet	1
Grand Total	**7**

Driving Actions	Total
Unknown	2
Improper/Careless Turn	2
Other	1
No contributing action	1
Speeding	1
Grand Total	**7**

Weather	Total
Clear	6
Rain	1
Grand Total	**7**

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3.3.6 NO. 6 – WASHINGTON AVENUE AND 15TH STREET

Washington Avenue has two travel lanes with a separate left turn lane for the westbound direction with bike lanes and parking along both sides of the roadway (no bus zones). 15th Street is a two-way (single lane) roadway on the north leg of the intersection and a one-way (single lane) roadway on the south leg of the intersection. On-street parking is allowed on both sides of 15th Street on the south leg while parking is prohibited on the north leg of 15th Street. Pedestrian signal heads are provided for crossing all four legs of the intersection. Overhead street lighting is present on the northeast and southwest corners of the intersection. Target is located on the northeast quadrant and the Construction Mall is located on the northwest quadrant of the intersection. The data revealed that a total of 7 reported motor vehicle collisions occurred within the five-year period (1.4 crashes per year). A crash summary is provided in Table 8.

Table 8 – Crash Data Summary: Washington Avenue & 15th Street

Year	Total
2013	1
2014	2
2016	1
2017	3
Grand Total	**7**

Collision Type	Total
Angle	3
Pedestrian	2
Rear-End	1
Hit Fixed Object	1
Grand Total	**7**

Illumination	Total
Street Light	4
Daylight	3
Grand Total	**7**

Severity	Total
Possible Injury	4
Property Damage Only	2
Fatal	1
Grand Total	**7**

Road Surface	Total
Dry	7
Grand Total	**7**

Driving Actions	Total
Unknown	2
Running Red Light	3
No contributing action	1
Tailgating	1
Grand Total	**7**

Weather	Total
Clear	7
Grand Total	**7**

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3.3.7 NO. 7 – WASHINGTON AVENUE AND 17TH STREET

Washington Avenue has two travel lanes and a separate left turn lane for the westbound approach with bike lanes and parking along both sides of the roadway (no bus zones). 17th Street is one-way (single lane) southbound. No pedestrian signal heads are provided for crossing 17th Street. Overhead street lighting is present on the northeast, southeast, and southwest corners. The data revealed that a total of 7 reported motor vehicle collisions occurred within the five-year period (1.4 crashes per year). A crash summary is provided in Table 9.

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Table 9 – Crash Data Summary: Washington Avenue & 17th Street

Year	Total
2013	1
2014	1
2015	1
2016	1
2017	3
Grand Total	**7**

Illumination	Total
Street Light	1
Daylight	6
Grand Total	**7**

Road Surface	Total
Dry	7
Grand Total	**7**

Weather	Total
Clear	7
Grand Total	**7**

Collision Type	Total
Angle	7
Grand Total	**7**

Severity	Total
Possible Injury	2
Property Damage Only	2
Suspected Minor Injury	3
Grand Total	**7**

Driving Actions	Total
Unknown	1
No contributing action	2
Turning from Wrong Lane	1
Running Red Light	2
Improper/Careless Turn	1
Grand Total	**7**

3.3.8 NO. 8 – WASHINGTON AVENUE AND 22ND STREET

Washington Avenue has two travel lanes and a separate left turn lane for the eastbound approach with bike lanes and parking along both sides of the roadway (no bus zones). 22nd Street is one-way (single lane) northbound with a bike lane and bus zone provided. No pedestrian signal heads are provided for crossing 22nd Street. Overhead street lighting is present on the northeast and southwest corners. The data revealed that a total of 7 reported motor vehicle collisions occurred within the five-year period (1.4 crashes per year). A crash summary is provided in Table 10.

Table 10 – Crash Data Summary: Washington Avenue & 22nd Street

Year	Total
2013	2
2014	1
2015	1
2016	2
2017	1
Grand Total	**7**

Collision Type	Total
Same Direction Sideswipe	1
Angle	2
Rear-End	3
Pedestrian	1
Grand Total	**7**

Illumination	Total
Daylight	5
Dawn	1
Street Light	1
Grand Total	**7**

Severity	Total
Unknown Severity	4
Possible Injury	1
Property Damage Only	2
Grand Total	**7**

Road Surface	Total
Dry	6
Wet	1
Grand Total	**7**

Driving Actions	Total
No contributing action	2
Unknown	1
Careless Pass or Lane Change	1
Fleeing Police (Chase)	1
Failure to Respond to TCD	1
Running Red Light	1
Grand Total	**7**

Weather	Total
Clear	6
Rain	1
Grand Total	**7**

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3.3.9 NO. 9 – WASHINGTON AVENUE AND GRAYS FERRY AVENUE

Grays Ferry Avenue has one travel lane approaching the intersection with a separate right turn lane in the northbound direction and separate left turn lane in the southbound direction. Washington Avenue has two travel lanes with bike lanes and parking along both sides of the roadway (no bus zones). The westbound approach of Washington Avenue has a separate left turn lane and shared left/right turn lane. Pedestrian signal heads are provided for crossing all legs of the T-intersection. crossing 8th Street. Overhead street lighting is present on the southeast, southwest, and northwest corners. The data revealed that a total of 7 reported motor vehicle collisions occurred within the five-year period (1.4 crashes per year). A crash summary is provided in Table 11.

Table 11 – Crash Data Summary: Washington Avenue & Grays Ferry Avenue

Year	Total
2013	1
2014	2
2015	1
2016	2
2017	1
Grand Total	**7**

Collision Type	Total
Angle	2
Hit Fixed Obj.	4
Rear-End	1
Grand Total	**7**

Illumination	Total
Daylight	4
Street Light	3
Grand Total	**7**

Severity	Total
Property Damage Only	1
Unknown Severity	4
Suspected Serious Injury	1
Possible Injury	1
Grand Total	**7**

Road Surface	Total
Dry	5
Wet	2
Grand Total	**7**

Driving Actions	Total
Affected by Physical Condition	1
Unknown	2
Driver was distracted	1
Speeding	1
Too Fast for Conditions	2
Grand Total	**7**

Weather	Total
Clear	5
Rain	2
Grand Total	**7**

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3.3.10 NO. 10 – WASHINGTON AVENUE AND 8TH STREET

Washington Avenue has two travel lanes and a separate left turn lane for the westbound approach with a "Share the Road" condition for bicycles. On-street parking is allowed along both sides of the roadway (no bus zones). 8th Street is one-way (single lane) southbound with parking allowed on both sides of the roadway. No pedestrian signal heads are provided for crossing 8th Street. Overhead street lighting is present on the northeast and southwest corners. The data revealed that a total of 6 reported motor vehicle collisions occurred within the five-year period (1.2 crashes per year). A crash summary is provided in Table 12.

Table 12 – Crash Data Summary: Washington Avenue & 8th Street

Year	Total
2013	1
2014	1
2015	2
2016	1
2017	1
Grand Total	**6**

Collision Type	Total
Angle	4
Same Direction Sideswipe	2
Grand Total	**6**

Illumination	Total
Daylight	4
Street Light	2
Grand Total	**6**

Severity	Total
Possible Injury	4
Suspected Minor Injury	1
Unknown Severity	1
Grand Total	**6**

Road Surface	Total
Dry	6
Grand Total	**6**

Driving Actions	Total
Unknown	2
Careless Pass or Lane Change	2
Improper/Careless Turn	1
Running Red Light	1
Grand Total	**6**

Weather	Total
Clear	6
Grand Total	**6**

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4 TRAFFIC OPERATIONS

4.1 2019 EXISTING CONDITIONS

Weekday AM and PM peak hour Synchro traffic model files were provided from the City of Philadelphia and updated for this report. Synchro Version 9.2 (Build 915 Revision 6) was used for the traffic analysis. As part of the scope, the City of Philadelphia requested that the models be back-saved into Synchro Version 8.0. Simulations run with Version 8.0 have the possibility of producing different results than documented in this report.

The original scope included Washington Avenue from 4th Street to Grays Ferry Avenue (24 signalized intersections). Based on this original scope of work, traffic data and travel time runs were obtained for these intersections. However, per further correspondence with the City of Philadelphia, subsequent to the data collection effort, the segment of Washington Avenue from Front Street to 4th Street was also included in the traffic analysis Synchro network.

The following Synchro models were updated accordingly:

- 2019 Existing Weekday AM Peak Hour
- 2019 Existing Weekday PM Peak Hour
- 2019 Existing Weekend Saturday Peak Hour - developed

Based on the traffic data collected along the corridor in April 2019, the data was summarized with the following inputs included in the models:

- System peak hour utilized
- Peak hour factor (PHF) by intersection
- Heavy vehicle percentages per movement
- Conflicting pedestrians
- Conflicting bicycles
- Bus blockages
- Parking maneuvers
- 60 second cycle length (except at Broad Street) double alternate offsets

Minor modifications to the existing Synchro files provided from the City of Philadelphia included:

- Left turn lane storage lengths and tapers

4.1.1 MODEL CALIBRATION

Calibration is an iterative process where differences between field and model data are identified and resolved based on further investigation of the field data. The following parameters were used to calibrate the existing Synchro models:

- Utilized Urban Core facility type (per PennDOT Publication 46).
- Utilized 2100 pcphph base saturation flow rate for signalized intersections per Publication 46 (Exhibit 10-9).
- Utilized start-up lost time of 2.5 seconds per Publication 46 (Exhibit 10-10).
- Utilized extension of effective green time of 4.0 seconds per Publication 46 (Exhibit 10-10).
- Lost time of -1.5 seconds.
- Seeded network for 15 minutes.

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- Ran four 15-minute intervals, with the peak set for the 3rd interval.
- Adjusted vehicle characteristics within SimTraffic to match existing traffic data collected.
- Adjusted simulation settings to represent driver behavior at Broad Street.

SimTraffic was also utilized to obtain travel times along the corridor. Ten random runs were completed and the results averaged. Table 13 compares the existing and model SimTraffic travel time runs.

Table 13 – Existing Travel Time Comparison along Washington Avenue

Washington Avenue Direction / Peak	Field Measured Travel Time (minutes)	SimTraffic Measured Travel Time (minutes)	Difference
Eastbound AM	8.6	7.9	- 8%
Westbound AM	8.6	8.1	- 6%
Eastbound PM	9.5	8.5	- 10%
Westbound PM	8.7	8.0	- 8%
Eastbound Saturday	10.0	8.3	- 17%
Westbound Saturday	8.1	8.1	0%

All models are within the range of acceptable error. It is important to note that the majority of the excess delay experienced in the field travel time runs as compared to the SimTraffic data is due to illegal double parking restricting the roadway to one lane. This was particularly the case for the eastbound conditions along Washington Avenue. This type of behavior cannot be accurately modeled in SimTraffic.

Analysis of the corridor was summarized by the following parameters:

- Intersection level of service (LOS) and delay per the Highway Capacity Manual (2010 HCM)
- Arterial LOS and travel time
- SimTraffic travel time

Based on the analysis, it is suggested the Arterial LOS and SimTraffic travel time results be the comparison between scenarios. The intersection LOS and delay per the 2010 HCM considers each location as an isolated intersection. Since this analysis is looking at improvements in the future such as corridor wide retiming along with geometric changes, the arterial LOS and SimTraffic travel time results are the better comparison metrics. Overall intersection LOS and delay shows LOS D or better; individual movements of LOS D or better are shown except at the Washington Avenue and Broad Street intersection.

The 2019 existing AM, PM, and Saturday peak hour measures of effectiveness (LOS, delay, and travel times) are summarized in Tables 16, 17, and 18 respectively.

4.2 FUTURE CONDITIONS (EXISTING GEOMETRY)

Once the existing models were calibrated, Synchro models were developed for the following future scenarios for weekday AM & PM along with weekend Saturday peak hours:

- Future Conditions [Existing Geometry (5-lane cross section) – Optimized]
    - Synchro derived offsets
    - Double alternate offsets
    - Single alternate offsets

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There are a few projects of note along the study corridor:

- The Delaware River Waterfront Corporation (DRWC) is currently advancing a design concept for the Washington Avenue Connector project to improve the connector between the City's neighborhoods and the waterfront. The limits of the project include Washington Avenue from Columbus Boulevard to 4th Street. DRWC's design assume the preservation of the 5-lane cross section, while parks and a shared use trail would be added to the south side of the roadway. Design is to be completed by the middle of this year, at which time DRWC anticipates seeking funding for the project.
- A protected bike lane project is proposed along 11th Street from Bainbridge Street to Reed Street. This project includes a two-way protected cycletrack along with new pavement over unused trolley tracks, painted bump-outs, flex posts, and re-painted crosswalks and lane markings.

  These projects do not affect the development of the future Synchro models.

As outlined in Section 2.1.1, existing volumes were utilized for future conditions due to 0% growth per PennDOT's Philadelphia County urban non-interstate roadway classification and coordination with the City of Philadelphia. This scenario was reviewed to compare different offset alternatives along the corridor under existing geometric conditions. The current cycle length of 60 seconds was utilized for this analysis (except at Broad Street, which currently operates as a part of a 90 second cycle coordinated corridor). Clearance intervals [vehicular (yellow & all-red) & pedestrian] were kept as currently implemented. Synchro offsets were based on a progression speed of 25 mph with manual adjustments. The speed limit along Washington Avenue was maintained at 30 mph for the simulation. SimTraffic travel times along the corridor (both directions of Washington Avenue) results are illustrated in Table 14.

Table 14 – Future (Existing Geometry) Washington Avenue Travel Time Comparison

Washington Avenue Peak Hour	Travel Time (Minutes)			
	Existing Conditions	Future Conditions (Existing Geometry)		
		Synchro	Double Alternate	Single Alternate
AM	13.0	16.5	16.9	21.5
PM	16.5	19.8	18.1	23.1
Saturday	16.6	17.5	17.0	22.3

Increases in travel time from existing to future conditions is primarily due to the phasing/timing change at Washington Avenue & Broad Street (SR 0611) from permitted to protected/permitted left turn phasing along all approaches.

Future findings show that continuing to have double alternate offsets results in a continuous green band at 20 mph. Updating offsets along the corridor to single alternate offsets results in a continuous green band at 10 mph.

The future AM, PM, and Saturday peak hour measures of effectiveness (LOS, delay, and travel times) are summarized in Tables 16, 17, and 18 respectively.

4.3 FUTURE CONDITIONS (SELECTIVE ROAD DIET CONCEPT)

The Selective Road Diet Concept from the 2015 study was then re-analyzed for the future weekday AM & PM periods, along with weekend Saturday peak hours. The cross sections along the Washington Avenue corridor include:

- 3-lane cross section west of 16th Street
- 5-lane cross section between 16th Street and 13th Street

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- Transitional 4-lane section between 13th Street and 12th Street
- 3-lane cross section between 12th Street and 5th Street
- Transitional 4-lane section between 5th Street and 4th Street
- 5-lane cross section between 4th Street and Front Street

For the Selective Road Diet Concept analysis, left turn pockets were modeled in Synchro so SimTraffic simulation could accurately depict the ability of a vehicle to bypass left turn vehicles. This was discussed with the City of Philadelphia on June 13, 2019 and was agreed upon to accommodate two left turn vehicles. Clearance intervals [vehicular (yellow & all-red) & pedestrian] were kept as currently implemented. Synchro offsets were based on a progression speed of 25 mph with manual adjustments. The speed limit along Washington Avenue was maintained at 30 mph for the simulation.

4.3.1 CYCLE LENGTHS – 60 & 65 SECONDS

The analysis of the 60 and 65 second cycle lengths for this scenario was based on the previous recommendations of the 2015 study. Due to the updated traffic volumes collected in April 2019, the Selective Road Diet Concept with these cycle lengths cause the Arterial LOS to degrade from LOS D (existing conditions) to LOS F with longer travel times to traverse the corridor.

The future road diet concept AM, PM, and Saturday peak hour measures of effectiveness (LOS, delay, and travel times) for the 60 and 65 second cycle lengths along the corridor are summarized in Tables 7, 8, and 9 respectively.

Due to the LOS and travel time degradation, additional cycle lengths were reviewed for feasibility. Since the Broad Street (SR 0611) corridor is timed for progression at 90 second cycle lengths, it made sense to test this cycle length along the Washington Avenue corridor.

4.3.2 CYCLE LENGTH – 90 SECONDS

The 90 second cycle length along the corridor was reviewed for practicality for the future condition Selective Road Diet Concept. As such, one 90 second scenario was reviewed, which incorporated Synchro offsets along with additional adjustments. This increase in cycle length improved Arterial LOS and travel times along the corridor when compared to the 60 & 65 second cycle length scenario. When compared to the existing conditions, Arterial LOS remained at LOS D except for the PM peak hour eastbound direction which experiences a LOS E. SimTraffic travel times along the corridor (both directions of Washington Avenue) results are illustrated in Table 15.

Table 15 – Future (Existing Geometry) Washington Avenue Travel Time Comparison

Washington Avenue Peak Hour	Travel Time (Minutes)	
	Existing Conditions	Future Conditions (Road Diet 90 sec.)
		Synchro
AM	13.0	19.5
PM	16.5	23.8
Saturday	16.6	17.7

The 90 second cycle length was analyzed since it allows acceptable corridor travel times during the PM peak. The same cycle length was utilized in the analysis of the AM and Saturday peaks, but due to lower volumes, a shorter cycle length may be feasible during further study.

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The future road diet concept AM, PM, and Saturday peak hour measures of effectiveness (LOS, delay, and travel times) for are summarized in Tables 16, 17, and 18 respectively.

Additionally, Washington Avenue directional travel time graphs are illustrated in Figures 7 through 12 outlining the following:

- Existing field measured (averaged, shortest, and longest runs)
- Existing SimTraffic
- Future (Existing Geometry) – 60 second Double Offset
- Future (Selective Road Diet Concept) – 90 second cycle length

The issue causing most delay during the analysis of the 90 second cycle length is the queue spillback from the left turn lanes at certain corridor intersections. The eastbound left turn onto 11th Street in the AM peak and the westbound left turn on 19th Street during the PM peak occasionally spill back through the two-way left-turn lane into the through travel lane. Other nearby adjacent intersections have available left turn capacity and further discussions with the City of Philadelphia should consider that some motorists may divert to adjacent intersections to avoid longer delays. Traffic diversion was not considered as part of the submitted models. Additionally, as the data was collected prior to the installation of the protected/permissive phasing at the intersection of Broad Street and Washington Avenue, it is possible that more motorists are now utilizing Broad Street, rather than adjacent north / south streets.

