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MEMORANDUM

Date: May 14, 2014

To: Planning Commission
Houghton Community Council

From: Jon Regala, Senior Planner
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Subject: Zoning Code Amendments to Multi-Family Parking Requirements
File No. CAM13-02032

I. RECOMMENDATION

The Planning Commission should conduct a joint study session with the Houghton Community Council to review, discuss, and provide direction on multi-family parking requirements for consideration at a future study session.

II. BACKGROUND

A. King County - Right Size Parking (RSP). As part of the adopted 2013 – 2014 Planning Work Program, the City is considering amendments for multi-family parking requirements. As a project resource, King County, with their Right Size Parking project has completed one of the most comprehensive surveys of multi-family parking utilization available. The data includes a survey of approximately 228 sites throughout the County, totaling over 33,000 housing units, and over 50,000 parking stalls. This study, funded by a grant from the Federal Highway Administration, is part of a project called Right Size Parking. This data and subsequent statistical analysis was used in creating a powerful web-based interactive tool (RSP Calculator) to allow a user to estimate parking use based on site and development characteristics.

The County's Right Size Parking project included resources for cities to implement pilot projects to put the data to practical use. Kirkland was one of four King County cities selected to participate in a pilot project. Kirkland's focus is to study and potentially revise multi-family parking requirements to be in-line with the findings of the Right Size Parking project. The other cities involved with the project have varying goals:

- **Kent:** Identify best code and management strategies for mixed use areas in the suburban context.
- **Seattle:** Evaluate existing policies and programs, explore private shared parking opportunities.
- **Tukwila:** Identify parking strategies for TIBS station-area; explore private shared parking.

Redmond is pursuing a similar 'right size parking' project (outside the grant program) with the same King County team that is assisting Kirkland. Redmond's project is broader and seeks to understand the parking demand requirements for existing and

planned land uses in the Overlake and Downtown with potential application to the SE Redmond and Willows Road areas.

Background information on the Right Size Project's methodology, including site selection criteria, data collection procedures (including obtaining property owner permission), details on the variable analysis, strategies for Kirkland code changes, and the RSP calculator can be found in the following documents or webpages:

- Research Methods - Phase I (see Attachment 1)
- Research Methods - Phase II (see Attachment 2)
- Technical Memo dated February 7, 2013 prepared by Center for Neighborhood Technology (see Attachment 3)
- Parking Requirements and Utilization Gap Analysis dated July 12, 2013 prepared by Fehr & Peers (see Attachment 4)
- RSP Kirkland Pilot Project Technical Memo dated November 12, 2013 (see Attachment 5)
- RSP Calculator: http://www.rightsizeparking.org/
- Additional background information regarding the Right Size Parking project can be found at the following website under the 'Deliverables' tab: http://metro.kingcounty.gov/up/projects/right-size-parking/

B. Previous Meetings.

1. Study Session. On November 21, 2013, the Planning Commission held a joint study session with the Houghton Community Council and was briefed on the County's Right Size Parking project and Kirkland's code amendment project. Several people from the public spoke on this topic and expressed the following comments:

   - Mixed-use projects should be included in the study
   - The City's 1.7 stall per multi-family unit makes projects economically unfeasible
   - On-street and shared parking should be options for providing parking
   - Having adequate parking is a good goal
   - Need to figure in lack of on-street parking
   - Stalls should be adequately sized
   - Need to consider visitor parking
   - Popular businesses/restaurants can take up majority of parking stalls
   - Having a surplus of parking sometimes can be good

   Generally speaking, both the Planning Commission and Houghton Community Council thought that staff should continue to explore a context approach where a base parking requirement is established and the final parking rate is determined by applying adjustments based on factors such as transit availability and residential unit type. A market based approach, where developers set the parking minimum, was not thought to be acceptable given the risk for undersupplying parking and need for reliable on-street parking management.

   Additional parking data of Kirkland multi-family sites and background information of the study and data collection process were requested for further review. Staff also met briefly with the City Council Planning & Economic Development Committee earlier on the same evening. Feedback from the committee was similar in that a context based approach was more acceptable and that additional background information regarding the parking data should be provided.

2. Parking Pricing and Management Meeting. On May 7, 2014 the City of Kirkland and King County METRO hosted a meeting with a group of local developers and property managers. The property managers that attended were those that had property included as part of the parking data counts. Developers in attendance were those that have built multi-family projects (including mixed-use) in Kirkland or are currently under construction. The goal of the meeting was to have a discussion regarding how parking is priced and how managing parking affects parking demand. A summary of the meeting discussion can be found in Attachment 6.

3. Kirkland Alliance of Neighborhood (KAN) Meeting. On May 14, 2014, staff attended the KAN meeting and provided an update on this code amendment project. Staff responded to comments and questions. Important comments from the KAN members included concerns regarding the accuracy of the data, how the RSP calculator and utilization data would be used in determining code changes, and how reduced transit service would affect a context based approach to reducing parking requirements. Several members drew from past experience as property manager and/or their own observations of neighboring multi-family developments when pointing out that their experience/observations of high multi-family parking demand do not coincide with the reduced parking demand predictions of the RSP calculator and Kirkland parking data gathered to date. Limiting spillover parking onto neighborhood streets was a major concern.

C. Anticipated Growth. Under the requirements of the Growth Management Act, the State Office of Financial Management must make periodic growth forecasts for each county. These forecasts are then required to be the basis for local comprehensive plans. Based on the King County Countywide Planning Policies growth targets, Kirkland is expected to accommodate approximately 7,300 new multi-family housing units by 2035. This averages out to about 348 housing units per year. For comparison, from 2006 through 2011 the city gained about 1,500 units (single and multi-family) for the six-year period or approximately 250 units per year.

Using the City's general multi-family parking requirement of 2.2 stalls per unit (includes guest parking at a conservative 0.5 stalls per unit), the projected 7,300 new multi-family housing units will require 16,060 new parking stalls at the high end. By comparison, the RSP calculator predicts that parking should be calculated at 1.23 stalls per unit (8,979 parking stalls). Figure 1 below is from the RSP calculator and shows the projected construction parking costs, vehicle miles traveled, and comparative greenhouse gas emissions resulting from the different parking requirement rates.

Figure 1- RSP Parking Impact Chart

Impact	Estimated Utilization (From Model)	Compared To (User Input)
Estimated Parking Use Ratio:	**1.23**	**2.2**
Total Stalls:	8,994	16,111
Surface Parking		
Total Capital Costs (Land & Construction):	$73,982,289	$132,525,796
Monthly Costs per Residential Unit (including O&M):	$104	$187
Annual GHG Emissions from Construction and Maintenance (kg CO2e):	638,554	1,143,853
Structure Parking		
Total Capital Costs (Land & Construction):	$158,406,279	$283,755,998
Monthly Costs per Residential Unit (including O&M):	$209	$374
Annual GHG Emissions from Construction and Maintenance (kg CO2e):	1,555,912	2,787,134
Estimated Annual VMT of Building Residents:	90,449,778	162,024,304
GHG Emissions from Vehicle Use of Residents (kg CO2):	36,766,160	65,859,879

Bringing the City's parking requirements more in line with actual parking demand supports and promotes multimodal transportation options, green building policies, environmental stewardship, economic development, and land/use growth policies.

III. KIRKLAND MULTI-FAMILY PARKING REGULATIONS

For the most part, Kirkland's multi-family parking requirements have not changed for many years. In early 2000, North Rose Hill business districts (2003) and Totem Lake (2004) were modified so that parking would be reviewed on a case-by-case basis where requirements would be based on parking demand studies. In 2011, the City modified the CBD multi-family parking rates to be more consistent with parking reduction approvals that were based on parking demand studies. The result was a reduced parking standard for multi-family development in Downtown Kirkland:

> *Residential uses must provide a minimum of one (1) parking stall per bedroom or studio unit and an average of at least 1.3 parking stalls per unit for each development. In addition, guest parking shall be provided at a rate of 0.1 stalls per bedroom or studio unit with a minimum of two (2) guest parking stalls provided per development.*

However, the majority of the City's multi-family zones require 1.7 stalls per unit and up to 0.5 stalls per unit for guest parking depending on the availability of street parking. Figure 2 below summarizes the multi-family parking requirements for the various zones throughout the City. The chart also begins to compare RSP calculator results (based on corresponding zoning district) with code required parking and parking utilization data for various projects obtained as part of King County's RSP project (10 sites).

Parcels within a contiguous business district (i.e., CBD, JBD, etc.) were selected using the RSP calculator and the default values. For parcels that were not contiguous such as the RM zone, several parcels were selected from each RM zoned area through the City and

again the default RSP calculator values were used to provide an average rate. Attachment 5 contains a zoning map that shows these multi-family areas.

FIGURE 2. MULTI-FAMILY PARKING SUMMARY CHART – (stalls per unit unless noted)

Zone	KZC MF Parking Req.	KZC MF Guest Parking Req.	KZC MF Total	RSP Calculator (includes guest parking)	KZC Req. minus RSP	Actual Utilization Data (only sites with data)
Waterfront District	2	Up to 0.5	2.5	1.27	+1.23	1.38
Medium Density Residential*	1.7	Up to 0.5	2.2	1.24	+0.96	1.35 1.50 1.13
High Density Residential**	1.7	Up to 0.5	2.2	1.28	+0.92	1.31
Commercial & Office Zones						
BC Business Commercial	1.7	Up to 0.5	2.2	1.23	+0.97	
BN Neighborhood Business	1.7	Up to 0.5	2.2	1.25	+0.95	
PR & PLA Professional Residential & Planned Areas	1.7	Up to 0.5	2.2	1.22	+0.98	
Business Districts						
CBD Downtown Kirkland	1 per bedroom - Must average 1.3 per unit	0.1 per bedroom – minimum 2 per development	Approx. 1.45	1.23	+0.22	0.90
MSC Market Street Corridor	1.7	Up to 0.5	2.2	1.15	+1.05	
JBD Juanita Business District	1.7	Up to 0.5	2.2	1.19	+1.01	1.07 0.64
RHBD Rose Hill Business District	1.7	Up to 0.5	2.2	1.2	+1.00	
NRHBD North Rose Hill Business District	Demand based	Demand based	Demand based	1.22	n/a	1.25
TL - Totem Lake						
TL1A to 8	Demand based	Demand based	Demand based	1.19	n/a	1.12
TL9B to 11	1.7	Up to 0.5	2.2	1.26	+0.94	
YBD - Yarrow Bay Business District						
YBD 1 (TOD site)	1.1	0.05	1.15	1.16	-0.01	
YBD 2, 3	1.7	Up to 0.5	2.2	1.19	+1.01	

** **Medium density** - The following zones: RM 5.0; RMA 5.0; RM 3.6; RMA 3.6; WD I; WD III; TL 9B; PLA 2, 3B; PLA 6F, H, K; PLA 7C; PLA 9; PLA 15B; and PLA 17.*

*** **High density** - The following zones: RM 2.4; RMA 2.4; RM 1.8; RMA 1.8; PLA 5A, D, E; PLA 6A, D, I, J; PLA 7A, B; and TL 1B.*

IV. CONTEXT APPROACH TO PARKING REQUIREMENTS

A. Right Size Parking Calculator. The County's parking calculator is a helpful and interactive tool based on countywide data on actual multi-family parking use. It is based on several key variables:

- Average Rent
- Units per Residential square feet
- Percent of Units Designated Affordable
- Average Occupied Bedroom Count
- Parking Price as a fraction of Rent
- Gravity measure of Transit Service
- Gravity measure of Intensity (population + jobs)

As previously shown in Figure 2, staff used the RSP calculator to determine the parking rate for the various multi-family zones and business districts within Kirkland. Generally speaking, the results show that the Zoning Code requires more parking than what the calculator predicts. When comparing the calculator results against actual Kirkland parking utilization data (10 sites), the calculator predictions are lower than what the actual parking utilization data shows. Both the RSP calculator and parking data collected suggests that the City's parking requirements are on average higher than actual parking demand.

B. Local Parking Data.

1. Kirkland Multi-Family Sites - General. Because of the general nature of the RSP calculator, additional local parking utilization information was requested for analysis. The ten Kirkland sites for which parking data had already been gathered with the County's project, provided a baseline from which staff could begin to determine criteria for picking additional study multi-family sites within Kirkland. Staff identified the need to include sites that consisted of condominiums, developments that varied in unit counts, are located outside areas previously surveyed, had poor transit, and lacked nearby services. Staff was successful in obtaining owner permission to gather parking utilization data for fifteen multi-family projects in Kirkland that met a combination of these factors. However, information for only three sites has been gathered to date. Obtaining data for the remaining sites is ongoing and will be provided to the City when available.

2. Kirkland Downtown. In early 2011, the City Council adopted changes to the multi-family parking requirements in the Central Business District (CBD). The parking standard was reduced from 1.7 stalls per unit plus 0.5 stalls per unit to require the following:

> *Residential uses must provide a minimum of one (1) parking stall per bedroom or studio unit and an average of at least 1.3 parking stalls per unit for each development. In addition, guest parking shall be provided at a rate of 0.1 stalls per bedroom or studio unit with a minimum of two (2) guest parking stalls provided per development.*

The changes were based in large part to parking utilization data obtained in 2006 by the Public Works Department (see Attachment 7) and utilization data from parking modifications approved by the City up to 2010 (see Attachment 8).

Figure 3 below summarizes the parking utilization information from the 2006 counts done by Public Works and provides conservative parking rates by including the adjoining on-street parking data that was collected at that time.

Figure 3 – 2006 CBD Parking Utilization I

2006 CBD Parking Utilization Info										
	Guest Parking		Tenant Parking		Guest Parking (Average)		Tenant Parking (Average)		Total Stalls	Counts done at approx. 5 a.m. and over a period of several hrs
4/7/2006	Spaces	Occupied	Spaces	Occupied	Rate/Bedroom	Rate/Unit	Rate/Bedroom	Rate/Unit		Counts done by Public Works and with permission from
Tiara De Lago	0		29	?	0.00	0.00	0.85	1.69	29.00	owners
Waterview	6	0	82	57	0.00	0.00	0.68	1.13	88.00	
Brezza	20	5	127	88	0.03	0.05	0.73	1.20	147.00	
Portsmith	13	5	260	181	0.03	0.05	0.65	1.12	273.00	
Plaza on State	11	3	146	108	0.04	0.06	0.85	1.22	157.00	
7/7/2006										
Tiara De Lago		0		22						
Waterview		0		51						
Brezza		3		92						
Portsmith		11		163						
Plaza on State		7		90						
					0.02	0.03	0.75	1.27	1.31	=Total average parking per unit
									0.77	= Total average parking per bedroom
	Street Parking						Tenant Parking (Average) includes street parking			
	4/7/2006	7/7/2006					Rate/Bedroom	Rate/Unit		
Waterview	13	5					0.80	1.31		
Brezza	7	3					0.77	1.27	1.42	=Total Average parking per unit including street parking
Portsmith	8	7					0.68	1.17	0.83	=Total Average parking per bedroom including street parking
Plaza on State	3	0					0.86	1.24		
Tiara De Lago	0	3					0.96	1.92		

Other CBD parking data includes one large apartment complex which was surveyed with the County's RSP project (included in Figure 4 below). The five condominium sites previously counted in 2006 by Public Works were requested to be revisited with the recent counts being conducted by King County METRO's consultants so that the parking data can be updated and studied. However, only approval to access the Portsmith condominium property has been granted at this time with the parking counts expected to occur in the upcoming week or two.

Additional and more current CBD parking data can be found in Attachment 9, which contains a parking modification approval by the City for the 324 Central Mixed-Use project. The study contains parking utilization information for the Watermark apartments at 530 2nd Avenue and the Kirkland Central Condominiums (211 Kirkland Avenue). The parking utilization rates are also summarized in Figure 4 below. These counts also included adjoining on-street parking to give a more conservative parking estimation.

Figure 4 – CBD Parking Utilization II

	Stalls per Bedroom	Stalls per Unit
2006 CBD Condo Data – 5 sites (from Figure 3 above)*	0.83	1.42
CBD apartment complex (2011 RSP)	0.70	0.90
Kirkland Central Condos (March 2014)*	0.95	1.23
Watermark Apts. (March 2014)*	0.76	1.30
Average (8 sites)	**0.81**	**1.29**

* Includes on-street parking

3. Redmond RSP. Redmond is pursuing a similar 'right size parking' project (outside the grant program) with the same King County team that is assisting Kirkland. To help supplement the Kirkland data, staff looked to Redmond to see if any of their parking data could be useful. While Redmond's RSP project is broader in scope (includes commercial and office uses), parking utilization was collected for several multi-family projects in Redmond's Overlake neighborhood (see Attachment 10). It is summarized as follows:

Overlake Multi-Family Parking Demand Summary

Area	Actual (Observed) Peak Demand	Code Minimum Requirement	Average Built Supply – RSP sites
Overlake Village	0.93/unit	1.0/unit (MF)	1.57/unit (MF)
Overlake Employment	0.99/unit	1.0/unit (MF)	
Overlake Residential	1.07/unit	1.5 – 2.0/unit	

- Use in Overlake Village and the Overlake Employment area is very much aligned with zoning code parking minimums.
- Use in Overlake Residential area is well below the zoning code minimum (i.e. Code is requiring more than is actually being used).
- Right sized parking (RSP) average overbuild is 0.50 - 0.64/unit
  - This project will further refine this number for Overlake sites.

C. Emerging Trends. Fehr & Peers has provided a preliminary analysis of the Kirkland data which can be found in Attachment 11. The analysis shows that for the Kirkland observed sites, the KZC requires more multi-family parking stalls than what is typically being used. The memo also begins to provide insight as to why the RSP calculator either underestimates or over predicts parking utilization when compared to the collected data. Nine of the thirteen sites are within a 15% level of error.

The analysis notes that of the three locational variables used in the RSP Calculator – population density, job density, and transit service/accessibility, changes to the transit variable affects parking demand more so than population and job density. An example of this was given in the analysis where if the transit score for Site 9 (Table 1 of the analysis) was increased by 19%, the result would be an approximately 22% reduction in the predicted parking utilization rate. The RSP Calculator results shows variability in the 'intensity' of job concentration and population between the different areas of Kirkland. However, the variability with the transit service did not change to the same degree as population or employment throughout Kirkland.

As mentioned previously, staff has identified 15 additional multi-family sites that should be included for study. The goal is to include sites that are geographically distinct and are located outside areas that are better served by transit in order to provide a comparison with sites already surveyed. Additional information is needed regarding this topic before identifying clear trends with the data.

D. Potential Code Changes. Of the context based approach adjustments described in the Kirkland Technical Memo, Appendix 6.1 (see Attachment 5), staff recommends focusing on the following items:

- Adjustments for Housing Unit Types
- Reduction for Transportation Alternatives – Frequent Transit
- Reductions for Off-Street Parking Management - Unbundling

The following adjustments are already addressed by the KZC:

KZC Section 105.34 Covered Bicycle Storage - If covered and secured bicycle storage is provided on site, a credit towards parking requirements at a ratio of one (1) less parking stall per six (6) bicycle spaces will be granted. The Planning Official may increase credits according to size of development and anticipated pedestrian and bicycle activity and proximity to transit facilities. A maximum reduction of five (5) percent of required parking stalls may be granted. If a reduction of five (5) or more stalls is granted, then changing facilities including showers, lockers shall be required.

KZC Section 105.45 Location of Parking Areas Shared Facilities - Two (2) or more uses may share a parking area if the number of parking spaces provided is equal to the greatest number of required spaces for uses operating at the same time. To insure that a parking area is shared, each property owner must sign a statement in a form acceptable to the City Attorney, stating that his/her property is used for parking by the other property. The applicant must file this statement with the King County Bureau of Elections and Records to run with the properties.

KZC Section 112.20.4.b Affordable Housing Incentives – The required parking may be reduced to 1.0 space per affordable housing unit. No additional guest parking is required for affordable housing units. If parking is reduced through this provision, the owner of the affordable housing unit shall sign a covenant, in a form acceptable to the City Attorney, restricting the occupants of each affordable housing unit to a maximum of one (1) automobile.

In addition, required parking may be reduced under the following KZC section:

KZC Section 105.103.3.c Parking Modification - For a modification to KZC 105.20 and 105.45, a decrease in the required number of spaces may be granted if the number of spaces proposed is documented by an adequate and thorough parking demand and utilization study to be sufficient to fully serve the use…

The remaining adjustment/reduction considerations provided in the Technical memo (workforce, senior housing, etc.) could be addressed as part of a future project. Currently, staff does not have parking data that would support any changes regarding those topics. Attachment 12, Right Size Parking Model Code provides additional background on the adjustments.

E. Discussion Items. The context based approaches are described below with questions for consideration.

1. Adjustments for Housing Types. In general, the Downtown multi-family parking rate is closer to actual utilization rates than previously required before the 2011 code change. In the CBD, the average parking rate based on available data for multi-family developments (1.29 stalls per unit – see Figure 4) is in line with what the code requires: a minimum of 1.30 stalls per unit. It is also closer to what the RSP calculator predicts for the CBD as a whole (1.23 stalls per unit) than what the code previously required.

   While the data supports requirements when viewed on a 'per unit' basis, there is a discrepancy when viewed on the 'per bedroom' basis used in the KZC. The average utilization result in Figure 4 is about 0.81 stalls per bedroom. However, the KZC requires 1 stall per bedroom with a *minimum average* of 1.3 stalls per unit. Applying this calculation to existing Downtown developments shows that the KZC actually is requiring a higher average parking rate (1.87 stalls/unit) when compared to the average parking utilization rate but still lower than the 2.2 stalls per unit the code required pre-2011.

Figure 5 – Parking Code Application Example

Condo	No. of stalls	Req. guest stalls	Total	Total rate/unit	
Waterview	79.00	7.9	87.00	1.81	
Brezza	124.00	12.4	137.00	1.83	
Portsmith	263.00	26.3	290.00	1.90	
Plaza on State	117.00	11.7	129.00	1.59	
Tiara De Lago	26.00	2.6	29.00	2.23	
				1.87	**Total Average**

Where the 1 stall per bedroom calculation begins to correspond to the 1.3 stall per unit average is when a project is made up of primarily one bedroom or studio units.

The County's draft model code suggests that parking stall demand based on a 'per bedroom' formula is not a linear 1 to 1 calculation. For example, a 3-bedroom unit would not typically require 3 parking spaces. Instead, the RSP Calculator estimates, using the countywide data that parking rates per bedroom could be calculated as follows:

Studio	1-Bedroom	2-Bedroom	3-Bedroom +
0.85X	1X	1.6X	1.8X

As stated in the Technical Memo for Kirkland (see Attachment 5), the 'X' would be the baseline minimum parking requirement and would be multiplied by the factor corresponding to the unit type. Additional analysis is still required in order to determine what the baseline minimum 'X' parking requirement would be. Using the Kirkland data known to date, Fehr & Peers estimates the rates for Kirkland are less than the generalized countywide rates:

Studio	1-Bedroom	2-Bedroom	3-Bedroom +
0.93X	1X	1.25X	1.39X

Staff will look to Fehr & Peers and the City Transportation Engineer for an updated recommendation based on a review of the existing data and data still forthcoming of Kirkland sites.

In regards to visitor parking, the parking utilization data provided gives the total peak parking demand for multi-family developments inclusive of guest parking. The parking counts were done late at night when parking demand is the highest for a residential use. Since the data includes guest parking stalls, they are subsequently reflected in the RSP 'per-bedroom calculation rate' above and no separate visitor parking rate is proposed.

Staff would like feedback on the following questions:

- Should staff continue to explore a context based approach based on what emerges as key variables (unit mix, transit, neighborhood type, etc.)? This would be a change from the current blanket parking requirement approach.
- Is this context based approach to calculating parking appropriate for the CBD?
- Providing adequate visitor parking has been noted as a concern. Given the available parking supply for surveyed sites at peak hours, concerns regarding lack of visitor parking may be more of a parking management issue. Should additional study be dedicated toward visitor parking management and identifying code changes to ensure adequate parking supply for users?

2. Totem Lake and North Rose Hill Business District. Currently, the majority of the Totem Lake zones (TL 1A to 8) and all of the North Rose Hill Business District (NRH 1A to 6) require that parking be provided based on actual parking demand:

> **KZC Section 105.25 Number of Parking Spaces – Not Specified in Use Zones**. If this code does not specify a parking space requirement for a particular use in a particular zone, the Planning Official shall establish a parking requirement on a case-by-case basis. The Planning Official shall base this determination on the actual parking demand on existing uses similar to the proposed use.

The remaining Totem Lake zones (TL 9B to 11) which allow multi-family development still have the general standard of 1.7 stalls per unit plus guest parking up to 0.5 stalls per unit. These zones for the most part are located in or near the Par-Mac area of Totem Lake just west of I-405 and currently contains a mix of industrial, office, and indoor recreational type uses. The multi-family parking requirements in this area were made different from the TL 1A to 8 zones because of the distance from Totem Center (area around Totem Lake Mall and Evergreen Hospital) and lack of transit options. Since the City is in the currently in the process of updating the Totem Lake Neighborhood Plan, no changes to the Totem Lake parking requirements are recommended with this project.

3. Reduction for Transportation Alternatives – Frequent Transit. In general, the RSP calculator predicts a multi-family parking reduction of 25% to 50% depending on the proximity and level of service of transit. This is the basis for a parking reduction factor related to transit provided in the model code for Kirkland. However, Fehr & Peers' review of the parking data collected to date and comparison with the RSP calculator shows little relationship between the transit variable and parking demand given the job and population variability across the study sites (see Attachment 11, Table 1). Observations noted in the memo that may help to explain this include a 'self-selection' bias where people reside in buildings appropriate to their car ownership situation and the walkability of certain areas. If this option is used, it will need to be recalibrate based on upcoming service cuts.

   Staff believes that additional data is needed before making a recommendation on this topic. If all data sites are counted, we will have a total of 25 sites that would have been surveyed and be representative of the varying types of multi-family scenarios. With this information staff could also look to other resources such as the '10-minute' neighborhood tool which is currently being refined. This tool incorporates Geographic Information System (GIS) technology to illustrate the walkability of Kirkland neighborhoods based on land use and existing transportation links including transit. Given the countywide nature of the model, staff would like to focus on the local data when starting to understand impacts of transit availability as it relates to multi-family parking demand.

4. Parking Price Unbundled from Unit Price. Statistical analysis of the RSP data has shown a 20% reduction in parking demand when the price of parking is unbundled from the price of rent. When the charge for parking is made clear to tenants, there is a better understanding of parking costs which in turn could influence the decision to own a car and/or use other modes of transportation. See Attachment 5, Section 5.5 and Attachment 12, Section 3.6.1 for additional background discussion on parking pricing.

   Staff has identified several issues with this approach and would like feedback on the following items:

   - In general, what is the comfort level with unbundling parking pricing and being allowed to reduce the parking requirement? Clarifying questions:
     - Are there concerns with existing data?
     - Is additional local (Kirkland) data needed?
     - Is additional analysis needed on this topic?
   - Parking spillover onto neighboring streets by tenants that own a car but park on the street in order to avoid parking costs has been identified as a concern. How should this be addressed? Options include:
     - Allow only with a combination of high availability of transit and reduced options for on-street parking?

- Require a Transportation Management Plan (bus subsidy, etc.)?
- Specify in lease agreements limitations on car ownership?
- Require a covenant?
- Given that the City has limited resources for managing time-limited street parking, are there other options that should be considered?

V. NEXT STEPS

Due to the additional time needed for data collection and analysis, staff recommends another study session before taking any code amendments to a public hearing. This will allow for additional input and clarification regarding the approach to take on this project.

VI. ATTACHMENTS

1. Research Methodology I
2. Research Methodology II dated November 28, 2011
3. Technical Memo dated February 7, 2013 prepared by Center for Neighborhood Technology
4. Parking Requirements and Utilization Gap Analysis dated July 12, 2013 prepared by Fehr & Peers
5. RSP Kirkland Pilot Project Technical Memo dated November 12, 2013
6. Parking Pricing/Management Meeting Summary
7. 2006 CBD Condo Parking Counts
8. CBD Parking Spreadsheet from 2010/2011 Amendments
9. 324 Central Way Parking Modification Approval dated April 17, 2014
10. City of Redmond RSP Powerpoint
11. Fehr & Peers Memo dated May 12, 2014
12. RSP Model Code for Cities

King County METRO

Right Size Parking

Research Methodology
Phase I – Site Selection and Field Data Collection

BACKGROUND

King County Metro has been awarded a grant in the Federal Highway Administration (FHWA) Value Pricing Program. The project will assemble local information on multifamily residential parking utilization to guide parking supply and management decisions in the future.

As part of the grant effort, research will be conducted in two phases:

- **Phase I** – Site selection and field data collection consisting of on-site parking inventory counts and assembly of physical building and pricing information.
- **Phase II** – Independent variable data collection, statistical analysis, and model development will be done to predict parking utilization.

This document covers the Phase I research methodology. The collection of parking inventory data will help King County assess parking utilization in existing multifamily residential buildings to learn more about resident's parking needs. Approximately 240 properties will be the subject of parking field counts to assess residential parking utilization. Due to time and budget limitations, a specific site selection methodology was developed to ensure a representative sample is collected within the constraints of the project. In addition, information about the physical building characteristics and parking/housing pricing will be collected to support the Phase II research.

Given the relatively large number of sites, a data collection team will be used to conduct parking counts. To manage the data collectors and ensure quality data the following methodology and protocols were developed.

1. PROBLEM AND RESEARCH OBJECTIVE

Research has shown that over-building of residential parking supply leads to increased automobile ownership, vehicle miles traveled, congestion and housing costs.[1,2] Recent research has found that households with guaranteed parking at home have a greater propensity to use the automobile for journey to work trips, even when those trips are

[1] Shoup, Donald C. 2005. The high cost of free parking. Chicago: Planners Press, American Planning Association.

