FORM FOLLOWS PARKING:
STRATEGIES FOR MITIGATING THE IMPACTS OF EXCESS PARKING SUPPLY

by

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BLA, Iowa State University, 2014

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We accept this project as conforming
to the required standard

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FORM FOLLOWS PARKING:
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THE IMPACTS OF EXCESS PARKING SUPPLY

UNIVERSITY OF BRITISH COLUMBIA - SCHOOL OF COMMUNITY AND REGIONAL PLANNING

NEAL T. ABBOTT - APRIL 2016
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The negative implications of excess off-street parking have been discussed at length. From the large financial costs to the negative impacts parking can have on urban form, parking, while a seemingly unimportant component of the urban landscape, plays a significant role in informing both mode choice and overall density. The West End neighborhood, often found to have some of the highest residential densities in Vancouver, is not immune to these issues as well. In recent years, the West End’s Residential Parking Permit (RPP) program has faced consistent issue with congestion and parking shortages, as the on-street parking supply is often over 90% occupied. With permits costing roughly $6 a month, this on-street parking option is often substantially cheaper than parking in one’s own building. As a result, while the neighborhood’s on-street parking supply is consistently in high demand, off-street parking facilities in the neighboring residential properties are sparsely used, with occupancy rates consistently below 50%. Additionally, this leads to increased traffic in the area and creates difficulty for visitors and caretakers looking for places to park. Through the shared parking strategies examined in this report, the off-street stalls offer a potential solution for on-street congestion. Furthermore, study of common building forms in the area reveals that many residential properties could make large contributions to the RPP program with just their existing surface parking lots, alleviating the need to undergo costly retrofits. With these options in mind, the City of Vancouver could address its prevalent parking congestion issues by working with West End properties to unlock currently underutilized parking supplies.
PART I -- INTRODUCTION & BACKGROUND INFORMATION

Significance of Parking in the United States & Canadian Cities 1.1
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Shared / District Parking Overview 1.3
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Introduction

For over two decades, parking research and policy recommendations have focused on one primary item, reducing the oversupply of off-street parking. During this time, cities have experimented with various strategies to not only reduce parking requirements for new construction, but find ways to utilize the unused existing supply. For nearly just as long, the City of Vancouver has outlined strategies to maximize the use of existing parking structures without encouraging further car ownership (Vancouver, 2002 & Vancouver, 1997). The following document will examine the overall impacts of excess vehicular parking and explore strategies for mitigating its various negative impacts.

Comprised of three parts, this report will first give an introduction to the various financial implications parking can have on building construction, how parking can shape urban form, and how shared parking can act as a solution for overbuilt parking. In this chapter, parking strategies from around the globe will be discussed and compared to the City of Vancouver’s current approaches to off-street parking. Additionally, the chapter will show what current regulations would need to change in order to accommodate new parking strategies.

The second part focuses on the West End neighborhood’s Residential Parking Permit (RPP) zone and analyzes how shared parking could potentially utilize excess off-street parking to alleviate on-street congestion. This segment provides an inventory of the area’s multifamily building stock, their various off-street parking supplies, and the on-street parking occupancy rates for each block in the zone. After exploring the inventory of existing on-street and off-street parking conditions in the area, the chapter will demonstrate how targeted properties in the West End could utilize their excess parking to dramatically reduce on-street parking congestion.

Part III shows the various, site specific strategies buildings can take to facilitate shared parking. From minor upgrades to ambitious alterations, multiple approaches are demonstrated to show how buildings can maximize the utilization of their parking investments while maintaining building security for their residents. This chapter will also offer different shared parking business models, illustrating various marketing and partnership schemes will give building owners, city officials, and residents essential information to determine if shared parking would work within their neighborhood.

Land dedicated exclusively for moving and housing automobiles

![Figure 1: Parking Stall Size Comparisons](image_url)
1.1 The Significance of Parking

is the largest allocation of city space in most North American cities (Eran, 2012). Though much of this valuable land is now dedicated to the storage of private automobiles, it rarely sees full utilization. While the City of Vancouver has done a better job than most North American cities at limiting the overabundance of parking, there is still much room for improvement. In Metro Vancouver alone, parking in strata properties were found to have vacancy rates ranging from roughly 20-40% (Metro Vancouver, 2012). Excess parking not only encourages driving by increasing the opportunities to find parking at the end of trips, but also dissuades other forms of travel by making the built environment hospitable to primarily private motor vehicles (Jaffe, 2016). With substantial area dedicated to automobile travel, disproportionately high automobile mode shares should not come as any surprise. With parking infrastructure liberally distributed throughout the built environment, walking, cycling, and transit becomes less ways to move about a city. This trend continues as right of ways are designed to maximize vehicle flow rather than pedestrian safety. Comprehensively, urban design is jeopardized as blocks are broken up by parking lots and sidewalks interrupted by curb cuts – resulting in not only less diverse mode shares, but less desirable spaces to inhabit.

1.1.1 Financial Costs of Parking

Overabundance in parking supply not only helps inform mode choice, but creates a series of serious financial burdens through both direct construction costs and indirect opportunity costs of not being able to utilize the land for other, more productive uses. In Metro Vancouver, construction of on-site parking can range from $20,000 to $45,000 per stall, in addition to maintenance and operation costs (Metro Vancouver, 2012). These high costs can be exacerbated even further within the City of Vancouver where parking is often required to be built underground and where the price of land is at a premium. With parking requirements reaching over 1 stall per residential unit, housing affordability can often be sacrificed for ample off-street parking. In King County, Washington parking was found to be anywhere from 10-20% of the total construction costs. Through broad, non-site specific minimum parking requirements, governments require projects to develop a standard amount of parking without giving proper consideration to transportation and urban design features that can reduce the likelihood of car ownership, such as dense, mixed used development and frequent transit access. The same King County study found that this excess parking development (0.4 stalls of unused parking per unit), on average, added $400,000 per project (Rowe, 2013). Although parking was found to make up 10-20% of the construction costs, only 6% was recovered through parking fees, which, unless absorbed by the developer, would end up adding to a future tenant’s rent (Rowe, 2013).

The following table details the estimated costs of parking per stall throughout the King County region and what those figures end up meaning for future tenants (CNT, 2013). To calculate these figures the Right Size Parking Project assigned an average land value cost based on location, job / residential density, and street network density. Average operation and maintenance costs for each of these types of parking facilities were then added to the capital costs and divided by the parking stall / unit ratio to determine the monthly costs per residential unit.

In a 2014 interview, Donald Shoup, recently retired UCLA professor and parking researcher, was quoted in saying “[the United States] is the Saudi Arabia of developable land” (Shoup, 2014). By this Shoup implied that many cities in America are sitting on what can be seen as a vast supply of potential wealth in the form of underutilized land. Without developing on these highly valuable pieces of property, cities forego the potential revenue earned through property taxes and other fees. In a similar line of thought, research from the University of Connecticut concluded that the City of Hartford had lost $21 million annually in tax revenue by

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<td>Parking Ratio x $480</td>
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**Note:**

Total Capital Costs = Land & Construction  Monthly Costs per Unit = Land, Construction, Operation, and Maintenance
increasing its parking supply from 1950s levels (Blanc, 2014). Not only would developing on these valuable surface parking lots increase revenue, but it would increase the city’s density - making walking, biking and transit much more feasible in these otherwise car dependent environments.

1.1.2 How Parking and Parking Requirements Shape Urban Form

Parking not only consumes large areas of usable land within a city, it can also dictate the design of proposed buildings and developments. Cities, such as Vancouver, often require a building’s parking stock to be located on-site. While seemingly reasonable to want parking to be near the building it is intended to serve, and not place new demands on on-street parking, these types of requirements can radically alter the form or cost of a project. Projects may need to buy neighboring lots, excavate for expensive underground parking, change building material in order to build taller structures, or reduce the project’s overall footprint in order to reduce the parking requirement. Many of these options produce undesirable results for a city’s overall form. Buying neighboring lots or shrinking the project’s scale will reduce the area’s overall residential and commercial density (and the project’s floor to area ratio (FAR)), reducing the convenience of walking, cycling, or transit. If the project elects to raise or bury its parking supply, the additional costs of supplying structured parking will likely be passed onto the building tenants. Through minimum and on-site parking requirements, cities are effectively lowering their densities and overall affordability.

Diagram 2 illustrates how these different strategies for meeting parking requirements impact the proposed lot and its surrounding block. While this example uses a relatively small parking requirement (1 stall per unit), it can be seen that if the requirement was raised to a common rate of 1.5 or 2 stalls per unit, and implemented over the entire block, the neighborhood’s form and character would be dramatically altered.