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Table 16 – Washington Avenue AM Peak Hour Measures of Effectiveness (MOE)

HCM 2010 Intersection Analysis											
Street Name	Existing	Future			Future Road Diet						
		Single Offset	Double Offset	Synchro Offset	60 sec - Single Offset	60 sec - Double Offset	60 sec - Synchro Offset	65 sec - Single Offset	65 sec - Double Offset	65 sec - Synchro Offset	90 sec - Synchro Offset
25th St	8.8 / A	17.3 / B	15.2 / B	17.3 / B	29.8 / C	24.1 / C	24.1 / C	24.3 / C	24.3 / C	15.1 / B	9.1 / A
24th St	2.2 / A	18.6 / B	10.6 / B	10.6 / B	28.4 / C	18.3 / B	7.5 / A	18.9 / B	16.6 / B	5.7 / A	4.0 / A
23rd St	10.3 / B	18.7 / B	10.4 / B	10.4 / B	20.1 / C	18.3 / B	11.9 / B	27.5 / C	11.5 / B	6.5 / A	4.9 / A
22nd St	13.4 / B	21.3 / C	13.5 / B	13.5 / B	28.5 / C	15.6 / B	10.9 / B	22.5 / C	19.9 / B	13.7 / B	11.0 / B
21st St	11.1 / B	19.7 / B	11.2 / B	11.2 / B	18.1 / B	16.7 / B	21.2 / C	29.7 / C	18.2 / B	8.9 / A	8.9 / A
20th St	11.8 / B	20.1 / C	11.8 / B	11.8 / B	17.0 / B	21.6 / C	11.6 / B	19.4 / B	14.2 / B	8.9 / A	9.4 / A
19th St	11.3 / B	20.5 / C	11.3 / B	11.3 / B	37.3 / D	24.4 / C	23.2 / C	32.9 / C	15.0 / B	9.7 / A	6.6 / A
18th St	12.5 / B	20.9 / C	12.5 / B	12.5 / B	28.9 / C	22.6 / C	21.1 / C	23.2 / C	22.0 / C	15.5 / B	11.1 / B
17th St	11.5 / B	20.1 / C	11.6 / B	11.6 / B	35.3 / D	20.0 / B	17.9 / B	31.4 / C	20.3 / C	13.1 / B	8.3 / A
16th St	12.3 / B	22.0 / C	12.3 / B	12.3 / B	30.5 / C	24.0 / C	20.6 / C	22.9 / C	15.6 / B	10.9 / B	10.2 / B
15th St	12.4 / B	20.1 / C	12.4 / B	12.4 / B	20.1 / C	12.4 / B	12.4 / B	19.3 / B	10.8 / B	10.8 / B	5.7 / A
Broad St	29.2 / C	47.2 / D	47.2 / D	47.2 / D	41.9 / D	41.9 / D	41.9 / D	43.9 / D	43.9 / D	43.9 / D	44.8 / D
13th St	18.1 / B	18.1 / B	18.1 / B	9.5 / A	19.8 / B	19.8 / B	12.7 / B	23.2 / C	23.2 / C	11.7 / B	13.0 / B
12th St	11.4 / B	19.8 / B	11.5 / B	6.5 / A	35.2 / D	24.2 / C	18.0 / B	21.2 / C	15.3 / B	18.3 / B	8.0 / A
11th St	15.9 / B	23.0 / C	16.1 / B	8.1 / A	28.7 / C	24.4 / C	24.1 / C	31.9 / C	20.8 / C	18.7 / B	13.3 / B
10th St	11.6 / B	19.8 / B	11.7 / B	3.7 / A	36.7 / D	21.7 / C	25.9 / C	21.8 / C	20.9 / C	18.5 / B	7.4 / A
9th St	12.8 / B	20.6 / C	12.8 / B	4.9 / A	36.1 / D	29.8 / C	32.0 / C	35.7 / D	24.8 / C	18.3 / B	10.6 / B
8th St	12.4 / B	12.5 / B	12.5 / B	3.8 / A	25.0 / C	25.0 / C	14.3 / B	18.2 / B	18.2 / B	13.1 / B	7.1 / A
Passyunk Ave	6.0 / A	6.0 / A	6.0 / A	6.0 / A	37.5 / D	37.5 / D	37.5 / C	16.9 / B	16.9 / B	16.9 / B	8.3 / A
7th St	12.1 / B	12.1 / B	12.1 / B	3.6 / A	26.6 / C	26.6 / C	20.1 / C	16.0 / B	16.0 / B	10.1 / B	6.1 / A
6th St	11.5 / B	20.3 / C	11.5 / B	3.6 / A	29.4 / C	22.7 / C	34.1 / C	31.6 / C	19.8 / B	8.8 / A	4.4 / A
5th St	13.9 / B	21.4 / C	14.0 / B	2.8 / A	33.7 / C	19.6 / B	12.2 / B	25.6 / C	21.2 / C	9.2 / A	8.5 / A
4th St	11.7 / B	19.8 / B	11.8 / B	4.5 / A	21.2 / C	15.1 / B	19.4 / B	22.9 / C	12.5 / B	5.7 / A	7.1 / A
Synchro Arterial LOS											
EB	D	D	D	D	F	F	F	F	F	F	D
WB	D	D	D	D	F	F	F	F	F	F	D
SimTraffic Travel Time (sec)											
EB	477.1 7.9 mins	630.1 10.5 mins	512.8 8.5 mins	520.1 8.7 mins	2133.8 35.6 mins	2524 42.1 mins	1431 23.9 mins	1974.6 32.9 mins	1631.4 27.2 mins	2120.8 35.3 mins	692.7 11.5 mins
WB	485.3 8.1 mins	659 11.0 mins	504.1 8.4 mins	470.5 7.8 mins	1087.3 18.1 mins	1113.9 18.6 mins	1683.8 28.1 mins	1097.61 18.3 mins	930.8 15.5 mins	952 15.9 mins	480 8.0 mins

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Table 17 – Washington Avenue PM Peak Hour Measures of Effectiveness (MOE)

Washington Ave Model Comparisons - PM Peak											
HCM 2010 Intersection Analysis											
Street Name	**Existing**	**Future**			**Future Road Diet**						
		Single Offset	**Double Offset**	**Synchro Offset**	**60 sec - Single Offset**	**60 sec - Double Offset**	**60 sec - Synchro Offset**	**65 sec - Single Offset**	**65 sec - Double Offset**	**65 sec - Synchro Offset**	**90 sec - Synchro Offset**
25th St	11.7 / B	16.2 / B	13.1 / B	9.1 / A	50.2 / D	50.2 / D	23.5 / C	35.0 / D	35.0 / D	26.5 / C	12.7 / B
24th St	3.2 / A	19.9 / B	12.8 / B	3.2 / A	35.3 / D	26.5 / C	15.4 / B	24.1 / C	17.5 / B	9.8 / A	5.7 / A
23rd St	10.2 / B	19.9 / B	10.2 / B	3.5 / A	28.7 / C	24.1 / C	18.5 / B	32.3 / C	14.3 / B	10.0 / B	6.0 / A
22nd St	13.1 / B	20.7 / C	13.1 / B	7.1 / A	34.0 / C	19.8 / B	13.4 / B	22.6 / C	20.9 / C	14.3 / B	8.4 / A
21st St	12.8 / B	21.8 / C	12.8 / B	6.2 / A	24.5 / C	21.5 / C	24.5 / C	32.7 / C	20.1 / C	14.0 / B	9.2 / A
20th St	13.1 /B	20.9 / C	13.1 / B	4.3 / A	33.9 / C	32.8 / C	30.5 / C	26.6 / C	21.3 / C	26.8 / C	10.9 / B
19th St	13.4 / B	23.6 / C	13.4 / B	6.4 / A	49.8 / D	38.6 / D	39.9 / D	41.2 / D	21.3 / C	23.1 / C	10.3 / B
18th St	12.6 / B	21.3 / C	12.6 / B	3.7 / A	44.7 / D	37.7 / D	53.9 / D	31.2 / C	30.4 / C	25.9 / C	7.4 / A
17th St	12.9 / B	22.3 / C	12.9 / B	8.0 / A	49.4 / D	34.3 / C	32.3 / C	39.6 / D	26.9 / C	19.9 / B	10.6 / B
16th St	12.2 / B	21.3 / C	12.2 / B	4.2 / A	26.6 / C	23.8 / C	20.5 / C	21.4 / C	14.9 / B	18.3 / B	7.0 / A
15th St	13.4 / B	21.4 / C	13.4 / B	13.4 / B	20.5 / C	12.4 / B	12.4 / B	19.9 / B	11.1 / B	14.3 / B	9.8 / A
Broad St	30.5 / C	48.3 / C	48.3 / C	48.3 / C	45.5 / D	45.5 / D	45.5 / D	46.6 / D	46.6 / D	46.6 / D	47.5 / D
13th St	15.8 / B	15.8 / B	15.8 / B	8.2 / A	15.5 / B	15.4 / B	9.9 / A	18.7 / B	18.7 / B	9.0 / A	5.6 / A
12th St	15.0 / B	21.9 / C	15.0 / B	6.4 / A	33.9 / D	25.2 / C	16.6 / B	23.4 / C	16.8 / B	10.5 / B	9.9 / A
11th St	13.4 / B	21.9 / C	13.4 / B	11.7 / B	27.0 / C	22.4 / C	13.5 / B	30.0 / C	16.8 / B	9.9 / A	10.1 / B
10th St	14.7 / B	21.6 / C	14.7 / B	8.8 / A	39.0 / D	25.5 / C	25.6 / C	25.8 / C	24.2 / C	16.4 / B	9.9 / A
9th St	11.5 / B	20.7 / C	11.5 / B	3.8 / A	47.5 / D	45.1 / D	45.5 / D	42.8 / D	29.8 / C	24.8 / C	7.6 / A
8th St	15.0 / B	15.0 / B	15.0 / B	5.4 / A	32.6 / C	32.6 / C	21.1 / C	20.0 / C	20.0 / C	13.2 / B	8.9 / A
Passyunk Ave	5.3 / A	5.3 / A	5.3 / A	5.3 / A	41.7 / D	41.7 / D	41.7 / D	20.3 / C	20.3 / C	20.3 / C	6.6 / A
7th St	11.5 / B	11.5 / B	11.5 / B	3.9 / A	25.7 / C	25.7 / C	20.0 / B	17.4 / B	17.4 / B	10.3 / B	6.6 / A
6th St	14.1 / B	21.4 / C	14.1 / B	7.5 / A	27.6 / C	22.1 / C	24.8 / C	31.3 / C	21.6 / C	14.1 / B	7.9 / A
5th St	11.9 / B	20.3 / C	11.9 / B	4.0 / A	33.2 / C	20.1 / C	12.4 / B	22.1 / C	18.7 / B	8.8 / A	6.8 / A
4th St	13.5 / B	20.4 / C	20.4 / C	11.5 / B	21.5 / C	18.1 / B	7.8 / A	24.5 / C	12.0 / B	6.3 / A	6.6 / A
Synchro Arterial LOS											
EB	D	D	D	D	F	F	F	F	F	F	E
WB	D	D	D	D	F	F	F	F	F	E	D
SimTraffic Travel Time (sec)											
EB	509.4 8.5 mins	679.2 11.3 mins	552.8 9.2 mins	499.6 8.3 mins	3420.9 57.0 mins	2807.6 46.8 mins	2847.8 47.5 mins	2253.1 37.6 mins	2116.4 35.3 mins	2117.7 35.3 mins	814.0 13.6 mins
WB	482.9 8.0 mins	705.1 11.8 mins	536.5 8.9 mins	688.3 11.5 mins	1496.9 24.9 mins	1532.3 25.5 mins	1444.5 24.1 mins	1549.9 25.8 mins	1234.3 20.6 mins	1164.6 19.4 mins	614.2 10.2 mins

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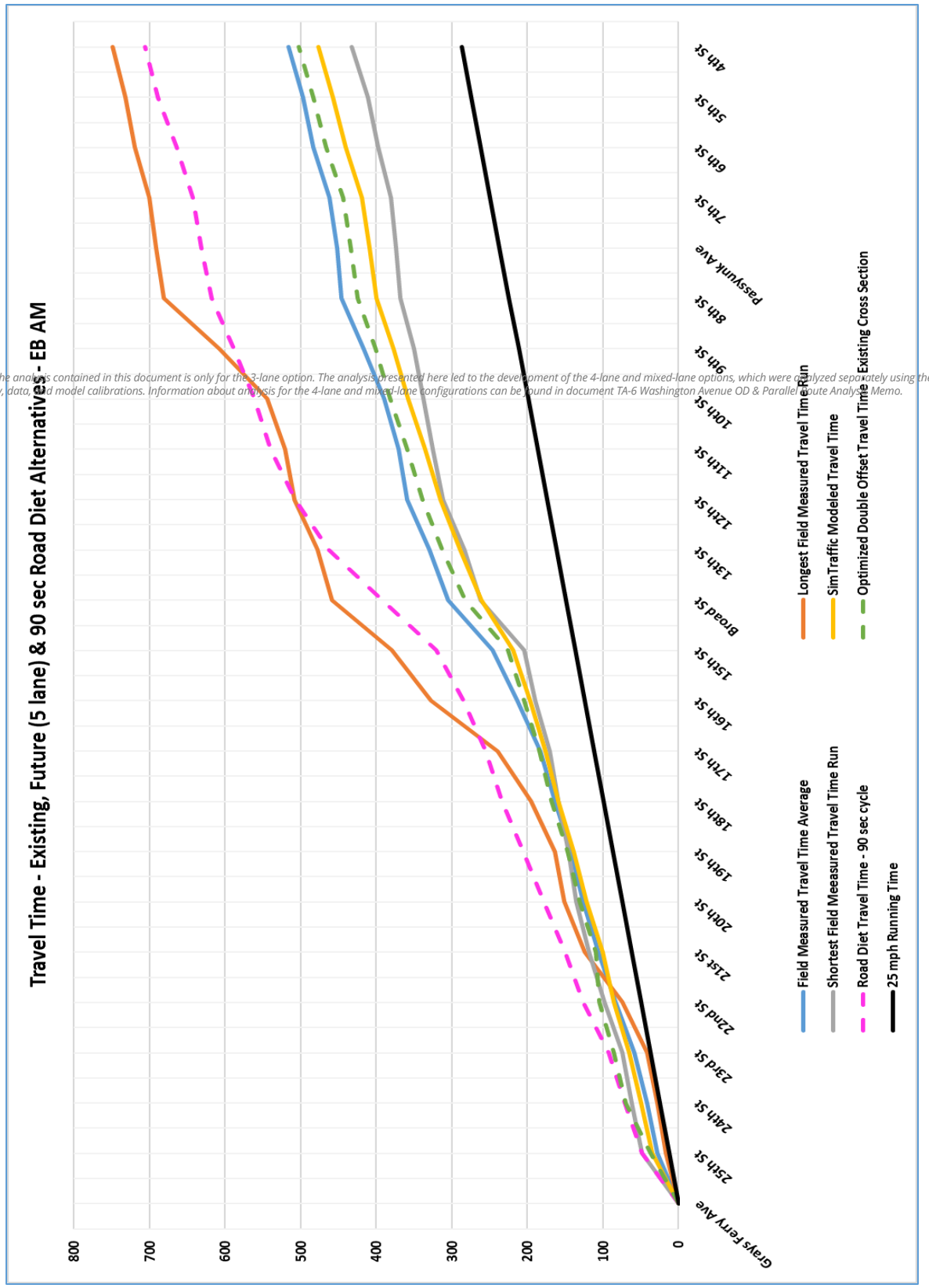
Table 18 – Washington Avenue Saturday Peak Hour Measures of Effectiveness (MOE)

Washington Ave Model Comparisons - Saturday Peak											
HCM 2010 Intersection Analysis											
Street Name	**Existing**	**Future**			**Future Road Diet**						
		Single Offset	**Double Offset**	**Synchro Offset**	**60 sec - Single Offset**	**60 sec - Double Offset**	**60 sec - Synchro Offset**	**65 sec - Single Offset**	**65 sec - Double Offset**	**65 sec - Synchro Offset**	**90 sec - Synchro Offset**
25th St	10.8 / B	16.0 / B	12.4 / B	7.9 / A	24.2 / C	17.1 / B	17.1 / B	22.7 / C	22.7 / C	13.3 / B	9.3 / A
24th St	2.2 / A	18.6 / B	10.5 / B	2.2 / A	28.5 / C	18.3 / B	7.5 / A	16.6 / B	16.6 / B	5.7 / A	4.0 / A
23rd St	10.6 / B	19.1 / B	10.6 / B	2.8 / A	19.8 / B	17.9 / B	15.4 / B	27.4 / C	11.3 / B	6.3 / A	5.8 / A
22nd St	11.7 / B	20.3 / C	11.7 / B	4.7 / A	26.9 / C	12.9 / B	8.0 / A	19.0 / B	15.9 / B	6.9 / A	8.0 / A
21st St	12.6 / B	20.3 / C	12.6 / B	4.8 / A	17.9 / B	18.2 / B	19.7 / B	29.7 / C	19.6 / B	9.2 /A	7.7 / A
20th St	11.9 / B	20.7 / C	11.9 / B	7.1 / A	17.0 / B	20.9 / C	20.9 / C	19.0 / B	13.4 / B	11.1 / B	6.7 / A
19th St	11.7 / B	20.5 / C	11.7 / B	3.3 / A	36.4 / D	25.1 / C	18.4 / B	32.0 / C	15.2 / B	16.2 / B	5.9 / A
18th St	11.6 / B	21.5 / C	11.6 / B	4.2 / A	35.6 / D	28.9 / C	26.8 / C	25.8 / C	23.4 / C	21.0 / C	7.1 / A
17th St	13.7 / B	20.7 / C	12.5 / B	3.8 / A	48.3 / D	33.1 / C	34.8 / C	38.4 / D	27.9 / C	22.8 / C	7.5 / A
16th St	11.6 / B	21.3 /C	11.6 / B	4.3 / A	31.9 / C	27.8 / C	26.3 / C	23.9 / C	16.5 / B	21.4 /C	6.9 / A
15th St	12.4 / B	20.3 / C	12.4 / B	12.4 / B	19.9 / B	12.0 / B	12.0 / B	19.0 / B	10.4 / B	13.5 / B	5.3 / A
Broad St	27.6 / C	41.4 / D	41.4 / D	41.4 / D	39.2 / D	39.2 / D	39.2 / D	40.1 / D	40.1 / D	40.1 / D	40.6 / D
13th St	15.5 / B	15.5 / B	15.5 / B	7.9 / A	17.0 / B	17.0 / B	9.3 / A	18.4 / B	18.4 / B	8.5 / A	5.2 / A
12th St	13.1 / B	19.9 / B	13.1 / B	4.2 / A	29.1 / C	20.5 / C	15.9 / B	19.8 / B	13.3 / B	7.4 / A	6.9 / A
11th St	16.3 / B	24.2 / C	16.3 / B	9.9 / A	23.3 / C	17.5 / B	13.5 / B	26.9 / C	17.1 / B	9.7 / A	10.1 / B
10th St	12.9 / B	20.0 / C	12.9 / B	4.2 / A	28.0 / C	14.5 / B	16.8 / B	19.3 / B	17.7 / B	6.8 / A	6.7 / A
9th St	12.0 / B	20.2 / C	12.0 / B	4.3 / A	24.6 / C	18.3 / B	20.6 / C	29.8 / C	18.7 / B	9.4 / A	8.2 / A
8th St	14.0 / B	14.0 / B	14.0 / B	4.9 / A	20.4 / C	20.4 / C	9.6 / A	16.0 / B	16.0 / B	10.9 / B	7.5 / A
Passyunk Ave	5.2 / A	5.2 / A	5.2 / A	5.2 / A	19.0 / B	19.0 / B	23.1 / C	10.3 / B	10.3 / B	10.3 / B	6.3 / A
7th St	11.9 / B	11.9 / B	11.9 / B	4.6 / A	19.8 / B	19.8 / B	14.3 / B	15.0 / B	15.0 / B	8.4 / A	8.2 / A
6th St	13.0 / B	20.5 / C	13.0 / B	11.4 / B	24.2 / C	16.8 / B	8.6 / A	26.9 / C	17.2 / B	6.6 / A	5.8 / A
5th St	6.3 / A	19.5 / B	11.5 / B	11.5 / B	28.7 / C	16.3 / B	12.6 / B	19.6 / B	16.6 / B	10.0 / B	6.2 / A
4th St	10.1 / B	20.9 / C	13.9 / B	10.8 / B	21.6 / C	18.7 / B	23.7 / C	24.6 / C	12.5 / B	6.7 / A	7.9 / A
Synchro Arterial LOS											
EB	D	D	D	C	F	F	F	F	F	F	D
WB	D	D	D	D	F	F	F	F	F	F	D
SimTraffic Travel Time (sec)											
EB	496.7 8.3 mins	660 11.0 mins	522.3 8.7 mins	442.6 7.4 mins	2215.1 36.9 mins	2044.8 34.1 mins	1831.6 30.5 mins	1377.0 23.0 mins	1380.9 23.0 mins	1293.9 21.6 mins	536.2 8.9 mins
WB	499.9 8.3 mins	675.9 11.3 mins	496.7 8.3 mins	606.9 10.1 mins	1646.1 27.4 mins	1434.1 23.9 mins	1406.6 23.4 mins	1501.6 25.0 mins	1161.4 19.4 mins	1123.3 18.7 mins	528.2 8.8 mins

JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

Figure 7 – Washington Avenue AM Peak Hour Eastbound Travel Time



JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

Figure 8 – Washington Avenue AM Peak Hour Westbound Travel Time

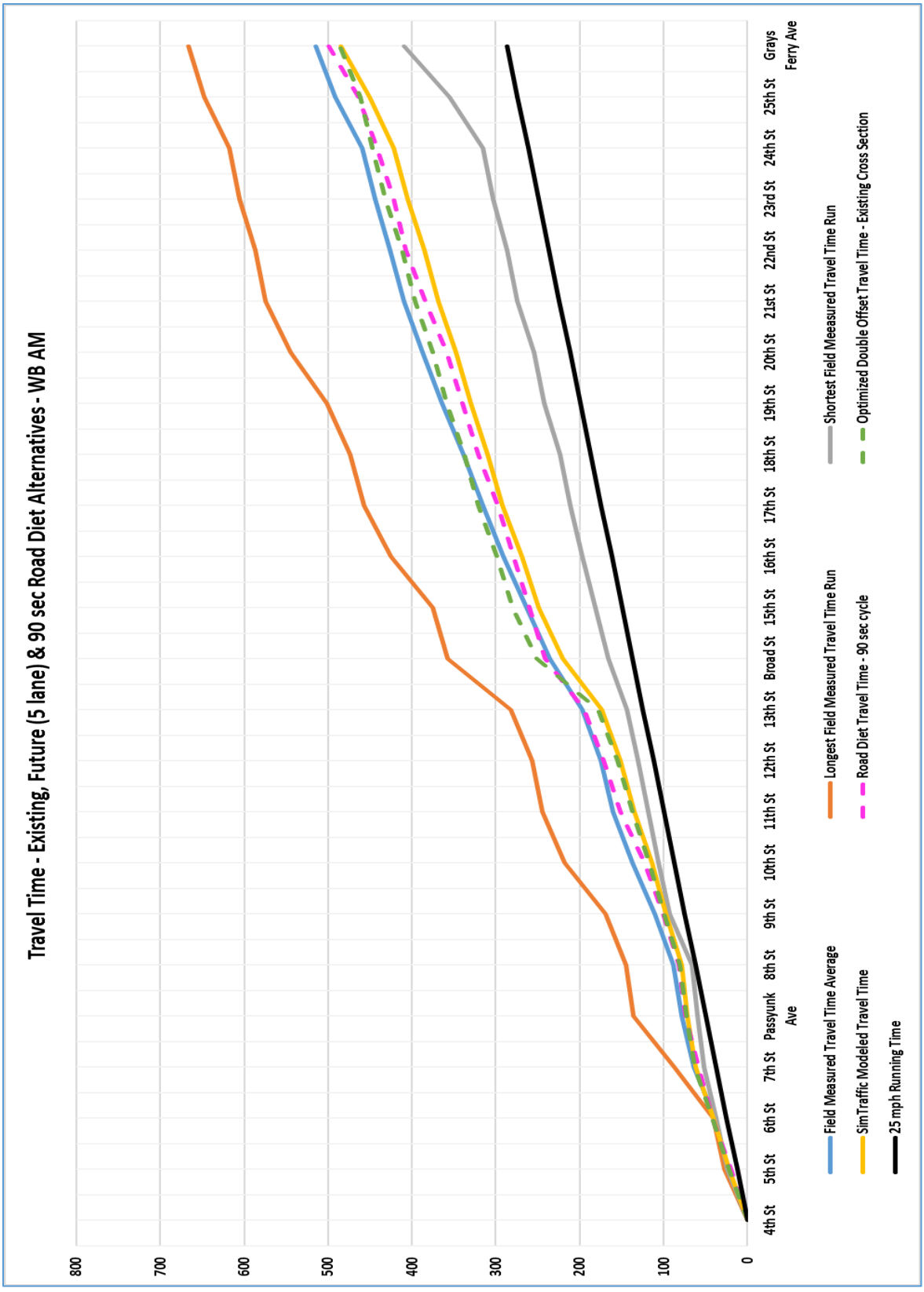


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Figure 9 – Washington Avenue PM Peak Hour Eastbound Travel Time

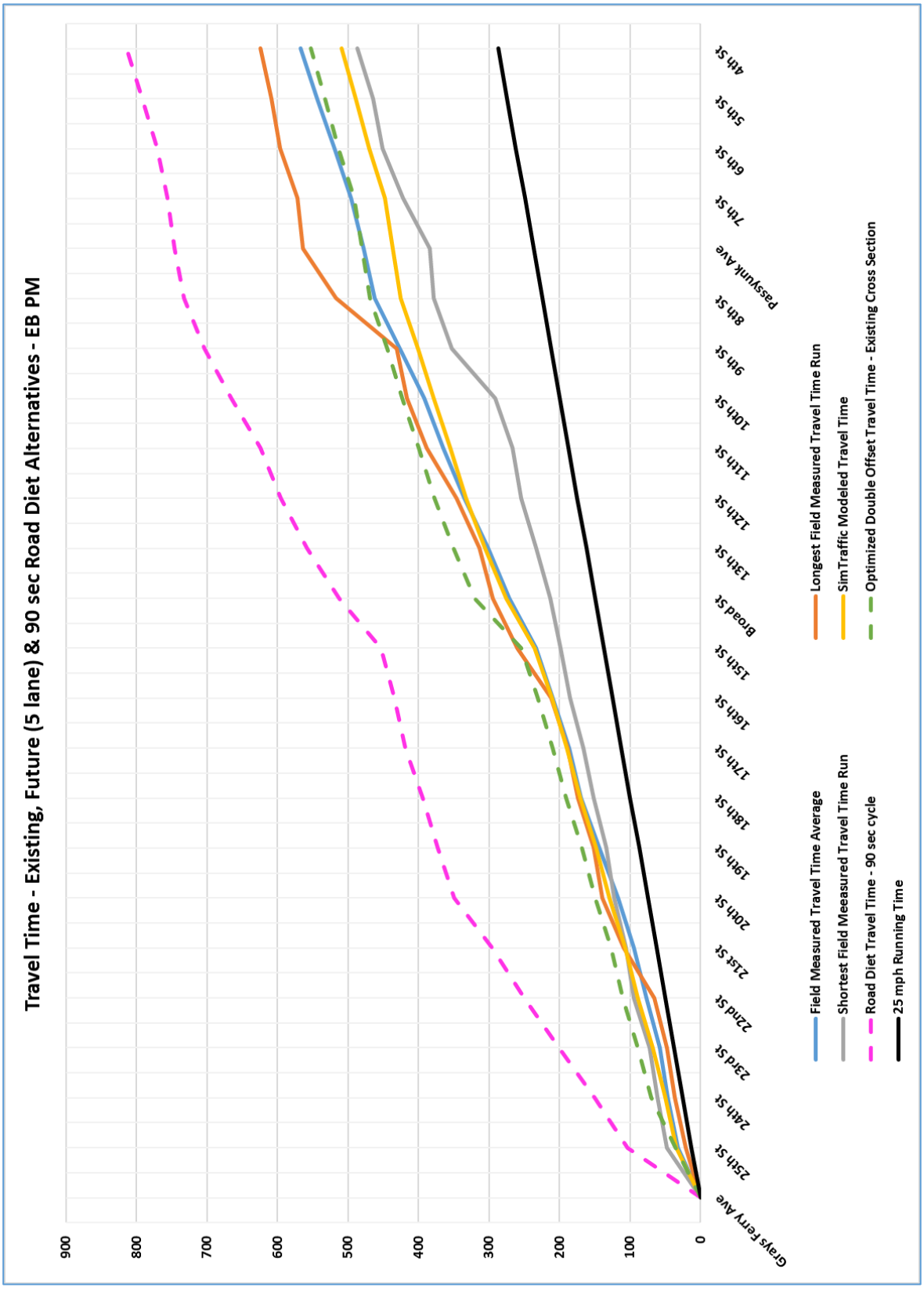

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Figure 10 – Washington Avenue PM Peak Hour Westbound Travel Time

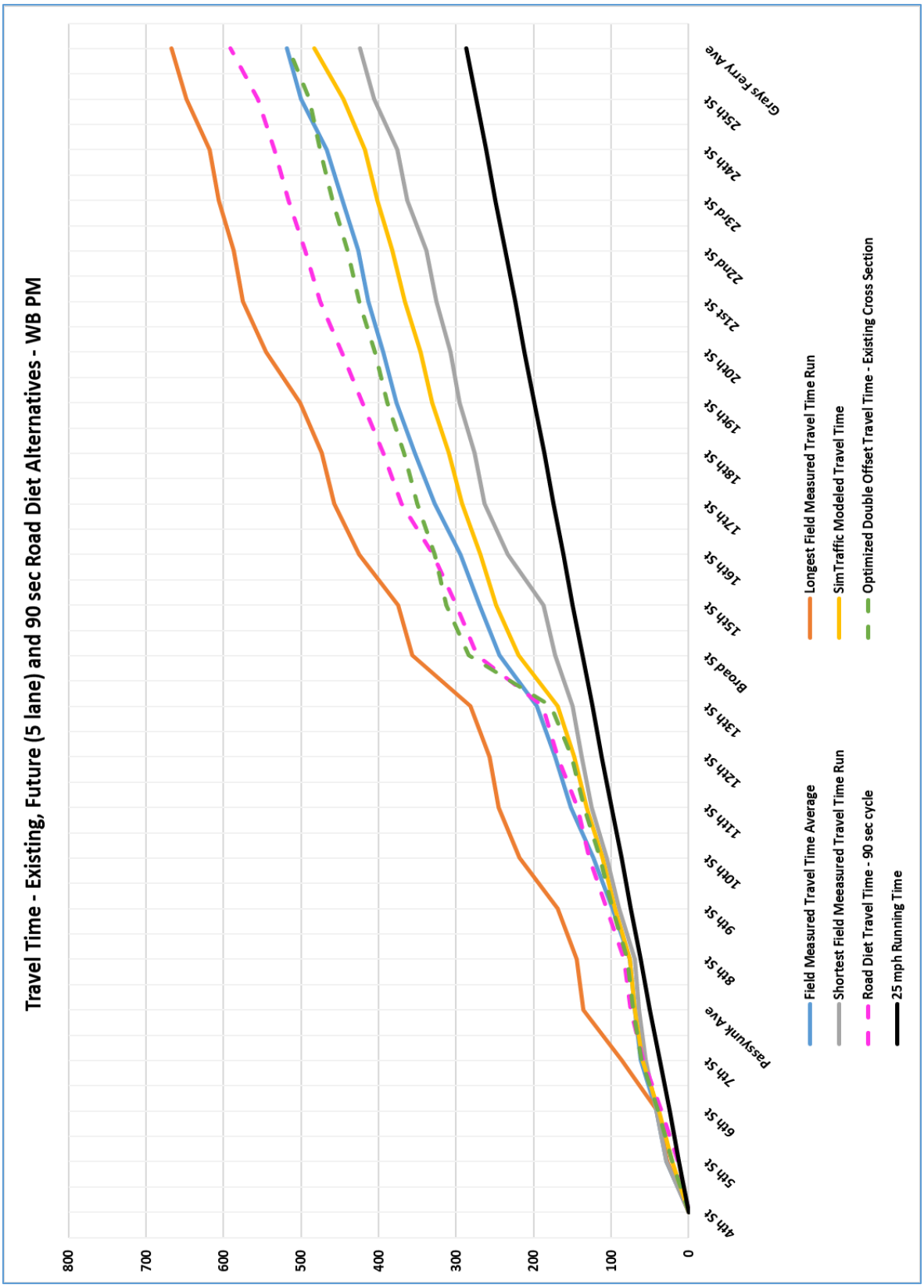

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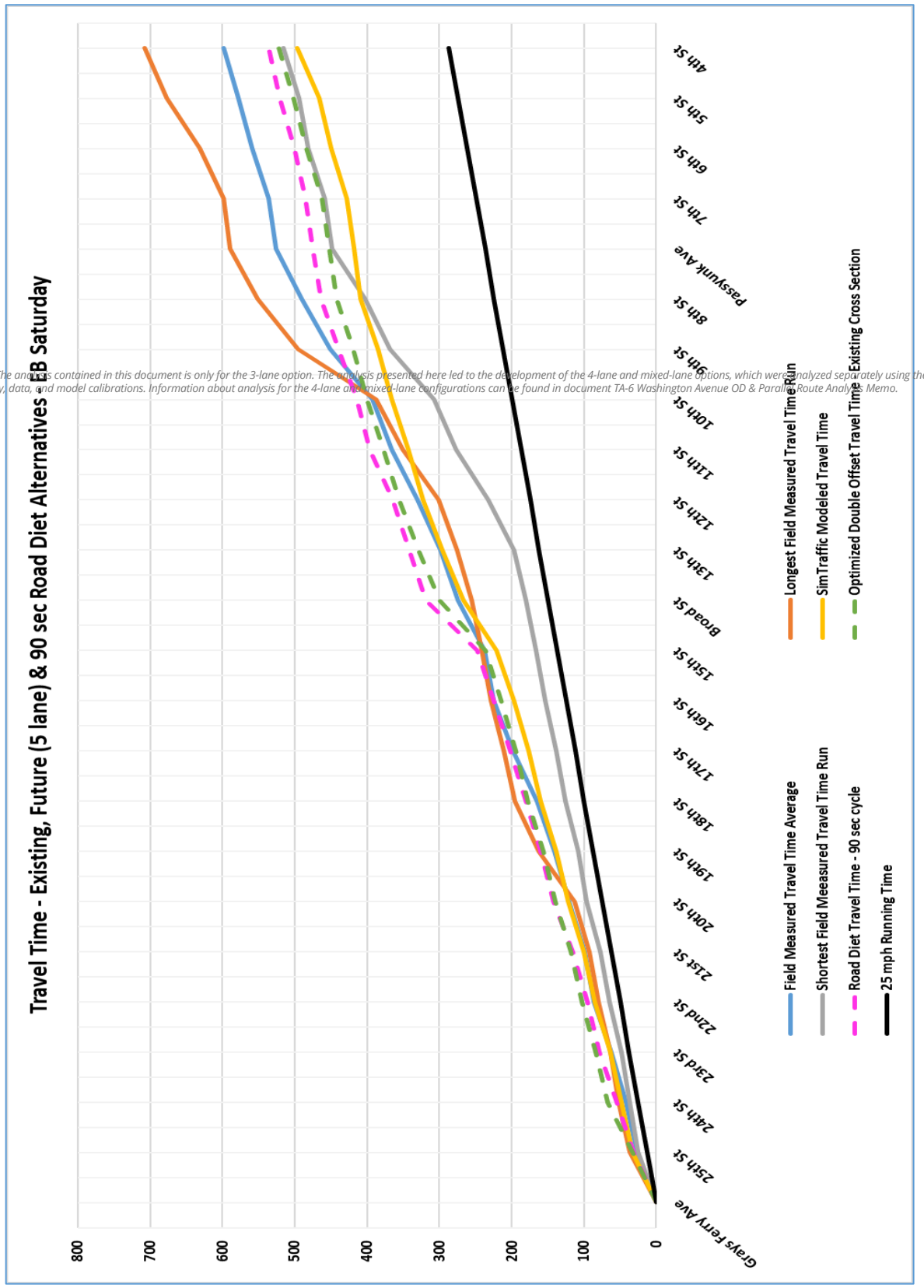
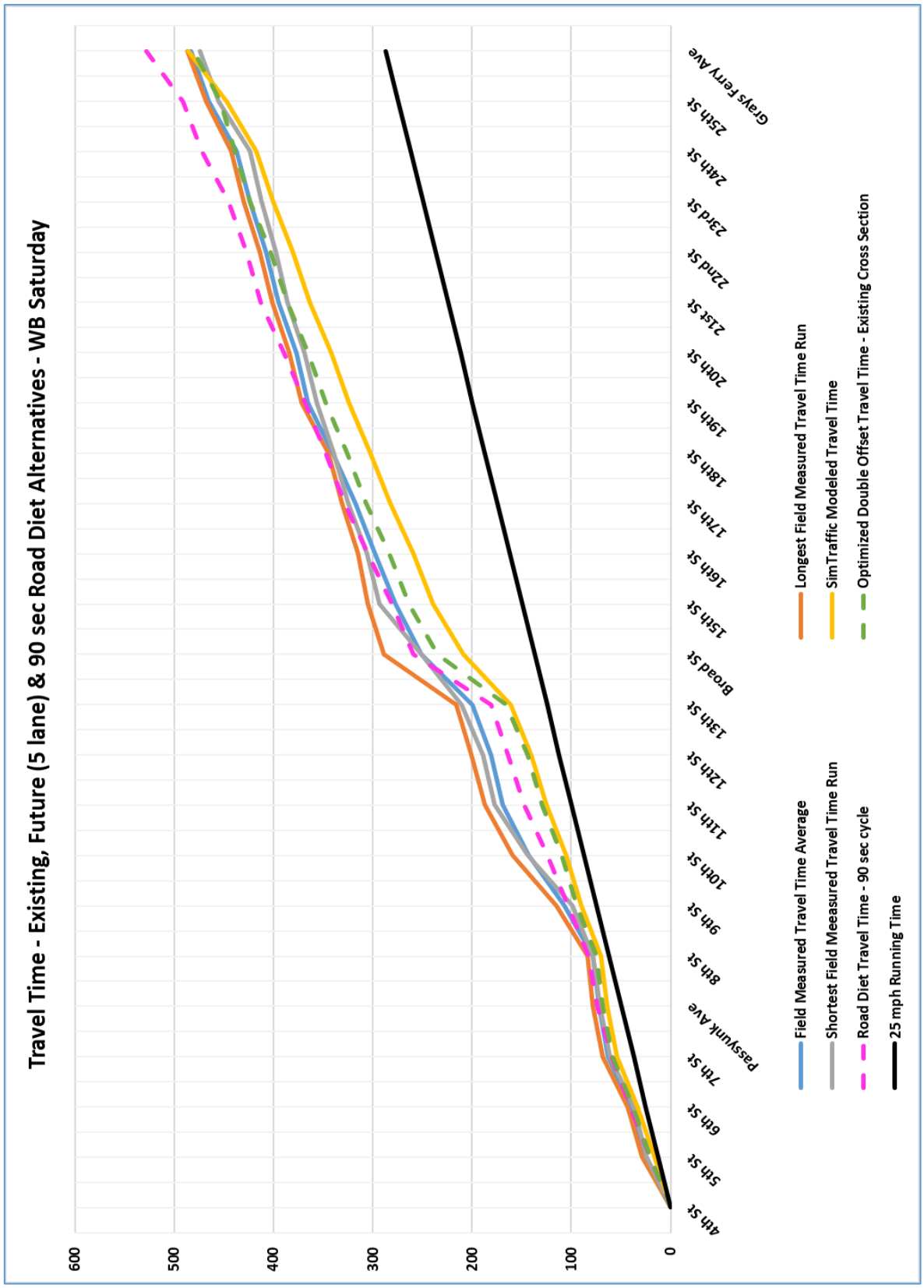
Figure 11 – Washington Avenue Saturday Peak Hour Eastbound Travel Time



JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

Figure 12 – Washington Avenue Saturday Peak Hour Westbound Travel Time



JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

5 SUMMARY OF FINDINGS

5.1 TRAFFIC ANALYSIS

A Synchro corridor analysis was conducted along Washington Avenue for three peak periods (weekday AM, weekday PM, and weekend Saturday). Existing condition models were calibrated and utilized for the following future scenarios:

- Future Conditions (Existing Geometry – Optimized)
  - Synchro derived offsets
  - Double alternate offsets
  - Single alternate offsets
- Future Conditions (Selective Road Diet Concept – Optimized)
  - Synchro derived offsets (60 second cycle length)
  - Double alternate offsets (60 second cycle length)
  - Single alternate offsets (60 second cycle length)
  - Synchro derived offsets (65 second cycle length)
  - Double alternate offsets (65 second cycle length)
  - Single alternate offsets (65 second cycle length)

Based on the results of the Selective Road Diet Concept (2015 Study) analysis, both the existing 60 and proposed 65 second cycle lengths along the corridor yields a decrease in the arterial's level of service and increase in travel times. This being the case, a 90 second cycle length was analyzed for the corridor and shown to provide a viable alternative option for the selective road diet concept. However, the following considerations should be noted:

- While HCM 2010 reports the side street delay as LOS D or better, longer queues were observed at the following intersections during the SimTraffic simulations:
  - Southbound 15th Street and southbound 19th Street during the PM peak hour. The southbound 15th Street approach can likely be adjusted in the field to provide more green time due to the 5-lane cross section along Washington Avenue in the vicinity of this intersection.
  - Northbound 11th Street, 9th Street, and 18th Street during the AM peak hour. Longer queues and cycle failures only occurred occasionally during the SimTraffic simulations.
- During the PM peak hour, the eastbound approach to 25th Street is near capacity due to the high volume of traffic originating from northbound Grays Ferry Avenue. Much of this traffic originates outside of the local Washington Avenue network and causes the majority of the delay west of Broad Street.
- The eastbound left turn onto 11th Street in the AM peak hour and the westbound left turn onto 19th Street during the PM peak hour occasionally spills back through the center left-turn lane into the through travel lane. This causes propagating delays throughout the system. The left turn headway factors were reduced at these locations to match the driver behavior observed at the Broad Street intersection during the travel time runs.

