Measuring the Parking Characteristics of Transit – Oriented Developments: MLK East Busway – East Liberty Station, Pittsburgh, PA

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Introduction

The goal of this research was to analyze the parking characteristics at three new Transit-Oriented Developments (TOD), Eastside Bond (2016), East Liberty Target (2011), and Walnut on Highland and The Penn at Walnut on Highland (2016), located in the neighborhood of East Liberty in Pittsburgh, PA. These three TODs were chosen because of their proximity along the MLK East Busway. This analysis aims to provide a methodology for quantifying parking characteristics at existing TODs in an urban setting and compare the actual utilization of parking to what was proposed at the time of development based on the City of Pittsburgh requirements. This research also aims to provide parking recommendations for a new proposed TOD, Giant Eagle, in the neighborhood of Shadyside as well as other future projects in the urban environment.

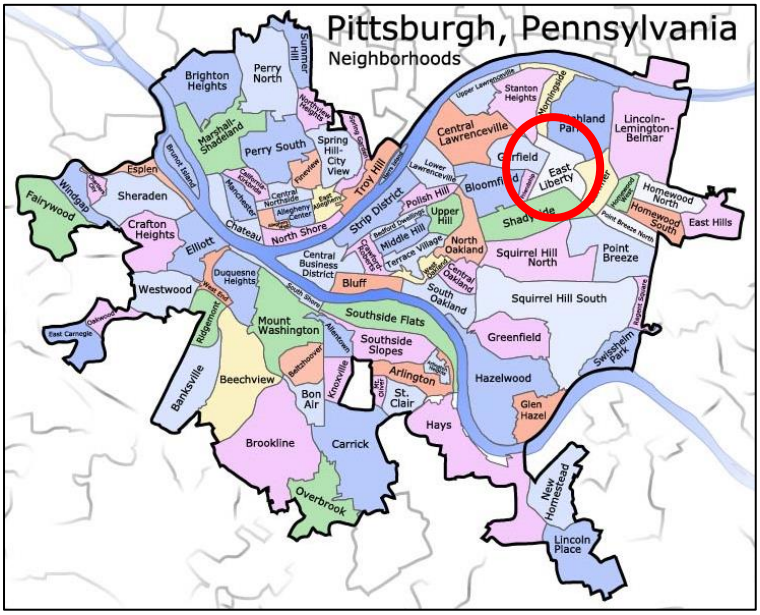
To complete this research, there were three primary tasks. The first task included efforts in conjunction with the Port Authority of Allegheny County (PAAC) to conduct an intercept survey, to determine the influence area of the TOD based upon how far people travel to the East Liberty east busway transit station. The second task included collecting parking inventory and usage data from Eastside Bond, East Liberty Target, Walnut on Highland and the Penn at Walnut on Highland. In addition, parking inventory was collected along the on-street parking facilities throughout the study area. The final task used the data collected through the survey, parking inventory and building research to analyze the parking characteristics of the three TODs for comparison to the forecasted parking needs, the City of Pittsburgh parking requirements, and Denver, CO parking requirements, which was chosen because of its similarities to Pittsburgh and much more aggressive parking reductions.

In order to summarize the tasks stated above, the following report first provides a summary of relevant literature focusing on best practices in TOD and recent research on parking characteristics at TODs throughout the country. Following the Literature review, a methodology of data collection is provided as well as a summary of the collected data. The last section of this report presents the analysis and findings from the collected data, providing information to quantify parking characteristics surrounding East Liberty East Busway Station and recommendations for future TODs and the City of Pittsburgh parking requirements.

Background

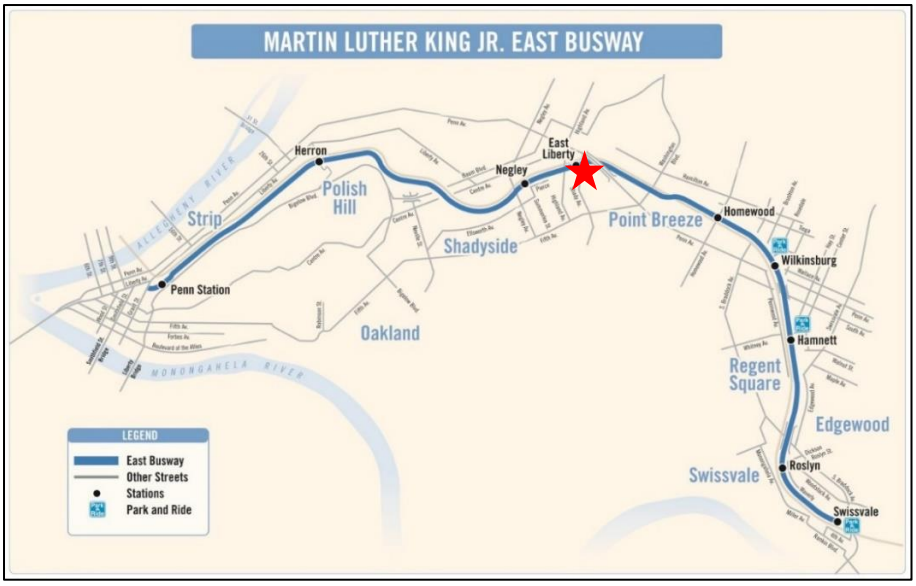
East Liberty is a diverse and vibrant neighborhood located in the northeast corner of Pittsburgh, circled in red shown in Figure 1.

Figure 1: Map of Pittsburgh Neighborhoods



East liberty is also located along the MLK East Busway, shown in Figure 2. Since the early 2000s this direct access to reliable and rapid public transit has been a catalyst for redevelopment in the neighborhood, beginning with the introduction of Home Depot and Whole Foods in the early 2000s. Since then, the neighborhood has experienced a major spike in investment and redevelopment as well as increased ridership, carrying up to 28,000 riders each weekday, on the MLK East Busway.

Figure 2: MLK East Busway Stations



With these recent investments in rapid and reliable transit as well as neighborhood connectivity and economic development, East Liberty has become a perfect neighborhood for the implementation of Transit-Oriented developments in recent years.

In this research we focused on three different TODs located adjacent to the East Liberty MLK East Busway Station, Eastside Bond, East Liberty Target, Walnut on Highland and the Penn at Walnut on Highland. These TODs are shown below within the study area, outlined in red, in Figure 3. Within this study area, the on-street parking facilities were also included in the analysis, shown in Figure 4. In addition to the existing TODs in the study area, a new proposed Giant Eagle Supermarket TOD on the opposing side of the busway will also be analyzed in this research, however, there is limited information.

Figure 3: East Liberty Study Area Showing Transit Oriented Developments

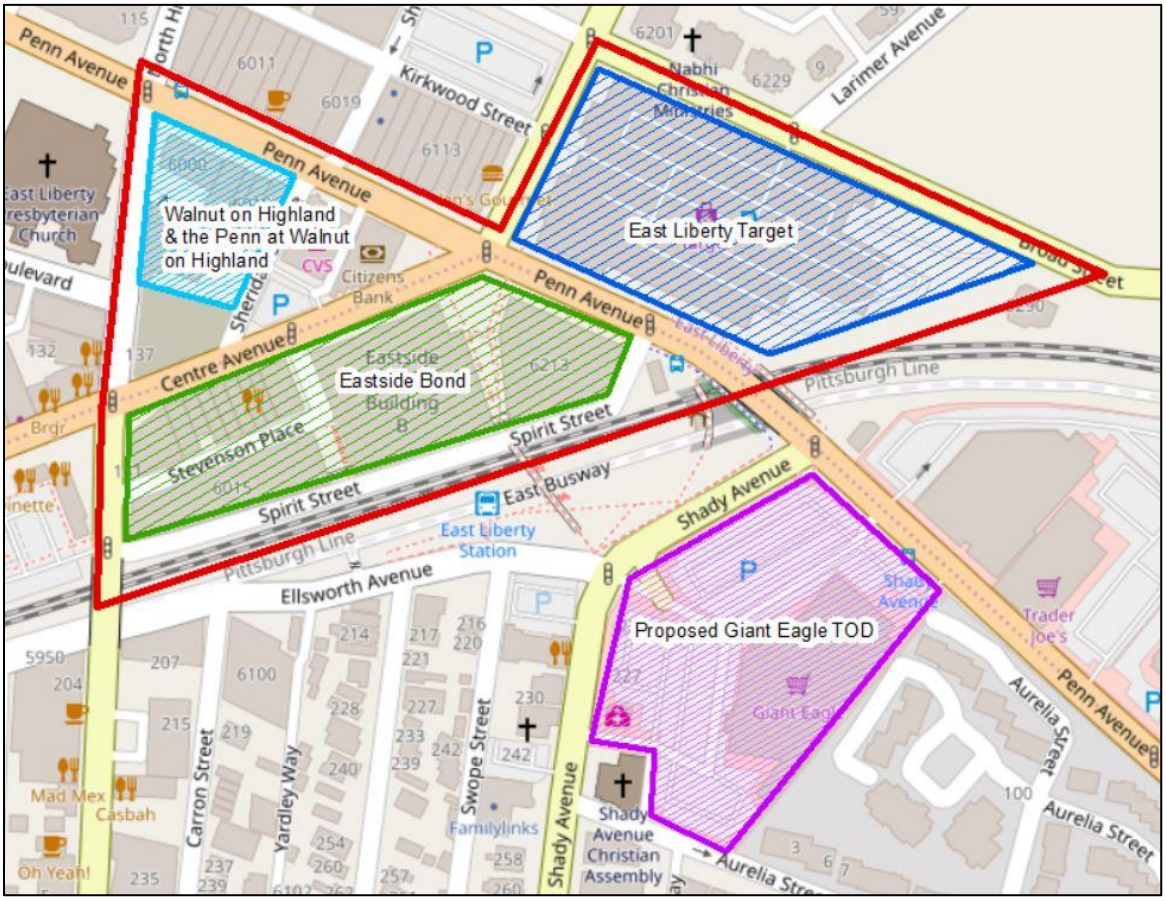
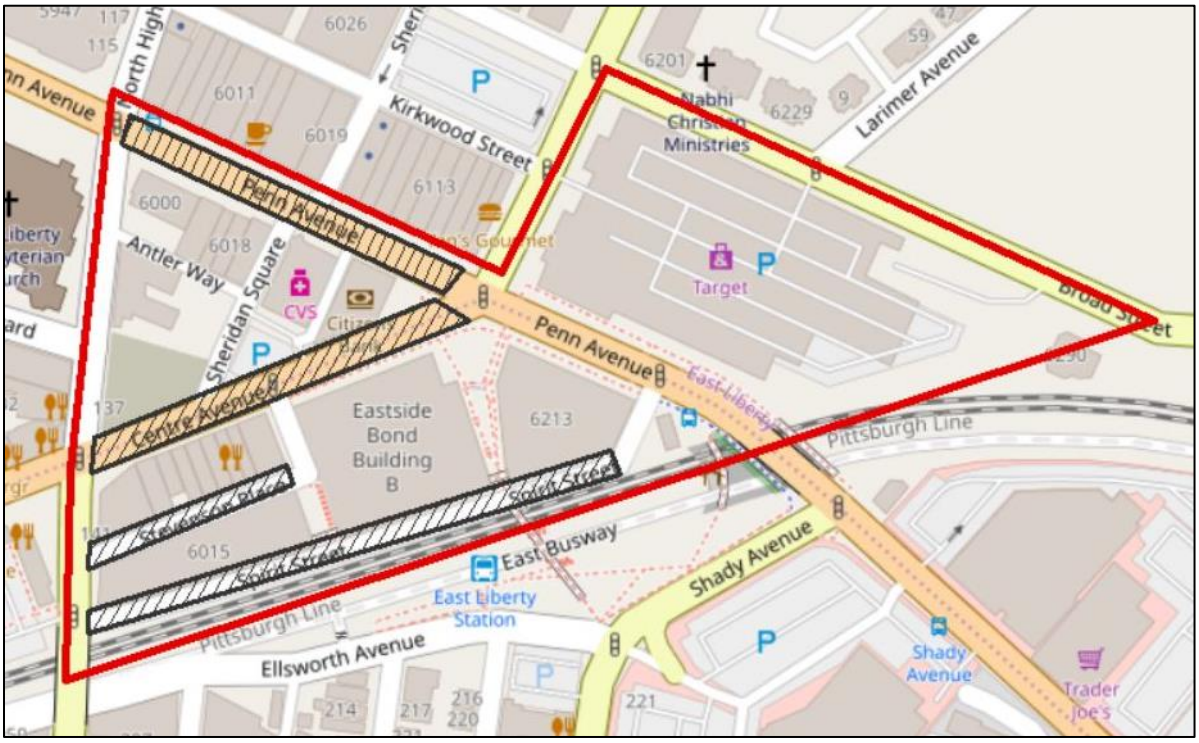
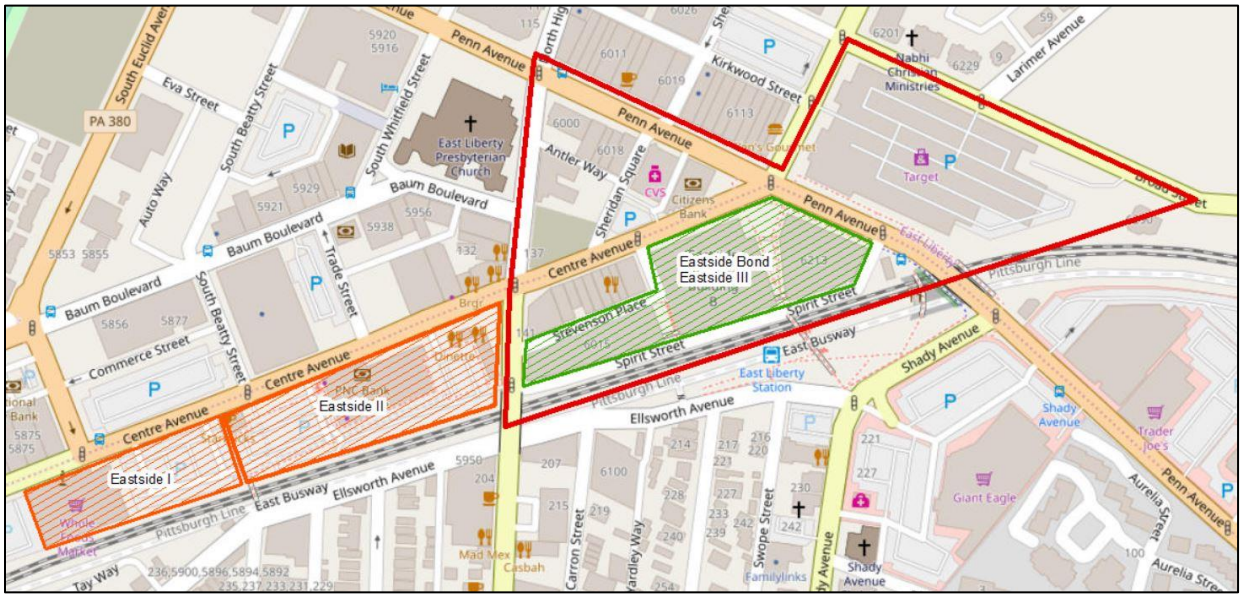


Figure 4: East Liberty Study Area Showing On-street Parking Facilities



The first TOD, Eastside Bond, was the third of three developments known as the Eastside development plan. The Eastside Development plan was a three phase TOD plan created with joint efforts from the City of Pittsburgh, East Liberty Development Inc. (ELDI), the Port Authority of Allegheny County (PAAC), and Mosites Development Company (Figure 5).

