City of Bozeman Parking Study

A Project Completed for the City of Bozeman Parking Commission and Downtown Bozeman Partnership

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Executive Summary

The City of Bozeman's downtown district possesses a number of parking resources. These include on-street parking, off-street parking lots, a parking garage, private (business) parking lots and alley parking. With the rapid growth in the City of Bozeman and the increased number of downtown visitors, it is critical for the City of Bozeman to have updated information on parking inventory and usage metrics for better planning of City resources. This was the primary reason behind the previous major parking study that was conducted in 2010 and the two follow-up studies conducted in 2012 and 2014. The current study presented in this report builds upon the previous studies while providing more extensive information to the City of Bozeman on downtown parking resources. Specifically, the current study considered an expanded study area with 16 additional blocks, both peak and off-peak season parking observations, and a greater level of detail in examining parking inventory.

In the current study, the parking inventory conducted in June 2017 found that a total of 5,878 non-residential parking stalls were available in the downtown study area. This represented an average of 113 stalls per block, although some blocks contained far more or less than this average. Publicly-owned stalls comprised around 52.3 percent of downtown parking inventory, while private stalls (i.e. business parking lots) comprised the remaining 47.7 percent. This totaled to 3,072 public parking stalls and 2,806 private parking stalls in the downtown area. In regards to parking type, on-street, off-street, and alley parking comprised 33.1 percent, 62.8 percent and 4.1 percent respectively. The inventory study also found that about half of the public parking in the downtown area had either a time, handicapped, or permit restrictions.

When occupancy rates were examined, different usage trends were exhibited depending on specific block locations and the main trip attractions within these blocks. In general, the parking occupancy rates were higher during weekdays compared to weekends both during peak and off-peak seasons, with only one or two exceptions. Occupancy rates at the block level never reached capacity (100 percent) for any of the blocks in the study area even during peak

hours. Occupancy rates were higher during mid-day and early afternoon hours and decline into the evening for the majority of blocks in the study area particularly on weekdays. This increase in occupancy rates is believed to be related to the lunch hour when downtown restaurants were heavily frequented. On the other hand, a few blocks exhibited a surge in parking occupancy rates in the evening during weekends, particularly those blocks bordering Main Street where major downtown restaurants exist.

Dwell time results from the three out of four City-owned parking lots (North Willson Lot was closed during the study) indicated that vehicles remained parked for an average of between 46 minutes and 1 hour 32 minutes. However, the majority of the mean dwell time values that were estimated for weekdays and weekends both for peak and off-peak seasons were around one hour. Overall, dwell time results indicated that most vehicles parked as part of trips which were not necessarily brief in nature.

The turnover rate analysis for the City-owned parking lots indicated that the parking lot at Mendenhall and Willson was more heavily utilized compared to the other two parking lots. The average turnover rate for this parking lot was 0.44 compared to 0.32 for the Mendenhall and Black parking lot and only 0.23 for the parking lot at Rouse and Babcock. These averages included the weekday and weekend observations both during peak and off-peak seasons. The individual turnover rates observed during a single day ranged between 0.15 and 0.55.

Chapter 1. Introduction

The downtown district of the City of Bozeman is one of the most popular and frequently-visited parts of the city. Due to the high number of restaurants, bars, shops, and other attractions within the downtown area, it is frequented by both locals and visitors. Although alternative forms of transportation (such as walking, biking, and the Streamline bus service) have been increasing in popularity within the downtown area, cars are still the primary mode of transportation for most people who visit.

The City of Bozeman's downtown district possesses a variety of parking resources, both public and private. These resources have been documented in a previous parking study performed in 2010. Studies in 2012, and 2014 have also documented various metrics of parking usage such as occupancy and dwell time. However, due to the continued development in the downtown area, and a shift in parking resources and behavior that resulted from that development, the City of Bozeman's Parking Commission decided that another study should be performed to update information on parking resources and usage. This is consistent with the 2009 Downtown Improvement Plan (1) which states "The Bozeman Parking Commission, in conjunction with the Downtown Bozeman Partnership, should conduct regular parking studies to determine and track the inventory of on-street, surface and structured parking spaces in addition to usage patterns and trends." Further, the 2016 Downtown Strategic Parking Management Plan (2) calls to "Implement performance measurements and reporting to inform decision-making. Routine and objective measurement and reporting ensures informed decision-making. Key metrics include occupancy, turnover, average duration of stay, and rate of violation."

In this parking study, the study area was expanded from previous studies to include about 16 additional city blocks primarily in the north and south fringes of the downtown area (see Figure 1-1). Parking inventory, including all on-street and off-street, private and public non-residential parking was collected for the entire study area. An occupancy study was conducted for the whole study area which examined usage patterns at the block level of detail. Dwell time parking

information was collected for the three city-owned public lots in the downtown area that were open when the study was performed. Finally, a trip purpose survey of visitors to the downtown area was performed. All studies (except for inventory data) were performed during the peak and off-peak seasons while considering the day of week variation in parking usage, i.e. weekdays versus weekends.

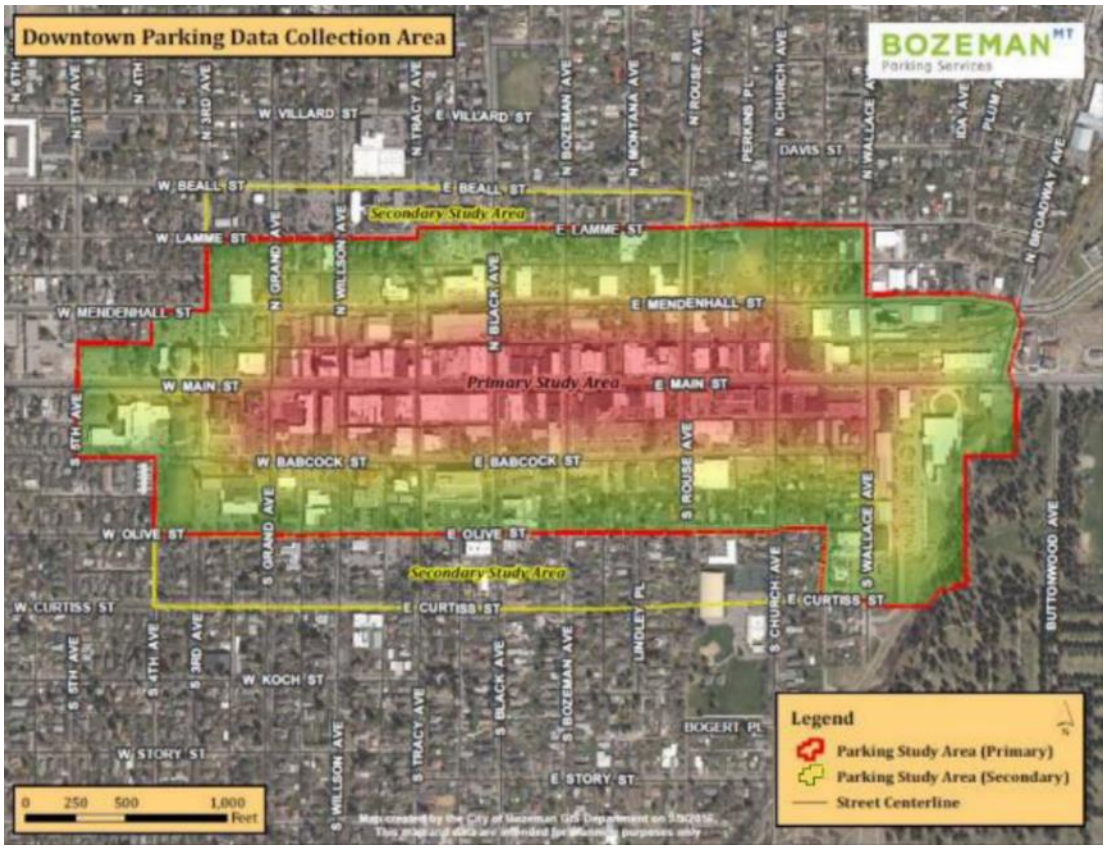


Figure 1-1: Overview of parking study area. Photo courtesy of City of Bozeman.

The purpose of this document is to provide the Parking Commission and the Downtown Bozeman Partnership with the results of the parking studies performed. These results are intended to provide the City with answers to the questions of available parking inventory, dwell time and turnover rates, occupancy rates as well as providing information on the trip purpose and vehicle occupancy for the downtown parking. The tasks presented in this document reflect those which were outlined in the Scope of Work document presented to the city.

1.1. Report Outline

This report is divided into 6 chapters. Beyond the introduction presented in Chapter 1, Chapter 2 presents the results of the parking inventory study. The main results of the four occupancy studies are presented in Chapter 3. Chapter 4 presents the results of the dwell time and parking turnover analyses while Chapter 5 presents the results of the trip purpose surveys. Chapter 6 summarizes the major findings of this parking study and presents a set of recommendations for the City to consider in managing their parking resources.

In addition to the information presented within the body of this report, a high volume of graphs, tables, and visuals were generated for the studies performed. Although these figures include valuable information, their inclusion within the main body of this report would have made it unnecessarily long. Therefore, they are included in appendices at the end of this report.

Chapter 2. Inventory

Due to the expansion of the current downtown study area of interest and the continued growth & development in the downtown area over the past several years, an update on the comprehensive parking inventory study completed in 2010 was deemed necessary. Inventory was completed for all 52 blocks in the study area, and all non-residential legal spaces (public and private) were documented.

2.1. Methodology

To complete the inventory study, a data collection crew member walked each block of the study area and counted every legal parking spot. The parking spaces and their characteristics were collected on a note sheet. These notes were later input into Excel for further analysis.

A legal parking spot was defined as either having pavement markings, a clear sign marking the spot, or located in a lot that was clearly marked to be used for legal parking. For on-street parking, the number of spots were approximated based on how many standard-sized vehicles could legally park on a street side. These numbers were later fine-tuned based on the observed number of legally parked cars during the occupancy study. There was no on-street lane striping to indicate the number of legal on-street parking spots anywhere in the study area.

Inventory was primarily collected between June 1st and June 6th. Streets and parking lots under construction were collected later once construction was completed and vehicles were allowed to park again. Google Maps was used to collect inventory data for streets and parking lots that were still under construction when this report was completed.

2.2. Overview of Parking Assets

Figure 2-1 shows the study area divided into 52 labeled blocks, which allowed the inventory information to be effectively organized.

2.2.1. Total Parking Inventory

Table 2-1 shows a complete inventory of parking within all 52 blocks of the study area. Several areas within the study area were closed for the duration of this study. Inventory for these areas was collected using Google Maps and checked against the inventory information from the 2010 parking study. Several blocks had public "restricted use" parking. This was parking owned by a public entity (such as the city or the county), but was restricted for use by only visitors to that entity. The list of public entities with restricted use parking are listed below Table 2-1. Other parking resources with unique circumstances are labeled by a "*," and a note explaining the circumstances is included below Table 2-1.

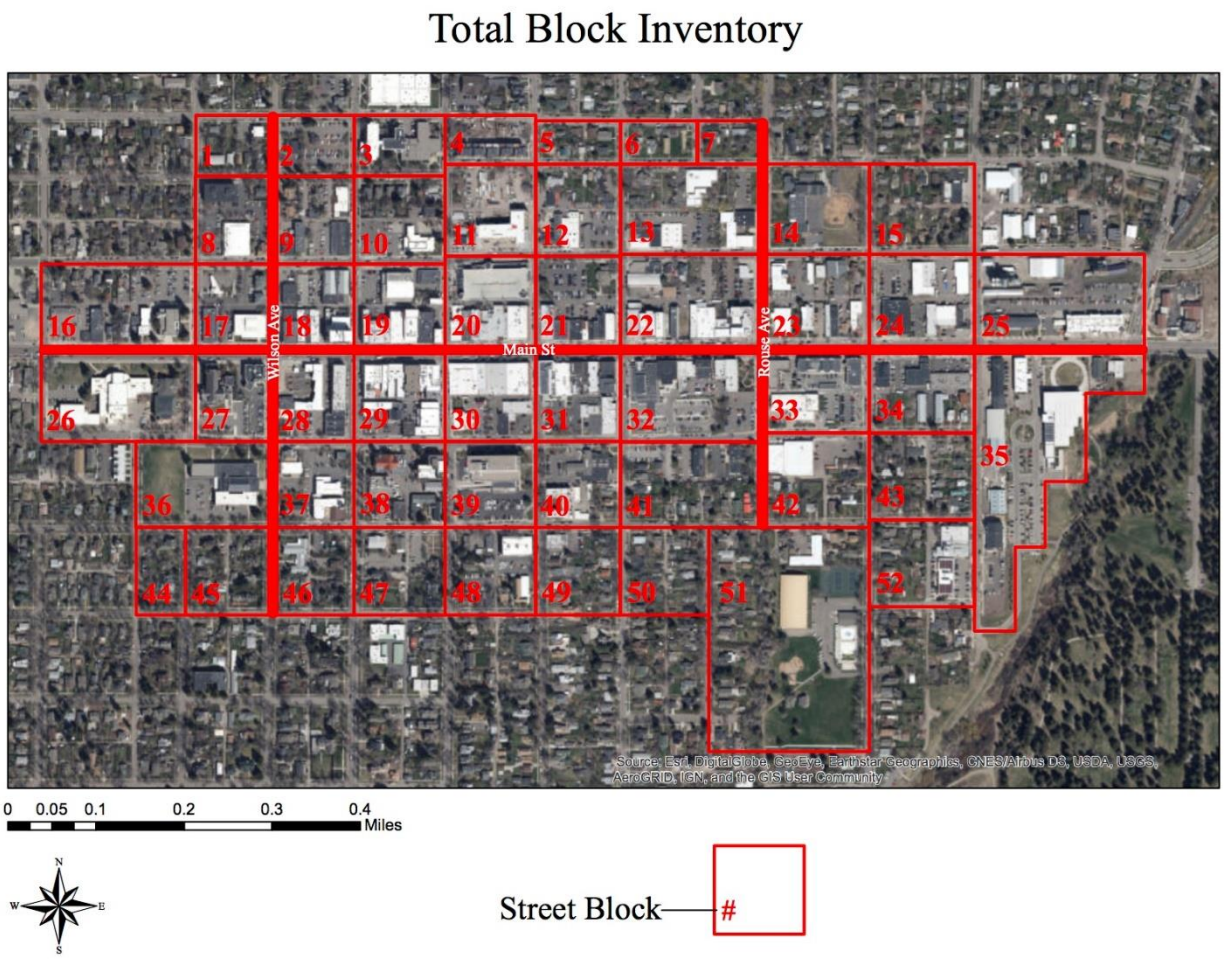


Figure 2-1: Parking study area organized into blocks.

Table 2-1: A complete record of all parking assets in the downtown area.

Type					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	Total
On-Street	Public	Unlimited		N	7	11	9	13	9	9	7	8	6	13	11	16	16		12	19	7	8					10	8	10								10	46	20				9	14	13	10	6	12	9	10	2	8	9	24*	14	425
				S	9	8	13	15	10	11	16		3					8	13									7	20	12						11	11	12		15	11	7	7	4	18	16*	11	6	12	11	12	11			17*	8	345
				E	6	5	4	4	4	4	0	11	10	10	10	8	8	11*	6		3						8		9							5		29	10		11	5		10		13	12	12	11	0	8	12	17		12	288
				W	3		6		6	4	5	10		10*		8	11	0	12	3								9	4	4	9					4	10		13	7		4	11	8	10	10*		13	10	10	10		16	29*	9	278
			♿		1 (W)		1 (E)						1 (N)				1 (S)			1 (S)	1 (E)										1 (W)										1 (W)		1 (E)				1 (N) 1 (S)			2 (W)		1 (S)					14
		Time Restricted (2 Hr)		N														1					9		10		14				21	9	5	13		12	14	22	15			8	7									5				165
				S								8	3	5		9	13			13	8	9	12	12	12	19	10					8	7		9																				157
				E																8	5	10	7	8	11					9	12	11		8	10	10	5																	114
				W																	7	9		11	9	8	8				10	8		8	9	8	4																	99
			♿											1 (S)		1 (S)				1 (S)		1 (S)		1 (S)		1 (W)	1 (S)							1 (N) 1 (W)		2 (N)					1 (N)														12
		Time Restricted (20 Min)																5 (S) 14 (W)																																							19
		Time Restricted (15 Min)																				2 (S)											1 (N)								12 (N)															15
		Loading Zone					1 (E)																		1 (W) 1 (S)								2						2 (E)	3 (W)	1 (N)										1 (E)				12
Off-Street	Public	Parking Garage																						435																																	435
		Unlimited																		63																		139																		202
			♿																	3																		4																		7
		Time Restricted												36						1			26		55										45			7														4				174
			♿											2									2		2									2			2																		10
		Restricted Use															43	31		11	14						6														119													58				282
			♿														5	1																						2																8
	Private/Business	Parking Garage																			52*																																				52
		Unlimited			14	119	6				103	74	10		15	83			10	77	44	19	26		32	84*		49	108	134	38	62	62	37	45	54	77	34	35	115	60	50	25		10	102	56	4*				42	2	24		70*	28	2039
			♿		0	2	1				5	2		3						3	2				1	3	4	7	4	7	3	2	3	2	8	6		2	4	4	2		2	2	2	1*				1	2	1		6	2	99
			Permit		0	0					4			96	59										6	16	20*			24					18	36	53						31												363
			Loading		0	0														1					1	1																														5
		Time Restricted											1																								17																			18
Alley	Public	Restricted Use																									10																													10
			♿																								1																													1
	Private/Business	Unlimited			0	0						4		8	17	8*				5		8	3	5*	31	27*		13		3			21	4						23								7					17	204
			♿											1									1		1															1														1	5
			Permit																																							12*														8	20
			Loading																										1																												1
Total					40	145	41	32	29	28	28	149	104	87	129	133	188	71	53	209	91	116	88	472	170	173	131	144	181	112	97	100	99	94	89	203	137	120	344	124	108	66	150	67	154	97	51	24	49	50	75	104	45	42	146	99	5878

Use of Public Restricted Use Parking	
13	City Hall
14	Hawthorne Elementary
16	Courthouse Elected & Motor Pool Parking
17	Montana Office of Public Assistance
23	Fire Station
39	Federal Building
48	City Building Division

Off-St Lot Public Time Restricted Length	
10	2 Hrs
16	15 Min
19	2 Hrs
21	2 Hrs
32	2 Hrs
35	30 Min
48	30 Min

Off-St Lot Private/Business Time Res. Length	
9	30 Min
33	2 Hrs

Parking Notes		
*	10	Construction along W side of block. Inventory taken from Google Maps.
*	13	Alley Spots are likely Residental Parking.
*	14	E St. No Parking M-F Due to Bus stop.
*	18	Both stories of Baxter Parking Garage Counted, as opposed to 2010 study.
*	19	Alley Parking may be residental, "tenant parkig only."
*	20	5 Additional Alley spots with cars parked in them labeled as "no parking."
*	22	Priv/Busi Lot includes 5 spots with a "No Parking" sign on it, Alley parking includes 3 permit spots.
*	23	Off St. Permit Parking is likely residental parking.
*	38	Alley permit parking is likely for residental use.
*	42	Construction along S and E sides of block. Inventory taken from Google Maps.
*	43	Construction along W side and in off-street lot of block. Inventory taken from Google Maps.
*	51	Bogert Pool Parking shared with park.
*	51	S street taken as Bogert Pl.
*	51	W side counted from Olive to Koch.
*	51	Construction along N side of block. Inventory taken from Google Maps.

2.2.2. Private vs Public Parking Assets

Overall, the ratio of total public parking versus private parking in the downtown area is close to even. However, there was vastly more private off-street and alley parking. Most of this parking was reserved for patrons or employees of businesses who owned the parking assets. Table 2-2 shows a detailed breakdown of public vs. private parking assets.

Table 2-2: Private, public, and total parking.

	Public	Private	Total
On-Street	1943 stalls (33.1%)	N/A	1943 stalls (33.1%)
Off-Street	1118 stalls (19%)	2576 stalls (43.8%)	3694 stalls (62.8%)
Alley	11 stalls (0.2%)	230 stalls (3.9%)	241 stalls (4.1%)
Total	3072 stalls (52.3%)	2806 stalls (47.7%)	5878 stalls

2.2.3. Parking Restrictions

About half of the parking in the downtown area had either a time, handicapped, or permit restriction. Most of the parking with a restriction of 30 minutes or shorter was intended for deliveries or quick drop-offs and pickups. Most of the public parking without any restrictions (especially on-street parking) was located on the outskirts of the study area. Table 2-3 provides an overview of parking restrictions in the downtown area.

Table 2-3: Overview of parking restrictions.

		None	♿	Permit	Restrict. Use	15 Min	20 Min	30 Min	2 Hrs
Public	On-Street	1336 stalls (68.8%)	26 stalls (1.3%)	N/A	N/A	15 stalls (0.8%)	19 stalls (1%)	N/A	547 stalls (28.2%)
	Off-Street	202 stalls (18.1%)	25 stalls (2.2%)	N/A	290 stalls (25.9%)	1 stall (0.09%)	N/A	11 stalls (1%)	605 stalls (54.1%)
	Alley	N/A	1 stall (9.09%)	N/A	10 stalls (90.9%)	N/A	N/A	N/A	N/A
Private	Off-Street	2091 stalls (81.2%)	99 stalls (3.8%)	363 stalls (14.1%)	N/A	N/A	N/A	1 stall (0.04%)	17 stalls (0.7%)
	Alley	204 stalls (88.7%)	5 stalls (2.2%)	20 stalls (8.7%)	N/A	N/A	N/A	N/A	N/A
Total	On-Street	1336 stalls (68.8%)	26 stalls (1.3%)	N/A	N/A	15 stalls (0.8%)	19 stalls (1%)	N/A	547 stalls (28.2%)
	Off-Street	2293 stalls (62.1%)	124 stalls (3.4%)	363 stalls (9.8%)	290 stalls (7.9%)	1 stall (0.03%)	N/A	12 stalls (0.3%)	622 stalls (16.8%)
	Alley	204 stalls (84.6%)	6 stalls (2.49%)	20 stalls (8.3%)	10 stalls (4.1%)	N/A	N/A	N/A	N/A

*Note: Percentages are calculated by dividing the given cell by the total number of parking spaces for that category (i.e. Public On-Street parking).

2.2.4. Inventory Maps

The following three pages contain three maps showing inventory information at the block level. Figure 2-2, 2-3, and 2-4 show the total parking inventory, the on-street and off-street parking inventory, and the private and public parking inventory for every block in the study area respectively.

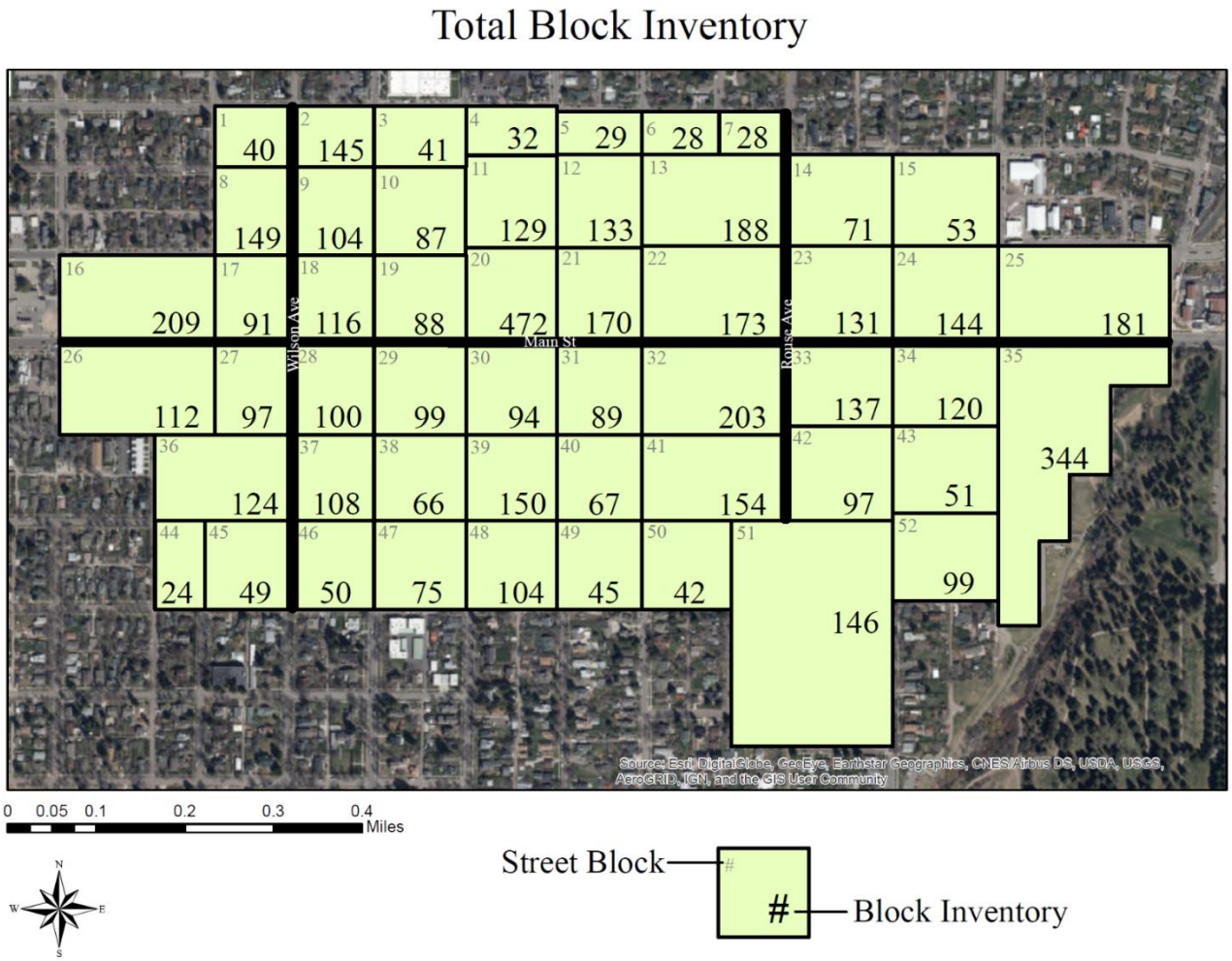


Figure 2-2: Map of total inventory by block.

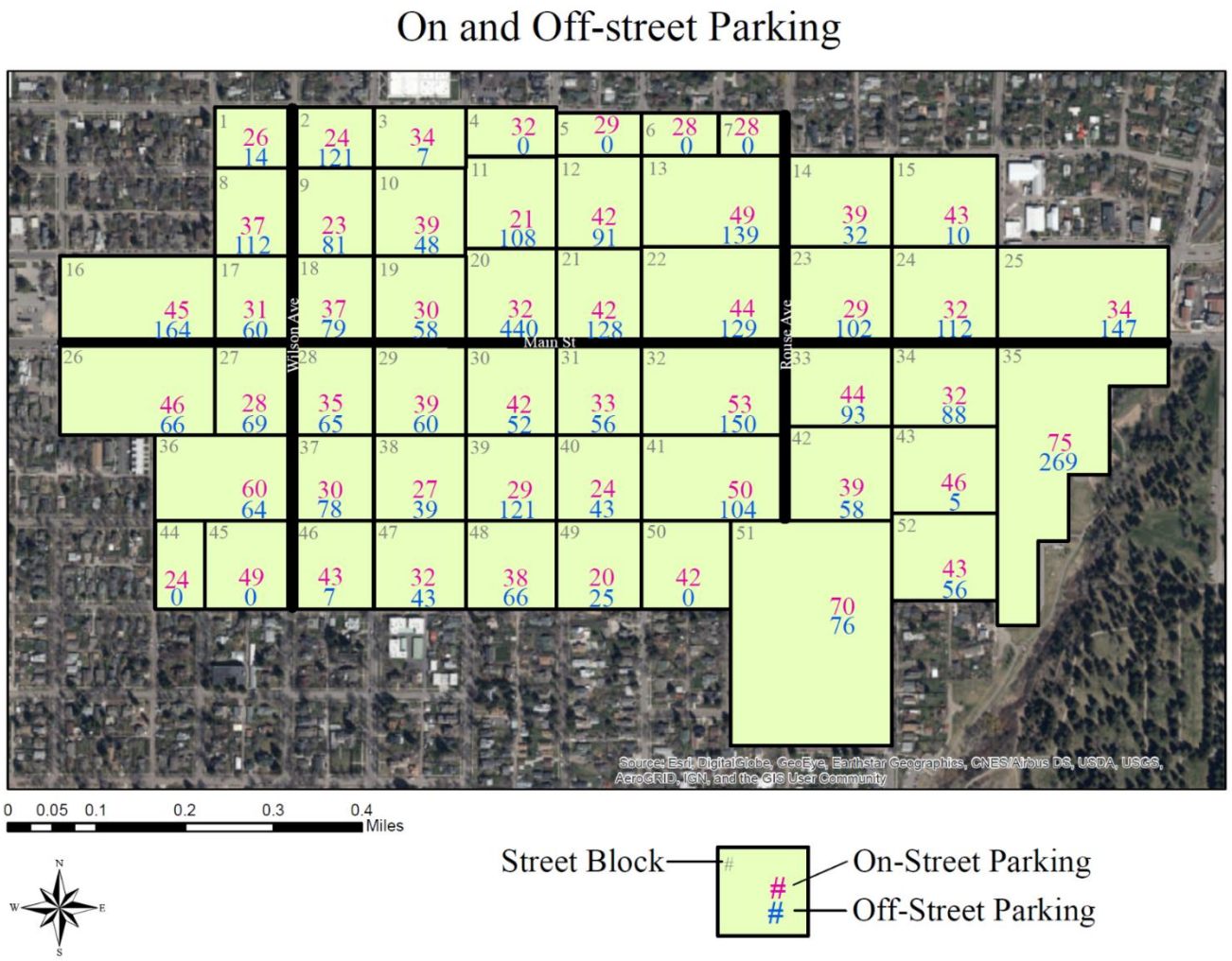


Figure 2-3: Map of on-street and off-street inventory by block.