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5.2 SAFETY REVIEW

There were 187 crashes that occurred along Washington Avenue during this five-year period, of which three were fatal crashes, two pedestrians and one vehicular.

Of particular interest, there were a high number of bicycle and pedestrian crashes along the corridor. While pedestrians and bicycles accounted for 10% of roadway users, they accounted for 41% of all crashes.

The removal of a travel lane in each direction is likely to slow motorists, thereby creating a safer roadway for vulnerable road users. By creating a more inviting roadway for alternative modes of transportation, crashes involving bicyclists and pedestrians can be expected to decrease in severity and rate.

5.3 NEXT STEPS (FURTHER STUDY)

The following traffic-related alternatives and approaches are recommended for the City of Philadelphia to consider as they continue to evaluate transportation options for the Washington Avenue corridor:

1. Selective Road Diet Concept (90 second cycle length) –
    a) Potential right turn lane removal along Washington Avenue at locations with minor right turn volumes, specifically near 40 vehicles during any peak hour [Based on PennDOT Publication 46 warrants for right turn lanes (Chapter 11, Figure 9)].
        - Passyunk Avenue
        - 21st Street
        - 23rd Street
        - 24th Street

    b) Left turn restrictions from short left turn storage due to existing geometry. By eliminating these left turns, potential spillback to the Washington Avenue through lanes may be eliminated.
        - Passyunk Avenue

    c) Left turn diversions where volumes show spillback onto Washington Avenue through lanes:
        - Washington Avenue eastbound left turns onto northbound 11th Street during the AM peak hour.
        - Washington Avenue westbound left turns onto southbound 19th Street during the PM peak hour.

    d) Bus queue jump lanes. The following locations were identified where side street simulation queues were noted:
        - Northbound 11th Street
        - Southbound 12th Street
        - Southbound 19th Street

    These jump lanes are designed to help buses bypass queued traffic and merge back to the flow of traffic after pickups/drop-offs.

2. Origin destination study to determine if commuter traffic is using Washington Avenue to bypass I-76 and I-676 or if the majority of the vehicular traffic is local in origin.

3. While the 90 second cycle length was analyzed due to the PM peak being the critical hour, shorter cycle lengths can be considered for the AM, Saturday, and off-peak periods.

4. Based on results from the future conditions model, the following option may warrant additional consideration/study:

JULY 2020 NOTE: The analysis contained in this document is only for the 3-lane option. The analysis presented here led to the development of the 4-lane and mixed-lane options, which were analyzed separately using the same methodology, data, and model calibrations. Information about analysis for the 4-lane and mixed-lane configurations can be found in document TA-6 Washington Avenue OD & Parallel Route Analysis Memo.

a) Modified Road Diet Concept [i.e. unbalanced section with two lanes towards Broad Street and one lane away from Broad Street] with a 90 second cycle length as follows:
    - Two lanes eastbound west of Broad Street, one lane westbound west of Broad Street
    - Two lanes westbound east of Broad Street, one lane eastbound east of Broad Street

The two-lane sections allow for sufficient gaps to accommodate opposite direction left turn movements. Of the two options presented, the eastbound two-lane section west of Broad Street would be more necessary to maintain the reduced travel time of vehicular traffic. However, maintaining a two-lane section with a higher cycle length may increase speeds in that direction.

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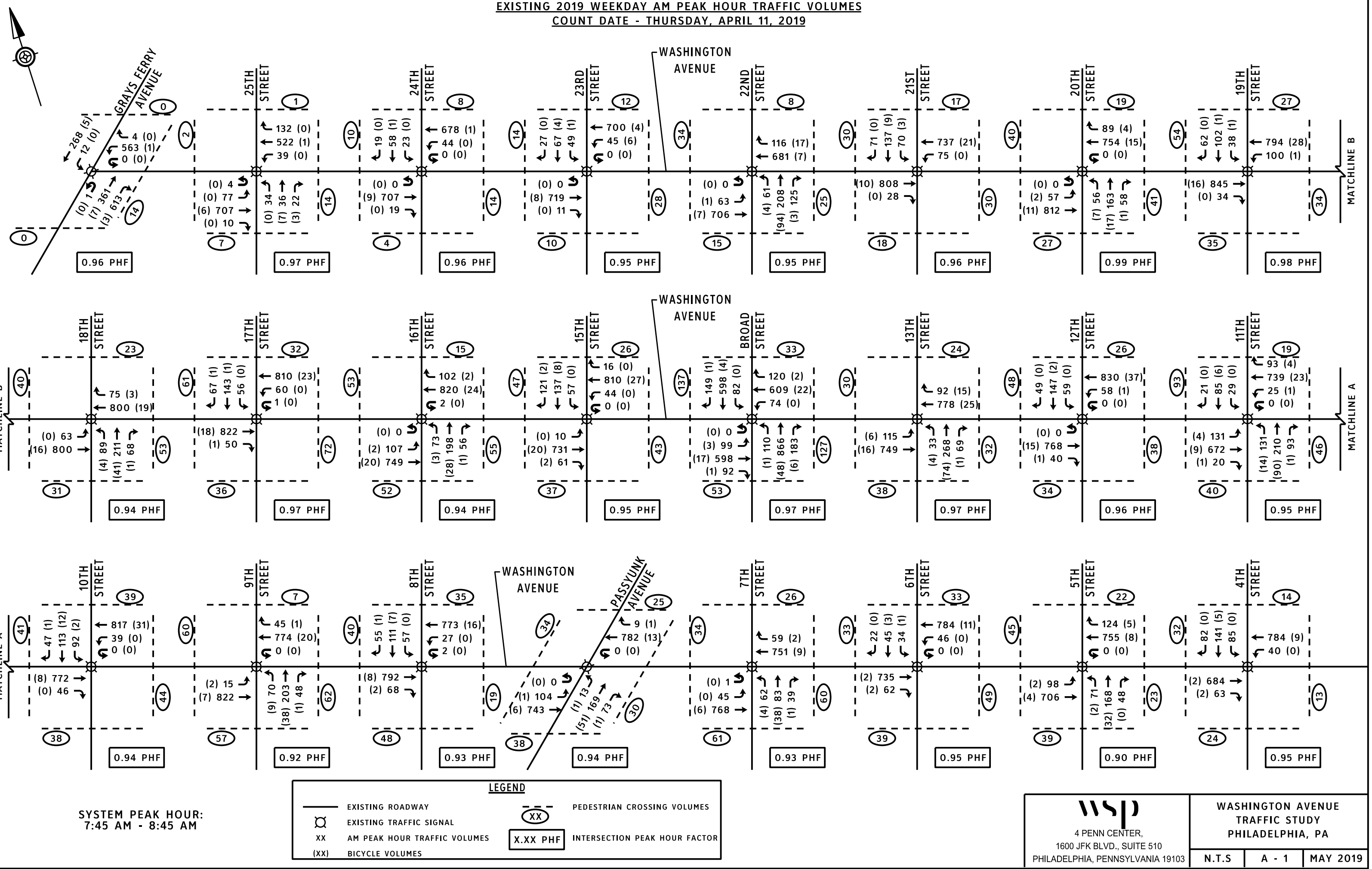
APPENDIX

A

TRAFFIC VOLUME FIGURES

EXISTING 2019 WEEKDAY AM PEAK HOUR TRAFFIC VOLUMES
COUNT DATE - THURSDAY, APRIL 11, 2019



SYSTEM PEAK HOUR:
7:45 AM - 8:45 AM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- XX AM PEAK HOUR TRAFFIC VOLUMES
- (XX) BICYCLE VOLUMES
- (XX) PEDESTRIAN CROSSING VOLUMES
- X.XX PHF INTERSECTION PEAK HOUR FACTOR

WSP
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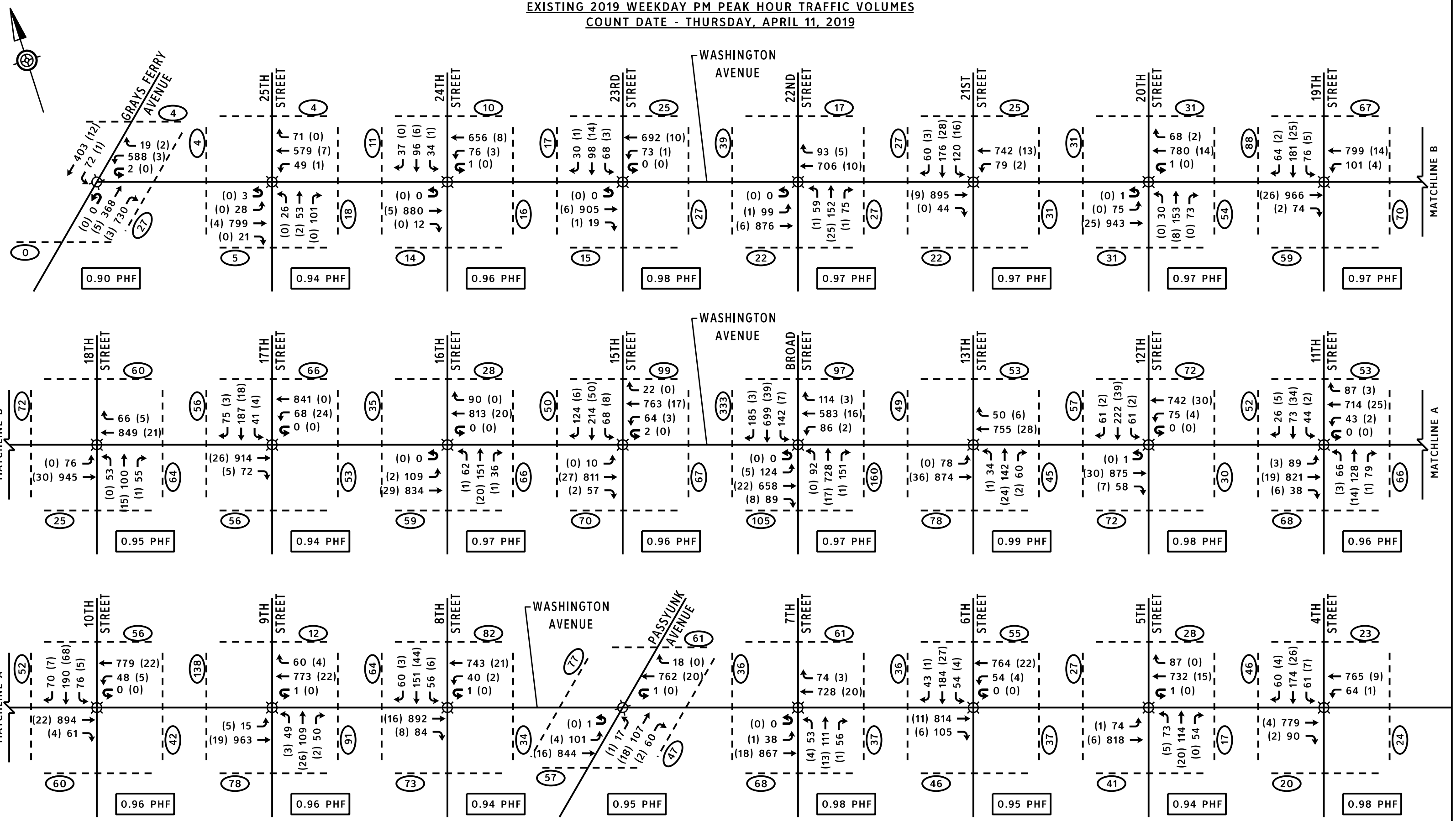
1600 JFK BLVD., SUITE 510
PHILADELPHIA, PENNSYLVANIA 19103

WASHINGTON AVENUE TRAFFIC STUDY
PHILADELPHIA, PA

N.T.S	A - 1	MAY 2019

EXISTING 2019 WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES
COUNT DATE - THURSDAY, APRIL 11, 2019



SYSTEM PEAK HOUR:
5:00 PM - 6:00 PM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- XX — PM PEAK HOUR TRAFFIC VOLUMES
- (XX) — BICYCLE VOLUMES
- (XX) — PEDESTRIAN CROSSING VOLUMES
- X.XX PHF — INTERSECTION PEAK HOUR FACTOR

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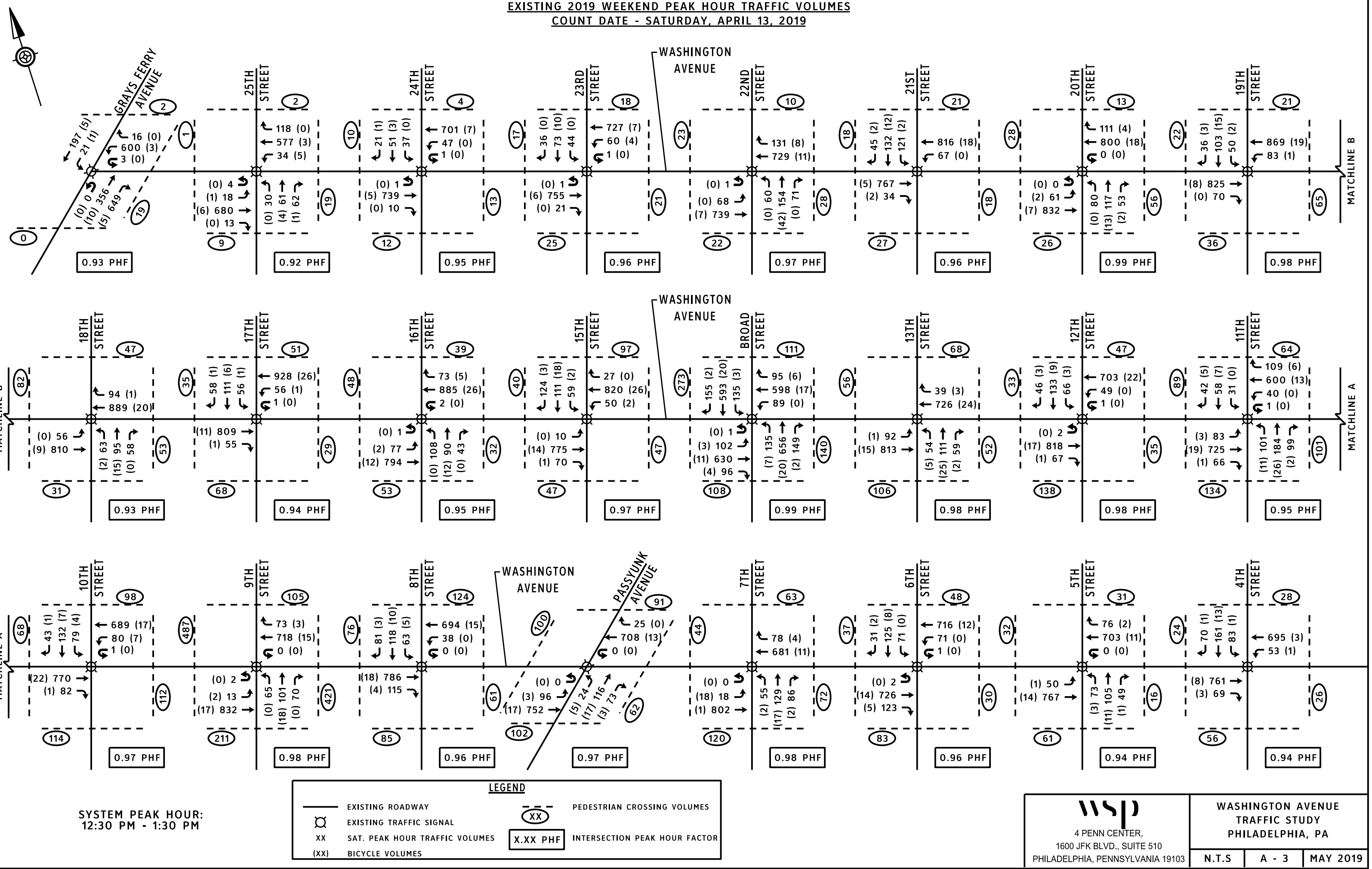
WASHINGTON AVENUE TRAFFIC STUDY PHILADELPHIA, PA		
N.T.S	A - 2	MAY 2019

EXISTING 2019 WEEKEND PEAK HOUR TRAFFIC VOLUMES
COUNT DATE - SATURDAY, APRIL 13, 2019



SYSTEM PEAK HOUR:
12:30 PM - 1:30 PM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- XX SAT. PEAK HOUR TRAFFIC VOLUMES
- (XX) BICYCLE VOLUMES
- (XX) PEDESTRIAN CROSSING VOLUMES
- X.XX PHF INTERSECTION PEAK HOUR FACTOR