Figure 5: Eastside Development Phases



The first phase, Eastside I, consisted of introducing Whole Foods into East Liberty. The second phase, Eastside II, completed in 2007, was made up of 84,942 square feet of retail, restaurants, and offices with surface and deck parking including 347 parking spaces (The Mosites Company). This first major mixed-use development restored the "commercial core" of the neighborhood.

The third phase, Eastside Bond (Eastside III) completed in 2016 (Figure 6),was a multistage TOD project that included three mixed-use buildings spread across 6-acres containing 360 market rate multi-unit residential building, 43,000 square feet of retail space, 554 space shared-use parking garage, available to the public and residents, and a 120 space bike garage (East Liberty Development, Inc.). In addition to the buildings, the project included roadway pedestrian and bike improvements, such as a new Pedestrain bridge, as well as upgrades to the existing East Liberty MLK East Busway Station to create a multi-modal transit center. This project was funded through both public and private finances and was the first project to receive funding through the Pennsylvania Transit Revitalization Investment District (TRID) Act (Urban Redevelopment Authority). The intent of this project was to enhance neighborhood connectivity and to produce rapid and reliable transit through safer and more efficient facilities. With these improvements to transit and neighborhood connectivity, the need for personal auto would ideally be decreased, therefore decreasing the parking needs within the neighborhood.

Figure 6: Eastside Bond (Eastside III)

The Second TOD located in the East Liberty study area that will be included in this research is the East Liberty Target. This TOD is located on a 5-acre site across Penn Avenue from Eastside Bond. Developed by The Mosites Company, this site includes a 143,000 square foot Target retail center, including approximately 30% grocery and 70% retail, elevated over a 462-space private parking lot, shown in Figure 7.

Figure 7: East Liberty Target

The third TOD this research will focus on is two new market rate apartment buildings: Walnut on Highland and the Penn at Walnut on Highland (Figure 7). These two buildings, both owned and managed by Walnut Capital, include a total of 188 units, 16,000 square feet in ground level retail and a privately shared parking garage with 182 spaces.

Figure 8: Walnut on Highland and The Penn at Walnut on Highland

The fourth and final TOD this research will focus on is a proposed TOD located in the neighborhood of Shadyside on the opposing side of the East Busway from Eastside Bond. Currently, this site is a shopping center with a Giant Eagle Supermarket, Wine and Spirits, Dollar Bank, and a few smaller retail and service stores. The site has a large surface lot that is extremely

underutilized, which has led to it becoming an unofficial Park-and-Ride for the MLK East Busway. While not finalized, the proposed plans for this new development include a 50,000 square foot Giant Eagle Supermarket, 45,000 Square feet in Retail and 585 parking spaces. While this site is not within the study area, it was included in the study to illustrate how current and proposed revised parking requirements could be applied to a planned TOD.

While one of the goals of all three existing TODs was to decrease car dependency through increased access to transit and services, there are still requirements to supply parking for residential units, retail and office space through the land development approval process with the City of Pittsburgh. Although, there has been recent research on the parking requirements for TODs, historically, TODs have over-parked the area being served. This leads to the topic of this research project: What are the parking characteristics of the Eastside Bond, East Liberty Target, Walnut Capital buildings? Is there too much or too little compared to the actual utilization and how can this be compared to future TODs such as the future Giant Eagle TOD? In addition, how can city parking requirements be revised to reflect the parking characteristics of Transit-Oriented Developments?

Literature Review

The following literature review provides a brief introduction into the best practices of TOD. This review also explores the impacts of TOD on trip generation and parking generation by summarizing two relevant and recent research reports: *Empty Spaces* written by Smart Growth America in Conjunction with The Department of City and Metropolitan Planning at The University of Utah and *Effects of TOD on Housing, Parking, and Travel* written by the Transportation Research Board (TRB) for the Transit Cooperative Research Program (TCRP).

Introduction

As defined by the Federal Highway Administration "Transit-Oriented Development, or TOD, includes a mix of commercial, residential, office and entertainment centered around or located near a transit station. Dense, walkable, mixed-use development near transit attracts people and adds to vibrant, connected communities." A successful TOD project is made up of seven key principles: Maximized location efficiency; Mixed-uses that promote transit; Walkability; Maximum connectivity and visibility to transit station; Streets for everyone; Value Capture of transit; and efficient parking facilities. Efficient parking facilities is the key effort for this research. TODs can provide accessible services while increasing ridership and decreasing the use of personal vehicles. Multiple studies on recent TODs show that people who live in TODs use transit more and own fewer or no cars than in other areas. However, the challenge of reducing parking is still prevalent.

Trip Generation and Parking Generation

The first report, *Empty Spaces* written by Smart Growth America in Conjunction with The Department of City and Metropolitan Planning at The University of Utah, who also published the same research in the Landscape and Urban Planning Journal, focused on parking and trip generation in five US cities. The case studies chosen where Englewood, CO; Wilshire/Vermont Station in Los Angeles, CA; Fruitvale Transit Village in Oakland, CA; Redmond, WA; and Rhode Island Row in Washington DC. Each of these TODs provided a somewhat different method to determine the required parking but all were consistent in supplying less parking than recommended by the ITE Trip Generation and Parking Generation Manuals.

While all five TODs supplied less than the standard parking typically required, the research still showed the actual demand to supply ratio fell between 19 to 46 percent during peak parking hours, generally 7am to 6pm. One of the reasons for the low parking occupancy was explained by there being fewer vehicle trips than expected because of mode shift. In each of the five TODs, the research showed 33 percent of trips being made using other modes of transportation besides personal vehicles.

In conclusion of the University of Utah Research, determined that the percentages found in the study cannot be used as a definite solution of how much parking should be required. However, it does supply a sense of what the vehicle reductions should be in some cases, as well as a methodology for collecting data and analyzing the parking needs at a new TOD.

In the TCRP Report, *Effects of TOD on Housing, Parking, and Travel*, the researchers studied 17 residential TOD cases in 6 major cities: Philadelphia, PA; Newark, NJ; Washington DC; San Francisco Bay Area, CA; and Portland, OR. These 17 case studies displayed the same research conclusions as above, stating that the trip and parking generation is much less than predicted in the ITE manual.

In the final recommendations of this research, under the right conditions, reducing the parking ratios by 50 percent can lead to an increase of land use density by 20 to 33 percent and produce savings of parking costs by 5 to 36 percent. This reduction in parking could lead to more TOD projects by reducing construction costs and reduced housing costs. They also recommend that those who develop projects that produce less vehicle trips should be rewarded with reduced traffic impact fees and exactions. Lastly, this research's main goal was to seed the further development by standards institutions such as ITE in changing their trip and parking generation prediction for TODs to reflect the actual needs.

Parking Regulations

With the relatively recent introduction of TOD zoning, many cities have begun to adjust their parking regulations in areas that are highly accessible to high quality transit services. Most have created reduced parking requirements or maximum parking requirements.

A recent study completed by the Center for Transportation Research at the University of Texas at Austin they concluded parking requirements in areas near transit can be reduced around 20 to 50 percent. However, they recognized that reducing parking requirements involves improving transit. To combat this, they suggested, subsidized transit passes, parking programs and priced parking. In this study they also emphasized the design of parking facilities, beginning with the design of the pedestrian facility first and designing for the automobile last, creating a safe and walkable facility. In addition to this, they recommend, if parking is necessary, it should be built out of sight from the transit station and further away if possible, in order to discourage transit riders from parking and riding.

In Pittsburgh, while there are no specific parking regulations for TODs, parking requirements throughout the city can be reduced based on the neighborhood location. For example, the central business district has been reduced by 100%, meaning when developing in this area there are no parking requirements. In East Liberty, the location of the TODs in this study, the parking requirement has been reduced by 50% for all uses except residential. In addition to this reduction, developers can reduce parking by 30% if they provide an equal amount of bicycle parking throughout the entire city. These reductions infer that as transit accessibility is increased, parking demand will be reduced.

Below are examples of several cities who have reduced parking requirements or created maximum parking guidelines for TODs.

Reduced Parking Regulations

Reduction in parking requirements is much more common throughout the country in neighborhoods located close to high quality transit.

In Los Angeles, CA along the metro the city has established TOD districts surrounding the metro station. Within these districts the city allows developers to reduce parking by 40% in new residential development and 60% for some commercial and civic activities (MITOD).

In San Diego, CA parking requirements have been reduced by 0.25 spaces per dwelling unit for transit areas or low-income housing (MITOD).

Arlington County, Virginia has public administration tools such as joint development grants and private-public partnerships to develop TODs with reduced minimum parking standards based on proximity to transit.

Maximum Parking Regulations

Maximum parking requirements are less common across the country. Ideally, maximum parking controls over parking by creating a maximum of parking spaces allowed based on the proximity to transit and development type.

In Portland, OR the city sets parking maximums based on intensity of development and proximity to transit service. Lower maximums are implemented in areas within a quarter mile of a frequently served transit station or bus stop. Higher maximums are implemented in areas outside of a quarter mile or more walk from a frequently served transit station or bus stop (Chapter 33.266,115).

In Denver, CO the city has also created maximums that only apply to Transit-Oriented Developments where the maximum must not exceed 110% of the minimum. In addition, the city allows reductions for developments being built near multi-modal facilities (Article 10.4).

Summary of Literature Review

After completing this literature review it is clear through the first two reports that the national standards for parking are not conducive to the introduction of TODs. In both the University of Utah Study and TRCP Report, the actual parking needs were approximately 50% of the recommended ITE standards. However, many cities are beginning to adjust their parking reductions to shift residents from personal auto to high quality transit. These reductions in parking minimums or implementation of maximums in TODs could reduce construction costs and increase the density of the TOD. Ideally the reduction in parking would also filter through to the residents by reducing housing and transportation costs.

The following research aims to support the conclusions found in this literature review by presenting the parking characteristics of four TODs in East Liberty; Eastside Bond, East Liberty Target, Walnut on Highland and The Penn at Walnut on Highland, and the proposed Giant Eagle TOD. The actual parking usage of each of these TODs will be compared to the capacity provided, City of Pittsburgh Parking Requirements and a selected city TOD ordinance that reflects a more realistic approach to TOD parking needs.

MLK Busway East Liberty Station Intercept Survey

In the first method of data collection, the Port Authority of Allegheny County (PAAC) conducted an intercept survey at the East Liberty MLK Busway Station throughout the day during multiple weekdays in October 2018. The purpose of this survey was to determine the influence area of the TOD based upon how far people travel to the transit station. The survey included several questions focused in three primary topics: User demographics, trip Purpose, and trip route. However, for this research the main emphasis is on the user's trip mode for arrival at the station and travel time using that mode.

Survey Methodology

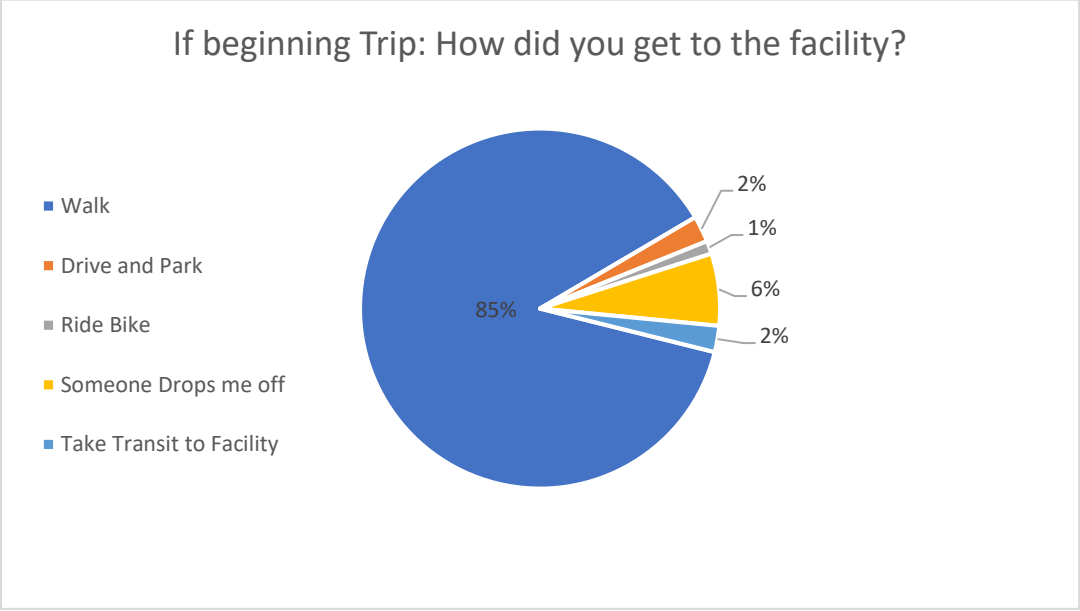
In order to determine the influence area, respondents were first asked if they were beginning or ending their trip. Based on their response, they were then asked how they got to the station and

the duration of trip, if beginning their trip, or how they were going to get to their destination and the duration, if ending their trip.

Survey Results

After completing the survey, the PAAC was able to collect data from 203 transit users. Of those responses 86% of them were beginning their trip at the East Liberty MLK East Busway Station. As expected, of the people who were beginning their trip, 85% of them walked to the station and only 2% drove and parked near the station (Figure 9). The people who drove and parked, all used the unofficial park-and-ride lot at the existing Giant Eagle parking lot.

Figure 9: Survey Results – Travel Mode



In asking how far the users walked to the station, 88% said it takes them less than 10 minutes to walk to the East Liberty MLK East Busway Station, while 60% of that 88% says it takes them 5-9 minutes (Figure 10). Assuming an average walking speed of roughly 4 ft/s, based on the Manual on Uniform Traffic Control Devices (MUTCD), which is a nationwide standard, it takes approximately 10 minutes to walk a half mile. Therefore, the 88% of transit users in this survey are walking a half mile or less to get to the station. This is consistent with most TOD research, in which the influence area of the transit station extends to about a half mile. This distance is important because all of the TODs in this study area are within a quarter mile of the transit station meaning customers and residents using the East Busway are walking to the station. This also shows the purpose of TODs, providing mixed-use development in close proximity to high quality transit to promote transit usage, economic development and neighborhood connectivity.