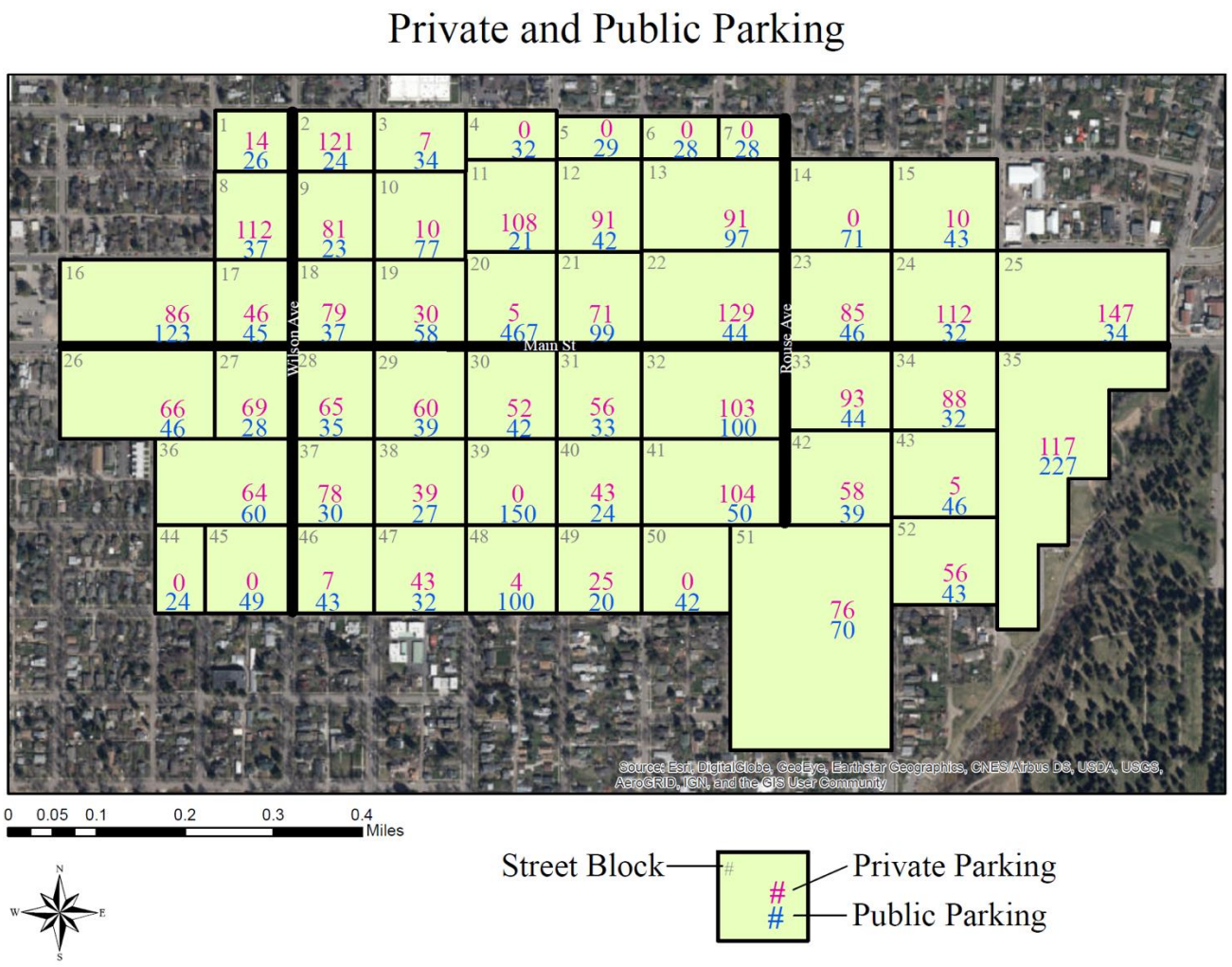


Figure 2-4: Map of private and public inventory by block.

Chapter 3. Occupancy

Occupancy rates are an effective way to measure the level of utilization of parking facilities over a period of time. They help show how parking demand fluctuates throughout the day for a block, parking structure, or well-defined study area. Occupancy rates were collected for every block in the study area.

3.1. Methodology

Due to the significantly increased area of the occupancy study, several changes were made to the field data collection procedures. The study area was divided into 4 zones, as shown color-coded in Figure 3-1. For each zone, one observer recorded occupancy counts for all blocks within the zone every hour for the duration of the study. Most data collection crew members used a bicycle to aid in their data collection. Parked vehicles were counted for each street of a block along with all off-street, non-residential parking associated with that block. The note sheet used for this data collection can be found in Appendix A.

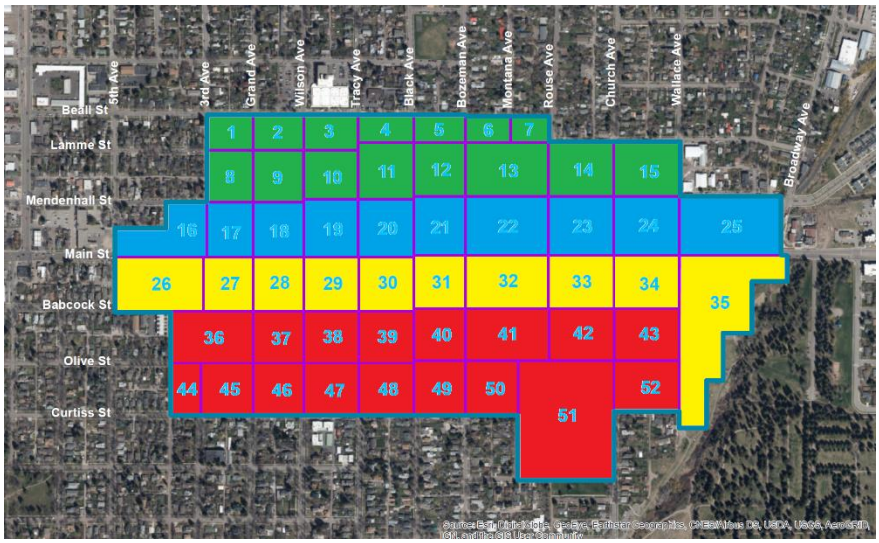


Figure 3-1: The 4 "zones" used for occupancy data collection.

The four zones shown in Figure 3-1 are labeled zones A through D throughout the rest of this chapter. The northernmost two rows (show in green) are Zone A. The row on the north edge of

Main Street (shown in blue) is Zone B. The row on the south edge of Main Street (shown in yellow) is Zone C. The southernmost two rows (shown in red) are Zone D.

Once all occupancy data had been recorded, it was input into excel in order to perform occupancy calculations. Occupancy rates were then computed using the following equation:

$$OR = \frac{N_T}{P_S} * 100\%$$

Where:

OR = Occupancy Rate (spaces/hr)

N_T = Total number of parked vehicles observed

P_S = Total number of legal parking stalls

3.2. Study Dates & Durations

Occupancy data was collected on a weekday and a weekend during both an off-peak and peak time of year. The off-peak season data collection was performed on April 26th (Wednesday) and April 29th (Saturday). The peak season data collection was performed on July 12th (Wednesday) and July 15th (Saturday).

The occupancy study duration for the off-peak season was 10 hours. On Wednesday, the study ran from 8 AM to 6 PM. On Saturday, the study ran from 10 AM to 8 PM. For the peak season, it was determined that a 12-hour duration would be more appropriate given the long daytime period in the summer season, which helps to capture evening occupancy rates on both the weekend and weekday studies. For this reason, the peak Wednesday study ran from 8 AM to 8 PM and the peak Saturday study ran from 10 AM to 10 PM. It was stipulated that the parking demand in the study area would start earlier on a weekday compared to the weekend, thus the earlier start time for weekdays data collection.

For the peak Wednesday occupancy study, there was some inconsistency in collecting the off-street parking occupancy counts for the green zone only. To address this issue, it was decided that the erroneous counts should be discarded and new off-street occupancy counts should be

collected on a later date when parking behavior was expected to be largely similar to the behavior on the primary study day. This supplementary study occurred on Wednesday, July 26.

3.3. Construction Areas

Some streets and blocks were closed to vehicles during some or all of the occupancy studies. Block 10, where a new office building is being constructed, would often have closed-off street side parking on 1-3 sides. The public parking lot in this block was also closed during all 4 occupancy studies. There was also significant construction around blocks 42, 43, and 51. Both Olive St. and Church Ave. were entirely closed within these blocks during the peak season.

3.4. Block Level Occupancy Rates

Of primary interest are the occupancy rates for the blocks consisting of the "heart" of the downtown area. In this section, blocks of interest bordering Main Street on the north or south and other blocks of interest with tangible non-residential parking assets within the study area will be discussed. Detailed occupancy information for other blocks in the study area are provided in Appendices B, C, and D.

3.4.1. Zone A

As shown in Figure 3-1, zone A consists of the northern part of the study area and encompasses blocks 1-15.

Block 8

This block contains several private residences, a large office building, and the Gallatin County Health Department. In total, this block contains 149 parking spaces. Off-street parking consists of several large parking lots distributed throughout the block. On-street parking exists on all 4 sides, with the south side being 2-hour restricted.

Weekday occupancy rates were significantly higher than weekend rates (they well exceeded 80 percent during the off-peak weekday study). Weekday rates remained consistent during regular business hours then tapered down in the evenings. Weekend rates remained consistent (between 20 and 30 percent) throughout the duration of the study.

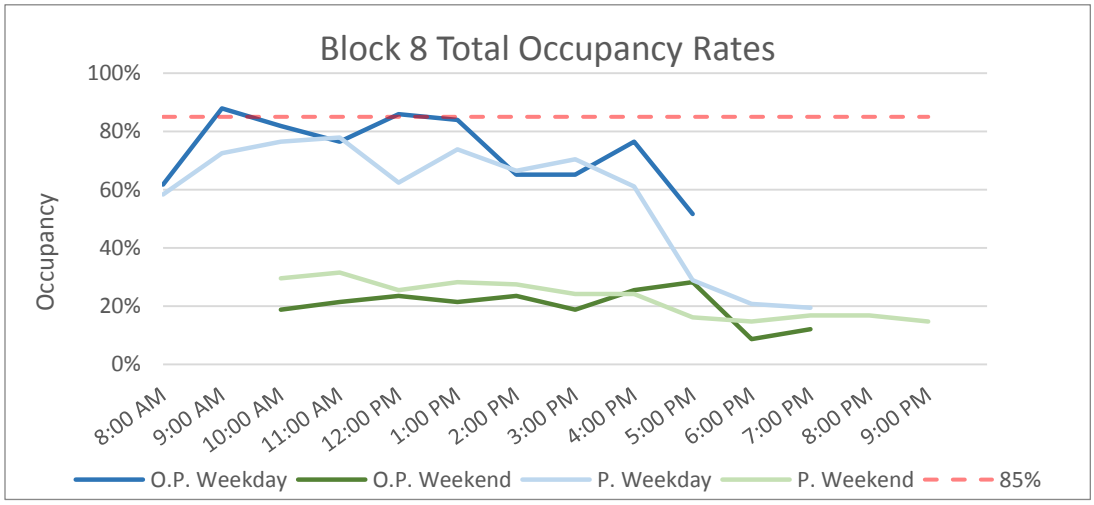


Figure 3-2: Block 8 total occupancy rates.

Block 13

This block contains various private businesses, several private residences, and Bozeman City Hall. In total, this block contains 187 parking spaces. Off-street parking consists of several parking lots distributed throughout the block. On-street parking exists on all 4 sides, with the south side being 2-hour restricted.

Similar to block 8, weekday occupancy rates were significantly higher than weekend occupancy rates. Weekday occupancy rates peaked in the morning, remained fairly consistent throughout regular business hours, then tapered down in the evenings. Weekend rates slowly increased throughout the day and peaked in the evening. This is most likely due to the Bozeman Taproom, which is a popular attraction in the evenings.

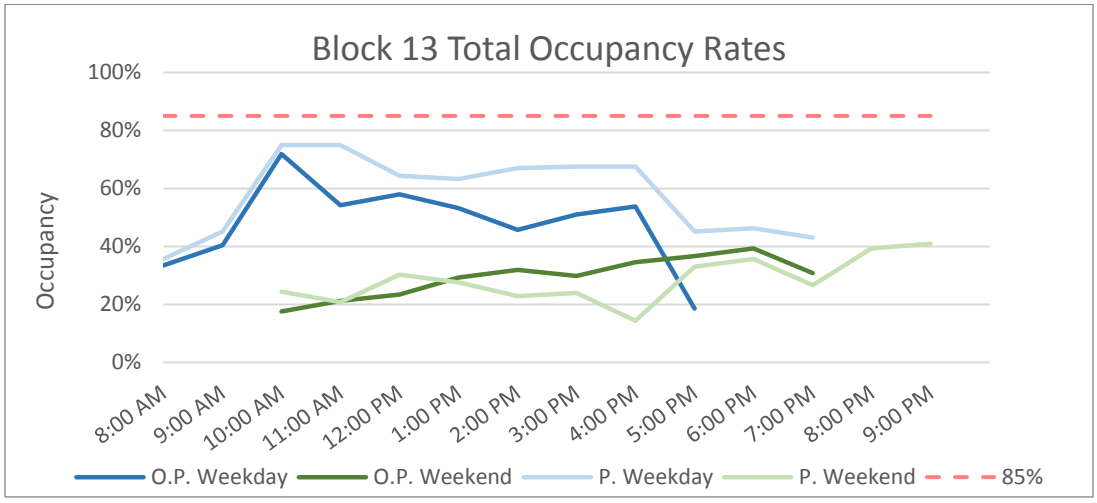


Figure 3-3: Block 13 total occupancy rates.

3.4.2. Zone B

As shown in Figure 3-1, zone B consists of that part of the study area between Main St. and Mendenhall and encompasses blocks 16-25.

Block 16

This block contains the Gallatin County Courthouse, several small businesses, and several private residences. In total, this block contains 209 parking spaces. The on-street parking is 2 hour restricted near the courthouse, and is unrestricted everywhere else. Off-street parking primarily consists of unrestricted public parking near the courthouse, and unrestricted private parking for the other businesses.

Occupancy rates varied significantly between weekdays and weekends. On weekdays, occupancy remained consistent throughout the day, then tapered down significantly after regular business hours. In particular, the public lot next to the courthouse was observed to be consistently full throughout regular business hours. On weekends, occupancy was significantly lower. The majority of cars parked on weekends were in private lots, the public lot next to the courthouse was nearly empty through the duration of the study.

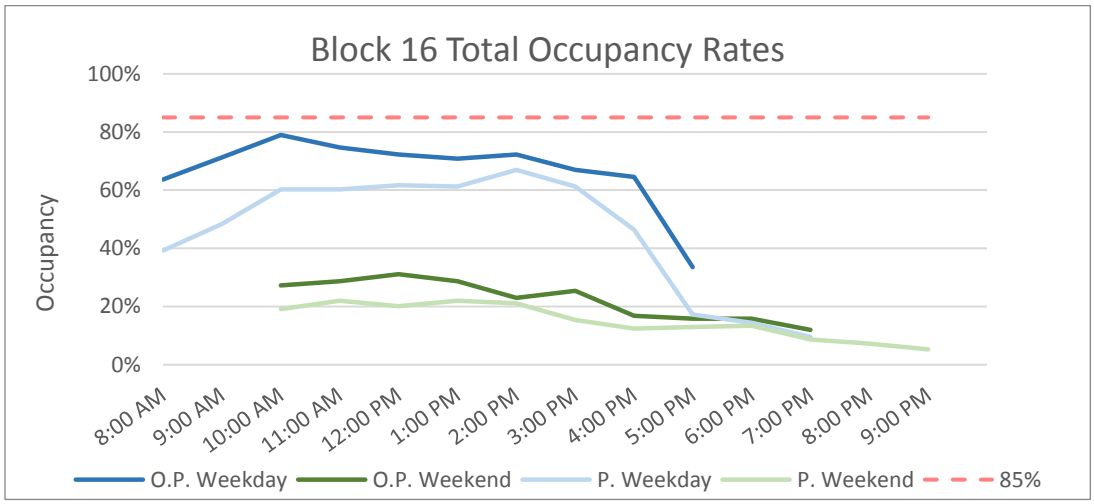


Figure 3-4: Block 16 total occupancy rates.

Block 17

This block contains only the Montana Office of Public Assistance and Wells Fargo. In total, this block contains 91 parking spaces. The majority of the on-street parking is time-restricted. The majority of off-street parking is intended for Wells Fargo employees and customers.

Occupancy rates varied significantly between weekdays and weekends. On weekdays, occupancy remained consistent during business hours, and tapered down significantly after-hours. On weekends, occupancy peaked at 12 PM (Wells Fargo is open from 9-1 on Saturday). However, parking remained consistent into the evening likely due to parking to visit businesses in neighboring blocks.

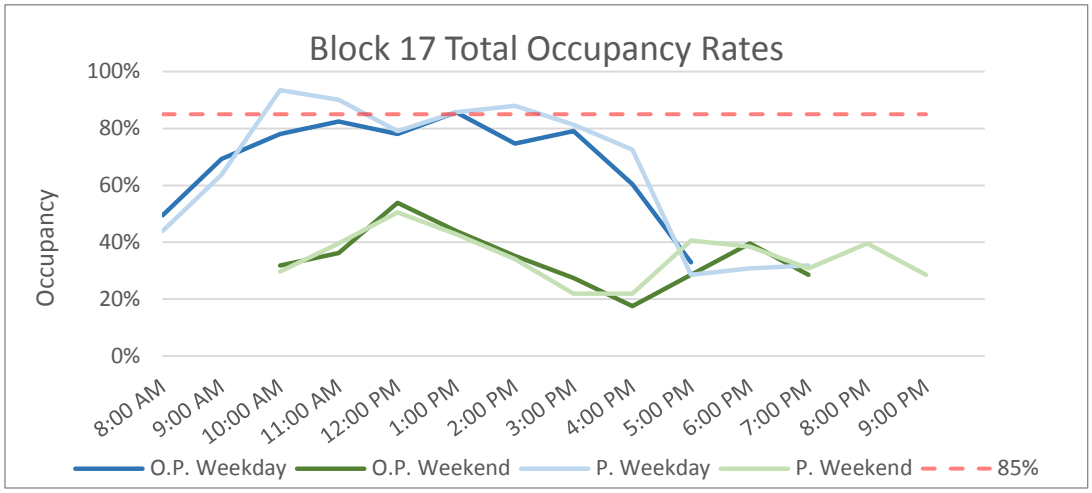


Figure 3-5: Block 17 total occupancy rates.

Block 18

This block contains various businesses and apartments. In total, the block contains 117 parking spaces. Most businesses rely on on-street parking and nearby public parking, however there is a small parking garage reserved for use by Baxter tenants and patrons.

Both weekend and weekday occupancy rates reached a similar peak in parking, however weekday rates peaked in the early afternoon while weekend rates peaked in the evening. These peaks can likely be attributed to a lunch rush and a dinner rush, respectively. The low peak occupancy rate for this block is attributed to the lower level of the parking garage next to the Baxter hotel, which remained nearly empty throughout every day of the study.

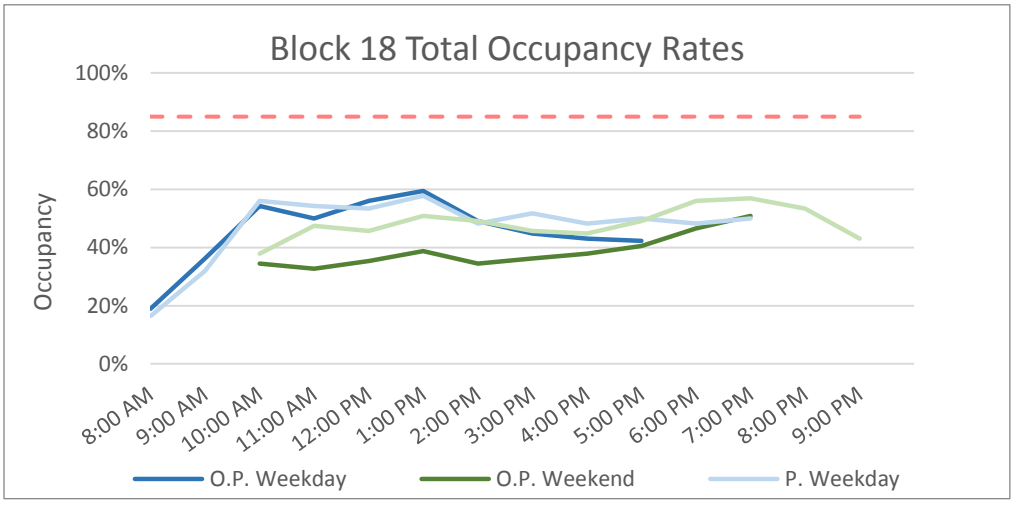


Figure 3-6: Block 18 total occupancy rates.

Block 19

This block contains various businesses, a public parking lot, and a large abandoned building. In total, the block contains 89 parking spaces. Approximately half of the off-street parking is in the smallest public parking lot in the downtown area, the Mendenhall and Willson lot. The other half is reserved for the various businesses in this block.

Both weekday and weekend occupancy rates shared the same basic shape. Each day had a peak in the noon and evening, with a "dip" in the afternoon. These peaks are likely attributed to a lunch rush and a dinner rush, respectively. For weekdays, the noon peak was higher than the evening peak. For weekends, the evening peak was higher.

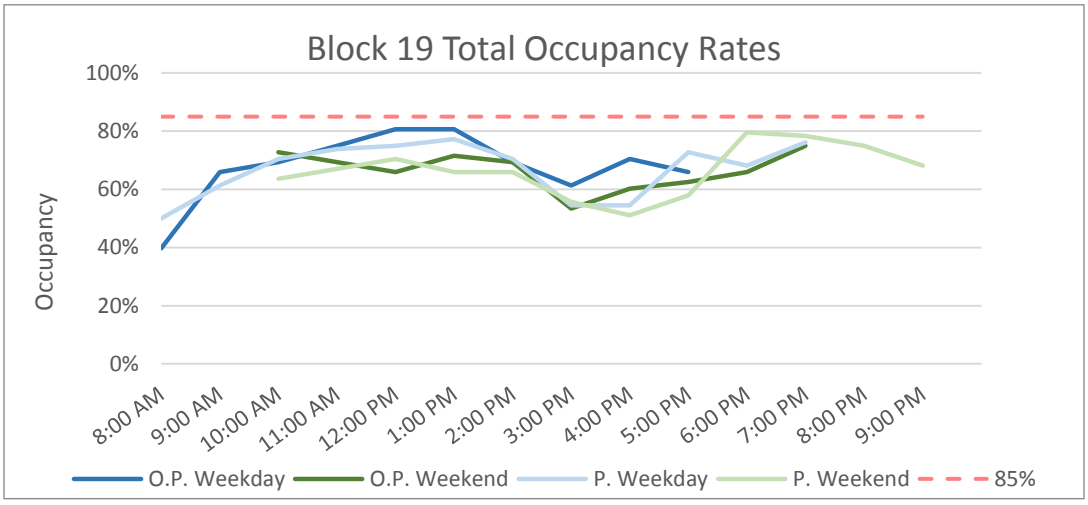


Figure 3-7: Block 19 total occupancy rates.

Block 20

This block contains various businesses and the large downtown parking garage. In total, the block contains 475 parking spaces. Although the vast majority of parking for this block is in the parking garage, there are several alley parking spaces as well.

Overall, the occupancy rates for weekdays were notably higher than those for weekends. Furthermore, the occupancy patterns exhibit a single peak around noon during weekdays and two peaks on weekends, one early in the afternoon and the second later in the evening. The highest peak was observed during the off-peak weekday study, however occupancy for the block never exceeded 62%. The final level of the parking garage was never observed with more than 2 vehicles, and the permit (basement) part of the garage was observed to never exceed about half of its capacity.

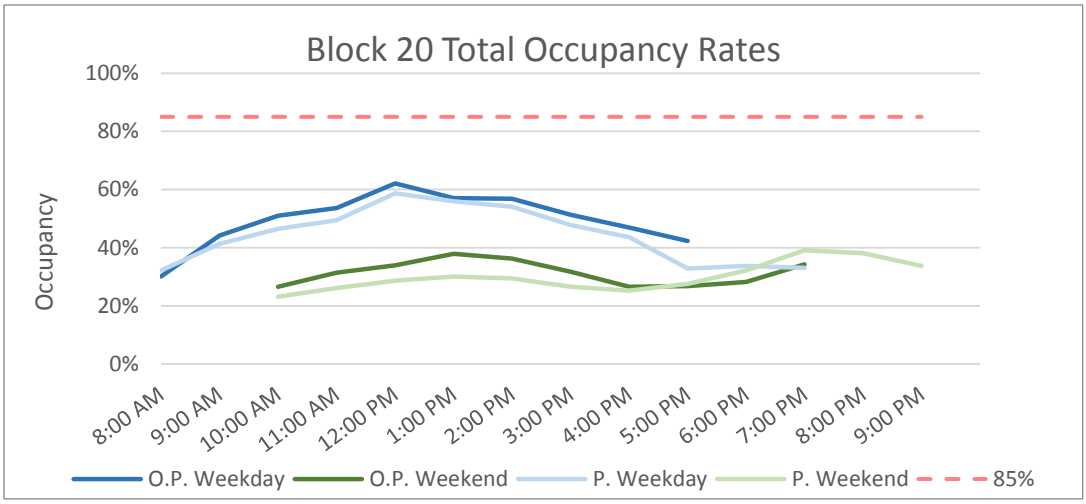


Figure 3-8: Block 20 total occupancy rates.

Block 21

This block contains various businesses and the largest public parking lot, the Mendenhall and Black parking lot. In total, this block contains 169 parking spaces. The Mendenhall and Black lot contains about half the parking for this block, with the other half split between private lots and alley parking for businesses.

On weekdays, occupancy rates gradually increases during morning hours, peaks around noon and remains relatively steady afterwards into the evening hours. On weekends, occupancy curves show two peaks; the first around noon and the second in the evening, which could be attributed to lunch and dinner rush hours, respectively. The Mendenhall and Black lot was observed to be completely full at least once during each study day. Further discussion of this parking lot is included in subsequent sections of this report.

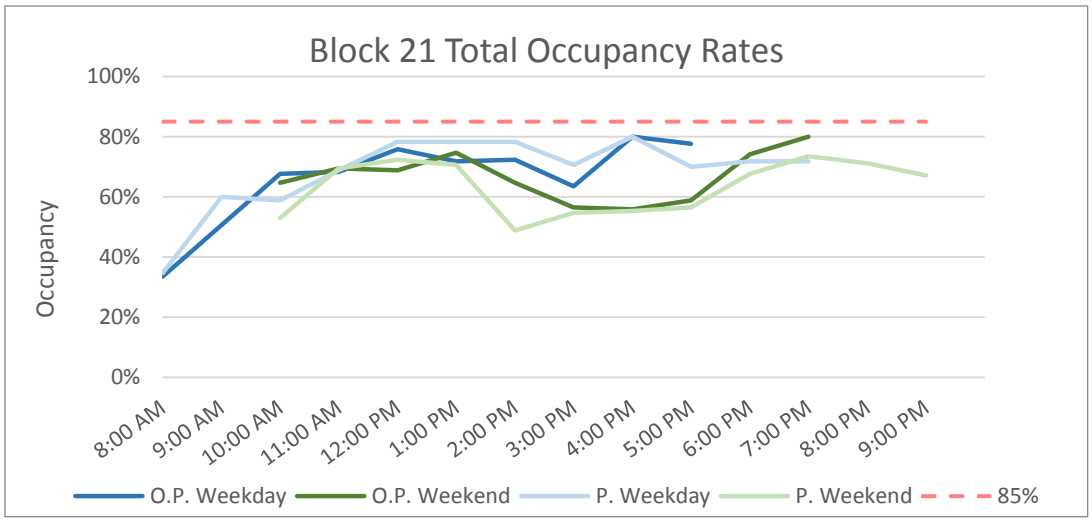


Figure 3-9: Block 21 total occupancy rates.