1.1.3 Parking’s Impacts on Transportation and Mode Choice

Land use and transportation are intrinsically tied. Land use patterns can inform how successful modes of travel perform and, in turn, different forms of transportation infrastructure nurture varying styles of spatial layout. Inherently, those areas that choose to invest heavily in auto-infrastructure will have to dedicate

Figure 2: Strategies for Meeting Parking Requirements

(1) Acquire Neighboring Lots
- Reduces residential density
- Creates undesirable walking environments

(2) Reduce Project’s Floor to Area Ratio
- Reduces area density
- Separates building from street
- Creates undesirable walking environment

(3) Elevate Building Above Parking
- Creates undesirable walking environment
- Increases construction costs
- Reduces building accessibility

(4) Excavate Site for Underground Parking
- Increases construction costs
- Reduces building affordability
substantial areas of land to housing these vehicles. As explored in the previous section, parking when liberally applied to an area, can deter other forms of travel while simultaneously promoting private automobile use. Cheap, abundant parking makes driving convenient. Ease of use is an essential element for promoting any form of travel, and by ensuring users will have an affordable, conveniently located place to store their vehicle, workplaces and businesses alike are ensuring that their employees or customers will elect to drive. In a 2001 study of Portland, OR commuters found that 61% of commuters drove to work independently when parking was free, but only 46% chose to drive alone when parking was $6 or more (Hess, 2001). Further, recent work from the University of Connecticut, using historic aerial imagery and mode share data, was able to find a strong correlation between the number of parking spaces per resident and employee and the automobile mode share (Jaffe, 2016).

Studies examining Houston, TX’s downtown urban fabric determined that surface parking alone made up between 21-27% of all surface area (Akbari, 2003). When combined with roads, surface areas dedicated exclusively to automobiles jumps to nearly 51%. With so much area dedicated to automotive travel, Houston’s commute rates for walkers and cyclists (1.2% and 0.3% respectively) are understandably low (CNT, 2014). While not an exclusive reasoning for why Vancouver’s Metro Core has larger of walking, biking, and transit mode shares than Houston, these surface area percentages are telling figures for what mode of travel each city has elected to support.
1.1.4 - Summary

- In King County, parking construction was found to add between $76 and $480 to monthly rent depending on parking type and suburban or urban location.

- Parking breaks up city streets and sidewalks, lowers area densities, and creates inhospitable pedestrian environments.

- Parking can often range from 10-20% of construction costs, which can greatly impact low income residents who generally place more of their income in housing.

- Occupying urban areas with parking costs cities tax revenue. Estimates in Hartford, CT concluded the city loses $21 million annually from lots added since 1950.
1.2 Vancouver’s Parking Policies & Planning Initiatives

1.2.1 How Parking Impacts Vancouver’s Transportation Goals

The City of Vancouver, like most North American cities, has historically been shaped by projects for accommodating automobile traffic. More so than any other mode of travel, cars require large swaths of land for both navigation and storage. Requirements for accommodating vehicular travel often leave the neighboring landscapes barren and less hospitable for pedestrian, bicycle, or transit use. Inevitably, dedicating large percentages of thoroughfares and right of ways to cars leaves little for any other use. Opportunities for vegetation, sidewalk amenities, or bike lanes are quickly eliminated as roads are shaped around vehicular flow. Unsurprisingly, these types of environments generally have relatively low pedestrian, cyclist, and transit mode shares. Pedestrians are asked to walk alongside speeding cars, yield to cars entering and exiting numerous curb cuts, and walk along hollow cityscapes – void of street activity as large expanses of surface parking breaks up building facades. The City of Vancouver has identified these conditions as serious barriers for achieving its transportation initiatives and has outlined several key strategies for reducing the negative repercussions of excess parking and automobile dominance.

More broadly, through the Greenest City 2020 Action Plan, Vancouver has prioritized reaching a mode share of 50% for walking, cycling, and transit and reducing residential driving distances by 20% by the year 2020. As of 2014, both of these initial goals have been achieved. Walking, cycling, and transit now encompass 50% of the City’s mode share, and average residential driving distance has shrunk 20% — “from 5,950 km per year per resident in 2007 to 4,680 km per year per resident in 2014” (Vancouver, 2015). Vancouver is now looking to build off of these successes and establish an even more diversified transportation makeup. To push these already impressive accomplishments further ahead, the City must now look to land-use and transportation to work in tandem. Limiting parking’s footprint will be a key component for both unlocking currently underperforming parcels of land and dissuading unnecessary auto use. Without efforts to dissuade existing surface parking and limit the amount of future parking, Vancouver will not be able to make large strides in reducing auto ownership.

In Transportation 2040, the City identifies parking management as “one of the biggest opportunities to support a smart and efficient transportation system” (Vancouver, 2012). With this approach in mind, the City of Vancouver has outlined several key provisions that are needed in order for the City to accommodate vehicular movement without promoting it as the sole form of travel. Particularly relevant to utilizing parking as a shared resource are the proposed motor vehicle policies:

M2.1 (Use off-street parking requirements to support reduced auto ownership and use),
M2.4 (Approach parking as a shared district resource), and
M2.7 (Manage parking in neighborhoods).

Parking is, and will remain, an essential element of the City’s transportation infrastructure. What these three policies, in partnership with Vancouver’s other parking and transportation initiatives, allow for is assurance that parking will not dictate mode choice. Utilizing parking as a shared resource permits parking to be managed at neighborhood or district levels, reducing the amount of overall land dedicated to parking infrastructure as creative partnerships are formed. In turn, this means more land can be put towards future developments or can be made into valuable pedestrian amenities. Through these changes, the City is better equipped to meet its larger mode share goals, as people trade car trips for new, hospitable pedestrian and transit opportunities.

1.2.2 Overview of Current Bylaws, Requirements, and Exemptions

Current City of Vancouver bylaws offer some progressive approaches for reducing parking’s impacts on the urban realm, but more can be done to ensure all forms of transportation can thrive throughout the city. As seen in Table 2, the City of Vancouver offers several different opportunities for developers to reduce the amount of parking required for a given project in exchange for amenities or cash payment. That said, Vancouver still has relatively high parking requirements, especially when its automotive mode share is compared to other, comparable cities. Using the present day West End neighborhood as sample area, Table 3 examines how parking bylaws throughout the years have resulted in varying amounts of parking supply. Using the current number of units and residential square footage, this table demonstrates what would happen if all of the multi-family buildings in the West End adhered to the respective year’s bylaw. The other years listed in the table either mark dates where the parking bylaw was altered or offer snapshots of how parking requirements compared during a given decade. The City of Vancouver first required residential parking in 1959. In 1964, parking bylaw requirements were increased. In 1975, specific parking regulations were introduced for the downtown region. 1986 and 1987 mark the years before and after Vancouver made parking its own bylaw (6059). Parking
requirements remained steady throughout the 1990s and then began to decrease in the 2000s. Ultimately, after nearly 60 years of parking regulation changes, Vancouver has returned to where it originally began with parking regulations and continues to search for the appropriate parking requirements.

In comparison to other North American cities, Vancouver lacks several key parking provisions other transit oriented cities are pursuing. While it must be noted that the City of Vancouver has a relatively low single occupancy vehicle mode share compared to other Canadian and U.S. cities, its fairly high parking requirements leave room for Vancouver to make even larger mode shifts (EPOMM, 2015). Comparable cities like Denver, CO; Portland, OR; and several cities in Washington state all have ambitious policies and strategies geared towards reducing or eliminating the need to construct new parking. These cities have either established shared parking systems, or they have implemented other reduction strategies that Vancouver could use to improve its current parking framework. On a global level, Stockholm, Zurich, Belgium, and several Asian cities also offer progressive parking policies for ways to encourage transportation alternatives through parking reform. Table 4 offers a brief overview of how other cities approach parking strategies, compiling methods used by North American, European, and Asian cities to mitigate excess parking and on-street parking spillover.

### 1.2.3 Fitting in with Transportation 2040 Goals

Outlined in Transportation 2040, the City of Vancouver acknowledges that parking is intrinsically tied to numerous facets of the City’s larger goals for transportation, safety, and land use.

The listed strategies establish how parking can be used to reduce car ownership, improve the pedestrian realm, and promote other modes of travel. These provisions recognize that parking, in order to promote more compact, pedestrian friendly, environments, must be seen as a shared and flexible resource. This will not only lessen the amount of land dedicated to parking, but promote other forms of transportation by making room for transit and reducing the amount of potential conflict points caused by curb cuts for pedestrians and cyclists. Through these improvements, Vancouver will take large strides towards achieving its overall safety goal of zero traffic related fatalities. Likewise, creating safer walking and cycling environments will be essential for meeting future mode share goals. Parking is a resource that will not, nor should, disappear from cities. This document, in partnership with Transportation 2040, aims to do is examine how to mitigate the negative impacts parking imposes on other modes of travel, land use, and the overall urban realm.

In addition to aiding other transportation initiatives, efforts to reduce parking also support Vancouver’s three pillars of sustainability: economy, people, and the environment. Parking management strategies, such as shared parking, not only reduce the demand for off-street parking facilities, but also provide economic benefits through repurposing land currently dedicated for parking. As some parking facilities become underutilized, or unnecessary, lots in highly developable areas will become available for either new developments or community amenities. Not only can these reductions in parking create more pedestrian amenities, but can also make urban environments safer through reducing the likelihood and severity of collisions through lighter and slower automobile traffic. Ultimately, all of these positive

<table>
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<td>1:5 Ratio (maximum of 1 shared vehicle / stall per 50 DUs)</td>
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<td>Shared Vehicles / Shared Parking Stalls (Market Rental)</td>
<td>Market Rental - 1:5 Ratio (4 shared vehicle + 4 shared stalls per 100 DUs)</td>
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<tr>
<td>Within Two Blocks of Rapid Transit / FTN</td>
<td>10% reduction of minimum parking requirement</td>
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<td>Small Car Spaces</td>
<td>Up to 25% of parking requirement (up to 40% with city approval)</td>
</tr>
<tr>
<td>Senior Housing</td>
<td>1 stall per 6 DUs</td>
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<tr>
<td>Low Income Housing</td>
<td>1 stall per 2 DUs</td>
</tr>
<tr>
<td>Payment in Lieu</td>
<td>$20,200 per stall removed from requirement (contingent on City approval)</td>
</tr>
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### Table 2: Parking Reductions & Exemptions in Vancouver, B.C. (2015) [DU = Dwelling Unit / FTN= Frequent Transit Network]
externalities connected to reduced parking also benefit the surrounding environment. Reduced reliance on automobiles, denser communities, and an overall reduction of surface area dedicated to impermeable surface parking will lessen the burden urban environments place on natural systems.