Figure 10: Survey Results – Travel Distance

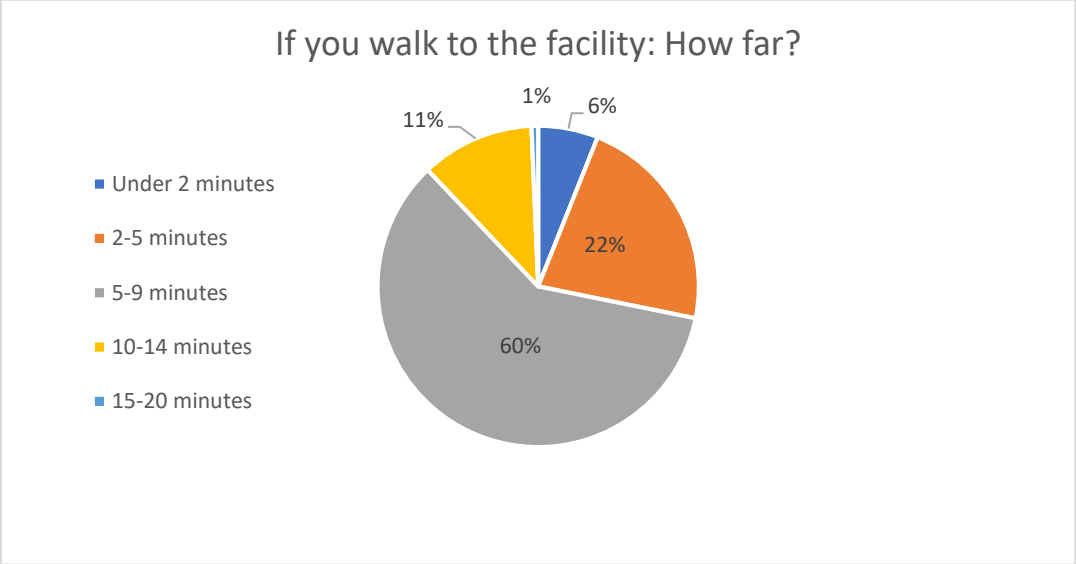
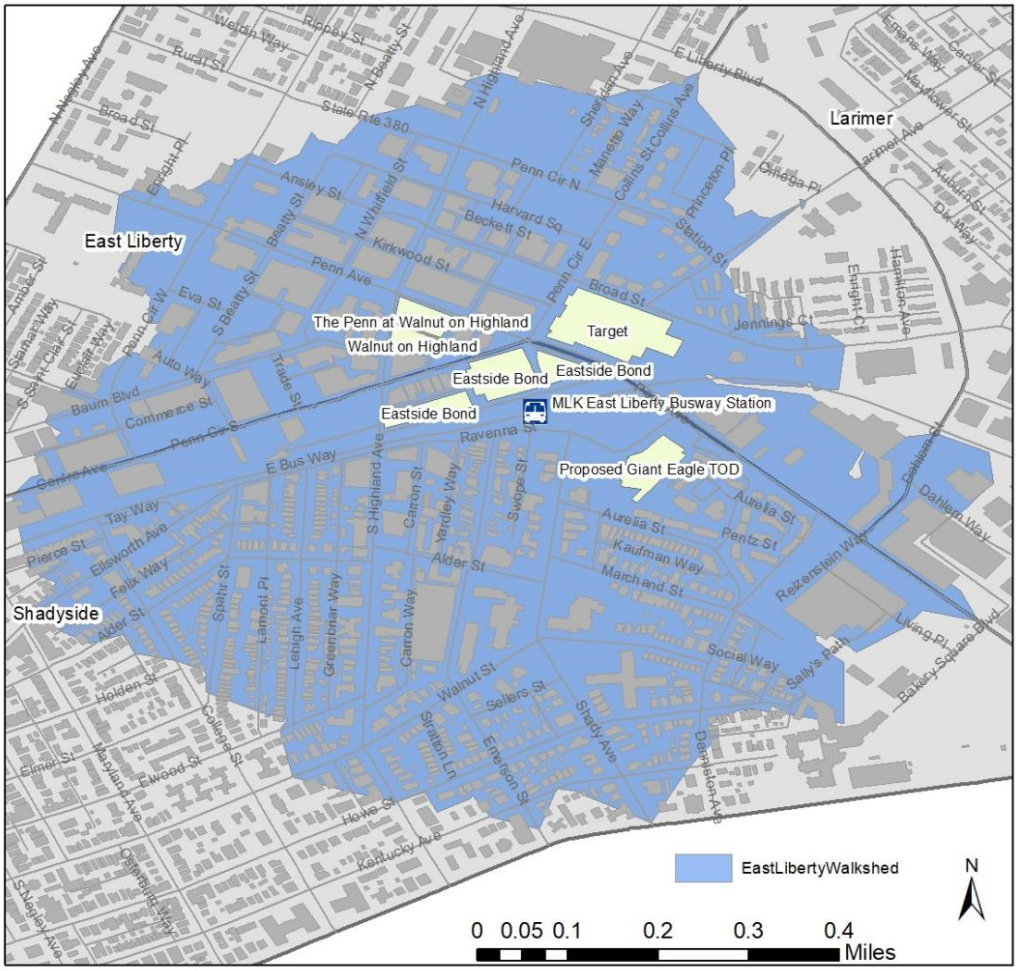


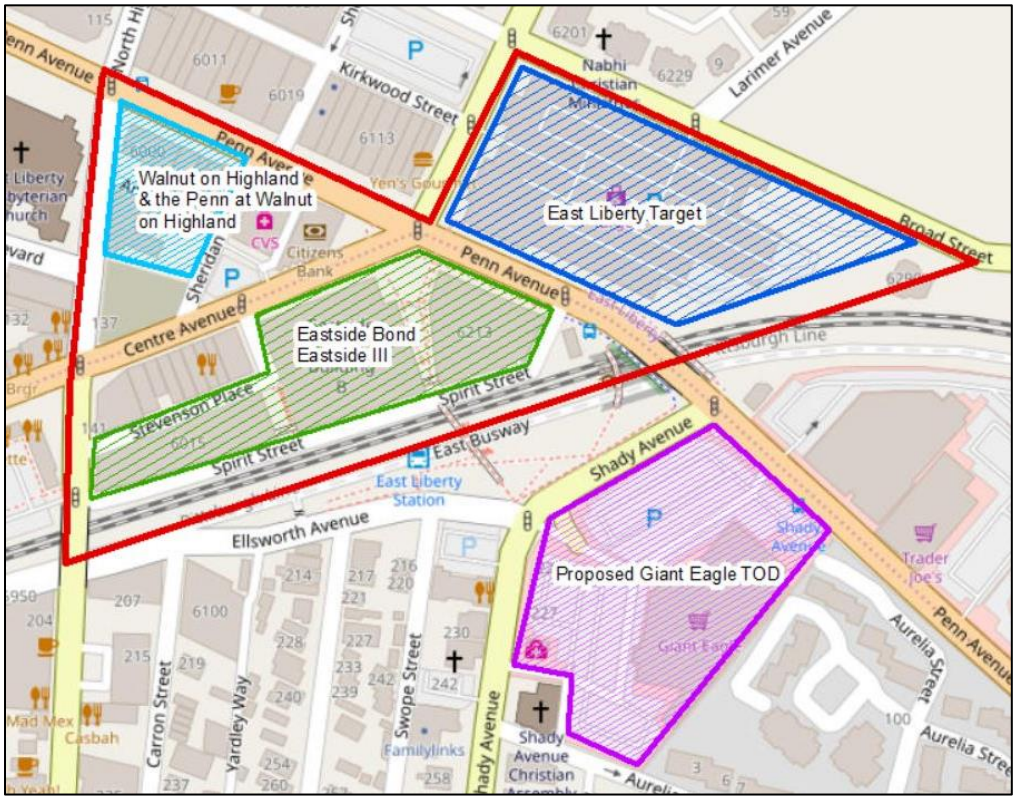
Figure 11: Half Mile Walkshed surrounding East Liberty
MLK East Busway Station



Data Collection

In the following section of this report, the data collection methodology and results are summarized for the study area shown below in Figure 12. The data collection for this research included collecting general building data for each TOD and manually counting parking inventory at Eastside Bond, East Liberty Target and on-street parking facilities. Due to permission restrictions, parking inventory was not able to be collected at the Walnut Capital buildings. This information was needed in order to compare the actual utilization to the built capacity and Pittsburgh and Denver requirements. The results of this data collection are summarized below for each TOD and the on-street parking facilities.

Figure 12: East Liberty Study Area Showing Transit Oriented Developments



Parking Inventory Methodology

In order to collect parking inventory for this research, permission was first requested from the each of the garage managers to manually collect data in the garage. Because of restrictions, data was only able to be collected at three of the four locations within the study area: Eastside Bond garage, East Liberty Target garage, and On-Street parking facilities. Data was collected on two weekdays, Tuesday October 9th and Thursday October 11th from 6:00am-11:00pm in order to capture demand for commuters in the morning and evening in addition to the retail, restaurant and other services located in the study area. Data was also collected on one Saturday, October 20th, from 8:00am-11:00pm in order to compare weekday to weekend parking utilization trends. Based on the ITE Trip Generation Manual (Institute of Transportation Engineers) October is

assumed to be a normal month for data collection, therefore no monthly adjustments were made to the data.

Eastside Bond Garage

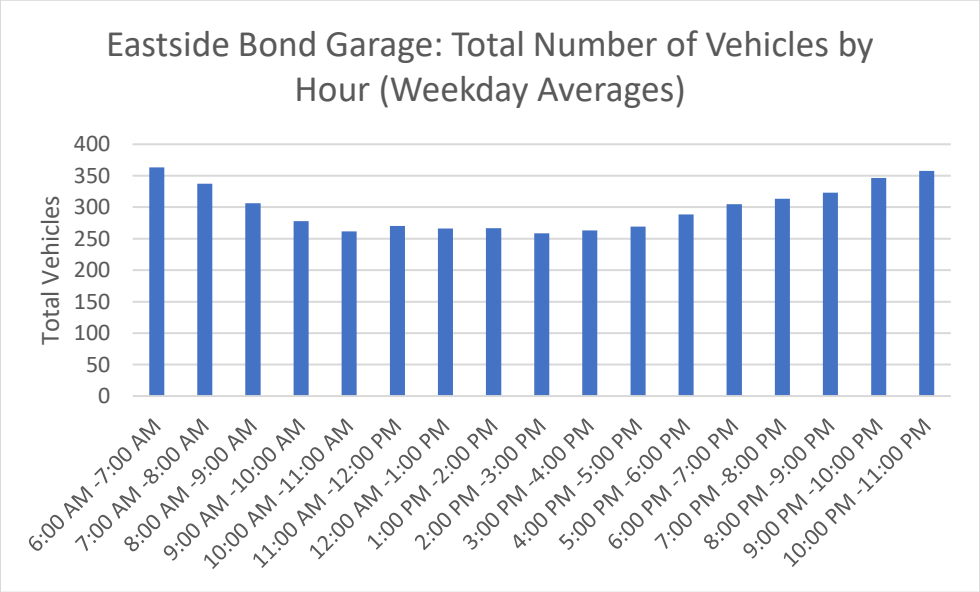
Eastside Bond is a TOD located directly adjacent to the East Liberty MLK east busway station. Included in the development is 43,000 square feet of retail, 360 apartment units and a 554-space parking garage. This parking garage is a shared use, public parking garage that consists of mostly residential parking leases in addition to parking leases for surrounding businesses and hourly parking for customers of surrounding restaurants, retail, and services.

Parking Inventory and Usage

After completing the parking inventory for the Eastside Bond garage, Figures 15 and 16 below show the total vehicle accumulation per hour for the average weekday and weekend.

Since the Eastside bond garage consists of mainly residential parking leases, the weekday graph prominently displays the trend of commuter usage. The peak utilization of the garage can be found in the morning and evening, before residents have left for work and after they return in the evening. The utilization rate during these times, 6:00am-9:00am and 6:00pm-11:00pm, ranges from 55%-65% and drops to as low as 47% from 2:00pm-3:00pm in the middle of the day. However, because of the surrounding restaurants, there is a small increase in utilization around lunch, 11:00am-2:00pm, and dinner time, 6:00pm-8:00pm, caused by customers using the garage on an hourly basis.

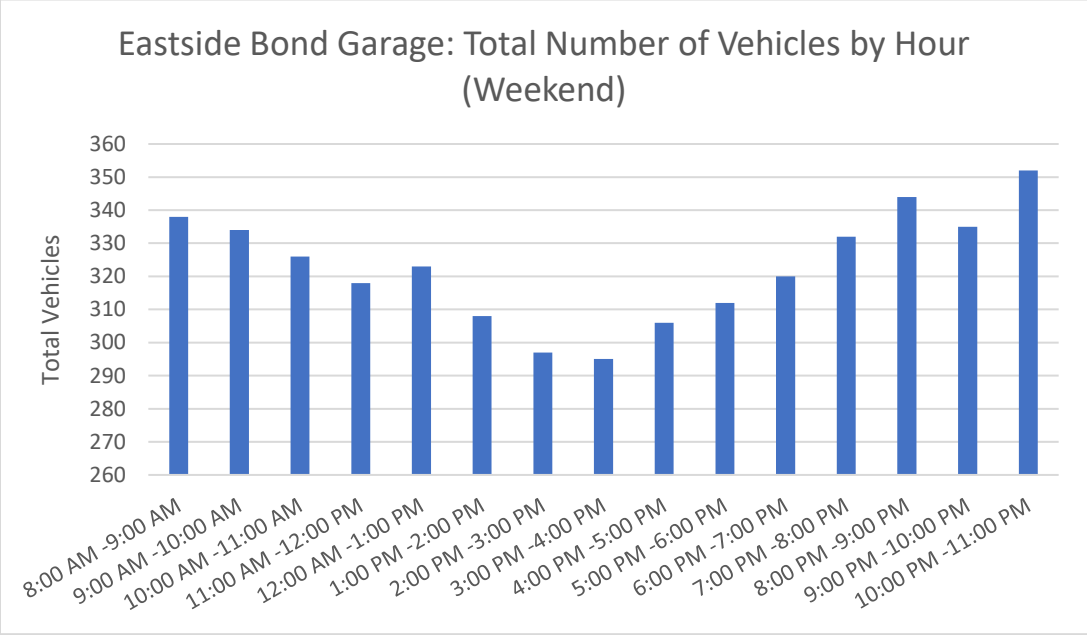
Figure 15: Weekday Parking Inventory – Eastside Bond Garage



In the weekend data, Figure 16 shows a similar trend of higher utilization in the morning and evening. However, the lowest utilization rate is only 53% as compared to the weekday 47%. This can be explained as the trips being made by residents during the weekend are primarily not work

related, meaning the residents could be leaving and returning at several points throughout the day. In addition, there are much greater increases shown during the lunch and dinner hours because of the nearby restaurants.

Figure 16: Weekend Parking Inventory – Eastside Bond Garage



East Liberty Target Garage

General Building Data

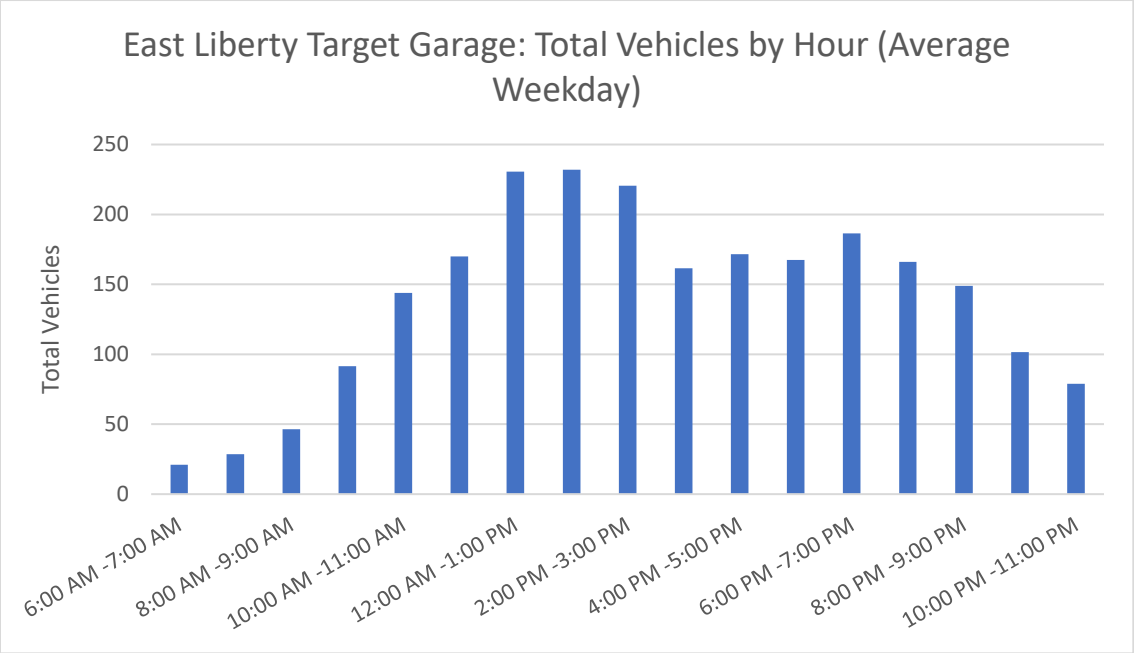
The East Liberty Target is a 143,000 SF big box retail store, elevated above a 462-space garage. The garage is for Target customers only and is supposed to be emptied at the close of business every night and kept empty by enforcement throughout the night. The hours for the business are 8:00am-11:00pm Sunday through Friday and 8:00am-12am on Saturdays.