Block 22

This block is one of the largest blocks within the study area and contains various businesses. In total, this block contains 174 parking spaces. The majority of off-street parking is within several parking lots, although there are several alley parking spaces for the bars and restaurants on Main Street.

Occupancy levels were observed to be very similar for all 4 study days. Occupancy increases gradually over morning hours, remains relatively steady during the afternoon period, then increases to reach peak levels in the evening due to the high number of restaurants and bars on this block.

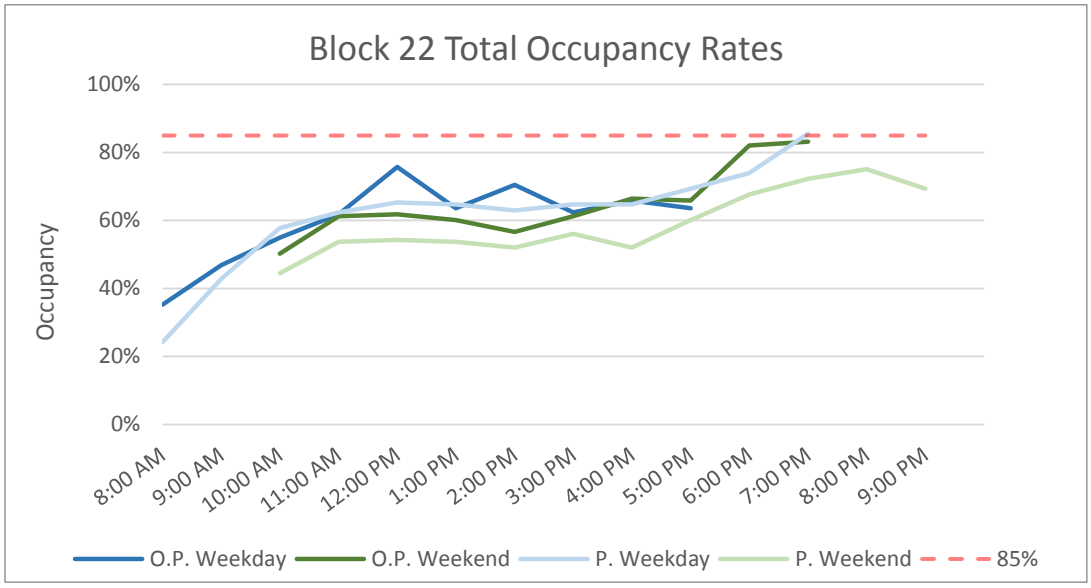


Figure 3-10: Block 22 total occupancy rates.

Block 23

This block contains various businesses, a residential apartment building, and a fire station. In total, this block contains 131 parking spaces. There are 4 parking lots for businesses, 1 for the apartment building, 1 for the fire station, and several alley parking spots.

Between off-peak and peak, the weekday and weekend studies followed very similar patterns. Peak occupancy rates were observed in the morning. This is most likely due to the fact that most restaurants in this block serve primarily coffee and breakfast. Occupancy rates during weekdays were notably higher than those during weekends.

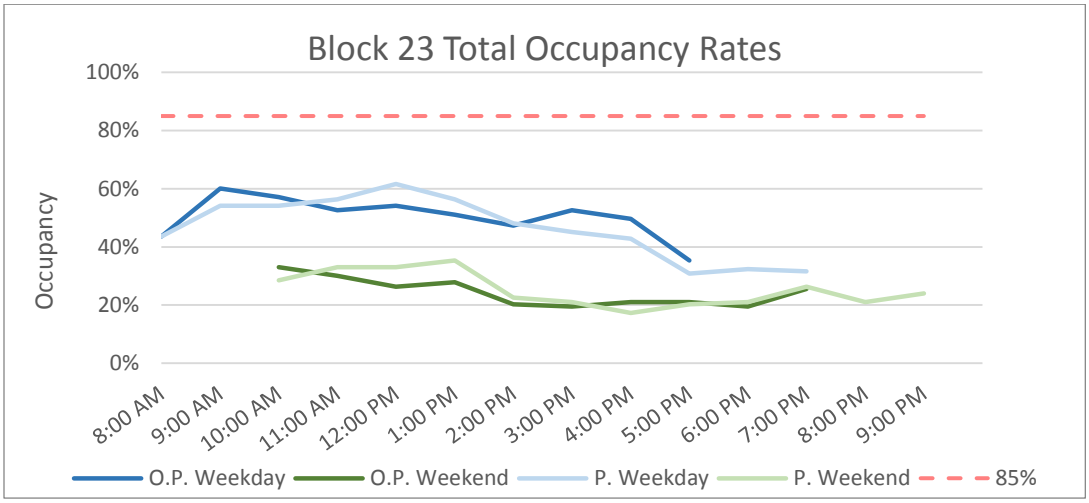


Figure 3-11: Block 23 total occupancy rates.

Block 25

This block contains various private businesses. In total, the block contains 181 parking spaces. One restaurant, Montana Ale Works, seemed to generate a majority of the block's parking usage in the evening. The northern half of this block contains a large amount of dirt open area primarily surrounding a warehouse and a business called the AG Depot. Legal on-street parking exists on the southern and western sides of this block. Cars were also observed parking on the street on the northern side of this block, however, the lack of curbs or markings on this side makes the number of available parking spots somewhat arbitrary.

In the morning, weekday occupancy levels were much higher than weekend levels. In the evening, however, all four study days shared a very similar dramatic peak. This was primarily due to the popularity of the block's main restaurant, Montana Ale Works, for dining in the evenings.

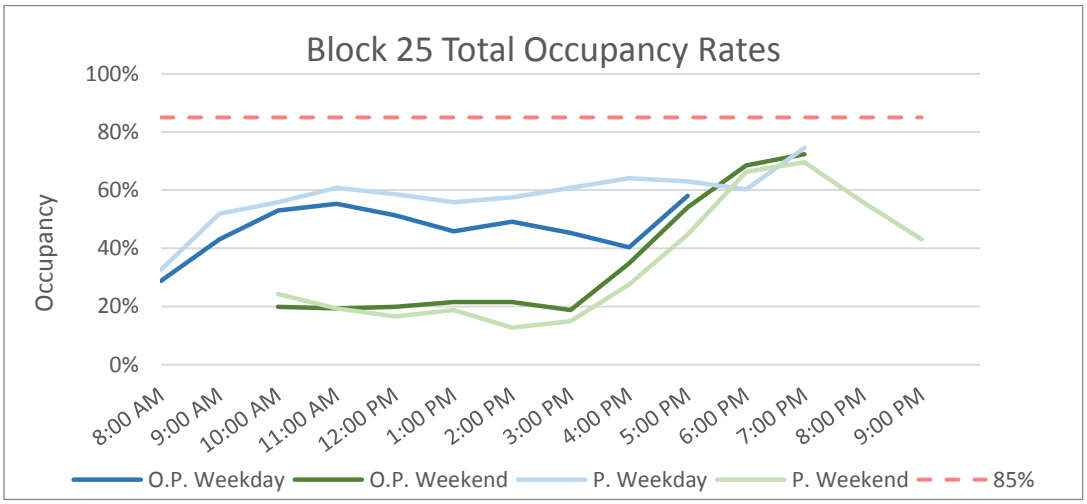


Figure 3-12: Block 25 total occupancy rates.

3.4.3. Zone C

As shown in Figure 3-1, zone C consists of that part of the study area just south of Main St. (i.e. between Babcock and Main) and encompasses blocks 26-35.

Block 26

This block contains only the Wilson school. In total, the block contains 112 parking spaces. Off-street parking consists of two lots associated with the school. On-street parking exists on all four sides, with the north side being 2-hour restricted.

Weekday occupancy rates were significantly higher than weekend rates during daytime working hours, mainly due to the number of offices that exist within the Wilson School. Weekend rates remained relatively low, with a small peak occurring in the evening. If a performance at the Wilson auditorium was scheduled during one of the study days, occupancy rates would have likely been significantly higher.

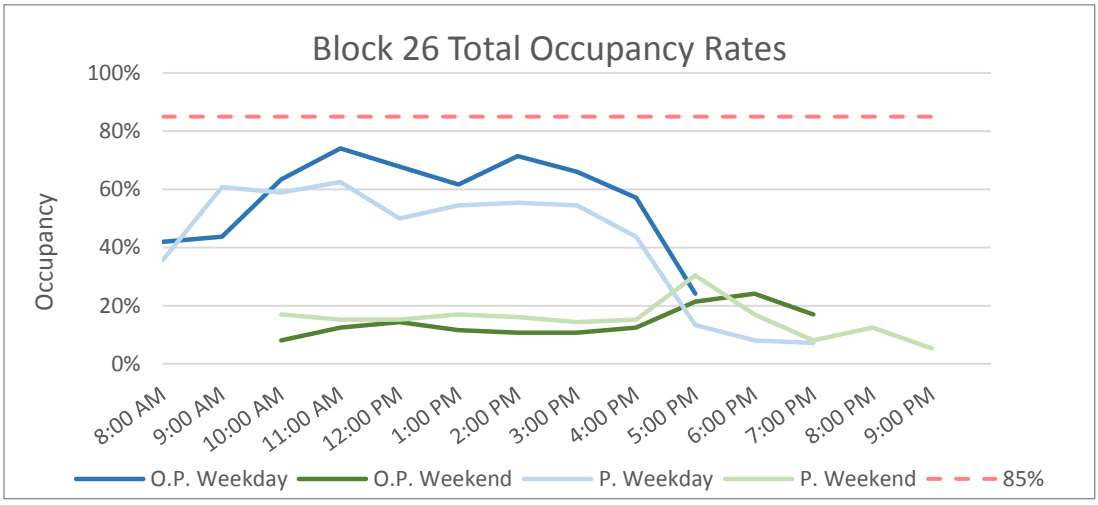


Figure 3-13: Block 26 total occupancy rates.

Block 27

This block contains a church and a bank. In total, the block contains 97 parking spaces. Off-street parking consists of two large lots on the southern half of the block. On-street parking exists on the north, east, and the west sides of the block, with the north and east sides being 2-hour restricted.

In the morning, weekday rates were higher than weekend rates. However, if the weekend occupancy studies had been performed on a Sunday they would have likely exhibited much higher occupancy rates due to church services. In the evening, the weekend rates exhibited a dramatic peak that far exceeded weekday rates. This was likely either due to dining in adjoining blocks or events occurring within the church.

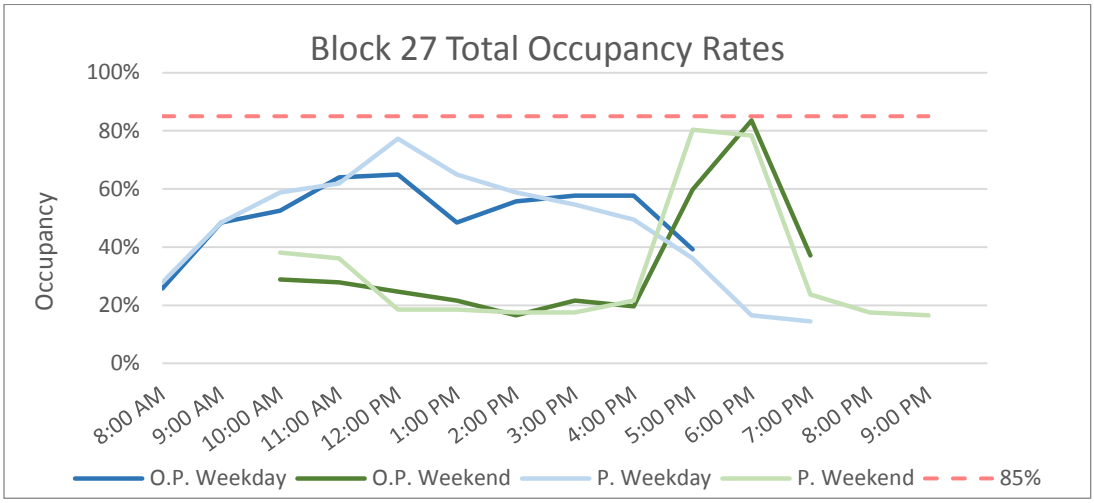


Figure 3-14: Block 27 total occupancy rates.

Block 28

This block contains various private businesses. In total, this block contains 100 parking spaces. Off-street parking primarily consists of two lots. On-street parking exists on all four sides, all of which are 2-hour restricted. Construction was happening on the northwest corner of this block throughout the summer, which may have affected occupancy rates.

Throughout most of the day, weekday occupancy rates were higher than weekend occupancy rates, however, both were similar in the evenings. The largest peaks happened on the weekdays around lunchtime.

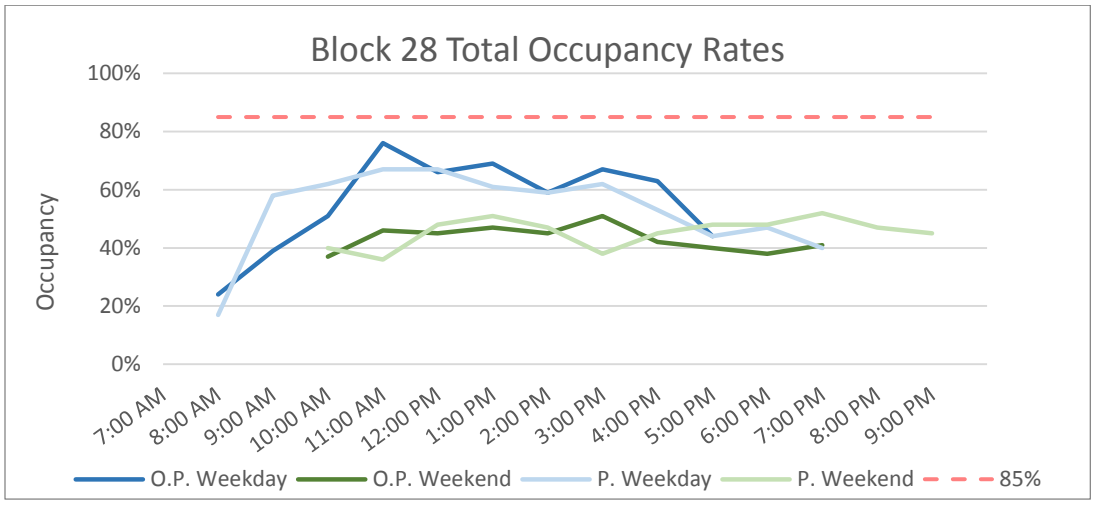


Figure 3-15: Block 28 total occupancy rates.

Block 29

This block contains various private businesses. In total, this block contains 99 parking spaces. Off-street parking consists primarily of two lots on the southern half of the block. On-street parking exists on all four sides, all of which are 2-hour restricted.

Occupancy rates were similar every study day except the peak weekend study. This is most likely due to the fact that most businesses in this block have similar hours on weekdays and weekends and are equally popular on both days.

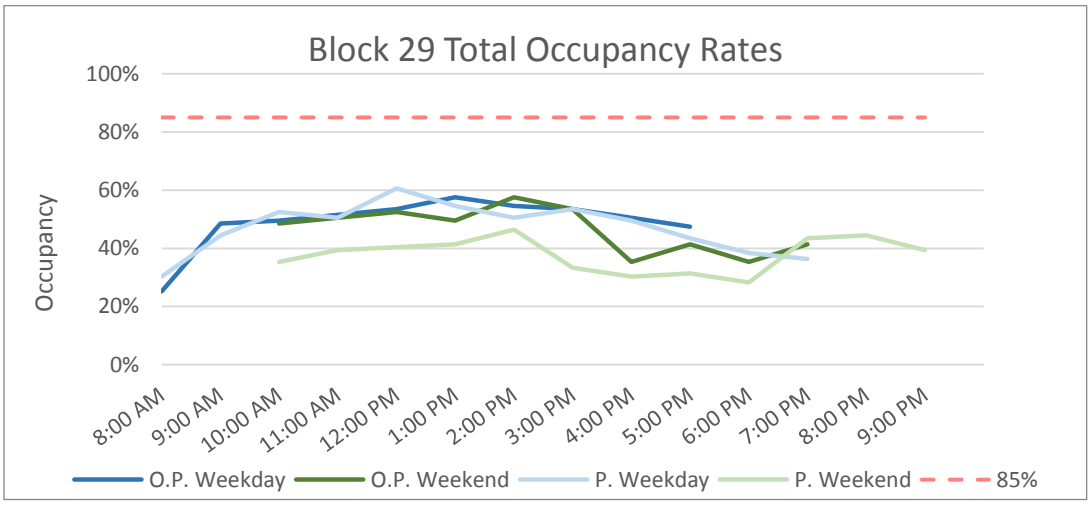


Figure 3-16: Block 29 total occupancy rates.

Block 30

This block contains various private businesses. Additionally, HRDC is in the southwest corner. In total, this block contains 94 parking spaces. Off-street parking consists primarily of three lots in the southern half of the block. On-street parking exists on all four sides, all of which are 2-hour restricted.

Weekday occupancy rates were higher than weekend rates. The peak for all four days occurred around noon.

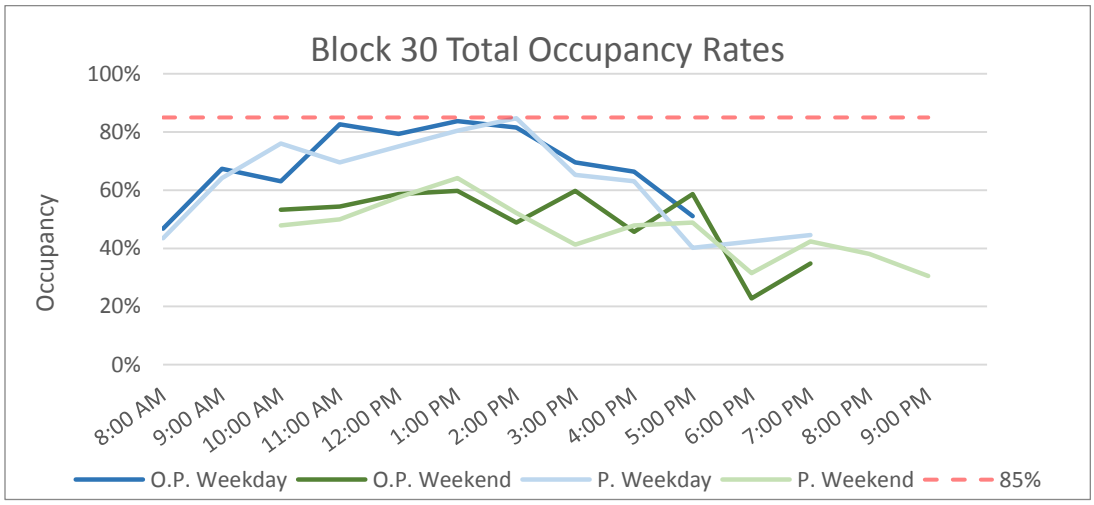


Figure 3-17: Block 30 total occupancy rates.

Block 31

This block contains various private businesses. In total, the block contains 89 spaces. Off-street parking consists primarily of two lots in the southern half of the block. On-street parking exists on every side but the south, all of which are 2-hour restricted.

Occupancy rates show similar patterns for all four study days, with the off-peak weekend exhibiting the highest rates for most of the day. All four days exhibited a peak around noon, then a lull in the early afternoon, followed by decline in parking demand into the evening.

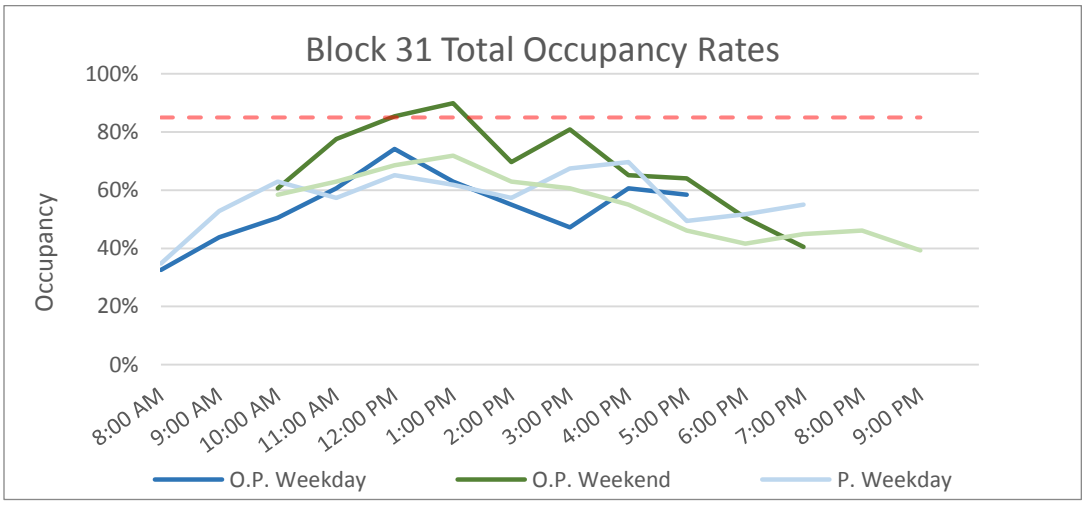


Figure 3-18: Block 31 total occupancy rates.

Block 32

This block contains various private businesses, a large bank complex, and a small park. Additionally, there is a city-owned public parking lot on the southeast corner of this block. In total, this block contains 203 parking spaces. Off-street parking consists primarily of several parking lots along the south half of the block. On-street parking exists on all four sides, of which every side except the south are 2-hour restricted.

Occupancy rates were somewhat similar for all 4 study days, with the peak weekday exhibiting the highest rates for most of the day. All four days exhibited a small peak around noon, then a lull in the early afternoon, followed by another peak in the evening. This evening peak is likely due to the high number of popular restaurants in this block.

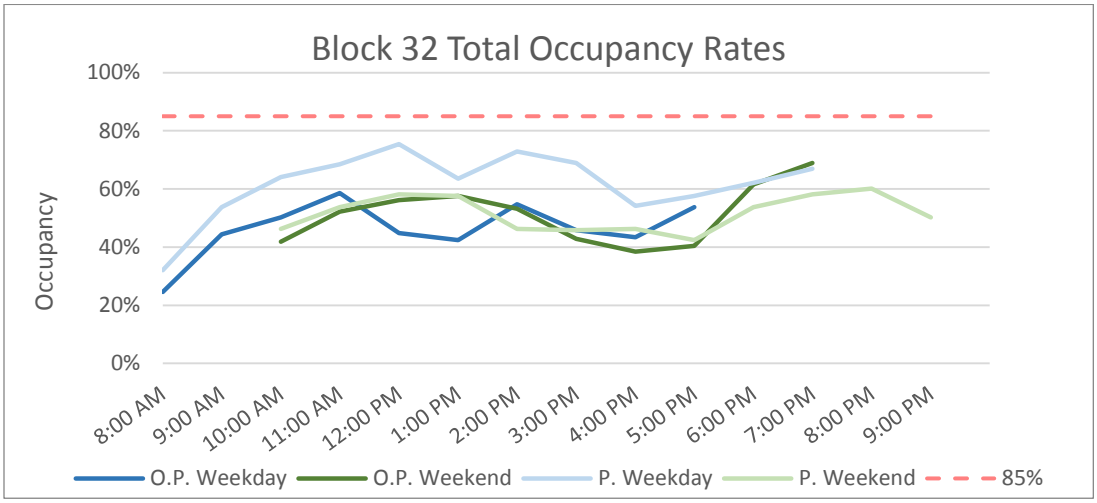


Figure 3-19: Block 32 total occupancy rates.

Block 33

This block contains various private businesses. In total, the block contains 137 parking spaces. Off-street parking consists primarily of several parking lots which border this block's alley. On-street parking exists on all four sides, with most sides containing a mix of unrestricted and 2-hour restricted parking.

All four study days exhibited similar occupancy patterns throughout the day, however the rates themselves differed significantly. Weekend occupancy rates were roughly similar and significantly lower than the weekday rates. However, the peak weekday exhibited much higher occupancy rates than the off-peak weekday.

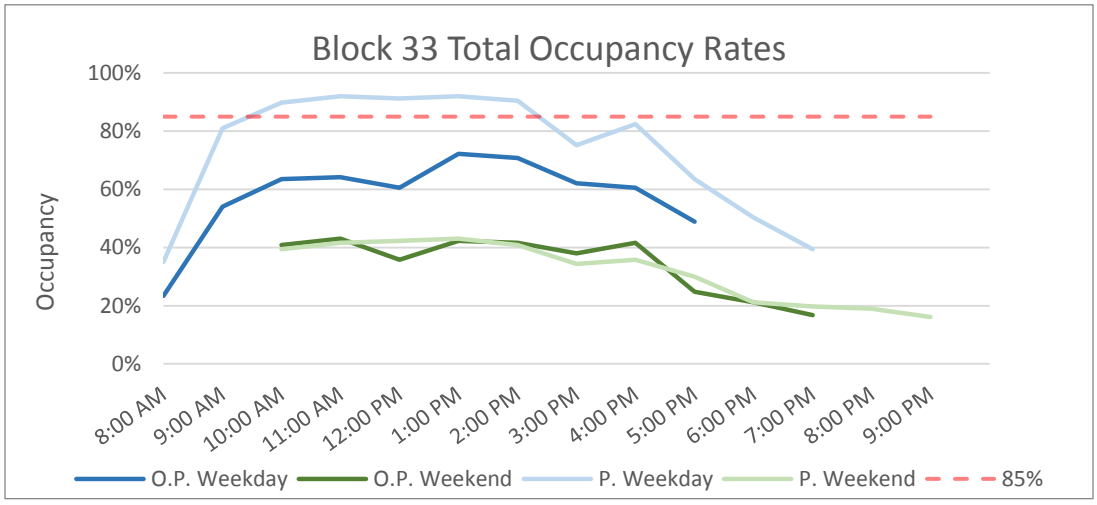


Figure 3-20: Block 33 total occupancy rates.

Block 34

This block contains several private businesses and several private residences. In total, this block contains 120 parking spaces. Off-street parking consists of about 4 lots that are spread throughout this block. On-street parking exists on every side except the east, with all four sides allowing unrestricted parking.

Every study except the peak weekday study exhibited similar occupancy levels. Those three studies peaked around noon and tapered down into the evening. The peak weekday study showed higher occupancy rates which remained consistently high throughout regular business hours.

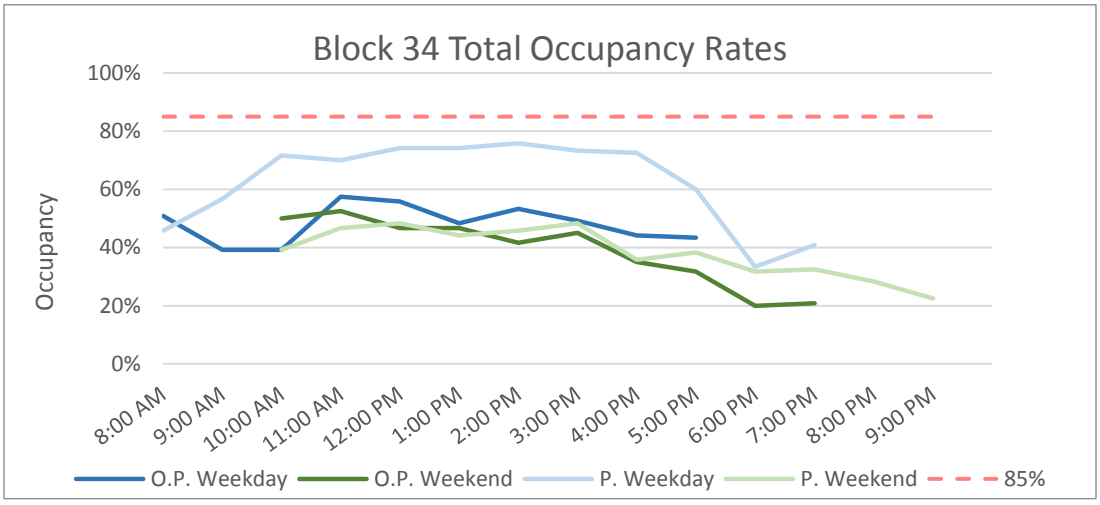


Figure 3-21: Block 34 total occupancy rates.