### 1.2.4 - Summary

- Parking impacts both land use and transportation as it hollows out cityscapes while promoting auto use and deterring other forms of travel.

- Vancouver’s parking requirements have returned to levels found in the 1950s, but are still quite high when compared to comparable cities that have eliminated parking minimums or established parking maximums.

- Parking policy, specifically promoting shared parking, will be an important steps in achieving Vancouver’s larger transportation, safety, and land use initiatives.

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<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
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<tbody>
<tr>
<td>Zero Parking Minimums</td>
<td>Buildings within specified districts need not construct parking</td>
<td>Seattle, WA</td>
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<tr>
<td></td>
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<td>Denver, CO</td>
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<tr>
<td></td>
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<td>San Francisco, CA</td>
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<tr>
<td>Unbundled Parking</td>
<td>Parking Stalls are required to be sold separately from residential units</td>
<td>Bellevue, WA</td>
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<td></td>
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<td>San Francisco, CA</td>
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<tr>
<td>Shared Parking</td>
<td>Owners of underutilized spaces may lease stalls to neighboring residents or businesses</td>
<td>Long Beach, CA</td>
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<td></td>
<td></td>
<td>Seoul, South Korea</td>
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<tr>
<td>Parking Benefit Districts</td>
<td>On-street or off-street parking facilities pool the revenue and apply the earnings towards common amenities (security / cleaning / transit)</td>
<td>Boulder, CO</td>
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<td>Pasadena, CA</td>
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<td></td>
<td></td>
<td>Barcelona, Spain</td>
</tr>
<tr>
<td>Parking Scans</td>
<td>Require projects to scan the surround area for potential shared parking arrangements before construction</td>
<td>Stockholm, Sweden</td>
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<tr>
<td>Parking Supply Cap</td>
<td>A certain stock of on-street and off-street parking is determined and old spaces must be removed in order to construct new parking</td>
<td>Zurich, Switzerland</td>
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<td></td>
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<td>Hamburg, Germany</td>
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<tr>
<td>On-Street / Off-Street Price Leveling</td>
<td>On-street parking prices are increased to comparable levels of surrounding off-street facilities</td>
<td>Stockholm, Sweden</td>
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<tr>
<td>Restrict on-street parking</td>
<td>Residents with off-street parking access cannot purchase on-street passes</td>
<td>Vancouver, WA</td>
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<td></td>
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<td>Tokyo, Japan</td>
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<td></td>
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<td>Toronto, ON</td>
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Table 4: Current Parking Reduction Strategies: National and International
## Table 3: Changes in Required Parking Spaces Under Different Parking Bylaws for the West End Neighborhood

<table>
<thead>
<tr>
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<td>Market CO-OP</td>
<td>17</td>
<td>640</td>
<td>626,408</td>
<td>447</td>
<td>550</td>
<td>712</td>
<td>737</td>
<td>727</td>
<td>727</td>
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<td>Non-Market Rental</td>
<td>18</td>
<td>1,625</td>
<td>1,030,928</td>
<td>736</td>
<td>905</td>
<td>812.5</td>
<td>812.5</td>
<td>812.5</td>
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<td>157</td>
<td>6,229</td>
<td>6,033,199</td>
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<td>5,294</td>
<td>6,856</td>
<td>7,098</td>
<td>7,006</td>
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<tr>
<td>Stratified Market Rental</td>
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<td>300,018</td>
<td>214</td>
<td>263</td>
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<td>353</td>
<td>348</td>
<td>348</td>
<td>336</td>
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<td>Unstratified Market Rental</td>
<td>411</td>
<td>19,293</td>
<td>12,618,147</td>
<td>9,013</td>
<td>11,072</td>
<td>14,340</td>
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<td>14,653</td>
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<td>14,132</td>
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<td>49</td>
<td>60</td>
<td>69</td>
<td>69</td>
<td>69</td>
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<td>69</td>
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<td>Other Rental</td>
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<td>835,510</td>
<td>597</td>
<td>733</td>
<td>949</td>
<td>983</td>
<td>970</td>
<td>970</td>
<td>554</td>
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<tr>
<td>Totals</td>
<td>633</td>
<td>29,512</td>
<td>21,512,781</td>
<td>15,366</td>
<td>18,877</td>
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<td>24,587</td>
<td>24,587</td>
<td>23,844</td>
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**Average Number of Spaces per Unit Under Each Bylaw**

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<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td>0.52</td>
<td>0.64</td>
<td>0.82</td>
<td>0.84</td>
<td>0.83</td>
<td>0.83</td>
<td>0.81</td>
<td>0.50</td>
</tr>
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</table>

**Additional Stalls Needed to Comply with 1959 Bylaw**

610

**Additional Stalls Needed to Comply with 1964 Bylaw**

4,120

**Additional Stalls Needed to Comply with 1974 Bylaw**

10,140

**Additional Stalls Needed to Comply with 2000 Bylaw**

9,088

---

**References / Examples**

Seattle, WA: Municipal Code 23.54.015

Denver, CO: Zoning Code 7.4

San Francisco, CA: Section 151

Bellevue, WA: Section 14.60.080(B)(1)(c)

San Francisco, CA: Section 167


Pasadena, CA: Kolozsvari & Shoup, 2003 p. 2-7

Barcelona, SP: Kodransky & Hermann,2011,p.34-37


Zurich, CH: Kodransky & Hermann,2011,p.68-72


Vancouver, WA: Section 19.08.010

Tokyo, JP: Bartter, 2011, p. 73

Toronto, ON: On-Street Permit Parking
1.3 Shared / District Parking Overview

1.3.1 What are Shared and District Parking?

Shared parking is not a new idea. Ad hoc parking relationships have existed for just as long as off-street parking itself. Simply put, shared parking is the practice through which two or more businesses use the same parking stalls to meet their parking requirements. Facilities with additional parking either sell their excess to neighboring businesses, or partner with a building or service that has a different parking schedule. While traditional shared parking strategies have involved churches, movie theatres, or other venues with irregular hours, growing costs of parking construction and improved technologies are making creative partnerships between standard business hour facilities more feasible. Similar to shared parking, district parking pairs nearby businesses and residential properties together to maximize the use of parking spaces in order to alleviate the need for new construction and reduce current on-street parking congestion. In doing so, parking can be viewed as a holistic, system-wide utility - allowing parking stalls to be consistently utilized and building owners to maximize the return of their investments on parking infrastructure.

King County Metro’s Right Size Parking study, and numerous other parking utilization projects, demonstrate that parking is both oversupplied and inconsistently utilized. Shared parking looks to make use of this underused resource in order to prevent future waste. In 2011, Metro surveyed nearly 240 residential developments and found that parking is, on average, oversupplied by 40% (stalls were supplied at 1.4 spaces per unit, but utilized at only 1 space per unit) (VIA, 2013). In comparing suburban areas to the CBD, suburban developments were found to have built parking at a rate of 1.6 stalls per unit with a 1.2 stalls per unit utilization, while the CBD had a 0.8 and 0.59 stalls per unit supply and utilization rate. As residents leave for work, daytime utilization rates drop even further. Without proper planning, these spaces will continue to go underutilized or completely unoccupied. By not tapping into this unused supply, future demand will lead to new parking facilities that will only see similar utilization rates. Shared parking looks to address wasteful practice by using vacant supplies — thus reducing, or eliminating, the need for developments to dedicate resources to unneeded parking.

There are roughly five different approaches to shared parking currently being used in North America and abroad. These five strategies can be characterized as:

- Alternate Schedule Partnerships,
- Mixed Use Development,
- Leased Parking Strategies,
- District Parking, and
- Capped Parking

Alternate schedule partnerships include some of the more traditional approaches to shared parking. This type of approach commonly involves one property allowing another nearby business to utilize its parking when closed, or its parking lot is not fully needed. More recently, this same thought process is being used to reduce the amount of parking properties must supply when two or more properties share the same parking facility. Traditionally, this would require both parties’ minimum parking requirement to be individually met within the same lot. Policies from Waltham, Massachusetts’s Section 5.2 of the city’s Parking Requirements where a “Parking Credit Schedule Chart” may be used to demonstrate the proposed parking overlap does not cause incident and a certain deduction can then be taken off the minimum parking requirements (Waltham, 2008). Progressive policies like this not only save all participating properties money by reducing overall construction costs but also encourage property owners to split the operation and maintenance costs for the shared parking facility.