[2] Litman, Todd. 2009. "Parking Requirement Impacts on Housing Affordability". Victoria, BC: Victoria Transport Policy Institute. http://www.vtpi.org/park-hou.pdf.

well served by transit.[3] In addition, misaligned parking policies present barriers to smart growth and efficient transit service provision.[4,5] Interviews with local King County development stakeholders in the fall of 2009 revealed a general lack of locally credible and context-sensitive data on parking utilization, which leads developers and financiers to remain conservative and over-build the parking supply. Also, jurisdictional parking minimums in zoning codes can limit developers from building parking to meet the true demand.[6]

In addition, the market for housing and vehicle ownership is shifting, with an increasing trend of households owning only one or no vehicles. According to the American Community Survey, 8.9% of housing units in King County do not have access to a vehicle. In the City of Seattle, 15.5% do not have access to a vehicle.[7] This data shows there is a significant share of households with no vehicle and yet jurisdiction zoning codes often require parking for all housing. This predicament leaves the housing market unable to respond to the market share of households with zero vehicles.

This Phase I research methodology is designed to provide context-sensitive multifamily residential parking utilization information. This information will be incorporated into the Phase 2 research which will be provided on a website to guide stakeholder's decisions about building new parking and managing existing parking. The objectives of the Phase I research design are to:

- Conduct parking inventory counts in King County, WA to ensure the highest possible statistical significance within the project time and budget constraints
- Provide a standard and replicable method to conduct field work to ensure consistency and accuracy in data
- Support the data needs for Phase II statistical research analysis

2. Site Selection

2.1. Constraints

[3] Weinberger, Rachel. 2011. "Death by a Thousand Curb-cuts: How minimum parking requirements stimulate driving". Paper presented at the annual meeting of the Transportation Research Board, Washington, D.C., January.

[4] Forinash, Christopher, Adam Millard-Ball, Charlotte Dougherty, and Jeffery Tumlin. 2004. "Smart Growth Alternatives to Minimum Parking Requirements." Paper presented at the annual meeting of the Transportation Research Board, Washington, D.C., January.

[5] Willson, Richard. 2005. "Parking Policy for Transit-Oriented Development: Lessons for Cities, Transit Agencies, and Developers". Journal of Public Transportation. 8 (5): 79-94.

[6] Rick Williams Consulting. 2009. Technical memorandum to King County Metro. "Preliminary Findings: Right Sizing Parking [REVISED]".

[7] American Community Survey. 2005-2009 American Community Survey 5-Year Estimates. http://www.factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=16000US5363000&-qr_name=ACS_2009_5YR_G00_DP5YR4&-ds_name=&-_lang=en&-redoLog=false

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To provide data for the statistical analysis portion of the research (Phase II), a sample of multifamily residential properties must be selected to conduct data collection (detailed in Section 4 of this document). Parking at multifamily developments is often supplied in underground or structured parking garages that are locked for tenant security and safety. To collect parking data at these properties, access to a private garage is often required. Based on local and national past experience, this process can be difficult as some property managers are not willing to provide access to the private parking garages for research purposes.[8] This restricted access has an impact on the site selection methods used in this research. Common random sampling techniques cannot be used in this process due to the excessive time that would be required to request site access from each property individually. To overcome this barrier, this research will select sites using a combination of a convenience and quota sampling techniques described in the next section.

2.2. Selection Methods

The site selection process uses the following steps:

1. Define the research location criteria
2. Define the building characteristic criteria
3. Define site selection process

Location Criteria

The geographic location of eligible properties was defined to ensure the sample was focused in areas where future multifamily residential development is likely zoned and expected to exist. An eligible property must meet be located in one of the following geographic areas:

1. Urban Growth Center[9]
2. Within 0.5 mile radius of an Activity Center[10] point
3. Within 0.5 mile radius of existing or planned frequent transit service stops or stations (Sounder, LINK, RapidRide, Seattle Streetcar)
4. Within 0.25 mile buffer of existing frequent all-day[11] transit routes.

[8] Daisa, J. M. and T. Parker. Trip Generation Rates for Urban Infill Land Uses in California. ITE Journal, Vol. 79, No. 6, 2010, pp. 30-39.

[9] Puget Sound Regional Council defines Urban Growth Centers as a part of the regional planning process. Growth centers have been identified for housing and employment growth, as well as for regional funding. A list of growth centers can be found here: http://psrc.org/growth/centers.

[10] The King County defines Activity Centers as a part of the recently adopted Strategic Plan Service Guidelines. Activity Centers are areas of concentrated activity that connect the County's all-day and peak transit network. A list of activity centers can be found here: http://metro.kingcounty.gov/planning/pdf/KCMT_ServiceGuidelines_07-11-11.pdf

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Building Characteristic Criteria

To be eligible for inclusion in the research sample, a property must be a multifamily residential property with a size equal to or greater than 10 units.[12] The units can either be leased as apartments or sold as condominiums. The property may contain mixed uses within the development, but this research will only inventory the residential portion of the parking (process explained in Section 3).

Site Selection Process

The site selection process uses a combination of convenience and quota sampling. Convenience sampling is used to overcome issues with gaining access to private property. To reduce the time and resources required to gain permission to each property in the sample, research staff will seek permission for multiple properties at once by asking for access to the entire portfolio of a local development or property management company. Considering this method has potential to produce an unrepresentative sample, research staff will conduct periodic Chi Square statistical checks of independent variable distribution of the sample against the distribution of the sample universe. A list of independent variables to be used in this study is included in the Phase II document, Attachment A. These checks will occur every time 50 additional properties are added to the sample.

For example, when staff is successful at acquiring permission from the first 50 properties, staff will then compare the variable distribution of the sample against the distribution of the sample universe. To normalize the sample and the sample universe, frequency distributions will be created using ranges within each independent variable dataset. The Chi Square test will then determine whether or not the sample is representative of the sample universe, at a given significance level. If the sample is representative, then research staff will continue using the convenience sampling process until the next 50 properties are added to the sample. If the sample is not representative, then research staff will start to selectively seek permission from properties that contain independent variable characteristics that meet criteria to fill quota where it is needed (or not representative). For example, if the first 50 properties happen to be all within Census blocks with high income households in comparison to the rest of eligible research locations (sample universe), this would be an indication of an unrepresentative sample and would trigger staff to add properties to the sample that are located in areas with lower and middle income households.

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[11] Frequent all-day transit routes are defined by the King County Metro Strategic Plan for Public Transportation 2011-2021, Service Guidelines. The route must operate throughout the day, seven days a week, with 15 minute frequencies (or more) during the weekday peak and off-peak hours and 30 minute (or more) during the weekday night and weekend hours. http://metro.kingcounty.gov/planning/pdf/KCMT_ServiceGuidelines_07-11-11.pdf

[12] The 10 unit minimum was chosen to focus the properties included in the study to include those that have significant capital investment in a parking lot, structure, or garage.

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3. Field Data Collection

3.1. Parking Utilization Counts + Field Observations

To assess parking utilization in each residential development, one parking utilization count will be conducted for each site. The method used to conduct the parking utilization count will follow the Institute of Transportation Engineer's (ITE) method presented in their Parking Generation manual.[13] Parking utilization is defined as the "accumulation of vehicles parking at a given site at any associated point in time…This value should be the highest observed number of vehicles within the hour of observation". Parking counts will be completed during mid-week days (Tuesday through Thursday) at the peak parking demand hours for residential land uses, which falls between 12:00 a.m. to 5:00 a.m. Parking counts will not be completed during weeks with major holidays considering residents could be on vacation. The parking utilization count will consist of counting the number of physically parked cars in the residential portion of the parking garage or lot at the time of the count. On-street parking will be included in the residential count only if a property manager indicates that a distinct supply of on-street parking has been reserved for the property's use. Commercial parking will not be counted during a residential count, based on the assumption that such uses are not in operation during the 12:00 a.m. to 5:00 a.m. period.

3.1.1. Mixed-Use Buildings (if applicable)

Although non-residential parking counts are not planned in this research scope, time and budget may be available to expand the scope. If applicable this section outlines the methods used for mixed-buildings.

Performing parking counts in mixed-use buildings presents some unique challenges not found in single use residential buildings. Commercial parking counts require distinguishing between residential and commercial parking demand during daytime hours. The difficulty in making this distinction is dependent on how parking is managed by the property. In instances where the parking is physically separated or residential parking permits are used (and enforced) it is not difficult. It becomes a challenge when the spaces are freely shared. To assess parking utilization of non-residential uses in mixed-use buildings, some counts will have to be performed during the daytime or evening for an extended period that matches the time of peak utilization for that use. It may be ideal to perform a count where the spaces are shared since this may be a key factor in being able to reduce parking supply based on opposite periods of demand. Collection methods in these cases may involve:

[13] Institute of Transportation Engineers. 2004. Parking Generation. Washington, D.C., USA: Institute of Transportation Engineers.

- ULI Shared Parking Methodology Analysis – In this method, no effort is used to distinguish between what land use each vehicle is associated with. The team would choose a mixed-use control site where the exact land use mix and sizes are known – most likely a complex site with multiple shared uses. Count the total combined parking utilization throughout the entire day. Compare the observed utilization to the ULI Share Parking methodology to see if it aligns with the suggested parking demand rates.

- Query Washington State Department of Licensing (DOL) database for number of registered vehicles and subtract residential cars during daytime commercial count. The data collector will need to utilize the license plates of the residential cars to subtract the actual vehicles that are parked on-site during the daytime account. This assumes that the DOL database is sufficient to assess residential parking utilization and would not require a separate residential count.

- Residential parking permits, if used, would enable the data collector to separate residential from non-residential parked vehicles.

- Signage to designate residential/non-residential parking, if used, would enable the data collector to separate residential from non-residential parked vehicles.

- A residential parking count that includes recording all residential license plates could be used to filter out residential cars during a daytime commercial count in a mixed-use building.

3.1.2. Physical Building and Pricing Information

In addition to counting parking utilization the data collectors will be responsible for collecting other building and pricing information listed in Attachment A. The information will be obtained primarily through a combination of fieldwork and information supplied by the property manager. A significant part of the data collection effort is to obtain data in support of Phase II including independent variables that may impact parking utilization.

3.1.1. Quality Control

To ensure the quality of the data collected the project team will perform follow-up parking counts within a week after the initial count for a sample of the buildings counted. Immediately following the initial count the Data Collection Manager will deploy another data collector the site within a week. The quality control counts will be selected at random. The number of sites to receive quality control counts is TBD. The data collector will follow the same procedures as for regular counts including collecting all available on-site fieldwork data. The follow-up data collection effort will be performed by separate staff from the original counter. The original counter will be

unaware of the follow-up count occurrence. Either the Data Collection Manager or data collector will need to contact the property manager to gain access to the site. Each property manager will be notified that a follow-up count may be required and to gain consent during the initial contact.

3.2. Information Flow + Field Count + Documentation

With 240 sites and three to four field workers, consultants and County staff communication on this project will be critical to its success. The fieldwork is one piece of a larger project to assess parking utilization in multi-family and mixed-use buildings along with other independent variables that may affect parking utilization. The County intends to submit the data and findings to ITE for inclusion in the next version of the *Parking Generation*. The data is also to support Phase II and the developments of a tool to help communities better predict parking utilization. Therefore, data management and quality control are equally important aspects of this project. Fortunately we have emerging technological assets that will assist us in our efforts to streamline the process.

3.2.1. *Information Flow*

King County staff and their partners are responsible for selecting the sites and coordinating the initial consent from the property owners. Once a site is selected and ready for a field visit county staff will forward the information on the site, including the address and property manager contact information, to the Data Collection Manager via email.

The Data Collection Manager will record the information in a master data sheet and post the site on the project's SharePoint site provided by King County. SharePoint is project management software that allows for shared calendars, project milestones, assigning tasks, project team communication and file sharing. The site is only accessible by project team members and not available to the general public.

Once posted on the site, the next data collector in the rotation will have a certain amount of time for which they have priority to perform the count. If they do not respond or cannot conduct the count, the next data collector in the rotation has the first option and so on.

3.2.2. Field Count

The fieldwork effort will usually require two visits to each site; an initial visit to meet with the property manager to discuss data needs (if any) and coordinate access for the actual parking count to be performed during the second site visit. Some of the information needed will be difficult to obtain from field observations, so the data collector will email the property manager an Adobe form in advance of the first visit to be filled out and emailed back to the data collector. To the best of their ability, data

collectors will arrange to drop off the key (if used) upon completion of the second visit to avoid a third trip and/or a mailing to return the key.

To perform the count the data collector will go to the site within the designated time period (12-5am) and perform the count. The count will be recorded on the standard data sheet that will be provided. Once the data collector finishes the fieldwork he/she will fill in the remaining information into the Adobe form. The Adobe form data can be compiled and exported to excel. The added advantage is the Adobe form creates a user-friendly record of the account for use in the future.

To ensure that the data collectors are indeed counting the site at the proper time, as well as to provide a clear record of the counts and increase the quality of the data we may utilize the following technologies:

- Geo-referenced picture of the building sign or other identifier using a smartphone or camera equipped with this ability. One benefit is that a wider range of potential data collectors may have a phone that has this capability. Images will only be used for internal purposes.

- Google Latitude allows users to "check in" that allows the Data Collection Manager to see their location using a phones GPS capabilities. The data collection manager could verify the data collectors performed the count at the appropriate time, take a screen shot of the location and file it. One added benefit is that the Data Collection Manager can track the data collectors in real time, but it requires the data collectors to have a smartphone.

- Evernote is a cloud based note program that provides a geo-referenced location (map) of where the note was taken. Notes taken on smart phones with the Evernote program can be recorded with the count data and sent to the data collection manager before leaving the site. The note will be titled with the address of the site. The benefit of using Evernote is that the program has database features that will store the data, allow it to be searchable and shared amongst project team members. The downside is that it would require data collectors to have the program and a capable smartphone. Evernote is the preferred method if available to data collectors.

- Photos of the site that also show the time of day and possibly the date on a phone could be used to verify counts. If the picture had a timestamp it would improve reliability and verification. While it's the least cost option, it is less reliable than the other methods.

3.2.3. Documentation

The Data Collection Manager will collect the count data and verification information and enter it on the master spreadsheet file (for integration into GIS) and in Evernote. The Evernote database can be shared with other project team members and will include all administrative documents including this methodology. It should be noted that all information collected from properties will be kept confidential to honor confidentiality agreements between each property and the County.

The Data Collection Manager will also provide a geo-referenced online map (ESRI ArcExplorer Online) of the sites and basic count data, which will be shared amongst the project team.

3.2.4. Reporting

The Data Collection Manager will report on data collection progress to King County staff on a quarterly basis. Any special findings or issues will be reported as needed.

4. Pilot Project

In order to test the methodology and data collection process we will conduct a pilot project including a mix of 20 sites. We may begin initial meetings with property managers before we have 20 properties identified, but will not perform the actual count until we have identified 20 sites for data collection. Once the initial 20 counts are preformed the Data collection Manager will provide a summary of the data and an assessment of the methods to be reviewed by the project team. The methodology may be revised based on the results of the pilot effort.

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Attachment A - Building Information Form

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Field Data Sheet

To be completed by data collector

Contact Information	
Parcel PIN	
Building Name:	
Building Address:	
Contact Name:	
Contact Title:	
Organization:	
Email:	
Phone:	
Would you like to keep this data anonymous? (Yes/No)	
Parking Information	
Total # Parking Spaces (including residential, commercial, retail and shared spaces)	
# Parking Spaces for Residential Use (off-street and on-site)	
# Parking Spaces for Residential Use (reserved off-site or on-street)	
# Parking Spaces dedicated for vanpool/van share	
# Parking Spaces dedicated for carshare	
# Parking Spaces for Nonresidential Use (separated from residential stall)	
# Parking Spaces for Nonresidential Use (shared with residential stalls)	
Total # Bike Parking Spaces	
Total # Scooter/Motorcycle Parking Spaces	
On-Street parking on block face(s) adjacent to building (yes/no)	
On-Street Parking Restrictions, if any	Other
Residential Parking Pricing (yes/no)	
Residential Monthly Parking Pricing Amount Per Space, if any	
Non-Residential Parking Pricing Amount Per Hour, if any	
Residential Parking Utilization (if known through # of residential parking permits sold or other means)	
Parking Demand Count Date	
Parking Demand Count Time	
Total Parking Inventory Count (vehicles observed during parking count)	
Building Information	
Total Square Footage	
Residential Square Footage	
# of Building Floors	
Non-residential building uses (please list)	
Total # of Residents	
Total # of Residential Units	
Total # of Affordable Units	
Number of units affordable to 80% to 100% median	
Number of units affordable at 60% to 80% median	
Number of units affordable below 60% median	

Provide the information below for each type of unit listed:	Total	Studio or Efficiency	1 bedroom	2 bedroom	3 bedroom
# of Senior Housing Units					
# of owner occupied units					
Average Price Per Square Foot of Owner Units					
# of rental occupied units					
# of rental unoccupied units					
Monthly rental cost					

Other Transportation Demand Management Strategies Used (bicycle facilities, transit passes, etc.) - Please list.	
Transit way finding or information offered on-site? (Y/N - If yes, explain)	

Right Size Parking Project
King County Metro Transit

Research Methods
Phase II – Model Development

November 28, 2011

Prepared by:
Center for Neighborhood Technology

BACKGROUND

King County Metro has been awarded a grant in the Federal Highway Administration (FHWA) Value Pricing Program. The project will assemble local information on multifamily residential parking utilization to guide parking supply and management decisions in the future.

As part of the grant effort, research will be conducted in two phases:

- **Phase I** – Site selection and field data collection consisting of on-site parking inventory and utilization counts and assembly of physical building and pricing information.
- **Phase II** – Independent variable data collection, statistical analysis, and model development will be done to predict parking utilization.

A literature review prefaces the methodology discussion for these two phases of the research. Beginning with an overview of the present standards for estimating parking demand and utilization, the literature review highlights studies which show that parking is often oversupplied. Many studies focused on the relationships between parking demand and household socio-demographic characteristics, housing type, qualities of the built environment, and parking price and supply are reviewed in consideration of the imbalance between supply and demand for parking at multifamily residential properties. The literature review also considers efforts to model these relationships as well as auto ownership models and their relationship to parking demand. Additionally, data sources that assess auto ownership or vehicle availability can potentially serve as proxy measures for estimating parking demand and the applicability of these sources is briefly addressed at the conclusion of the review.

The Phase I research methodology addresses the collection of parking utilization data that will help King County assess parking utilization in existing multifamily residential buildings to learn more about resident's parking needs. Approximately 240 properties will be the subject of parking field counts to assess residential parking utilization. Due to time and budget limitations, a specific site selection methodology was developed to ensure a representative sample is collected within the constraints of the project. In addition, information about the physical building characteristics and parking/housing pricing will be collected to support the Phase II research.

This document covers the Phase II research methodology. The collection of parking field data, as detailed in the Phase I methodology, will enable statistical analyses and the development of a model predicting parking utilization at multifamily residential developments based on a set of independent variables tested in regression analysis. Independent variables selected will capture the effects of housing characteristics, neighborhood household characteristics, accessibility, built form, and parking pricing and supply on parking utilization. The resulting predicted utilization will be displayed on a

website in which users will have the ability to incorporate development specific details to assess the resulting estimated parking utilization.

RESEARCH OBJECTIVES

As discussed in the literature review, a lack of consensus exists on the factors that drive demand for parking and utilization and account for the variation in auto ownership. While socio-demographic, housing, and built environment variables have all been shown to have an impact on parking and vehicle availability, their relative influence is a source of debate. There is more agreement on the fact that parking supply and pricing have a significant impact on parking demand and auto ownership, but these variables have been understudied. The appropriateness of using data on auto ownership as a proxy for parking demand is also an unresolved question. This research will attempt to address and provide clarity on these issues.

This Phase II research methodology is designed to identify and analyze independent or explanatory variables thought to affect multifamily residential parking utilization. A model will be developed to capture these relationships and estimate parking utilization as a function of the variables selected. The collection of field data will enable a unique analysis of variables often difficult to capture, including the supply and pricing of parking in conjunction with the resulting utilization. While the occupancy counts collected in Phase I field work will serve as the primary dependent variable representing parking utilization, the appropriateness of using data on registered vehicles as a proxy for parking utilization will also be analyzed. A website will be developed using the parking utilization model and will provide estimates to guide stakeholders' decisions about building new parking and managing existing parking. The objectives of the Phase II research design are to explain how the research will:

- Identify independent variables to be tested in regression analysis of occupancy counts collected in Phase I
- Conduct statistical analyses to test independent variables' significance in predicting parking utilization
- Develop model of parking utilization using regression analysis
- Test alternative methods of estimating parking utilization by evaluating correlation between Department of Licensing registration data and collected occupancy counts as to enable greater replicability without the need for field work
- Provide a set of standard and replicable methods to quantify parking utilization impacts that are conducive to an interactive website application

MODELING PARKING UTILIZATION

Using the parking occupancy counts collected in the field work described in Phase I as the dependent variable representing parking utilization, regression analysis will be used to estimate the relationship to several independent or explanatory variables. The resulting regression function will be used to model parking utilization.

The dependent variable of parking utilization will be defined as observed parking occupancy divided by the number of occupied dwelling units in the building. One potential difficulty or limitation of this definition may occur if the field data collection results in a case where 100 percent of the parking spaces are utilized. In these cases, there will be no way to determine if this is the result of supply perfectly meeting demand or parking being undersupplied or underpriced. In other words, is there a significant level of overflow that is not being accounted for in the occupancy counts on-site? Because the validity of these utilization rates cannot be determined, data from the Department of Licensing registrations will be considered to better understand the magnitude of the potential overflow. Determinations will be made on a case by case basis as to the appropriateness of the property's inclusion in the regression.

To construct this regression analysis, independent variables must be selected and tested. As highlighted in the literature review, little consensus exists on the predominant drivers of parking demand, although individual studies provide insight on variables to be tested and overall categories of variables to consider. The following theoretical framework has been constructed to guide the regression analysis and model development.

PARKING SUPPLY AND PRICE:
As the two predominant indicators of demand, it is believed that parking supply and price will have a large impact on parking utilization. As basic theory suggests, low supply should correspond to low utilization and high prices should also indicate low utilization. Clearly, this can vary depending on context, but this basic trend should hold true in the data. Because price and demand (in this case, utilization) can both change in response to changes in each other, this can cause a loop of causality. To address these potential issues of endogeneity, a two-stage approach will be considered.

PROPERTY/DEVELOPMENT CHARACTERISTICS:
Characteristics specific to the properties studied have been shown to be explainers of parking utilization. Higher density developments (both by lot size as well as by floor space) and lower rents have both correlated with low utilization rates.

NEIGHBORHOOD HOUSEHOLD CHARACTERISTICS:
To the extent that neighborhood demographics reflect the building/development demographics, high income, large household size, and many commuters per household in the neighborhood should all correlate with high auto ownership and thus high parking utilization rates.

ACCESSIBILITY:
High levels of access to public transit, jobs, and services are all expected to correspond with low parking utilization rates. Conversely, poor access requiring high dependence on auto travel should lead to high parking utilization.

BUILT FORM AND DEVELOPMENT PATTERNS:
Much research on auto ownership and auto use has highlighted the significance of built form and development patterns on auto dependence. High density, interconnected street networks, and a mix of land uses all correlate with low auto ownership and use, and therefore, should correspond with low parking utilization.

Because factors can be captured and represented in many different ways with many different variables, an extensive list of potential explanatory variables will be analyzed (see Attachment A). For example, while it is expected that transit access will correlate with parking utilization rates, the best measure of transit access to best explain utilization rates is unknown. Due to this, potential independent variables have been grouped into these five categories—parking supply and price, property/development characteristics, neighborhood household characteristics, accessibility, and built form and development patterns—enabling consideration of the greatest number of possible variables to capture these factors.

The dependent variable in the regression, parking spaces utilized per occupied dwelling unit, will be collected in the field work at the address/parcel level. This will therefore be the level of analysis. Independent variables will be related to this analysis level in one of two ways: (1) in cases of points of interest (e.g., job locations), gravity measures will be used to aggregate points weighting by their distance from the parcel centroid; and (2) in cases of average spatial characteristics (e.g., residential density), variables will be aggregated to a half mile buffer around the parcel centroid from the smallest geographic unit available (e.g., Census block group).

Within each group of independent variables, the correlation will be tested between each independent variable and the dependent variable. The dependent variable will be regressed against the independent variable most highly correlated first, with additional independent variables added to the fit, one at a time, based on the strength of the correlation. A t-value, indicating the significance of the independent variable in describing the relationship to the dependent variable, in conjunction with the R-squared value of the fit, will be used to assess the inclusion of the additional variables. As a general approach, an independent variable will be included in the fit if the R-squared value increases (even marginally) and the t-value is greater than one. This approach will be somewhat flexible, however, to allow for consideration of factors such as how previously added variables are impacted by the inclusion of additional variables. This process will serve to isolate the set of best independent variables providing the greatest fit within each category by eliminating highly correlated variables with redundant influence. For example, residential density and gross density will likely both correlate with the dependent variable. However, if residential density shows a stronger correlation and is therefore fit first, gross density, when added to the fit, may have a

high t-value but not increase the R-squared value. This will indicate that while gross density has a strong relationship with the dependent variable, this impact is redundant with that of residential density.

Once the independent variables have been narrowed to the list that best captures five factors identified in the theoretical framework, this process of regressing the occupancy counts against each independent variable one at a time will be repeated, this time without the categorization. Again, only those independent variables that add to the overall explanatory power of the fit will be included in the final regression function. The best fit that is obtained will represent the extent to which the set of independent variables selected describe the variation in parking utilization as observed in the occupancy counts. Further research, if necessary, will be suggested to assess the variation unable to be described.

ALTERNATIVE METHODS OF ESTIMATING PARKING UTILIZATION

Because field data collection is difficult, time consuming, and therefore expensive, it is desirable to represent parking utilization with more readily available and frequently updated data sources, as this will increase the capacity of this research to be replicated in areas where field work is not feasible. As the literature suggests, various measures of auto ownership have been tested as proxies for parking demand or utilization with mixed results. The US Census previously, and now the American Community Survey (ACS), report Vehicles Available, but at the smallest geographic scale of a Census block group. Clearly parcel level data within a block group can vary significantly. Vehicle registrations (available in King County from the Department of Licensing) provide address level data, but questions persist on the potential mismatch between the address of vehicle registration and the home location parking utilization (e.g., vehicles registered in areas with lower insurance costs or taxes).

In the interest of estimating parking utilization without field work, this research will aim to assess the appropriateness of using the Department of Licensing (DOL) registration data or Vehicles Available as proxies for parking utilization. To do so, the utilization rates at the properties where counts were collected will be compared with the DOL registration data for those addresses and the ACS data for the surrounding Census block group. The correlation between the datasets will be tested using a significance level of alpha equal to 0.10 and the critical value of the correlation will be determined after the sample size is known. If the correlation is deemed statistically significant, regression analysis will be used to determine if the regression coefficient is consistent with 1.0 (with a zero intercept) with 90 percent confidence as indicated by the t-value. This will be the necessary threshold for concluding that the two measures of vehicles per residential unit are suitable proxies for each other.

If these criteria are met, the regression analysis of utilization will be repeated using the same methods, however using the DOL registration data or the ACS Vehicles Available data as the dependent variable representing parking utilization, thereby providing a significantly larger sample size with greater geographic coverage. In this regression analysis, however, some

independent variables resulting from the field work (e.g., parking supply) will have to be excluded. The resulting goodness of fit, when compared to that from the regression of the utilization counts from the field data, will indicate if parking utilization can be estimated accurately without field work.

If neither the DOL registration data nor the ACS Vehicles Available data are deemed suitable proxies for the utilization counts data in and of themselves (as tested in the correlation and regression described above), the utilization counts from the field work data will then be regressed again, this time using the DOL registration data and the ACS Vehicles Available data as independent variables. In other words, if a strong correlation is found between the DOL registration data and the utilization data, but the regression coefficient is not consistent with one (making them unsuitable proxies), additional independent variables will be added to the regression to better estimate the dependent variable. While the occupancy counts from the field work will be used as the dependent variable here, this regression will assess if these data can be fit without the use of field work data as independent variables. Additional independent variables will be included along with the DOL registration data or the ACS Vehicles Available data, however excluding variables collected in the field work. This will result in a regression equation that will relate the DOL registration data, the ACS Vehicles Available data, and neighborhood data to collected utilization counts. If this regression provides a reliable fit, it will result in an equation and a model to estimate parking utilization without using the field work data as input variables, and thus be applicable to larger areas than just King County.

To assess the best possible fit for estimating parking utilization while concurrently assessing the need for field work in obtaining these results, this sequence of tests and regression analyses is structured to answer the following questions:

1. How well, as assessed through goodness of fit, can occupancy counts representing parking utilization be estimated through the use of independent variables in a regression analysis?
2. Can DOL registration data or ACS Vehicles Available data represent utilization counts data with 90% confidence?
3. If DOL registration data or the ACS Vehicles Available data are deemed an appropriate proxy for utilization counts, how well, as assessed through goodness of fit, can these data be estimated in a regression analysis *not* utilizing any data collected through field work?
4. If DOL registration data and the ACS Vehicles Available data are *not* deemed appropriate proxies for utilization counts, can the occupancy counts be accurately regressed, as assessed through goodness of fit, using DOL registration data and ACS Vehicles Available data in conjunction with other independent variables (excluding data as independent variables requiring field work)?

ESTIMATING PARKING UTILIZATION IMPACTS

Using best available research findings and accepted rule of thumb assumptions in the industry, impacts will be estimated on variables such as greenhouse gas emissions, vehicle miles traveled, mode split, development costs, and housing costs. For example, CNT's H+T Index provides values for average vehicle miles traveled (VMT) per auto. Using these data in conjunction with the estimated parking utilization, impacts on average VMT can be predicted. Also, if it is assumed that the average auto emits 0.0092 metric tons of carbon dioxide per gallon of gasoline consumed, and that the average auto gets 20.3 miles per gallon of gasoline, the impact of varying parking utilization levels on greenhouse gas emissions can be calculated.