Parking Inventory and Usage

After completing the parking inventory for the East Liberty Target garage the following graphs, Figures 17 and 18, show average weekday and weekend data utilization per hour.

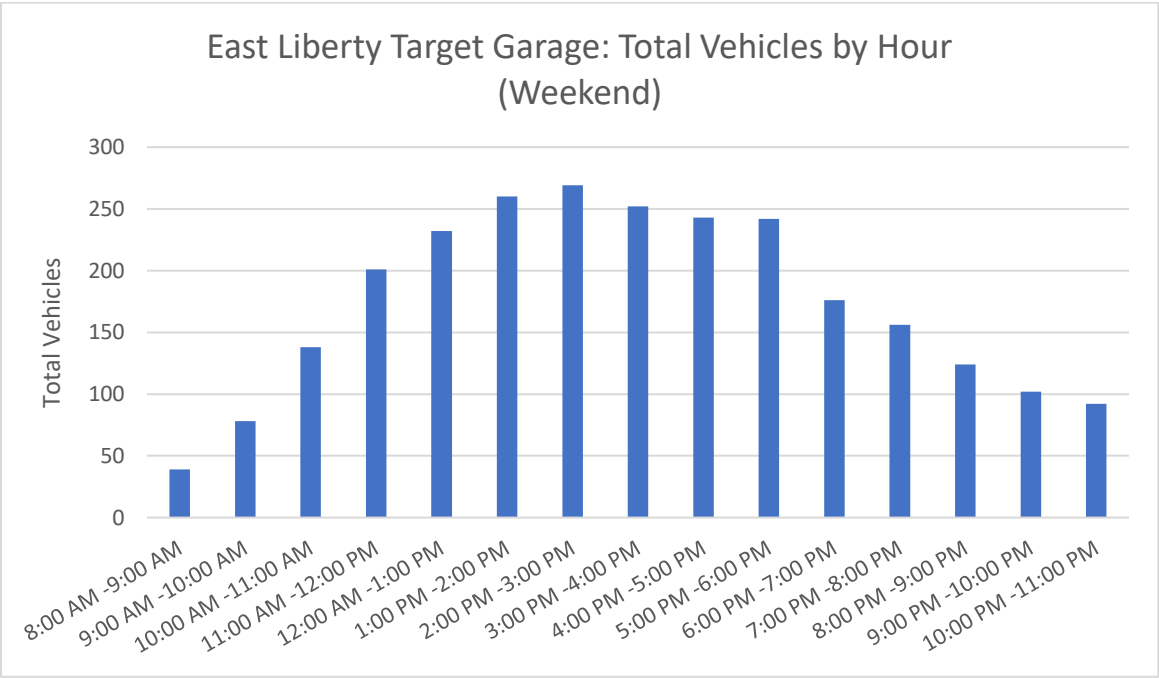
In order to keep data collection consistent across the entire study area, all counts began at 6:00am on weekdays, however, target does not open until 8:00am. While some of the vehicles located in the garage prior to opening may be employees, many were parking illegally overnight. Therefore, the utilization should be much lower from 6:00am-8:00am than shown below if parking restrictions were enforced. Following the opening of the store at 8:00am, there is a drastic increase in utilization in which the garage reaches its peak utilization of 49% to 52% from 12:00pm-3:00pm. Following this peak there is a steep decrease from 3:00pm-4:00pm which then levels out and slowly decreases throughout the evening.

Figure 17: Weekday Parking Inventory – East Liberty Target



The weekend data at East Liberty Target garage displays a similar trend throughout the day with a steep increase in usage throughout the morning and a slower decrease of utilization in the evening. However, the peak utilization is much higher during the weekend at 57% to 60% from 1:00pm-4:00pm as compared to the weekday peak of 49% to 52% from 12:00pm-3:00pm.

Figure 18: Weekend Parking Inventory – East Liberty Target



Walnut on Highland and the Penn at Walnut on Highland

General Building Data

Walnut on Highland and the Penn at Walnut on Highland are two new market rate apartment complexes owned and managed by Walnut Capital. Walnut on Highland, which was a remodel of an existing building, was the first to be opened and consists of a total of 116 units, one, two- and three-bedroom apartments. When they remodeled this building, they also built a brand new residential only parking garage with a total of 182 spaces. The Penn at Walnut on Highland was the second building to be built and opened next to Walnut on Highland, including 78 units, one- and two-bedroom apartments and 16,000 square feet of ground level retail. Because of the underutilization in the garage prior to building the Penn at Walnut on Highland, Walnut capital determined they would use the same parking garage for both buildings, however, the garage is only accessible to residents not customers of the ground level retail.

Parking Inventory and Usage

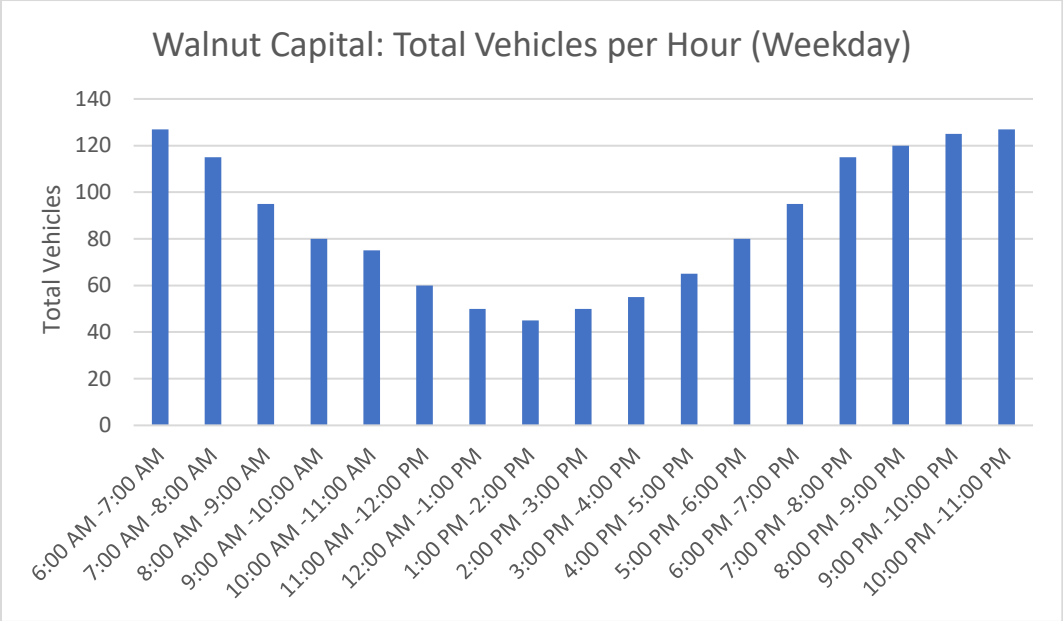
Due to permission restrictions, no parking inventory or utilization data was able to be collected for this garage. However, because the building's private residents can only use the garage, it can be assumed that the utilization trends would be similar to what was found in the Eastside Bond garage with resident parking leases. In addition, through contact with the property manager, information regarding the present occupancy of the buildings and the total number of parking spaces being leased by the residents was obtained. This information is displayed in table 4 below.

Table 4: Walnut Capital Buildings Occupancy

Building	Total Units	Current Occupants	Unit % Occupancy	Parking Spaces (Shared with Both Buildings)	# of parking leases	Utilization rate of parking lot
Walnut on Highland	116	112	96.6%	182	127	70%
The Penn at Walnut on Highland	78	76	97.4%			
Total	**194**	**188**	**96.9%**			

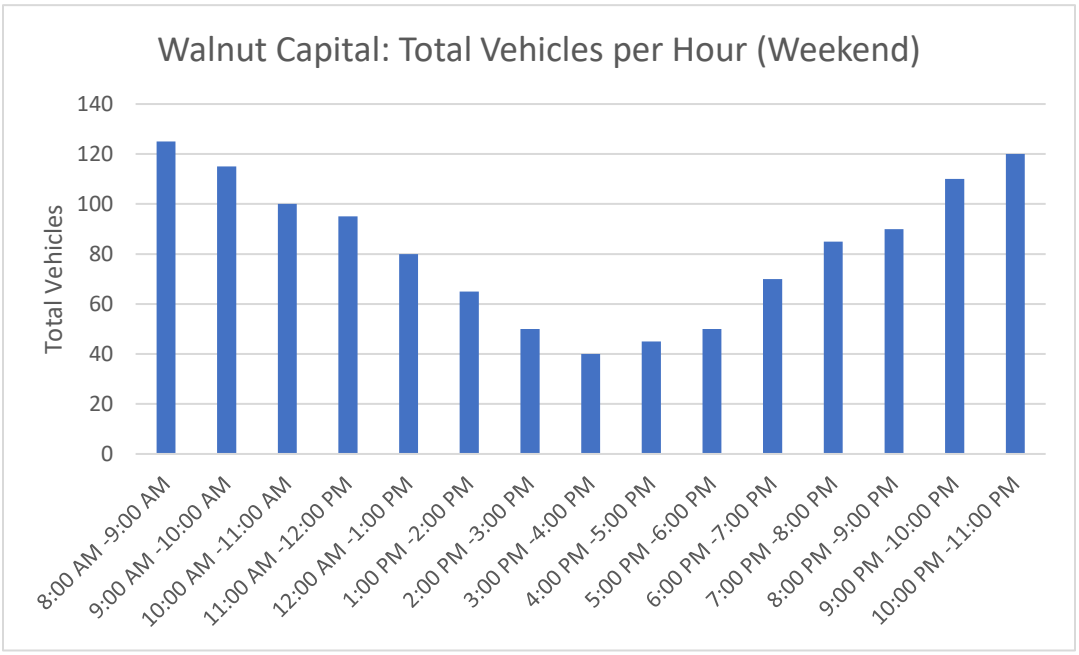
Using the trends seen in the Eastside Bond garage and the occupancy information stated above, Figures 19 and 20 were estimated. These graphs display the total vehicles per hour at the Walnut on Highland and the Penn at Walnut on Highland garage.

Figure 19: Weekday Parking Inventory – Walnut Capital



The graph of total vehicles per hour on the weekday displays a commuter trend, with the peak utilization in the morning and evenings, while the afternoon shows the lowest amount of utilization. In addition, the morning decreases much faster, assuming residents have to be somewhere at a required time, whereas in the evening the utilization increases at a much slower rate.

Figure 20: Weekend Parking Inventory – Walnut Capital



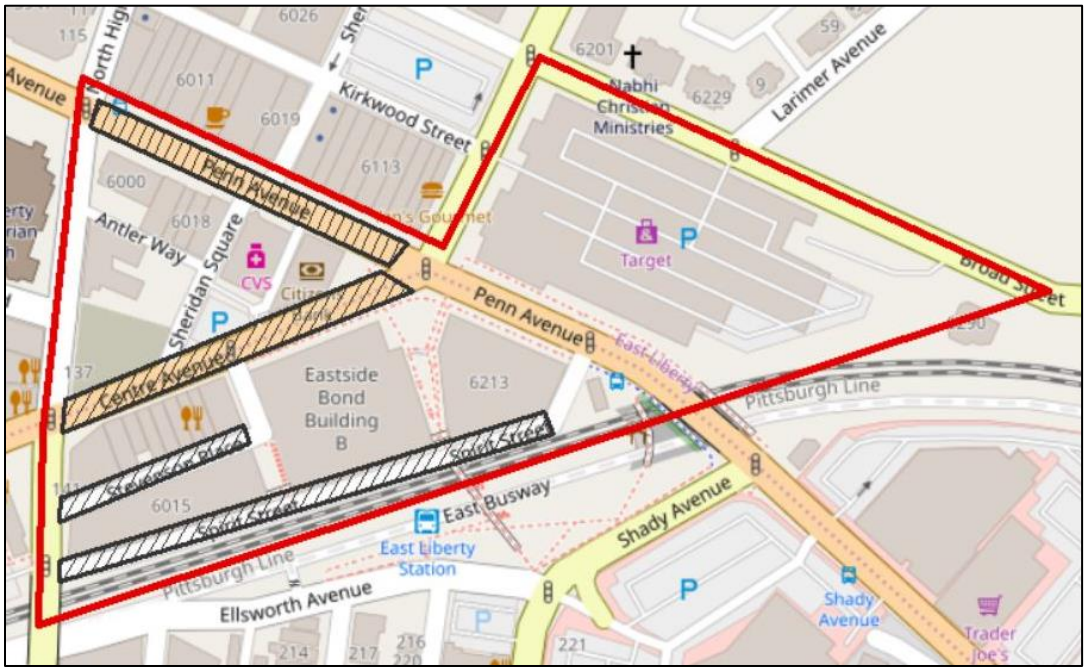
The weekend graph estimates a similar trend however, there are fewer cars in the lot than during a weekday, assuming some of the residents leave town for the weekend and there are no visitor spots provided. In addition, there are many more cars throughout the day than during the weekday because residents may be coming and going at different times throughout the day or not leaving at all.

On-Street Parking in Study Area

General Data

Within the Study area, outlined in red in Figure 21 below, there are on-street parking facilities, shown in the black hatched regions, located along four different lengths of roadways; Penn Avenue, Centre Avenue, Stevenson Place, and Spirit Street. All of these on-street facilities are hourly paid parking with a two-hour limit from to 8:00am to 6:00pm. During off hours, parking at any of these facilities is free. This allows for short term parking during the day for shopping and restaurant patrons and residents have the ability to use the spaces overnight.

Figure 21: On-Street Parking in Study Area



While the amount of parking spaces depends on the efficiency of the people using them, because the spaces are not marked, for analysis purposes, there are estimated to be 86 total on-street spaces available throughout the study area. This was determined by counting the total number of vehicles when the on-street parking facilities were at capacity. The breakdown of this parking is shown below in table 5. The on-street parking facilities were included in the parking inventory and TOD usage because patrons of ground level retail and restaurants located at the Penn at Walnut on Highland and Eastside Bond may be choosing to park in the on-street facilities instead in a parking garage.