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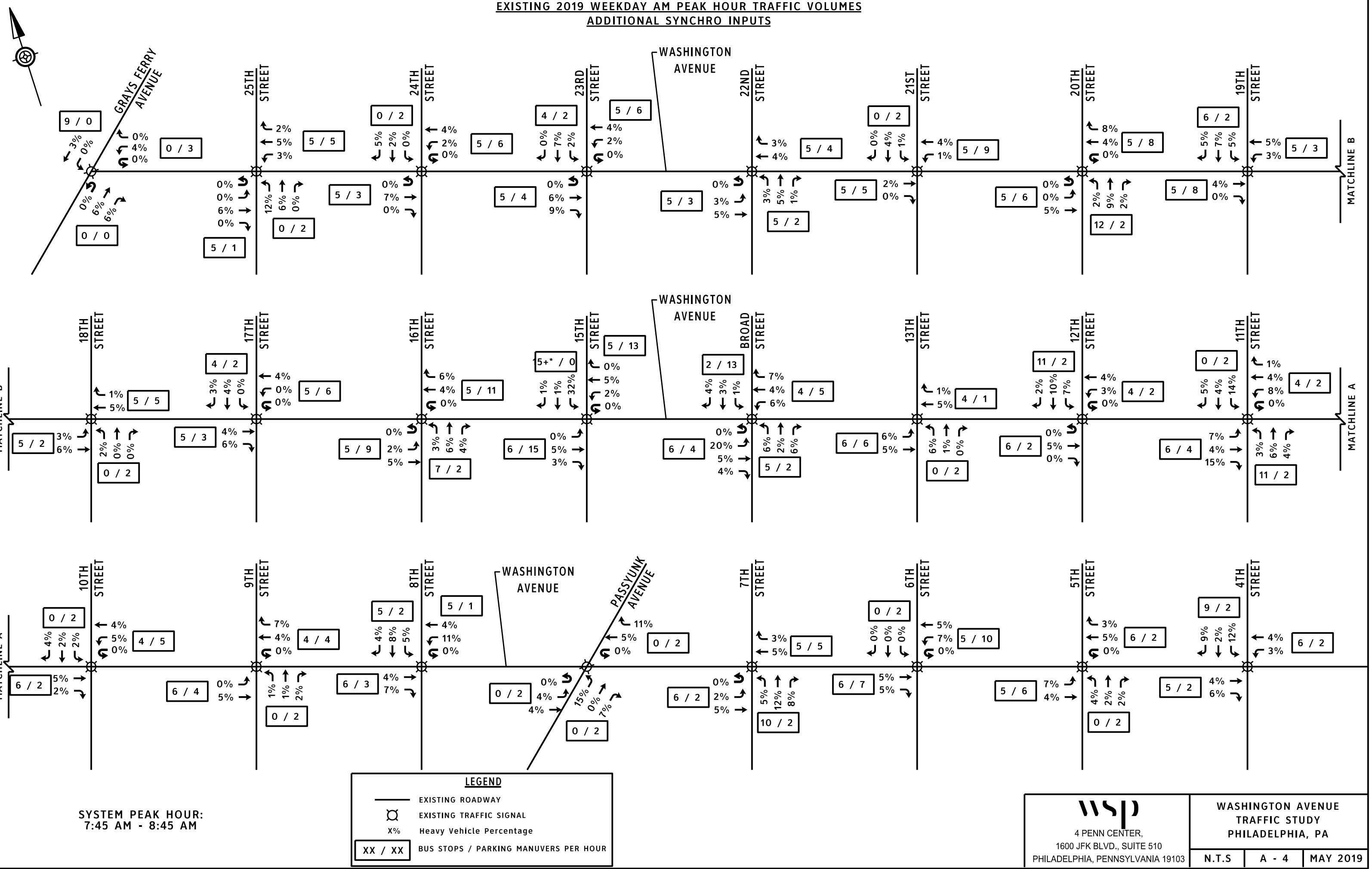
N.T.S	A - 3	MAY 2019

EXISTING 2019 WEEKDAY AM PEAK HOUR TRAFFIC VOLUMES
ADDITIONAL SYNCHRO INPUTS



SYSTEM PEAK HOUR:
7:45 AM - 8:45 AM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- X% Heavy Vehicle Percentage
- XX / XX BUS STOPS / PARKING MANUVERS PER HOUR

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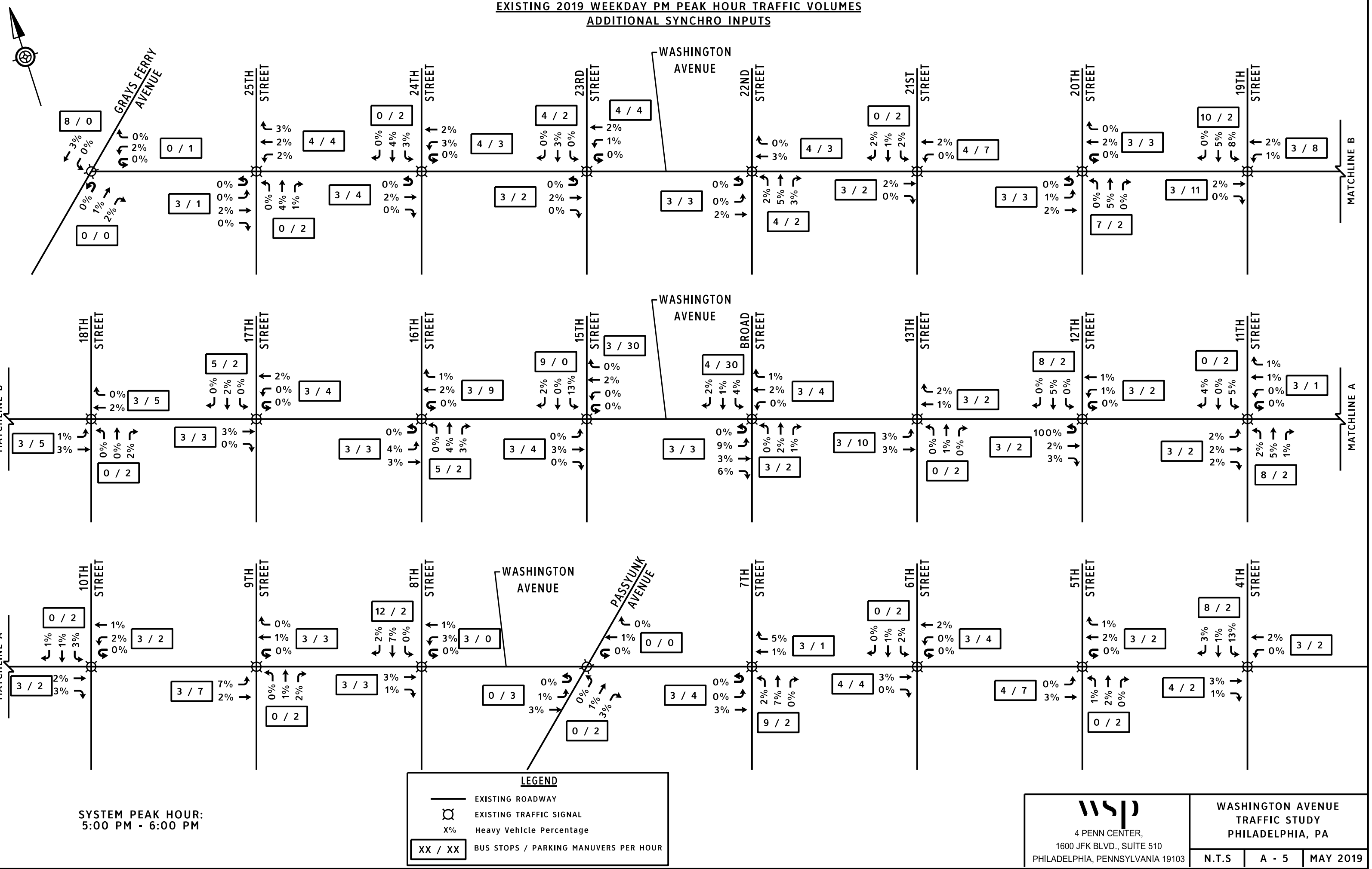
N.T.S	A - 4	MAY 2019

EXISTING 2019 WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES
ADDITIONAL SYNCHRO INPUTS



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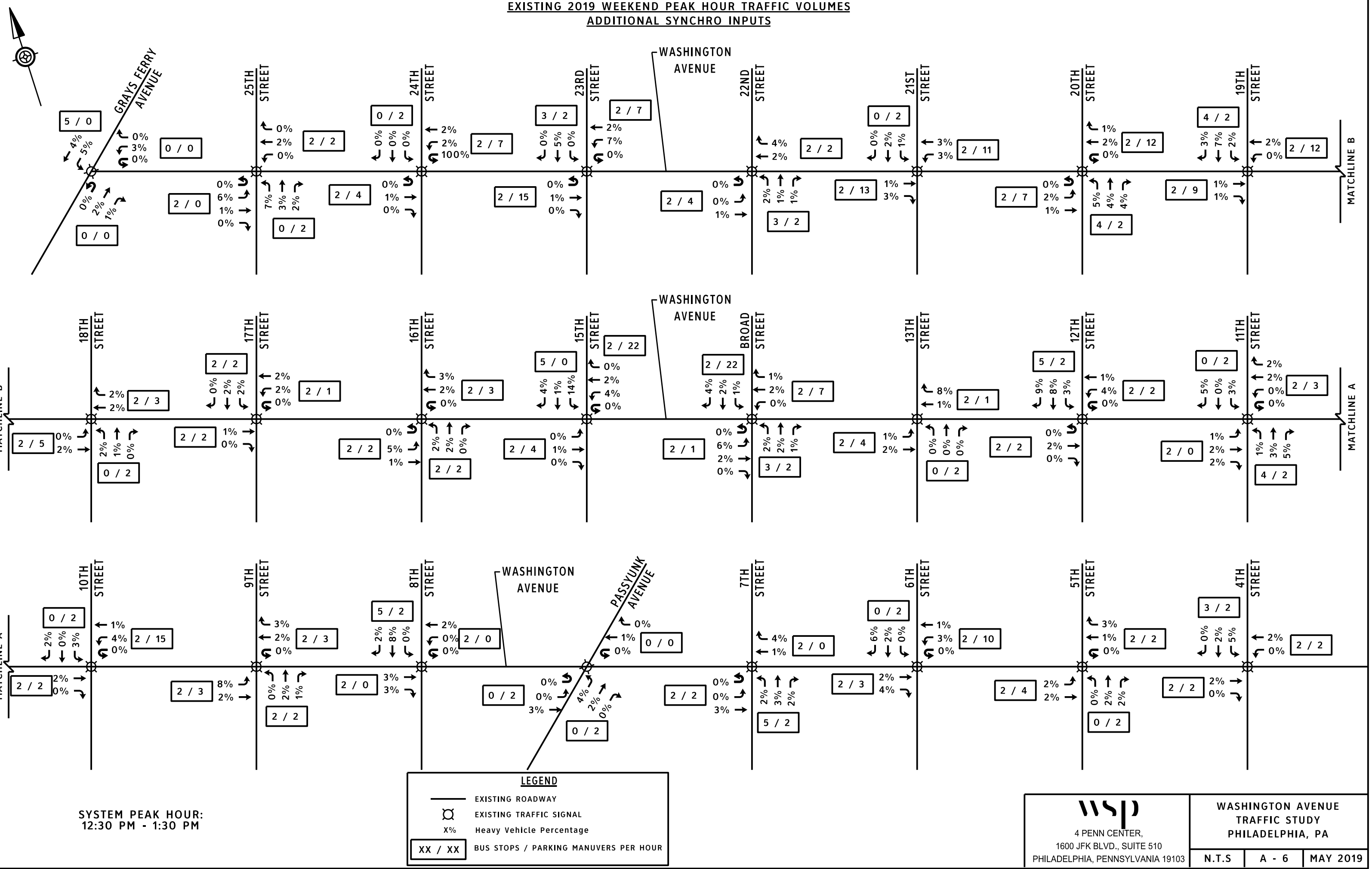
WASHINGTON AVENUE TRAFFIC STUDY
PHILADELPHIA, PA

N.T.S	A - 5	MAY 2019

EXISTING 2019 WEEKEND PEAK HOUR TRAFFIC VOLUMES
ADDITIONAL SYNCHRO INPUTS



SYSTEM PEAK HOUR:
12:30 PM - 1:30 PM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- X% Heavy Vehicle Percentage
- XX / XX BUS STOPS / PARKING MANUVERS PER HOUR

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WASHINGTON AVENUE
TRAFFIC STUDY
PHILADELPHIA, PA

N.T.S	A - 6	MAY 2019

OTIS
Office of Transportation, Infrastructure, & Sustainability
CITY OF PHILADELPHIA

TA-4
Washington Avenue OD and Parallel Route Analysis Memo

Notes
None

MEMO

TO: Office of Transportation, Infrastructure, and Sustainability (oTIS)

FROM: WSP – USA

SUBJECT: WO #23 - Washington Avenue Concept Development – Traffic Analysis Summary

DATE: DRAFT June 30, 2020

In the Spring of 2020, the City's Office of Transportation, Infrastructure, and Sustainability (oTIS) engaged WSP to assist in developing and evaluating street reconfiguration options for Washington Avenue between Grays Ferry Avenue and 4th Street that can be implemented by the Streets Department through a planned repaving project. This memorandum summarizes the methodology and results from the traffic analysis conducted as part of that effort. The 2020 work builds on previous traffic analysis that was completed by WSP in 2019 along the same corridor.

Washington Avenue between Grays Ferry Avenue and Delaware Avenue is scheduled to be repaved by the City of Philadelphia in 2021. The City aims to use this repaving project as an opportunity to create a safer and more accessible corridor by improving vehicular operations related to speed and safety, implementing pedestrian safety improvements, adding protected bike lanes along the corridor, and accommodating future enhancements to bus service/operations. The project study area is illustrated in Figure 1.

Washington Avenue is currently a 5-lane cross section roadway with two lanes in each direction and a center two-way left turn lane. As the repaving project will occur within the existing roadway and will not change curb lines, it is the City's intention use new pavement markings to stripe the selected street reconfiguration concept along the corridor.

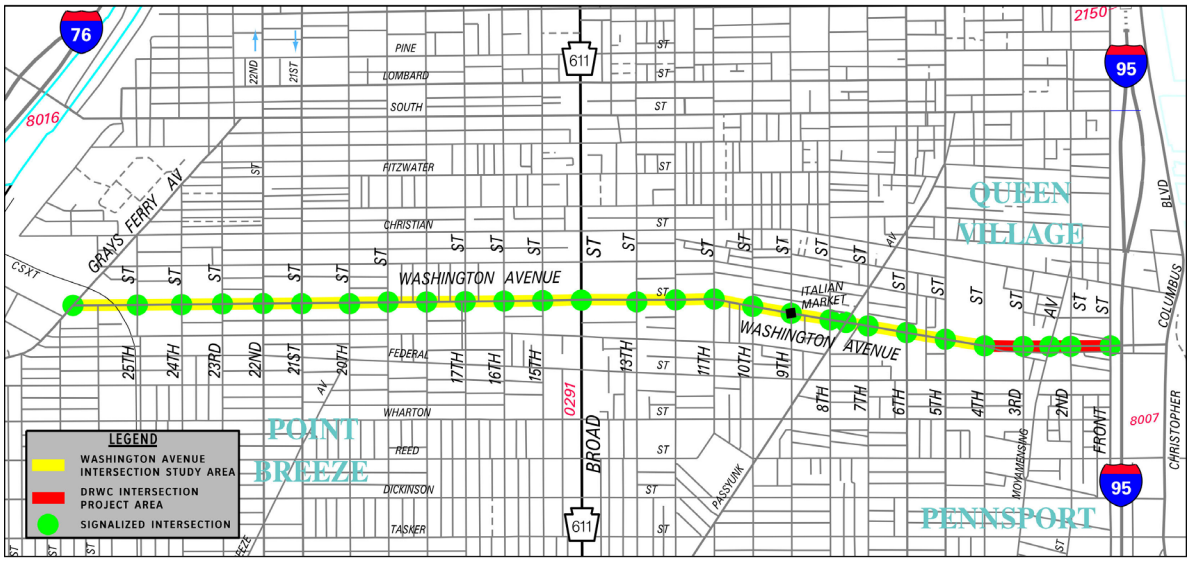


Figure 1: Washington Avenue Traffic Study - Project Study Area

In 2019, WSP developed the *Washington Avenue Traffic Study*, which analyzed the corridor based on a "Selective Road Diet Concept" (later referred to as the 3-Lane Option) with the following typical sections:

- 3-lane cross section west of 16th Street
- 4-lane cross section between 16th Street and 15th Street
- 5-lane cross section between 15th Street and 13th Street
- Transitional 4-lane section between 13th Street and 12th Street
- 3-lane cross section between 12th Street and 5th Street
- Transitional 4-lane section between 5th Street and 4th Street
- 5-lane cross section between 4th Street and Front Street *

Results from the 2019 study showed that a longer cycle length (90 seconds vs. 60 seconds in the existing condition) would be needed along the corridor during the peak hours to offset the reduced lane capacity. However, simulations from Synchro/SimTraffic showed some intersection locations with noticeable backups. Based on next steps outlined in the report and correspondence with the City, the following items were incorporated into the 2020 effort:

1. **Origin-Destination (O/D) Analysis:** travel data provided by a third-party vendor (StreetLight Data) was used to determine how motorists are currently using Washington Avenue. For instance, is commuter traffic using the corridor to bypass I-76, I-676, or I-95? Or is most of the vehicular traffic local in origin?
2. **Evaluation of Alternatives**: Traffic operations were modeled for the following three alternatives:

    - Option A: 3 Lane Cross-Section (Selective Road Diet Concept from January 2020 study)
      Variations of the original concept outlined above were analyzed including:
        - Right turn lane removal along Washington Avenue at all locations, except in the eastbound direction at S. 19th Street and the westbound direction at S. 11th Street
        - Right turn lanes at all intersection along the corridor.
        - Left turn diversions where volumes show spillback onto Washington Avenue through lanes during the PM peak hour (i.e. primarily at southbound 19th Street)
        - Analyses examining 0%, 5%, and 10% diversion to parallel routes

    - Option B: 4 Lane Cross Section (Modified Road Diet Concept from January 2020 study)
        - 4-lane cross section west of 16th Street
        - 5-lane cross section between 16th Street and 13th Street
        - 4-lane transitional section between 13th Street and 12th Street
        - 4-lane cross section between 12th Street and 5th Street
        - Transitional 4-lane section between 5th Street and 4th Street
        - 5-lane cross section between 4th Street and Front Street *

    - Option C: Mixed Cross-Section (New Alternative)
        - 3-lane cross section between Grays Ferry Avenue and S. 20th Street
        - 4-lane cross section between S. 20th Street and S. 16th Street
        - 5-lane cross section between S. 16th Street and S. 12th Street
        - 4-lane transitional cross section between S. 12th Street and S. 10th Street
        - 3-lane cross section between S. 10th Street and S. 5th Street
        - 4-lane transitional section between S. 5th Street and S. 4th Street
        - 5-lane cross section between S. 4th Street and Front Street *

      ** This section will be implemented through a separate project being led by the Delaware River Waterfront Corporation (DRWC)*

3. **Parallel Route Diversion Analysis** along Christian Street and Ellsworth Street to estimate the impact of potential diversion onto parallel streets based on results from the O/D analysis.

4. **Off-Peak Hour Analysis** to determine if a 60-second cycle length could be implemented for the selected alternative during off-peak hours. The main benefit of using a 60-second cycle during these periods would be shorter waiting times for pedestrians looking to cross Washington Avenue from the side streets. This analysis cannot be completed until the City has decided on the preferred alternative; therefore, results from the off-peak hour analysis are not included in this memo.