These impacts will be based, in part, on the trends identified in the research and analysis. For example, because the price of parking will be used as an independent variable in estimating parking utilization, an assessment of the impacts of parking prices on these various factors will also be possible. Therefore, if the cost of parking is increased, the model will estimate the resulting impact on parking utilization, and these subsequent impacts can also be calculated.

DEVELOPING PARKING UTILIZATION WEBSITE

To leverage the investment in this research, a website will be developed to support and guide parking supply and management decisions. Using the function developed in the regression analysis of the collected occupancy counts data, a model will estimate parking utilization in all developable parcels[1] in King County. Because the independent variables resulting from the field work will not be available for every parcel, characteristics specific to the building and development will be held constant. In other words, if average unit size, average rent, and the floor to area ratio are determined to be the significant factors defining the housing characteristics, an average value will be calculated for each of these variables. These values will then be used as inputs defining these characteristics in the model. This prototypical development will serve two purposes: it will enable the model to be run throughout the county, even where field data were not collected; and it will enable parking utilization to be assessed separate from the influence of the building or development under consideration. Many of the factors influencing parking utilization cannot be altered by stakeholders or in the context of deciding how much parking is necessary. By modeling utilization for the prototypical building, as a function of these variables on the ground, decision makers will be able to better understand the impacts of the factors they can control.

These controlled model outputs will be displayed through a mapping tool on the website. In other words, visitors to the site will first see a map of King County presenting estimated parking utilization for a prototypical building on all developable parcels in the county. Users

[1] as defined in the Location Criteria of the Phase I methodology

will then have the ability to select a parcel, input details specific to their proposed development, and see the new estimated parking utilization. Users will also, therefore, be able to alter these characteristics and compare the impacts. For example, if the price for planned parking at a proposed building is reduced by half, how will that impact the utilization of parking? The website will enable users to assess these impacts, and therefore, help guide stakeholders' decisions regarding appropriate parking levels.

This approach presents early concepts for the website. As both the analysis and the website development process progress, the most appropriate applications and presentations of the data will be considered and determined.

ATTACHMENT A: INDEPENDENT VARIABLES TO BE TESTED

Characteristics and Variables	Data / Source(s)	Geographic Level / Aggregation Method
Parking Supply and Price		
average cost per space per month	field work	parcel
car sharing access	local sources	gravity measure from parcel centroid
average neighborhood parking cost per day	local sources	block group -> parcel buffer
supply (on-site)	field work	parcel
Property / Development Characteristics		
average rent	field work	parcel
percent affordable units	field work	parcel
dwelling units by land area (footprint density)	field work, assessors data	parcel
dwelling units per 1000 SF (building density)	field work, assessors data	parcel
floor area ratio	field work	parcel
total units (by type and/or size)	field work, assessors data	parcel
proportion developed land within development	PSRC or KC GIS	parcel
price per square foot	field work	parcel
Neighborhood Household Characteristics		
household income (median, average, and per capita)	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
average household size	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
average commuters per household	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
presence of children (possibly % population under 18)	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
average age (possibly % in ranges)	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
average commute distance	LED data	block -> parcel buffer
average autos per household	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
selected monthly owner costs and gross rent	ACS (2005-2009 5-year estimates)	block group -> parcel buffer
Accessibility		
access by land coverage scaled by frequency of service (CNT's TCI)	GTFS data collected by CNT	parcel buffer
accessible area in a given time by transit (total area, jobs, etc)	Network analysis of GTFS data	polygon from parcel centroid
distance to nearest transit stop	GTFS data	network distance from parcel centroid
distance to nearest freeway interchange	TIGER/Line	network distance from parcel centroid
transit stop density	GTFS data	parcel buffer
job gravity	LED data	gravity measure from parcel centroid
service job gravity (access to amenities)	LED data	gravity measure from parcel centroid
job density	LED data	parcel buffer
activity measure (residential + employment)	ACS and LED	parcel buffer
gravity activity measure (residential + employment)	ACS and LED	gravity measure from parcel centroid
job type mix measures (gravity entropy)	NAICS codes in LED data	gravity measure from parcel centroid
proximity to schools		
walkscore	walkscore	parcel buffer
Built Form / Development Patterns		
entropy / land use mix measures	land use data	parcel buffer
residential density / gross density	Census TIGER/Line files	block group -> parcel buffer
average block size / intersection density / block density	Census TIGER/Line files	parcel buffer
link/node ratio	local sources	parcel buffer

Right Size Parking Project

King County Metro Transit

Technical Memo

February 7, 2013

Prepared by:
Center for Neighborhood Technology

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BACKGROUND

King County Metro was awarded a grant in the Federal Highway Administration (FHWA) Value Pricing Pilot Program. The project assembled local information on multi-family residential parking utilization to guide parking supply and management decisions in the future.

To prepare for the research effort, the project team assembled a methods committee of industry and academic experts. This committee provided valuable advice and feedback as the project team created three supporting documents to review literature and outline data collection and analysis methodology:

- **Literature Review** – Highlights previous studies that present standards for estimating parking demand and utilization in addition to studies that have inventoried multi-family parking.
- **Phase I** – Site selection and field data collection consisting of on-site parking utilization counts and assembly of physical building and pricing information.
- **Phase II** – Independent variable data collection, statistical analysis, and model development to predict parking utilization.

LITERATURE REVIEW

A literature review prefaced the methodology discussion of the research. Beginning with an overview of the present standards for estimating parking demand and utilization, the literature review found multiple studies which show that parking is often oversupplied. Many studies focused on the relationships between parking demand and various independent variables like household socio-demographic characteristics, housing type, qualities of the built environment, and parking price and supply. These variables are often considered for their potential influence on the imbalance between supply and demand for parking at multi-family residential properties. The literature review also documents past efforts to model these relationships as well as auto ownership models and their relationship to parking demand. Additionally, data sources that assess auto ownership or vehicle availability were reviewed for their potential to serve as proxy measures for estimating parking demand.

The full literature review can be found at: http://metro.kingcounty.gov/up/projects/right-size-parking/pdf/rsp-litreview_11-2011.pdf

PHASE I: SITE SELECTION AND FIELD DATA COLLECTION

The Phase I research methodology addressed the collection of parking data to help King County assess parking utilization in existing multi-family residential buildings to learn more about residents' parking needs. Approximately 240 properties were the subject of parking field counts assessing residential parking utilization. In addition, information about the physical building characteristics and parking/housing pricing was collected to support the Phase II research.

The full Phase I methodology can be found at: http://metro.kingcounty.gov/up/projects/right-size-parking/pdf/rsp-phase1-methods_12-02-2011.pdf

PHASE II: MODEL DEVELOPMENT

The Phase II research methodology addressed the statistical analyses and the development of a model predicting parking utilization at multi-family residential developments based on a set of independent variables tested in regression analysis. Independent variables tested capture the effects of housing characteristics, neighborhood household characteristics, accessibility, built form, and parking pricing and supply on parking utilization. The resulting predicted utilization is displayed on a website in which users have the ability to incorporate development-specific details to assess the resulting estimated parking utilization.

The original write up of the Phase II research design can be found at: http://metro.kingcounty.gov/up/projects/right-size-parking/pdf/rsp-phase2-methods_11-2011.pdf

RESEARCH OBJECTIVES

As discussed in the literature review, a lack of consensus exists on the factors that drive demand for parking utilization. While socio-demographic, housing, and built environment variables have all been shown to have an impact on parking and vehicle availability, their relative influence is a source of debate. There is more agreement on the fact that parking supply and pricing have a significant impact on parking demand and auto ownership, but these variables have been understudied. This research attempted to address and provide clarity on these issues in addition to providing practical tools to use in development and policy discussions. Specifically, the objectives of this research were to:

- Identify independent variables, both from a theoretical framework and a practical development and planning standpoint, to be tested in regression analysis of parking use data collected in Phase I
- Conduct statistical analysis to test independent variables' significance in predicting parking use
- Develop a model of parking use using regression analysis, maintaining the criteria that all variables be significant and multicollinearity be minimized
- Develop a website tool enabling interactive use of the model by interested stakeholders

PARKING UTILIZATION MODEL DEVELOPMENT METHODS

Information provided in this section summarizes methods, reiterates important points from the original methods documents, and indicates changes in methods that have occurred subsequent to the development of the research design. Please see full original methods documents at: http://metro.kingcounty.gov/up/projects/right-size-parking/.

SITE SELECTION

After initial feasibility testing of 20 sites, a total of 223 sites were assembled representing various types of multi-family development around urbanized King County. Convenience and quota sampling techniques were used to identify eligible sites. The geographic location of eligible

properties was defined to ensure the sample was focused in areas where future multi-family residential development could potentially occur (as described in the Phase I research methods). Numerous developers, property owners, and property management companies were asked to participate in the data collection effort and then quotas were established to ensure a representative sample. Quotas were developed for the following independent variable characteristics: transit connectivity, employment access, average medium gross rent, and average median household income.

Dependent Variable

The dependent variable used in the model estimating parking utilization was 'observed vehicles per occupied residential unit' collected from the field data. Parking utilization was observed on Tuesdays – Thursdays between midnight and 5 AM for all residential parking identified by the property manager at each multi-family development. Parking was mostly provided in off-street garages or lots located on the multi-family parcel, but sometimes in dedicated on-street stalls or satellite garages. Each property manager was interviewed and asked to identify all available parking for residents, which was included in the study. Furthermore, sites selected for the study were screened for building age and available parking supply to control for potential undersupplied parking where spillover could occur. The end results was identification of sites where the predominant parking could be measured through parking counts, excluding sites where undefined off-site, on-street parking may have resulted in underrepresentation of parking use.

Independent Variables

As highlighted in the literature review, little consensus exists on the predominant drivers of parking utilization, although individual studies provide insight on variables to be tested and overall categories of variables to consider. The following theoretical framework was constructed to categorize potential independent variables and guide the regression analysis and model development process.

Parking Supply and Price:

As the two predominant indicators of demand, it is believed that parking supply and price will have a large impact on parking utilization. As basic theory suggests, low supply should correspond to low utilization and high prices should also indicate low utilization. Clearly, this can vary depending on context, but this basic trend was hypothesized to hold true in the data.

Property/Development Characteristics:

Studies have shown characteristics specific to the properties studied to be indicators of parking utilization. Higher density developments (both by lot size as well as by floor space) and lower rents have both correlated with low utilization rates in these studies, and therefore, were hypothesized to correlate in the data.

Neighborhood Household Characteristics:

Research has shown neighborhood income, household size, and commuters per household all correlating with auto ownership rates. Therefore, to the extent that neighborhood

demographics reflect the building/development demographics, high income, large household size, and many commuters per household in the neighborhood are hypothesized to correlate with high auto ownership and thus high parking utilization rates.

Accessibility:

High levels of access to public transit, jobs, and services are all expected to correspond with low parking utilization rates. Conversely, poor access requiring high dependence on auto travel should correspond with high parking utilization in the data.

Built Form and Development Patterns:

Much research on auto ownership and auto use has highlighted the significance of built form and development patterns on auto dependence. High density, interconnected street networks, and a mix of land uses all have correlated with low auto ownership and use, and therefore, should theoretically correspond with low parking utilization in the data.

Because one variable can be represented in many different formats using different metrics, an extensive list of potential explanatory variables was analyzed. For example, while it was expected that transit access would correlate with parking utilization rates, the best measure of transit access to best explain utilization rates was unknown. Due to this, potential independent variables were grouped into the following five categories—parking supply and price, property/development characteristics, neighborhood household characteristics, accessibility, and built form and development patterns—enabling consideration of the greatest number of possible variables to capture these factors.

Data used to capture these variables were collected from a variety of sources. The field work surveys of property managers proved to be an important data source for the variables pertaining to specific buildings. The American Community Survey (ACS) 2006-2010 5-year estimates at the block group level and the 2010 Census at the block level were both used to capture characteristics of households in the neighborhoods as well as built environment characteristics (e.g. residential density). Local data were also obtained from the King County GIS Center (obtained in June, 2012), Walkscore (obtained April, 2012), Zipcar (obtained January, 2012), and Puget Sound Regional Council (PSRC) (employment data representing 2010). Local transit data compiled by CNT were also used, current as of May, 2012. Because data represent a snapshot in time, data were obtained with the effort to be as current and up-to-date as possible.

Because the dependent variable for the regression analysis pertains to the parcel level and data for these independent variables are at various geographic levels, data aggregation was necessary. Data pertaining to blocks or block groups were proportionally aggregated to a 0.5 mile buffer around each parcel. Many variables were aggregated using a gravity calculation (1/distance^2). These were point to point calculations (using Euclidian distances) from the centroid of each parcel to the point locations of the given data. Count and density calculations used a 0.5 mile buffer around each parcel and the land area contained within this buffer.

Attachment A lists all independent variables tested. The linear transformations tested (as described below in the regression analysis section), data sources, and aggregation methods are also noted in Attachment A.

REGRESSION ANALYSIS

MODELING PROCESS

Beginning with the presumption in regression analysis that the ordinary least squares (OLS) provides the optimal approach (with other methods only pursued if OLS proves inadequate), a simple linear regression model was used. However, because relationships between the dependent and independent variables were not all assumed to be linear, all variables were tested using various transformations. In other words, the correlations were tested for each independent variable in its linear form, but also in transformed forms, such as the natural log or inverse of each variable, to find the transformation that correlated best with the dependent variable. For variables that never equal zero (for example, however small, all parcels have some level of job access), the natural log, inverse, square root, square, and cube transformations were tested. Because the natural log and inverse cannot be calculated for a value of zero, for variables that could equal zero, only the square root, square, and cube transformations were tested. The dependent variable was then regressed against every independent variable (including all transformed versions) to test the individual correlations as a first step.

To construct the regression analysis, many approaches were tested to find the best method of including, removing, and finding the best set of variables. The linear regression function in SPSS was used, 'observed vehicles per occupied residential unit' was set as the dependent variable, and independent variables were included, added, and removed through various processes. Because each factor or characteristic was represented using many independent variables (as well as multiple transformations of each), multicollinearity, or a high level of correlation between independent variables, was an important consideration. High levels of multicollinearity can negatively impact the accuracy of models and must be minimized. In the end, the goal was to find the set of variables that made the most sense in terms of a theoretical framework and from practical development and planning standpoint, while also maintaining the criteria that all variables be significant (the probability that the coefficient is non-zero, or P less than 0.05) and all multicollinearity be low (as assessed through variance inflation factors, or VIF values, less than 5).

To build the model, many traditional statistical approaches were tested. A stepwise method was employed, using an entry criterion of 0.05 and a removal criterion of 0.10 for the probability of F, both within the five groups described above as well as ignoring the groupings. Another method involved adding independent variables to the regression one at a time, starting with the variables with the strongest correlation to the dependent variable. This approach was also applied to both the five groups of independent variables as well as to the full set of all variables. Another basic method tested was to include all variables in the initial regression and then remove variables one at a time, starting with those least significant.

While the R-square values resulting from each approach were good (in the range of 70 – 80%), none of the resulting sets of variables were ideal. Some approaches resulted in too many variables to be practical or useful in a planning or development context (well over 20). All approaches resulted with less than ideal or intuitive variables included. For example, one approach included the variable representing the count of three-bedroom units, but no other count or average number of bedrooms. From a planning or development standpoint, this does not represent a useful variable. Also, in all approaches, the resulting variables had high levels of multicollinearity.

To resolve these issues, the theoretical framework was revisited. Starting with a set of variables that appeared in the highly scoring results of multiple approaches and using the stepwise method, variables were tested based on logical candidates from a planning or development context. For example, in the case where the count of three-bedroom units was in the final set of variables, this was removed and all variables pertaining to average bedroom counts were added and tested in a stepwise method. Or, if two variables had high collinearity, such as block size and the transit connectivity index, one was removed and various variables were tested to replace the other.

Throughout this process, outlying cases were tested to ensure no one outlying property was influencing the fit too significantly. Cases (sample properties) with high leverage values (approximately > 0.5) or outlying residuals (as identified through separated tails in a residual histogram) were removed from the sample. In the end, 15 cases were removed based on these criteria, making the final sample 208 properties.

Supply of Parking

Supply is often cited as one of the most important variables in determining demand, and many past studies have found high correlations between the two factors. A high correlation was found in the data in this research as well, and the added explanatory power supply contributed in predicting parking use indicated that it should be included in the model. However, estimating parking utilization for the purposes of informing supply decisions should not be a function of supply. In other words, it was not desirable for the model to capture situations where parking utilization was low purely because little parking was supplied, rather than because little was demanded. Therefore, because the goal here was to estimate the full quantity of parking that would be demanded at a given property, parking supply was excluded as an independent variable from the model.

FINAL MODEL

The final model resulting from this regression analysis incorporated seven variables (listed and described below) – five pertaining to the property or development characteristics and two of the built environment, or specifically, access. The goodness of fit is explained with an R-square value of 81.0%, an adjusted R-square value of 80.3%, and a standard error of 0.16.

Table 1 below shows the seven variables, the transformation used, the coefficient values, the individual R-square values, and the stepwise R-square values. Individual R-square values

represent the correlation between the given variable and the dependent variable. The stepwise R-square value represents the improving R-square value as each variable is added to the final model.

Table 1: Model Variables

Independent Variable	Transformation	Coefficient	Individual R Square	Stepwise R Square
Constant	NA	1.980910	NA	NA
Gravity measure of Transit Frequency	Natural log	-0.066639	55.5%	55.5%
Percent of Units Designated Affordable	Square root	-0.022966	27.6%	67.1%
Average Occupied Bedroom Count	Inverse	-0.360291	34.3%	73.7%
Gravity measure of Intensity (population + jobs)	Inverse	35,353.047567	53.3%	76.2%
Units per Residential Square Feet	Inverse	0.000139	17.1%	78.7%
Average Rent	Inverse	-154.420722	6.7%	80.0%
Parking Price as a fraction of Average Rent	Square root	-0.334655	18.1%	81.0%

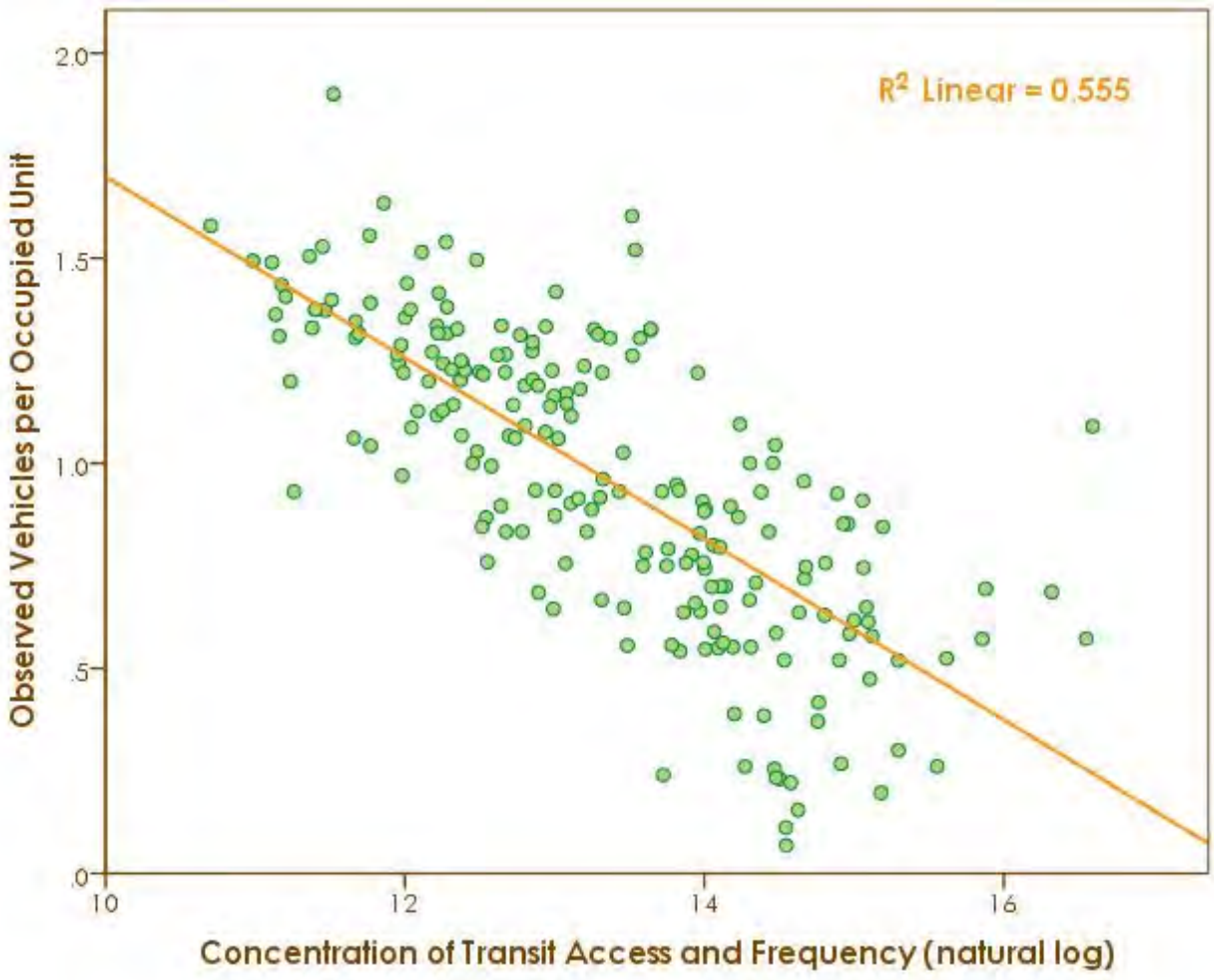
INDEPENDENT VARIABLES

Gravity measure of Transit Frequency

Gravity measures take into account both the quantity and proximity of the factor being measured by calculating the quantity divided by the distance squared from a given parcel's centroid. Therefore, the gravity measure of transit frequency accounts for all transit stops and stations, scaled by the frequency of service, and then sums the value to each parcel based on the distance from the given parcel. This can best be understood as a measure of concentration.

Many measures of transit access correlated strongly with parking utilization. Our data indicates, as seen in Figure 1, the natural log transformation of concentration of transit frequency and observed vehicles per occupied unit show a tight fit, and the R-square of 55.5% confirms this. Interestingly, transit access measures also correlated strongly with many other variables pertaining to the built environment (e.g. average block size). Therefore, the inclusion of a transit access measure in the model precluded the use of many other built environment or location characteristics, as multicollinearity would have been a problem. However, this was viewed as a positive finding, in the indication that transit is located and concentrated in areas where other built environment variables are high, and is able to account for many factors.

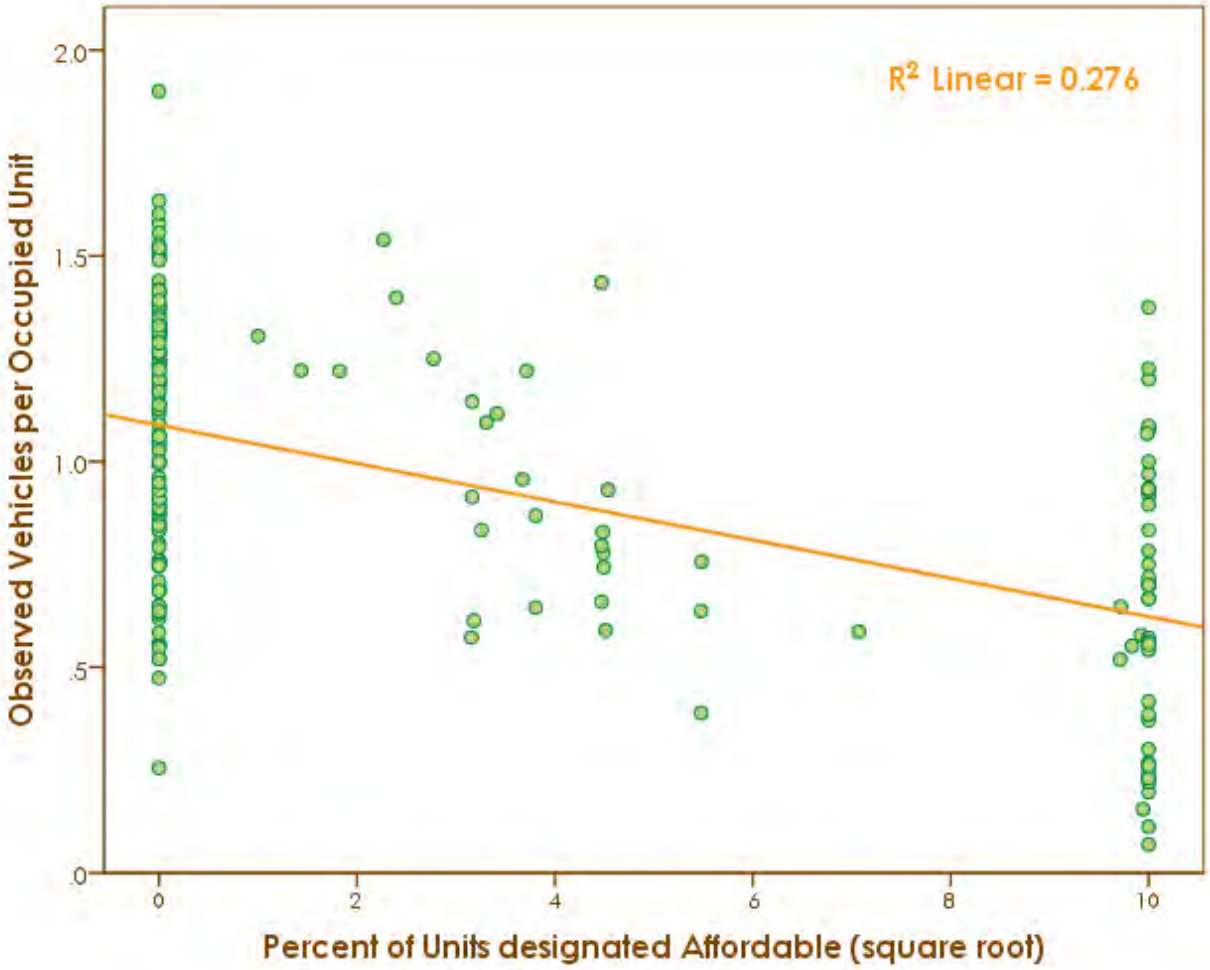
Figure 1: Gravity Measure of Transit Frequency



Percent of Units designated Affordable

This variable includes all units identified as affordable by any designation as a percent of all units (regardless of occupancy). Our data indicates that as the percent of affordable units goes up, parking utilization goes down (see Figure 2). In this case, the square root of the variable was the transformation that had the strongest correlation and was used in the final model. This was one trend that was frequently noted and agreed upon in the literature: affordable developments or those geared towards lower income households tend to demand less parking per unit.

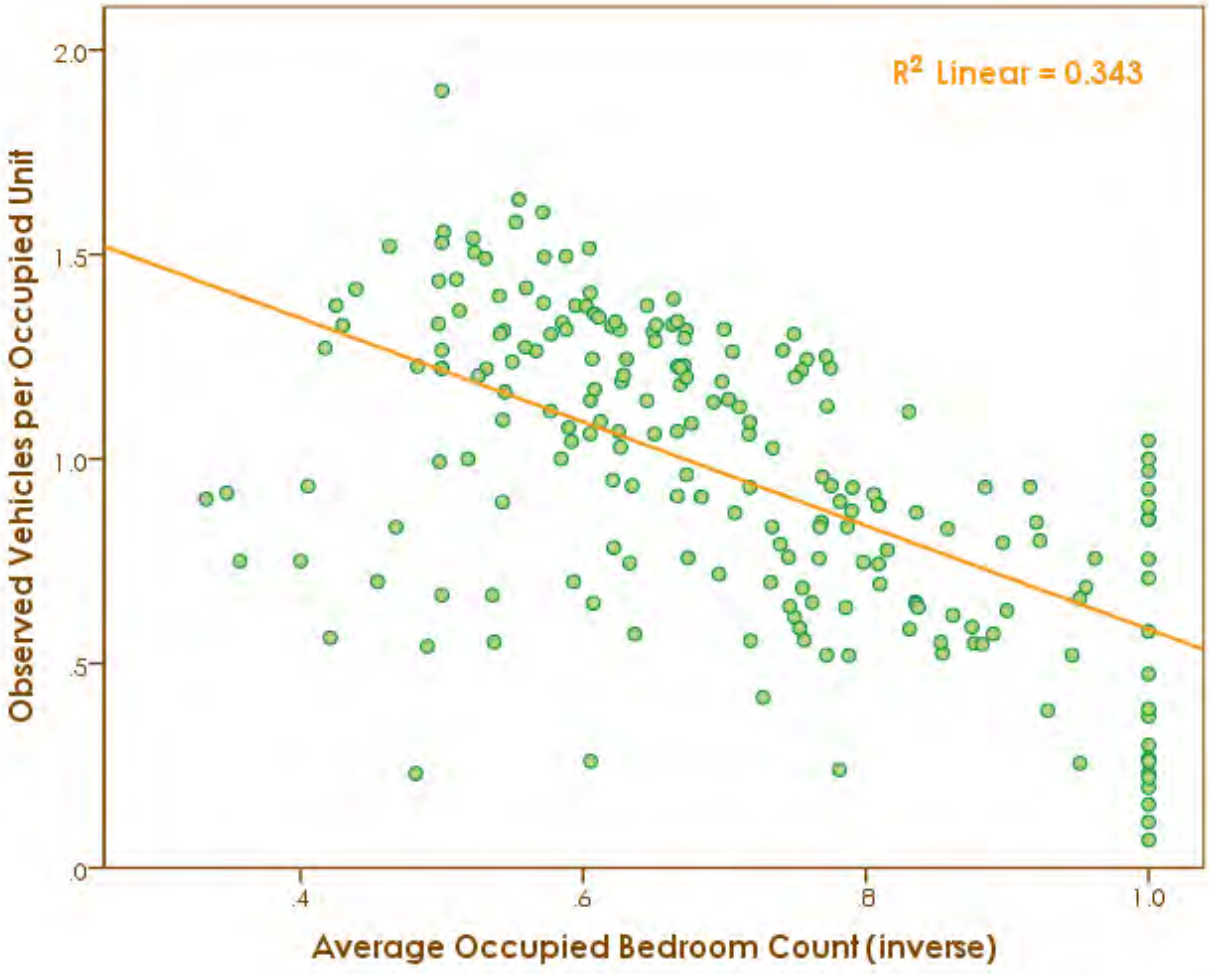
Figure 2: Percent of Units designated Affordable



Average Occupied Bedroom Count

Average occupied bedroom count is the average number of bedrooms in all occupied units. To calculate this average, studio units were assumed to have a bedroom count of one. Our data indicates that the average count of bedrooms has a positive correlation with parking utilization: as average bedroom count goes up, parking utilization goes up. However, because the inverse transformation had the strongest correlation, Figure 3 shows a negative trend.