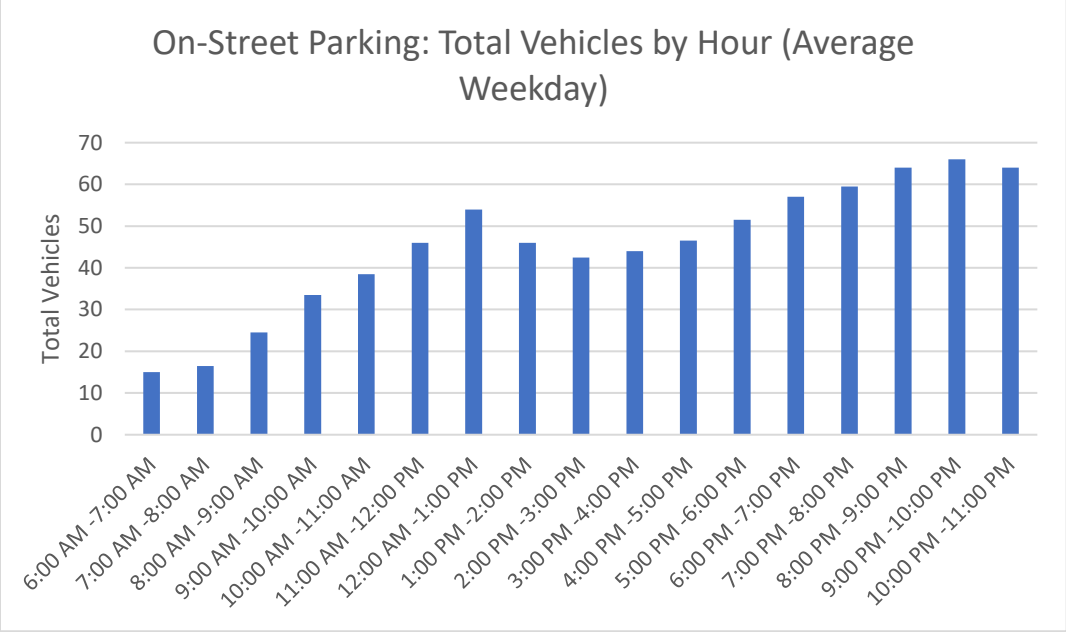
Table 5: On-Street Parking Facilities

Roadway Segment	Location of Parking	Number of Spaces
Center Ave. (Between Penn Ave and South Highland Ave.)	ONLY on eastbound side of roadway	15
Penn Ave. (Between Centre Ave. and North Highland Ave.)	Both sides of the roadway	24
Stevenson Place	ONLY on westbound side of roadway	10
Spirit Street	Both sides of the roadway	37
	Total	**86**

Parking Inventory and Usage

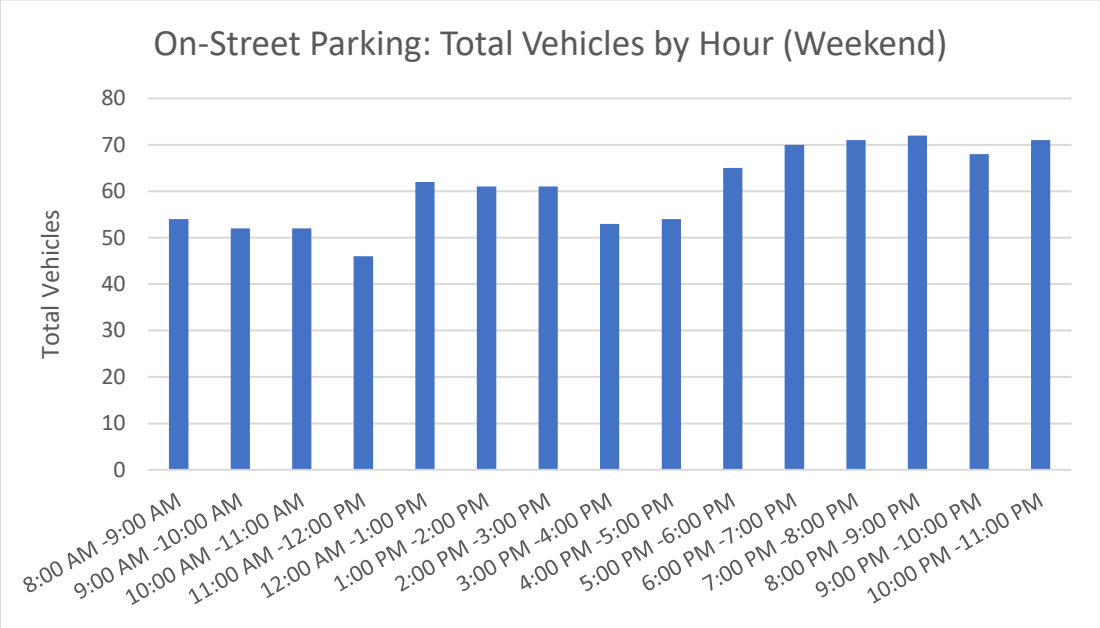
After collecting the parking inventory at the on-street parking facilities, there was a very different trend than the other facilities. During the weekday, there was very little utilization throughout the morning, with an initial peak of 63% around lunch time. There was then a decrease throughout the late afternoon and a larger peak in the evening, with the peak utilization being shown at 77% from 9:00pm-10:00pm. Since all of these on-street facilities are pay parking throughout the day until 6:00pm, this graph shows that most people park during after-hours.

Figure 22: Weekday Parking Inventory – On-Street Parking



The weekend parking utilization, shown in Figure 23 below is overall much higher than during the weekday. This graph also shows peak utilization rates around the lunch hours, 72%, and dinner hours, 83%. This demonstrates the use of the on-street parking for restaurant patrons.

Figure 23: Weekend Parking Inventory – On-Street Parking



Analysis

Upon completing the data collection phase, the TODs were analyzed and compared to three different criteria: built capacity, City of Pittsburgh minimum required with reduction factor and absolute maximum allowed, and Denver, CO minimum with reduction factor and absolute maximum allowed. The following section summarizes this analysis by first analyzing each TOD individually and then the total study area, including the three TODs and the on-street parking facilities.

Parking Requirement Data

City of Pittsburgh

The City of Pittsburgh provides parking requirements for both on-street and off-street parking facilities for all types of development. For each use there is a minimum amount of spaces required and a maximum amount of parking spaces allowed. In the table 1 below, the land uses that are relevant to the TODs in this research were tabulated.

Table 1: City of Pittsburgh Off-Street Parking Schedules (Sec. 914.02.A)

Use Type	Minimum Off-Street Required	Maximum Off-Street Allowed
Residential Multi-Unit	1 per unit	2 per unit
Grocery Store, over 10,000 sf	1 per 250 sf	1 per 100 sf
Restaurant	1 per 125 sf above first 2,400 sf	1 per 75 sf
Retail Sales and Services	1 per 500 sf above first 2,400 sf	1 per 175 sf

While these are the minimum and maximum off-street parking requirements, throughout the city there are neighborhoods and districts that have been exempt from parking requirements or the requirements can be reduced. These areas are shown in Figures 13 and 14 and table 2 below. Within East Liberty, the parking requirements for all land uses except residential can be reduced by 50%.

Table 2: City of Pittsburgh Off-Street Parking Exemption/Reduction Areas (Sec. 914.04)

Area	Use Type	Percent Decrease
SP Districts & PUBs	Any use	Parking Demand Analysis
Downtown	Any use	100
East Liberty	Any use except residential	50
SP-11 Lower Hill Planned Development	Any use	100
North Shore	Any use except residential	25
North Side	Any use except residential	25
Oakland	Any use except residential	50
Uptown Public Realm District	Any use	100

Figure 13: Parking Reduction Zoning Pittsburgh Neighborhoods

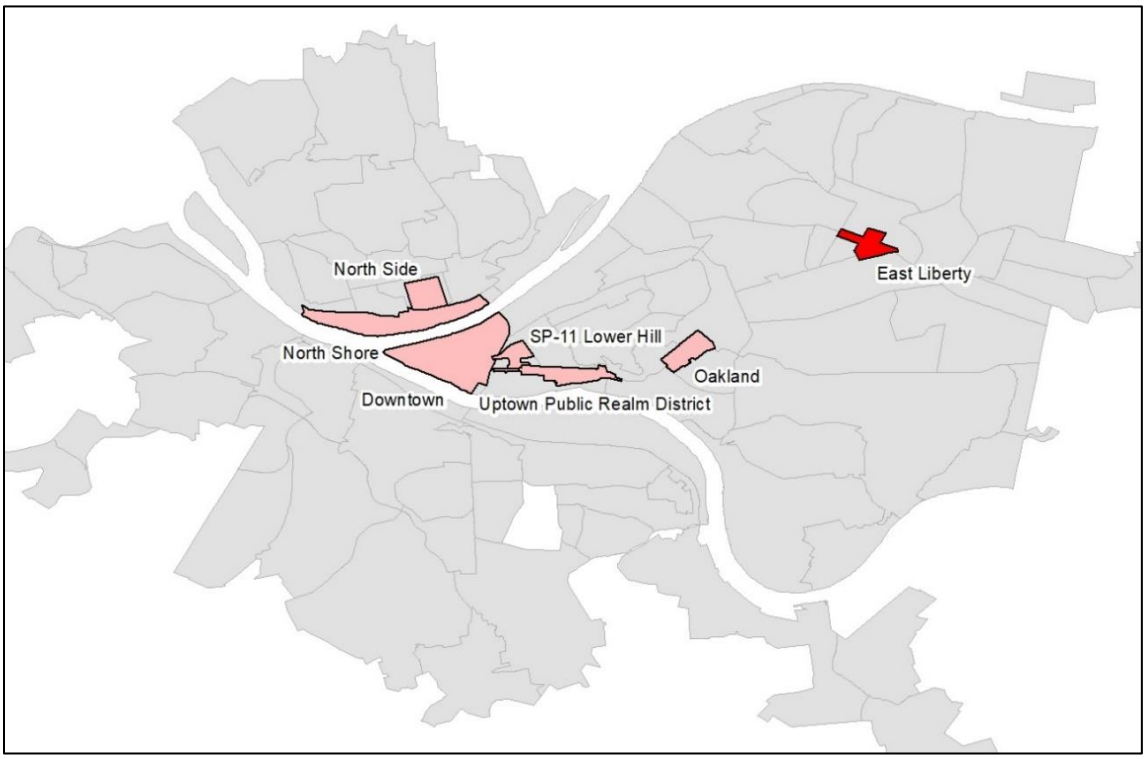
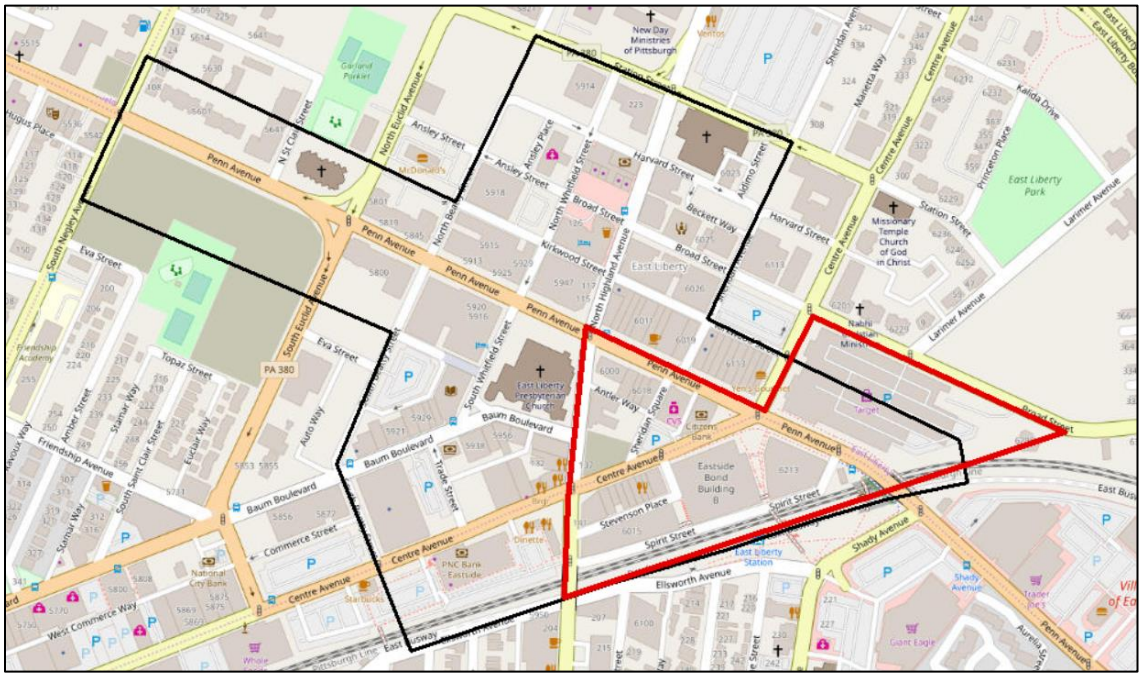


Figure 14: East Liberty Parking Reduction Zone and Study Area



Denver, CO

In addition to the comparing the utilization of the TODs to the built capacity and the City of Pittsburgh Parking Requirements, Denver Colorado was selected to also compare the utilization to TOD zoning requirements. Denver was chosen because they are a similar size city to Pittsburgh with similar infrastructure. However, Denver has much more aggressive parking requirements especially in transit areas. In order to accurately estimate the parking requirements for this research, the East Liberty neighborhood would be classified as an *Urban Center Neighborhood*, which is described as multi-unit residential and mixed-used commercial strips and commercial centers (Section 7.1.1) in the Denver parking requirements. For each use in this neighborhood the minimum requirements are listed in table 3 below. In addition to these minimums, Denver has created maximums in TOD districts, similar to East Liberty, that prohibits parking more than 110% of the minimum. However, in residential units, the maximum must not exceed 1 space per unit. They have also allowed a reduction of 25% in areas within a quarter mile of a high-quality transit corridor. This is lower than the City of Pittsburgh reduction zones, however, the Denver requirements are already much lower than the Pittsburgh requirements before including the reduction.

Table 3: Summary of Denver, CO Parking Requirements (Section 7.4.4)

Land Use	**Minimum Required**
Dwelling, Multi-Unit	0.75/Unit
Retail Sales, Services, Repair	1.25/1,000 SF
Food Sales or Market	1.25/1,000 SF

Eastside Bond

Parking requirements

In order to compare the actual utilization of the garage to other metrics, the City of Pittsburgh parking requirements were estimated using the parking code described above. Eastside bond is a multi-use building with 360 residential units, and 43,000 square feet in retail space. With this building information the parking requirements were estimated based on square footage and number of residential units. After completing this calculation, shown below in table 6, the minimum and maximum parking required for this development is 441 spaces and 966 spaces, respectively. Also shown in this table is the required parking if the 50% reduction was used, however, this reduction only applies to the retail spaces not residential. After applying the reduction to the retail space, the minimum required parking is reduced by 40 spaces.

Table 6: City of Pittsburgh Eastside Bond Parking Requirements

			Allowed Parking Spaces		50% Reduction for East Liberty	
Uses	**Gross SF**		**Minimum**	**Maximum**	**Minimum**	**Maximum**
Retail	43,000	SF	81	246	41	123
Residential	360	Units	360	720	360	720
	Total		441	966	401	843
Existing Number of Parking Spaces:	**554**					

Using the Denver, CO parking code described previously in this report, the parking requirements for the Eastside Bond Building was estimated and is shown below in table 7. For the minimum required and maximum allowed, the parking requirements were estimated to be 324 spaces and 473 spaces, respectively. These values were then reduced by 25% because of proximity to transit, which reduced the required minimum by 81 spaces and the allowed maximum by 118 spaces.