Block 35

This block contains a series of warehouses along the west side and the Bozeman Public Library. In total, the block contains 344 parking spaces. Off-street parking consists of the large public parking lot to the south of the library. This lot is primarily used for library parking, however, it is also used for events at the neighboring park. The edges of this block are only bordered by streets on the north and east sides. Both of these sides allow unrestricted on-street parking.

Both weekday studies exhibited consistently high occupancy levels throughout regular businesses hours then tapered down in the evenings. Weekend studies exhibited peaks in the early afternoon, then tapered down in the evenings. The peak weekend study exhibited much higher occupancy levels than the off peak weekend study, most likely due to the increased level of visitors and more desirable weather.

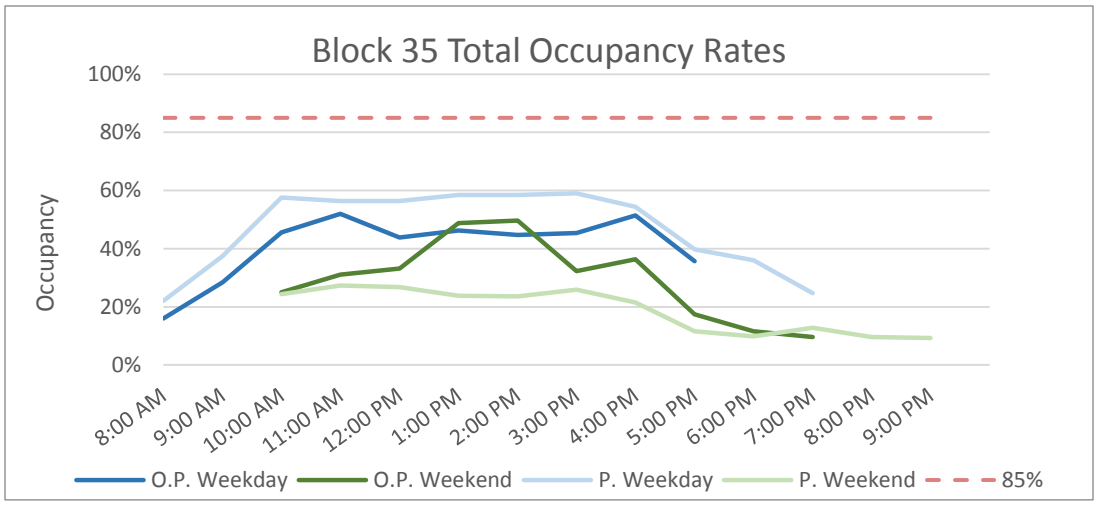


Figure 3-22: Block 35 total occupancy rates.

3.4.4. Zone D

As shown in Figure 3-1, zone D consists of the southernmost part of the study area and encompasses blocks 36-52.

Block 36

This block contains the Emerson Cultural Center and a large grass field on the western side. In total, this block contains 124 parking spaces. Off-street parking consists of a parking lot along the south side of the building. On-street parking exists on all 4 sides, with all sides allowing unrestricted parking.

All four occupancy curves exhibited different patterns. The off-peak weekday study remained consistent throughout the duration of the study. The peak weekday study exhibited a dramatic peak around noon followed by a dramatic decrease into the evening. The off-peak weekday exhibited a large peak in the morning (most likely due to an event), then a lull in the afternoon, followed by another smaller peak in the evening. The peak weekend exhibited consistently low occupancy rates throughout the day, with a peak in the evening.

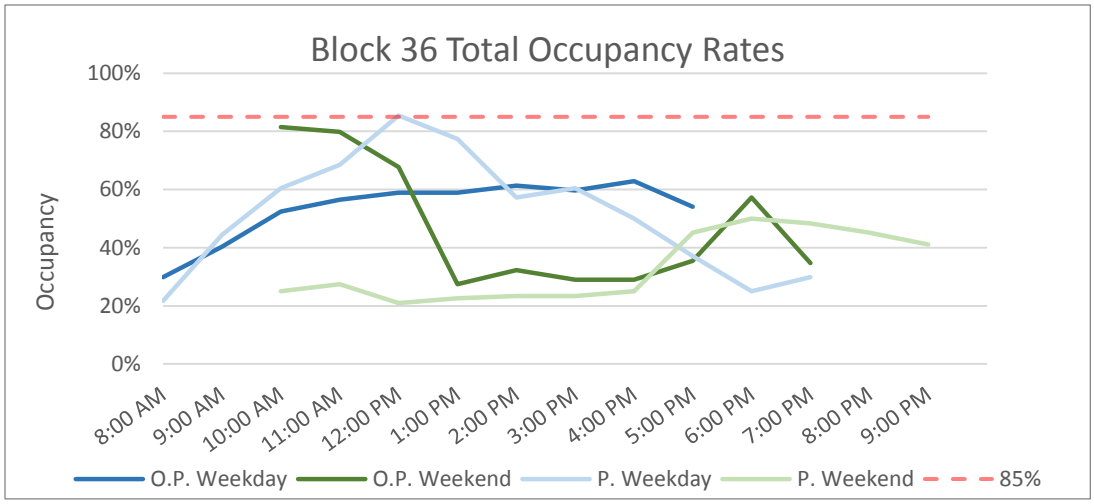


Figure 3-23: Block 36 total occupancy rates.

Block 48

This block contains various private businesses, several private residences, a church, and an office building containing several City of Bozeman offices including the parking division. In total, this block contains 104 parking spaces. Off-street parking primarily consists of two lots within the middle of the block. On-street parking exists on all 4 sides, with all sides except 5 spots on the north side allowing unrestricted parking.

All four occupancy curves exhibited different patterns. Both peak and off-peak weekdays exhibited similarly-high occupancy rates throughout regular business hours except for a dramatic drop in the off-peak weekday around noon. The off-peak weekend exhibited consistently low occupancy levels throughout the day. The peak weekend exhibited a dramatic peak around noon and another smaller peak in the evening.

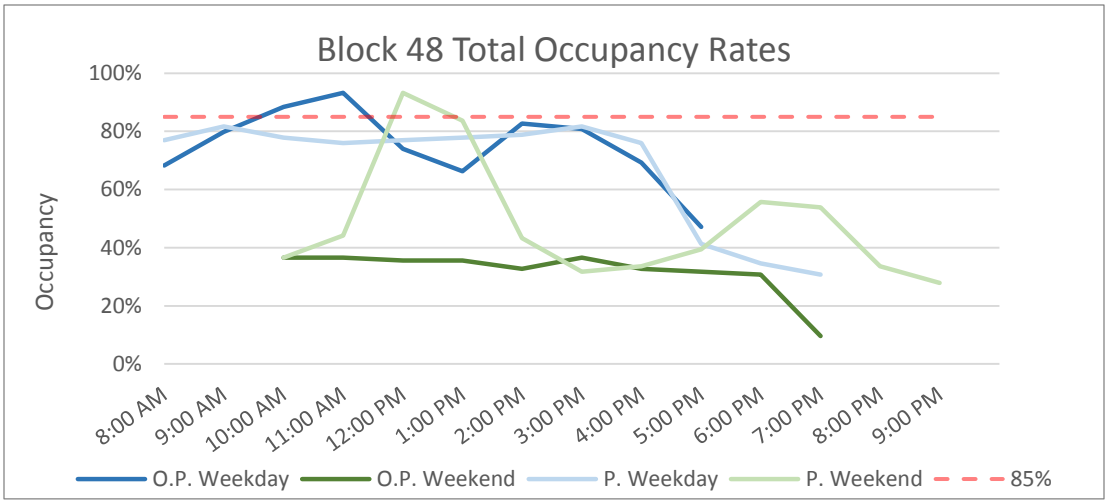


Figure 3-24: Block 48 total occupancy rates.

Chapter 4. Dwell Time

Dwell time is a measure of the length of time a vehicle remains parked in a parking facility. The benefit of the dwell time metric is that it provides an indication of parking behavior and overall parking capacity. Based on the preferences of the Parking Commission, the dwell times for the three city-owned parking lots were examined. Each parking lot had a time restriction of 2 hours. Similar to the occupancy study, data collection occurred on both a weekday and a weekend during off-peak and peak seasons. The parking lots examined were:

- Mendenhall St. and Wilson Ave. southeast corner;
- Mendenhall St. and Black Ave. southeast corner; and
- Babcock St. and Rouse Ave. northwest corner.

4.1. Data Collection

To collect dwell time data, an observer remained at a parking lot for around 8 hours. When a vehicle entered the parking lot, its license plate was recorded as well as the time it entered. When a vehicle left, the exit time was recorded, using the license plate as a reference. While an observer was recording the needed entrance data, they would also approach the driver and ask them three questions related to their trip purpose. This part of the study will be discussed in detail in the next chapter.

For each dwell time study performed, the observer attempted to collect data for about 70-100 vehicles, although the number of data points varied by the day of week and the size of the parking lot. Note that vehicles already present at the beginning of data collection, or that remained after data collection was completed were excluded from further analysis.

4.2. Analysis Methodology

A basic methodology was employed in analyzing dwell time once all data collection had been performed. First, dwell time duration for each vehicle was calculated using the entry and exit

times. As noted above, vehicles that were already present at the beginning or remaining at the end of data collection were not used in the analysis.

Once a dwell time duration had been calculated for every vehicle, descriptive statistics were then generated. For each study performed the mean (sum of observations divided by number of observations), median (50th percentile point), standard deviation (average deviation from mean value), minimum observed time, and maximum observed time were calculated for both all vehicles and only vehicles that remained parked in the lot for longer than the allowed 2 hour limit. Additionally, histograms were generated for each study day, displaying the frequency of dwell time observations rounded to the nearest 5 minutes.

4.3. Dwell Time Results

The results of the dwell time analysis as described above are presented in the following three sections.

4.3.1. Mendenhall St. and Wilson Ave. Southeast Lot

This lot, located directly west of the Armory, is in block 19 of the study area and contains 28 parking spaces, 2 of which are designated handicapped parking. This lot has a time restriction of 2 hours. Dwell time data was collected on 4 different dates. The off-peak data collection was performed on April 22nd (Saturday) and April 27th (Thursday). The peak data collections were performed on July 23rd (Sunday) and July 27th (Thursday). For all 4 days, data collection began in the late morning/early afternoon and ran until sufficient data was collected (5-8 hrs).

Descriptive statistics for the 4 dwell time studies performed are presented in Table 4-1. Also included are descriptive statistics for the vehicles that remained parked for longer than the allowed limit of two hours. Although not listed in the table, most vehicles that remained parked for longer than two hours on the weekdays did so in the evening when parking enforcement had stopped, usually around the dinner rush. Vehicles that exceeded the two-hour limit on the weekends did so throughout the day, likely assuming that parking enforcement did not happen on weekends.

Table 4-1: Dwell time descriptive statistics for the Mendenhall St. & Wilson St. lot.

	OP Weekday		OP Weekend		Peak Weekday		Peak Weekend	
	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours
Sample Size	84	7	88	5	93	9	97	19
Mean	0:53	2:25	1:07	3:24	1:03	2:49	1:23	3:04
Median	0:46	2:15	1:07	2:54	0:56	3:01	1:16	2:47
Standard Dev.	0:42	0:27	0:50	1:18	0:45	0:42	1:02	0:52
Minimum Obs.	0:02	2:01	0:03	2:17	0:04	2:05	0:03	2:03
Maximum Obs.	3:12	3:12	5:17	5:17	4:07	4:07	4:56	4:56

Figure 4-1 and Figure 4-2 present frequency distributions of dwell time durations at five-minute intervals. As can be clearly seen, there was a significantly higher number of violators of the two-hour parking limit during the peak studies, and in particular during the weekend peak study. Generally, frequency distributions for the weekend studies skewed to the right while distributions for the weekday studies skewed to the left. This indicates that most people parking during the weekdays remain parked for less time than during the weekends.

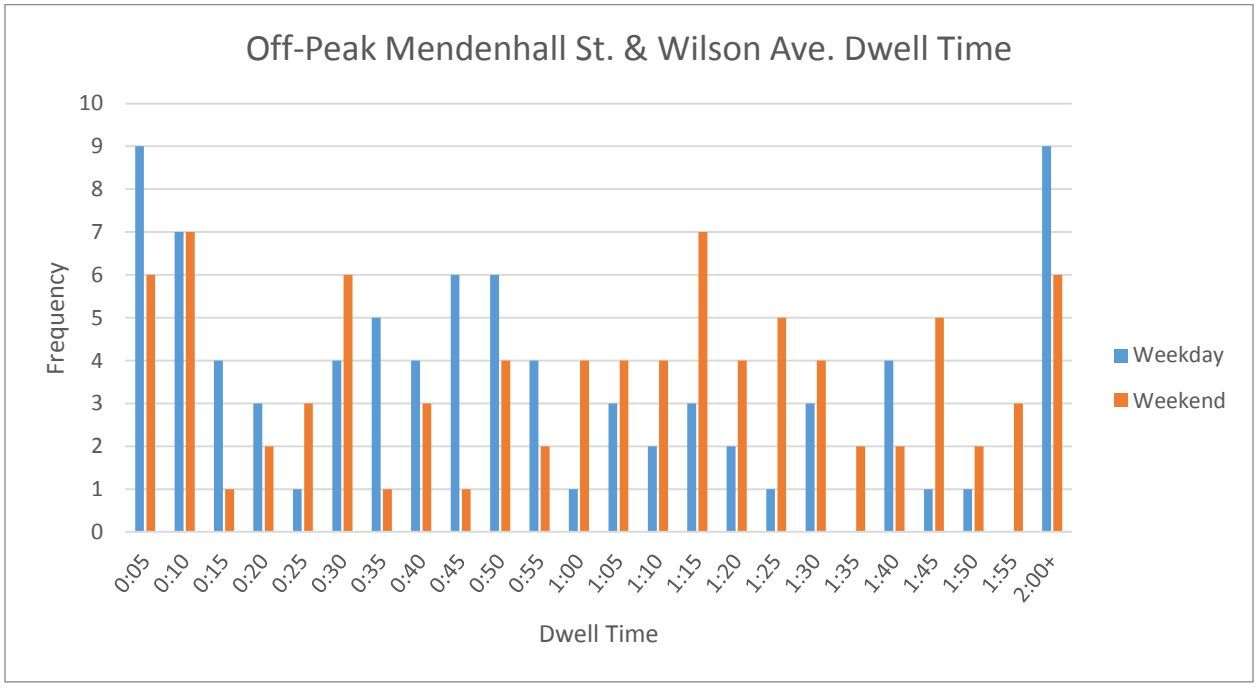


Figure 4-1: Off-peak Mendenhall St. & Wilson Ave. dwell time frequency diagram.

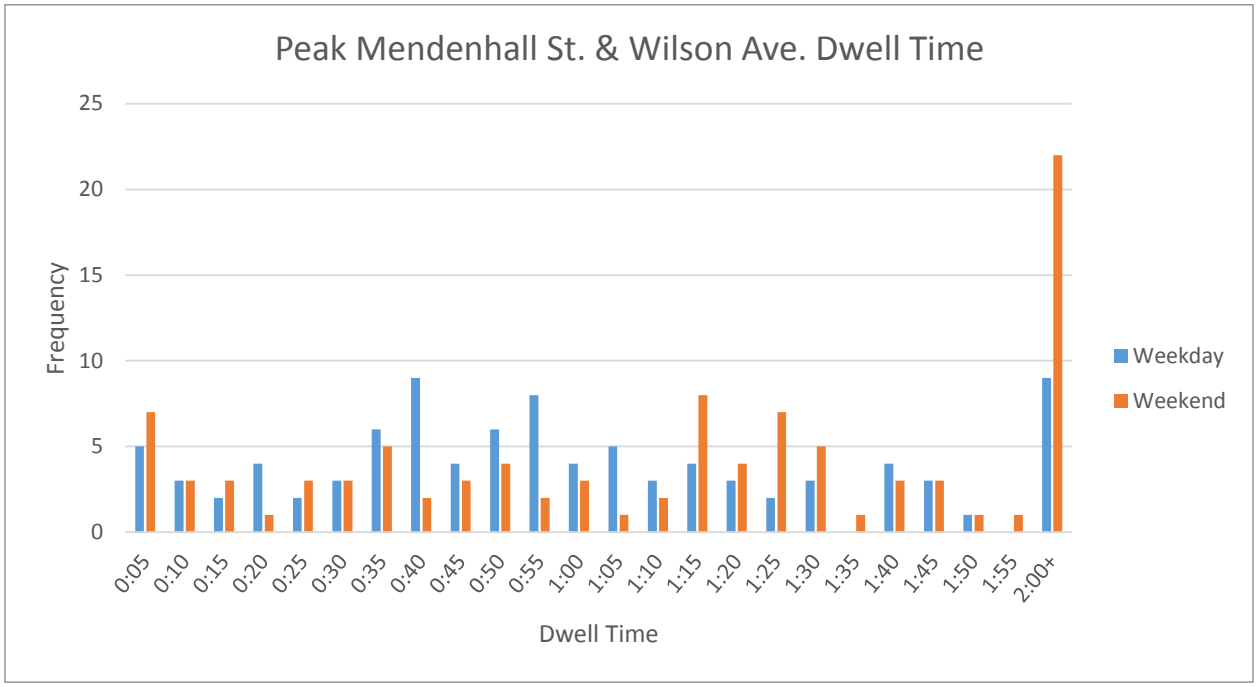


Figure 4-2: Peak Mendenhall St. & Wilson Ave. dwell time frequency diagram.

Overall, the results of the four dwell time studies performed indicate that most vehicles remain parked in the Armory lot for about an hour. The data collection crew member noted that they observed this lot completely full many times throughout the 4 studies, usually around peak dining times. This is underscored by the high number of vehicles that parked in this lot for food or drink, which is presented in the next chapter.

4.3.2. Mendenhall St. and Black Ave. Southeast Lot

This lot, located directly west of the historic Carnegie Library, is in the northwestern corner of block 21. It contains a total of 57 parking spaces, 2 of which are designated as handicapped parking. This lot has a time restriction of 2 hours. Dwell time data was collected on 4 different dates. The off-peak data collection occurred on April 27th (Thursday) and April 30th (Sunday). The peak data collection occurred on July 9th (Sunday) and July 24th (Monday). For all four studies, data collection began around noon and ran for about 5-9 hours into the evening.

Descriptive statistics for the 4 dwell time studies performed are presented in Table 4-2. Also included are descriptive statistics for the vehicles that remained parked for longer than the

allowed limit of two hours. Although not listed in the table, most vehicles that remained parked for longer than two hours on the weekdays did so in the evening when parking enforcement had stopped, usually around the dinner rush. Vehicles that exceeded the two-hour limit on the weekends did so throughout the day, likely assuming that parking enforcement did not happen on weekends.

Table 4-2: Dwell time descriptive statistics for the Mendenhall St. & Black Ave. lot.

	OP Weekday		OP Weekend		Peak Weekday		Peak Weekend	
	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours
Sample Size	104	17	93	16	97	4	102	22
Mean	1:17	2:26	1:32	3:44	1:00	2:26	1:18	3:04
Median	1:10	2:15	1:14	3:46	0:57	2:22	1:03	2:50
Standard Dev.	0:42	0:28	1:14	1:15	0:34	0:20	1:07	0:54
Minimum Obs.	0:02	2:00	0:05	2:01	0:02	2:07	0:01	2:05
Maximum Obs.	3:40	3:40	6:50	6:50	2:53	2:53	5:30	5:30

Figure 4-3 and Figure 4-4 present frequency distributions of dwell time durations at five-minute intervals. As can be clearly seen, there were many violators of the two-hour limit for every study day except the peak weekday study. Generally, frequency distributions for the off-peak studies seemed to skew farther left than for the peak studies. This indicates that vehicles were parking for longer durations during off-peak times of the year.

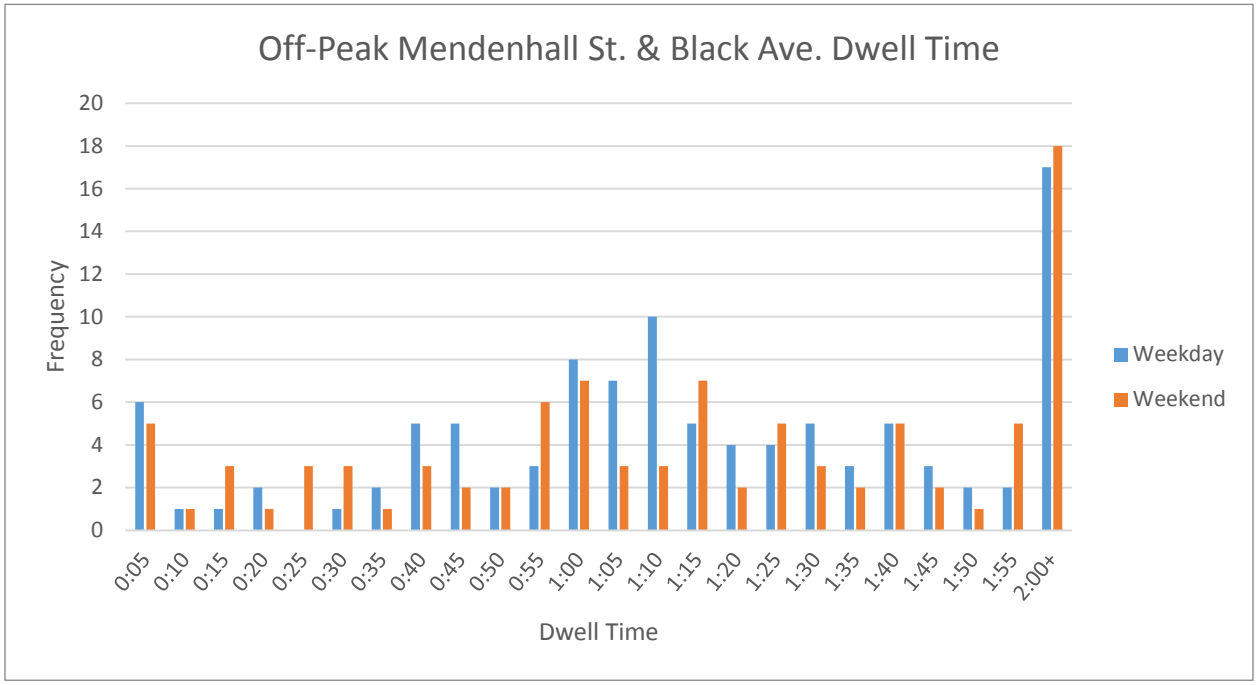


Figure 4-3: Off-peak Mendenhall St. & Black Ave. dwell time frequency diagram.

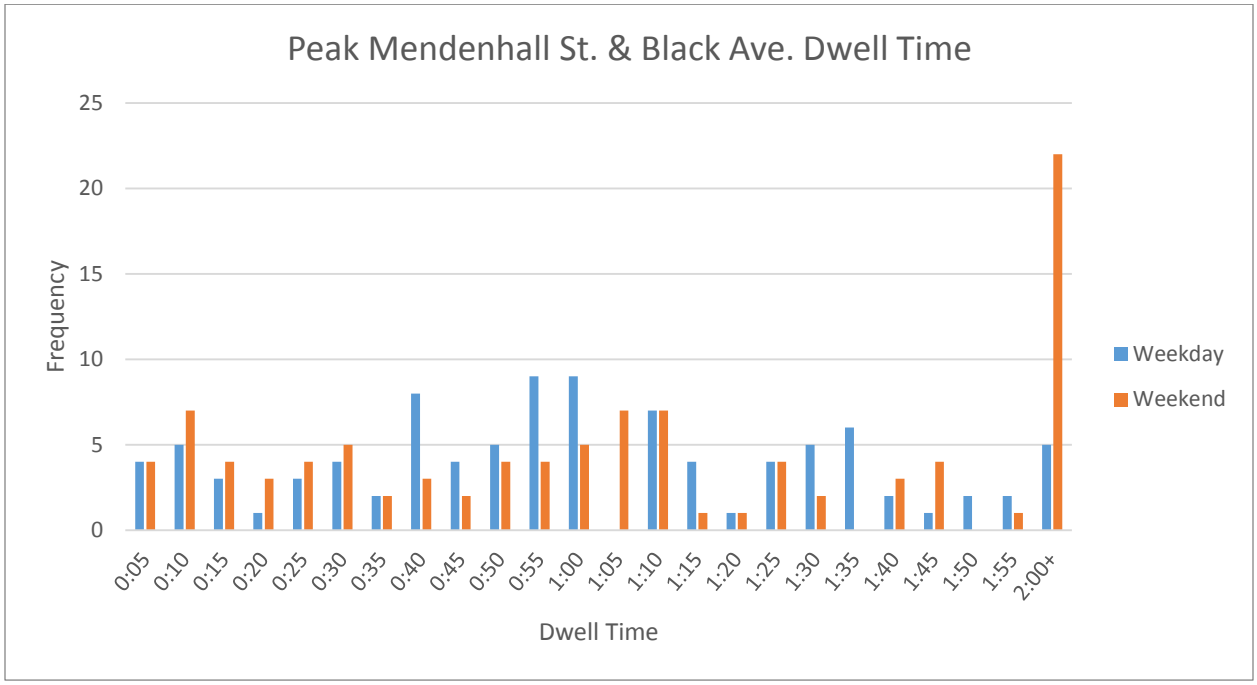


Figure 4-4: Peak Mendenhall St. & Black Ave. dwell time frequency diagram.

Overall, the results of the four dwell time studies performed indicate that most vehicles remain parked in the Carnegie lot for an hour or longer. Due to the large size of this lot and its proximity to the downtown parking garage, it was only observed to reach capacity briefly in several occasions over the 4 study days. Usually, this occurred during the noon lunch rush.

4.3.3. Babcock St. and Rouse Ave. Northwest Lot

This lot is located in the southeast corner of block 32. It contains 47 parking spaces, 2 of which are designated as handicapped parking. This lot has a time restriction of 2 hours. Dwell time data was collected on 4 different dates. The primary off-peak data collection occurred on April 27th (Thursday) and April 29th (Saturday). To ensure an adequate amount of data was collected, additional dwell time observations were taken on May 4th (Thursday) and May 6th (Saturday). These observations were taken during the same time of the primary data collection to ensure similar trip behavior and patterns. The peak data collection occurred on July 26th (Wednesday) and July 29th (Saturday). For all 6 study days, data collection began in the morning around 9 AM and ran for about 5 hours into the early afternoon.

Descriptive statistics for the 4 dwell time studies performed are presented in Table 4-3. Also included are descriptive statistics for the vehicles that remained parked for longer than the allowed limit of two hours. Since most data collection occurred in the morning and early afternoon, fewer violators of the two-hour time limit were observed than in the other parking lots. This is most likely due to the fact that most morning and early afternoon trip purposes have a shorter dwell time than evening trip purposes.

Table 4-3: Dwell time descriptive statistics for the Babcock St. & Rouse Ave. lot.

	OP Weekday		OP Weekend		Peak Weekday		Peak Weekend	
	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours	All Obs.	2+ Hours
Sample Size	57	3	71	3	74	3	75	7
Mean	0:52	2:31	0:56	2:36	0:46	2:34	0:58	2:34
Median	0:47	2:29	0:57	2:09	0:42	2:26	0:55	2:38
Standard Deviation	0:36	0:13	0:37	0:47	0:32	0:27	0:41	0:23
Minimum Obs.	0:02	2:19	0:04	2:08	0:05	2:11	0:02	2:06
Maximum Obs.	2:46	2:46	3:31	3:31	3:05	3:05	3:14	3:14

Figure 4-5 and Figure 4-6 present frequency distributions of dwell time durations at five-minute intervals. For all 4 studies, dwell time data generally skews to the left, indicating dwell times of generally under one hour. Also, dwell times that exceed two hours make up a smaller proportion of the data than in the other lots.