Figure 3: Average Occupied Bedroom Count

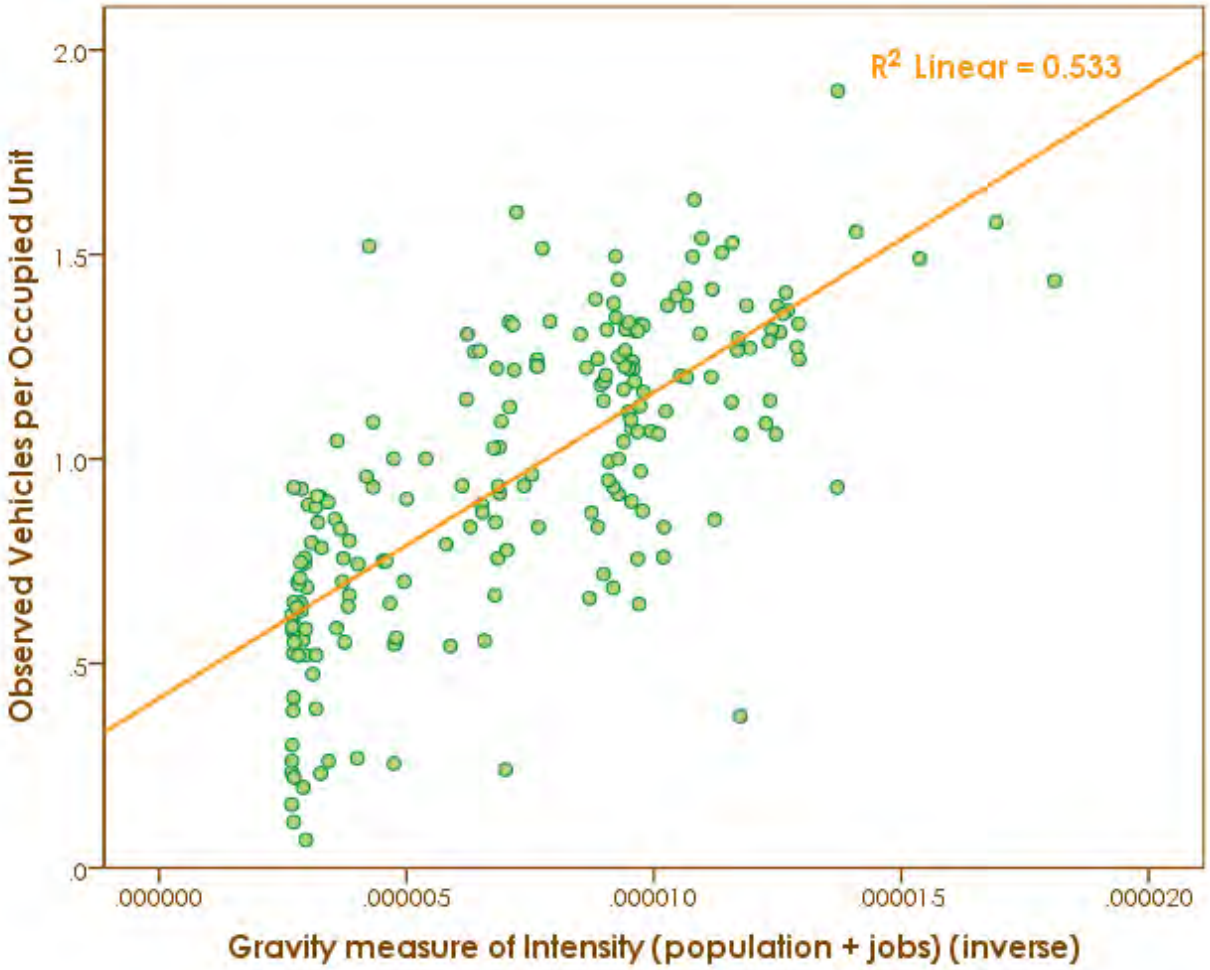


Gravity measure of Intensity (population + jobs)

As described above, gravity measures take into account both the quantity and proximity of the factor being measured by calculating the quantity divided by the distance squared from a given parcel's centroid. In the case of intensity, the factor being measured is the sum of population and jobs. Therefore, understanding this as a concentration, a high value can be the result of highly concentrated residential populations, highly concentrated jobs, or some combination of the two.

Previous research often found a strong correlation between both residential density and job access with auto ownership. The strong correlation of the gravity measure of intensity and observed vehicles per occupied unit observed in our data supports these findings. Measures of population concentrations, population and household density measures, and various measures of job access all correlated strongly with utilization: as people and/or jobs concentrate, parking utilization goes down. The inverse of the gravity measure of intensity was the variable that worked best in the model, therefore making the trend observed positive (as seen in Figure 4), or the opposite of that expected.

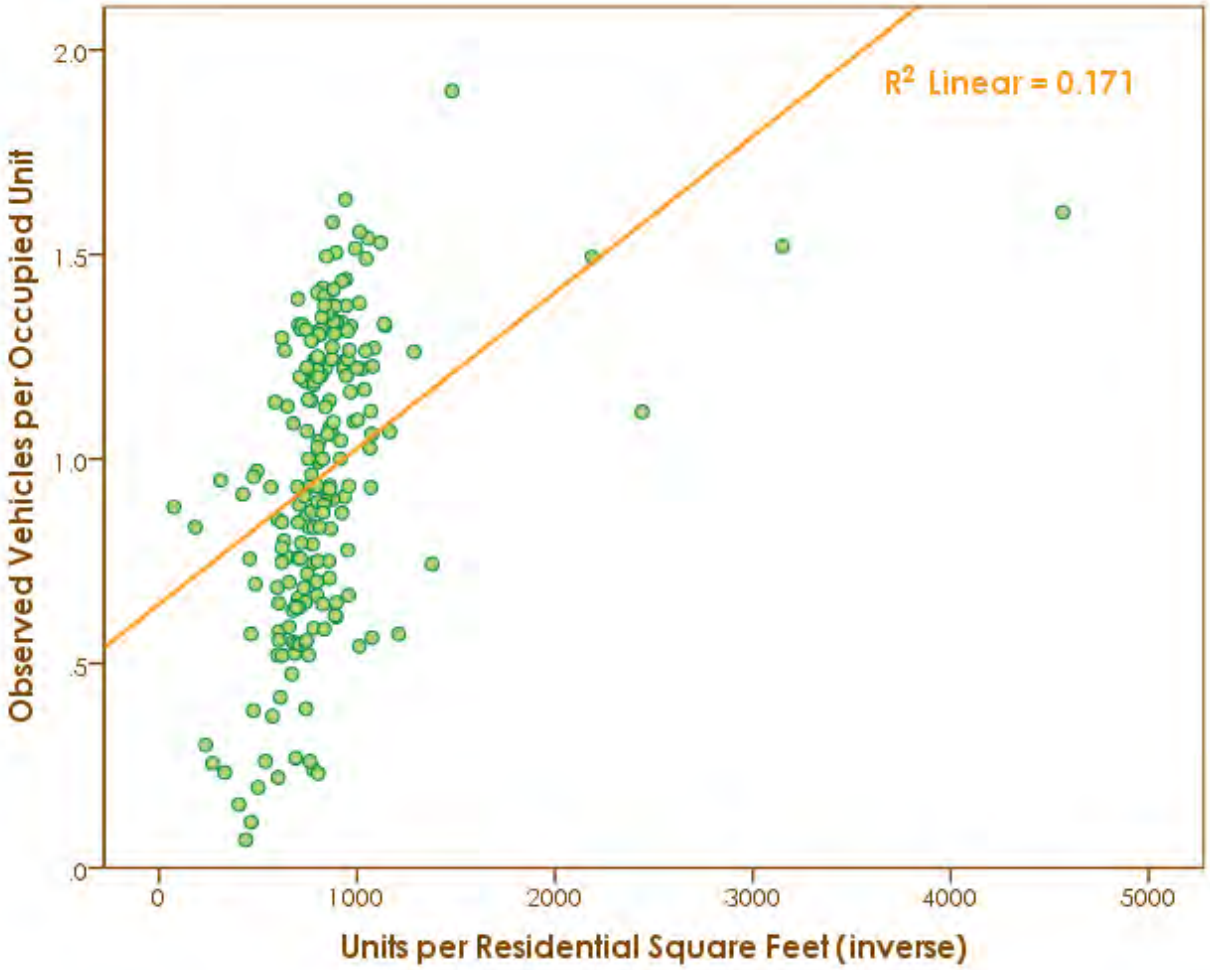
Figure 4: Gravity measure of Intensity



Units per Residential Square Feet

Obtained from the property managers, units per residential square feet is calculated as total residential units divided by the residential square feet of the development. This variable essentially captures the average size of units in that the greater the units per square feet, the smaller the units. Our data indicates that as units per residential square feet goes up, or average unit size goes down, parking utilization goes down. Again, because the inverse transformation showed the strongest correlation, it was used, and the opposite trend is observed in Figure 5.

Figure 5: Units per Residential Square Feet

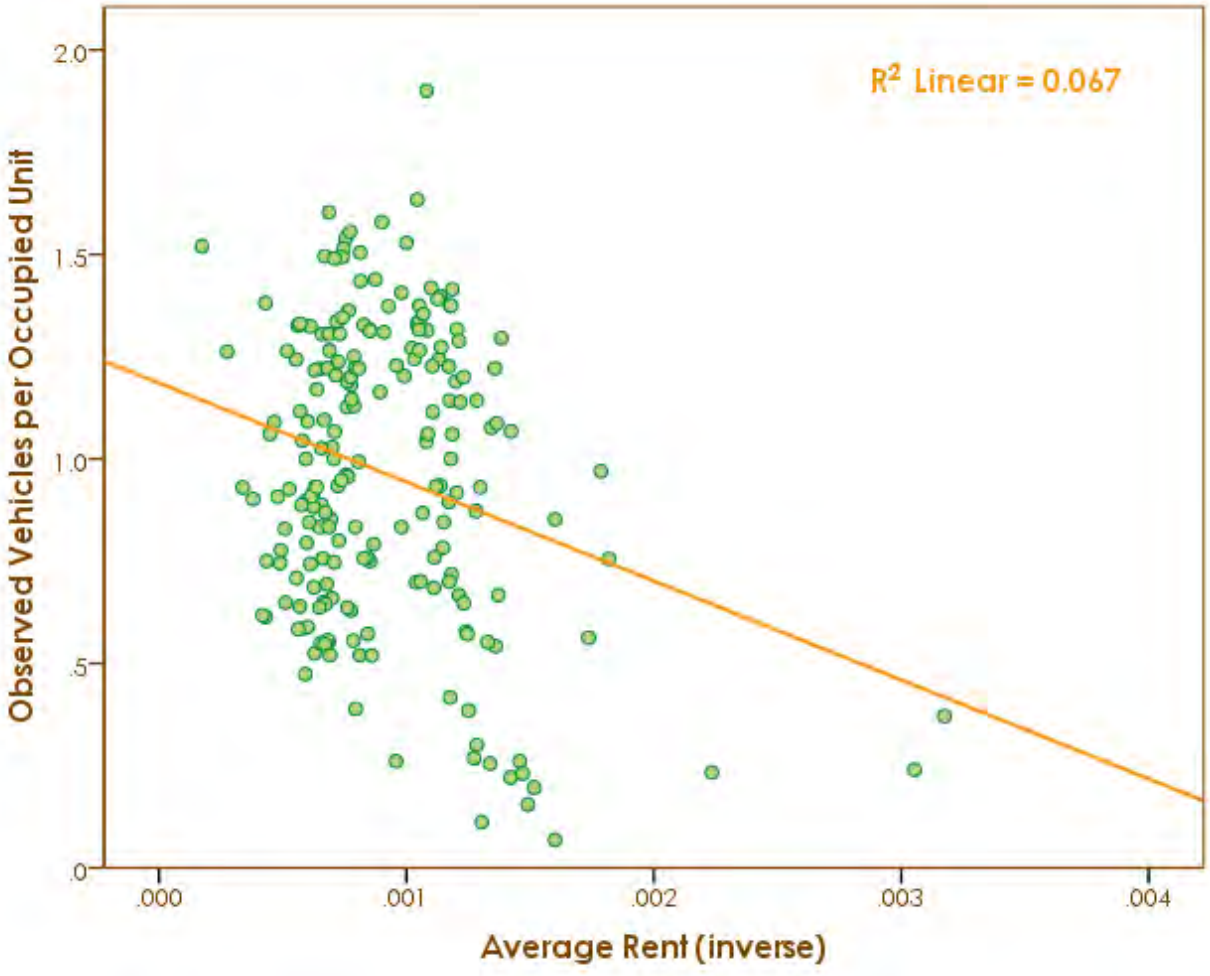


Average Rent

Obtained from the property managers, average rent represents the average monthly costs of all residential units in the building. Our data indicates that as average rent goes up, the observed parking utilization goes up. Because the inverse transformation was used due to its stronger correlation, the trend observed below, in Figure 6, is negative (as average rent goes up, the inverse of average rent goes down).

Average rent (in dollars) was not one of the variables with a very strong correlation by itself (R-square of 6.7%). However, when added to the set of variables comprising the model, average rent was significant and added more explanatory power than many variables with higher individual correlations.

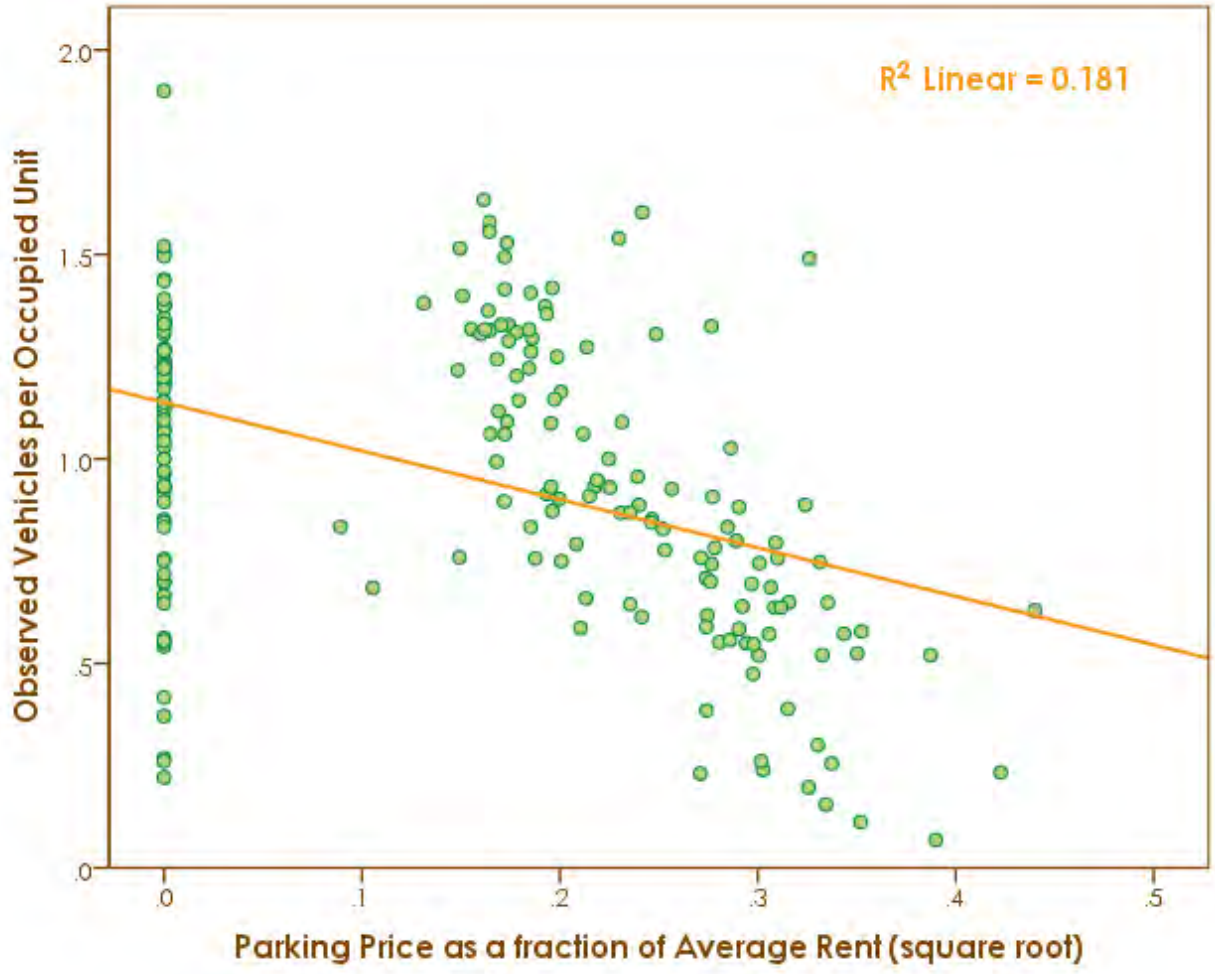
Figure 6: Average Rent (dollars)



Parking Price as a fraction of Average Rent

Parking price as a fraction of average rent is calculated as the monthly price of parking per stall divided by the average monthly rent. In properties with unpaid parking, this value is zero. This value approaches one as the cost of parking nears the cost of rent. According to basic economic theory and much literature, price should impact demand. However, parking price, as a dollar figure in and of itself, showed a very low correlation with parking utilization. A monthly parking price of $100, for example, is felt very differently between very expensive and very inexpensive residential developments. To account for this fact, parking price as a fraction of rent was used and correlated much more strongly with parking utilization. Our data indicates a negative trend, as seen in Figure 7, showing that as parking price nears the cost of rent, parking utilization goes down. Note that the square root transformation was used, as it correlated best with the dependent variable.

Figure 7: Parking Price as a fraction of Average Rent



LIMITATIONS

The final model resulting from this regression analysis can help support and guide decisions about parking supply and management. It cannot provide definitive answers about specific future policies or developments, but can serve as a resource to inform discussions as users weigh the factors affecting parking use and consider how much parking to provide.

Model Estimates and Data Collection

The final model is statistically very strong, but it is important to note that it is just a model and there is always error in estimates (the standard error for this model's estimates is 0.16; see Attachment B for the SPSS outputs of model parameters). Limitations on data collection also affect the model's accuracy. Observed parking mostly included supply that was on-site and off-street, unless additional parking provided for residents was noted by property managers. However, the sites selected for the study were screened based on building age and available parking supply, in order to control for potential undersupplied parking that could result in spillover. The result was sites studied whose predominant parking could be measured through parking counts, rather than those where undefined off-site parking would have resulted in an underrepresentation of parking use.

Additionally, data utilized in the model are collected and compiled representing one point in time. As factors of the built environment change (e.g. transit service is expanded), and parking utilization changes, it will be necessary to update both independent and dependent variables and reassess their relationships.

Potential Deviation from the Model's Estimates

Real-world parking use can and will vary from these estimates for many reasons. Actions can be taken to reduce parking use below the levels predicted by this model. In addition to non-typical development opportunities, transportation demand management strategies, including the provision of residential transit passes, car sharing memberships, and bicycle facilities, have been shown to reduce car ownership and parking use. Some of these strategies were tested as the model was developed, but not enough cases were available to test with statistical rigor, so the model does not capture their influence.

Model Coverage

To ensure confidence in the model estimates, limits were established for the coverage area. The sample utilized for data collection covered a wide range of built environment characteristics and land uses, but it did not cover the full spectrum found throughout the county. Therefore, the coverage for which model estimates were calculated was limited to range of built environment characteristics found in the data collection sample. In other words, areas of the county that had lower transit service, population, or job concentrations than those found in the sample were removed from the coverage area.

RIGHT SIZE PARKING WEBSITE

The Right Size Parking Calculator (www.rightsizeparking.org) was developed to support and guide parking supply and management decisions. Using the final model developed to estimate parking utilization, resulting outputs for most developable parcels in King County are illustrated on this interactive, mapping website. Users have the ability to select a parcel, input details specific to a proposed development, adjust factors of the built environment, and see the new estimated parking utilization. Users can also, therefore, alter these characteristics and compare the impacts. For example, if the price for planned parking at a proposed building is reduced by half, the impacts on estimated utilization can be viewed. The website enables users to assess these impacts, helping to guide stakeholders' decisions regarding appropriate parking levels.

PROTOTYPICAL DEVELOPMENT

The five variables in the final model specific to the building and obtained from field work are not available for all parcels across the study area. However, value inputs for these variables are necessary to run the model and produce utilization estimates for any given parcel. To create estimates for each study area parcel, the model is run for a prototypical building, in which these five variables are calculated as the averages from the field work sample, and parking utilization is estimated for it. Because the results of this analysis are presented on the interactive Right Size Parking Calculator, the user has the ability to change any of these inputs and estimate parking utilization for any set of building characteristics.

It is not assumed that this prototypical building will exist on all parcels. It is simply used as a baseline to show how parking utilization varies across the region if building characteristics are held constant. It is expected that a user interested in an area would adjust the building characteristics to better match the local context, both at the parcel, neighborhood, or even city level. Each parcel is treated individually, and the model is run assuming this prototypical building is built on any given parcel (or set of merged parcels when this feature is used).

PARKING UTILIZATION IMPACT CALCULATIONS

Using best available research findings and accepted rule of thumb assumptions in the industry, additional impacts were estimated to highlight the additional 'costs' of parking for display on the Right Size Parking Calculator website. Impacts calculated include: total capital costs of parking, monthly costs per residential unit, GHG emissions from construction and maintenance, annual vehicle miles traveled of building residents, and GHG emissions from the vehicle use of residents. The calculations used for each impact are specified below.

Total Capital Costs (land + construction)[1]

Average capital costs per stall were calculated as land and construction costs for both surface and structure parking, which vary by land costs (see Table 2 below). To calculate land costs, parcels were assigned the average land value per acre of their associated suburban, urban, or central business district location, which were defined by locational, employment and residential density, and street network density (intersections per acre) characteristics.

Monthly Costs per Residential Unit (including Operations & Maintenance)[2]

Average monthly operation and maintenance costs were calculated as a function of the parking ratio (stalls/unit) to estimate costs that would be potentially passed along to the residents on a per unit basis. These costs also vary by land costs, and were therefore calculated for suburban, urban, and central business district locations (as shown below in Table 2).

Table 2: Parking Costs by Land Use types

		Total Capital Costs (Land and Construction):		Monthly Costs per Residential Unit (including O&M):	
Suburban	Surface	*total stalls x*	$8,226	*parking ratio x*	$85
	Structured	*total stalls x*	$17,613	*parking ratio x*	$170
Urban	Surface	*total stalls x*	$26,665	*parking ratio x*	$235
	Structured	*total stalls x*	$25,222	*parking ratio x*	$233
CBD	Surface	*total stalls x*	$71,696	*parking ratio x*	$571
	Structured	*total stalls x*	$36,674	*parking ratio x*	$325

Annual GHG Emissions from Construction and Maintenance (kg CO_2E)[3]

Because emissions from construction and maintenance vary by the type of parking built, average estimates were calculated for both surface and structure parking.

kg CO2e from Surface Parking = total stalls * 71
kg CO2e from Structure Parking = total stalls * 173

Estimated Annual VMT of Building Residents[4]

Neighborhood level estimates of household vehicle miles traveled were averaged to a 0.5 mile buffer surrounding each parcel. It was then assumed that each parking stall built would contain an automobile that would be driven this average amount per year for the neighborhood.

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[1] www.vtpi.org/parking.xls from http://www.vtpi.org/tca/tca0504.pdf
[2] Ibid
[3] http://iopscience.iop.org/1748-9326/5/3/034001/fulltext/; Scenario 2 was used as a conservative estimate
[4] Census block group level VMT was utilized from the Center for Neighborhood Technology's H+T® Index to derive VMT per auto: htaindex.cnt.org

Annual VMT of residents = total stalls * average VMT per auto

GHG Emissions from Vehicle Use of Residents (kg CO_2)[5]

Using the VMT estimates calculated above, greenhouse gas emissions were estimated using average fuel efficiency and emissions factors.

GHG emissions from residents' vehicle use = Total VMT / average MPG (21.6 miles/gallon[6]) * carbon emissions factor (8.78 kg/gallon[7])

CONCLUSIONS

The research found that characteristics of a building, and therefore, the residents that will be drawn to it, play a role in determining the parking utilization. Luxury three-bedroom units will draw residents with different parking needs than an inexpensive building consisting primarily of studio units. Similarly, buildings in different locations with different built environment characteristics will require different levels of parking. Residents of a building in a downtown location with high levels of transit access and job access will require less parking than a building in a suburban location with few amenities or travel mode options.

In the model development, no one aspect or type of variable told the whole story. When taking the final five building characteristics and running the regression analysis on those alone, an adjusted R-square value of 65.8% was obtained. Taking the two location characteristics and just using those alone estimated utilization with an adjusted R-square of 59.4%. In other words, considering a building or development outside of the context in which it is built, one cannot accurately estimate parking ratios. And conversely, the built environment alone cannot fully account for variation in parking ratios. To accurately estimate parking ratios or utilization, both the building itself and the location in which it is constructed must be taken into consideration.

The Right Size Parking project and Calculator website provide analysts, planners, developers, and community members with a new tool to weigh these factors and consider the proper provision of parking. By highlighting additional impacts of parking levels, the website also enables users to consider questions of parking from different angles and assess the implications of not appropriately sizing parking.