Table 7: Denver, CO Eastside Bond Parking Requirements

			Allowed Parking Spaces		Reduction allowed	
Uses	**Gross SF**		**Minimum**	**Maximum for TOD**	**Minimum**	**Maximum**
Retail	43,000	SF	54	113	40	85
Dwelling, Multi-Unit	360	Units	270	360	203	270
	Total		324	473	243	355
Existing Number of Parking Spaces:	**554**					

Utilization

As found in the previous data collection section, Eastside bond had a maximum usage of 364 vehicles and 352 vehicles during the weekday and weekend, respectively. In comparing this utilization to the built capacity of the garage, 554 spaces, approximately 66% of spaces are utilized during the peak hour of the weekday and 64% utilized during the peak hour of the weekend. In comparing the City of Pittsburgh requirements, the minimum required, 401 spaces, would be 91% utilized on during the weekday peak hour and 88% utilized during the weekend peak hour. When comparing the City of Pittsburgh maximum allowed, 966 spaces, to the current utilization, only 38% of the maximum would be utilized during the weekday peak hour and 36% during the weekend peak hour.

Table 8: Eastside Bond Utilization VS Built Capacity
and Pittsburgh Parking Requirements

	Current Conditions			Pittsburgh Req.		Pittsburgh Req.	
	Utilized Spaces	Built Capacity	% Utilized	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	364	554	66%	401	966	91%	38%
Peak Weekend	352		64%			88%	36%

In comparing the peak utilization during the weekend and weekend to the Denver requirements, it can be noted that the Denver maximum allowed is very close to the Pittsburgh minimum required. The Denver maximum, 473 spaces, would be only 77% utilized during the weekday peak hour and 74% during the weekend peak hour. However, the minimum allowed, 243 spaces would create a deficiency of 50% during the weekday peak hour and 45% during the weekend peak hour.

Table 9: Eastside Bond Actual Utilization VS Denver, CO Requirements

	Current Conditions	Denver Req.		Denver Req.	
	Utilized Spaces	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	364	243	473	150%	77%
Peak Weekend	352			145%	74%

East Liberty Target

Parking requirements

While the city of Pittsburgh does not specify parking requirements for a big box store like Target, the requirements for parking were determined by the total gross square feet of each use. The gross floor area was split up by approximately 70% retail and 30% grocery; this is shown in table 10 below. The required parking for the East Liberty Target was estimated to be a minimum required of 438 spaces and a maximum allowed of 1001 spaces. The East Liberty 50% reduction factor was then calculated, reducing the minimum required to 219 spaces and maximum allowed to 501 spaces.

Table 10: City of Pittsburgh East Liberty Target Parking Requirements

			Allowed Parking Spaces		50% Reduction for East Liberty	
Uses	**Gross SF**		**Minimum**	**Maximum**	**Minimum**	**Maximum**
Total	**143000**	**SF**				
Super market over 10,000 SF	42900	SF	286	429	143	215
Retail	100100	SF	152	572	76	286
	Total		438	1001	219	501
Existing Number of Parking Spaces:	**462**					

In addition to the City of Pittsburgh parking requirements, the Parking requirements for the East Liberty Target were also calculated using Denver, CO specifications, shown in table 11 below. The big box store was again separated by 70% retail and 30% Grocery, however, in Denver the parking requirements are the same for both types of land uses. The requirements for this location were calculated to be a minimum of 179 spaces and a maximum of 375 spaces. These values were then reduced by the 25% because of proximity to transit, which reduced the minimum required by 45 spaces and the maximum allowed by 93 spaces.

Table 11: Denver, CO East Liberty Target Parking Requirements

			Allowed Parking Spaces		Reduction allowed	
Uses	**Gross SF**		**Minimum**	**Maximum for TOD**	**Minimum**	**Maximum**
Total	**143000**	**SF**				
Grocery	42900	SF	54	113	40	84
Retail	100100	SF	125	263	94	197
	Total		179	375	134	282
Existing Number of Parking Spaces:	**462**					

Utilization

Using the data collection described previously, the East Liberty Target had a peak hour maximum of 364 vehicles during the average weekday and 352 during the average weekend. These peak hour utilizations were compared to the built capacity, Pittsburgh requirements and Denver requirements shown in the table 12 below. The built capacity of this parking lot is 462 spaces, however, only 446 spaces can be utilized because there are cart return racks in 16 spaces. Of the 446 spaces only 52% are utilized during the weekday peak hour and 60% during the

weekend peak hour. In comparing the utilization to City of Pittsburgh minimum requirement, 219 spaces, the requirement would create a deficiency of 6% during the weekday peak hour and 23% during the weekend peak hour. However, the maximum City of Pittsburgh requirement,1001 spaces, would be only 23% utilized during the weekday peak hour and 27% during the weekend peak hour.

Table 12: East Liberty Target Actual Utilization VS Built Capacity and Pittsburgh Parking Requirements

	Current Conditions			Pittsburgh Req.		Pittsburgh Req.	
	Utilized Spaces	Built Capacity	% Utilized	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	232	446	52%	219	1001	106%	23%
Peak Weekend	269		60%			123%	27%

In comparing the peak utilization to Denver parking requirements, shown in table 13, the maximum allowed, 375 spaces, would be 62% utilized during the weekday peak hour and 72% during the weekend peak hour. However, the minimum required, 134 spaces, would create a deficiency of 73% during the weekday peak hour and 101% during the weekend peak hour.

Figure 13: East Liberty Target Actual Utilization VS Denver, CO Requirements

	Current Conditions	Denver Req.		Denver Req.	
	Utilized Spaces	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	232	134	375	173%	62%
Peak Weekend	269			201%	72%

Walnut on Highland and the Penn at Walnut on Highland

Parking requirements

Based on the parking requirements determined by the City of Pittsburgh, table 14 below, shows the minimum and maximum parking required and allowed for theses apartment buildings. Although the ground floor of the Penn at Walnut on Highland has 16,000 square feet of retail, the parking lot for the buildings is only accessible to residents, not customers therefore it was not considered in the requirements. Since the parking garage was only built for residential land use, no reductions are permitted because the 50% parking reduction applies to all uses except residential land use. As mentioned previously, the 182-space garage was originally built for only Walnut on highland, 116 units. Therefore, they built over the minimum required by 66 spaces. However, after building the Penn at Walnut on Highland, 78 units, without expanding the garage, they are under the minimum requirement by 12 spaces.

Table 14: City of Pittsburgh Walnut on Highland and the Penn at Walnut on Highland Parking Requirements

Uses	Gross SF		Allowed Parking Spaces Minimum	Allowed Parking Spaces Maximum	50% Reduction for East Liberty Minimum	50% Reduction for East Liberty Maximum
Residential Multi-Unit (Walnut on Highland ONLY)	116	Units	116	232	N/A	N/A
Residential Multi-Unit (Both Buildings)	194	Units	194	388	N/A	N/A
Existing Number of Parking Spaces:	**182**					

In addition to the City of Pittsburgh requirements, the TOD parking requirements were also estimated using Denver, CO parking requirements as shown below in table 15. After completing this estimation, the minimum required for this building was 146 spaces and the maximum allowed was 194 spaces. These values were then reduced by 25% based on transit proximity, which reduced the minimum required by 37 spaces and the maximum allowed by 48 spaces.

Table 15: Denver, CO Walnut on Highland and the Penn at Walnut on Highland Parking Requirements

Uses	Gross SF		Allowed Parking Spaces Minimum	Allowed Parking Spaces Maximum for TOD	Reduction allowed Minimum	Reduction allowed Maximum
Dwelling, Multi-Unit (Walnut on Highland ONLY)	116	Units	87	116	65	87
Dwelling, Multi-Unit (Both Buildings)	194	Units	**146**	**194**	**109**	**146**
Existing Number of Parking Spaces:	**182**					

Utilization

Using the data collection described previously, the peak hour maximum for the weekday and weekend for the Walnut Capital buildings was estimated to be 127 vehicles and 125 vehicles. In comparing this to the built capacity of the garage, 182 spaces, the garage is 70% utilized during the weekday peak hour and 69% utilized during the weekend peak hour. In comparing the actual utilization to the City of Pittsburgh minimum required, 194 spaces, there is a 65% utilization rate during the weekday peak hour and 64% during the weekend peak hour. While, the maximum allowed, 388 spaces, shows a utilization rate of 33% during the weekday peak hour and 32% during the weekend peak hour.

Table 16: Walnut Capital Actual Utilization VS Built Capacity and Pittsburgh Parking Requirements

	Current Conditions			Pittsburgh Req.		Pittsburgh Req.	
	Utilized Spaces	Built Capacity	% Utilized	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	127	182	70%	194	388	65%	33%
Peak Weekend	125		69%			64%	32%

When comparing the estimated utilization of the Walnut Capital Garage to the Denver requirements, the minimum required, 109 spaces, would create a deficiency of 17% during the weekday peak hour and 15% during the weekend peak hour. However, the maximum allowed, 194 spaces, the utilization rate is 65% during the weekday peak hour and 64% during the weekend peak hour. These calculations are shown below in table 17.

Table 17: Walnut Capital Actual Utilization VS Denver, CO Requirements

	Current Conditions	Denver Req.		Denver Req.	
	Utilized Spaces	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	127	109	194	117%	65%
Peak Weekend	125			115%	64%

Total Study Area

In beginning the analysis for the total study area, the actual utilization for each location in the study area was compared graphically for both the average weekday and weekend, shown below in Figure 24 and 25 by hour of the day. These graphics illustrate the difference in daily usage based on the type of land use. These graphics also displays the principle behind shared parking, which has started to be implemented in other TOD projects throughout the country. Shared parking accounts for residents leaving for work in the morning and return in the evening, during the week, while retail and restaurant customers use the parking lot throughout the day. On the weekend, while not as many residents leave the garage, there are still offsetting usage by retail and restaurant customers. This concept assumes that all spaces are available to all users as public parking facilities which is not the case in this TOD.

Figure 24: Comparison of total Vehicles per hour for each location (Weekday)

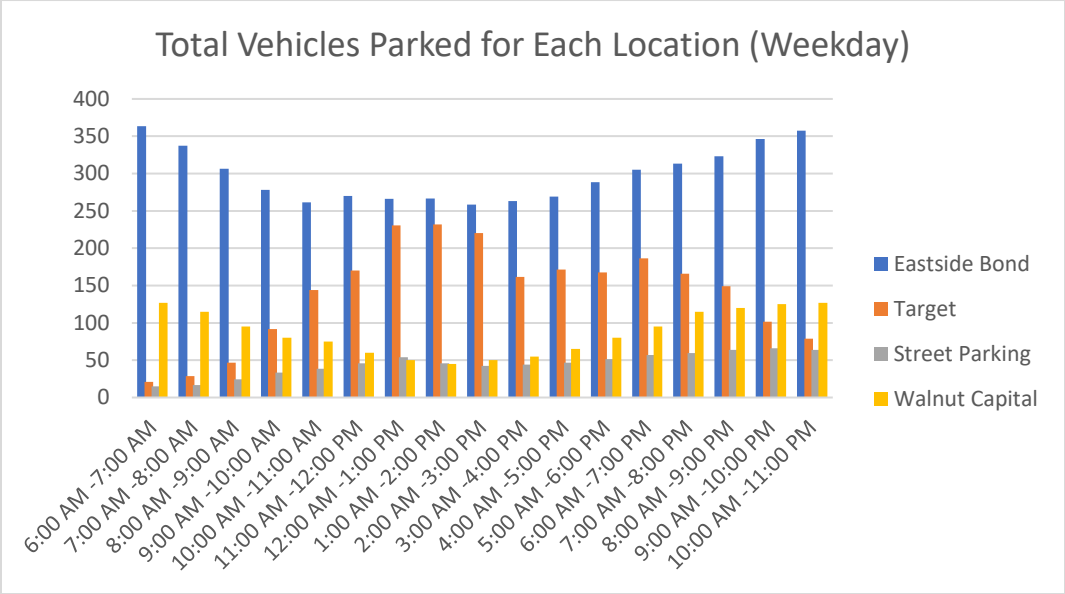
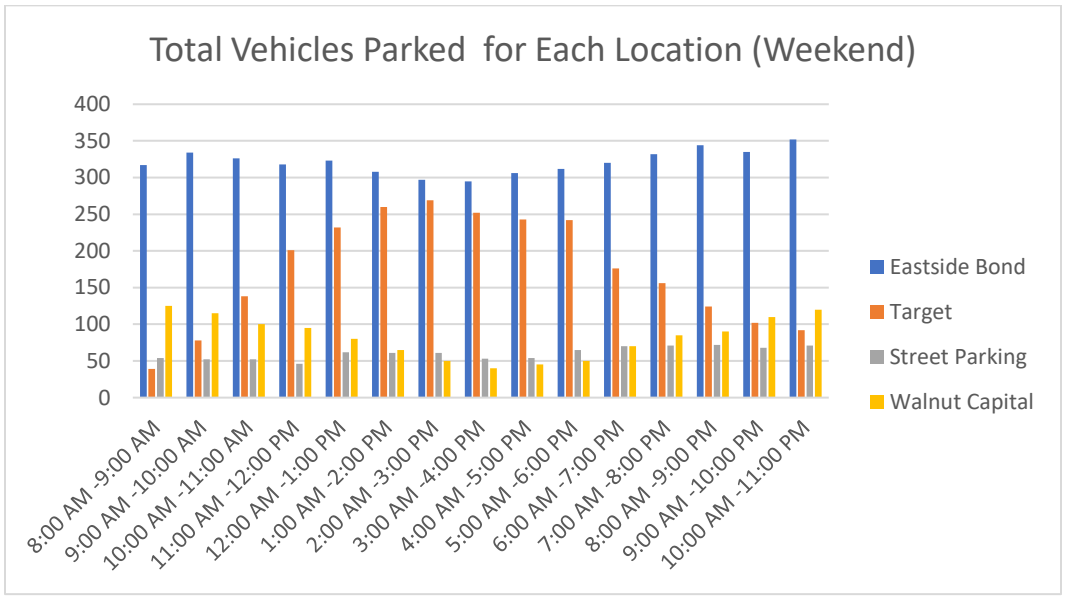


Figure 25: Comparison of total Vehicles per hour for each location (Weekend)



Using these data for each location in the study area, they were then summed to create total usage for the entire study area per hour, shown in Figure 26 and 27 below. This data provided the maximum utilization for the entire study area during the average weekday and weekend, which was found to be 52% from 7:00pm-9:00pm during the average weekday and 55% from 12:00pm-2:00pm during the average weekend.