Similar to the alternate schedule partnership, mixed use development strategies allow parking minimums to be reduced for land uses with differing parking needs. The premise behind mixed use development shared parking is to reduce the quantity of parking stalls before a structure is even built. In addition to the numerous other benefits that come with mixing land uses is the potential to reduce the amount of required parking. If a mixed use building can successfully demonstrate the proposed programs of the project (retail/commercial, commercial/residential, residential/retail) need less parking than their combined minimums through parking time table studies, then the project can elect to build just the amount of stalls needed to satisfy peak occupancy. The Cook Street Apartments in Portland, OR used this strategy for its 206 residential unit / 15,162 SF retail development, in which only 146 vehicular parking stalls, instead of the more than 250 spaces required under Portland’s existing parking code, were built (Portland, 2015).
Leased Parking Strategies look to make unoccupied, private stalls available to commuters or relieve congested city streets. By allowing building owners to rent currently vacant parking supplies, cities can address concerns about inadequate parking opportunities without having to invest further in expensive parking construction. Additionally, building owners are able to maximize on their investments by turning a profit on previously empty stalls. King County Metro’s Multifamily Park-and-Ride program offers a strong precedent on how these strategies can be implemented in a number of ways, from a fully privatized model, publicly run service, or a public/private partnership (hybrid) (VIA, 2015). Depending on the business model of the program, these unlocked private stalls can either be used to target specific issues within a city (expand commuter parking opportunities or relieve on-street parking congestion) or can be opened to the general public.

District parking is based around the idea of using parking as a communal utility. If a new project requires parking for its occupants, it can partner with surrounding properties to satisfy this need, so long as the partnering facility is within an established walkable distance, can prove their excess parking exists, and signs a covenant to guarantee the use of the parking. In order to make these policies feasible, properties must be permitted to establish parking outside of the parcel. Currently, The Capitol Hill EcoDistrict is advocating for a district parking system within Seattle, Washington’s Capitol Hill neighborhood (Capitol Hill EcoDistrict, 2015). Through this recently released report, Capitol Hill EcoDistrict demonstrates how the potential system could function, surveys residents and business owners about the proposed system, and recommends useful policy changes that would help promote a district parking system. While not currently a frequently used strategy for providing parking, this strategy has the potential to play larger roles in the future as parking supplies become seen as a shared resource.

Capped parking, like district parking strategies, views parking as a holistic, systemized resource. Under this system, a city will identify a certain quantity of parking for a particular area, and new projects must remove existing stalls in order to place parking within the development. In the case of Zurich, CH the city, in 1996, established a limit for off-street parking and now requires on-street parking to be removed in order for a new project to add off-street parking to the area (Kodransky & Hermann, 2011). In doing so, curbside parking was reclaimed for expanded sidewalks, bike lanes, and other civic amenities.

### 1.3.2 Shared Parking’s Impact on Land Use and Affordability Goals

With the City of Vancouver anticipating nearly 150,000 new residents between 2011 and 2041, land, which is already at a high premium, will need to be used with increased efficiency (Metro Vancouver, 2015). Scrutinizing land currently used for surface parking will be an essential part for accommodating further growth. Shared parking will be a necessary component for ensuring that the removal of surface parking does not lead to further on-street parking congestion. Conversely, shared parking looks to alleviate demand for added parking by not only revealing where excess parking exists, but open these underutilized stalls to relieve surrounding congestion. As the demand for parking is consolidated into fewer, shared facilities, more land can be dedicated to other, more productive uses. By steering transportation and land use patterns away from heavily consumptive automobile systems, larger areas will exist for the City of Vancouver’s other citywide initiatives.

Despite its mundane image, parking will continue to play a vital role in many of the City’s efforts to remain an accessible and affordable community. The high costs of constructing and maintaining parking supplies directly impact a city’s ability to remain accessible to all income groups. Todd Litman of the Victoria Transport Policy Institute notes that on the national level in the United States, structured parking costs roughly $15,500 per stall (Victoria Transport Policy Institute, 2013). With these figures in mind, in addition to his estimates that these facilities require resurfacing every 5-10 years and major reconstruction every 20-40 years, the prospect of sharing these evermore expensive costs between multiple parties becomes more appealing. Likewise, the opportunity costs of dedicating large areas of land to parking spaces can be costly for businesses as well. As previously noted, and even without considering maintenance or opportunity costs, parking construction can consume up to 20% of overall building costs. This sizeable increase in cost is often placed on potential buyers, making units that were once within budget no longer financially feasible. Further, these increases are more detrimental
for low income housing residents as the increases in construction costs will make up a larger portion of their monthly rent than higher priced apartments.

1.3.3 Current Obstacles for Shared Parking in Vancouver

While shared parking offers a great potential for addressing many transportation and land use issues, there are still hurdles that must be addressed in order for these potential partnerships to flourish. In Vancouver, there remain several key legislative barriers stopping progressive parking strategies, like shared parking, from becoming feasible. Currently, Vancouver’s parking bylaw does not permit parking stalls to fulfill parking requirements for multiple uses. Although the bylaw permits parking to be combined in multi-use developments, the minimums for each use must be calculated separately, except when the project is specifically authorized by the Director of Planning and the City Engineer (Vancouver, 2014). Provincially, the BC Strata Property Act also causes roadblocks for an efficient parking system. Under this act, parking stalls cannot be sold independently from their paired property (Province of British Columbia, 2015). In doing so, excess parking becomes difficult to sell or lease and property owners cannot take full advantage of their stalls. Once these current legal barriers are addressed, new issues may arise with what percentage of parking stalls are eligible to be shared. Will only completely vacant stalls be available, or can stalls left during the day or night be shared as well? These currently blanketed policies do not allow for creative solutions to parking requirements, and do not help promote settings conducive to the City of Vancouver’s land use and transportation initiatives. Without reexamining these current bylaws and acts, only so much can be done to improve Vancouver’s parking overages.

The next issue Vancouver must address in terms of parking is data collection. Currently Vancouver and the GVRD have little data about the times stalls are used, utilization, or even the number of stalls that exist. All of these pieces of information are necessary not only for developing informed decisions about how to address parking but to make the case that parking surplus does exist throughout the city and proper alterations could remedy the solution. In order to obtain this much needed data, parking facilities must start installing entrance/exit gates, or at least video surveillance to assess how many cars are in the facility and during what periods of the day. Without these crucial bits of information, Vancouver will continue to oversupply parking at the detriment of all other forms of travel.

Finally, the last obstacle will be convincing property owners and residents. Many owners and residents will be hesitant to let strangers into their building, but, if properly designed, these issues can also be alleviated. Making the parking secure is essential. If possible, residential parking and shared facilities should be on separate floors of parking structures and require keycard access. While this is not always feasible, many building owners and residents may be open to the idea if it is lucrative for all parties - the building owner has the opportunity to maximize on his or her parking investments and residents may be offered a reduced rate if they agree to share their spaces with outside users. Although building owners may be hesitant to be the first to venture into shared parking agreements, traction for shared parking will grow as parking facilities upgrade their monitoring / security and shared parking agreements become a commonplace.

1.3.4 - Summary

- Shared parking is the practice through which two or more businesses use the same parking stalls to meet their parking requirements.
- District parking is a form of shared parking that uses an zone’s parking supply as an area resource. New projects can use current excess from other properties to alleviate the need for new construction and reduce current on-street parking congestion.
- The B.C. Property Strata Act and the City of Vancouver’s Parking Bylaw cause regulatory barriers for effective shared parking strategies.

1.4 - Visualizing Shared Parking

The following section visualizes the five shared parking strategies through a series of hypothetical scenarios. Each strategy is given a description, scenario, policies required for implementation, and examples of where the strategy is currently practiced. The strategies are then paired with a series of diagrams in order to better demonstrate how each strategy operates.
1.4.1 -- Alternate Schedule Partnerships

Description

Not all land uses have the same parking demands. Because of this, many municipalities have enacted legislation to promote smart pairing of uses in order to reduce overall parking supply. Alternate schedule partnerships is the most traditional form of shared parking and relies on neighboring land uses having different utilization schedules (traditionally, these pairings have featured daytime facilities such as offices, banks, and schools joined with nighttime or weekend operations such as movie theatres, auditoriums, or churches). Often times municipalities will require either a parking demand study and/or a contract to be signed between the two parties. Demand studies generally assess the current utilization of a parking facility and determine when and how many spaces are available to be shared. Alternatively, cities can establish shared parking reduction calculations to determine how much parking can be eliminated by different partnerships.

Policies Required for Implementation

- Allow facilities to lease excess stalls
- Allow parking supplies lower than the combined individual requirements through shared parking demand studies
- Permit parking to be located outside of the parcel it is intended to serve

Examples

-- Waltham, MA Zoning Code: Section 5.2

(Waltham’s parking code establishes a “Parking Credit Schedule Chart” to calculate the minimum parking requirements for different combinations of land uses)

-- San Diego, CA Example Shared Parking Agreement

(The following link details the standard terms and conditions of shared parking agreements - Example Agreement)

-- King County Metro Park-and-Ride: Leased Lots Program

(Metro currently leases nearly 2,600 stalls over 66 lots. Many of these leased agreements are with area churches that are adjacent to major transit corridors. In exchange for small monthly fees, Metro is able to expand its park-and-ride network, giving more area residents the opportunity to use transit and fills otherwise vacant parking lots)

Illustrative Scenario

After expanding its facilities, an office could no longer house all of its parking on their existing lot. Instead of spending large sums of money to construct additional structured parking, the company looked to partner with a neighboring church with excess parking. The church, having been built during the 1980s, had ample parking due to much higher parking minimums. Recent updates to the local municipal code allowed shared parking to reduce parking requirements by 90% as long as an authorized agreement between the two facility partners was established and a study demonstrated that peak demands did not overlap.