ORIGIN & DESTINATION ANALYSIS

The trip data and analysis platform provided by a third-party vendor – StreetLight Data – was utilized to conduct the O/D study. The trip data is gathered from location-based cellphone data (personal vehicles/autos) and GPS device data (commercial trucks). The O/D study incorporated three types of analysis:

1. Using Washington Avenue as a middle filter (i.e. a zone in StreetLight that only analyzes motorists passing through that location), analyze the origin-destination pair of all motorists originating at the Grays Ferry Bridge, the S. 34th Street Bridge, westbound I-76, northbound I-95, and southbound Christopher Columbus Boulevard and traveling to one of the numbered zones illustrated in Figure **2** during the AM peak. The PM peak analysis was completed by swapping the origin and destination pairs to determine how motorists were leaving the city.
2. Main routes (i.e. Top Routes feature within StreetLight) were determined to outline the origins and destinations of vehicles passing through both the westernmost or easternmost extent of the Washington Avenue corridor.
3. Using Washington Avenue just east and west of Broad Street as a middle filter to determine the number of vehicles using Washington Street as a route to travel between zones.

Gates were setup along I-76, I-95, Columbus Boulevard, S. 34th Street, and Grays Ferry Avenue to capture trips passing through these roadways into each identified zone. The following gates and zones were developed to track vehicle destinations using Washington Avenue as part of their trip (shown in **Figure 2**).

Figure 2: Washington Avenue Zones and Gates

- Zone 1
  - North/South Limits – Grays Ferry Avenue / Oregon Avenue
  - East/West Limits – 26th & 27th Streets / I-76
- Zone 2
  - North/South Limits – Washington Avenue / Oregon Avenue
  - East/West Limits – Broad Street / 26th & 27th Streets
- Zone 3
  - North/South Limits – Washington Avenue / Oregon Avenue
  - East/West Limits – I-95 / Broad Street
- Zone 4
  - North/South Limits – Manning Street / Washington Avenue
  - East /West Limits – Broad Street / Schuylkill River
- Zone 5
  - North/South Limits – Manning Street / Washington Avenue
  - East/West Limits – I-95 / Broad Street
- Zone 6
  - North/South Limits – I-676 / Manning Street
  - East/West Limits – I-95 / Schuylkill River
- Zone 7
  - North/South Limits – Girard Avenue / I-676
  - East/West Limits – I-95 / Schuylkill River

- Gates
  - EB & WB Washington Avenue between Grays Ferry Road and S. 25th Street
  - EB & WB Washington Avenue between S. Water Street and S. Front Street
  - NB & SB Christopher Columbus Boulevard north of Christian Street
  - NB & SB I-95 south of Exit 20 and the Morris Street on-ramp.
  - EB & WB Grays Ferry Bridge
  - NB & SB University Avenue Bridge (S. 34th Street)
  - EB & WB I-76 between exits 347 and 346C.

All traffic analyses were conducted using count data collected in April of 2019 for the *Washington Avenue Traffic Study*. The validity of using only one month of StreetLight data (from April 2019) was verified by checking the one-month data against averaged data from the entirety of 2019. Results show that the April 2019 data is consistent with the yearly data.

Analysis of Regional Traffic Using Washington Avenue

Entering Washington Avenue

The purpose of the first analysis was to determine how regional traffic is utilizing Washington Avenue and test the possibility that commuters were using the study area to bypass traffic on adjacent freeways (I-76 or I-95) to either access Center City or traverse across the city. Entry gates were set up along the Grays Ferry Bridge, University City Bridge (S. 34th Street), westbound I-76, northbound I-95, and southbound Christopher Columbus Boulevard. Figure 3 shows the origin distribution of vehicles passing through each middle filter gate placed along Washington Avenue. Percentages do not sum to 100% as some motorists (5%-10%) continue through the entire corridor, others make a quick pick up/drop off and exit via the same entry gate, while others may park along Washington Avenue. In order to properly conduct an analysis of local trips between zones, the zones boundaries could not overlap Washington Avenue or Broad Street.

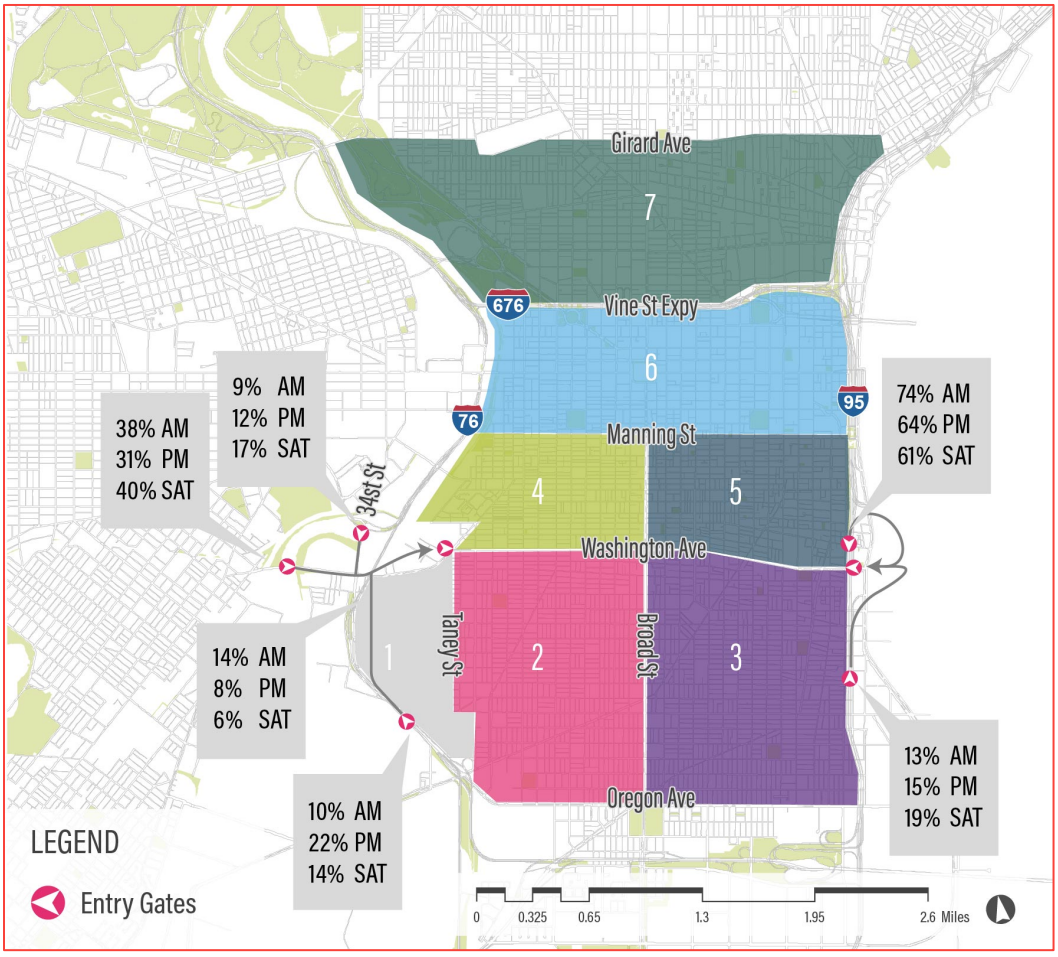


Figure 3: Percentages of Entering Traffic

Table 1 converts those percentages to volumes utilizing the counts conducted in April 2019 and shows the number of vehicles that access each zone during the AM, PM, and Saturday peak hours.

	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7
EB Grays Ferry Bridge	1 (4) [0]	48 (34) [33]	20 (37) [48]	68 (39) [55]	35 (43) [57]	48 (30) [7]	11 (3) [4]
SB University City Bridge	1 (2) [0]	14 (13) [22]	9 (18) [46]	9 (16) [7]	9 (13) [5]	9 (6) [0]	0 (2) [0]
WB I-76	1 (0) [0]	7 (17) [29]	4 (10) [13]	35 (51) [17]	6 (4) [10]	30 (56) [19]	1 (4) [3]
NB I-95	0 (1) [0]	2 (2) [2]	19 (16) [39]	9 (5) [6]	33 (65) [50]	23 (14) [5]	2 (1) [0]
SB Christopher Columbus Blvd	11 (9) [6]	203 (104) [37]	152 (228) [228]	48 (13) [7]	49 (38) [36]	13 (11) [5]	1 (4) [7]

Table 1: Entering Traffic Matrix

Based on the analysis results, there are not a significant number of drivers using Washington Avenue to bypass freeway traffic. Using visualizations available in the StreetLight platform, approximately 33% of motorists destined to Center City are exiting westbound I-76 at Exit 346C (Vare Avenue) to bypass queues, but they are rejoining the freeway at the Exit 346B interchange.

The greatest origin for motorists entering Washington Avenue from the west are the Grays Ferry Bridge and southbound Christopher Columbus Boulevard from the east (including traffic from the southbound I-95 off ramp).

Exiting Washington Avenue

Table 2 and Figure 4 show the results for motorists exiting the Washington Avenue corridor. Gates are placed in the same locations with the direction reversed. Similar to the entering traffic results, motorists do not use Washington Avenue to bypass freeway traffic and the largest percentage of motorists are destined to the Grays Ferry Bridge and northbound Christopher Columbus Boulevard.

	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7
WB Grays Ferry Bridge	4 (3) [6]	34 (41) [10]	40 (26) [10]	14 (46) [35]	17 (50) [54]	2 (24) [6]	1 (9) [0]
NB University City Bridge	3 (1) [0]	27 (13) [29]	48 (18) [44]	17 (13) [10]	27 (10) [8]	2 (5) [10]	0 (1) [0]
EB I-76	4 (2) [6]	19 (4) [12]	1 (1) [4]	44 (10) [19]	2 (1) [4]	4 (3) [2]	2 (0) [0]
SB I-95	2 (2) [0]	0 (0) [0]	9 (20) [17]	0 (1) [7]	99 (37) [24]	2 (6) [3]	0 (0) [0]
NB Christopher Columbus Blvd	11 (9) [0]	89 (108) [38]	302 (201) [236]	19 (23) [8]	48 (32) [45]	0 (18) [9]	0 (4) [0]

Table 2: Exiting Traffic Matrix

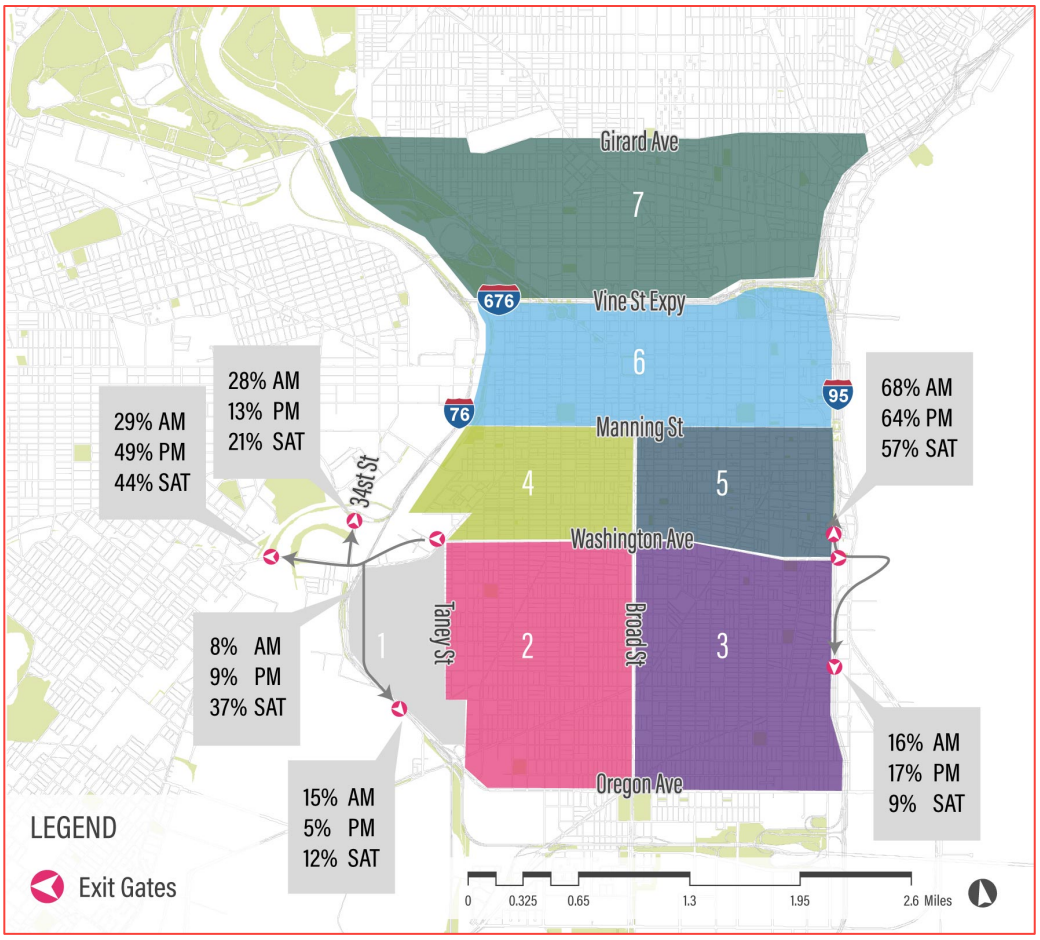


Figure 4: Percentages of Exiting Traffic

Top Routes, a feature within the StreetLight platform, can be used to determine the main routes that motorists traverse when accessing or departing a zone. In order to determine how regional traffic uses Washington Avenue, a Top Routes analysis was conducted at the entry and exit gates at the east and west ends of the corridor. Figure 5 conveys the local roadways used by motorists to **turn off of** Washington Avenue in both directions (i.e. destinations), while Figure 6 conveys the local roadways used by motorists **to turn on to** Washington Avenue in both directions (i.e. origins).

At the western end of the corridor, 50% of the regional traffic entering or exiting Washington Avenue is accounted for around S. 15th Street / Broad Street. At the eastern end of the corridor, 50% of the regional traffic entering or exiting Washington Ave is accounted for around S. 5th Street or S. 7th Street depending on the peak period. The grey line in Figure 5 and Figure 6 conveys the total amount of local traffic that is present within the corridor at that cross street. In these graphs, local traffic is defined as motorists that have an origin or destination within the study area**. It is notable that only around 5%-10% of the traffic present along Washington Avenue continues across the entire corridor.** The majority of motorists using Washington are local in nature and either driving to another location within the study area or leaving the corridor at the east and west extents.

Figure 5: Destinations of Vehicles Entering Washington Avenue (AM Peak)

Figure 6: Origins of Vehicles Exiting Washington Avenue (PM Peak)

Analysis of Local Traffic Using Washington Avenue

To gain an understanding of local zone-to-zone travel using the Washington Avenue corridor, a second analysis was conducted in the StreetLight platform using a middle filter just to the east and west of Broad Street. This type of analysis provides a general idea about the number of motorists that are driving short distances between the geographic zones shown in **Figure 2**.

Table 3 shows the number of motorists driving between two zones in the **eastbound direction** during the associated peak hour. Analyzing the volumes between zones that cross Broad Street at Washington Avenue and comparing to the total volume along the eastbound approach of the intersection indicates that zone-to-zone local traffic represents 27.4%, 19.6%, and 25.7% in the AM, PM, and Saturday peak hours, respectively.

	ZONE 2	ZONE 4	ZONE 5	ZONE 6
ZONE 1	12 (13) [45]	32 (24) [37]	48 (18) [8]	21 (6) [9]
ZONE 3	18 (39) [32]	10 (2) [20]	8 (6) [7]	4 (3) [0]
ZONE 5	5 (23) [18]	0 (6) [4]	0 (0) [0]	0 (0) [0]
ZONE 6	2 (6) [6]	3 (1) [0]	0 (0) [0]	0 (0) [0]
ZONE 7	13 (11) [10]	23 (6) [8]	16 (7) [6]	1 (0) [3]

Table 3: Local Traffic Matrix - Eastbound Traffic

Similarly, Table 4 shows the number of motorists driving between two zones in the **westbound direction** during the associated peak hour. Analyzing the volumes between zones that cross Broad Street at Washington Avenue and comparing to the total volume along the eastbound approach of the intersection indicates that zone-to-zone local traffic represents 24.5%, 27.1%, and 19.8% in the AM, PM, and Saturday peak hours, respectively.

	ZONE 1	ZONE 3	ZONE 5	ZONE 6	ZONE 7
ZONE 2	14 (31) [22]	35 (44) [35]	84 (27) [31]	12 (7) [3]	7 (7) [12]
ZONE 4	15 (30) [30]	11 (6) [10]	3 (8) [9]	1 (0) [0]	3 (10) [0]
ZONE 5	5 (21) [0]	0 (5) [0]	0 (0) [0]	0 (0) [0]	2 (8) [0]
ZONE 6	3 (3) [3]	0 (3) [0]	0 (0) [0]	0 (0) [0]	2 (2) [0]

Table 4: Local Traffic Matrix - Westbound Traffic

EVALUATION OF ALTERNATIVES

Building off earlier analysis conducted for the *Washington Avenue Traffic Study*, three street reconfiguration concepts were developed in close coordination with the City. These concepts were then analyzed using Synchro Version 9.2 (Build 915 Revision 6) to determine the anticipated impacts on traffic operations. The three concepts are described in more detail in the following section. For comparison purposes, the existing cross section along Washington Avenue is shown in Figure 7.

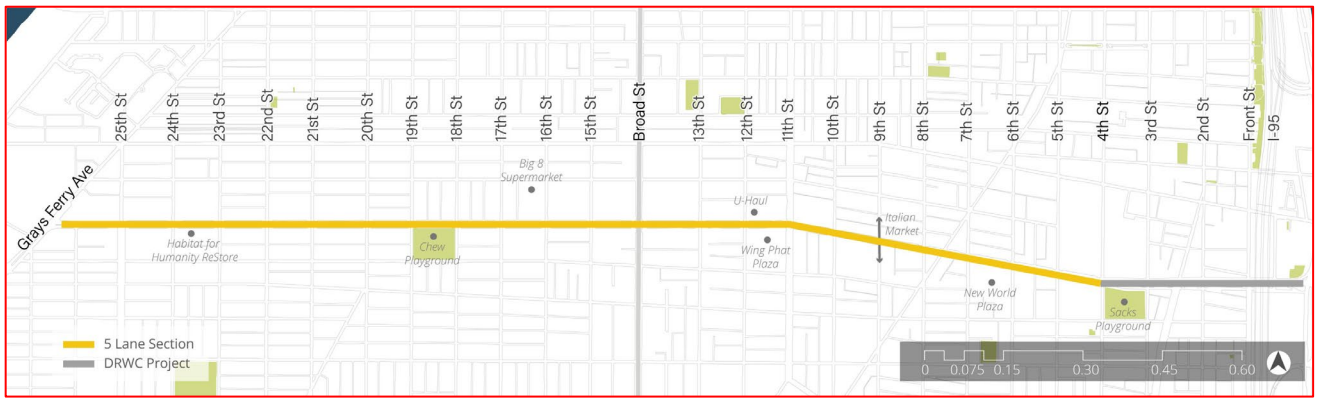


Figure 7: Existing Cross Section

As part of the analysis conducted in the 2019 traffic study, several additional analyses were recommended for further study as part of this effort. The following modifications aimed at mitigating of queues and congestion were studied:

- Diversion rates of 0%, 5%, and 10%
- Right turn lanes at all signalized study intersection
- Right turn lanes at selected signalized intersections (following an iterative process, right turn lanes along eastbound Washington Avenue at S. 19th Street and westbound Washington Avenue at S. 11th Street were included)
- Left turn restriction along eastbound Washington Avenue at Passyunk Avenue
- Bus queue jump lanes or far side bus stops on the side streets
- Redistribution of high-volume left turn movements along the corridor to lower-volume intersections

Prior to developing additional models for study, an investigation of previous research and literature was conducted in order to determine a reasonable diversion rate based on similar road diets conducted in the United States. The overall roadway grid network, existing conditions on parallel routes, analysis of the origin-destination data, and that research led to a decision that 10% diversion would be a reasonable rate to use for the Washington Avenue corridor. Diversion was also analyzed at 5% for the Mixed Cross Section because that option provides increased capacity at certain critical areas.