Figure 26: Total Vehicles for Entire Study Area by Hour (Weekday)

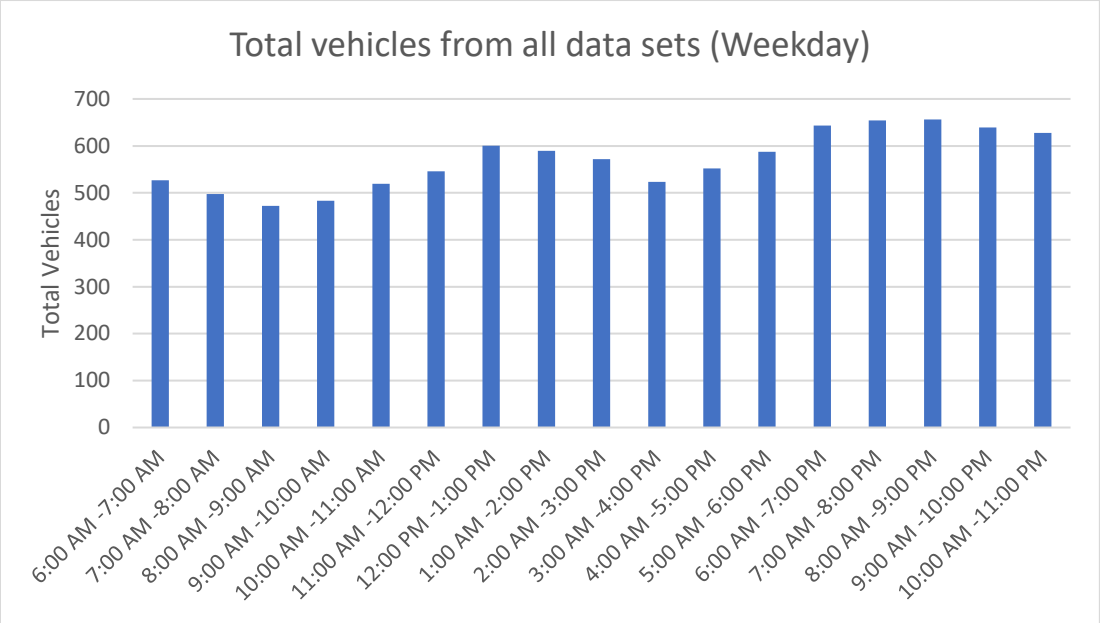
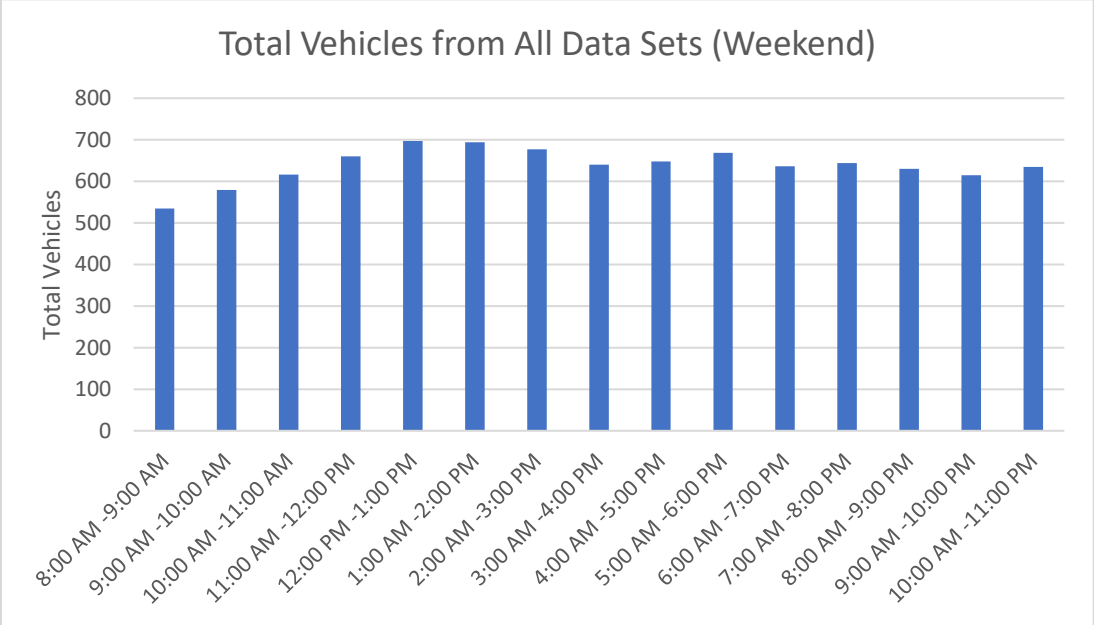


Figure 27: Total Vehicles for Entire Study Area by Hour (Weekend)



These maximum vehicle utilizations per hour were then compared to the built capacity, the City of Pittsburgh minimum requirements and maximum allowed parking regulations and the Denver, CO minimum requirements and maximum allowed regulations, shown in table 18 and 19 below. It is again noted that this comparison assumed that these could be shared parking facilities, which they are not. When comparing the peak weekday and weekend utilization to the built capacity of the entire study area, only 55% of the spaces are utilized during the weekday peak hour and 59% during the weekend peak hour. In comparing the minimum parking required by the City of

Pittsburgh, 814 spaces, 81% of the spaces would be utilized during the weekday peak hour and 85% during the weekend peak hour. When considering the parking maximum recommended by the City of Pittsburgh, 2355 spaces, the peak utilization for both the weekday and weekend created a surplus of approximately 70%.

Table 18: Total Study Area Utilization vs Built Capacity and City of Pittsburgh Requirements

	Current Conditions	Current vs Built		Pittsburgh Req.		Pittsburgh Req.	
	Utilized Spaces	Built Capacity	% Utilized	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	656	1182	55%	814	2355	81%	28%
Peak Weekend	694		59%			85%	29%

In analyzing the actual utilization to the Denver, CO requirements, it is important to note that their maximum value, 810 spaces is set at the City of Pittsburgh's minimum, 814. In this case, the utilization during the peak hour leaves approximately 16% spaces available within the study area. However, Denver's minimum required, 486 spaces, is approximately 40% below the peak utilization for the weekday and weekend.

Table 19: Total Study Area Utilization vs Denver, CO Requirements

	Current Conditions	Denver Req.		Denver Req.	
	Utilized Spaces	Absolute Min	Absolute Max	% Utilized	% Utilized
Peak Weekday	656	486	810	135%	81%
Peak Weekend	694			143%	86%

Proposed Giant Eagle Transit-Oriented Development

General Building Data

Currently, on the opposing side of the busway in the neighborhood of Shadyside there is a shopping center with several small retail and service stores as well as a Giant Eagle grocery store. This shopping center, as it exists now, contains a large parking lot that is extremely underutilized by costumers. Because of this, the parking lot has become an unofficial park-and-ride for transit riders using the East Liberty Busway station. In recent years, there has been plans to create a TOD in this location because of its proximity to the East Busway. This proposed development includes a 50,000 square foot Giant Eagle supermarket, 45,000 square feet of retail and 585 parking spaces.

Parking requirements

Based on the parking requirements created by the City of Pittsburgh, the minimum and maximum parking spaces allowed for each use in summarized in table 20 below. Because the

proposed TOD is outside the East Liberty reduction zone, there are no applicable reductions for this site. Therefore, the minimum required for the Giant Eagle TOD is 419 spaces and the maximum allowed is 757 spaces.

Table 20: City of Pittsburgh Proposed Giant Eagle TOD Parking Requirements

			Allowed Parking Spaces		50% Reduction for East Liberty	
Uses	**Gross SF**		**Minimum**	**Maximum**	**Minimum**	**Maximum**
Giant Eagle Supermarket	50000	SF	333	500	N/A	N/A
Retail	45000	SF	85	257	N/A	N/A
	Total		**419**	**757**	**N/A**	**N/A**
Proposed Number of Parking Spaces:			**585**			

When calculating the Denver parking requirements, shown below in table 21, the minimum required, and maximum allowed prior to the transit reduction was 119 spaces and 249 spaces, respectively. After applying the 25% reduction the minimum required and maximum allowed were reduced by 30 spaces and 62 spaces, respectively.

Table 21: Denver, CO Proposed Giant Eagle TOD Parking Requirements

			Allowed Parking Spaces		Reduction allowed	
Uses	**Gross SF**		**Minimum**	**Maximum for TOD**	**Minimum**	**Maximum**
Giant Eagle Supermarket	50000	SF	63	131	47	98
Retail	45000	SF	56	118	42	89
	Total		**119**	**249**	**89**	**187**
Proposed Number of Parking Spaces:	**585**					

Summary of Results

After completing the analyses, a summary of the results is shown below in table 22. When comparing the actual utilization to the built capacity of each TOD and the total study area, the utilization rate is between 52% and 70% during the peak hour of the weekend and weekday. This shows that each of these TODs were over parked by at least 30% when built.

Table 22: Summary of Analyses

	Actual Utilization	Built Capacity		Pittsburgh Requirments				Denver Requirments			
Eastside Bond		**Built**	**% Utilized**	**Min**	**Max**	**% Utilized of Min**	**% Utilized of Max**	**Min**	**Max**	**% Utilized of Min**	**% Utilized of Max**
Peak Weekday	364	554	**66%**	401	966	**91%**	**38%**	243	473	**150%**	**77%**
Peak Weekend	352		64%			88%	36%			145%	74%
East Liberty Target											
Peak Weekday	232	446	52%	219	1001	106%	23%	134	375	173%	62%
Peak Weekend	269		**60%**			**123%**	**27%**			**201%**	**72%**
Walnut Capital											
Peak Weekday	127	182	**70%**	194	388	**65%**	**33%**	109	194	**117%**	**65%**
Peak Weekend	125		69%			64%	32%			115%	64%
Total Study Area											
Peak Weekday	656	1182	55%	814	2355	81%	28%	486	810	135%	81%
Peak Weekend	694		**59%**			**85%**	**29%**			**143%**	**86%**

When comparing the actual utilization, to the City of Pittsburgh requirements, the results were very interesting. The Eastside bond minimum required, 401 spaces, which is 153 spaces below the built capacity and shows a utilization rate of approximately 90% during the peak hour of the weekend and weekday. When Analyzing Eastside Bond, it is important to note that only the retail space in the building could be considered for the 50% parking reduction. The total study area shows similar utilization rates, with a peak of 85% during the weekend and weekday peak hour when compared to the built capacity, with the minimum spaces required being 368 spaces below the built capacity.

However, Walnut Capital shows much lower utilization rates with a peak of 65% when compared to the Pittsburgh Parking requirements. This is because the East Liberty 50% reduction do not apply to residential uses.

The East Liberty Target shows the opposite result. The peak weekday and weekend utilization were over the minimum Pittsburgh requirements by 6% during the weekday peak hour and 23% during the weekend peak hour. In this case, the 50% reduction could have been be applied to the entire building, however, this would be too much of a reduction based on the actual utilization.

When comparing the actual utilization to the maximum allowed City of Pittsburgh parking requirements, all of the TODs and the total study area show an average of only 29% utilized during the weekend and weekday peak hour. This data displays that while the City of Pittsburgh minimum requirements are reasonable when compared to the actual peak hour utilization, the maximum allowed is much higher than necessary. It is noted that even greater efficiency could be achieved if shared parking facilities were provided in this TOD. Also, while the East Liberty reduction factor can be used for most land uses, residential is not included in this reduction.

When comparing the actual utilization to the Denver, CO requirements, it is important to first note that the Denver maximum allowed parking requirements are very close, if not the same as

the City of Pittsburgh minimum parking requirements except for the East Liberty Target. When looking at the maximum Denver requirements, the utilization rate is between 62% to 86% during the peak hour weekday and weekend. This is very similar to the utilization of the built capacity. However, the minimum parking requirements for Denver, CO would result is a shortfall of parking in all the TODs and the total study area. This data displays the opposite as the City of Pittsburgh requirement, the minimum parking requirements are much more aggressive than the Pittsburgh requirements and do not meet the current utilization. However, the maximum allowed is much closer to the current utilization.

Recommendations

After completing this research, the results are very similar to the conclusions found in the literature review described previously in this report. Historically, TODs have been overparked which is shown again in Eastside Bond, East Liberty Target, and The Walnut Capital Buildings: Walnut on Highland and the Penn at Walnut on Highland.

When comparing the actual utilization to the City of Pittsburgh minimum and maximum requirements, this data displays that the minimum required, including the 50% reduction for all uses except residential, is an appropriate requirement to meet the current needs of the TODs.

Although, the minimum supply is enough parking based on the current demand, because residential units are not considered in the reduction factor, the TODs with residential units experience more underutilization than the TODs including only retail and other land uses. Therefore, this data leads to a recommendation that there should be some type of reduction factor for residential units in close proximity to high quality transit. While a 50% reduction may be too drastic, as shown in the deficient caused by the Denver requirements, a 25% reduction or a limit of only 1 space per unit may better reflect the trends of residents who choose to live closer to transit. A reduction factor like this would account for residents that use transit instead of owning a personal vehicle.

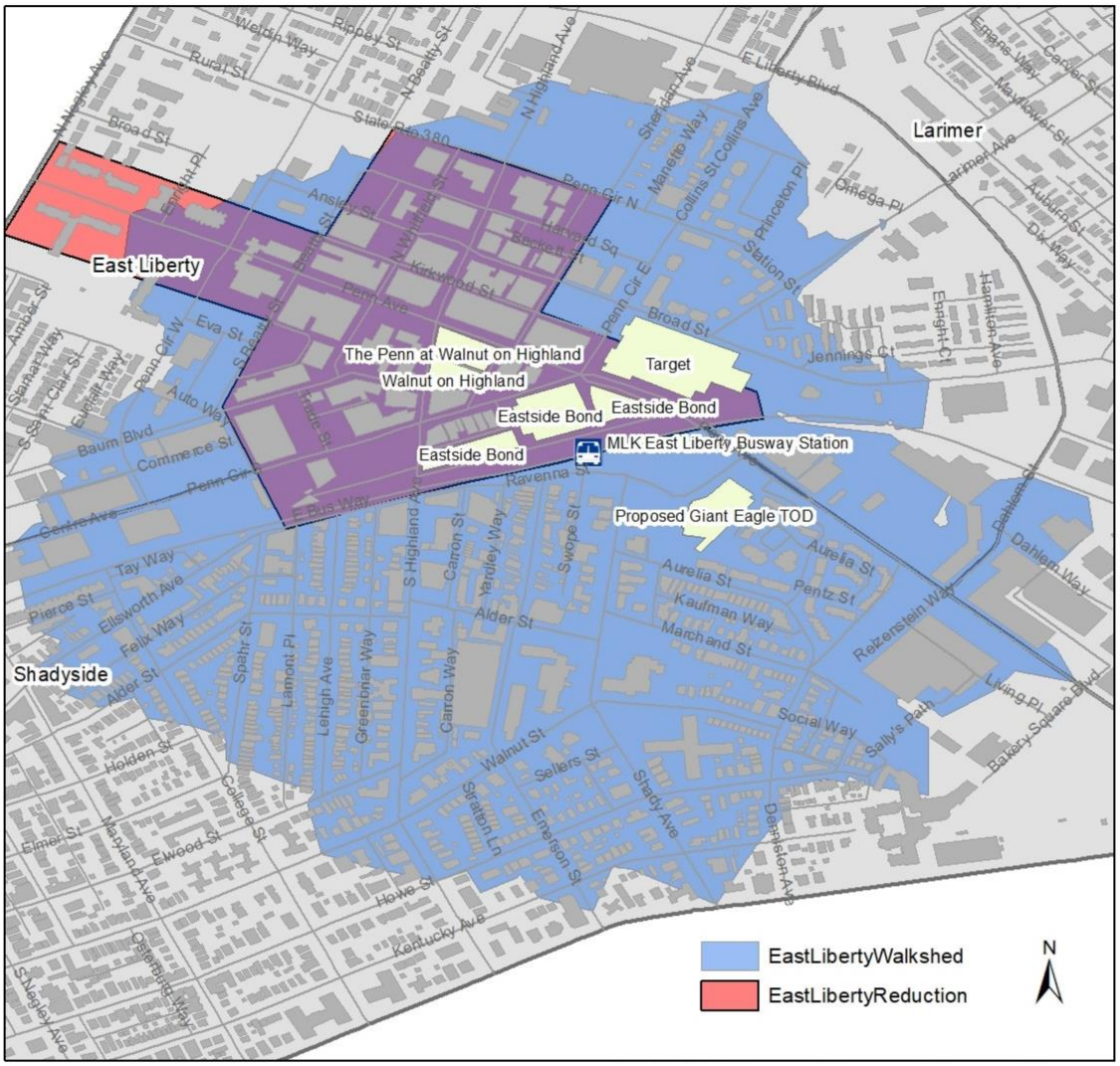
While the City of Pittsburgh minimum requirements seem to accurately predict the parking needs of the TODs, the maximum allowed by the City of Pittsburgh leaves a great deal of variation for developers to build more parking than necessary. Within the Total study area, there is a difference of approximately 1,500 spaces between the maximum allowed and the minimum required. With a reduction in the maximum allowed, developers have less parking variation and more developable land that could allow for greater land use density within the TOD and decreased construction costs.