The combined parking demands of both the church and the office building could not be met by the current facility, but, given the varying schedules of use, both building’s could meet their individual needs with the lot. As a result of this partnership, the office avoided costly parking investments and the church was able to lower the costs of operating and maintaining its parking facilities. Further, this partnership was able to take place without causing on-street parking spillover onto neighboring blocks that could have taken place if both uses required the parking lot during the same hours of the day.
### Figure 4: Alternate Schedule Partnership Parking Comparison

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<th></th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
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</table>

#### Church Parking Demand
- Maximum Church Utilization: 46 of 60 Stalls

#### Office Parking Demand
- Maximum Office Utilization: 37 of 60 Stalls

#### Total Lot Parking Stock
- Maximum Combined Utilization: 83 of 60 Stalls

#### Potential On-Street Spillover

### Figure 5: Alternate Schedule Partnership Diagram
1.4.2 -- Mixed Use Development

**Description**

Modern development continues to shift away from single use projects, and cities are now tasked with developing new policies for nurturing these mixed use developments. As seen in the alternate schedule partnerships example, different land uses can often take advantage of differing parking demand timetables. Knowing these varying demands can also allow new developments to reduce the amount of required parking. By removing parking stall assignments, and allowing business customers or office employees to occupy the same stalls during off-peak residential hours, commercial and residential projects can reduce the amount of needed stalls and save hundreds of thousands in construction costs.

**Policies for Implementation**

-- Allow mixed use properties to reduce their minimum parking requirements based on shared parking standards

-- Permit parking stalls to be utilized by the building’s different occupants

---

**Figure 6:** Utilization by Hour of the Day for Combined Parking Minimums
Examples

-- Joule: Seattle, WA
(295 apartment units + 29,000 ft² of retail = 370 stalls)
-- 300 Ivy: San Francisco, CA
(63 apartment units + 5,465 ft² = 35 stalls)
-- Cook Street Apartments: Portland, OR
(206 apartment units + 15,162 ft² = 146 stalls)

Illustrative Scenario

The developer of a new mixed use project has determined the project will require 3 underground levels of parking in order to meet the minimum parking requirements for each individual proposed land use. Individually, the proposed 750m² of office space would require 12 stalls and the 28 1-bedroom apartments would require 28 stalls. Only 17 stalls can fit on each floor, meaning the third level of parking would be left primarily unused. To avoid this costly excess, the developer explores new legislation allowing land uses to utilize shared parking stalls to meet individual parking requirements. After exploring this new option, and calculating the shared parking requirement with the city’s parking credit schedule chart, it was concluded that the project would only need 29 stalls. With this 11 stall reduction, the project only needed to construct 2 levels of parking, saving hundreds of thousands of dollars in construction costs and allowing the building to lower rents for future tenants.
Combined Minimum Requirements

- 51 Stalls (11 excess stalls)
- 17 Stalls (per floor)

Combined Minimum Requirements (40 Stalls)
- 750 m² Office Space
- 28 1-Bedroom Apartments

Parking Floor Layout
- Parking Stall: 3m x 6m
- One-way Aisles: 3m x 40m

Existing Parking Requirements
- Office: 1 stall per 100 m² for first 300 m² / 1 stall per 50 m² after
- Residential: 1 per unit

Figure 7: Mixed Use Development Diagram
Shared Minimum Requirements (29 Stalls)

- 750 m² Office Space
- 28 1-Bedroom Apartments

Weekday Requirements

<table>
<thead>
<tr>
<th>Night</th>
<th>Day</th>
<th>Evening</th>
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<tr>
<td>Residential Requirements</td>
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<td>60% (17)</td>
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<tr>
<td>Commercial Requirements</td>
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<td>100% (12)</td>
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<tr>
<td>Total Requirements</td>
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<td>29</td>
</tr>
</tbody>
</table>

Parked Requirements:

<table>
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<tr>
<th>Night</th>
<th>Day</th>
<th>Evening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Requirements</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Commercial Requirements</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Total Requirements</td>
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<td>29</td>
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</table>

Parking Credit Schedule

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<th>Evening</th>
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<td>90% (26)</td>
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<td>Weekday Day</td>
<td>100% (12)</td>
<td>10% (2)</td>
</tr>
<tr>
<td>Weekday Evening</td>
<td>10% (2)</td>
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<tr>
<td>Weekend Day</td>
<td>90% (26)</td>
<td></td>
</tr>
<tr>
<td>Weekend Evening</td>
<td>5% (1)</td>
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</table>

34 Stalls (5 excess stalls)
1.4.3 -- Leased Parking Strategies

Description

Excess parking often exists within large groups of buildings. In areas with older building stocks, and consequently the larger parking requirements of former bylaws, the supply of excess parking stalls can reach even higher levels. What this third strategy aims to do is unlock many of these currently inaccessible stalls for commuters, neighboring residents, or visitors to the area. Depending on the target user groups (area residents, commuters, or visitors), and the desired outcome, business models will vary. The program can be entirely privatized, allowing the building owner to market his or her vacant stalls to the general public or a specific audience. Alternatively, a city could elect to partner with a group of building owners in an effort to supply stalls to certain users, like commuters or neighboring residents. The city would agree to rent a certain amount of stalls for a fixed price with the owners and then distribute passes to area commuters or neighborhood residents who would prefer to pay for a reserved parking stall. Regardless of the business model, this strategy is contingent on buildings being able to lease their currently under utilized parking. Cities must also determine if properties can only lease stalls that are vacant throughout the day or if stalls that are empty part of the day can be sold as well. As seen in the subsequent diagrams, allowing buildings to lease daytime vacancies as well can drastically increase the amount of available stalls. With new technologies allowing properties to track real-time usage and sell stalls accordingly, maximizing parking utilization is becoming increasingly feasible.

Policies for Implementation

-- Separate housing costs from parking costs
-- Allow buildings to sell, lease, or rent excess parking
-- Require utilization studies to demonstrate excess parking

Selecting Potential Properties (these three filters demonstrate how cities can target specific properties appropriate for leased parking)

(1) Select Study Area

(2) Select Properties within 200m of frequent transit

Figure 8: Selecting Target Properties
Examples

-- Public Model
(King County Metro: Multifamily Park-and-Ride)

-- Private Model
(Toronto, ON: Rover // San Francisco, CA: MonkeyParking // Boston, MA: SPOT )

Note - The legality of these private models has come into question. Previous models, such as Haystack in Boston, were outlawed because they attempted to profit off public parking. The new models listed above focus on off-street, privatized parking. In doing so, these companies pair owners of private parking with potential buyers instead of relying on public, on-street parking.

Illustrative Scenario

A city recently added a leased parking section to its parking code. This new provision allows new or remodelled properties to meet their parking requirements by partnering with surrounding buildings with excess parking. In order to do so, the new building must first identify potential partnerships through several queries. The property must be within close proximity to frequent transit (200m), designated as a multifamily property, and currently have at least 10+ vacancies. The two properties then calculate their peak demands independently, agree on how much parking can be accommodated within the current facility, and then validate the signed covenant for approval from the city.
**Differing Leasing Strategies** - Depending on the parking demand timetables of the partnering properties, more stalls may be available than just the completely unoccupied stalls. If a residential building owner, and the residents, agree to lease certain stalls only during the daytime, then the available stock dramatically increases and fewer stalls remain unoccupied throughout the day.

*Figure 9: Leased Parking Diagram*
**Subscription Leases** - A building owner makes the stalls that are currently unoccupied 24/7 available for neighboring residents and employees to lease.

**Subscription & Short Term Leases** - A building owner reduces the price of parking for residents who are willing to lease their parking stalls between 6:00am and 8:00pm during the work week in addition to leasing unoccupied stalls. The stalls are then made available for short term parking for a daily or hourly rate.
1.4.4 -- District Parking

Description

District parking is a strategy used to make parking into a shared utility. Viewing parking as a shared resource allows properties to maximize their parking stock and reduce the area dedicated to vehicular storage. Every time a building is proposed, it must first search the surrounding area in order to assess if its parking needs might be met with current excess in other buildings. As long as a building can establish a partnership, or several partnerships, to share another building’s parking resource, it does not have to construct new parking. These partnerships must be supplemented with a study detailing the current excess parking and also a formal agreement showing the duration of the partnership and how many stalls will be dedicated to each property. Properties can either lease the stalls that were built in addition to the minimum requirement or prove that the minimum required stalls are not being fully occupied through a parking utilization study.

Policies for Implementation

-- Require buildings to search for partnerships before constructing new parking

-- Allow buildings to supply their parking off-site

-- Allow buildings to lease excess parking

-- Allow buildings to demonstrate underutilized parking through utilization study.