After further analysis, the proposed left turn restriction along eastbound Washington Avenue at Passyunk Avenue was not found to be viable. The volume of left turns could not be diverted without causing significant operational issues at adjacent intersections. Bus queue jump lanes and far side bus stops were not modeled in these analyses because, after discussions with SEPTA, they are not anticipated to be a likely consideration in the short term.

The traffic analysis also considered the potential for future growth in traffic volumes. Assumptions for future growth were primarily based on the City of Philadelphia's guidance to use PennDOT's Growth Factors for August 2018 to July 2019, which show a growth factor of 0% for Philadelphia Urban Non-Interstate Roadways. This means that existing volumes were used for both the existing and future condition models. However, the growth factor was also informed by a validation process for the existing April 2019 traffic counts. Based on Table 355 of the PennDOT Traffic Data Report, the April 2019 traffic counts represent, on average, an overestimate of the yearly average weekday volume by 6.2%. This further supports the future growth assumption.

Option A: 3 Lane Cross-Section

The layout for this option is consistent with the original layout studied in the *Washington Avenue Traffic Study*. As proposed, the 3 Lane option incorporates the following roadway cross sections:

- 3-lane cross section west of 16th Street
- 4-lane cross section between 16th Street and 15th Street
- 5-lane cross section between 15th Street and 13th Street
- Transitional 4-lane section between 13th Street and 12th Street
- 3-lane cross section between 12th Street and 5th Street
- Transitional 4-lane section between 5th Street and 4th Street
- 5-lane cross section between 4th Street and Front Street [Delaware River Waterfront Corporation (DRWC)] project

Option A provides acceptable traffic performance while maximizing multimodal benefits including shorter pedestrian crossing distances, improved transit access, and expanded pedestrian space for portions of the corridor.

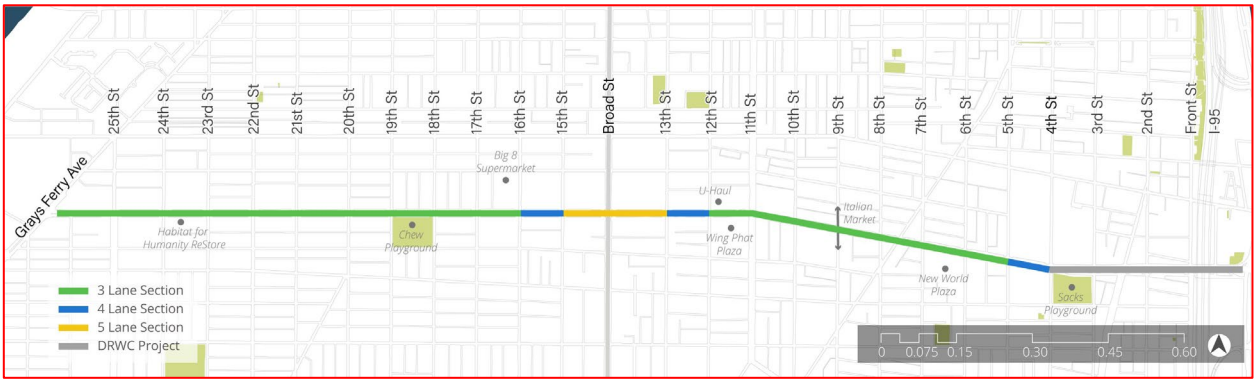


Figure 8: Option A: 3 Lane Cross-Section

Option B: 4 Lane Cross-Section

As proposed, the 4 Lane option incorporates the following roadway cross section:

- 4-lane cross section west of 16th Street
- 5-lane cross section between 16th Street and 13th Street
- 4-lane transitional section between 13th Street and 12th Street
- 4-lane cross section between 12th Street and 5th Street
- Transitional 4-lane section between 5th Street and 4th Street
- 5-lane cross section between 4th Street and Front Street

This alternative was considered in order to mitigate the impacts to minimize impacts to traffic operations by retaining four lanes of through capacity. The simulation model depicted that delays along the corridor are mainly due to the difficulty motorists would have making left turns across the opposite direction of traffic with fewer adequate gaps due to the lane reduction. Designing the cross section with two lanes towards Broad Street and one lane away from Broad Street helps mitigate the issue by creating more gaps available to left-turning vehicles.

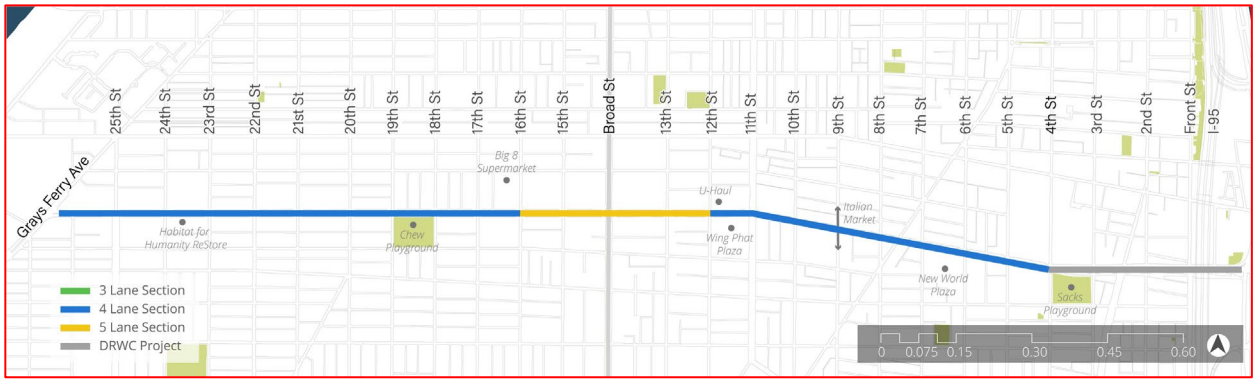


Figure 9: Option B: 4 Lane Cross-Section

Option C: Mixed Cross-Section

As proposed, the Mixed option incorporates the following roadway cross sections:

- 3-lane cross section between Grays Ferry Avenue and S. 20th Street
- 4-lane cross section between S. 20th Street and S. 16th Street
- 5-lane cross section between S. 16th Street and S. 12th Street
- 4-lane transitional cross section between S. 12th Street and S. 10th Street
- 3-lane cross section between S. 10th Street and S. 5th Street
- 4-lane transitional section between S. 5th Street and S. 4th Street
- 5-lane cross section between S. 4th Street and Front Street

This concept combines attributes of Options 1 and 2 by refining the intersections based on the specific operational concerns found in the models. This alternative provides 4-lane sections only in the vicinity of those intersections to create more adequate gaps for left turning motorists.

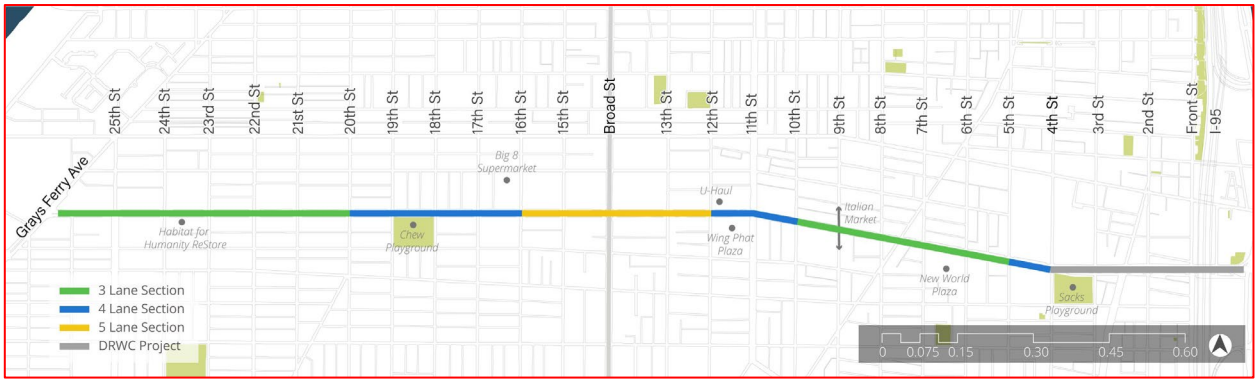


Figure 10: Option C: Mixed Cross-Section

Summary of Traffic Modeling Results

Table 5 compares results from the traffic analysis for each of the three alternatives evaluated. The table displays the models that were analyzed in order to develop the alternatives, including sub options that compared including versus not including right turn lanes. Results from the traffic analysis were evaluated primarily using the following metrics:

- Arterial LOS and travel time
- SimTraffic travel time and side street queuing

While each of the alternatives exhibit varying increases in travel time/delay, these increases are relatively minor compared to the overall existing corridor travel times. For each peak period, the last row in Table 5 indicates which of the sub options were found to be feasible from a traffic simulation perspective. Acceptable models were based on observation of the simulations, considering green bands throughout the corridor, travel time, corridor LOS, side street delays, and queueing for all approaches. Additionally, all models that were found acceptable do not have any side street approaches with a Level of Service worse than a D. There was at least one sub option that was considered feasible for the 3 Lane, 4 Lane, and Mixed options. **After reviewing results from Table 5, the three options that the City of Philadelphia selected to present to the public were:**

- The 3-Lane Cross Section with 10% diversion and right turn lanes at two locations:
  - EB Washington Avenue at S. 19th Street
  - WB Washington Avenue at S. 11th Street
- The 4-Lane Cross Section with no diversion and no right turn lanes
- The Mixed Lane Cross Section with 5% diversion and no right turn lanes

It is important to reiterate that the diversion rate was determined prior to the development of the models in Synchro.

Washington Ave Synchro Model Comparisons

	AM Peak Hour						
	Existing	Future Road Diet (Grays Ferry Ave to 4th Street)					
		4-Lane Section	4-Lane Section	3-Lane Section	3-Lane Section	3-Lane Section	Mixed Cross Section
Diversion	**0%**	**0%**	**0%**	**10%**	**10%**	**10%**	**5%**
Right Turn Lanes	**No**	**Yes**	**No**	**Yes**	**No[1]**	**No**	**No**
LOS	**Synchro Arterial LOS**						
EB	D	D	D	D	D	D	D
WB	D	D	D	D	D	D	D
Travel Time	**SimTraffic Travel Time in Minutes (change from Existing)**						
EB	7.9	9.3 (+1.4)	9.7 (+1.8)	9.1 (+1.2)	8.6 (+0.7)	14.1 (+6.2)	9.4 (+1.5)
GF to Broad	4.3	5.2	5.3	5.4	4.7	-	5.3
Broad to 4th	3.6	4.1	4.4	3.7	3.9		4.1
WB	8.1	8.2 (+0.1)	9.6 (+1.5)	8.0 (-0.1)	8.7 (+0.6)	8.8 (+0.7)	9.3 (+1.2)
4th to Broad	4.4	4.4	5.4	4.1	4.5	-	5.1
Broad to GF	3.7	3.8	4.2	3.9	4.2		4.2
Viable Simulation Results?	-	Yes	Yes	Yes	Yes	No	Yes
	PM Peak Hour						
	Existing	Future Road Diet (Grays Ferry Ave to 4th Street)					
		4-Lane Section	4-Lane Section	3-Lane Section	3-Lane Section	3-Lane Section	Mixed Cross Section
Diversion	**0%**	**0%**	**0%**	**10%**	**10%**	**10%**	**5%**
Right Turn Lanes	**No**	**Yes**	**No**	**Yes**	**No[1]**	**No**	**No**
LOS	**Synchro Arterial LOS**						
EB	D	D	D	D	D	D	D
WB	D	D	D	D	D	D	D
Travel Time	**SimTraffic Travel Time in Minutes (change from Existing)**						
EB	8.5	9.0 (+0.5)	10.5 (+2.0)	8.7 (+0.2)	9.5 (+1.0)	9.4 (+0.9)	11.0 (+2.5)
GF to Broad	4.6	4.7	5.3	5.1	5.3	-	6.4
Broad to 4th	3.9	4.3	5.2	3.6	4.2		4.5
WB	8.0	9.1 (+1.1)	9.6 (+1.5)	7.7 (-0.3)	8.1 (+0.1)	8.1 (+0.1)	8.7 (+0.7)
4th to Broad	4.3	5.0	5.3	4.1	4.3	-	4.3
Broad to GF	3.7	4.1	4.3	3.6	3.8		4.4
Viable Simulation Results?	-	Yes	Yes	Yes	Yes	No	Yes

NOTES

General: The majority of the increased delay resulted from left turn queueing/spillback at 11th and 19th Streets, impacting the corridor travel time. Each scenario applied methods to mitigate that queue spillback.

General: No changes were made to the left turn phasing along the corridor.

[1]- This option provides right turn lanes at two locations: EB direction at 19th St & WB direction at 11th St. Bike signals could be used if bus stops were to be consolidated or shifted to the far side.

Table 5: Synchro Model Results

PARALLEL ROUTE DIVERSION ANALYSIS

Traffic analysis was conducted to estimate traffic impacts from potential diversions from Washington Avenue to parallel streets based on implementation of the selected street reconfiguration option. While Philadelphia's grid of streets provides multiple route options for motorists, based on proximity and connectivity, Christian Street (to the north) and Ellsworth Street (to the south) were determined to be the most likely parallel routes to experience potential diversion and were analyzed accordingly.

Additional traffic data was needed to perform this analysis. New traffic data was collected in January/February 2020 at the following locations (diagrams showing the turning movement counts are included in Appendix A):

- Weekday 24-hour traffic volume and classification data:
  - Christian Street between 20th and 21st Streets
  - Christian Street between 11th and 12th Streets
  - Washington Avenue between 20th and 21st Streets
  - Washington Avenue between 12th and 13th Streets
  - Ellsworth Street between 20th and 21st Streets

- Weekday intersection turning movement counts (7 - 9 AM, 4 – 6 PM):
  - Christian Street & Grays Ferry Avenue
  - Christian Street & Broad Street
  - Christian Street & 11th Street
  - Ellsworth Street & Broad Street

The first step in modeling potential diversion from Washington Avenue is to determine the alternate routes to be analyzed. Washington Avenue is part of a grid system with cross-streets located approximately 300-500 feet apart. A motorist will not have to travel far out of their way to find an alternate route. While drivers have many options, such as Ellsworth Street, Christian Street, Carpenter Street, and Reed Street, the analysis was focused on two streets – Christian Street and Ellsworth Street – because they are the closest and most continuous street adjacent to Washington Avenue.

- **Christian Street** is a continuous bi-directional road that extends from Grays Ferry Avenue to Christopher Columbus Boulevard.
- **Ellsworth Street** is a continuous one-way (eastbound) road between Grays Ferry Avenue and S. 11th Street. East of S. 11th St, the road switches directionality twice.

Diversion Assumptions

The next step was to determine the overall percentage of motorists that will reasonably choose another route. Results from the O/D analysis, coupled with research on similar road diets implemented in the United States, informed the decision to assume that a maximum of 10% of the total approach volume on Washington Avenue would divert to parallel routes.

Zone-specific diversion rates were developed based on knowledge of the local road system. The percentages below reflect the estimated number of motorists from outside the system that would divert to and from Washington Avenue during a peak period. The PM peak was analyzed as it reflects the highest hourly volume collected. The percentages were applied to volumes derived from the O/D analysis as summarized in previous sections. The 10% diversion volumes and percentage of traffic assigned to parallel routes are as follows:

- **Entering Washington Avenue at Columbus Blvd (WB direction)**:
  - 86 vehicles in the PM peak
  - 63% diverted to westbound street south of Washington Avenue (54 vehicles)
  - 37% diverted to Christian Street (32 vehicles)

- **Exiting Washington Avenue at Columbus Blvd (EB direction)**:
  - 80 vehicles in the PM peak
  - 61% diverted to eastbound street south of Washington Avenue (49 vehicles)
  - 39% diverted to Christian Street (31 vehicles)
- **Entering Washington Avenue Grays Ferry Ave (EB direction)**:
  - 84 vehicles in the PM peak
  - 26% diverted to Ellsworth Street (22 vehicles)
  - 74% diverted to Christian Street (62 vehicles)
- **Exiting Washington Avenue Grays Ferry Ave (WB direction)**:
  - 59 vehicles in the PM peak.
  - 36% diverted to westbound street south of Washington Avenue (21 vehicles)
  - 64% diverted to Christian Street (37 vehicles)

Regional Component of Diverted Traffic

As noted in the O/D section of this memo, most of the regional traffic using the Washington Avenue corridor either originates from a side street, turns onto a side street, or has a destination along the corridor. This leaves only about 10-15% of motorists traveling the entire corridor from end to end (i.e. crosstown traffic). The total volume of crosstown traffic in each direction is listed below, with the number diverted from Washington Avenue in parentheses. These values are a subset of the total diversion volumes shown earlier in this section.

- Entering Washington Avenue at Columbus Blvd (WB direction): 30 vehicles (6 diverted)
- Exiting Washington Avenue at Columbus Blvd (EB direction): 65 vehicles (13 diverted)
- Entering Washington Avenue Grays Ferry Ave (EB direction): 63 vehicles (12 diverted)
- Exiting Washington Avenue Grays Ferry Ave (WB direction): 38 vehicles (8 diverted)

Local Component of Diverted Traffic

While StreetLight Data is a good tool for analyzing regional trip patterns, the determination of route choices for local trips is not fine-grained enough to accurately predict turning movements at each intersection within each individual zone. Therefore, it was assumed that local motorists would divert from Washington Avenue onto the parallel routes at approximately the same percentages as regional motorists disperse to the zones. The diverted volumes derived from this analysis were then modeled in Synchro to determine impacts to selected intersections along Christian Street and Ellsworth Street.

Route Choice

The volumes derived from the diversion analysis were then routed through the system to be analyzed as a proposed condition. It is acknowledged that some local and regional drivers will decide to take an alternate route other than the ones studied. For example, instead of diverting onto Christian Street, a motorist may decide to take Bainbridge Street**. But since Christian Street and Ellsworth Street were identified as the most likely parallel diversion routes, the Synchro analysis assumes that all diverted traffic is shifted to these streets where the routing is practical.** Motorists with an origin or destination north of Washington Avenue were diverted onto Christian St, and those with an origin or destination south of Washington Avenue and traveling eastbound (west of S. 11th Street) were diverted onto Ellsworth Street. Given the limitations of the O/D data as described in the previous paragraph, the local and regional diversion was considered to occur at similar rates and were combined as part of a singular analysis.

Analysis Results

The final step in this analysis was determining the performance of parallel routes based on the assumed diversion volumes and routing. Results comparing existing and proposed traffic performance during the PM peak are shown in Table 6. **It is important to note that only the maximum 10% diversion scenario was analyzed, which is in effect modeling the 3 Lane Option.** While not specifically analyzed, the Mixed Option (5% diversion) would be expected to produce results closer to existing conditions, while the 4-Lane Option (no diversion) would match existing conditions.