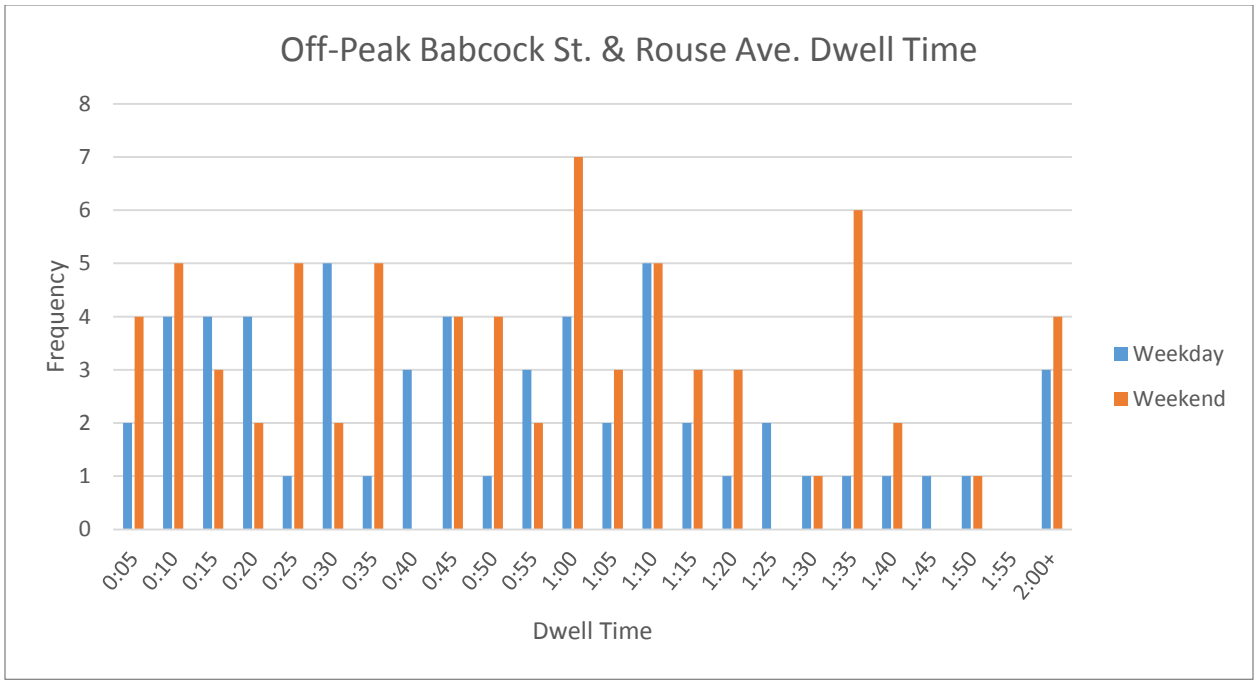


Figure 4-5: Off-peak Babcock St. & Rouse Ave. dwell time frequency diagram.

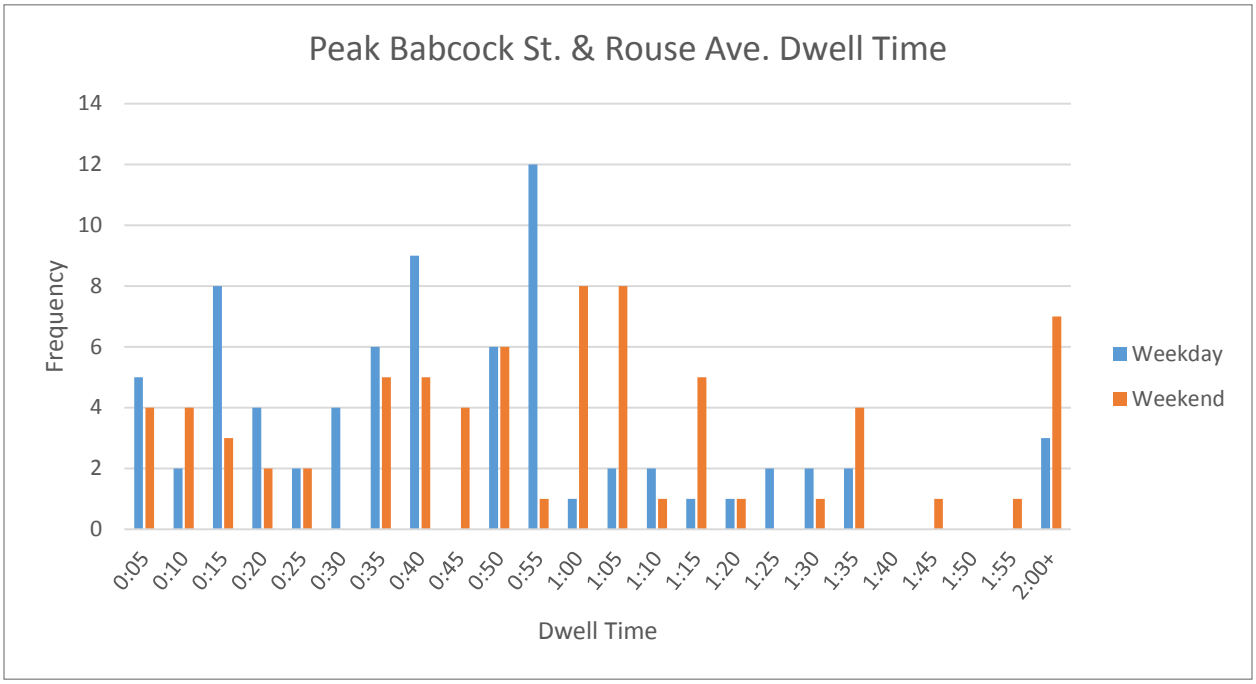


Figure 4-6: Peak Babcock St. & Rouse Ave. dwell time frequency diagram.

Overall, the results of the dwell time studies performed indicate that most drivers remained parked for under an hour. This is underscored by mean dwell times shown in Table 4-3, which range from 45 minutes to just under an hour. Similar to the Carnegie lot above, this lot was observed to be completely full several times over the four study days, usually around the noon lunch rush.

4.4. Turnover Rate

In addition to examining the dwell time for each of the lots/areas discussed in the previous sections, the turnover rate for these parking assets was also of interest. The parking turnover rate refers to the number of individual vehicles which occupy a particular space over a specific period of time, usually one hour. Turnover is computed as:

$$TR = \frac{N_T}{P_S * T_S}$$

Where:

TR = Parking Turnover Rate, in vehicles/stall/hour

N_T = Total Number of Parked Vehicles Observed

P_S = Total Number of Legal Parking Stalls

T_S = Total Duration of Study Period, in hours

4.4.1. Turnover Rate Analysis

Table 4-4 presents results of the turnover analysis. As shown, the average turnover rate differed between each parking lot by about 0.1. Each lot and study day exhibited a turnover rate of less than 1. Since a turnover rate of 1 would mean that each spot in a parking lot contained one vehicle every hour, a turnover rate of less than 1 and a mean dwell time less than 1 both indicate that the lot often does not reach capacity throughout the duration of the study.

Expectedly, the Mendenhall St. and Wilson Ave. Armory lot had the highest turnover rate. This is most likely due to its small size and its proximity to popular shops and restaurants that receive a high number of patrons during peak dining times, i.e. higher parking occupancies.

Table 4-4: Turnover rates for all 3 parking lots.

			Observed Vehicles	Stalls	Study Duration (hrs)	Turnover Rate
Mendenhall & Wilson	Off-Peak	Weekday	84	28	8	0.38
		Weekend	88	28	8	0.39
	Peak	Weekday	93	28	6	0.55
		Weekend	97	28	8	0.43
	Average					**0.44**
Mendenhall & Black	Off-Peak	Weekday	104	57	5	0.36
		Weekend	93	57	8	0.20
	Peak	Weekday	97	57	4.5	0.38
		Weekend	102	57	5.5	0.33
	Average					**0.32**
Babcock & Rouse	Off-Peak	Weekday	57	47	8	0.15
		Weekend	71	47	7	0.22
	Peak	Weekday	74	47	5	0.31
		Weekend	75	47	6.5	0.25
	Average					**0.23**

Chapter 5. Trip Purpose Survey

This study also collected data related to the trip purpose of drivers who were parking downtown. The trip purpose survey was performed at the same three city-owned parking lots as the dwell time study, and happened concurrently with that study. Performing both studies concurrently allowed dwell time data to be attributed to trip purpose which yielded additional valuable information.

To conduct the trip purpose study, a surveyor would approach the driver of a vehicle that had just parked and ask them three questions. These questions were:

- Trip purpose, the reason for visiting the downtown area;
- Location of residence; where the driver of the vehicle currently lives; and,
- Trip frequency, how often the driver visits the downtown area.

Depending on several factors, the surveyor would collect the data relevant to that driver's dwell time either before or after interviewing them. Even if there were multiple people in a vehicle, whose responses to the three questions may have varied, only the driver was interviewed.

For the peak trip purpose study in July, the number of passengers in every vehicle was also recorded. This was added due to the additional information it would yield without significantly increasing the effort on the part of surveyors.

5.1. Further Discussion on Questions

Although the questions were attempted to be as straightforward as possible, their answers may vary based on how those interviewed interpreted the questions. This section details the categories of each question that helped quantify data and also discusses any potential variations that could have affected the results of this study.

5.1.1. Trip Purpose

The first question, trip purpose, was probably the most straightforward question in the survey and easiest for drivers to answer in a straightforward manner. The responses to this question were ordered into the following categories for ease of analysis.

"Food/Drink" included every restaurant, café, bar, and coffee shop. People who responded saying they were hanging out with friends were also classified under "Food/Drink," since most places downtown that serve as social hubs serve food or drinks.

"Fitness" included businesses such as The Ridge, Pure Barre, Main Street Fitness, and any other fitness club or yoga studio.

"Short Term/Errand" included people who were doing any sort of drop-off or pick-up or who simply responded that they were running an errand.

"**Business/Professional Services"** included people who were visiting a doctor, dentist, lawyer, bank, or any other business of similar nature.

"Work" included people who either were parking while working in a downtown business or who were parking while attending a meeting or some other professional errand.

"Misc." included any other responses that couldn't be included in the above categories. Some people simply responded "Misc." because they were uncomfortable or unwilling to answer this question. People who said they simply were walking around or showing guests the main street area were also classified as "Misc." Other "Misc." responses specific to a parking lot will be discussed in later sections.

5.1.2. Location of Residence

Location of residence was also a straightforward question. Responses by drivers were organized into four categories:

"Bozeman" includes homes within both the city and the greater Bozeman area (such as the Bridger foothills or neighborhoods in southern Gallatin Valley). Generally, if a person resided in

Bozeman for at least half of the year, they were included in the Bozeman category. This included Montana State University students and those that owned vacation or part-time homes in Bozeman.

"Surrounding Communities" extends as far west as Three Forks, as far east as Livingston, and as far south as Big Sky (there aren't any major established communities within close proximity to Bozeman from the north). Generally, "Surrounding Communities" includes those that are small enough and close enough to Bozeman that residents likely visit Bozeman on a somewhat frequent basis to work or visit businesses that can't be found closer than Bozeman.

"In-State" includes any other town or city within Montana.

"Out-of-State" includes any location outside of Montana. Out-of-State visitors were from a wide variety of states, including eastern states as far away as Vermont. A few visitors from Canada were interviewed, although not enough to warrant a separate international category.

5.1.3. Trip Frequency

Trip frequency most likely varied based on the drivers' interpretation of the question. The question was worded "How often would you say you come to the downtown area?" This wording helped clarify that surveyors were interested in how often they visited the downtown area, not just the parking lot they were specifically at that day.

Although it was assumed that most people parking downtown use vehicles as their main mode of transportation—the weather was good for every dwell time survey performed, meaning that most of those who usually walk or bike probably did so during the study days as opposed to driving to avoid harsh weather—some people indicated that they usually bike downtown. If this was mentioned, the surveyors clarified that they were interested in how many times a driver *drove* downtown.

Most drivers gave their trip frequency answer as a "per week" or "per month" value. The answers were sorted into the following categories:

"5-7 Days/Week" was used to indicate drivers who drove to downtown on what could be considered a regular basis. These drivers usually either worked downtown, worked out regularly at a downtown gym, or frequented downtown businesses at a higher-than-average rate.

"1-4 Days/Week" was used to indicate drivers who frequent businesses on a less-average basis or visit downtown for other purposes on a somewhat regular basis.

"1-3 Days/Month" was used to indicate drivers who usually lived in Bozeman or nearby but either avoided the downtown area or lived/worked far enough away that visiting the downtown area on a regular basis was impractical. Some drivers who said they only visit the downtown area 1-3 days/month said they do so primarily because they find parking frustrating and difficult to find.

"Rare" was used to indicate drivers who visit the downtown area less frequently than once a month. Most of these drivers lived either out-of-state or within the farther reaches of Montana. Almost all drivers from Bozeman who said they visit downtown rarely said they do so primarily because they find parking frustrating and difficult to find.

5.2. Survey Results

The following sections provide detailed results from the trip purpose surveys.

5.2.1. Mendenhall St. and Wilson Ave.

The Mendenhall St. and Wilson Ave. parking lot is close to many popular shopping and dining locations. Results of the trip purpose survey indicated that drivers who parked in this lot did so primarily for food/drink or shopping activities. In particular, many drivers specified that they were dining at Ted's Montana Grill. Most of these drivers seemed to be unaware that restaurant parking existed in the parking garage located in block 18, the same block as Ted's Montana Grill. In addition to the misc. activities described at the beginning of this chapter, many of the drivers with misc. trip purposes were attending music or theater performances at venues such as the Ellen Theater or Cactus Records.

Figure 5-1 shows the distribution of trip purposes for each day trip purpose data was collected. Since this lot is not within proximity to a gym or many professional offices, the fitness and business/professional services categories were virtually nonexistent. The food/drink category was much more popular during the peak studies. Consequently, the shopping category was much less popular during the peak studies.

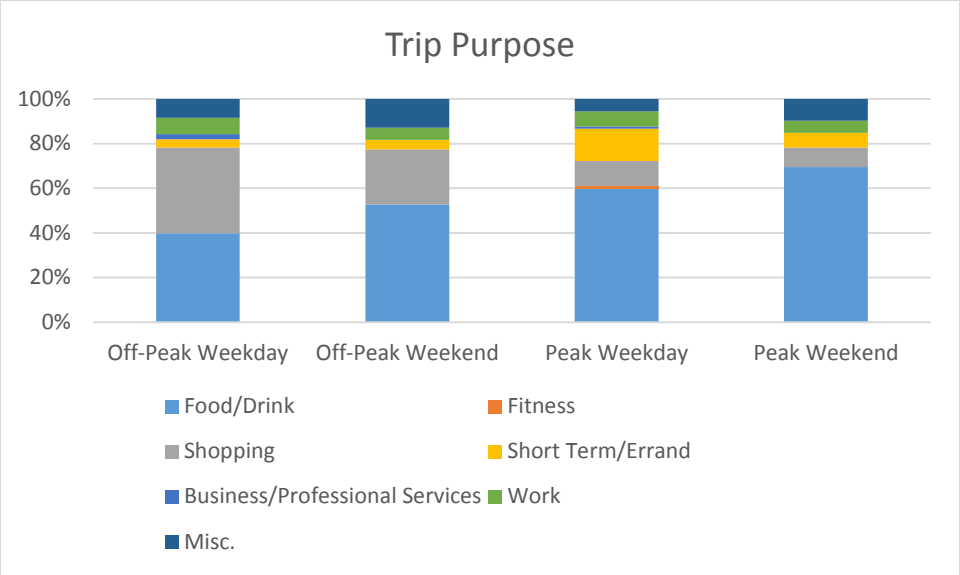


Figure 5-1: Trip purpose for the Mendenhall St. & Wilson Ave. lot.

Table 5-1 shows a numerical breakdown of trip purpose data for all 4 study days. Although it shows the same data as the above figure, it is provided to show actual percentages for each trip purpose category.

Table 5-1: Numerical trip purpose data for the Mendenhall St. & Wilson Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Food/Drink	40%	53%	60%	70%
Fitness	0%	0%	1%	0%
Shopping	39%	25%	11%	9%
Short Term/Errand	4%	4%	14%	7%
Business/Professional Services	2%	0%	1%	0%
Work	7%	5%	7%	5%
Misc.	8%	13%	6%	10%

Figure 5-2 shows a distribution of driver residences for each study day. As expected, there were many more out-of-state visitors during the peak time of year. This underscores Bozeman's popularity as a summer destination town.

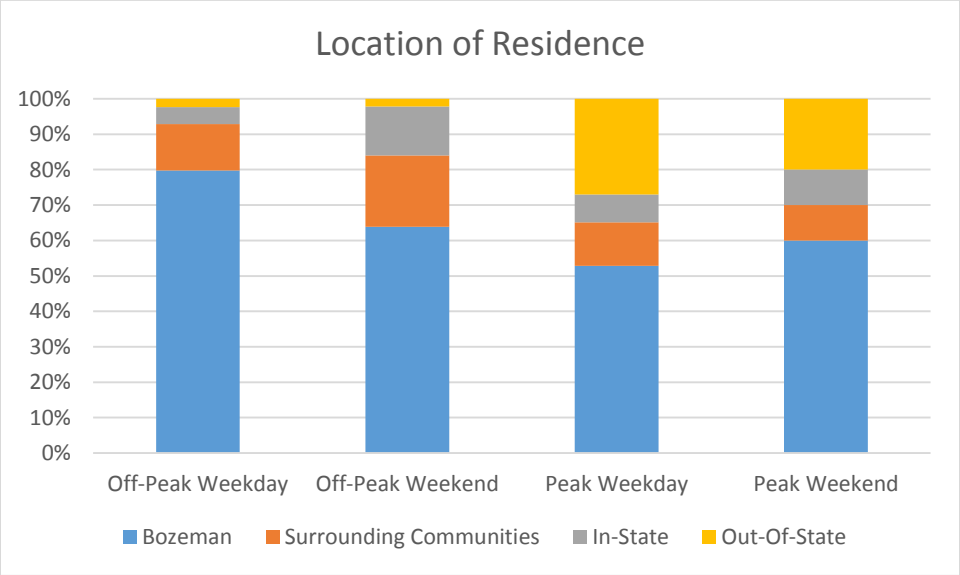


Figure 5-2: Location of residence for the Mendenhall St. & Wilson Ave. lot.

Table 5-2 shows a numerical breakdown of residence data for all 4 study days. Although it exhibits the same data as the above figure, it shows actual percentages for each residence category.

Table 5-2: Location of residence data for the Mendenhall St. & Wilson Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Bozeman	80%	64%	53%	60%
Surrounding Communities	13%	20%	12%	10%
In-State	5%	14%	8%	10%
Out-Of-State	2%	2%	27%	20%

Figure 5-3 shows a distribution of trip frequencies for each study day. The increased number of rare trip frequencies during the peak season can be attributed to the higher number of out-of-state visitors that only visit Bozeman once every year or so.

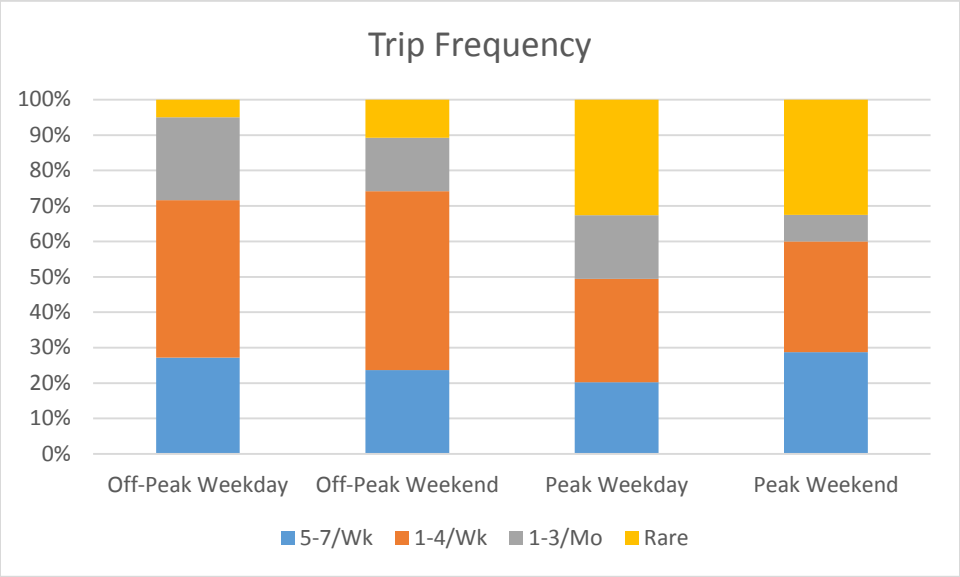


Figure 5-3: Trip frequency data for the Mendenhall St. & Wilson Ave. lot.

Table 5-3 shows a numerical breakdown of trip frequency data for all 4 study days. Although it shows the same data as the above figure, it is provided to show actual percentages for each trip frequency category.

Table 5-3: Numerical trip frequency data for the Mendenhall St. & Wilson Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
5-7/Wk	27%	24%	20%	29%
1-4/Wk	44%	51%	29%	31%
1-3/Mo	23%	15%	18%	8%
Rare	5%	11%	33%	33%

The data above clearly shows that most people visit this lot to either shop or visit a nearby bar or restaurant. Although most visitors live in Bozeman and visit the downtown area on a weekly basis, there is a noticeable increase in the number of Out-of-State visitors during the peak season.

5.2.2. Mendenhall St. and Black Ave.

The Mendenhall St. and Black Ave. parking lot is close to many shops, restaurants, and several popular gyms. Results of the trip purpose survey indicated that drivers who parked in this lot

did so for either fitness or food/drink activities. In addition to the misc. activities described at the beginning of this chapter, many drivers with misc. trip purposes were participating in the Gear Belly pub crawl, which uses the lot as a staging area on the weekends. The 15-person "pub bike" waits in the lot as participants arrive, then departs on an approximately 2-hour excursion. Most Gear Belly participants will park in the lot during this time.

Figure 5-4 shows the distribution of trip purposes for each day trip purpose data was collected. Due to this lot's proximity to a wide range of businesses, all trip purpose categories are represented throughout the 4 study days. As seen below, fitness was the most popular activity on weekdays while food/drink was the most popular on weekends.

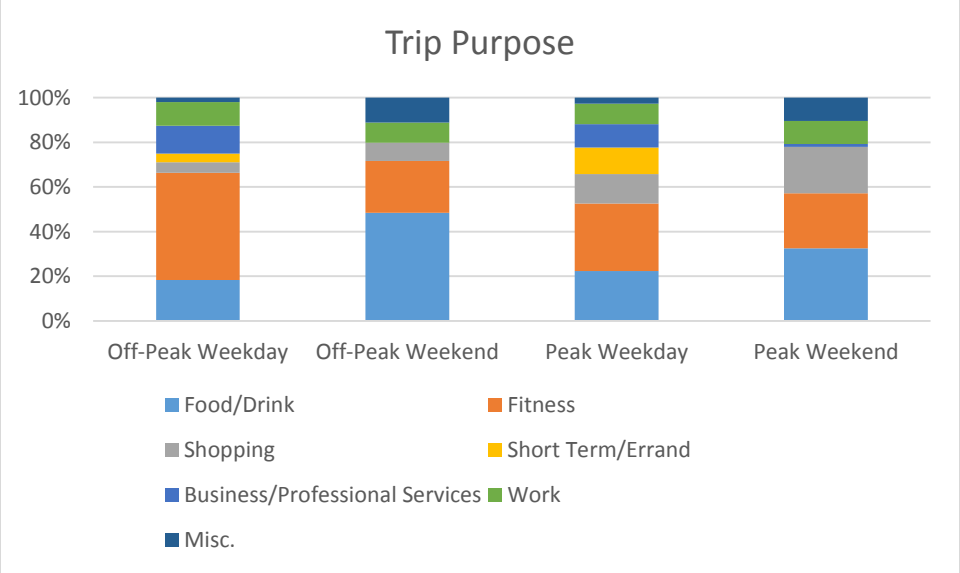


Figure 5-4: Trip purpose data for the Mendenhall St. & Black Ave. lot.

Table 5-4 shows a numerical breakdown of trip purpose data for all 4 study days with actual percentages shown for each trip purpose category.

Table 5-4: Numerical trip purpose data for the Mendenhall St. & Black Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Food/Drink	18%	48%	22%	32%
Fitness	48%	23%	30%	25%
Shopping	5%	8%	13%	21%
Short Term/Errand	4%	0%	12%	0%
Business/Professional Services	13%	0%	11%	1%
Work	11%	9%	9%	10%
Misc.	2%	11%	3%	10%

Figure 5-5 shows a distribution of driver residences for each study day. As expected, there were more out-of-state visitors during the peak time of year, although the vast majority of drivers lived in Bozeman. This is most likely because almost every person who visited this lot for a fitness-related activity lived in Bozeman.

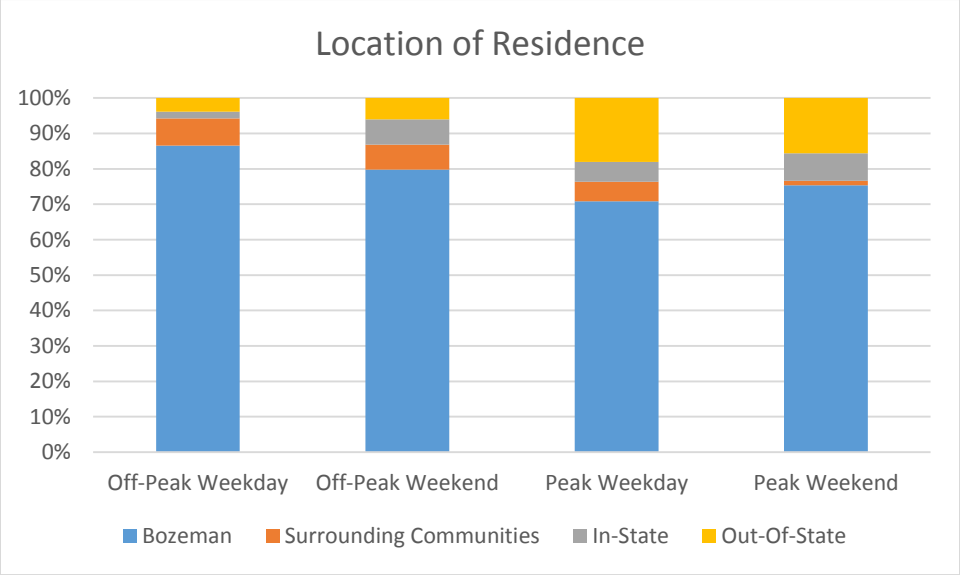


Figure 5-5: Location of residence data for the Mendenhall St. & Black Ave. lot.

Table 5-5: Location of residence data for the Mendenhall St. & Black Ave. lot. shows a numerical breakdown of residence data for all 4 study days. Although it shows the same data as the above figure, it is provided to show actual percentages for each residence category.

Table 5-5: Location of residence data for the Mendenhall St. & Black Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Bozeman	87%	80%	71%	75%
Surrounding Communities	8%	7%	6%	1%
In-State	2%	7%	6%	8%
Out-Of-State	4%	6%	18%	16%

Figure 5-6 shows a distribution of trip frequencies for each study day. Due to the large proportion of people who use this lot for fitness-related purposes, most visited on a weekly basis.

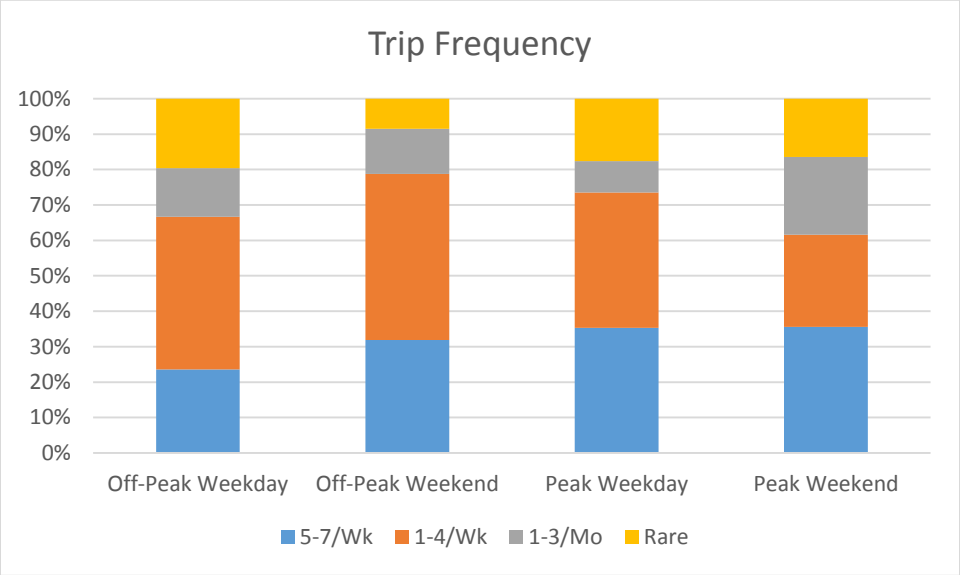


Figure 5-6: Trip frequency data for the Mendenhall St. & Black Ave. lot.

Table 5-6 shows a numerical breakdown of trip frequency data for all 4 study days with actual percentages for each trip frequency category.

Table 5-6: Numerical trip frequency data for the Mendenhall St. & Black Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
5-7/Wk	24%	32%	35%	36%
1-4/Wk	43%	47%	38%	26%
1-3/Mo	14%	13%	9%	22%
Rare	20%	9%	18%	16%

As can be seen in the above data, people who visited this lot did so primarily for fitness and food/drink activities, although every category is represented. The higher number of fitness trip purposes in this lot is likely the reason why the vast majority of its visitors were from Bozeman and visited on a weekly basis.