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[5] Ibid
[6] http://www.fhwa.dot.gov/policyinformation/statistics/2010/vm1.cfm
[7] page 17 in http://www.theclimateregistry.org/downloads/2012/01/2012-Climate-Registry-Default-Emissions-Factors.pdf

Variable	Specific Variable	Transformations Tested	Data Source	Aggregation Method
Parking Supply and Price				
average cost per space per month	average monthly price ($) per residential space	square root, square, cube	field work	NA
	residential paid parking (yes/no)	n/a	field work	NA
	average parking price / average rent	square root, square, cube	field work	NA
car sharing access	carsharing spaces at development / total residential units	square root, square, cube	field work	NA
supply (on-site)	residential parking spaces / total residential units	natural log, inverse, square root, square, cube	field work	NA
	residential parking spaces / total residential bedroom count	natural log, inverse, square root, square, cube	field work	NA
Property / Development Characteristics				
average rent	average monthly rent ($) of all residential units	natural log, inverse, square root, square, cube	field work	NA
percent affordable units	percent of all residential units designated as affordable	square root, square, cube	field work	NA
	percent of all residential units designated affordable to 80-100% AMI households	square root, square, cube	field work	NA
	percent of all residential units designated affordable to 60-80% AMI households	square root, square, cube	field work	NA
	percent of all residential units designated affordable to less than 60% AMI households	square root, square, cube	field work	NA
percent senior designated units	percent of all residential units designated as senior units	square root, square, cube	field work	NA
dwelling units by land area (footprint density)	total residential units / land area of parcel	natural log, inverse, square root, square, cube	field work	NA
	total residential square feet / land area of parcel	natural log, inverse, square root, square, cube	field work	NA
	total building square feet / land area of parcel	natural log, inverse, square root, square, cube	field work	NA
building density	total residential units / total residential square feet	natural log, inverse, square root, square, cube	field work	NA
	total building square feet	natural log, inverse, square root, square, cube	field work	NA
	total residential square feet	natural log, inverse, square root, square, cube	field work	NA

total units (by type)	total residential units	natural log, inverse, square root, square, cube	field work	NA
	total occupied residential units	natural log, inverse, square root, square, cube	field work	NA
	total bedrooms (assuming studios equal 0)	square root, square, cube	field work	NA
	total bedrooms (assuming studios equal 1)	natural log, inverse, square root, square, cube	field work	NA
	count of occupied studio units	square root, square, cube	field work	NA
	count of occupied 1 bedroom units	square root, square, cube	field work	NA
	count of occupied 2 bedroom units	square root, square, cube	field work	NA
	count of occupied 3 bedroom units	square root, square, cube	field work	NA
	total bedrooms in occupied units (assuming studios equal 0)	square root, square, cube	field work	NA
	total bedrooms in occupied units (assuming studios equal 1)	natural log, inverse, square root, square, cube	field work	NA
	average bedrooms per unit (assuming studios equal 0)	square root, square, cube	field work	NA
	average bedrooms per unit (assuming studios equal 1)	natural log, inverse, square root, square, cube	field work	NA
	average bedrooms per occupied unit (assuming studios equal 0)	square root, square, cube	field work	NA
	average bedrooms per occupied unit (assuming studios equal 1)	natural log, inverse, square root, square, cube	field work	NA
Neighborhood Household Characteristics				
household income (median, average, and per capita)	average neighborhood income	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
	average median neighborhood income	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
	average per capita neighborhood income	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
average household size	average neighborhood household size	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
average commuters per household	average neighborhood commuters per household	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
presence of children (% population under 18)	average percent of neighborhood population under 18 years old	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
average age	average neighborhood population median age	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
average autos per household	average neighborhood autos available per household	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers

selected monthly owner costs and gross rent	average neighborhood gross rent	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
	average median neighborhood gross rent	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
	average neighborhood selected monthly owner costs	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
	average median neighborhood selected monthly owner costs	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
Tenure (renters v. owners)	average neighborhood percent renter households	natural log, inverse, square root, square, cube	ACS 2006-2010	averaged from block groups to parcel buffers
Accessibility				
access by land coverage scaled by frequency of service (CNT's TCI)	transit connectivity index	natural log, inverse, square root, square, cube	CNT's GTFS data	block group model applied to parcels
accessible area in a given time by transit (total area, jobs, etc)	accessible area (acres) by transit in 30 minutes	natural log, inverse, square root, square, cube	CNT's GTFS data	area accessible in 30 minutes by transit
	total jobs contained within a 30 minute transit access area	natural log, inverse, square root, square, cube	CNT's GTFS data and PSRC employment	count of jobs in transit access shed
	total service jobs contained within a 30 minute transit access area	natural log, inverse, square root, square, cube	CNT's GTFS data and PSRC employment	count of service jobs in transit access shed
	total population contained within a 30 minute transit access area	natural log, inverse, square root, square, cube	CNT's GTFS data and Census 2010	population in transit access shed
distance to nearest transit stop	network distance to nearest transit stop	square root, square, cube	CNT's GTFS data	NA
	Euclidean distance to nearest transit stop	natural log, inverse, square root, square, cube	CNT's GTFS data	NA
transit stop density	count of transit stops within 0.5 miles of parcel	natural log, inverse, square root, square, cube	CNT's GTFS data	count in parcel buffer
	density of transit stops within 0.5 miles of parcel	natural log, inverse, square root, square, cube	CNT's GTFS data	count in parcel buffer / land area (acres)
	gravity measure (quantity scaled by distance) of transit stops and frequency	natural log, inverse, square root, square, cube	CNT's GTFS data	gravity calculation from parcel centroid
job gravity	gravity measure (quantity scaled by distance) of total jobs	natural log, inverse, square root, square, cube	PSRC employment	gravity calculation from parcel centroid
job density	total jobs within 0.5 miles of parcel	natural log, inverse, square root, square, cube	PSRC employment	count in parcel buffer
	density of total jobs within 0.5 miles of parcel	natural log, inverse, square root, square, cube	PSRC employment	count in parcel buffer / land area (acres)
service job access (access to amenities)	gravity measure (quantity scaled by distance) of service jobs	natural log, inverse, square root, square, cube	PSRC employment	gravity calculation from parcel centroid
	service jobs within 0.5 miles of parcel	natural log, inverse, square root, square, cube	PSRC employment	count in parcel buffer
activity measure (residential + employment)	density of sum of population and jobs within 0.5 mils of parcel	natural log, inverse, square root, square, cube	PSRC employment and Census 2010	count in parcel buffer / land area (acres)
gravity activity measure (residential + employment)	gravity measure (quantity scaled by distance) of population plus jobs	natural log, inverse, square root, square, cube	PSRC employment and Census 2010	gravity calculation from parcel centroid

proximity to schools	gravity measure (quantity scaled by distance) of high schools	natural log, inverse, square root, square, cube	KC GIS	gravity calculation from parcel centroid
	network distance to nearest high school	square root, square, cube	KC GIS	NA
	Euclidean distance to nearest high school	natural log, inverse, square root, square, cube	KC GIS	NA
	total count of high schools within 0.5 miles of parcel	square root, square, cube	KC GIS	count in parcel buffer
	gravity measure (quantity scaled by distance) of middle schools	natural log, inverse, square root, square, cube	KC GIS	gravity calculation from parcel centroid
	network distance to nearest middle school	square root, square, cube	KC GIS	NA
	Euclidean distance to nearest middle school	natural log, inverse, square root, square, cube	KC GIS	NA
	total count of middle schools within 0.5 miles of parcel	square root, square, cube	KC GIS	count in parcel buffer
	gravity measure (quantity scaled by distance) of elementary schools	natural log, inverse, square root, square, cube	KC GIS	gravity calculation from parcel centroid
	network distance to nearest elementary school	square root, square, cube	KC GIS	NA
	Euclidean distance to nearest elementary school	natural log, inverse, square root, square, cube	KC GIS	NA
	total count of elementary schools within 0.5 miles of parcel	square root, square, cube	KC GIS	count in parcel buffer
	gravity measure (quantity scaled by distance) of all schools	natural log, inverse, square root, square, cube	KC GIS	gravity calculation from parcel centroid
	network distance to nearest school	square root, square, cube	KC GIS	NA
	Euclidean distance to nearest school	natural log, inverse, square root, square, cube	KC GIS	NA
	total count of schools within 0.5 miles of parcel	square root, square, cube	KC GIS	count in parcel buffer
walkscore	average walkscore within 0.5 miles of parcel	natural log, inverse, square root, square, cube	Walkscore	averaged from block to parcel buffers
	walkscore value of block containing parcel	natural log, inverse, square root, square, cube	Walkscore	NA
zipcar	gravity measure (quantity scaled by distance) of zipcar locations	natural log, inverse, square root, square, cube	Zipcar	gravity calculation from parcel centroid
	network distance to nearest zipcar location	square root, square, cube	Zipcar	NA
	Euclidean distance to nearest zipcar location	square root, square, cube	Zipcar	NA
	total count of zipcars within 0.5 miles of parcel	square root, square, cube	Zipcar	count in parcel buffer
	total count of zipcar locations within 0.5 miles of parcel	square root, square, cube	Zipcar	count in parcel buffer

Bike Access	total feet of bike routes (class 3) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (all classes) within 0.5 miles of parcel	natural log, inverse, square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (class 4) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (class 2) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (class 5) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (class 0) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	total feet of bike routes (class 1) within 0.5 miles of parcel	square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
Built Form / Development Patterns				
entropy / land use mix measures / job mix measures	Herfindahl-Hirschman index using gravity percents of 8 job types	natural log, inverse, square root, square, cube	PSRC employment	gravity calculation from parcel centroid
	Herfindahl-Hirschman index using gravity percents of 3 job types	natural log, inverse, square root, square, cube	PSRC employment	gravity calculation from parcel centroid
	Herfindahl-Hirschman index using gravity percents of 6 job types	natural log, inverse, square root, square, cube	PSRC employment	gravity calculation from parcel centroid
	Herfindahl-Hirschman index using percents of 8 job types	natural log, inverse, square root, square, cube	PSRC employment	averaged from block groups to parcel buffers
	Herfindahl-Hirschman index using percents of 6 job types	natural log, inverse, square root, square, cube	PSRC employment	averaged from block groups to parcel buffers
	Herfindahl-Hirschman index using percents of 3 job types	natural log, inverse, square root, square, cube	PSRC employment	averaged from block groups to parcel buffers
residential density / gross density	residential household density	natural log, inverse, square root, square, cube	Census 2010	aggregated from blocks to the parcel buffer
	residential population density	natural log, inverse, square root, square, cube	Census 2010	aggregated from blocks to the parcel buffer
	total household density	natural log, inverse, square root, square, cube	Census 2010	aggregated from blocks to the parcel buffer
	total population density	natural log, inverse, square root, square, cube	Census 2010	aggregated from blocks to the parcel buffer
	gravity measure (quantity scaled by distance) of total population	natural log, inverse, square root, square, cube	Census 2010	gravity calculation from parcel centroid
average block size / intersection density / block density	average block size in acres	natural log, inverse, square root, square, cube	Census TIGER/Line	land area (in acres) / count of blocks in parcel buffer
	intersection density	natural log, inverse, square root, square, cube	Census TIGER/Line	count in parcel buffer / land area (acres)
	count of intersections within 0.5 miles of parcel	natural log, inverse, square root, square, cube	Census TIGER/Line	count in parcel buffer
pedestrian environment	feet length of car accessible roads within 0.5 miles of parcel	natural log, inverse, square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	feet length of pedestrian accessible ways within 0.5 miles of parcel	natural log, inverse, square root, square, cube	KC GIS	sum of length (ft) in parcel buffer
	density of feet length of car accessible roads within 0.5 miles of parcel	natural log, inverse, square root, square, cube	KC GIS	sum of length (ft) in parcel buffer / land area (acres)
	density of feet length of pedestrian accessible ways within 0.5 miles of parcel	natural log, inverse, square root, square, cube	KC GIS	sum of length (ft) in parcel buffer / land area (acres)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.900[a]	.810	.803	.1601834987

a. Predictors: (Constant), inv_grv_intensity, inv_avg_rent, inv_units_per_res_sqft, sqrt_park_price_per_rent, inv_avg_occ_bdrms_studio1, sqrt_pct_afford, ln_gravity_transit_frequency

b. Dependent Variable: obs_over_occ

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.857	7	3.122	121.692	.000[a]
	Residual	5.132	200	.026		
	Total	26.989	207			

a. Predictors: (Constant), inv_grv_intensity, inv_avg_rent, inv_units_per_res_sqft, sqrt_park_price_per_rent, inv_avg_occ_bdrms_studio1, sqrt_pct_afford, ln_gravity_transit_frequency

b. Dependent Variable: obs_over_occ

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.981	.254		7.803	.000		
	inv_avg_rent	-154.421	38.796	-.166	-3.980	.000	.550	1.819
	inv_units_per_res_sqft	.000	.000	.151	4.482	.000	.835	1.197
	sqrt_pct_afford	-.023	.004	-.259	-6.148	.000	.534	1.872
	inv_avg_occ_bdrms_studio1	-.360	.088	-.167	-4.073	.000	.569	1.759
	sqrt_park_price_per_rent	-.335	.105	-.120	-3.188	.002	.670	1.492
	ln_gravity_transit_frequency	-.067	.017	-.225	-3.888	.000	.284	3.523
	inv_grv_intensity	35353.048	6016.133	.345	5.876	.000	.276	3.626

a. Dependent Variable: obs_over_occ

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.080785654	1.597279429	.963375164	.3249472171	208
Std. Predicted Value	-2.716	1.951	.000	1.000	208
Standard Error of Predicted Value	.015	.113	.029	.011	208
Adjusted Predicted Value	.061698392	1.613297462	.963549829	.3249460289	208
Residual	-.3843965232	.3773984909	.0000000000	.1574517892	208
Std. Residual	-2.400	2.356	.000	.983	208
Stud. Residual	-2.416	2.367	-.001	1.001	208
Deleted Residual	-.3895747066	.3810002208	-.0001746643	.1632693758	208
Stud. Deleted Residual	-2.446	2.395	.000	1.005	208
Mahal. Distance	.884	102.845	6.966	9.003	208
Cook's Distance	.000	.063	.005	.007	208
Centered Leverage Value	.004	.497	.034	.043	208

a. Dependent Variable: obs_over_occ

FEHR PEERS

FINAL MEMORANDUM

Date: July 12, 2013

To: Daniel Rowe, King County Metro

From: Chris Breiland and Jeff Pierson, Fehr & Peers

Subject: ***Parking Requirements and Utilization Gap Analysis***

SE12-0248.01

EXECUTIVE SUMMARY

This memorandum provides a comparison of local municipal code minimum parking requirements with multifamily off-street parking utilization forecast by the King County Multi-Family Residential Parking Calculator (www.rightsizeparking.org). This analysis reviews the difference between municipal code and forecast utilization rates to document how well the code aligns with forecast utilization. The motivation behind this research is that misaligned parking requirements may spur the need to supply more parking than is necessary – leading to oversupply and increased housing costs. In addition, misaligned parking requirements can make it difficult to unbundle the price of parking from rent and charge a market rate for parking. Market rate parking pricing, in turn, can support the use of non-auto modes (by making the cost of car ownership a more explicit out-of-pocket cost) and lower the cost of housing (by reducing the level of cross subsidization from rent to parking). The outcome of this comparison is a map and underlying data that details how municipal requirements for parking supply differ from model forecast parking utilization.

Results outline the extent and location where there is a gap between forecast parking utilization and municipal code minimum requirements. The analysis indicates that in most locations, particularly south and east King County, parking requirements are higher than forecast parking utilization, often by around 50%. Minima, in the absence of maxima, do not preclude a developer from supplying parking in excess of the minimum amount required. Thus, the areas with forecast parking utilization above minimum requirements do not constitute a similar gap in municipal code. A subsequent analysis of parking maxima revealed that in Renton, which has a requirement that is both a minimum and a maximum, a few areas have maximum parking requirements that are below forecast utilization.

In addition to the potential that parking minima drive excess supply, there are other potentially negative outcomes of high minimum requirements. Large expanses of parking negatively impacts the scale of a neighborhood, makes walking less attractive, and reinforces car dependency. In addition, excess parking increases the amount of impervious surface, increases the urban heat island effect, reduces the quality of the built environment, and can drive up the cost of development. On the regulatory side, the process of requiring developers to frequently seek project level approval for variances also consumes City staff time, delays the development process, and may result in fewer projects making it out of the early development phase.

Current municipal codes were also compared to a selection of built projects. Data reveal that in Seattle, most of the surveyed developments contain more parking than is currently required. In areas outside Seattle, as many developments provide less than the required minimum parking as provide more than the required minimum. Causes for these discrepancies may be that developments were planned under previous code requirements, reductions or variances were

granted, or that developers simply built more parking than the code required due to anticipated market demand.

The results of this analysis highlight areas where parking requirements should be reviewed to better align with forecast utilization, and address areas where minimum requirements are requiring developments to provide unnecessary parking. This process will feed into a draft of model code language, which will recommend alternative approaches to setting minimum requirements where relevant.

BACKGROUND

The King County Multi-Family Residential Parking Calculator ("RSP model," http://www.rightsizeparking.org/) forecasts parking utilization per multi-family dwelling unit for parcels throughout King County. The calculator's estimates are based on a model developed from data collected in the winter and spring of 2012 at over 200 developments in urban and suburban localities in King County, Washington.

Through minimum requirements, cities require parking in a similar fashion – either by dwelling unit or number of bedrooms. These minimum requirements stipulate the least amount of parking that must be built for residents and visitors, but localities do allow reductions to these requirements on a case-by-case basis.

Combining these data sources, the forecast utilization can then be compared to the minimum amount of parking that each development would be required to provide under municipal codes. The analysis is presented at the parcel level, and was completed for areas throughout King County that were likely to be zoned for multi-family development based on information provided by the King County Assessor's Office and the Puget Sound Regional Council (PSRC) These areas are shown in Figures 1 and 4.

PARKING UTILIZATION – RIGHT SIZE PARKING MODEL

The RSP model uses inputs from a combination of location (transit availability, population, jobs) and building characteristics (rent, parking price, building form) to forecast parking utilization per dwelling unit. Model development is detailed in a February 7, 2013 Technical Memo (http://www.rightsizeparking.org/Right_Size_Parking_Technical_Memo.pdf). For this analysis, the area covered by the RSP model was divided into six place types to better reflect local development characteristics. An average building type was identified in each of the six areas that was similar to the actual collected data (for example, developments in urban settings contained a higher percentage of studio and one bedroom units than suburban developments). **Table 1** shows the inputs to the RSP model by place type, rounded to the nearest whole unit. Standard building types were used in each place type such that location characteristics were the key drivers of model parking utilization predictions. This allows for a comparison with municipal codes which vary by City or neighborhood. Model outputs of parking utilization by place type were then joined together in one database for comparison with municipal codes.

TABLE 1. GAP ANALYSIS MODEL INPUTS BY PLACE TYPE

	Urban Downtown (Downtown Seattle)	**Regional Center** (Downtown Bellevue, Overlake)	**Suburban Center** (Bel-Red, Northgate)	**Suburban Commercial** (Aurora Avenue in North Seattle/Shoreline, 85th Street in Kirkland)	**Inner Suburb** (Loyal Heights, Seattle Central District)	**Traditional Suburb** (Tukwila, Renton)
Studio Units	63	36	13	12	9	8
1 Br Units	79	67	54	71	66	52
2 Br Units	30	35	29	78	55	83
3 Br Units	4	1	7	10	6	12
Average Bedroom Count[1]	1.2	1.3	1.4	1.6	1.5	1.7
Studio Rent	$957	$1,148	$1,014	$977	$1,108	$808
1 Br Rent	$1,270	$1,488	$1,208	$1,077	$1,096	$956
2 Br Rent	$2,073	$1,987	$1,411	$1,312	$1,332	$1,140
3 Br Rent	$2,742	$2,005	$1,325	$1,593	$1,424	$1,360
Average Rent[2]	$1,328	$1,529	$1,249	$1,207	$1,207	$1,078
Studio Sq ft	472	564	612	598	527	541
1 Br Sq ft	672	764	812	798	727	741
2 Br Sq ft	872	964	1,012	998	927	941
3 Br Sq ft	1,072	1,164	1,212	1,198	1,127	1,141
Total Building Square Feet[2]	113,272	106,396	89,636	153,658	110,472	134,655
Affordable Units	39	20	18	21	20	13
Mo. Parking Cost	$127	$103	$44	$23	$17	$19

[1] Calculated based on other inputs. This input is what the RSP model uses for forecast of parking utilization. Studios count as one bedroom.

[2] Calculated based on other inputs. This input is what the RSP model uses for forecast of parking utilization.

Source: Right Size Parking Data Collection, 2012

PARKING SUPPLY – MUNICIPAL CODES

The minimum amount of off-street parking that must be built for multifamily residential units is determined by the municipal code for the jurisdiction where the building is constructed. Cities vary in their approach to off-street parking requirements. For some cities, a single minimum parking rate per multifamily dwelling unit is required for all units citywide. For others, rates vary by zone throughout the city. Finally, within the multifamily parking requirements, some cities require different amounts of parking based on the number of bedrooms within a dwelling unit. **Table 2** shows the required multi-family minimum parking rates for each area within the boundary of the RSP model. Rates are shown for each bedroom type included in the model. For cities that have different parking requirements by zone, these are shown as well. These rates include any required visitor parking. For example, if two parking spaces are required for a two bedroom unit in addition to one visitor space per five units, then the parking requirement is 2.2 for a two bedroom unit.

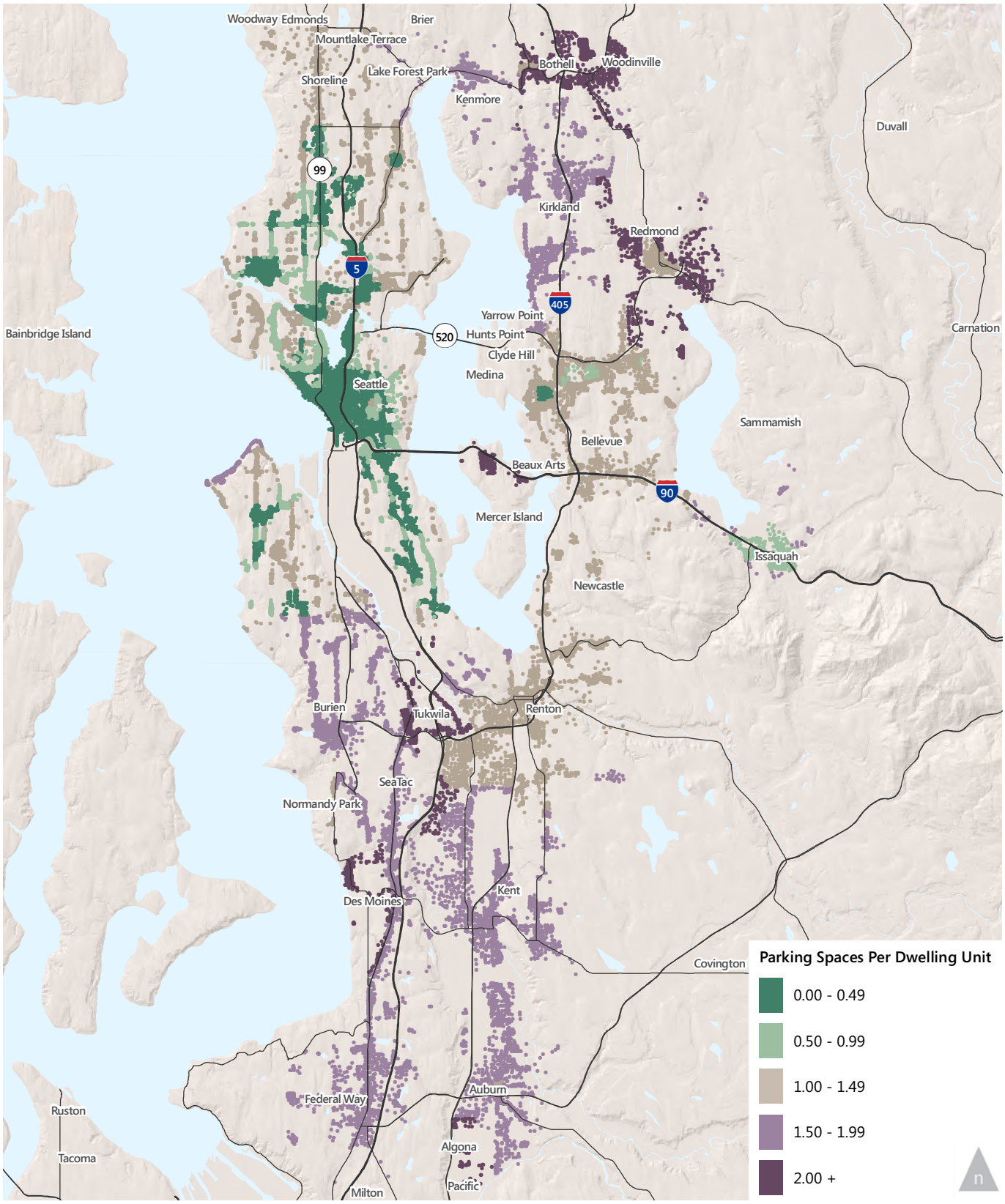
In addition to required off-street parking spaces, a most cities allow for optional reductions to parking supply based on unique building attributes or opportunities (for example, shared parking). Generally these reductions must be documented and approved through an independent parking analysis, and are subject to Development Director approval. These types of case-by-case modifications were not included in this analysis.

For each place type (as described in the previous section), the minimum parking requirements were calculated to match the building type entered into the RSP model. The results of this exercise are parcel-level parking requirements for an average multifamily development. These requirements are shown in **Figure 1.**

TABLE 2. MULTI-FAMILY OFF STREET PARKING MINIMUM REQUIREMENTS BY CITY & ZONE[1]

City or Zone	Studio	1 Br	2 Br	3 Br
Algona	2.0	2.0	2.5	2.5
Auburn	1.5	1.5	1.5	2.0
Downtown Urban Core	*1.0*	*1.0*	*1.0*	*1.0*
Bellevue	1.2	1.2	1.6	1.6
DNTN-O1, -O2	*0.0*	*0.0*	*0.0*	*0.0*
DNTN-R, -MU, -OB, -OLB	*1.0*	*1.0*	*1.0*	*1.0*
BR-MO1, -OR1, -OR2, -RC1, -RC2, -RC3	*0.75*	*0.75*	*0.75*	*0.75*
BR-MO, -OR, -RC, -CR, -GC, -R, -ORT	*1.0*	*1.0*	*1.0*	*1.0*
Bothell	2.2	2.2	2.2	2.2
Downtown Core, Transition, and Neighborhood Districts	0.75	0.75	1.5	2.25
Burien	1.8	1.8	1.8	1.8
Des Moines	2.1	2.1	2.1	2.1
Pacific Ridge Neighborhood	*1.5*	*1.5*	*2.1*	*2.1*
Federal Way	1.7	1.7	1.7	1.7
Issaquah	1.0	2.0	2.0	2.0
CBD Zone	0.85	1.7	1.7	1.7
Central Issaquah	*0.75*	*1.0*	*1.0*	*1.0*
Kenmore	1.4	1.7	1.9	2.2
Downtown Commercial & Residential west of 68th Ave NE	*1.2*	*1.2*	*1.7*	*1.9*
Kent	1.0	2.0	2.0	2.0
Kirkland	1.7	1.7	1.7	1.7
CBD-1, -2, -8	*1.1*	*1.1*	*2.2*	*3.3*
Totem Lake	*[a]*	*[a]*	*[a]*	*[a]*
Lake Forest Park	1.5	1.5	1.5	1.5
Mercer Island	2.0	2.0	2.0	2.0
Newcastle	1.0	1.0	1.5	2.0
Normandy Park	1.0	1.0	1.0	1.0
Pacific	2.0	2.0	2.0	2.0
Redmond	2.0	2.0	2.0	2.0
Downtown, Overlake Village, & Neighborhood Commercial	*1.25*	*1.25*	*1.25*	*1.25*
Renton	1.0	1.0	1.0	1.0
Center Downtown	*1.0*	*1.0*	*1.0*	*1.0*
RM-U, -T, -F, -R14, -R10	*1.0*	*1.0*	*1.4*	*1.6*
Sammamish	1.2	1.5	1.7	2.0
SeaTac	1.0	1.5	2.0	2.0
Seattle	1.0	1.0	1.0	1.0
UW Parking District	*1.0*	*1.0*	*1.5*	*1.5*
Alki Parking Area	*1.5*	*1.5*	*1.5*	*1.5*
Urban Centers & Urban Villages within Frequent Transit Corridor	*0.0*	*0.0*	*0.0*	*0.0*
Other Areas Within Frequent Transit Corridor	*0.5*	*0.5*	*0.5*	*0.5*
Shoreline	0.75	0.75	1.5	1.5
Tukwila	2.0	2.0	2.0	2.0
Urban Renewal Overlay	*1.0*	*1.5*	*2.0*	*2.5*
Woodinville[2]	2.0	2.0	2.0	2.0
King County	1.2	1.5	1.7	2.0

[1] These values assume no reductions that would require municipal approval.
[2] Woodinville does not have specific requirements for MF housing. In practice, most developers complete parking studies. 2.0 spaces per DU is the traditional requirement.
[a] Developments within the close-in Urban Center zones of Totem Lake do not have a specified minimum and refer to Kirkland Zoning Code 105.25 where the Planning Official establishes a requirement on a case-by-case basis.
Source: Fehr & Peers, 2013, Based on Jurisdictional Municipal Codes



* Based on typical multi-family building types

Figure 1.

Municipal Minimum Parking Requirements

FEHR PEERS

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RESULTS

Minimum Parking Requirements

To compare the RSP Model forecast utilization to the municipal minimum parking requirements, the required parking (based on assumed building types in Table 1) was divided by the forecast parking utilization for each parcel. Any value below 1.0 indicates that the minimum requirements are below the forecast utilization, while any value above 1.0 indicates that the minimum requirements are greater than the forecast utilization. **Figure 2** displays the region-wide distribution of results. Overall, 55% of parcels have minimum parking requirements that are equal or less than the RSP model utilization (including 33% of parcels which have a requirement of zero), and 45% have requirements above the RSP model utilization.

Since a majority of the parcels in Seattle have minimum parking requirements below forecast utilization in the RSP model, the distribution of parcels outside of the City of Seattle was also examined. This distribution is shown as **Figure 3.** After removing the City of Seattle, 82% of parcels have minimum parking requirements that are greater than the RSP model utilization. **Appendix A** contains additional city-level histograms.

Figure 4 displays the full region-wide gap analysis. Most of the Eastside and South King County require more parking than forecast utilization. Seattle, Normandy Park, Shoreline, Issaquah, Renton, and parts of Bellevue have minimum parking requirements that are below forecast utilization values.

Table 3 provides the City or zone level summary of the average gap. As shown in Figure 4, the difference between code and forecast utilization varies at the parcel level. Thus, while the average provides a point of comparison with city code, the actual utilization for parcels can vary widely inside of a single City or zone.

The table also includes the number of RSP survey sites within each zone and the average utilization at these locations. These values show that the forecasted utilization rates are mostly consistent with observed utilization rates. Care should be taken before drawing any conclusions from zones with a limited number of sample sites (<5). Differences in forecasted and observed utilization rates may arise from unique characteristics of the sample site or an additional explanatory variable unique to the city or zone that was not captured in the model.