Examples

-- Seattle, WA: Capitol Hill (Pike Pine District Shared Parking)

-- Stockholm Sweden (Kodransky & Hermann, 2011, p.56-61)

Illustrative Scenario

A city has recently identified over supply of underpriced parking as a major contributor to automobile use. Surveys of a neighborhood discovered that buildings were, on average, 40% over supplied with parking. In an effort to curb this trend, and promote other forms of travel, the city is allowing new projects to forego parking construction if they can establish parking partnerships with surrounding buildings. The regulation stipulates that a building must complete a utilization study, sign a contractual agreement, and only partner with properties within 400 meters of the new project.
Figure 10: District Parking Diagram
1.4.5 -- Capped Parking

Description

In areas where a city has determined that the current supply of parking is sufficient, or over supplied, capped parking can be an effective mechanism for maintaining these desired limits. Capped parking can also be implemented at a variety of scales and enforced in several ways. Limits can be established at a district-wide level, as seen in downtown Zurich, or at a smaller neighborhood or block level. To enforce these limitations, projects can be required to help finance the removal of on-street parking or surface parking; alternatively, cities can restrict car registration to owners who can prove they have a location to store their vehicle. This approach should be limited to areas where parking supply is well understood and inventoried. In areas selected for this type of program, parking supply can be efficiently controlled and curbside parking can be reclaimed for other civic amenities. As seen through Boston’s downtown parking freeze, these efforts can also be focused to specific types of parking or limited to a certain duration.

Policies for Implementation

-- Establish a maximum number of parking stalls for an area

-- Require buildings to record and report parking supplies

-- Allow buildings to meet parking requirements off-site

Examples

-- Zurich, Switzerland (Kodransky & Hermann, 2011, p. 68-72)

-- Tokyo, Japan (Barter, 2011, p. 73)

-- Boston, MA (Parking Freeze)

Illustrative Scenario

A city has recently conducted a detailed inventory of a neighborhood’s parking supply, finding that the area holds 2500 stalls. The city wants to use this neighborhood as a pilot for a larger district-wide parking cap program and restricts each block within the area to keep its current stock of parking. A proposed project within the area calls for 35 new parking stalls. As a result of the new parking cap, the project also plans to remove the 35 adjacent street parking stalls. In exchange for being permitted to add off-street parking stalls to the area, the project agrees to help finance the installation of new street amenities including a protected bike lane and new street vegetation.
Neighborhood Parking Cap: 2500 Stalls
Current Block Supply: 200 Stalls (35 on-street // 165 off-street)

Figure 11: Capped Parking Diagram
Current Supply by Block: **200 stalls** (35 on-street + 165 off-street)

**Figure 12:** Capped Parking - Street Infill
Proposed Supply by Block: **200 stalls** (0 on-street + 200 off-street)

**Additions:**
- Street Vegetation
- Improved Pedestrian and Cyclist Infrastructure

+35 off-street stalls

-35 on-street stalls
PART II -- ANALYSIS OF THE WEST END RPP ZONE

2.1 Background Site Inventory
2.2 Site Analysis Methodology
2.3 Results
2.4 Summaries and Conclusions
West End Shared Parking System Analysis

The goal of this analysis is to determine if shared parking could be used as a strategy for addressing the West End’s current on-street parking congestion. Using information collected by the City of Vancouver, and data received from the Insurance Corporation of British Columbia (ICBC), this study was able estimate how many vehicles are likely to regularly park in each multifamily property within the West End’s RPP zone. Combining this information with past on-street occupancy studies, performed in conjunction with the West End Official Community Plan, this analysis was then able to hypothesize how excess parking supply in multifamily buildings in the West End could be used to alleviate crowded city blocks throughout the neighborhood. While future data will need to confirm precise parking occupancy rates for each potential building, this study broadly demonstrates the glut of parking that exists within the region and how, if redistribution occurred, a shared parking system could provide a major asset to the community.

2.1 Background Site Inventory

The first step of this process involved pairing datasets to each specific parcel within the West End RPP zone. The RPP Zone covers the majority of the West End, with the exception of blocks south of Denman St. along Robson, Alberni, and W. Georgia. This study chose to examine only multifamily properties with 4 or more units within this specific region, notably excluding the Mole Hill community which possesses many unique characteristics that don’t allow it to conform to many current regulations. 630 properties within the West End met this set of criteria. Of these 630 properties, 46 were found to have 50 or more vacancies. These 46 properties became the focal points for the analysis, as they were seen to be the most likely to be able to facilitate a potential shared parking program. It was concluded that building owners would need to reach a certain level of profitability in order to be interested in the program and those buildings with the highest vacancies have the highest potential to produce a profitable return. The following charts and graphs depict the overall makeup of all 630 multifamily buildings in the West End RPP zone, exploring tenure, parking ratios, and building ages. After this, the 46 buildings with 50 or more vacancies are highlighted and analyzed independently.

Through this inventory, it can be seen that the West End has a very diverse makeup of multifamily properties – ranging in size, decade, and tenure. In both the inventory of all 630 properties and the 46 properties of interest, market rental makes up the largest share of properties. While they represent the largest portion of tenures, they were found to have the lowest number of parking stalls per unit, supplying a little over a third of what strata properties in the area were found to have (Market Rental: 0.44 stalls per unit / Strata: 1.28 stalls per unit). Unsurprisingly, properties built between the 1960s and 2000s were found to have the most parking. As demonstrated in Part I, earlier parking bylaws in the City of Vancouver required much more parking, and the results can clearly still be seen today.
2.1 West End - Residential Parking Permit Zone

Figure 13: Number of Multifamily Buildings per Residential Unit Range

West End Neighborhood
Figure 14: Number of Multifamily Buildings Constructed per Decade
2.1 West End - Residential Parking Permit Zone

Figure 15: Properties by Tenure
Average Number Parking Stalls/ per Unit - By Tenure

- Strata
- Stratified Market Rental
- Unstratified Market Rental

1 parking stall/ per unit

- Parking Bylaw Created - 1959
- Parking Requirements Increased - 1963
- Specific Downtown Parking Requirements - 1975
- Parking is Given its Own Bylaw (6059) - 1987

Average Number Parking Stalls/ per Unit - By Decade

- 1910: 0.28
- 1920: 0.16
- 1930: 0.20
- 1940: 0.23
- 1950: 0.48
- 1960: 0.65
- 1970: 1.07
- 1980: 1.13
- 1990: 1.36
- 2010: 1.22
Figure 16: Selected Properties by Age, Units, and Tenure
2.2 Site Analysis Methodology

2.2.1 Data Collection and Calculation

The data used in this study was obtained from the City of Vancouver and the Insurance Corporation of British (ICBC). Property information (name, address, tenure, construction date, number of rooms, number of stalls, residential parking permit registrations, and tax coordinates) was obtained from the City of Vancouver. Vehicle registrations were obtained from ICBC’s vehicle ownership registration database. On-street parking data (number of RPP parking stalls per block and the parking occupancy) came from surveys for the West End Community Plan, which, in August of 2012 covered all parking spaces in the West End Residential Parking Permit Zone (RPP). For the purposes of this study, the terms listed below were determined using the following calculations:

**On-Street Parking Calculations**

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total RPP Parking Stalls</td>
<td>Number of RPP stalls for a give block</td>
</tr>
<tr>
<td>Occupancy Rate</td>
<td>( \frac{\text{Total RPP Parking Stalls} - \text{Vacant Stalls}}{\text{Total RPP Parking Stalls}} )</td>
</tr>
<tr>
<td>Target Occupancy Rate</td>
<td>Rate used to determine how many cars must be relocated on each block</td>
</tr>
<tr>
<td>Vehicles to Relocate*</td>
<td>( \text{Occupied Stalls} - (\text{Target Occupancy Rate} \times \text{Total RPP Parking Stalls}) )</td>
</tr>
<tr>
<td>Vehicles Left</td>
<td>Number of cars that could not be absorbed by neighboring buildings</td>
</tr>
<tr>
<td>New Occupancy Rate</td>
<td>( \frac{\text{Total RPP} - (\text{Vacant} + (\text{Vehicles to Relocate} - \text{Vehicles Left}))}{\text{Total RPP}} )</td>
</tr>
</tbody>
</table>

* All results were rounded down to the nearest whole number

**Off-Street Parking Calculations**

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parking Stalls</td>
<td>All structured or surface parking listed in a building’s construction documents</td>
</tr>
<tr>
<td>Vehicle Ownership</td>
<td>The number of cars registered through ICBC to the property’s address</td>
</tr>
<tr>
<td>Parking Surplus</td>
<td>( \text{Parking Stalls} - \text{Vehicle Ownership} )</td>
</tr>
<tr>
<td>Adjusted Surplus* **</td>
<td>( \text{Parking Stalls} - \text{Vehicle Ownership}) \times 0.95</td>
</tr>
<tr>
<td>Adjusted Occupancy Rate</td>
<td>( \frac{\text{Parking Stalls} - \text{Adjusted Surplus}}{\text{Parking Stalls}} )</td>
</tr>
<tr>
<td>Vehicles Absorbed</td>
<td>Number of on-street Vehicles relocated within buffer area</td>
</tr>
<tr>
<td>Remaining Surplus</td>
<td>( \text{Adjusted Surplus} - \text{Vehicles Absorbed} )</td>
</tr>
</tbody>
</table>

* All results were rounded down to the nearest whole number

** A 0.05 reduction simulates cars yet to change their registration address and changes in the number of stalls

**Table 5**: On-Street & Off-Street Parking Calculations

---

**On-Street Analysis**

<table>
<thead>
<tr>
<th>Total Parking Supply</th>
<th>Occupied</th>
<th>Vacant</th>
<th>Target Occupancy</th>
<th>Vehicles to Relocate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish Target Occupancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resulting Occupancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2.3 Site Analysis Overview

The analysis in the following section explores how multifamily buildings in the West End could use their excess parking to relieve on-street RPP congestion. To do this, two main factors needed to be explored: how many vehicles need to be relocated, and which blocks would a building impact? To examine the first question, each block was given a target occupancy rate. The target occupancy represents the desired parking availability for each block in the area. Once this is determined, the number of vehicles needing to be moved is simply the number of vehicles needing to be moved in order to reach the target occupancy rate.