5.2.3. Babcock St. and Rouse Ave.

The Babcock St. and Rouse Ave. lot is close to many restaurants, bars, and shops. It is also the easternmost and the only city-owned parking lot south of main street. Results of the trip purpose survey indicate that drivers who parked in this lot did so primarily for food/drink activities. Drivers who parked in this lot with a misc. trip purpose did so for the reasons described at the beginning of this chapter. There were no unique misc. trip purposes.

Figure 5-7 shows the distribution of trip purposes for each day trip purpose data was collected. Since this lot is not within proximity to a gym, the fitness category was virtually nonexistent. Aside from fitness, each category was represented on at least one study day.

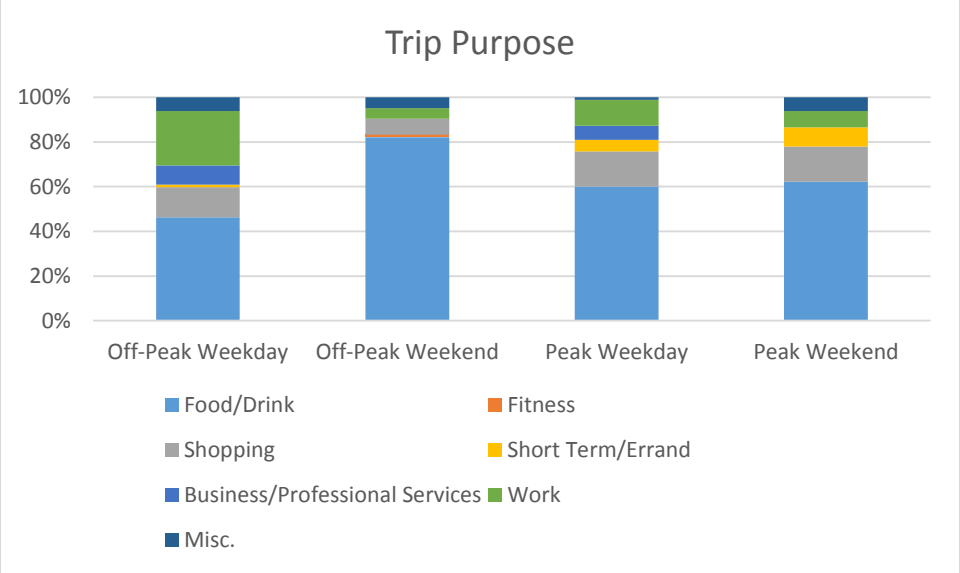


Figure 5-7: Trip purpose for the Babcock St. & Rouse Ave. lot.

Table 5-7 shows a numerical breakdown of trip purpose data for all 4 study days with actual percentages shown for each trip purpose category.

Table 5-7: Numerical trip purpose data for the Babcock St. & Rouse Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Food/Drink	46%	82%	60%	62%
Fitness	0%	1%	0%	0%
Shopping	13%	7%	16%	16%
Short Term/Errand	1%	0%	5%	9%
Business/Professional Services	9%	0%	6%	0%
Work	24%	5%	12%	7%
Misc.	6%	5%	1%	6%

Figure 5-8 shows a distribution of driver residences for each study day. As expected, there were many more out-of-state visitors during the peak time of year. This underscores Bozeman's popularity as a summer destination town.

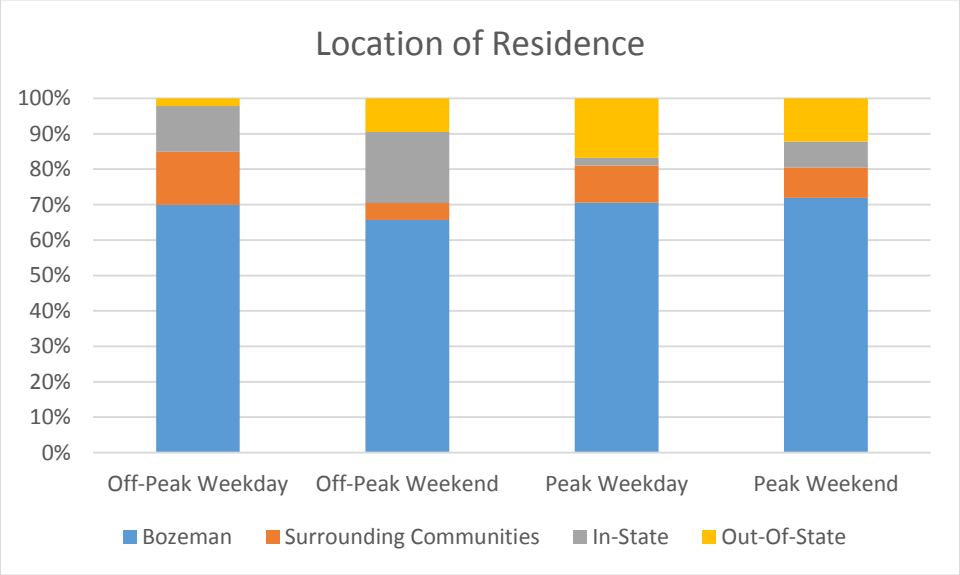


Figure 5-8: Location of residence for the Babcock St. & Rouse Ave. lot.

Table 5-8 shows a numerical breakdown of residence data for all 4 study days with actual percentages for each residence category.

Table 5-8: Location of residence data for the Babcock St. & Rouse Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
Bozeman	70%	66%	71%	72%
Surrounding Communities	15%	5%	11%	9%
In-State	13%	20%	2%	7%
Out-Of-State	2%	10%	17%	12%

Figure 5-9 shows a distribution of trip frequencies for each study day. The increased number of rare trip frequencies during the peak season can be attributed to the higher number of out-of-state visitors that only visit Bozeman once every year or so.

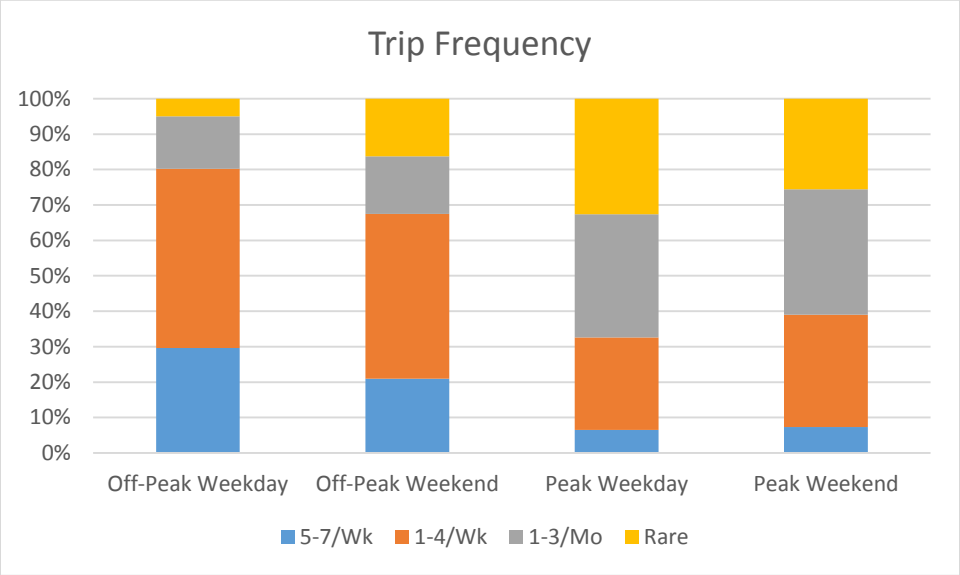


Figure 5-9: Trip frequency for the Babcock St. & Rouse Ave. lot.

Table 5-9 shows a numerical breakdown of trip frequency data for all 4 study days with actual percentages shown for each trip frequency category.

Table 5-9: Trip frequency data for the Babcock St. & Rouse Ave. lot.

	Off-Peak		Peak	
	Weekday	Weekend	Weekday	Weekend
5-7/Wk	30%	21%	7%	7%
1-4/Wk	51%	47%	26%	32%
1-3/Mo	15%	16%	35%	35%
Rare	5%	16%	33%	26%

The data clearly shows that most people who park in the Babcock St. and Rouse Ave. lot do so for food/drink purposes, although every trip purpose category except fitness is represented for at least one day. The data also indicates that there were a much higher proportion of people from out-of-state parking at the lot during the peak season.

5.3. Number of Occupants

During the peak data collection, the number of occupants arriving in each vehicle was also recorded. Table 5-10 shows the average number of vehicle occupants that parked in every vehicle for each lot and study day. The lower average number of occupants in the Mendenhall St. and Black Ave. Carnegie lot is most likely due to the higher number of people visiting for fitness activities.

Table 5-10: Average # of occupants per vehicle for each lot & study day.

	Weekday	Weekend
Mendenhall & Wilson	2	2
Mendenhall & Black	1.4	1.5
Babcock & Rouse	1.6	2

Table 5-11 shows a breakdown of the average number of occupants for every trip purpose. The trip purpose with the consistently lowest average number of passengers per vehicle was fitness. Food/drink and shopping were among the activities with the highest number of average occupants per vehicle.

Table 5-11: Average # of vehicle occupants by trip purpose.

		Food/ Drink	Fitness	Shop.	Short Term/Err.	Bus/Prof Services	Work	Misc.
Mendenhall & Wilson	Weekday	2.2	1.0	1.6	1.5	1.0	1.2	2.7
	Weekend	2.2	N/A	2.0	1.2	N/A	1.4	2.1
Mendenhall & Black	Weekday	1.9	1.0	2.1	1.7	1.3	1.0	1.5
	Weekend	1.9	1.0	2.1	N/A	1.0	1.1	1.6
Babcock & Rouse	Weekday	1.8	N/A	1.9	1.2	1.2	1.0	N/A
	Weekend	2.3	N/A	2.0	1.4	N/A	1.0	1.8

5.4. Dwell Time by Trip Purpose

Because every person who was interviewed for the trip purpose survey also had their dwell time recorded, the average dwell time for each trip purpose could be calculated. Table 5-12 presents this information for every parking lot and study day. Cells shaded in orange only had their averages calculated from 2-3 entries, so their value may not represent a realistic average for that trip purpose. Cells labeled "N/A" had zero entries or only one entry for that given trip purpose and study day.

Unsurprisingly, work trips had the highest average dwell time. Many vehicles observed parking in lots for work actually parked much longer, however their exit times were not recorded before the end of the study so their data was not included in the dwell time analysis. Fitness and food/drink also had fairly high average dwell times within every lot.

Table 5-12: Dwell time data by trip purpose for every lot.

			Food/ Drink	Fitness	Shop.	Short Term/ Err.	Bus/Prof Services	Work	Misc.
Mendenhall & Wilson	Off-Peak	Weekday	0:55	N/A	0:44	0:07	0:58	1:25	1:23
		Weekend	1:10	N/A	0:56	0:36	N/A	1:28	1:28
	Peak	Weekday	1:15	N/A	1:01	0:38	N/A	N/A	0:32
		Weekend	1:16	N/A	0:54	0:10	N/A	4:24	2:26
	Average		**1:09**	**N/A**	**0:54**	**0:22**	**0:58**	**2:26**	**1:27**
Mendenhall & Black	Off-Peak	Weekday	1:19	1:16	1:25	0:08	0:57	2:07	1:02
		Weekend	1:35	1:21	0:47	N/A	N/A	5:40	3:38
	Peak	Weekday	0:52	1:14	1:00	0:35	1:03	1:28	0:46
		Weekend	1:03	1:19	0:39	N/A	0:29	2:55	1:21
	Average		**1:12**	**1:17**	**0:58**	**0:21**	**0:50**	**3:02**	**1:42**
Babcock & Rouse	Off-Peak	Weekday	0:52	N/A	0:49	N/A	1:27	0:50	0:37
		Weekend	0:56	N/A	0:26	N/A	0:17	1:50	1:30
	Peak	Weekday	0:48	N/A	0:39	0:46	0:41	N/A	N/A
		Weekend	1:01	N/A	1:14	0:35	N/A	N/A	0:27
	Average		**0:54**	**N/A**	**0:47**	**0:40**	**0:48**	**1:20**	**0:51**

Chapter 6. Conclusions and Recommendations

This project has performed several different tasks examining parking in downtown Bozeman. It has included an update of inventory data for downtown Bozeman, an evaluation of occupancy rates at the block level for the entire study area, an analysis of dwell time at the three open city-owned parking lots, and a survey of visitors' trip purpose in those same lots. Based on the work completed during this project, several conclusions and recommendations have been drawn. These are discussed in the following sections.

6.1. Conclusions

The results of the inventory study indicate that there were a total of 5,878 parking spots within the downtown study area. Most of the blocks within the outlying parts of study area had a small number of parking spaces due to the often smaller size of the blocks and the high number of residences within these blocks, the parking spots of which were not included in the study. Most blocks within the core of the study area, bordering Main St., had between 100-200 spaces. Off-street parking within these blocks was exclusively private except for the three open city-owned parking lots. Expectedly, the block with the most parking was block 20, which contains the parking garage.

The results of the occupancy study performed indicate that most blocks within the core of the study area, and some blocks in the outlying areas, achieved a peak occupancy rate that was close, but still below its capacity. Although no block reached 100% occupancy, this was often due to private parking within a block that was restricted to most visitors to that block. Furthermore, many of the most popular lots, including all three city-owned lots, were often observed to reach capacity throughout the day. Most blocks followed a predictable occupancy pattern throughout the day, and weekday occupancy levels were higher than weekend levels for all but a few blocks.

Dwell time results indicated that vehicles remained parked for an average of 45 minutes to 1 hour 30 minutes depending on the lot. There was a noticeable difference in average dwell time between lots and between weekday and weekend observations. Furthermore, the average dwell time for each lot organized by trip purpose yielded additional parking trends that could be useful for future planning in the downtown area.

Trip purpose results indicate that although people visit downtown for a wide variety of reasons, the most popular trip purpose in every parking lot was food/drink. Shopping and fitness were also popular options for people parking downtown. Although most people who park downtown live in Bozeman and visit the downtown area on a weekly basis, there was a noticeable increase during the peak season in out-of-state visitors who only visited Bozeman, and thus the downtown area, once or twice a year. Given Bozeman's increasing popularity as a summer destination, the proportion of out-of-state visitors is likely to increase into the future.

6.2. Recommendations

Based on the work completed, the project team has developed a series of recommendations for the Parking Commission to consider. Note that these recommendations reflect the views of the researchers and are presented for consideration and discussion purposes only.

Throughout the course of inventory data collection, student data collectors had difficulty determining the number of on-street spots on any particular block side. In addition, the gaps between vehicles parked on-street varied widely. Excessive gaps between vehicles likely reduced the number of vehicles that could legally park on that street. Adding pavement markings to indicate legal on-street parking would allow an orderly use of this parking resource and likely increase its capacity.

The results of the occupancy study performed suggest that the city possesses an adequate number of publicly-owned stalls. Although, on average, the city does have enough parking spaces throughout the downtown area to meet demand, some lots and streets were observed to reach capacity at several points throughout the day which forced some drivers to find

alternative areas to park. The inability to accommodate a handful of vehicles throughout the day does not necessarily justify adding costly parking facilities. This assessment is supported by the fact that the occupancy rates at the block level were well below capacity for the vast majority of blocks in the study area. However, these existing parking facilities should be monitored closely as future developments occur to ensure that excessive demand doesn't become significantly prohibitive to people attempting to visit the downtown area.

As parking demand increases, there are a few options that could help reduce demand in high-density areas without adding new parking facilities. Measures could be taken to make better strategic use of current parking assets by working with local businesses to make their private parking available to visitors outside that businesses' peak visiting times. This would be especially useful during the evening dinner rush when most professional businesses are closed. Also, providing incentives for using the parking garage, which was never observed to be more than 2/3 full, could help reduce demand in the surrounding parking facilities. Ideas include extending the free parking time limit to a duration longer than the nearby public parking lots or by implementing a new metering system within the garage that allows drivers to park their cars faster than the current system. Newer metering technologies utilize License Plate Recognition (LPR) to record when a vehicle enters a parking facility. This would allow drivers to quickly enter the parking garage without having to stop to collect a ticket, reducing the time required to park and removing queues that currently form if multiple vehicles are attempting to enter the garage at the same time.

Another key option to help reduce parking demand is to improve the alternative transportation options to the downtown area. Better biking facilities could be developed to encourage people to bike downtown in pleasant weather. Better access to public transportation into the downtown area could also help reduce parking demand. Increased investment into the Streamline bus system could help add more bus lines, making the bus a viable option to a greater number of residents. A park-and-ride system could also be developed, which could especially reduce the utilization of parking facilities by people who work downtown.

When determining improvements to downtown parking facilities, public perception should be another crucial factor to consider. The increase in traffic and parking demand within the downtown area has frustrated many local residents, particularly older residents who vividly remember when parking demand within the downtown area was significantly lower. Many visitors voiced their displeasure with the state of downtown parking to student data collectors during the dwell time and trip purpose studies. A better system to allow residents to voice parking feedback could help the commission determine the public's perception of the state of parking in the downtown area. Potential solutions include periodic parking feedback surveys of downtown visitors performed by the city or a website that visitors could visit to give feedback, perhaps accessible from the information kiosks located downtown.

As part of this work, an inventory spreadsheet was generated. This spreadsheet, presented as Table 2-1, allows parking resources to be recorded and organized based on various characteristics. If requested, an excel copy of this spreadsheet can be provided to the parking commission and the city's parking division. This spreadsheet can be easily updated as parking facilities are added or removed in the future, allowing the city to have an up-to-date database of all parking in the downtown area.

REFERENCES

1. LMN Architects et al. (2009). Downtown Bozeman Improvement Plan, Available at: https://s3.us-west-2.amazonaws.com/dba-2021/Resource-PDFs/DBIP_Final_12-14-09_SM.pdf. Accessed on 10/30/2017.

2. Rick Williams Consulting (2016). Downtown Strategic Parking Management Plan. Available at: https://www.bozeman.net/Home/ShowDocument?id=1762. Accessed on 10/30/2017.

Appendix A. Data Collection Sheets

To complete all the studies within this report, the decision was made to only use paper for data collection instead of electronic devices such as phones, tablets, etc. which could have proved unreliable. Because of this, data collection sheets had to be generated for every field study performed. This appendix shows example data sheets used in the field.

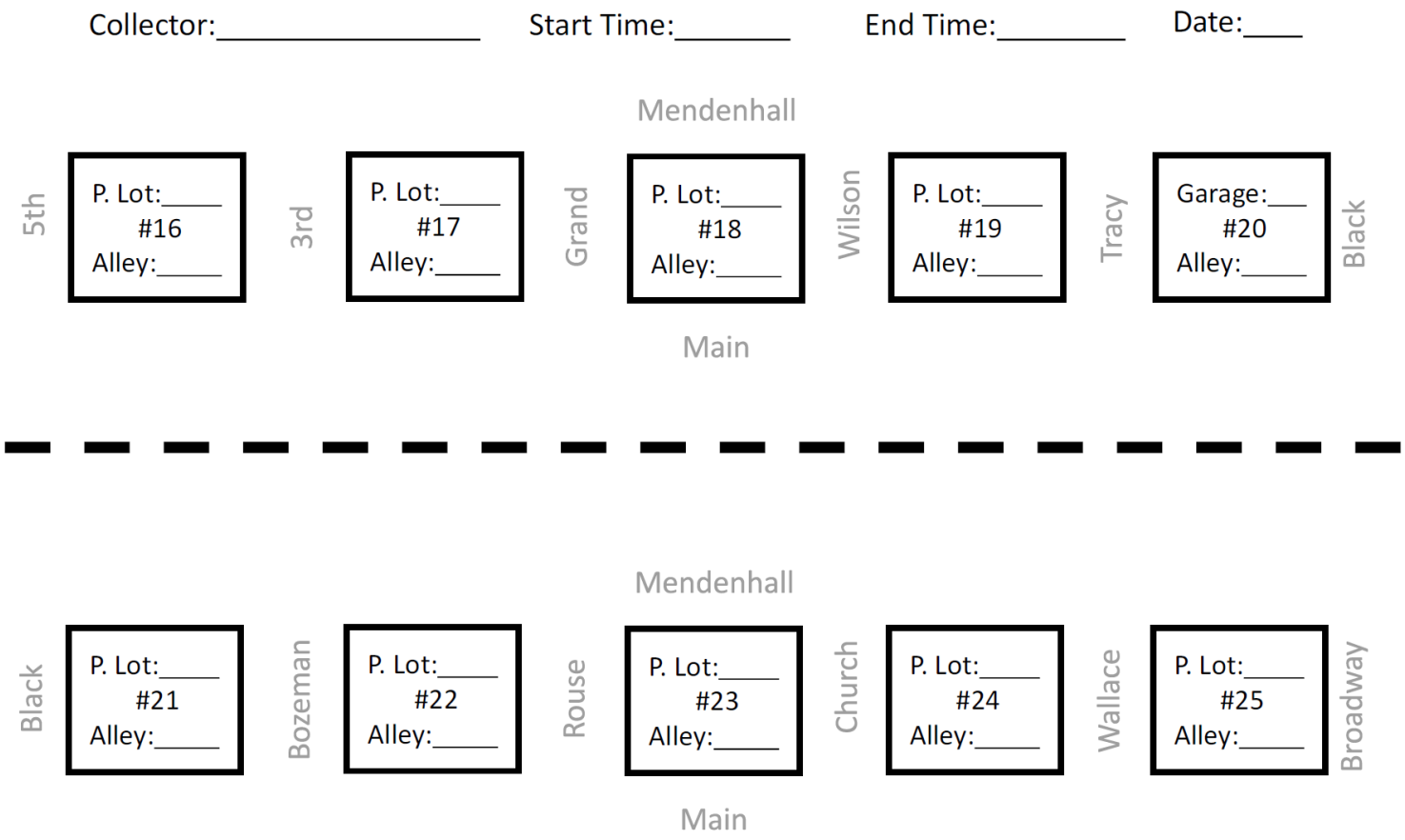
Inventory

Below is an example inventory data collection sheet. Four of these sheets were generated; one for each of the four zones detailed in 2.2.4.

Type				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
On-Street	Public	Unlimited	N															
			S															
			E															
			W															
			♿															
		Time Restricted (2 Hr)	N															
			S															
			E															
			W															
			♿															
		Time Restricted (20 Min)																
		Time Restricted (15 Min)																
		Loading Zone																
Off-Street	Public	Parking Garage																
		Unlimited	♿															
		Time Restricted	♿															
		Restricted Use	♿															
	Private/Business	Parking Garage																
		Unlimited	♿															
			Permit															
			Loading															
		Time Restricted																
Alley	Public	Restricted Use	♿															
	Private/Business	Unlimited	♿															
			Permit															
			Loading															
Total																		

Occupancy

Below is an example of an occupancy data collection sheet used. This particular sheet is for the zone B. One of these sheets was used for each hour of data collection. The off-street parking was recorded inside each square, and the on-street parking was written along each side of each square.



Dwell Time/Trip Purpose

Below is an example data collection used for the dwell time and trip purpose study. A student data collector would fill out about 5 of these sheets for every study day. The description and plate number fields were only used to aid in identifying the vehicles again as they departed from a lot. That information was not inputted into excel and exists only on the physial copies of the data sheets.

Bozeman Parking Study

Lot		Date	
Collector		Type (Pay, Permit, etc.)	
Start Time		End Time	

Description	Plate #	# P's	Enter Time	Exit Time	Purpose for Trip	Origin	Frequency of Trip

Appendix B. Occupancy Tables by Parking Type

Included in this appendix are tables showing the occupancy level for each block every hour by parking type (i.e. on-street, off-street).

Total Occupancy Tables

| | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | 17 | | 18 | | 19 | | 20 | | 21 | | 22 | | 23 | | 24 | | 25 | | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | | 32 | | 33 | | 34 | | 35 | | 36 | | 37 | | 38 | | 39 | | 40 | | 41 | | 42 | | 43 | | 44 | | 45 | | 46 | | 47 | | 48 | | 49 | | 50 | | 51 | | 52 | |
|---|---|---

Off-Street Occupancy Tables

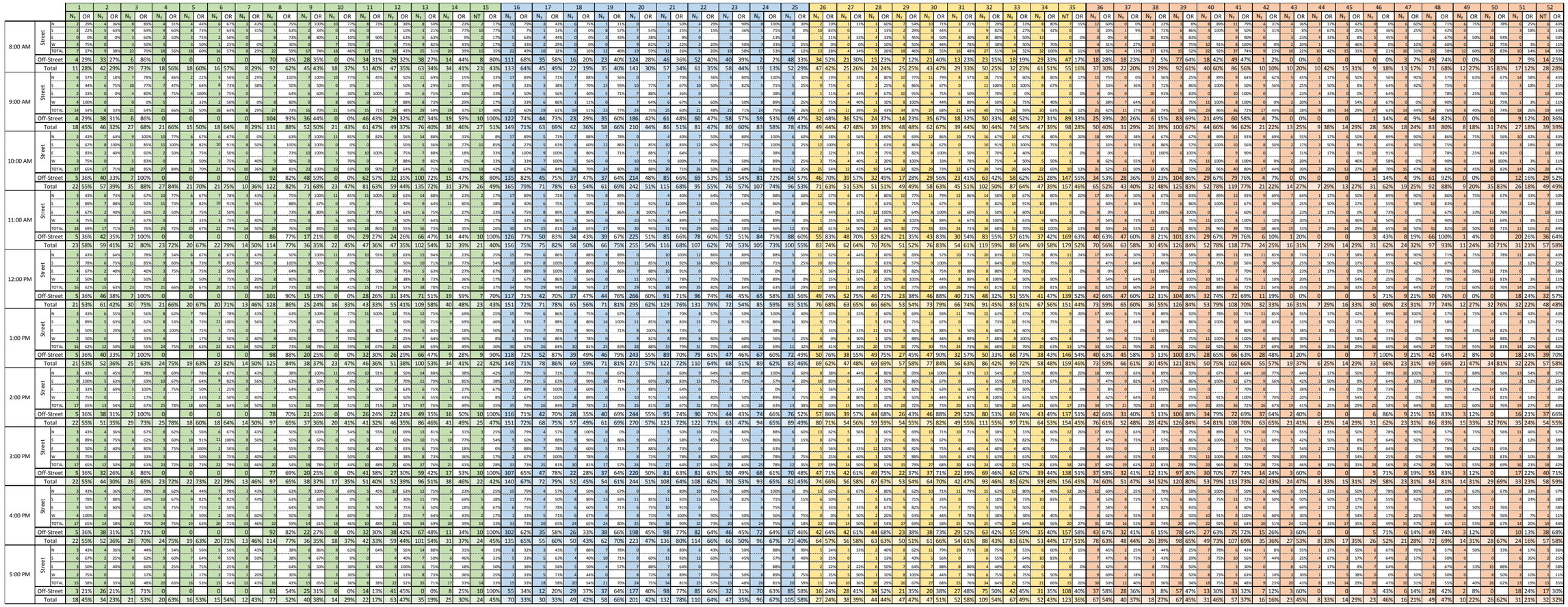
| | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | 17 | | 18 | | 19 | | 20 | | 21 | | 22 | | 23 | | 24 | | 25 | | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | | 32 | | 33 | | 34 | | 35 | | 36 | | 37 | | 38 | | 39 | | 40 | | 41 | | 42 | | 43 | | 44 | | 45 | | 46 | | 47 | | 48 | | 49 | | 50 | | 51 | | 52 | |
|---|---|---

Appendix C. Complete Occupancy Tables

This appendix will include the full-sized occupancy tables for each occupancy study performed. Although less functional, these tables show the occupancy level and actual number of vehicles parked down to the block side. This appendix is included if detailed analysis is needed for a particular block for planning purposes.

Off-Peak Weekday Study

This study was performed on Wednesday, April 26th, 2017.