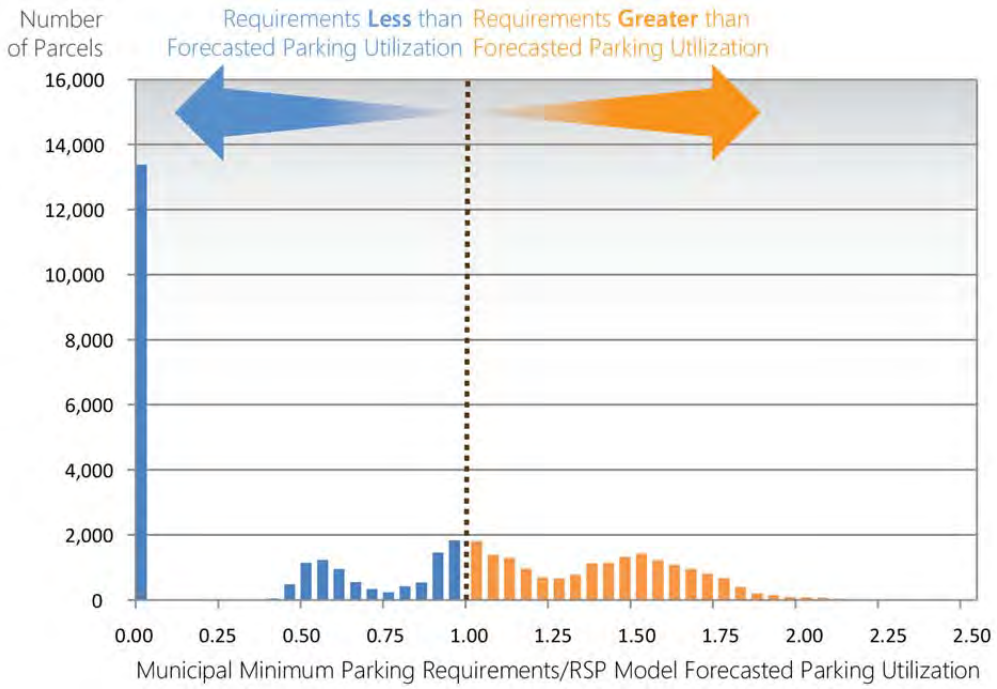

Figure 2. Ratio of Supply to Demand for Multi-family parcels in King County

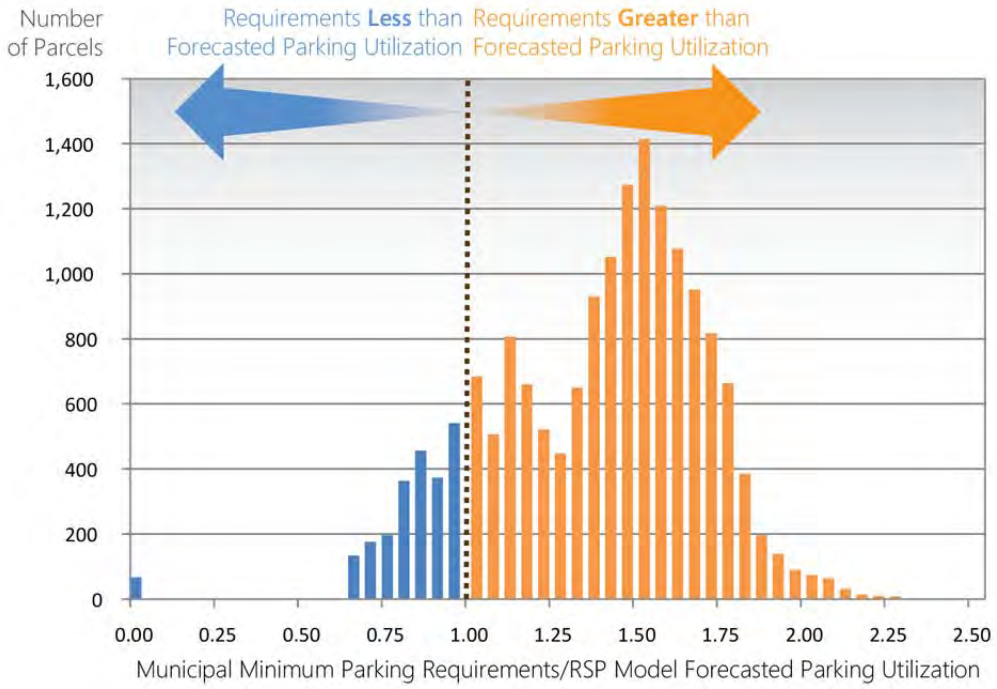

Figure 3. Ratio of Supply to Demand for Multi-family parcels in King County (Non-Seattle)

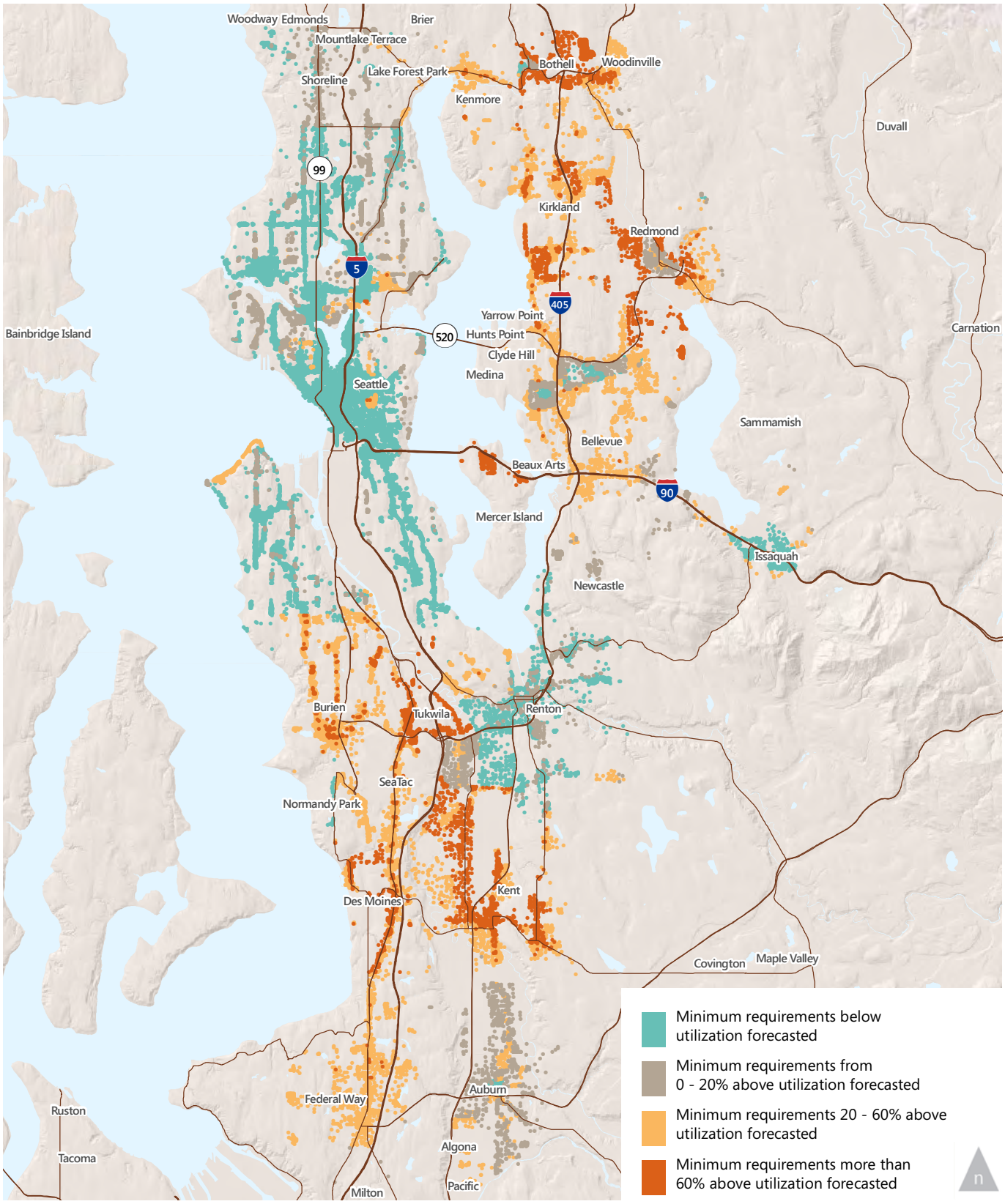

Figure 4.

Municipal Minimum Parking Requirements Compared to RSP Model Parking Utilization

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FEHR PEERS

TABLE 3. COMPARISON OF MUNICIPAL PARKING CODE REQUIREMENTS, RSP FORECAST UTILIZATION, AND OBSERVED SITE UTILIZATION

City or Zone	Average Required Minimum[1] (Spaces/DU)	Average Forecast Utilization (Spaces/DU)	Difference[2] (Spaces/DU)	RSP Survey Sites	Observed Average Utilization (Spaces/DU)
Algona	2.04	1.39	0.65	0	-
Auburn	1.53	1.31	0.22	0	-
Downtown Urban Core	*1.00*	*1.23*	*-0.23*	*0*	-
Bellevue	1.41	1.09	0.32	20	1.21
DNTN-O1, -O2	*0.00*	*0.83*	*-0.83*	*2*	*1.14*
DNTN-R, -MU, -OB, -OLB	*1.00*	*0.88*	*0.12*	*2*	*1.98*
BR-MO1, -OR1, -OR2, -RC1, -RC2, -RC3	*0.75*	*0.98*	*-0.23*	*0*	-
BR-MO, -OR, -RC, -CR, -GC, -R, -ORT	*1.00*	*0.97*	*0.03*	*2*	*1.23*
Bothell	2.20	1.26	0.94	1	1.5
Downtown Core, Transition, and Neighborhood	*1.20*	*1.17*	*0.03*	*0*	-
Burien	1.80	1.17	0.63	4	1.14
Des Moines	2.10	1.28	0.82	3	1.22
Pacific Ridge Neighborhood	*1.77*	*1.16*	*0.61*	*2*	*1.28*
Federal Way	1.70	1.23	0.47	7	1.23
Issaquah	1.94	1.45	0.48	3	1.50
CBD Zone	*N/A[3]*	*N/A[3]*	*N/A[3]*	*0*	-
Central Issaquah	*0.98*	*1.40*	*-0.42*	*0*	-
Kenmore	1.83	1.24	0.59	0	-
Downtown Comm. & Res. west of 68th Ave NE	1.52	1.19	0.33	*0*	-
Kent	1.94	1.20	0.74	9	1.37
Kirkland	1.70	1.10	0.60	10	1.16
CBD-1, -2, -8	*1.56*	*1.04*	*0.52*	*0*	-
Lake Forest Park	1.50	1.16	0.34	0	-
Mercer Island	2.00	1.18	0.82	1	1.06
Newcastle	1.35	1.28	0.06	1	1.37
Normandy Park	1.00	1.33	-0.33	0	-
Pacific	2.00	1.45	0.55	0	-
Redmond	2.00	1.18	0.82	6	1.28
Downtown, Overlake Village, & Neighborhood Comm.	*1.25*	*1.03*	*0.22*	*10*	*1.05*
Renton	1.00	1.15	-0.15	3	1.24
Center Downtown	*1.00*	*1.04*	*-0.04*	*0*	-
RM-U, -T, -F, -R14, -R10	*1.24*	*1.20*	*0.04*	*4*	*1.34*
Sammamish	1.63	1.44	0.19	0	-
SeaTac	1.75	1.19	0.56	4	1.02
Seattle	1.00	0.98	0.02	3	0.85
UW Parking District	*1.18*	*0.85*	*0.33*	*1*	*0.90*
Alki Parking Area	*1.50*	*1.15*	*0.35*	*0*	-
Urban Centers & Villages within Frequent Transit Cor.	*0.00*	*0.83*	*-0.83*	*86*	*0.66*
Other Areas Within Frequent Transit Corridor	*0.50*	*0.88*	*-0.38*	*5*	*0.86*
Shoreline	1.16	1.13	0.03	2	0.80
Tukwila	2.00	1.12	0.88	7	1.20
Urban Renewal Overlay	*1.80*	*1.11*	*0.70*	*1*	*1.00*
Woodinville[4]	2.00	1.31	0.69	1	1.90
King County	1.62	1.14	0.48	7	1.30

[1] These values assume no reductions that would require municipal approval and include any required off-street guest parking spaces.
[2] Positive values indicate minimum requirements are above RSP forecast utilization.
[3] The CBD in Issaquah is not an area included in the RSP Model.
[4] Woodinville does not have specific requirements for MF housing. In practice, most developers complete parking studies.
Source: Fehr & Peers, 2013, Based on Jurisdictional Municipal Codes and RSP Model

Gaps between Forecast Utilization and Required Supply

Figure 3 indicates that outside of Seattle, local cities require on average 0.4 extra parking spaces per dwelling unit for every occupied multifamily dwelling unit relative to utilization. If developments were constructed to code, the implications of this policy are increased housing costs and a general oversupply of parking that is likely in contrast with many long-term community goals that encourage transit use and active transportation. Supplying excess parking relative to demand also makes potential efforts to unbundle parking[1], reduce development and housing costs, and manage supply through price infeasible.

From Figure 4 and Table 3, the largest gaps occur in Bothell, Des Moines, Mercer Island, Redmond, and Tukwila, not including any areas with reduced requirements (for example, downtown Redmond). These cities individually require on average 0.75 spaces or more extra per dwelling unit as compared to forecast utilization. The RSP model was based on an average multi-family development site of 150 units. Based on this size of development and outside of any variances, the minimum codes in these cities would require developers to build over 110 surplus parking spaces per development.

Many cities have adopted lower minimum requirements within their downtown area or other similar neighborhoods. For example, Redmond reduces the citywide minimum requirement from 2.0 spaces per dwelling unit to 1.25 spaces in their downtown. This reduces the gap in forecast utilization from 0.78 spaces to 0.20 spaces. Neighborhood or area requirements like these are a more accurate means to apply minima and recognize the increased density and transit options in more urban and mixed use contexts.

On the other end of the spectrum, the minimum parking requirements are less than forecast utilization in much of Seattle and in parts of Issaquah, Renton, and Bellevue. Parking requirements less than forecast utilization could also be seen as a gap. However, a low minimum does not automatically translate to low levels of parking supply. Rather, this approach allows more flexibility during the development process and reduces the need for City-approved reductions.

Maximum Parking Requirements

In suburban settings, low maxima could help address a glut of existing excess parking by encouraging shared parking options. In urban settings, maxima are often coupled with residential parking permit systems or metered on-street parking to address potential spillover. Only seven cities within the study area have parking maxima for multifamily residential developments. These locations are within Auburn, Bellevue, Bothell, Issaquah, Normandy Park, Redmond, and Renton. **Table 4** shows the parking minima and maxima for these areas and the RSP model forecast utilization ranges.

[1] Excessive parking supply makes it difficult to unbundle parking pricing since there is less of an ability charge for/increase parking prices in a competitive environment where all multifamily properties have ample parking, which can be used as a free or very low cost amenity to attract tenants.

TABLE 4. MAXIMUM PARKING REQUIREMENTS AND FORECAST PARKING UTILIZATION

City and Zone	Parking Minimum	Parking Maximum	Forecast Utilization Range	Forecast Utilization Average	Difference (Max-Avg)
Auburn	-	-	-	-	-
DUC	1	2[1]	1.0 – 1.3	1.2	0.8
Bellevue	-	-	-	-	-
Bellevue DNTN-O1, -O2	0	2	0.7 – 0.9	0.8	1.2
Bellevue DNTN-R, -MU, -OB, -OLB	1	2	0.7 – 1.0	0.9	1.1
Bellevue BR-MO1, -OR1, -OR2, -RC1, -RC2, -RC3	0.75	2	0.8 – 1.0	1.0	1.0
Bellevue BR-MO, -OR, -RC, -CR, -GC, -R, -ORT	1	2	0.7 – 1.1	1.0	1.0
Bothell	-	-	-	-	-
Downtown Core, Transition, and Neighborhood	1.2[2]	1.6[2]	1.0 – 1.3	1.2	0.0
Issaquah	-	-	-	-	-
Central Issaquah	1.0[3]	1.6 – 1.7[4]	1.2 – 1.5	1.4	0.3
Normandy Park	1	2	1.2 – 1.4	1.3	0.7
Redmond	-	-	-	-	-
Downtown, Overlake Village, & Neighborhood Comm.	1.25	2.5	0.8 – 1.4	1.0	1.5
Renton	1	1.75	0.8 – 1.4	1.2	0.55
Center Downtown	1	1	0.8 – 1.1[5]	1.0	0.0
RM-U, -T, -F, -R14, -R10	1.2 – 1.3[6]	1.2 – 1.3[6]	0.9 – 1.4[7]	1.2	0.1

[1] Maximum is for surface parking.
[2] Minimum and maximum parking are calculated by number of bedrooms. The minimum is 0.75 per bedroom and the maximum is 1.0 per bedroom. The provided value is the requirement by dwelling unit based on the assumed average building type.
[3] Varies by unit size. The minimum is 0.75 per unit less than 600 sq. ft. and 1.0 for all other unit types. The provided value is the averages by dwelling unit based on the assumed average building type.
[4] Varies by number of bedrooms. The maximum is 1.0 per studio, 1.25 per 1 bedroom, and 2.0 per two bedroom or larger unit. The provided value is the average by dwelling unit based on the assumed average building type.
[5] Utilization exceeds maxima for 87% of parcels under assumed average building types.
[6] Varies by number of bedrooms. The minima *and* maxima are 1.0 per 1 bedroom or studio dwelling unit, 1.4 per 2 bedroom dwelling unit, and 1.6 per 3 bedroom or larger dwelling unit.
[7] Utilization exceeds maxima for 4% of parcels under assumed average building types.
Fehr & Peers, 2013

For the most part, maxima are set at levels considerably above anticipated utilization. In Downtown Renton and Renton zones RM-U, -T, -F, -R14, and -R10, the RSP model utilization for some parcels exceeded the maximum allowed parking rates. However, the excess demand was never greater than 0.1 spaces per unit.

BUILT PARKING COMPARED TO MINIMUM PARKING REQUIREMENTS

The previous analysis compared standard municipal codes to forecast utilization. Comparing the built parking supply of over 200 multifamily sites with their current minimum code requirements revealed that most developments do not build parking exactly to code. In Seattle, where many locations have a minimum of 0 or 0.5 spaces per dwelling unit, projects provided on average 0.85 spaces more than current zoning requires.

Outside of Seattle, the average built supply of survey sites was equal to minimum requirements, but only 20% of developments were within +/- 0.10 spaces of the requirement. The remaining 80% were split evenly above and below the minimum requirement. The discrepancies between minimum requirement and built parking appear to be caused by (1) changes in code requirements, (2) reductions for transit accessible or affordable housing, (3) shared parking between commercial uses, (4) and overbuilding in planning for potential condominium conversion. **Table 5** provides a subset of the 200 survey sites which includes only buildings built since 2008 when, presumably, there have been few substantial changes to municipal code requirements.

TABLE 5. MUNICIPAL CODE PARKING REQUIREMENTS AND BUILT PARKING SUPPLY, 2008-2011 DEVELOPMENTS

Required/DU	Built/DU	Difference
1.25	1.20	-0.05
1.25	1.10	-0.15
1	1.85	0.85
1	1.48	0.48
0.5	1.39	0.89
0.5	0.99	0.49
0	1.70	1.70
0	1.31	1.31
0	1.27	1.27
0	1.23	1.23
0	1.19	1.19
0	1.03	1.03
0	0.98	0.98
0	0.97	0.97
0	0.88	0.88
0	0.79	0.79
0	0.78	0.78
0	0.72	0.72
0	0.69	0.69
0	0.67	0.67
0	0.65	0.65
0	0.59	0.59
0	0.53	0.53

Fehr & Peers, 2013

The data in Table 5 indicate two key points regarding minimum parking requirements. First, where requirements are high, developers may secure reductions to lower how much parking they are required to build. Second, low or no parking requirements do not translate into developers providing no parking. The actual parking supply decisions are affected by other site or development specific variables.

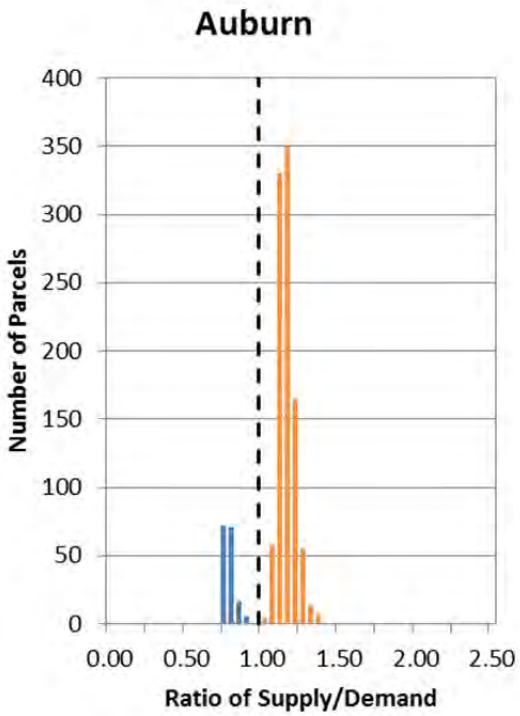
CONCLUSION

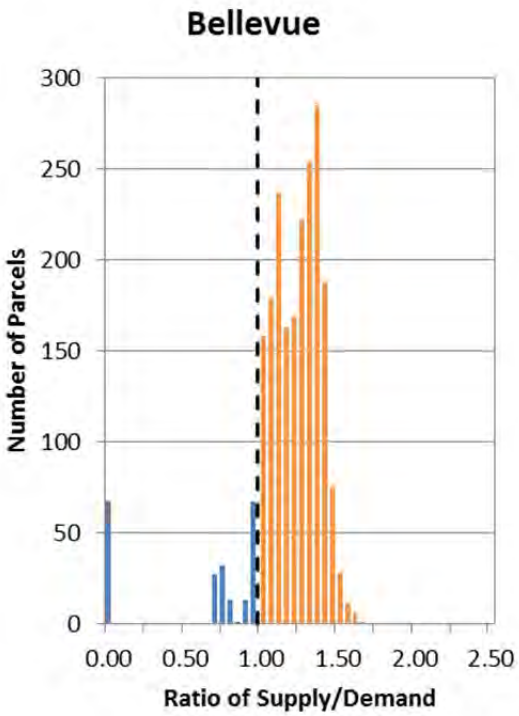
Outside of Seattle, most municipal parking codes currently require more parking than the RSP model predicts will be utilized. On average, this amount is around 0.4 spaces per dwelling unit, and a small group of cities require over 0.75 extra spaces for each dwelling unit. This excess parking likely drives new developments to either build expensive and unused parking or delay projects to apply for reductions to reduce their required parking. Seattle has very low requirements, but historically developers have built more parking than is required by code.

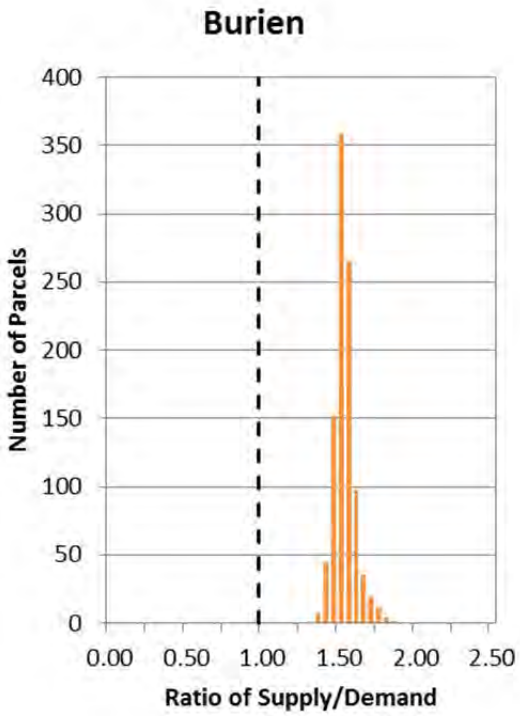
Multiple cities have reduced minimums in their downtown zones. This can be an effective way to reduce the gap between required and utilized parking, and recognizes that less parking is often needed in more urban or mixed use contexts where transit is available.

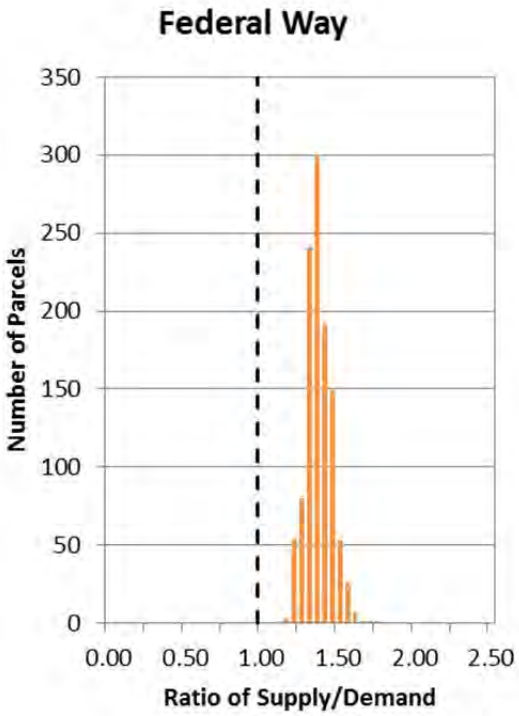
The results of this memorandum can be used to fine-tune minimum parking requirements to reduce the potential of oversupply or excessive variances. Similarly, the results also suggest that areas with parking maxima could explore options to ensure that the code is working effectively to reduce parking space construction while providing adequate flexibility.

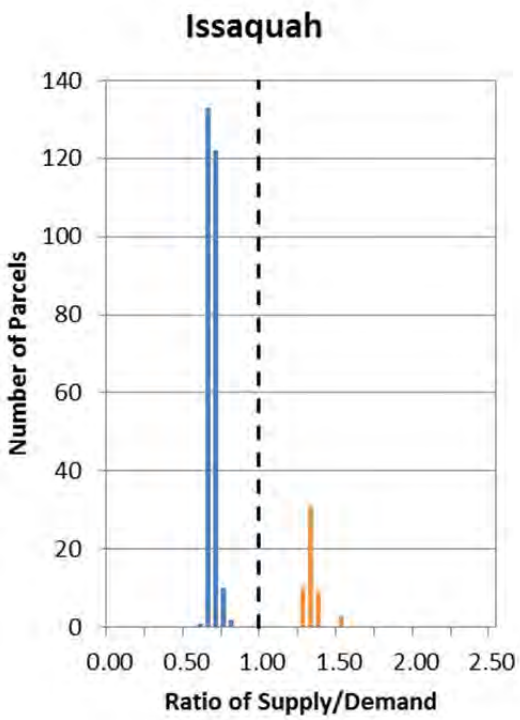
APPENDIX A – ADDITIONAL CITY-LEVEL COMPARISONS OF MUNICIPAL MINIMUM PARKING REQUIREMENTS AND RSP MODEL FORE CASTED UTILIZATION