When comparing the utilization of the City of Pittsburgh requirements to the Utilization of the Denver, CO requirements, the Denver minimum requirements are too aggressive based on the current utilization of the Study area, however the maximum is similar to the City of Pittsburgh minimum requirements. This proposes that the City of Pittsburgh requirements can be reduced to better predict the current demand, however, they can not be reduced as aggressively as the Denver TOD Requirements. Although, as TODs continue to be built and transit continues to enhance in the City of Pittsburgh, requirements similar to Denver could be used as people switch

their mode from personal auto to Transit. This also illustrates that reduction factors cannot be applied uniformly from one city to another or even one TOD to another in the same city.

In addition to adjusting the Pittsburgh minimum and maximums, the 50% reduction zone currently does not fully account for access to high quality transit. As stated previously in this research, the reduction zone is located only in the neighborhood of East Liberty, adjacent to the East Liberty busway station, as shown in red in Figure 28 below. However, based on the survey results, 85% of people walk to this station and of those 85%, 88% of them walk a half a mile or less, shown in blue in Figure 28 below. Based on this data it is recommended that the reduction zone be based on the half a mile walk shed surrounding the busway station. In addition to adjusting the parking reduction zone based on the influence area of the East Busway, the percent reduction could also be adjusted based on the actual usage or mode share data of existing TODs.

Figure 28: Comparison of parking reduction zone to transit walkshed



Proposed Giant Eagle Transit-Oriented Development

Upon completing this research, the new proposed Giant Eagle TOD was analyzed based on the data collected from the other TODs in East Liberty. The new Proposed TOD is planned to have a 50,000 square foot Giant Eagle supermarket, 45,000 square feet of retail and 585 parking spaces. Since this TOD is located in the neighborhood of Shadyside, outside the East Liberty reduction zone there are no applicable reductions for the city of Pittsburgh Parking requirements. Therefore, the City of Pittsburgh minimum required is 419 spaces which is 166 spaces below the proposed parking and the maximum allowed is 757 spaces which is 172 spaces over the proposed parking. Based on this data and the research completed it can be predicted that this facility will be over parked by 40% at least. This could be prevented by allowing a reduction based on transit proximity and lowered maximums.

References

Arrington, G.B. and Robert Cervero. *Effects of TOD on Housing, Parking, and Travel*. Transit Cooperative Research Program Report 128. Washington DC: Transportation Research Board, 2008. September 2018.

City and County of Denver, CO. *Denver Zoning Code - Article 10, Division 10.4*. Denver, 11 October 2018.

East Liberty Development, Inc. *About East Liberty*. 2018. <https://www.eastliberty.org/about-east-liberty/>.

Ewing, Reid, et al. "Trip and parking generation at transit-oriented developments: Five US case studies." *Landscape and Urban Planning* (2016): 10.

Federal Highway Administration. *Transit-Oreinted Development*. 2018. September 2018. <https://www.transit.dot.gov/tod>.

Institute of Transportation Engineers. *Trip Generation Manual*. Vol. 9. Washington D.C., 2012.

Mixed-Income Transit-Oriented Development (MITOD). *Target-TOD Parking Regulations*. 2018. September 2018.

Pittsburgh Department of City Planning . *East Liberty Station: Realizing The Potential*. Pittsburgh , 2017.

Portland, Oregon. "Chapter 33.266.115 Maximum Allowed Parking Spaces ." 24 May 2018. *Parking, Loading, And Transportation And Parking Demand Management.*

Smart Growth America, Department of City and Metropolitan Planning at the University of Utah. "Empty Spaces: Real parking needs at five TODs." 2017.

The Mosites Company. *Portfolio*. 2018. <http://mosites.net/portfolio/>.

Urban Redevelopment Authority. *East Liberty Transit Oriented Development*. n.d. September 2018. <https://www.ura.org/pages/east-liberty-transit-oriented-development>.

Appendix A

Eastside Bond Weekday Data

Time Increment	Total Vehicles (10/9/18)	Total Vehicles (10/11/18)	Average Weekday	Total Average Vehicles/total spaces
6:00 AM -7:00 AM	361	366	364	66%
7:00 AM -8:00 AM	342	333	338	61%
8:00 AM -9:00 AM	312	301	307	55%
9:00 AM -10:00 AM	281	275	278	50%
10:00 AM -11:00 AM	260	263	262	47%
11:00 AM -12:00 PM	273	267	270	49%
12:00 PM -1:00 PM	268	264	266	48%
1:00 PM -2:00 PM	266	267	267	48%
2:00 PM -3:00 PM	261	256	259	47%
3:00 PM -4:00 PM	268	258	263	47%
4:00 PM -5:00 PM	279	259	269	49%
5:00 PM -6:00 PM	287	290	289	52%
6:00 PM -7:00 PM	308	302	305	55%
7:00 PM -8:00 PM	322	305	314	57%
8:00 PM -9:00 PM	341	329	323	58%
9:00 PM -10:00 PM	354	339	347	63%
10:00 PM -11:00 PM	359	356	358	65%

Eastside Bond Weekend Data

Time Increment	Total Vehicles (10/20/18)	Total Vehicles/Total Spaces
6:00 AM -7:00 AM	-	-
7:00 AM -8:00 AM	-	-
8:00 AM -9:00 AM	338	61%
9:00 AM -10:00 AM	334	60%
10:00 AM -11:00 AM	326	59%
11:00 AM -12:00 PM	318	57%
12:00 PM -1:00 PM	323	58%
1:00 PM -2:00 PM	308	56%
2:00 PM -3:00 PM	297	54%
3:00 PM -4:00 PM	295	53%
4:00 PM -5:00 PM	306	55%
5:00 PM -6:00 PM	312	56%
6:00 PM -7:00 PM	320	58%
7:00 PM -8:00 PM	332	60%
8:00 PM -9:00 PM	344	62%
9:00 PM -10:00 PM	335	60%
10:00 PM -11:00 PM	352	64%

East Liberty Target Weekday Data

Time Increment	Total Vehicles (10/9/18)	Total Vehicles (10/11/18)	Average Total Vehicles	Total Average Vehicles/Total Spaces
6:00 AM -7:00 AM	28	14	21	5%
7:00 AM -8:00 AM	32	25	29	6%
8:00 AM -9:00 AM	45	48	47	10%
9:00 AM -10:00 AM	89	94	92	21%
10:00 AM -11:00 AM	134	154	144	32%
11:00 AM -12:00 PM	172	168	170	38%
12:00 PM -1:00 PM	261	200	231	52%
1:00 PM -2:00 PM	252	212	232	52%
2:00 PM -3:00 PM	234	207	221	49%
3:00 PM -4:00 PM	160	163	162	36%
4:00 PM -5:00 PM	165	178	172	38%
5:00 PM -6:00 PM	162	173	168	38%
6:00 PM -7:00 PM	175	198	187	42%
7:00 PM -8:00 PM	167	165	166	37%
8:00 PM -9:00 PM	152	146	149	33%
9:00 PM -10:00 PM	91	112	102	23%
10:00 PM -11:00 PM	74	84	79	18%

East Liberty Target Weekend Data

Time Increment	Total Vehicles (10/20/18)	Total Vehicles/Total Spaces
6:00 AM -7:00 AM	-	-
7:00 AM -8:00 AM	-	-
8:00 AM -9:00 AM	39	9%
9:00 AM -10:00 AM	78	17%
10:00 AM -11:00 AM	138	31%
11:00 AM -12:00 PM	201	45%
12:00 PM -1:00 PM	232	52%
1:00 PM -2:00 PM	260	58%
2:00 PM -3:00 PM	269	60%
3:00 PM -4:00 PM	252	57%
4:00 PM -5:00 PM	243	54%
5:00 PM -6:00 PM	242	54%
6:00 PM -7:00 PM	176	39%
7:00 PM -8:00 PM	156	35%
8:00 PM -9:00 PM	124	28%
9:00 PM -10:00 PM	102	23%
10:00 PM -11:00 PM	92	21%

Walnut on Highland and The Penn at Walnut on Highland Weekday and Weekend Estimated Data

Time Increment	Total Vehicles (Weekday)	Total Average Vehicles/total spaces	Total Vehicles (Weekend)	Total Average Vehicles/total spaces
6:00 AM -7:00 AM	127	70%	-	-
7:00 AM -8:00 AM	115	63%	-	-
8:00 AM -9:00 AM	95	52%	125	69%
9:00 AM -10:00 AM	80	44%	115	63%
10:00 AM -11:00 AM	75	41%	100	55%
11:00 AM -12:00 PM	60	33%	95	52%
12:00 PM -1:00 PM	50	27%	80	44%
1:00 PM -2:00 PM	45	25%	65	36%
2:00 PM -3:00 PM	50	27%	50	27%
3:00 PM -4:00 PM	55	30%	40	22%
4:00 PM -5:00 PM	65	36%	45	25%
5:00 PM -6:00 PM	80	44%	50	27%
6:00 PM -7:00 PM	95	52%	70	38%
7:00 PM -8:00 PM	115	63%	85	47%
8:00 PM -9:00 PM	120	66%	90	49%
9:00 PM -10:00 PM	125	69%	110	60%
10:00 PM -11:00 PM	127	70%	120	66%

On-Street Parking Weekday Data

	Total Vehicles (10/9/18)					Total Vehicles (10/11/18)						
Time Increment	Center	Spirit	Penn	Stevenson	Total	Center	Spirit	Penn	Stevenson	Total	Average Weekday	Total Average Vehicles/Total Spaces
6:00 AM -7:00 AM	3	4	8	1	16	0	5	6	3	14	15	17%
7:00 AM -8:00 AM	3	3	11	1	18	0	5	8	2	15	17	19%
8:00 AM -9:00 AM	3	3	20	4	30	0	5	10	4	19	25	28%
9:00 AM -10:00 AM	7	8	21	3	39	3	6	16	3	28	34	39%
10:00 AM -11:00 AM	4	10	24	3	41	6	7	20	3	36	39	45%
11:00 AM -12:00 PM	5	10	22	4	41	15	8	24	4	51	46	53%
12:00 PM -1:00 PM	15	9	24	6	54	15	9	24	6	54	54	63%
1:00 PM -2:00 PM	12	8	15	6	41	12	9	22	8	51	46	53%
2:00 PM -3:00 PM	12	12	16	5	45	7	7	20	6	40	43	49%
3:00 PM -4:00 PM	15	9	18	8	50	8	8	15	7	38	44	51%
4:00 PM -5:00 PM	15	9	20	8	52	10	9	12	10	41	47	54%
5:00 PM -6:00 PM	15	9	19	8	51	15	9	18	10	52	52	60%
6:00 PM -7:00 PM	15	12	24	7	58	15	9	22	10	56	57	66%
7:00 PM -8:00 PM	14	13	20	8	55	14	16	24	10	64	60	69%
8:00 PM -9:00 PM	15	21	24	8	68	12	18	20	10	60	64	74%
9:00 PM -10:00 PM	15	28	18	1	62	14	26	20	10	70	66	77%
10:00 PM -11:00 PM	12	31	11	1	55	13	36	14	10	73	64	74%

On-Street Parking Weekend Data

	Total Vehicles (10/20/18)					
Time Increment	**Center**	**Spirit**	**Penn**	**Stevenson**	**Total**	**Total Vehicles/Total Spaces**
6:00 AM -7:00 AM	-	-	-	-	-	-
7:00 AM -8:00 AM	-	-	-	-	-	-
8:00 AM -9:00 AM	5	32	15	2	54	63%
9:00 AM -10:00 AM	7	28	15	2	52	60%
10:00 AM -11:00 AM	7	26	16	3	52	60%
11:00 AM -12:00 PM	8	16	18	4	46	53%
12:00 PM -1:00 PM	15	18	24	5	62	72%
1:00 PM -2:00 PM	16	15	24	6	61	71%
2:00 PM -3:00 PM	15	16	24	6	61	71%
3:00 PM -4:00 PM	9	14	22	8	53	62%
4:00 PM -5:00 PM	11	18	15	10	54	63%
5:00 PM -6:00 PM	15	26	16	8	65	76%
6:00 PM -7:00 PM	14	28	18	10	70	81%
7:00 PM -8:00 PM	12	29	20	10	71	83%
8:00 PM -9:00 PM	12	34	16	10	72	84%
9:00 PM -10:00 PM	10	34	14	10	68	79%
10:00 PM -11:00 PM	9	36	16	10	71	83%

Total Study Area Weekday Data

Time Increment	Eastside Bond	Target	Street Parking	Walnut Capital	Total Vehicles	Total Vehicles/Total Spaces
6:00 AM -7:00 AM	364	21	15	127	527	42%
7:00 AM -8:00 AM	338	29	17	115	498	39%
8:00 AM -9:00 AM	307	47	25	95	473	37%
9:00 AM -10:00 AM	278	92	34	80	483	38%
10:00 AM -11:00 AM	262	144	39	75	519	41%
11:00 AM -12:00 PM	270	170	46	60	546	43%
12:00 PM -1:00 PM	266	231	54	50	601	47%
1:00 AM -2:00 PM	267	232	46	45	590	46%
2:00 AM -3:00 PM	259	221	43	50	572	45%
3:00 AM -4:00 PM	263	162	44	55	524	41%
4:00 AM -5:00 PM	269	172	47	65	552	44%
5:00 AM -6:00 PM	289	168	52	80	588	46%
6:00 AM -7:00 PM	305	187	57	95	644	51%
7:00 AM -8:00 PM	314	166	60	115	654	52%
8:00 AM -9:00 PM	323	149	64	120	656	52%
9:00 AM -10:00 PM	347	102	66	125	639	50%
10:00 AM -11:00 PM	358	79	64	127	628	49%

Total Study Area Weekend Data

Time Increment	Eastside Bond	Target	Street Parking	Walnut Capital	Total Vehicles	Total Vehicles/Total Spaces
8:00 AM -9:00 AM	317	39	54	125	535	42%
9:00 AM -10:00 AM	334	78	52	115	579	46%
10:00 AM -11:00 AM	326	138	52	100	616	49%
11:00 AM -12:00 PM	318	201	46	95	660	52%
12:00 PM -1:00 PM	323	232	62	80	697	55%
1:00 AM -2:00 PM	308	260	61	65	694	55%
2:00 AM -3:00 PM	297	269	61	50	677	53%
3:00 AM -4:00 PM	295	252	53	40	640	50%
4:00 AM -5:00 PM	306	243	54	45	648	51%
5:00 AM -6:00 PM	312	242	65	50	669	53%
6:00 AM -7:00 PM	320	176	70	70	636	50%
7:00 AM -8:00 PM	332	156	71	85	644	51%
8:00 AM -9:00 PM	344	124	72	90	630	50%
9:00 AM -10:00 PM	335	102	68	110	615	49%
10:00 AM -11:00 PM	352	92	71	120	635	50%