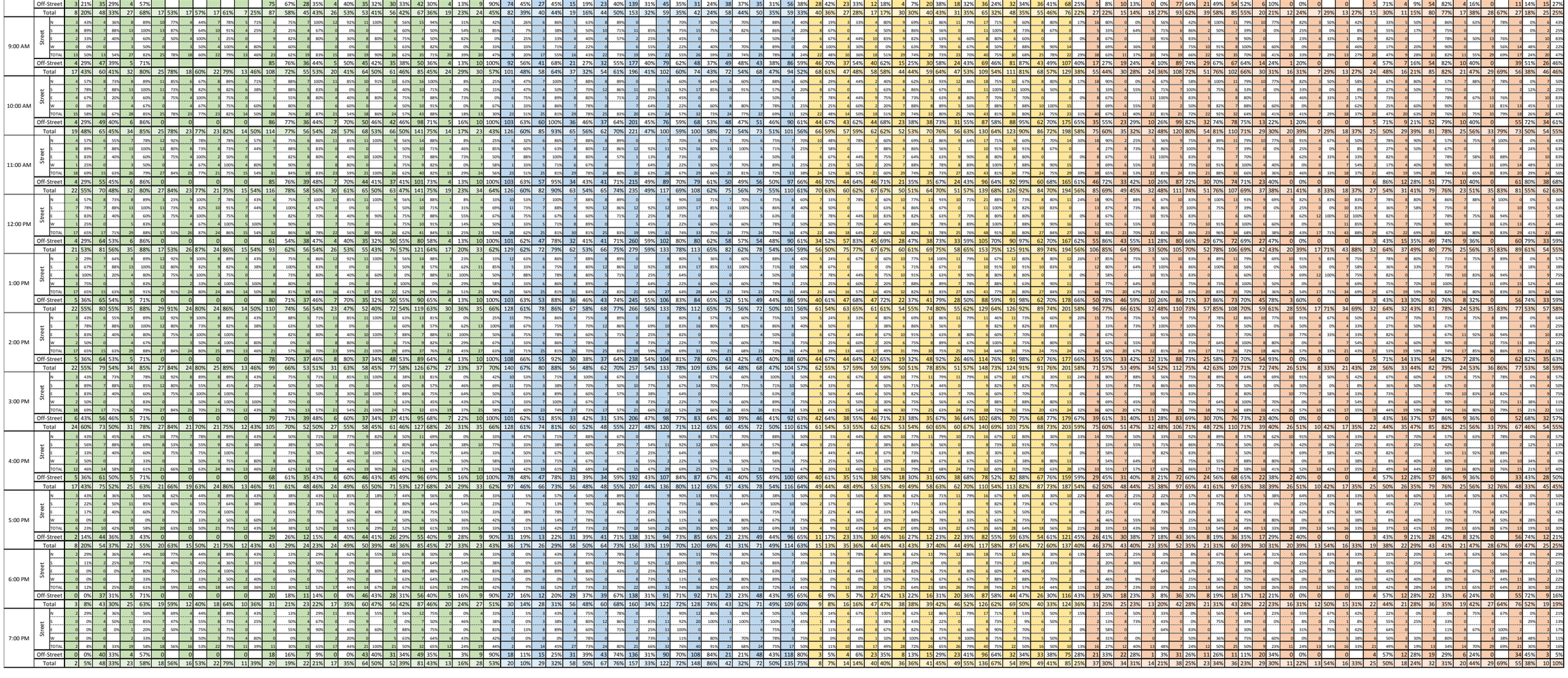


Off-Peak Weekend Study

This study was performed on Saturday, July 29th, 2017.

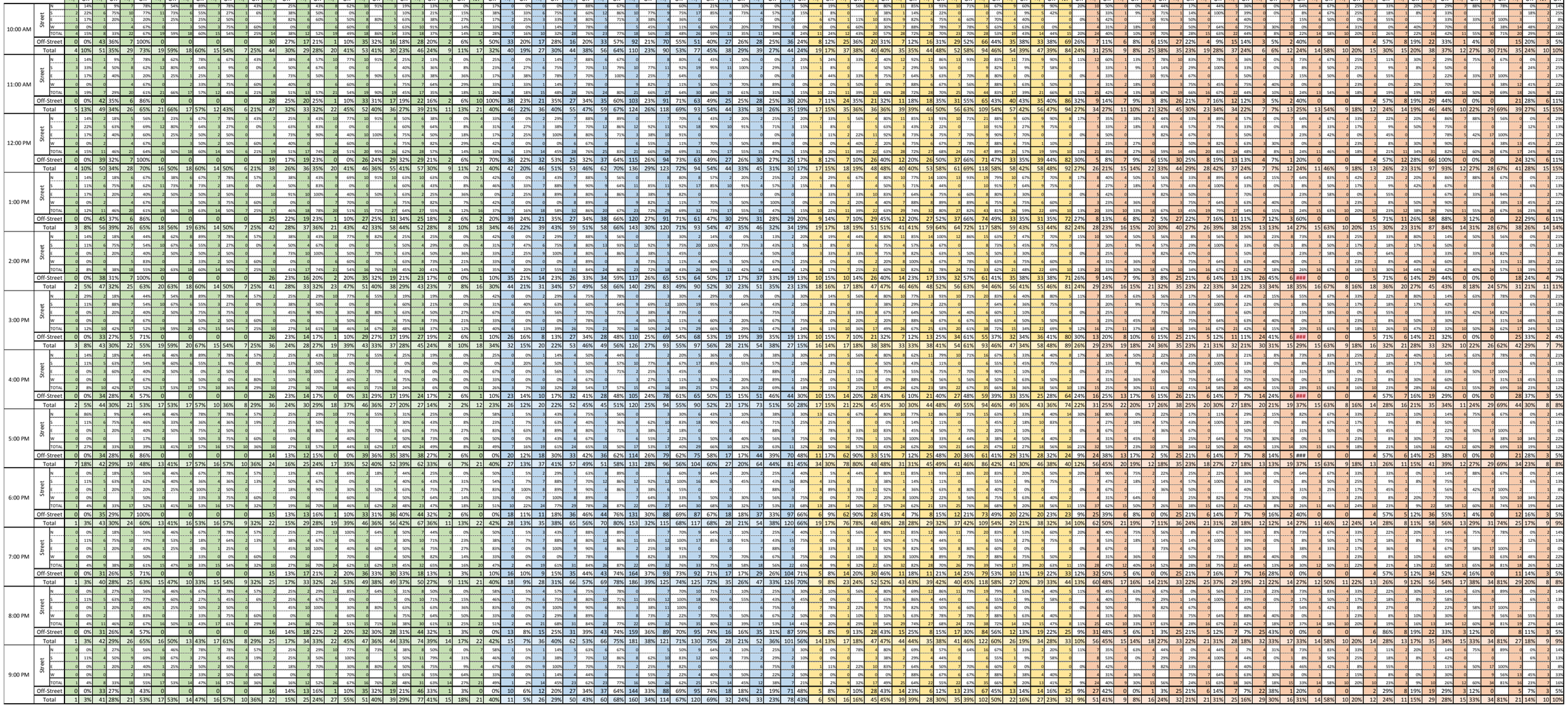
Peak Weekday Study

This study was performed on Wednesday, July 12th, 2017.



Peak Weekend Study

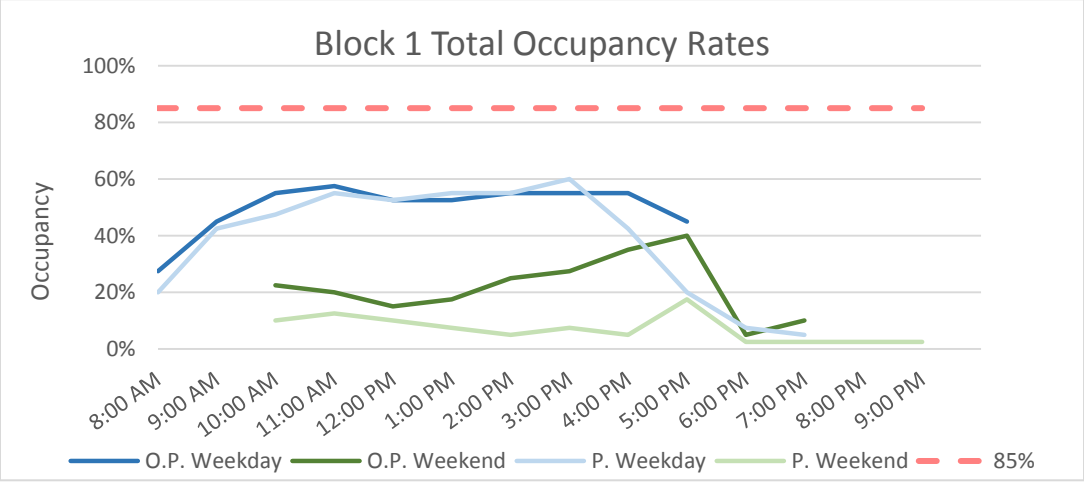
This study was performed on Saturday, July 15th, 2017.



Appendix D. Full Block-Level Occupancy Graphs

This appendix will include all the graphs showing block-level occupancy rates that were not included in Chapter 3. These are provided to allow detailed analysis and comparison for every block where occupancy rates were recorded.

Block 1



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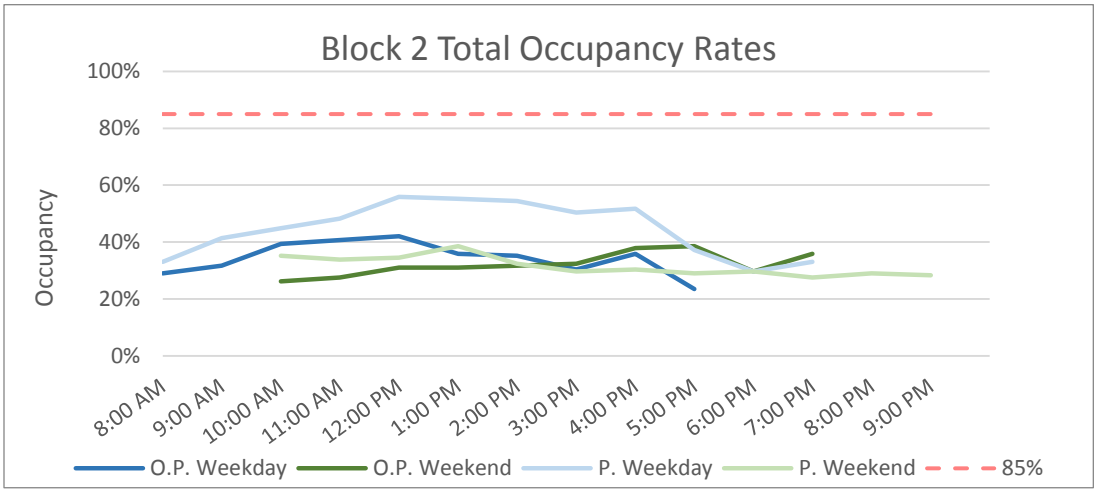

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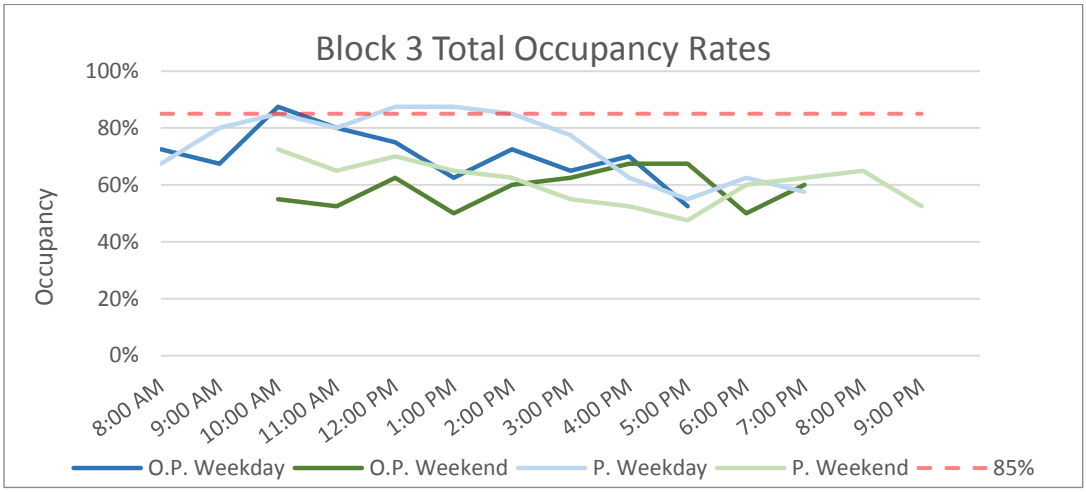

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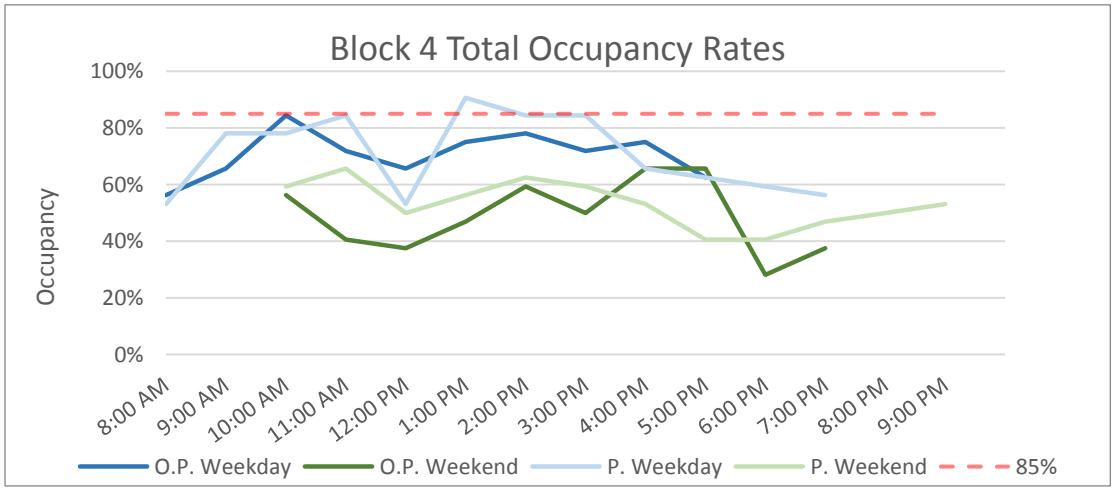

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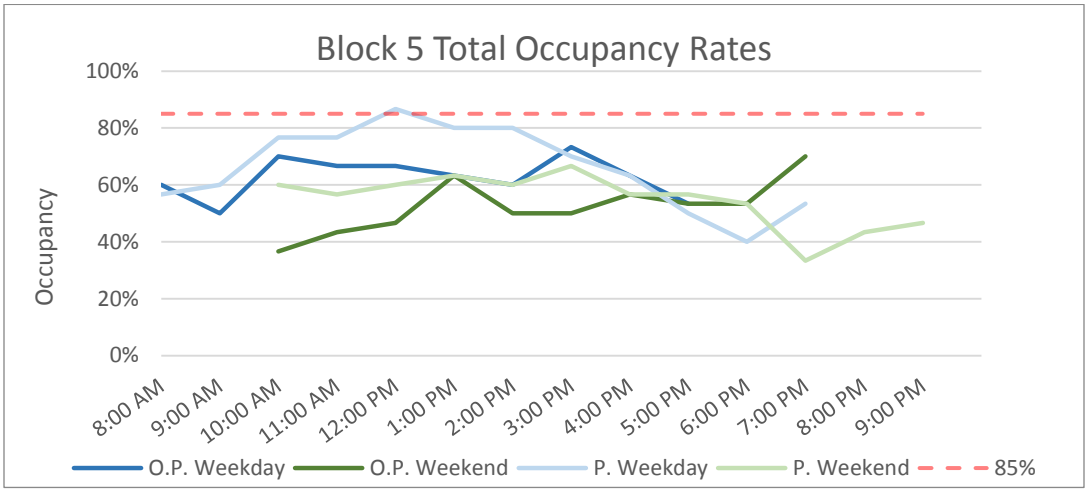

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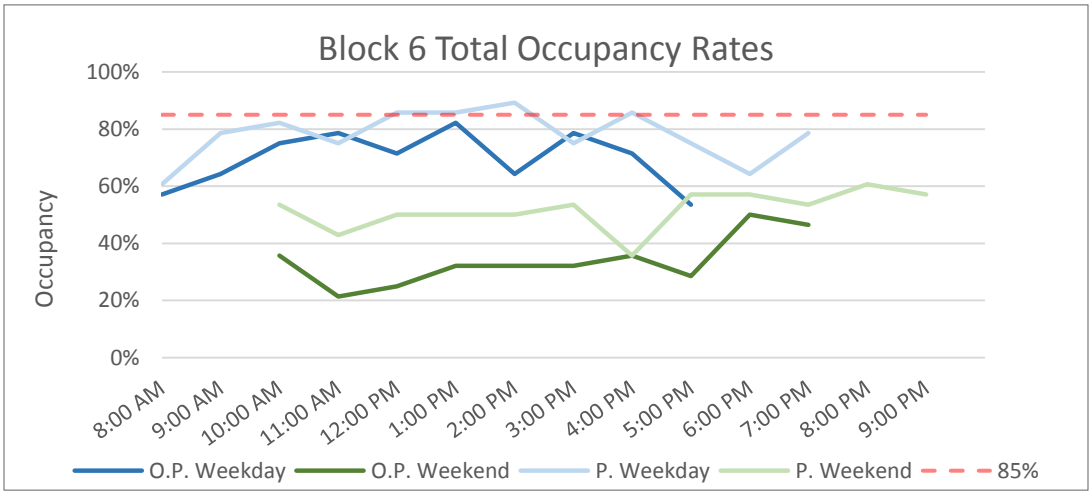

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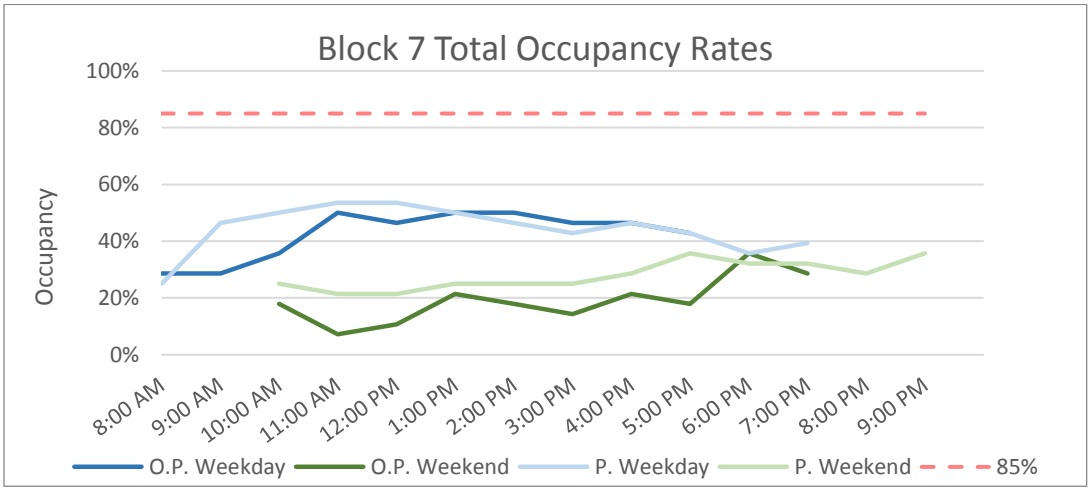

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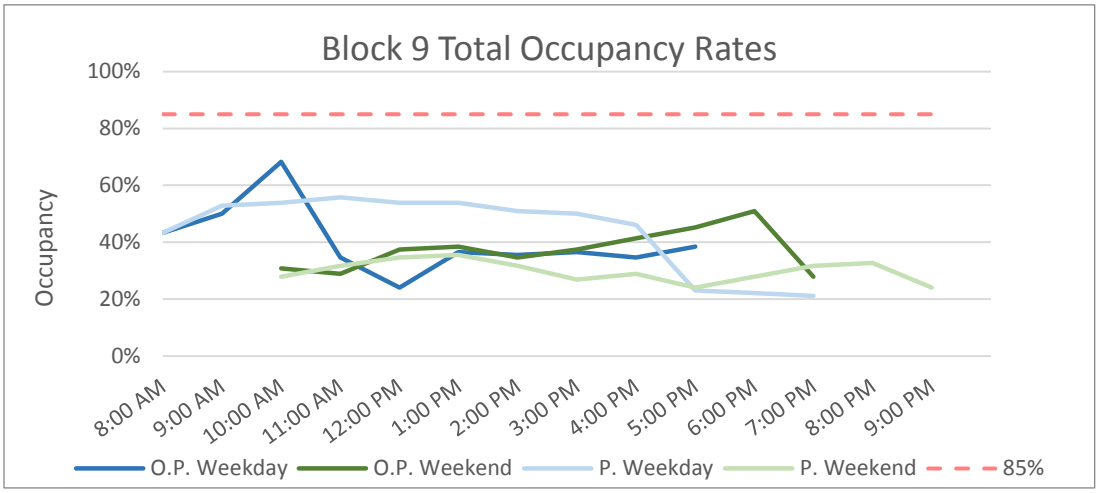

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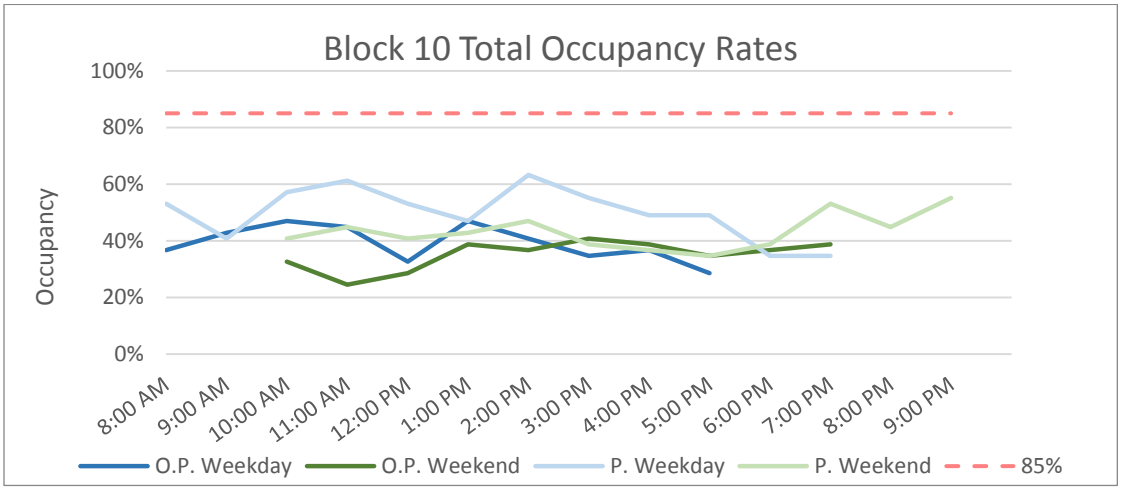

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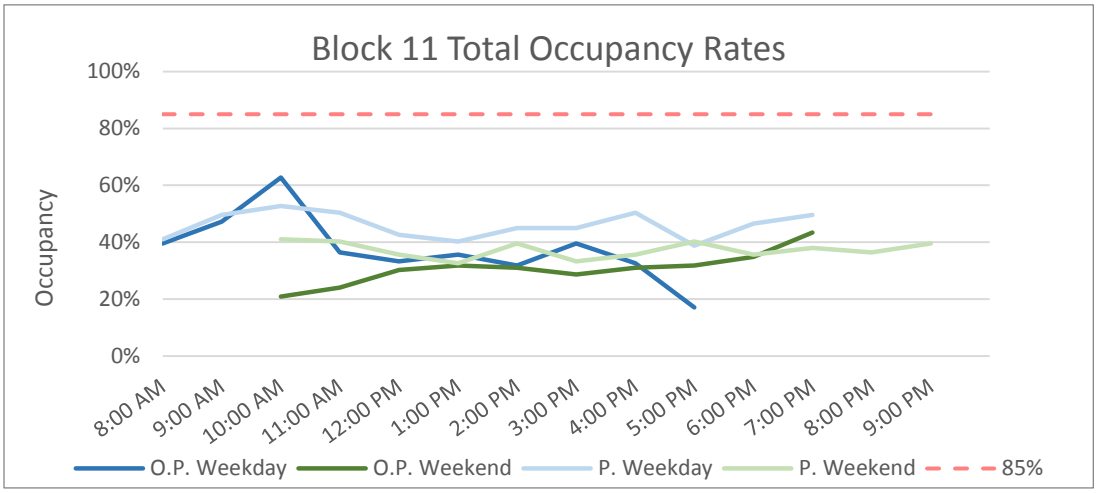
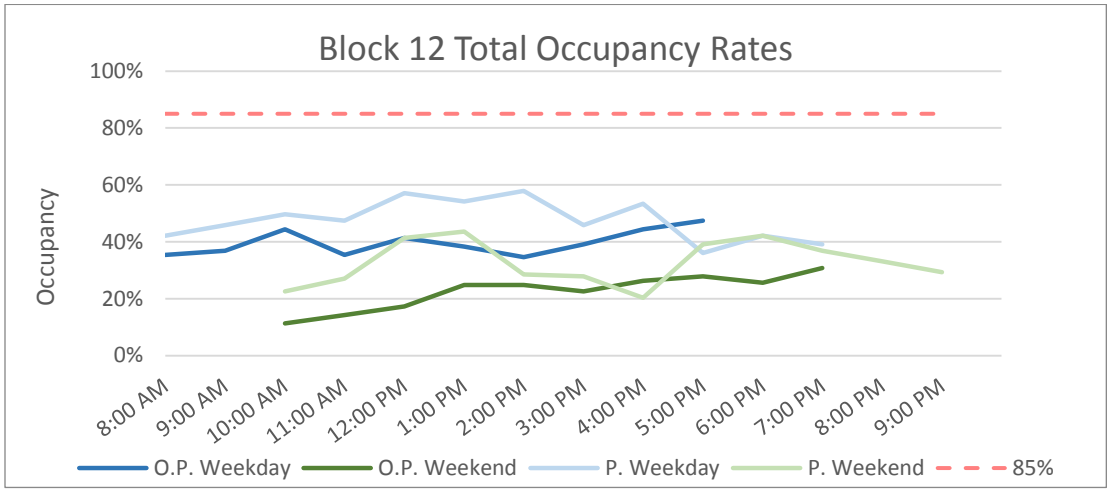
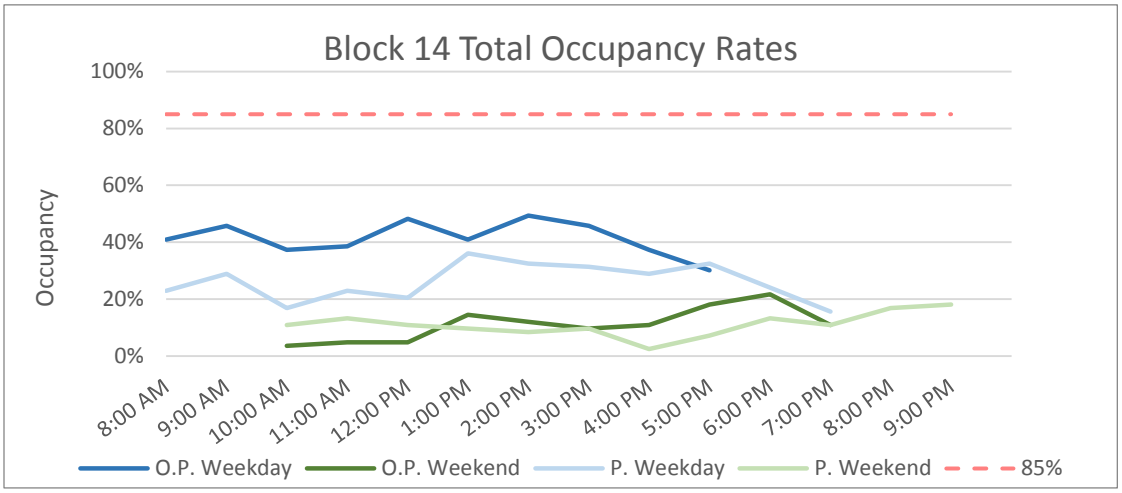


Block 12



Block 14



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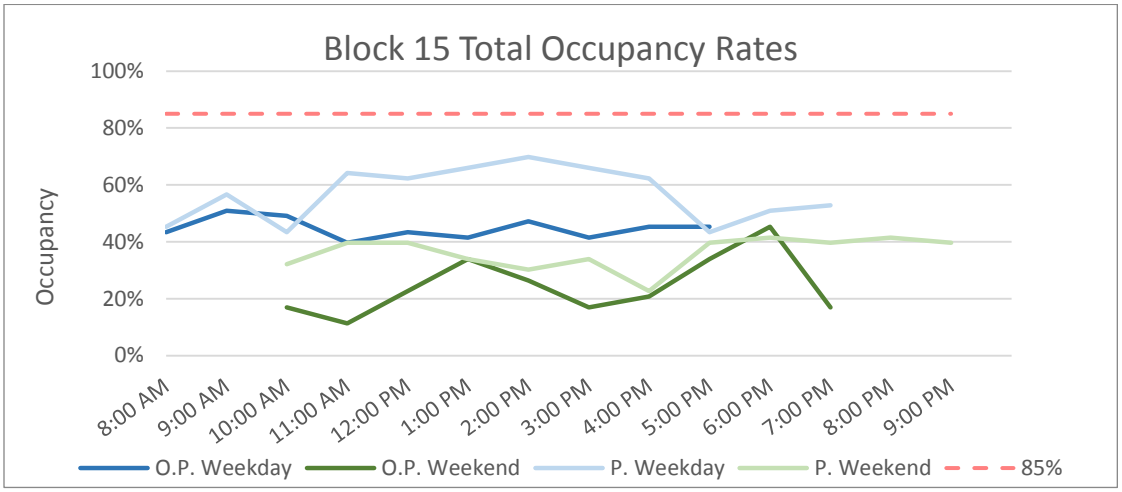