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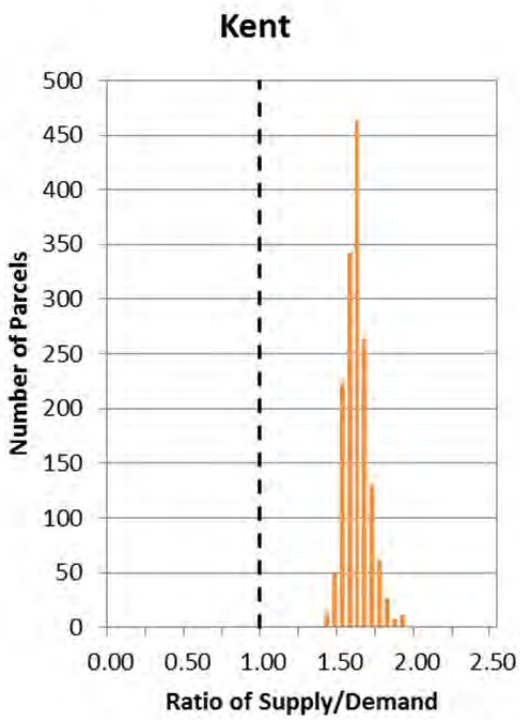
2.50
Ratio of Supply/Demand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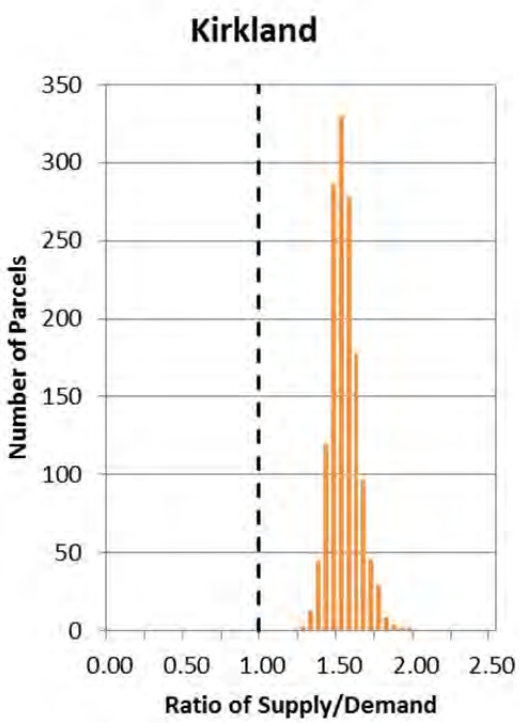
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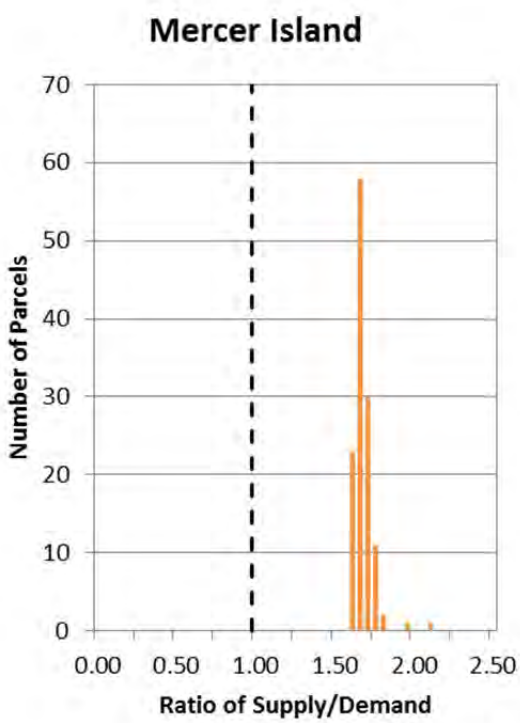
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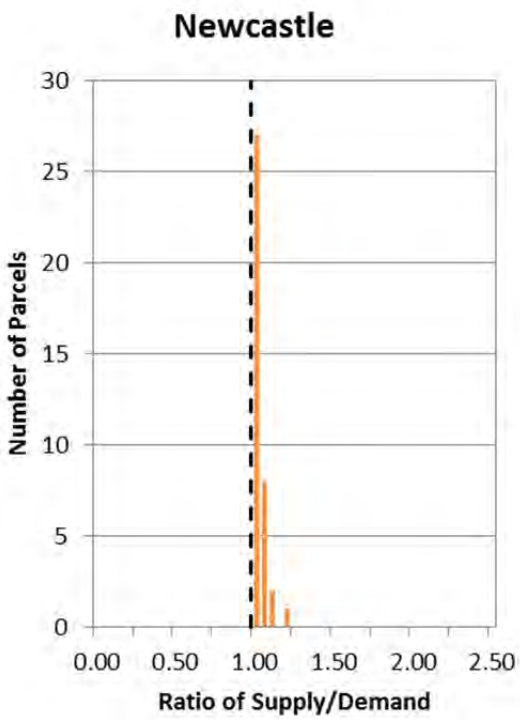
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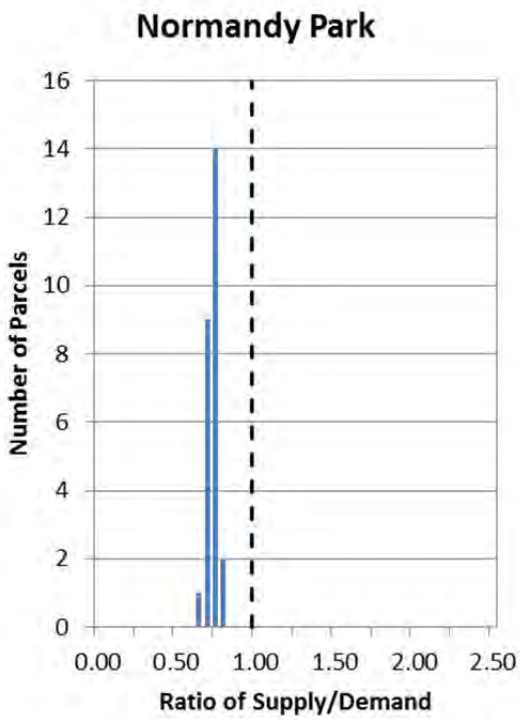
Ratio of Supply/Demand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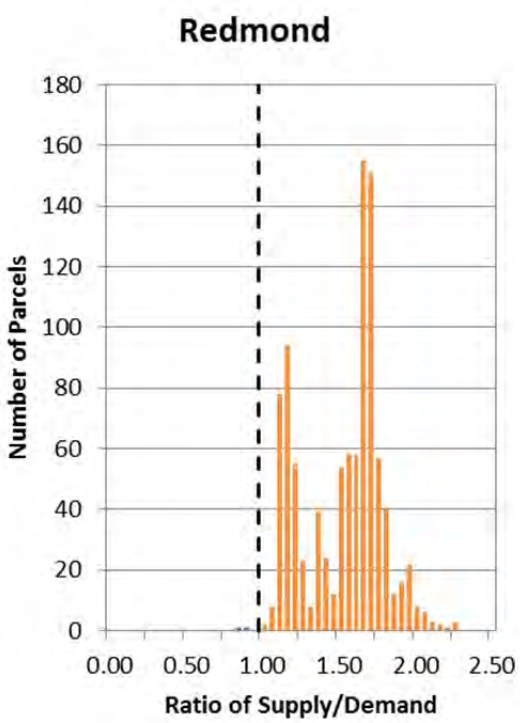
Ratio of Supply/Demand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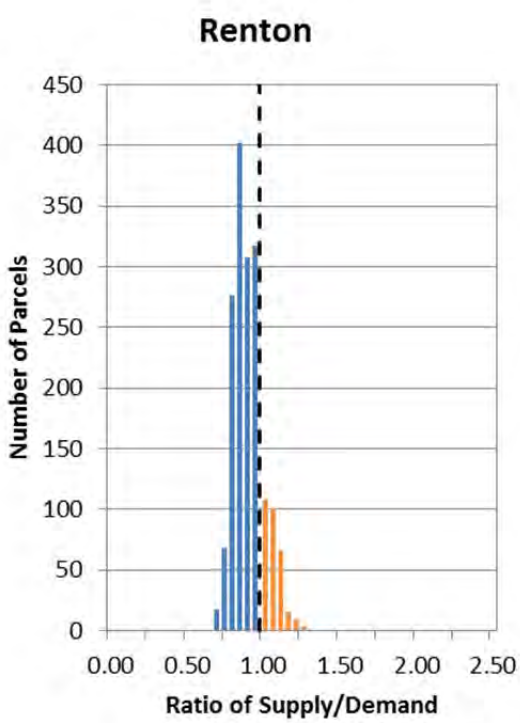
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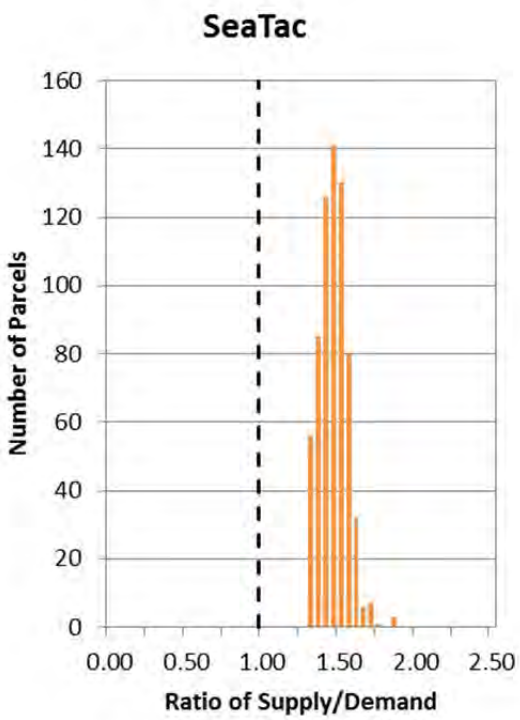
Ratio of Supply/Demand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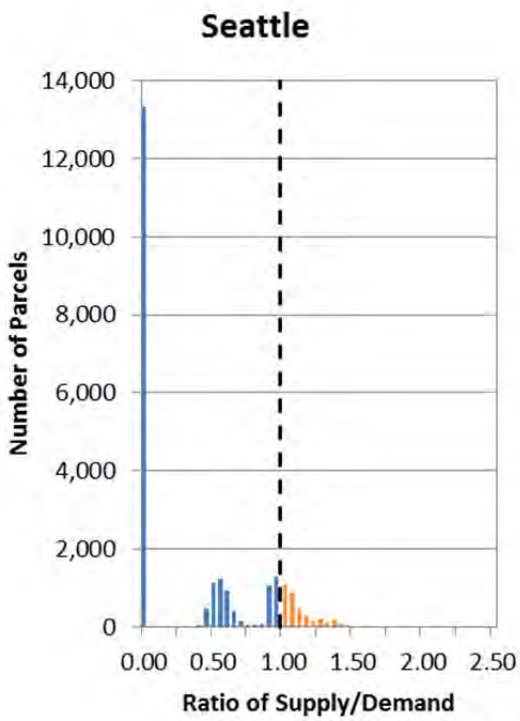
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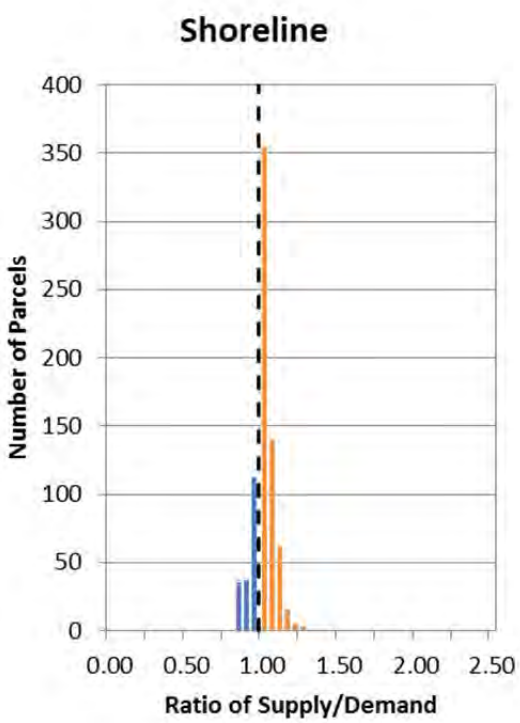
Ratio of Supply/Demand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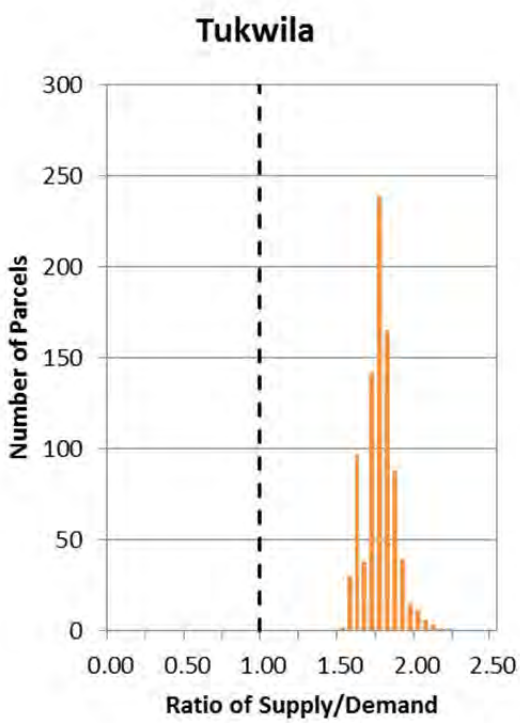
Ratio of Supply/Demand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1.00
1.50
2.00
2.50
Ratio of Supply/Demand

RSP Kirkland Pilot Project Technical Memo
Right Size Parking Project – King County Metro
11-12-13

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2. The RSP Project
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1 EXECUTIVE SUMMARY

This technical memo describes the opportunities to apply "right size parking" concepts in the City of Kirkland through a pilot project funded by the King County Metro Right Size Parking (RSP) project. It is intended to provide ideas and guidance for the most promising avenues to pursue in the Kirkland RSP Pilot Project. The memo begins with background information on the larger RSP project, and a summary of the proposed Kirkland RSP Pilot. It then provides an overview of the parking environment in Kirkland, followed by a discussion of RSP strategies that would be most appropriate in Kirkland, including market- and context-based approaches to setting minimums, on-street management, shared parking, and pricing.

2 THE RIGHT SIZE PARKING PROJECT

Right Size Parking (RSP) is three year grant project funded by the Federal Highway Administration's Value Pricing Program and managed by King County Metro Transit. The overarching goal of the RSP project is to foster livable communities by optimizing the allocation of parking resources. More specifically, the purpose of the RSP project is to impart data and strategies to help developers, jurisdictions, and neighborhoods accurately project the optimum amount of parking for new multifamily developments.

The amount of parking is optimized—i.e. right sized—when it strikes a balance between supply and demand, and the challenge lies in determining the correct balance with confidence. Today, multifamily buildings often provide too much parking, which can be an impediment to achieving a wide range of community goals. However, providing too little parking can also be a significant risk in terms of real estate marketability and neighborhood impacts.

The RSP project has produced numerous work products, including best practices research, a technical policy memo on RSP barriers and opportunities, multifamily parking utilization surveys, parking code gap analysis, an online multifamily parking demand calculator, model parking code, strategies for pricing, transportation demand management, and parking management, and lastly, pilot projects.[1] The pilot projects are intended to apply the RSP concepts developed in earlier phases, working in partnership with municipalities or private parties.

The RSP project also included a robust stakeholder engagement process. The process included separate segments for the initial project phase and the demonstration project phase, with a series of 15 meetings occurring over an approximately 1.5 year period. Stakeholders were divided into two groups: (1) a jurisdictional committee consisting primarily of planning staff from King County cities, and (2), a development committee consisting primarily of private and non-profit developers and development financers. A City of Kirkland planning staff member was an active participant on the jurisdictional committee for both phases on the RSP stakeholder process and the City Planning Director served on the development committee.

2.2 The RSP Multi-Family Residential Parking Calculator

The RSP project included an extensive survey of multi-family projects in King County to collect data on parking supply and utilization. The projects surveyed 228 sites throughout the County, totaling over 33,000 housing units and over 50,000 parking stalls. The RSP utilization survey data was used to develop a statistical model that predicts parking demand based on land use and building characteristics. After analyzing over 100 variables, the following seven variables were selected that together can predict over 80% of the observed variation in parking utilization in multifamily projects:

- transit frequency
- percent of affordable units
- number of bedrooms
- population and employment density
- unit size
- unit rent
- parking price

A public, web-based user interface was built to allow easy access to the information provided by the RSP Multifamily Residential Parking Calculator.[2] The web tool has several components for communicating

[1] See http://metro.kingcounty.gov/up/projects/right-size-parking/ for RSP reports and documents.
[2] The RSP King County Multi-Family Residential Parking Calculator is online here: http://www.rightsizeparking.org/

RSP information. The home page gives explanatory information and displays a "heat map" of King County that color codes areas according to predicted parking demand i.e., green indicates lower demand, and red indicates higher. The interface allows users to zoom in and select a specific parcel (or parcels), after which data for a prototypical building on that site is displayed. Project parameters and land use context factors can then be adjusted by the user to represent a planned project, or to simply observe how different factors affect predicted parking demand. The web interface also displays comparative parking "impacts," including capital costs for parking construction, and vehicle-miles traveled and greenhouse gas emissions for building residents.

The RSP calculator could be used as a tool for municipalities to help determine defensible parking requirements for development projects on a case-by-case basis. The RSP Calculator and the data behind it could also provide valuable input for setting the metrics for "context-based" adjustments to minimums, as was done for several of the RSP model code metrics, as noted in Appendix 6.1.

2.3 The RSP Model Code

One of the main work products of the RSP Project is a model code document that integrates all of the research, stakeholder input, and analysis to provide a resource for planners to implement code that supports RSP and other regional goals. The model code is comprised of two approaches: *market-based*, and *context based*. In the market-based approach minimums are set to zero, and the market determines the amount of parking. The RSP project concluded that a market-based approach most effectively matches parking supply with parking demand and eliminates the possibility of requirements forcing developers to build more parking than is needed. At the same time, it cannot be overstressed that removing minimums does not mean that no parking can be built, nor does it mean that no parking will be built. In almost all cases, developers will build parking anyway, because their projects would not be marketable without it.

It was also recognized that a market-based approach might not be acceptable in many jurisdictions, and the model code includes a context-based approach for which minimums are set based on the unique context and characteristics of a given project. The process has two steps: First, a generalized place type and associated base parking minimum is assigned. Second, a series of adjustments is applied to that base minimum to account for specific building and contextual features, such as the unit type, expected tenant, proximity to transit, use of transportation demand management and so on. The full menu of possible context-based adjustments proposed in the model code is given in Appendix 6.1. Further information on the RSP Model Code can be found in the RSP Model Code Technical Memo, available for download at the King County Metro RSP web site.[3]

[3] http://metro.kingcounty.gov/up/projects/right-size-parking/

3 THE KIRKLAND RSP PILOT PROJECT

Kirkland was awarded one of four pilot project grants by RSP to investigate updating the City's parking codes to promote RSP outcomes that align with City goals. RSP multifamily parking utilization survey data indicate that in Kirkland, actual parking demand is less than what parking codes require and that, where modifications are not being requested and approved, parking is being oversupplied in multifamily projects. This oversupply is at cross purposes with many of Kirkland's stated goals, including supporting economic development, creating affordable housing, building a sustainable community, encouraging efficient transportation, and protecting community character.

The City of Kirkland's adopted 2013-2015 Planning Work Program includes code amendments to consider revised parking standards, and the pilot project will assist in that endeavor. The objectives of the pilot project are to review all multifamily parking requirements for the City and establish requirements that reflect market demand, protect adjoining neighborhoods from parking spillover, and are adaptive to changing conditions. The pilot project will also explore opportunities to unbundle parking pricing by reviewing acceptance in the local real estate market as well as acceptance in adjoining neighborhoods. The project scope includes:

- Attendance and presentations at a series of meetings with the Kirkland City Council Planning and Economic Development Subcommittee, the Planning Commission, the Transportation Commission, and the Houghton Community Council
- Parking utilization surveys of multifamily projects
- Development of a Technical Memo that addresses RSP opportunities in Kirkland
- Parking Pricing Research
- Development of draft parking code

Kirkland's RSP pilot project grant includes support from the following consultant team that has been engaged throughout the larger RSP project:

- Rick Williams Consulting: on-street and off-street parking inventories and utilization surveys, strategies for on-street parking management and shared parking
- Fehr & Peers: parking demand data analysis, transportation demand management strategies
- VIA Architecture and Planning: policy and code analysis and development, land use planning
- Kidder Matthews: real estate development economics and market analysis, pricing analysis

4 EXISTING PARKING ENVIRONMENT IN KIRKLAND

4.1 Minimums

As shown in the map in Appendix 1, Kirkland's multifamily zones can be divided into five categories based on their parking stall minimum requirements:

- Downtown (CBD)
  - 1 per bedroom or studio units (minimum 1.3 per unit average)
  - guest parking: 0.1 bedroom or studio unit with a minimum of two per development
  - in-lieu fee option
- General Residential
  - 1.7 per unit
  - guest parking: up to 0.5 per unit
- Shoreline
  - 2.0 per unit
  - guest parking: up to 0.5 per unit
- Totem Lake: Case by Case basis (KZC 105.25)
- South Kirkland TOD: 1.1 per unit

Other pertinent elements of Kirkland's multifamily parking code include:

- Discretionary parking modifications where a detailed study documents lower demand than the code requirement. When such changes are being considered, City code requires public notice to all property owners within a 300' radius of the development site and allows administrative decisions by the planning official and traffic engineer to be appealed to the hearing examiner. This public notice requirement and appeal process has the potential to cause significant delays in project permitting.
- Parking requirements for affordable housing units may be reduced to one stall per unit if the owner commits by covenant to one car per unit.
- Bicycle parking spaces are required for new development with six or more motor vehicle parking spaces, at a ratio of one bicycle space for each 12 required motor vehicle parking spaces. Covered and secured bicycle storage provided on site can be credited towards parking requirements at a ratio of one less parking stall per six bicycle spaces (maximum 5% reduction in required parking).
- Two or more uses may share a parking area if the number of parking spaces provided is equal to the greatest number of required spaces for uses operating at the same time, with a City-approved agreement between property owners. Final parking stall requirements are based on analysis of peak demand for each use.
- In the CBD (downtown) zones, projects may pay a fee-in-lieu of $20,000 per stall into a special fund that is used to provide and upgrade municipal off-street parking.
- In CBD zones that allow residential suites, the minimum is reduced to 0.5 per unit for residential suites that agree to manage demand and monitor and limit car ownership.

4.2 On-street Parking

Areas with regulated on-street parking are primarily located in downtown, typically with 2 hour limits, but also some 30 minute limits. First Street, 3rd Avenue, 2nd Avenue South, and State Street have 4 hour limits. In downtown, on-street parking has no time limit on Market Street north of Central Way, Central Way between 3rd and 5th Streets, and 3rd Avenue between 1st and 2nd Streets.

Downtown Kirkland also has several off street lots including:

- Lake Street & Central Way Lot (3 hour limit)
- Lakeshore Plaza Lot (3 hour limit)
- Peter Kirk Municipal Garage (4 hour limit)

The Lake Street Lot and Lakeshore Plaza have pay stations that charge $1.00 per hour from 5 p.m. to 9 p.m. All Day parking (9 a.m.-9 p.m., Mon-Sat) is available in the Park & Main Lot for $1.00 per hour. There are also several private pay lots in downtown. Downtown employee parking permits are available at no charge for parking at the Peter Kirk Municipal Garage (library garage).

The City has generally been opposed to Residential Parking Zones (RPZs). Kirkland staff has indicated that the City will likely want to avoid any changes to parking codes that would necessitate the implementation of parking management, which is seen as too much of a drain on City resources, and also unpopular with residents.

4.3 RSP Surveys

The RSP data represents a robust collection of regional data from multifamily sites throughout King County and a significant statistical analysis of context-based variables that affect parking demand. Parking utilization for each site was observed under carefully controlled, consistent conditions. Parking counts were completed during mid-week days (Tuesday through Thursday) at the peak parking demand hours for residential land uses, which falls between 12:00 a.m. to 5:00 a.m. Parking counts were not completed during weeks with major holidays considering residents could be on vacation.

The RSP parking utilization survey included 10 multifamily projects located in Kirkland, and the results, aggregated by neighborhood, are shown in Table 1. On average, the 10 projects supplied 43 percent more parking than the observed utilization. The amount of oversupply in individual buildings ranged between 14 to 173 percent. These result are consistent with the RSP survey findings county wide, which showed that on average buildings supply 40 percent more parking than the observed utilization.

The average observed parking ratio was 1.20 per unit, ranging between 0.9 and 1.5 for individual buildings. The observed average ratio is significantly lower than the minimums specified for Kirkland's downtown (1.6), general residential zones (1.7) and shoreline zones (2.0). Only the South Kirkland TOD area has a lower minimum than the observed average, but that area has unique conditions.

Totem Lake minimums are determined on a case-by-case basis, so a direct comparison to the observed utilization can't be made. However, a multifamily development just south of Totem Lake was recently

approved for a ratio of 1.1 per unit. There is also a recent affordable multifamily project in Totem Lake that was approved for a parking ratio of 0.79 per unit.

Four of the 10 Kirkland projects surveyed charge residents rent for parking that is unbundled from the rent of the unit (in other words, the tenant pays apartment rent and parking rent separately – if needed). Monthly parking rates in these buildings ranged between $40 and $83. Three of the 10 projects had shared parking between residents and other uses, though the number of shared stalls was relatively small, numbering 12, 14, and 33 stalls.

TABLE 1: Summary of the ten projects in Kirkland surveyed by the RSP project

N'hood	Projects	Total Resid. Units	Total Resid. Stalls	Supply (stalls / unit)	Utilization (stalls / unit)	Excess Supply (stalls/ unit)	Stalls Shared w/other Uses	Bicycle Parking Stalls	Total Resid. Square Footage	Stud.	1-bds.	2-bds.	3-bds.
Juanita	4	891	1,557	1.75	1.20	0.55	47	0	742,855	24	334	274	48
Totem Lake	2	400	564	1.41	1.18	0.23	12	0	295,342	50	167	149	28
Other*	4	613	978	1.60	1.22	0.38	0	92	190,436	38	251	285	36
TOTALS	10	1,904	3,099	1.63	1.20	0.43	59	92	1,986,314	112	752	708	112

*These four projects are located in Bridal Trails, Lakeview, Moss Bay, and North Rose Hill, but specifics are undisclosed to protect confidentiality.

4.4 RSP Gap Analysis

The following analysis compares the City of Kirkland's municipal parking code against the predicted RSP multifamily parking utilization rates. Within multifamily or mixed use zoning areas, the ratio of the minimum parking requirement to the RSP-predicted parking utilization was calculated for each parcel.

Figure 1 and Table 2 summarize the results of the parking supply to RSP demand analysis. On the map, blue shaded parcels (of which there are none in Kirkland) would represent a situation where municipal parking minima are less than predicted utilization, orange parcels (e.g., South Kirkland Park and Ride) have parking minima roughly aligned with utilization, and the tan and brown parcels have minima that exceed RSP expected utilization.

As shown, the City's minimum parking requirements generally result in a minimum-to-utilization ratio of above 120 percent, which also could be interpreted as 20 percent or greater oversupply. Ratios exceeding 160 percent are present in several areas of the City. Much of the variation shown on the map has to do with the predicted parking utilization rates from the RSP model. For example, the rate of "oversupply" is higher along 100th Ave NE in Juanita because the RSP tool predicts that parking utilization is lower in areas that are immediately adjacent to corridors with transit service (e.g. the 255 Route).

The only area where the code is in rough balance with utilization is in the South Kirkland Park and Ride area, which recently underwent a parking code adjustment with the development of TOD zoning for the site. Also notable is that the Totem Lake area has parking requirements that are determined on a

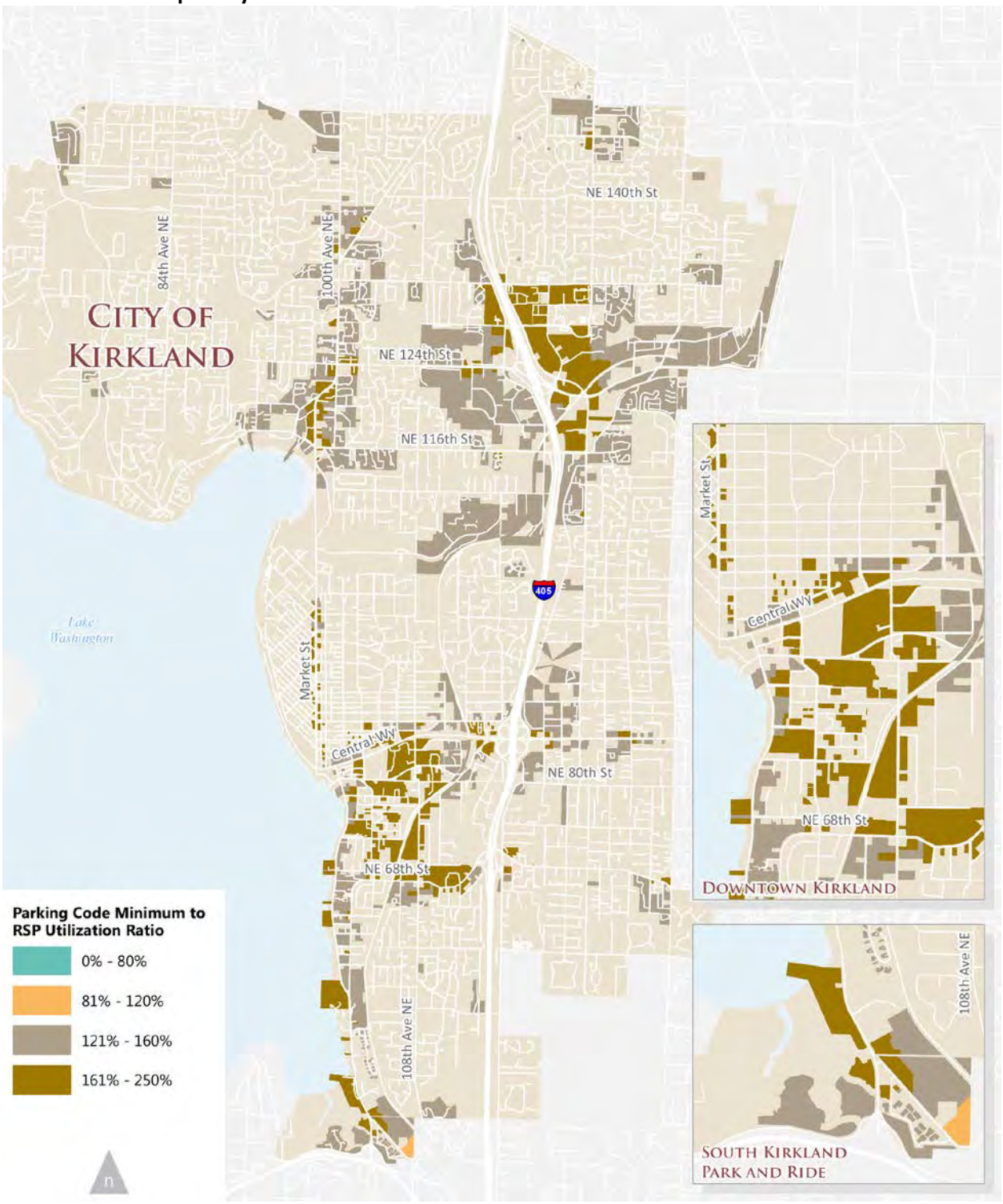
project-by-project basis. The figure shows the gap in parking requirements and utilization that would occur assuming that the City's typical rate of 1.7 parking stalls per unit was applied. However, based on conversations with City staff, two recent projects have been approved with parking supplies that are roughly equal to the anticipated RSP utilization.

TABLE 2: RSP Gap Analysis

Location	Required Minimum (stalls per unit)	Average RSP Predicted Utilization (stalls per unit)	Required Minimum to RSP Predicted Utilization Ratio	Gap Between Requirement and RSP Predicted Utilization (stalls per unit)
General Residential	1.70	1.10	155%	0.60
Downtown (CBD -1, -2, -8[1])	1.56	1.04	149%	0.52
Totem Lake	1.70[2]	1.05	162%	0.65
S. Kirkland TOD	1.15	1.05	110%	0.10

Notes:
[1] CBD average parking requirements are vary by bedroom and location. An average was calculated based on the typical housing in the area.
[2] Totem Lake does not have traditional parking minima. They are set project-by-project. For this analysis, the typical City requirement was assumed.

FIGURE 1: RSP Gap Analysis



4.5 The Kirkland Comprehensive Plan

The Kirkland Comprehensive Plan includes numerous goals and policies that provide rationale for updating the regulations described above to promote RSP outcomes. With respect to Land Use, one of the most relevant policies is LU-5.1, which includes the following principles:

- Encourage multimodal transportation options, especially during peak traffic periods.
- Promote an intensity and density of land uses sufficient to support effective transit and pedestrian activity.
- Encourage pedestrian travel to and within the commercial area by providing… placement of off-street surface parking to the back or to the side of buildings to maximize pedestrian access from the sidewalk.
- Promote non-SOV travel by reducing total parking area where transit service is frequent.

More directly, policy LU-3.5 states: "Incorporate features in new development projects which support transit and non-motorized travel as alternatives to the single-occupant vehicle." Note that more efficient utilization of parking should be considered a "feature" supporting transportation alternatives.

Regarding transportation specifically, Policy T-1.4 contains the following language:

> "Kirkland's vision for transportation promotes the movement of people throughout the City and region by expanding opportunities to use transit, ridesharing, and nonmotorized facilities…. Alternate modes of travel reduce energy consumption, air pollution, and noise levels… the City should pursue all possible alternatives to the single-occupant vehicle."