In order to demonstrate which on-street blocks may benefit from a building opening its vacancies to RPP users, each of the target properties was given a catchment area in the form of a buffer. The different buffer sizes represented various walking distances (50m, 100m, and 200m). The number of vehicles over the assigned target occupancy rate were then added to the building whose buffer the block fell within. Once all the vehicles were added to the building they were paired with, occupancy rates for both the blocks and the buildings were recalculated to show the overall impacts of the redistribution.

2.2.3 On-Street Parking Analysis

Determining Number of Cars to Relocate and Assigning Cars to Properties -

Using the West End Community Plan data, each block and lane was first given an existing occupancy rate. This information was then placed in the midpoints of the West End's street and laneway center lines. The occupancy rate was found by subtracting vacant RPP stalls from the total number of RPP stalls and then dividing the product by the total number of RPP stalls. The blocks and lanes were represented by their line’s midpoint. Next, target occupancy rates of 85% and 65% were assigned, and the number of vehicles that needed to be relocated from each block in order to reach the desired target occupancy rate was calculated. 85% is the target occupancy often cited to achieve roughly 1 to 2 spaces per block (Shoup, 2009), and 65% was used to simulate a less crowded residential block where parking would appear readily available. While residents would not be required to use these facilities, it can be assumed that users would elect to utilize these new off-street RPP stalls as long as they maintain the same or similar competitive pricing seen in the current RPP program.

Two fields, “Vehicles to Relocate” and “Vehicles Left,” were then used to determine how many cars would need to be relocated in order to reach the block’s target occupancy. “Vehicles to Relocate” was the number of vehicles that needed to be removed from the given block, and “Vehicles Left” was the remaining number of vehicles, which was used to find the resulting occupancy rate for a block after “Vehicles to Relocate” were transferred to a neighboring building. “Vehicles to Relocate” was subtracted from a building’s surplus only if the midpoint of the block was within the building’s buffer. If the midpoint was outside the catchment area, or only some of the vehicles could be absorbed, the remaining “Vehicles to Relocate” was added to the “Vehicles Left” figure. Midpoints were used in order to only select blocks that were at least halfway within a building’s catchment area. Once all potential cars were relocated to nearby properties, each block received an “Adjusted Occupancy Rate” which represented the occupancy rate of RPP stalls for each block after the “Vehicles to Relocate” were removed.

Measuring Distances from Congested Blocks to Uncongested Blocks-

While the model does not go through an in depth balancing process, it does quantify the distances between areas of congestion and unoccupied spaces. After cars are redistributed
to buildings, and each block receives a new occupancy rate, the blocks left with occupancy rates above 90% are measured to assess how close they are to lower occupancy areas (45-70%). Using the block midpoints, a line is drawn from the congested block to the closest 45-70% occupancy block. The distance is then measured and an average is found.

2.2.5 Notes and Assumptions:

While knowing the number of vehicles registered to a building gives a strong indication of how many stalls are likely unoccupied, future studies will likely need to confirm occupancy numbers by conducting a multi day utilization study. By counting the number of stalls and vehicles at night, and then monitoring vehicle entrances and exists, one would be able to have a more precise figure of a building’s actual parking utilization rate. Likewise, while the number of RPP permits registered to each building is known, it cannot be fully determined how the permits are used and if the permit holders always choose to park their vehicle on the street. With this in mind, it can be assumed that occupancy rates are likely lower than what is used in this analysis because many RPP holders will likely use their permit to park their vehicles on the street. Conversely, opening up new supplies of RPP stalls would certainly induce further demand. Knowing how many residents who do not already use the service, but would do so if off-street stalls were available will be essential for the City to determine what the proper amount of available stalls should be.

Future studies would also need to run the model to equilibrium. While none of the target occupancies or buffer inputs result in any building exceeding its surplus, certain buildings capture a larger share of cars because the order in which each building surplus is calculated has remained constant. Additionally, overlapping buffers do not give a distance based preference to buildings that are closer to blocks that are within multiple building buffers. Although there are multitude of factors in a user’s decision to select one building over another (form, security, ease of use, and distance to destination) it is safe to assume that the buildings nearest to a certain block would absorb the majority of the cars. Finally, each block would need to be balanced as more spaces become unoccupied. As certain blocks become less occupied, spillover from neighboring blocks is likely to occur, leading to a more equal occupancy rate across the RPP. To account for this, each block with a 90% or higher occupancy rate was measured to assess its distance to the closest lower occupancy block (50-70%). In doing so, it can be understood how likely congested blocks will be able to spillover onto recently uncongested blocks.

Notwithstanding the previous notes, the building surpluses are potentially conservative. In addition to the 5% reduction to account for vehicle registration error, the building occupancy rates do not subtract RPP permits. While the ownership of a RPP permit does not always result in less cars parking in a building’s

2.2.4 Off-Street Parking Analysis

Selecting Target Buildings -
In order to assess the potential to expand the RPP program into off-street multifamily buildings in the West End, target buildings were first selected. Buildings in the West End were clipped to just the buildings fitting within the confines of the RPP zone. Next, all multifamily buildings were selected. Each building’s tax coordinate code was then paired with the building’s total number of number of parking stalls, the number of units, the number of RPP permits, and the number of ICBC registered vehicles for the given address. Using this information, all multifamily buildings with an “adjusted surplus” greater than 50 stalls were then selected. These three queries resulted in 46 multifamily buildings being selected, with parking surpluses ranging from 51 to 143 unoccupied stalls.

Building Buffers and On-Street Absorption -
Once the 46 properties were selected, each building was given a buffer of 50m, 100m, and 200m from the building’s edge. These different buffer sizes were used to simulate varying walking distances from a participating RPP building to surrounding blocks in the West End. 200m was selected to represent the length of the longest blocks in the West End, and is also within Smith and Butcher’s “Level of Service By Walking” rating for residential uses (<800ft) (Smith & Butcher, 2008). From 200m block length, 100m and 50m were then used to simulate the walking distance for a half block and quarter block.

After the buffer distance was selected, each building absorbs the number of “Vehicles to Relocate” within the given buffer area, so as long as there was enough surplus within the given building. If the building was full, the “Stalls to Relocate” are added to the block’s “Vehicles Left” value. If the block was within multiple buffers, the “Stalls to Relocate” are given to the other buildings. In the instance that a block midpoint is not within a buffer, or all the buffers the point falls within are full, the “Vehicles to Relocate” number are returned as “Cars Left” for the given block. After all potentially absorbed cars are accounted for, each building is given an updated surplus number and occupancy rate.
off-street facilities, it is likely that RPP holders elect to park their vehicles on the street. Within the 46 selected multifamily buildings, subtracting the RPP permits would, on average, add nearly another 20 parking spaces.

Building form, and various other microscale features, will also likely inform the success of integrating RPP stalls into multifamily buildings. While later sections of this report will examine building retrofits for accommodating multiuser parking designs, this study does not take into account various building elements that could make certain buildings more suitable, such as multiple gates, secured building access, and alternate entrances for non-building residents.

The following images compare the current building and on-street parking occupancies to various scenarios. The sections are split between building numbers and on-street RPP numbers. Each page has the existing condition, the result of the buffer / target occupancy inputs, and the change between the two scenarios.
50m Buffer
**Figure 17:** 50m Building Buffer + 85% Target On-Street Occupancy Rate - **Building Analysis**

**Average Building Occupancy Rate:** 47%

**Total Stalls in Selected Buildings:** 7394

**Total Vacancies in Selected Buildings:** 3771

**Existing Occupancy Rates**

- **< 40%**
- **41-60%**
- **61-80%**
- **81-100%**

**100m Buffer and a 85% on-street occupancy**

- **< 40%**
- **41-60%**
- **61-80%**
- **81-100%**

**Average Building Occupancy Rate:** 49%

**Total Cars Absorbed by Selected Buildings:** 122

**Total Vacancies in Selected Buildings:** 3649
Average Change in Building Occupancy Rate: 2%
**Existing Occupancy Rates**
- < 40%
- 41-60%
- 61-80%
- 81-100%

**100m Buffer and a 85% on-street occupancy**
- < 40%
- 41-60%
- 61-80%
- 81-100%

**Average Building Occupancy Rate: 47%**
**Total Stalls in Selected Buildings: 7394**
**Total Vacancies in Selected Buildings: 3771**

**Average Building Occupancy Rate: 52%**
**Total Cars Absorbed by Selected Buildings: 317**
**Total Vacancies in Selected Buildings: 3454**
Change in Occupancy Rates

- 0-5%
- 5.1-10%
- 10.1-15%
- 15.1-20%
- 20.1-25%

Average Change in Building Occupancy Rate: 5%
Figure 19: 50m Building Buffer + 85% Target On-Street Occupancy Rate - Street Analysis