INTERSECTION	LOS / DELAY (SEC)		DELAY (SEC)	VOLUME TO CAPACITY (V/C) RATIO (EB / WB)	
	Existing	Proposed	Difference	Existing	Proposed
Grays Ferry Ave at Christian St / S. 25th St	C / 28.8	D / 37.4	8.6	0.76 / 0.50	0.93 / 0.80
Broad St at Christian St	B / 18.1	B / 19.4	1.3	0.60 / 0.48	0.71 / 0.59
Broad St at Ellsworth St	B / 15.5	B / 15.8	0.3	0.44 / N/A	0.54 / N/A
Christian St at S. 11th St	B / 15.3	B / 16.3	1.0	0.58 / 0.35	0.66 / 0.42

Table 6: Intersection LOS and Delay with Diversions (PM Peak / 10% Diversion)

In general, the diversion of motorists from Washington Avenue to adjacent streets is expected to have minimal impacts on traffic operations along those streets. In terms of vehicle delay, the traffic model shows that the intersection of Grays Ferry Avenue at Christian Street / S. 25th Street experiences the greatest increase in delay (8.6 seconds) during the weekday PM peak period. This intersection also has the largest increase in volume to capacity (v/c) ratio, but still operates below capacity in both directions in the proposed condition.

For all other intersections, the model shows that local parallel routes have enough roadway capacity to handle any increases from traffic diversion and still operate well below capacity. For instance, along Christian Street at Broad Street, both the east and west approaches are currently operating at less than 60% capacity during the PM peak. When applying the diverted traffic to Christian Street, even with the v/c ratios increasing by about 10% (from 60% to 71% heading EB and 48% to 59% heading WB), both approaches are still well below capacity.

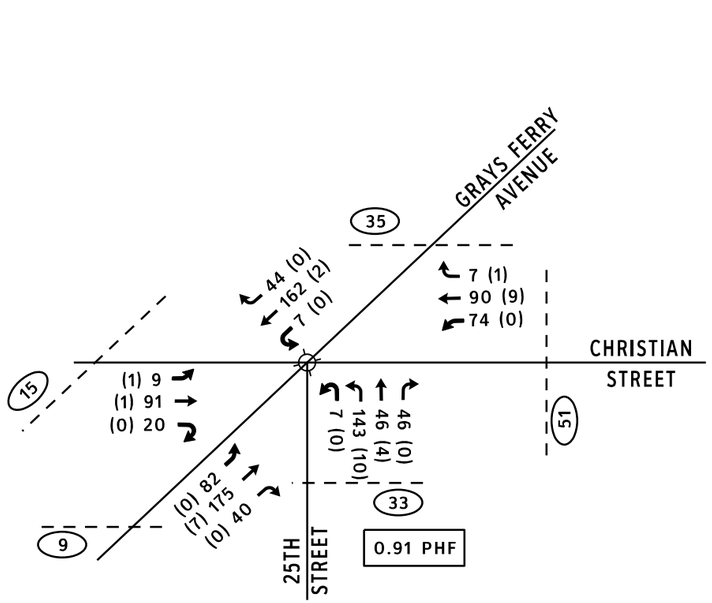
SUMMARY

In the Spring of 2020, the City's Office of Transportation, Infrastructure, and Sustainability (oTIS) engaged WSP to assist in developing and evaluating street reconfiguration options for Washington Avenue between Grays Ferry Avenue and 4th Street that can be implemented by the Streets Department through the repaving project. This memorandum summarizes the methodology and results from the traffic analysis conducted as part of that effort.

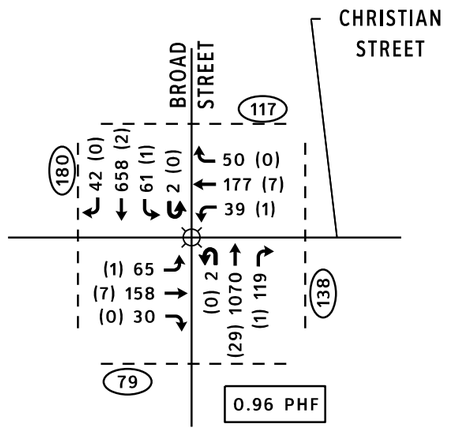
After analyzing a number of options and sub options, three street layout alternatives (3 Lane Cross Section, 4 Lane Cross Section, Mixed Cross Section) were found to be acceptable from a traffic simulation perspective. The City is currently engaging in a public participation process to solicit feedback from stakeholders about the three alternatives, which will guide the City in selecting a preferred alternative for implementation through the repaving project.

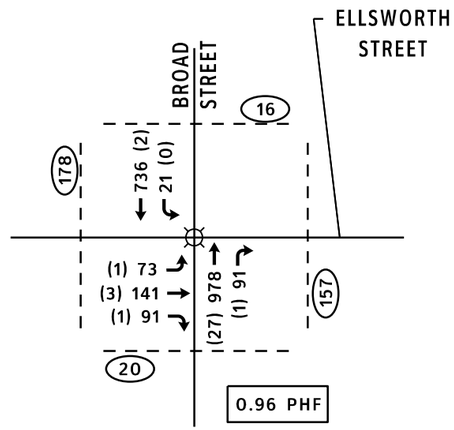
APPENDIX A

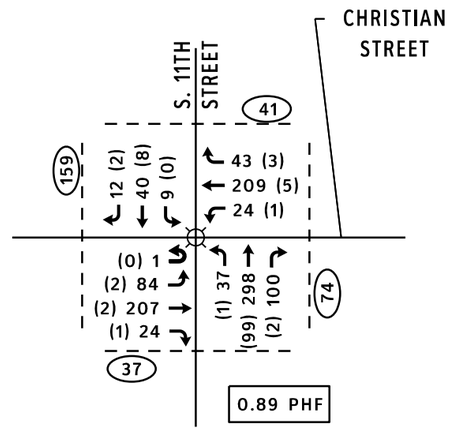
EXISTING 2020 WEEKDAY AM PEAK HOUR TRAFFIC VOLUMES
COUNT DATE - WEDNESDAY, JANUARY 29, 2020



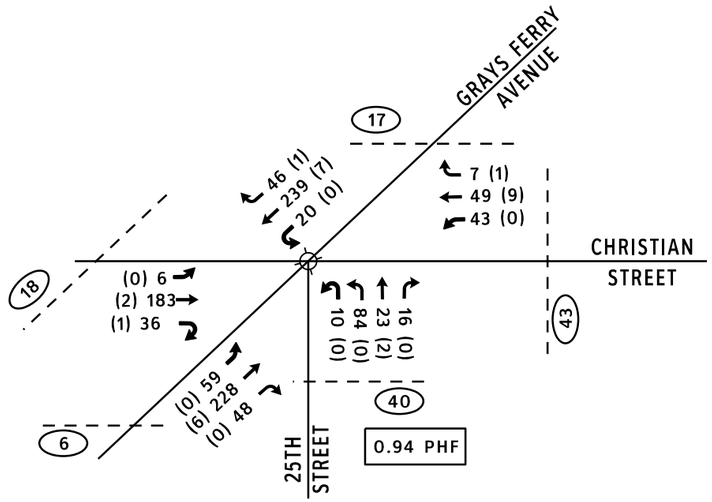
AM PEAK

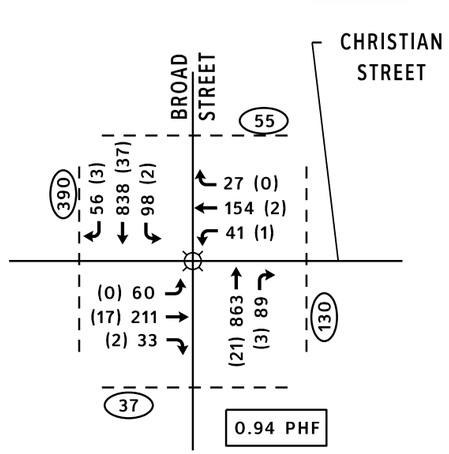


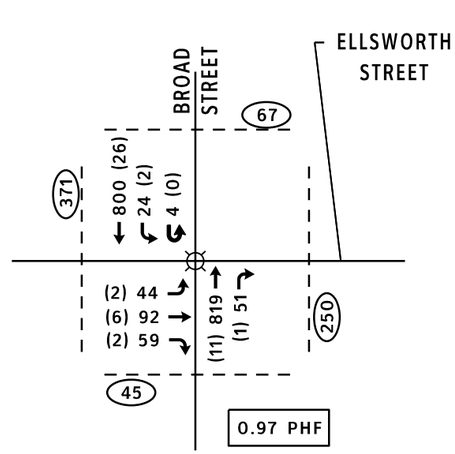


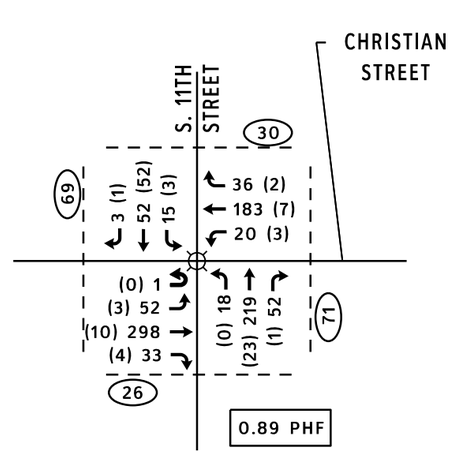


PM PEAK









SYSTEM PEAK HOURS:
7:45 AM - 8:45 AM
5:00 PM - 6:00 PM

LEGEND

EXISTING ROADWAY	XX — PEDESTRIAN CROSSING VOLUMES
EXISTING TRAFFIC SIGNAL	X.XX PHF — INTERSECTION PEAK HOUR FACTOR
XX — AM PEAK HOUR TRAFFIC VOLUMES	
(XX) — BICYCLE VOLUMES	

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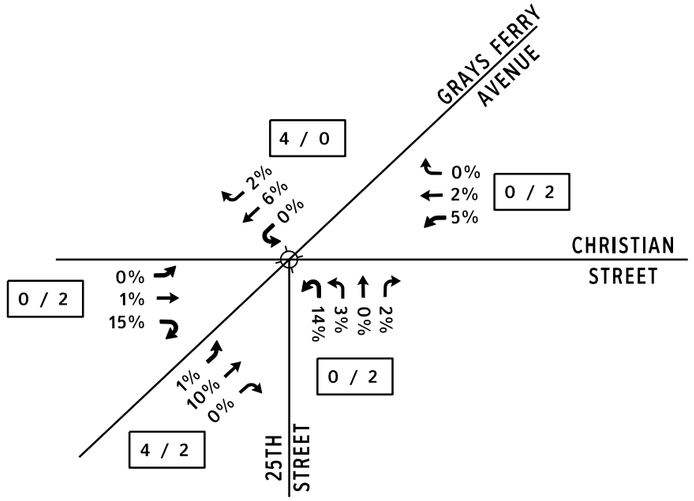
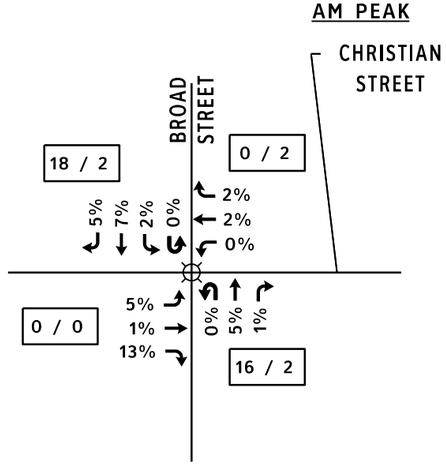
PHILADELPHIA, PA

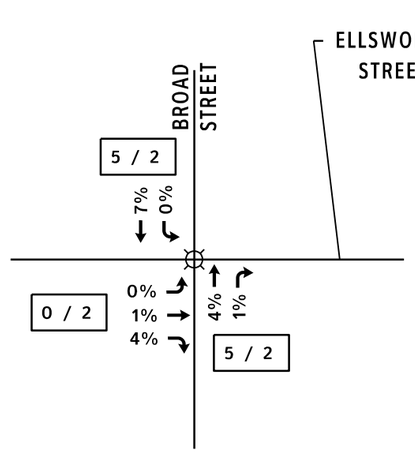
N.T.S	A - 1	JUN 2020

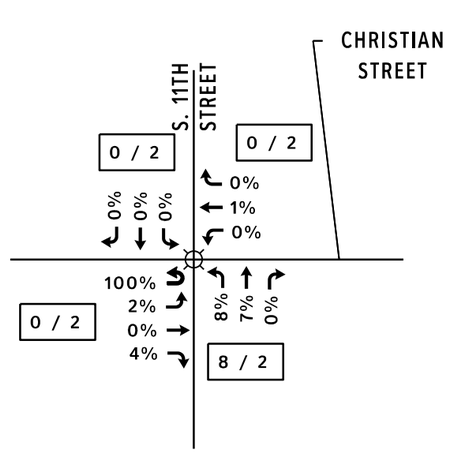
EXISTING 2020 WEEKDAY AM PEAK HOUR TRAFFIC VOLUMES
ADDITIONAL SYNCHRO INPUTS

AM PEAK

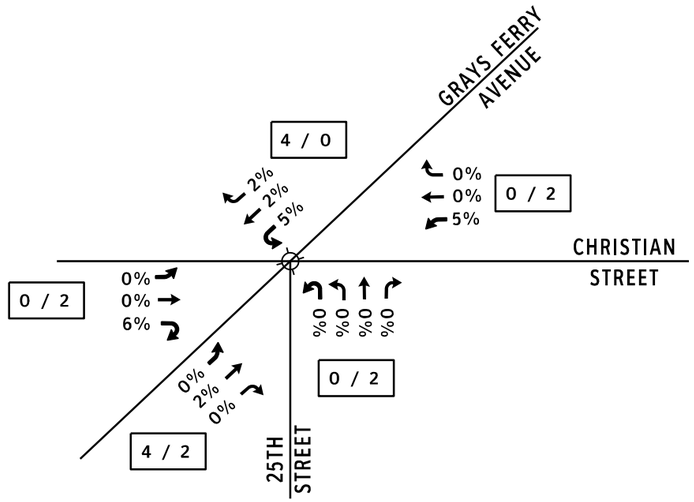


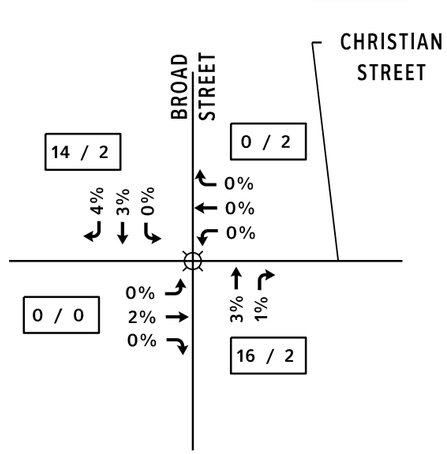


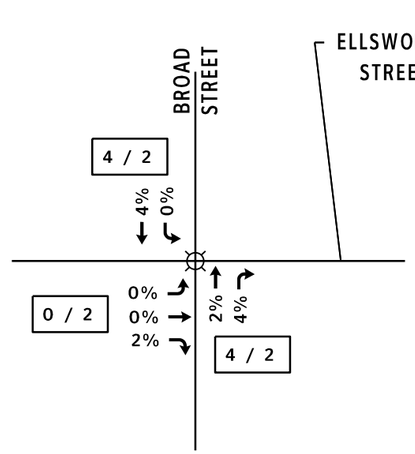


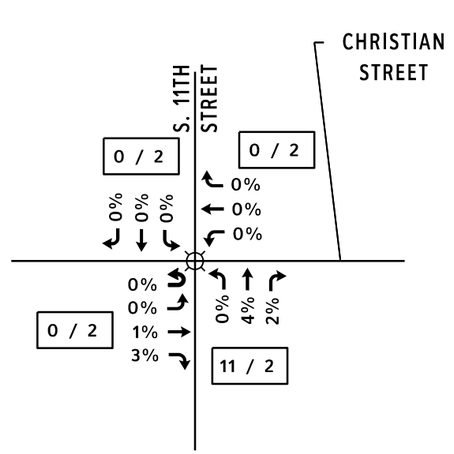


PM PEAK









SYSTEM PEAK HOURS:
7:45 AM - 8:45 AM
5:00 PM - 6:00 PM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- X% Heavy Vehicle Percentage
- XX / XX BUS STOPS / PARKING MANUVERS PER HOUR

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TRAFFIC STUDY
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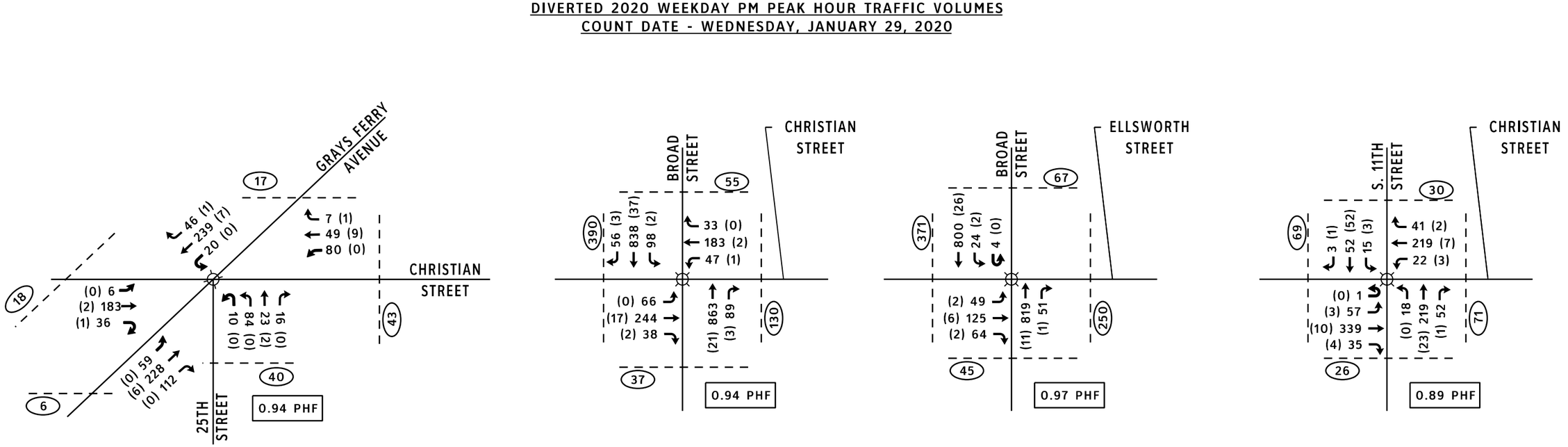
N.T.S	A - 2	JUN 2020

DIVERTED 2020 WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES
COUNT DATE - WEDNESDAY, JANUARY 29, 2020



SYSTEM PEAK HOURS:
5:00 PM - 6:00 PM

LEGEND

- EXISTING ROADWAY
- EXISTING TRAFFIC SIGNAL
- XX — AM PEAK HOUR TRAFFIC VOLUMES
- (XX) — BICYCLE VOLUMES
- XX — PEDESTRIAN CROSSING VOLUMES
- X.XX PHF — INTERSECTION PEAK HOUR FACTOR

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N.T.S	A - 3	JUN 2020