More generally, framework goal FG-7—*Encourage a sustainable community*—includes the following language: "We strive to accomplish our goal by reducing our contribution to climate change… Among the varied tools are land use goals and regulations that encourage pedestrian-oriented and compact development in our neighborhoods…"

Additional framework goals that are aligned with RSP include:

- *FG-3 Maintain vibrant and stable residential neighborhoods and mixed-use development, with housing for diverse incomes, ages, and lifestyles.*
- *FG-9 Provide safety and accessibility for those who use alternative modes of transportation within and between neighborhoods, public spaces, and business districts and to regional facilities.*
- *FG-10: Create a transportation system which allows the mobility of people and goods by providing a variety of transportation options.*
- *FG-14: Plan for a fair share of regional growth, consistent with State and regional goals to minimize low-density sprawl and direct growth to urban areas.* (Note that one of the benefits of RSP is that it enables higher density development by reducing the need for parking.)

5 STRATEGIES

5.1 Market-based Approach

The RSP Model Code's preferred recommendation for promoting RSP outcomes is a market-based approach, which involves removing minimums and letting the market determine how much parking is built. However, due to concerns about the risk introduced by unregulated parking, in most of the City of Kirkland a market-based approach is likely to be unacceptable to the community in the near term, with the possible exception of the Totem Lake area.

Totem Lake is the only area in the City where the parking requirements are determined on a case-by-case basis. This approach is intended to give developers flexibility. There is interest and momentum within the City to get development happening in Totem Lake. For these reasons, Totem Lake is the best opportunity in Kirkland to explore a market-based approach to parking minimums.

The chief concern to address for a market based approach is what happens if developers underbuild parking, and in particular, determining where spillover parking would have impacts. Much of the Totem Lake area consists of superblocks with strip commercial development and large surface parking lots; there is very little on-street parking. As such, any spillover from underparked residential buildings would most likely impact private surface parking lots, and this could create a burden of policing the lots on those property owners. However, Totem Lake is a designated regional urban center, and most cities do not consider potential parking spillover into private lots to be an "impact" in urban centers. There is typically an expectation that private property owners have the responsibility to manage their parking in urban locations.

On the other hand, if surface lots are underutilized—which many in Totem Lake appear to be—a demand for residential parking could provide a new source of income for the owners of surface parking lots. Further study of parking resources in Totem Lake would be necessary to develop a market-based approach that properly mitigates any potential negative impacts to surrounding properties.

Of the several parking management strategies described in the RSP Model Code, one that may be best suited to a market-based approach in Totem Lake is improving utilization of existing off-street parking lots. Totem Lake has numerous off-street surface parking lots, most of which appear to have significant excess supply, at least during specific times of the day or week. Enabling this parking resource to be utilized would provide a safety valve for any spillover problems caused by underbuilt multifamily parking. Municipalities can play a direct role in connecting parking consumers with parking lot owners. For example, the City of Long Beach, CA, administers an innovative program that enables owners of underutilized private parking lots to lease their parking to local residents.[4]

[4] Information on the City of Long Beach program can be found at http://www.communityparking.com

5.2 Context-based Approach

Kirkland's existing codes that set parking minimums in the downtown, general residential, and shoreline areas all have the potential to be improved through the incorporation of elements of the "context-based" approach proposed in the RSP Model Code. Each of these areas is discussed separately below.

Downtown

The current code for downtown was adopted in 2010, but there have not yet been any major multifamily developments to test it. The RSP gap analysis discussed above indicates that there is room to lower the minimum and still accommodate expected parking demand. Refining parking minimums using a context based approach would be a defensible way to lower minimums and get the requirements more in line with actual demand.

The first step of the RSP context-based approach is to set a baseline parking minimum based on the general level of urban characteristics of the place. Because downtown is the most urban area in Kirkland, it would be expected to have a lowest baseline minimum of all Kirkland's multifamily areas (based on RSP predictive variables).

Given that parking requirements are minimums only, and also that urbanizing places such as downtown Kirkland can be expected to exhibit general trend toward lower parking demand over time, it is appropriate to set minimums at or slightly below the RSP calculator's demand predictions. Considering the predicted utilization for the CDB shown in Table 2 above, an appropriate choice for the baseline minimum would be approximately 1 per unit.

There are several possible context based adjustments proposed in the RSP model code that could be applied in downtown Kirkland. (For reference the full menu of options in the RSP model code is provided in Appendix 2.) In particular, one factor unique to the downtown code is the way the minimum is defined to scale up linearly with the number bedrooms in a unit. Actual demand is not linearly proportional to bedrooms as the bedroom count gets higher, so as bedroom count goes up the required minimum in downtown becomes incorrectly inflated. As noted in the Gap Analysis section above, based on average bedroom counts in typical multifamily housing in Kirkland's downtown, the required minimum would be 1.6 per unit. That is barely a reduction from the general residential requirement of 1.7 per unit.

The effect of the number of bedrooms on demand could be more accurately accounted for through the set of adjustments recommended in the RSP model code, as shown in Table 3 below. The "X" in the table indicates that the baseline minimum would be multiplied by this factor to determine the adjusted minimum. The specific factors in Table 3 were based on statistical analysis of data from the 208 multifamily projects that were used to develop the RSP parking utilization calculator (bedroom count was one of the seven independent variables used in the predictive statistical model).

Table 3: RSP Model Code proposed multipliers to adjust minimums according to bedroom count

studio	1-bedroom	2-bedroom	3-bedroom+
0.85X	1X	1.6X	1.8X

Note that Kirkland's current requirement for 0.1 guest stalls per bedroom could also be modified according to the metrics in Table 3 above.

Other context-based adjustments (see Appendix 2 for reference) that would be most relevant to downtown Kirkland, and that are not sufficiently addressed in existing code, include:

- Low-income units: The RSP survey data showed an average demand reduction of 35 percent for these units.
- Senior units: The RSP survey data showed an average demand reduction of 50 percent for these units.
- Assisted living units: Existing Kirkland allows a reduction to 1 per unit, but this could be further reduced based on the RSP multifamily survey data (see Appendix 2 for the RSP model code's proposed reduction).
- Transit Access: The RSP Model Code proposes a reduction of 25 to 50 percent, depending on proximity and level of service.
- Transportation Management Plan (TMP): Existing Kirkland code specific to residential suites includes TMPs as one of several conditions for reduced parking requirements. The RSP Model Code proposes a reduction of up to 20 percent.
- Transit supportive building and site design: The RSP Model Code proposes a reduction of up to 10 percent.
- Parking price unbundled from the unit price: The RSP survey data showed an average demand reduction of 20 percent when parking was unbundled.
- Remote parking: The RSP Model Code proposes a one-for-one exchange of on-site for off-site parking.
- Car share stalls: The RSP Model Code proposes a reduction of four stalls for every car share stall.

<u>General Residential</u>

The RSP gap analysis discussed above indicates that there is room to lower the minimum in the general residential areas and still accommodate expected parking demand. As with downtown, a context-based approach could provide a defensible methodology for reducing minimums. Unlike downtown, however, the general residential zones are spread throughout the City and have large variations in basic land use characteristics. The RSP context-based approach involves setting a baseline minimum, but due to these variations, a uniform baseline may not be appropriate for all of the general residential areas. For example, Juanita Village is one area that could be expected differ enough from the more typical general residential areas such that it could be assigned a unique baseline minimum.

Determining the best way to handle baseline minimums in the general residential areas will require further analysis of how land use varies among the different general residential areas. Note that large-area parking demand maps generated by the online RSP calculator tool could be used to help characterize land use variation. In any case, given the projections of the RSP calculator (see Table 2), an appropriate baseline would be about 1.1 per unit.

Several of the context-based adjustments described above for downtown would also be appropriate for the general residential areas, including number of bedrooms, low-income, senior, and assisted living units, and transit access. Unbundling, TMPs, and car share are likely to be less appropriate in general residential areas with a more suburban character and less transit. In particular, RSP research has shown that parking price has dwindling influence on parking demand in places where there are limited alternatives to travel by car.

Shoreline Areas

The shoreline zones have the highest minimums in the City at 2 per unit. Not only is this relatively high requirement inconsistent with Kirkland's general residential zones (1.7 per unit), it is also in conflict with shoreline policies that indicate parking is not a desired use in these areas. These circumstances support the case for reductions in required minimums in the shoreline zones. If nothing else, minimums should at least be made consistent with the general residential requirement of 1.7 per unit.

As with the downtown and general residential areas, a context-based approach could provide a defensible methodology for reducing minimums in the shoreline areas. The areas cover a relatively limited extent, and are similar in general land use characteristics—most are located directly on the shore of Lake Washington on the west side of Lake Washington Blvd between downtown and Yarrow Bay. Thus, it can be expected that a single baseline minimum would apply well to all the areas; although, consideration should be given to removing the shoreline parking designation for the parcels near downtown and to apply the downtown rates.

Regarding context-based adjustments, those recommended above for the general residential areas would be most appropriate for the shoreline areas. In fact, one potential option would be to standardize the context-based approach for both the shoreline and general residential areas.

Totem Lake

Totem Lake should be considered for a market-based approach to parking minimums, as discussed in the next section. If the existing case-by-case approach is retained, the City could explore the potential for allowing the RSP Parking Calculator to be used to review the parking minimums proposed by developers.

South Kirkland TOD

The requirements in this zone—1.1 per unit—were recently updated to be consistent with the planned TOD, currently under construction. As such, it is not likely to need any further changes in the near term.

5.3 On-street Management

In general, as parking resources become more highly utilized, the need for on-street management rises. However, management requires City resources, and can be unpopular with local businesses and residents. A key point to make clear is that if parking minimums are reduced according to the concepts developed by the RSP project, the impact on street parking should be minimal. When parking requirements are based on RSP principles, it means that parking resources are used to their maximum efficiency, i.e., demand is absorbed by empty stalls in residential projects and no additional pressure is put on stalls on the street. Thus, in most of Kirkland on-street management should not be seen as an issue that would be exacerbated by reduced minimums that have been properly calibrated.

Currently, on-street parking management in Kirkland is almost entirely limited to the downtown area, and it may be appropriate to reassess these measures, depending on the specifics of what is proposed regarding adjustments to multifamily parking minimums. Since most of downtown on-street parking has a two hour limit, it would not be expected that residential parking spillover is creating much if any conflict with commercial parking. However, it is possible that spillover parking is impacting neighborhoods adjacent to downtown where on street parking does not have time limits. If downtown minimums are proposed to be reduced, the potential for this type of spillover should further explored, ideally through on-the-ground observation.

One parking management strategy discussed in the RSP Model Code that the City could consider is utilization monitoring. Public perception of on-street parking availability is not always aligned with actual utilization. In some cases, utilization surveys may help assuage concerns if the surveys document that there actually is significant excess on-street parking supply within a given neighborhood. Another potential option is for cities to commit to routine utilization monitoring, and implement contingency measures if utilization rates hit unacceptable levels. This method would be most suitable to mitigate potential impacts of a market-based approach for which minimums have been removed. (Note: To the best of our knowledge there is no precedent for a City making such a commitment to monitor and mitigate, but it is suggested here as an avenue for exploration if significant parking reductions are pursued.)

5.4 Shared Parking

Kirkland allows shared parking throughout the City “if the number of parking spaces provided is equal to the greatest number of required spaces for uses operating at the same time…” But there are further steps the City could consider to better promote shared parking as an RSP strategy.

The potential for shared parking agreements between adjacent properties greatly expands the opportunities for shared parking, but it also necessitates the establishment of formal legal agreements between different property owners. The risk and hassle associated with such agreements is a major barrier to the implementation of shared parking. To overcome this barrier and promote adoption of shared parking schemes, the City could consider developing a model shared parking agreement designed to make the process easier to navigate and to reduce legal risk.

Because they typically have a single owner, mixed-use projects present an opportunity for shared parking without the need for a legal agreement between different owners. Within individual mixed-use projects that contain uses that have complementary parking utilization patterns, sharing of the onsite parking can allow for a reduced number of parking stalls in the project. Shared parking arrangements in mixed-use projects also open the possibility for accommodating guest parking in a pool of shared parking, such that the extra stall requirement for guest parking could be eliminated.

A shared arrangement within a single project usually requires that the parking facility be designed to allow all tenants and visitors access to all areas of the parking lot. In typical mixed-used buildings with structured parking, the residential portion of the parking is designed to be securely isolated from parking available to non-residents. One possible solution is a moveable gate or barrier that could accommodate variations in utilization between the residential and commercial portions of the project. Another design strategy is to make multifamily parking garages accessible to all tenants and visitors without compromising resident security, for example with parking elevators open to public plazas instead of interior lobbies.

Because downtown has relatively high density and a diverse mix of uses, it can be expected to have the best opportunities for shared parking in Kirkland. In the general residential zones, the biggest opportunity for shared parking is in the Juanita Village area, where there is an appropriate mix of uses. In most other general residential areas, it is much less likely that there will be complimentary uses near each other to support shared parking. The preponderance of private surface parking lots presents a unique opportunity for shared parking in the Totem Lake area. No matter what the location, the key role that the City can play is to facilitate connections between multifamily developers and owners of adjacent available parking that could support shared parking arrangements.

5.5 Pricing

Pricing parking in multifamily developments is most effective when off-site parking options such as on-street stalls or public parking lots are also priced, which is not the case in most of Kirkland. In addition, Kirkland's dominant land use patterns and limited transit are such that pricing parking in multifamily buildings would be expected to have a modest effect on parking utilization and car ownership. In Kirkland, some households may be willing to reduce from owning two cars to one car, but going totally car free is likely to be a realistic option only for residents of areas with significant transit service (i.e. – the 255 bus route).

However, even with the above limitations, promoting priced parking is an important strategy the City could pursue to help encourage an evolution toward RSP in Kirkland. When the price of parking is unbundled from the price of the unit, consumers get a more transparent understanding of the actual costs of storing their car, and that understanding typically underscores the potential of alternatives to owning car.

One method Kirkland could use to promote pricing in multifamily developments is to offer a reduction in parking requirements in exchange for unbundling. The RSP model code context-based approach proposes a reduction of 20 percent for unbundling, based on data from the multifamily utilization survey. If desired, that percent reduction could be tailored to better fit the Kirkland context, since in much of the City that context may translate to a weaker relationship between parking price and utilization, as noted above. The City could also consider specifying reductions that vary by zone, or offering the reduction in the downtown area only. Since it the most urban area in Kirkland, the downtown area would be expected to have the strongest relationship between pricing and utilization.

Pricing on-street parking in downtown Kirkland would complement unbundling in multifamily buildings to create a rational market for parking that would promote RSP outcomes. To help overcome political resistance to charging for on-street parking, the City could consider implementing a Parking Benefits District in downtown. In Parking Benefit Districts, revenue collected for parking fees within the District are spent on improvements within District. Because the revenue gets spent locally, members of the community tend to be much more receptive to parking management that involves meters or paid permits.

APPENDIX 6.1: RSP Model Code proposed context-based adjustments and reductions

ADJUSTMENTS FOR HOUSING UNIT TYPE:

studio*	1-bedroom*	2-bedroom*	3-bedroom+*	residential suite
0.85X	1X	1.6X	1.8X	0.5X

ADJUSTMENTS FOR RESIDENT CHARACTERISTICS:

very low-income	low-income*	workforce	senior*	assisted living	dormitory
0.5X	0.65X	0.75X	0.5X	0.33X	0.33X

REDUCTIONS FOR TRANSPORTATION ALTERNATIVES:

frequent transit	fixed-guideway transit	bike share facility	resident TMP	transit-supportive design
25% / 50%	50% / 100%	up to 25%	up to 20%	up to 10%

REDUCTIONS FOR OFF-STREET PARKING MANAGEMENT:

unbundling*	shared parking	remote parking	in-lieu fee	deferred parking	lease/deed restricted parking
20%	up to 50%	up to 100%	up to 100%	up to 50%	up to 100%

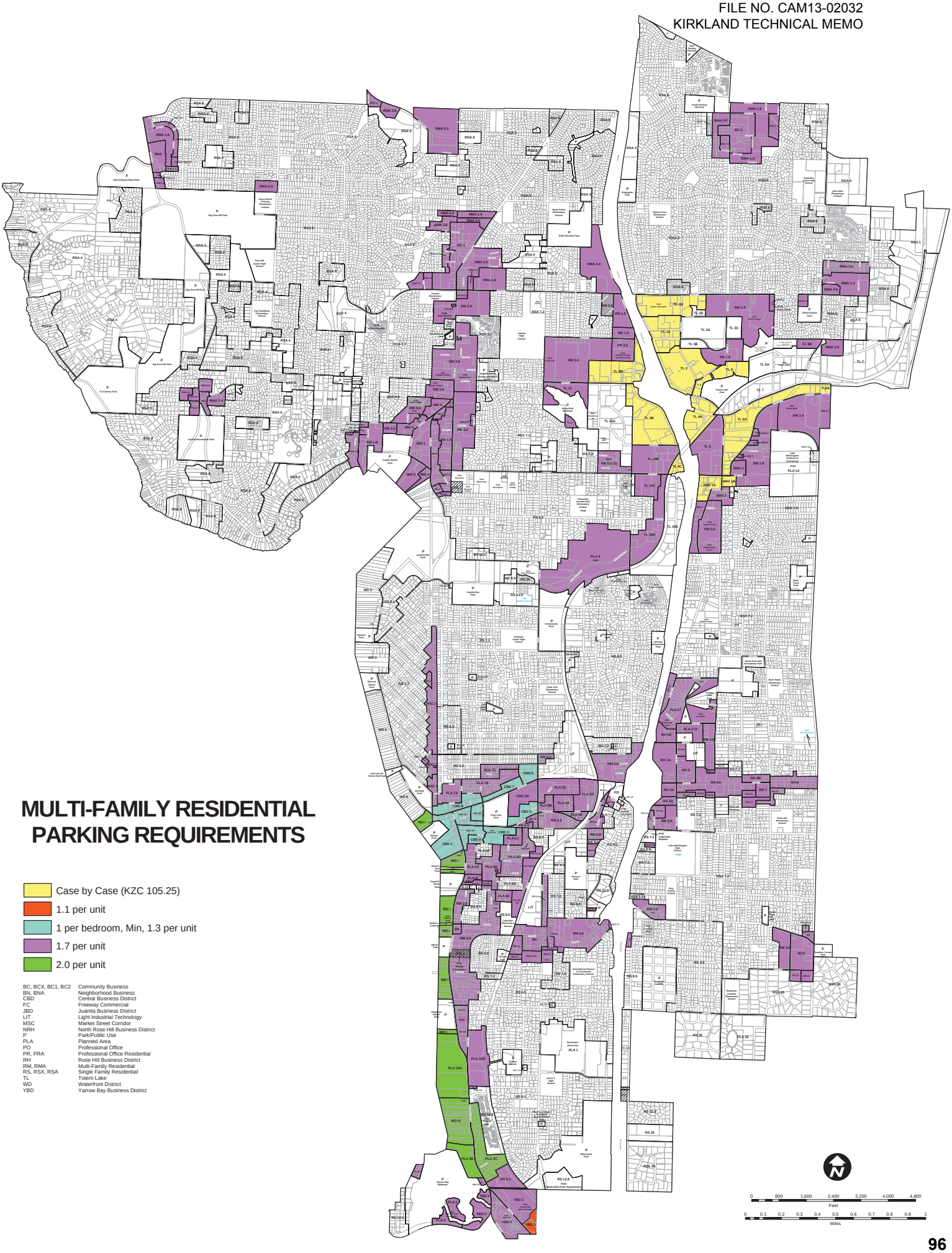
PARKING STALL SUBSTITUTIONS:

car share stalls	bike parking stalls	motorcycle parking	adjacent on-street spaces
4 : 1 (up to 40%)	1 : 4 (up to 25%)	1 : 2 (up to 5%)	1 : 1

Notes:

1. *Factors appended with an asterisk* are those that were derived from the RSP multifamily parking utilization survey statistical analysis.*
2. *An "X" in the table indicates that the baseline minimum would be multiplied by this factor to determine the adjusted minimum.*

APPENDIX 6.2: Kirkland's multifamily zones and parking requirements


MULTI-FAMILY RESIDENTIAL
PARKING REQUIREMENTS
Case by Case (KZC 105.25)
1.1 per unit
1 per bedroom, Min, 1.3 per unit
1.7 per unit
2.0 per unit
BC, BCX, BC1, BC2 Community Business
BN, BNA Neighborhood Business
CBD Central Business District
FC Freeway Commercial
JBD Juanita Business District
LIT Light Industrial Technology
MSC Market Street Corridor
NRH North Rose Hill Business District
P Park/Public Use
PLA Planned Area
PO Professional Office
PR, PRA Professional Office Residential
RH Rose Hill Business District
RM, RMA Multi-Family Residential
RS, RSX, RSA Single Family Residential
TL Totem Lake
WD Waterfront District
YBD Yarrow Bay Business District
0 800 1,600 2,400 3,200 4,000 4,800
Feet
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Miles

To: Jon Regala
From: Michael George
Date: May 9, 2014
Event: King County Metro/City of Kirkland Meeting

RE: Multifamily Parking Pricing & Management Stakeholder Comments

Introduction:
The City of Kirkland and King County Metro facilitated a round table discussion with local developers, property managers and other experts. The following summarizes participants' comments.

Code Comments:

- The general consensus was that parking minimums need to be revised to better match demand for parking.
    - i) Parking codes should consider specific neighborhood characteristics, instead of a one size fits all approach.
    - ii) Businesses that depend on on-street parking must be considered when making code changes that could increase on-street parking demand.
- Multifamily minimum parking requirements that attempt to match tenant parking demand must account for visitor parking.
    - i) No consensus on how much visitor parking to require by code, but most agreed that .5 spaces per unit is too high.
    - ii) During peak demand days (holidays, parades etc…), tenants will park on-street and allow visitors to park in their reserved stalls.
    - iii) Single-family neighborhoods typically expect some on-street visitor parking. Similar expectations should be set for multi-family neighborhoods.
    - iv) Providing visitor parking can present security challenges. The group suggested a number of potential solutions including, multiple parking gates, a system to buzz in visitors, and allowing visitors to share parking with commercial tenants in mixed use buildings with separate residential parking areas.
    - v) Even in projects that provide adequate visitor parking, visitors still park on the street for convenience.
    - vi) It can be a management issue to keep tenants from using visitor parking for second vehicle.
- It's not good practice to set parking minimums higher then necessary, then require developers to provide something extra-ordinary in return providing less parking than code allows.
- City Code should allow ZipCar to put up signage directing users to vehicles located in privately owned spaces that aren't visible from the street.
- Projects should be required to make electric car charging stations available by code.
- Need more common sense in determining comparable sites to use for parking demand studies. The current system forces developers to use comparables that aren't representative of their projects.

Comments Specific to Eastside/Kirkland:

- Eastside mentality is becoming more accepting of paid parking and unbundling parking from unit rents. This is creating a stronger market for priced-parking.
- Bike parking/storage is being included in more eastside projects.
    - i) Bike parking can either consist of bike racks or dedicated bike storage rooms.
    - ii) Dedicated storage rooms provide more security than bike racks.
- The City should do a better job advertising public parking locations; better signage is necessary.
- On street parking management is a key ingredient to the larger parking solution. Kirkland needs to do a better job enforcing on-street parking rules.

General Observations:

- Parking should be built to accommodate adaptive reuse so surplus parking can be converted to more productive uses as demand declines.
- Apartment and condominium parking demand is different, but parking decisions must consider the possibility of condo conversions.
- It's harder to lease surface spaces for shared parking than garage stalls. It's not clear whether this is due to project location, or more willingness to pay for secure covered parking.
- Tenant demographic characteristics can dictate the demand for parking.
- It is common for 1-bedroom units to own two cars, and for 2-bedroom units to only own one. This can create a supply and demand mismatch.
- Developers should build to future standards, and consider an area's car ownership trendline.
- Parking codes should not be set around peak demand days.
- It's important to understand how changing transit service effects parking demand. For example, how are upcoming King County Metro service cuts going to affect driving habits?

CONDO PARKING COUNT - APRIL 27, 2006 - APPROXIMATELY 5:00 A.M. START AND OVER A PERIOD OF SEVERAL HOURS

.

LOCATION	Guest Parking			Tenant Parking			ALL	On-Street	
	# Spaces	# OCCUP.	Occupancy	# Spaces	# OCCUP.	Occupancy	Occupancy	# OCCUP.	Occupancy
TIARA DE LAGO	0			29				0	
WATERVIEW	6	0	0	82	57	69.5%	64.8%	3	
								3	
								7	
BREZZA	20	5	25.0%	127	88	69.3%	63.3%		
								7	
PORTSMITH	13	5	38.5%	260	181	69.6%	68.1%		
								8	
PLAZA	11	3	27.3%	146	108	74.0%	70.7%	1	
								2	
TOTAL	50	13	26.0%	615	434	70.6%	67.2%	31	

CONDO PARKING COUNT - JULY 27, 2006 - APPROXIMATELY 5:00 A.M. START AND OVER A PERIOD OF SEVERAL HOURS

LOCATION	Guest Parking			Tenant Parking			ALL	On-Street	
	# Spaces	# OCCUP.	Occupancy	# Spaces	# OCCUP.	Occupancy	Occupancy	# OCCUP.	Occupancy
TIARA DE LAGO	0			28	22	78.6%		3	
WATERVIEW	6	0	0	82	51	62.2%	58.0%	5	
BREZZA	20	3	15.0%	127	92	72.4%	64.6%	3	
PORTSMITH	13	11	84.6%	260	163	62.7%	63.7%	7	
PLAZA	11	7	63.6%	146	90	61.6%	61.8%		
TOTAL	50		0.0%	643	418	65.0%	60.3%	15	

CENTRAL BUSINESS DISTRICT - PARKING SPREADSHEET

(HIGHLIGHTED ROWS INDICATE PROJECTS WITH APPROVED PARKING REDUCTION) Revised 4/29/2014 to include Slater 116 and Waterbrook/Ondine

Project	Year Complete	Residential Units	No. of Bedrooms	Code Required Residential Parking [5]	Commercial Square Footage (gfa)	Base Code Requirements: Commercial (1/350 or 300 s.f. depending on zone)	TOTAL Required by Code	Parking Provided TOTAL [2]	Provided - Base Required	Residential Parking Provided	Residential Parking Rate: stalls/unit [2]	Guest Parking Rate/unit	Residential Parking @ 1 stall/bedroom	City Approved Rate: Stalls/ Bedroom [2]	Actual Residential Parking Provided: Stalls / Bedroom [4]
Plaza on State Condominiums [3]	1996	81	117	138	2,852	9	147	165	18	156	1.93	0.23	117	n/a	1.33
Watermark Apartments	1997	60	103	102	0	0	102	106	4	106	1.77	0.07	103	n/a	1.03
Park Avenue Condominiums	1997	38	76	65	0	0	65	84	19	84	2.21	0.51	76	n/a	1.11
602 5th Street Condominiums	1997	14	28	24	0	0	24	31	7	31	2.21	0.51	28	n/a	1.11
Tiara De Lago Condominiums [3]	1998	13	26	23	2,360	7	30	30	0	23	1.77	0.07	26	n/a	0.88
Chaffee Condominiums	1998	12	24	21	0	0	21	25	4	25	2.08	0.38	24	n/a	1.04
6th Avenue Condominiums	1998	22	44	38	0	0	38	49	11	49	2.23	0.53	44	n/a	1.11
Brezza Condominiums	1999	75	124	128	0	0	128	148	20	148	1.97	0.27	124	n/a	1.19
Tera Apartments [3]	1999	161	208	274	7,000	20	294	226	-68	206	1.28	?	208	?	0.99
Portsmith Condominiums	1999	153	263	261	0	0	261	276	15	276	1.80	0.10	263	n/a	1.05
220 1st Street Apartments [1]	2000	48	79	82	0	0	82	85	3	85	1.77	0.07	79	n/a	1.08
Soho Condominiums	2001	58	86	99	0	0	99	89	-10	89	1.53	?	86	?	1.03
West Water Apartments [1, 3]	2002	64	91	109	11,900	34	143	118	-25	84	1.31	?	91	?	0.92
Kirkland Central Condominiums [3]	2006	110	142	187	9,168	27	214	176	-38	149	1.35	0.05	142	1.05	1.05
Boulevard Condominiums [3]	2006	119	149	203	8,869	26	229	179	-50	153	1.29	0.03	149	1.03	1.03
128 State Condominiums	2007	124	158	211	0	0	211	168	-43	168	1.35	0.06	158	1.06	1.06
Bank of America/Merrill Gardens [3]	2010	66	80	113	12,368	36	149	137	-12	101	1.53	0.15	80	1.15	1.26
OTHER BUSINESS DISTRICTS															
Luna Sol - North Rose Hill Business District [3]	2010	52	60	89	9,888	33	122	94	-28	57	1.10	0.15	60	1.15	0.95
Waterbrook/Ondine - Juanita Business District	2012	102	111	174	4,139	14	188	158	-30	135	1.32	0.10	111	?	1.22
Slater 116	2013	108	108	Case-by-Case	10,200	34	Case-by-Case	128	Case-by-Case	78	0.72	0.10	108	1.10	0.72

Notes:

1) 220 1st Street and West Water Apartments have a shared parking agreement for approximately 6 stalls
2) Totals include guest parking. Actual # of designated stalls and management of those stalls should be determined through site surveys
3) Residential projects with commercial use have shared parking opportunities, particularly for guest parking. Actual utilization/management should be determined through site surveys
4) Actual rate per bedroom may be lower or higher than approved rate due to shared parking opportunities or surplus stalls were providec
5) Guest parking not included. See *Guest Parking Rate* column. The City may require guest parking spaces in excess of the required parking spaces, up to a maximum additional 0.5 stall per dwelling unit, if there is inadequate guest parking on the subject property