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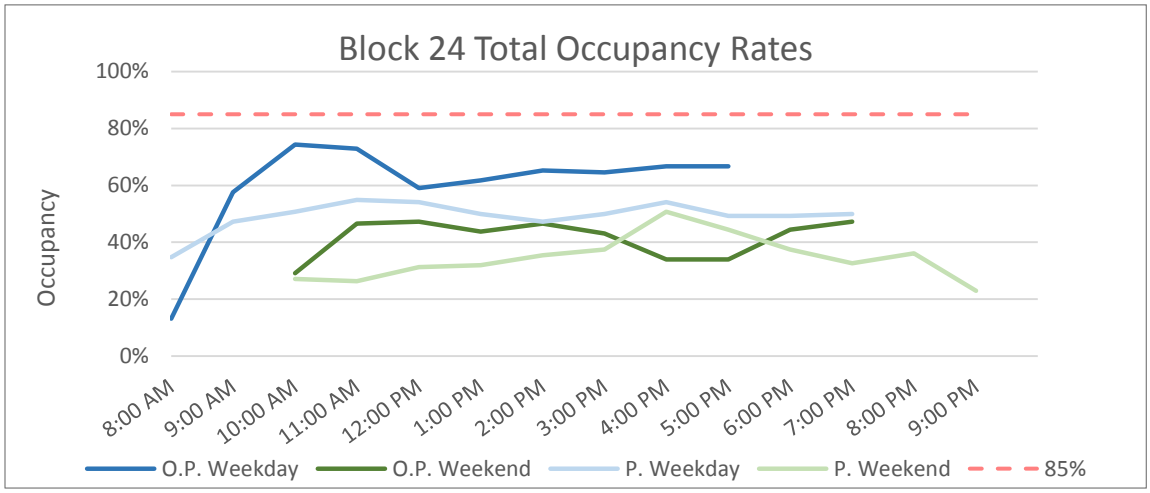

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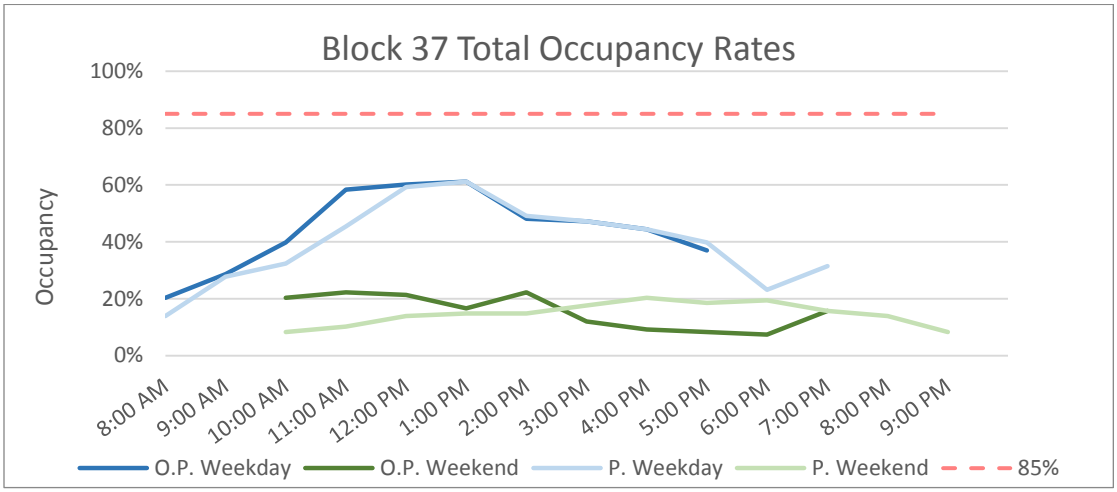

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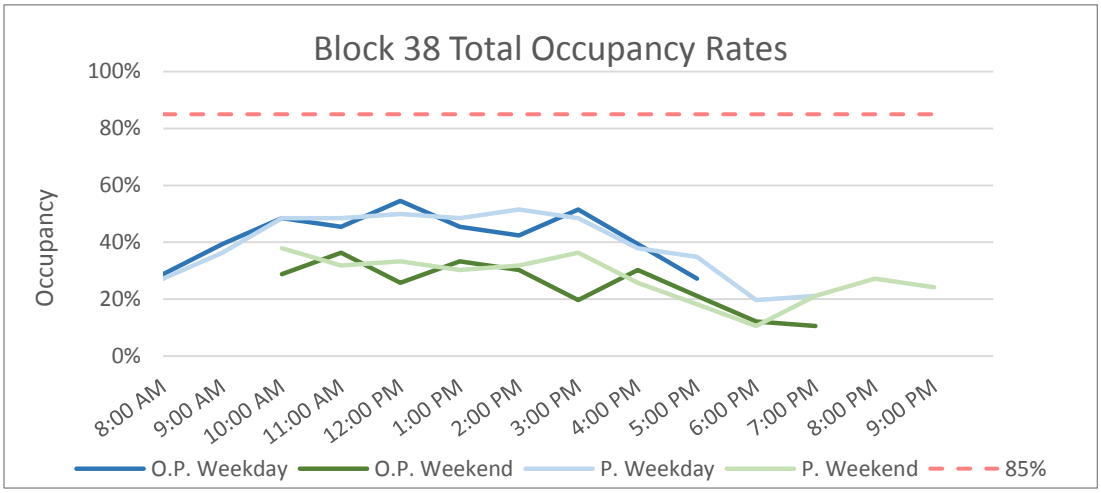

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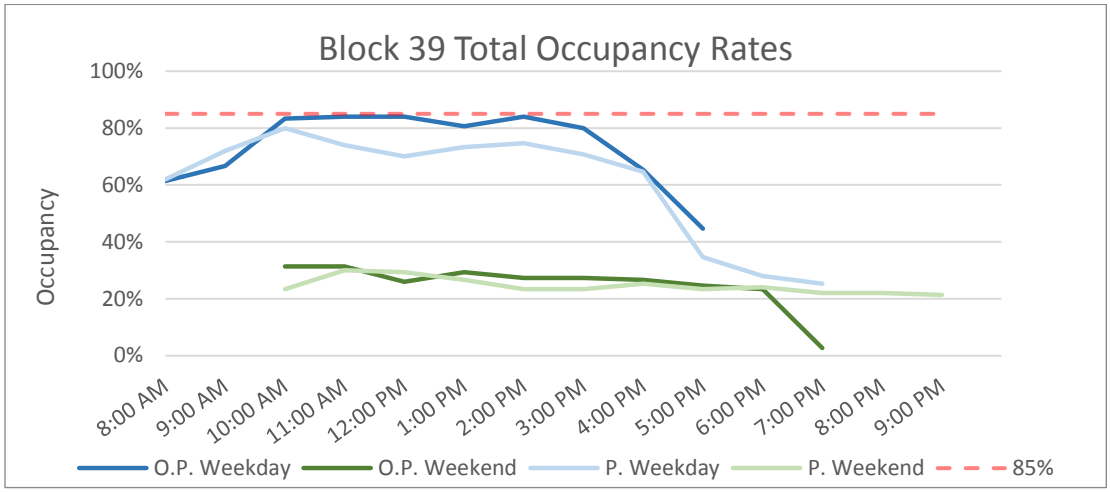

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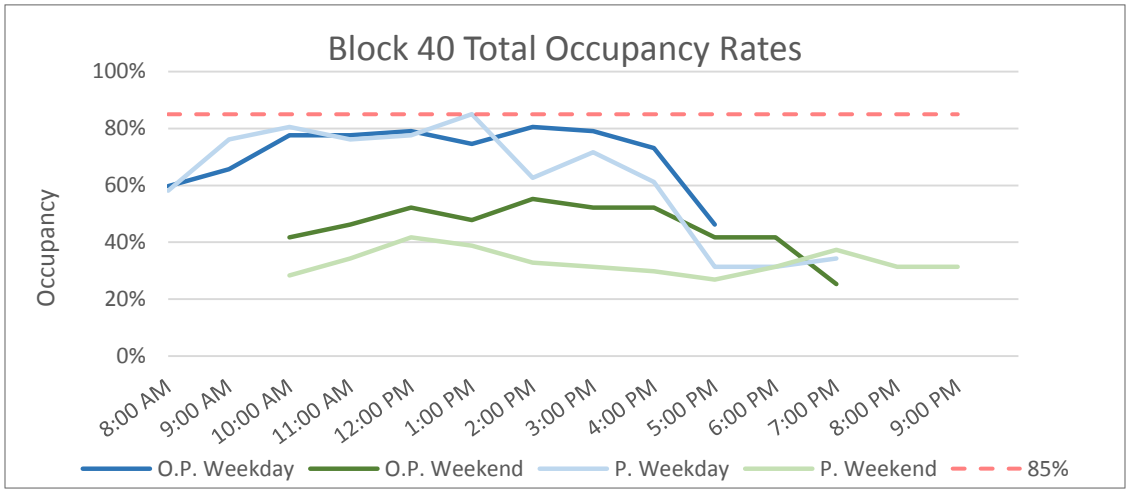

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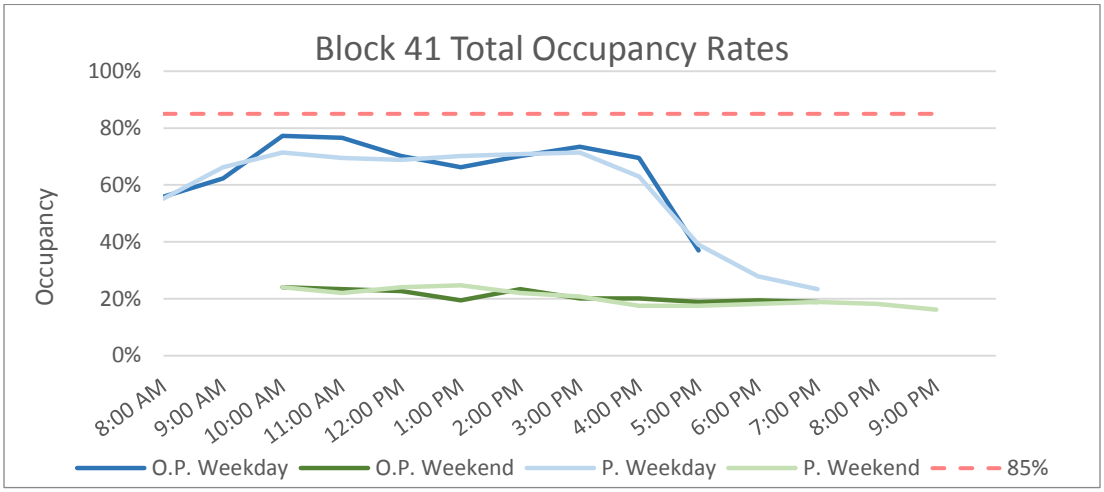

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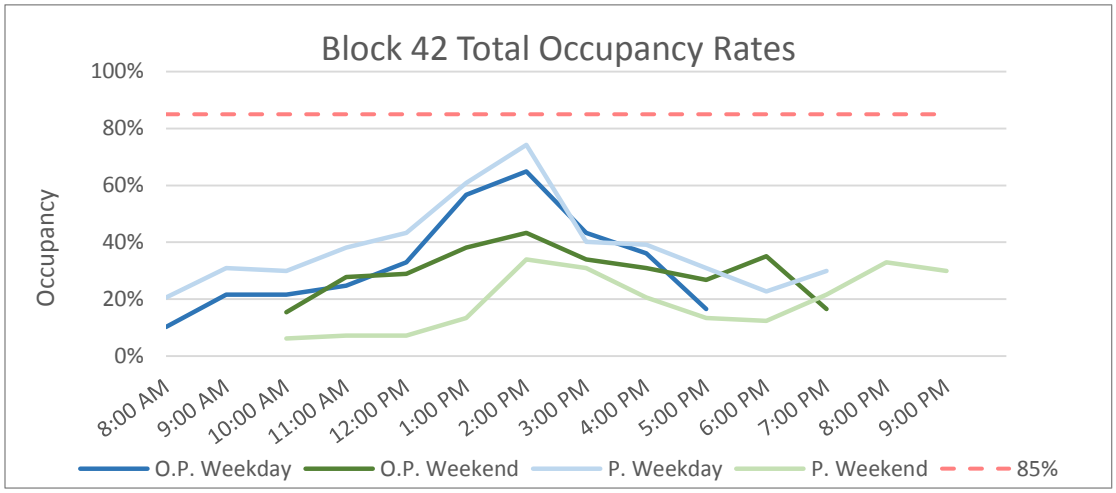

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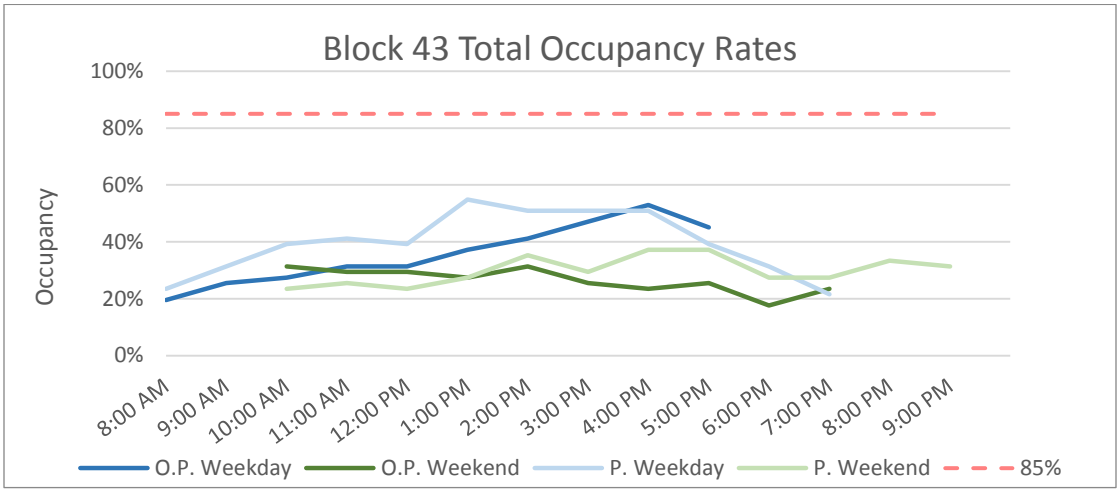

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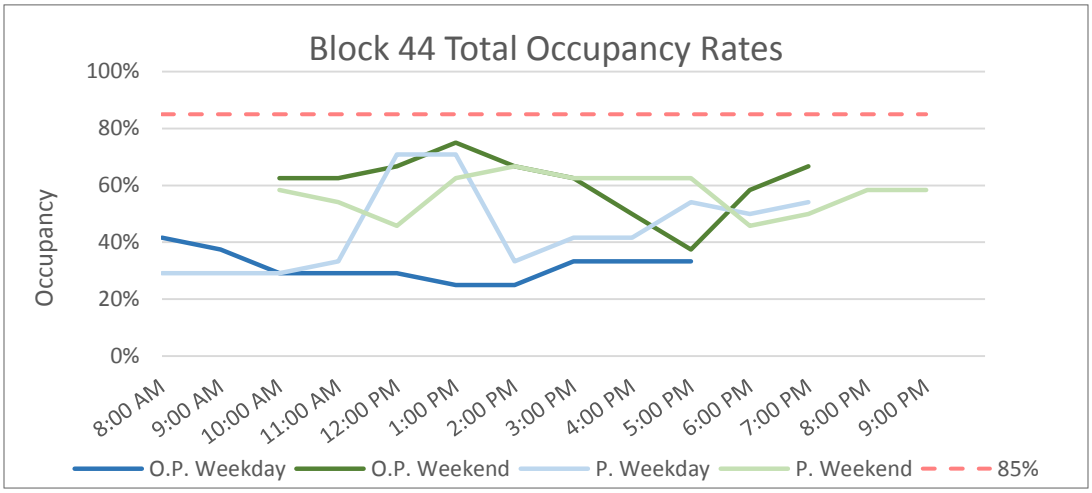

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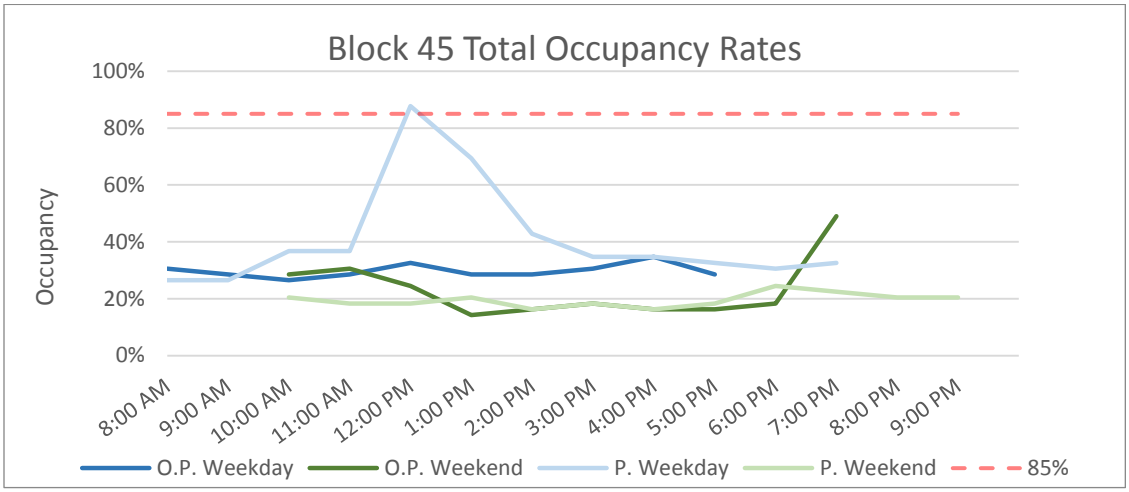

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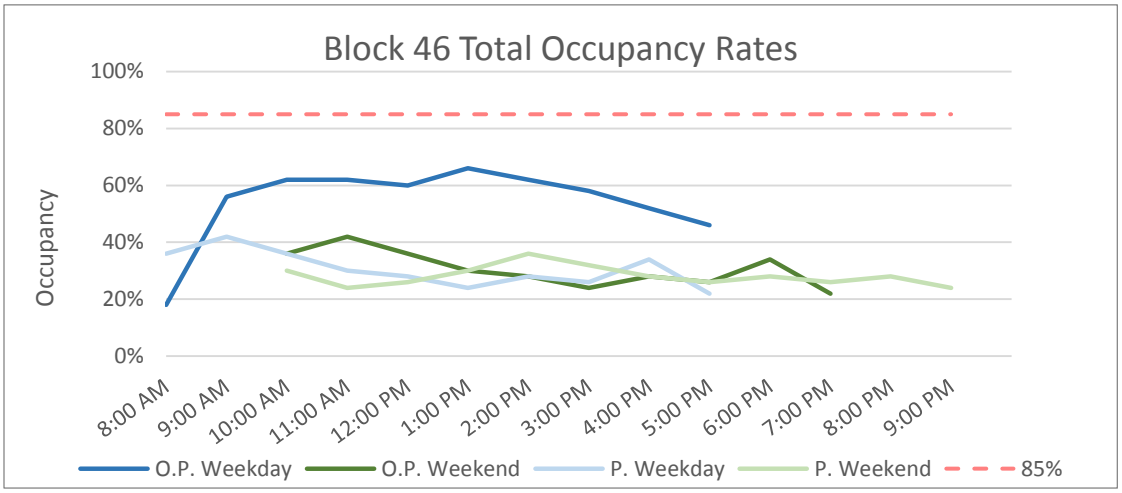

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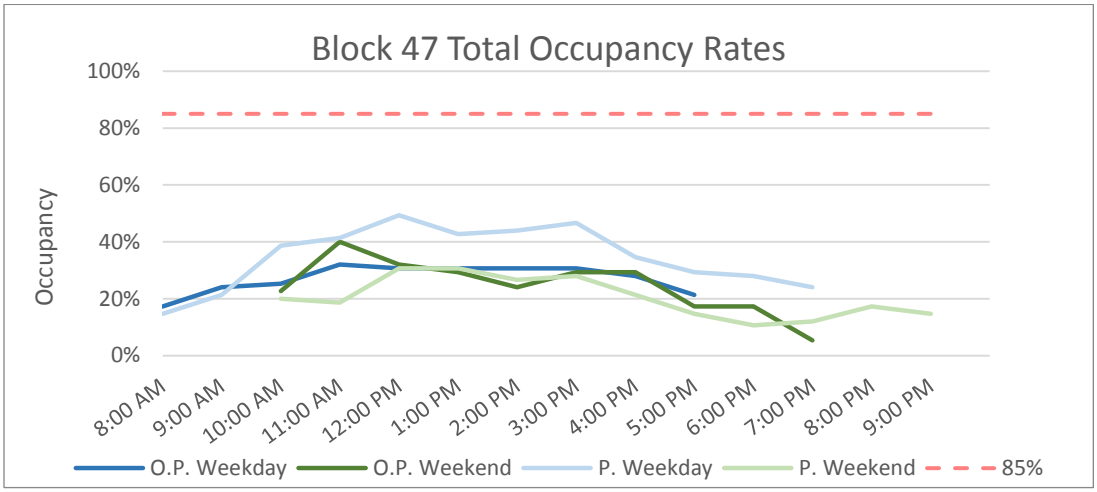

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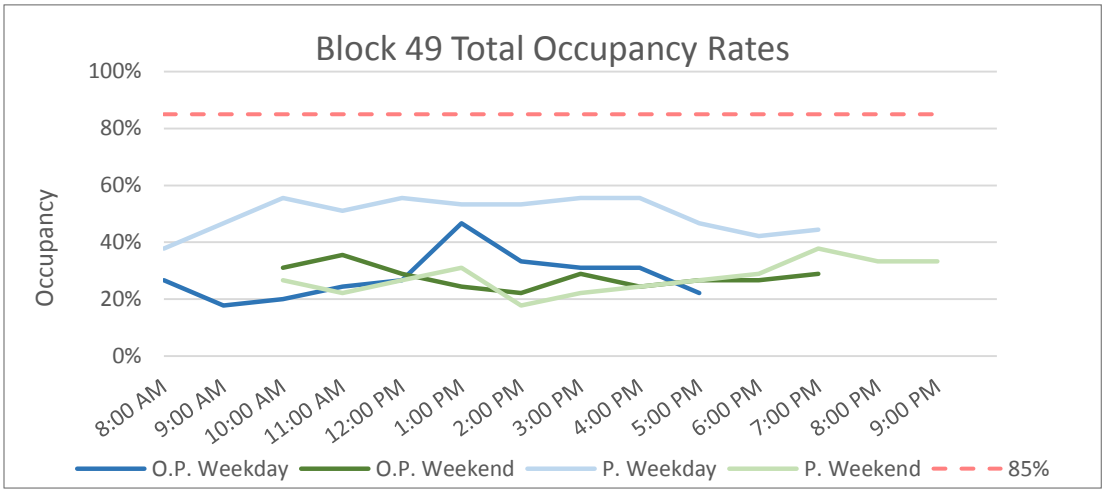

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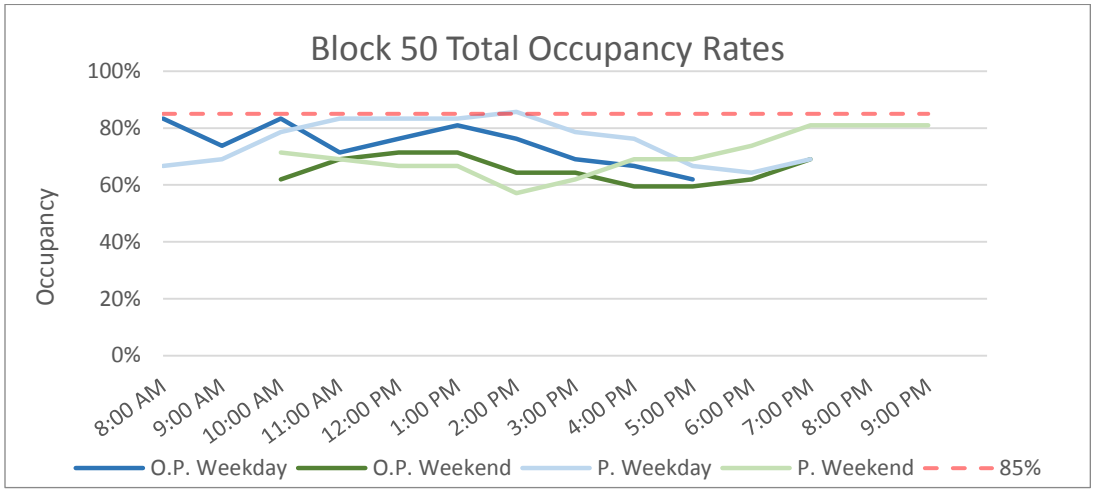

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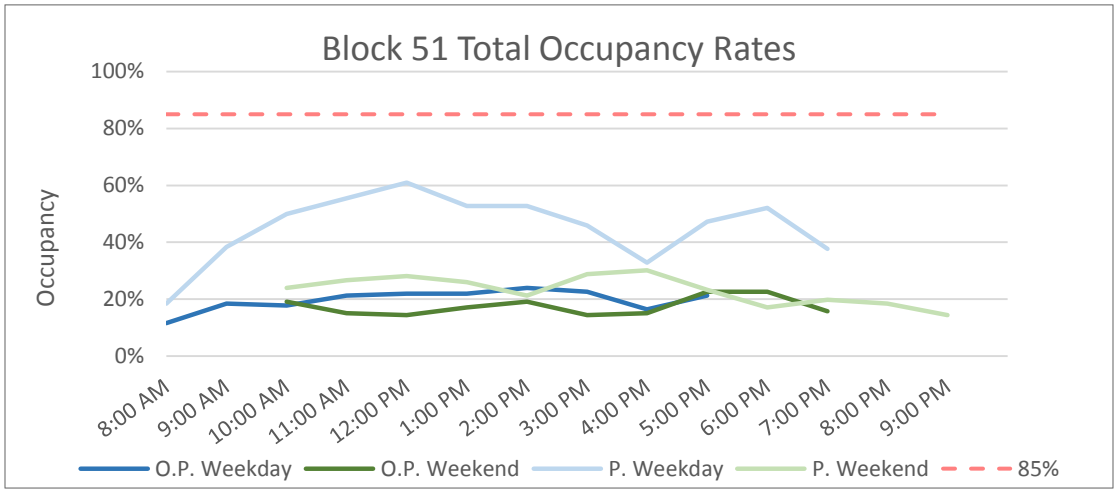

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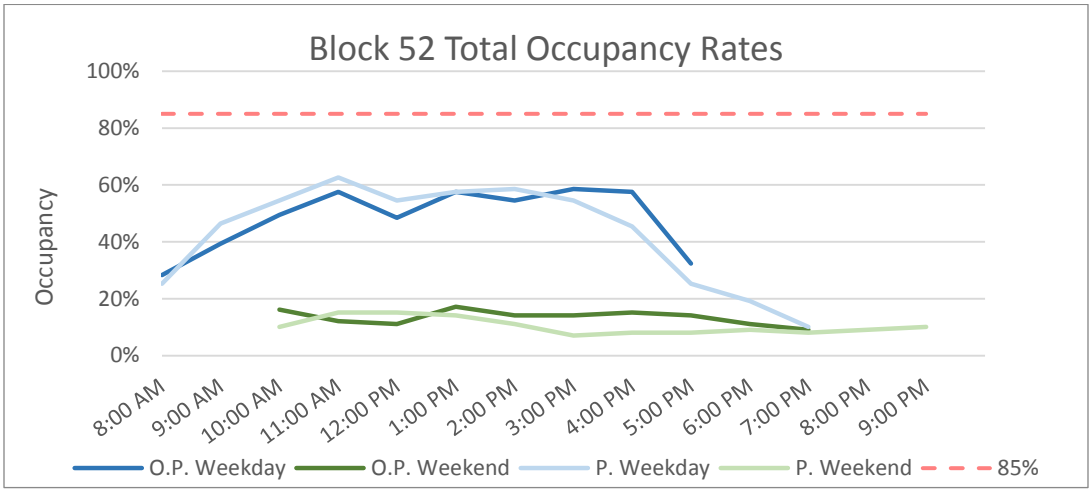
Block 52 Total Occupancy Rates
Occupancy
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40%
20%
0%
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9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
O.P. Weekday
O.P. Weekend
P. Weekday
P. Weekend
85%