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

Existing Occupancy Rates

<table>
<thead>
<tr>
<th>0-50%</th>
<th>51-60%</th>
<th>61-70%</th>
</tr>
</thead>
<tbody>
<tr>
<td>71-80%</td>
<td>81-90%</td>
<td>91-100%</td>
</tr>
</tbody>
</table>

100m Buffer / 85% on-street occupancy

Average On-Street Occupancy Rate: 84%
Total Cars Removed from West End RPP: 122
Total RPP Vacancies in the West End: 438
Average Change in On-Street Occupancy Rate: 5%

Average Distance from High Occupancy to Low Occupancy Blocks: 199.59m
Figure 20: 50m Building Buffer + 65% Target On-Street Occupancy Rate - Street Analysis

Existing Occupancy Rates

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

100m Buffer / 85% on-street occupancy

Average On-Street Occupancy Rate: 77%
Total Cars Removed from West End RPP: 317
Total RPP Vacancies in the West End: 633
Average On-Street Occupancy Rate: 12%

Average Distance from High Occupancy to Low Occupancy Blocks: 89.00m
100m Buffer
Figure 21: 100m Building Buffer + 85% Target On-Street Occupancy Rate - Building Analysis

Average Building Occupancy Rate: 47%
Total Stalls in Selected Buildings: 7394
Total Vacancies in Selected Buildings: 3771

Average Building Occupancy Rate: 50%
Total Cars Absorbed by Selected Buildings: 205
Total Vacancies in Selected Buildings: 3566
Average Change in Building Occupancy Rate: 3%
Figure 22: 100m Building Buffer + 65% Target On-Street Occupancy Rate - Building Analysis

Existing Occupancy Rates

- < 40%
- 41-60%
- 61-80%
- 81-100%

Average Building Occupancy Rate: 47%
Total Stalls in Selected Buildings: 7394
Total Vacancies in Selected Buildings: 3771

100m Buffer and a 85% on-street occupancy

- < 40%
- 41-60%
- 61-80%
- 81-100%

Average Building Occupancy Rate: 55%
Total Cars Absorbed by Selected Buildings: 558
Total Vacancies in Selected Buildings: 3213
Average Change in Building Occupancy Rate: 8%
Figure 23: 100m Building Buffer + 85% Target On-Street Occupancy Rate - Streets Analysis

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

Average On-Street Occupancy Rate: 81%
Total Cars Removed from West End RPP: 205
Total RPP Vacancies in the West End: 521
Average Change in On-Street Occupancy Rate: 9%

Average Distance from High Occupancy to Low Occupancy Blocks: 174.93m
Figure 24: 100m Building Buffer + 65% Target On-Street Occupancy Rate - Street Analysis

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

Average On-Street Occupancy Rate: 68%
Total Cars Removed from West End RPP: 558
Total RPP Vacancies in the West End: 874
Average Change in On-Street Occupancy Rate: 23% 

Average Distance from High Occupancy to Low Occupancy Blocks: 70.67m
200m Buffer
Figure 25: 200m Building Buffer + 85% Target On-Street Occupancy Rate - Building Analysis

Average Building Occupancy Rate: 47%
Total Stalls in Selected Buildings: 7394
Total Vacancies in Selected Buildings: 3771

Existing Occupancy Rates

- < 40%
- 41-60%
- 61-80%
- 81-100%

Average Building Occupancy Rate: 51%
Total Cars Absorbed by Selected Buildings: 279
Total Vacancies in Selected Buildings: 3492

100m Buffer and a 85% on-street occupancy
Average Change in Building Occupancy Rate: 4%

Change in Occupancy Rates

- 0-5%
- 5.1-10%
- 10.1-15%
- 15.1-20%
- 20.1-25%
**Figure 26:** 200m Building Buffer + 65% Target On-Street Occupancy Rate - Building Analysis

- **Average Building Occupancy Rate:** 47%
- **Total Stalls in Selected Buildings:** 7394
- **Total Vacancies in Selected Buildings:** 3771

**Existing Occupancy Rates**
- < 40%
- 41-60%
- 61-80%
- 81-100%

**100m Buffer and a 85% on-street occupancy**
- **Average Building Occupancy Rate:** 58%
- **Total Cars Absorbed by Selected Buildings:** 767
- **Total Vacancies in Selected Buildings:** 3004

- < 40%
- 41-60%
- 61-80%
- 81-100%
Average Change in Building Occupancy Rate: 11%

Change in Occupancy Rates

- 0-5%
- 5.1-10%
- 10.1-15%
- 15.1-20%
- 20.1-25%
Figure 27: 200m Building Buffer + 85% Target On-Street Occupancy Rate - Street Analysis

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

Average On-Street Occupancy Rate: 68%
Total Cars Removed from West End RPP: 550
Total RPP Vacancies in the West End: 866
Average Change in On-Street Occupancy Rate: 12%
Figure 28: 200m Building Buffer + 65% Target On-Street Occupancy Rate - Street Analysis

Average On-Street Occupancy Rate: 88%
Total RPP Spaces in The West End: 2747
Total RPP Vacancies in the West End: 316

Average On-Street Occupancy Rate: 62%
Total Cars Removed from West End RPP: 739
Total RPP Vacancies in the West End: 1055
Average Change in On-Street Occupancy Rate: 30%
2.4 Summaries & Conclusions

Table 6: Property Summaries for Each Scenario

<table>
<thead>
<tr>
<th>Target Rate</th>
<th>Buffer</th>
<th>Parking Total (Sum)</th>
<th>Current Vacancies (Sum)</th>
<th>Occupancy Rate (Avg)</th>
<th>Cars Absorbed (Sum)</th>
<th>Vacancies w/ Absorbed (Sum)</th>
<th>Occupancy Rate w/ Absorbed (Avg)</th>
<th>Change in Occupancy Rate (Avg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85</td>
<td>50</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>122</td>
<td>3649</td>
<td>0.49</td>
<td>0.02</td>
</tr>
<tr>
<td>0.65</td>
<td>50</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>317</td>
<td>3454</td>
<td>0.52</td>
<td>0.05</td>
</tr>
<tr>
<td>0.85</td>
<td>100</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>205</td>
<td>3566</td>
<td>0.50</td>
<td>0.03</td>
</tr>
<tr>
<td>0.65</td>
<td>100</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>554</td>
<td>3213</td>
<td>0.56</td>
<td>0.08</td>
</tr>
<tr>
<td>0.85</td>
<td>200</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>279</td>
<td>3492</td>
<td>0.51</td>
<td>0.04</td>
</tr>
<tr>
<td>0.65</td>
<td>200</td>
<td>7394</td>
<td>3771</td>
<td>0.47</td>
<td>757</td>
<td>3014</td>
<td>0.58</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Across the 46 studied properties in the West End neighborhood there are nearly 7,800 off-street parking stalls, almost half of them vacant. On average, this has resulted in an occupancy rate of 47%, leaving ample space for potential shared parking strategies. Through the previous table it can be seen that, even when adding additional vehicles to the selected properties, occupancy rates remain quite low. While the vehicle additions range from roughly 120 to 760, the average occupancy rate is hardly altered – increasing between 2% and 11%.

Figure 29: Number of Selected Buildings in Each Occupancy Rate Range
In contrast to the multifamily building findings, the RPP zone parking condition in the West End has the potential to change markedly. While the majority of RPP blocks are, on average, roughly 90% occupied, relocating roughly 750 cars could bring the average down to as low as 60%. Current calculations do not take into account redistribution of cars from areas of high concentration to areas of lower concentration, but the average distances between these blocks show that redistribution is likely to occur. As can be expected, the redistribution distance is dramatically reduced as the target rate decreases, causing more lower occupancy blocks to appear.

Through the previous tables and visualizations, it can be seen that the West End’s on-street parking congestion can be dramatically improved by minimally increasing the occupancy rates of a few selected multifamily buildings. This potential partnership between the RPP program and private buildings could not only utilize currently vacant building, but increase the amount of temporary parking for caretakers and visitors – an issue commonly voiced by West End residents. With these findings and potential outcomes in mind, the City of Vancouver and the building owners will likely need to do more thorough utilization studies of both the individual buildings and the surrounding blocks. Once completed, these currently underutilized resources can begin to address larger neighborhood access and circulation issues.

<table>
<thead>
<tr>
<th>Target Rate</th>
<th>Buffer (m)</th>
<th>RPP Stall Total (Sum)</th>
<th>RPP Stall Vacancies (Sum)</th>
<th>Current Occupancy Rate (Avg)</th>
<th>Cars Removed (Sum)</th>
<th>Final Occupancy Rate (Avg)</th>
<th>Change in Occupancy Rate (Avg)</th>
<th>High Occ. Blocks 100m to Low Occ. Blocks</th>
<th>Redistribution Distance (m) (Avg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85</td>
<td>50</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>122</td>
<td>0.85</td>
<td>0.05</td>
<td>16 of 76</td>
<td>199.59</td>
</tr>
<tr>
<td>0.65</td>
<td>50</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>317</td>
<td>0.78</td>
<td>0.12</td>
<td>47 of 76</td>
<td>89.00</td>
</tr>
<tr>
<td>0.85</td>
<td>100</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>205</td>
<td>0.81</td>
<td>0.09</td>
<td>7 of 33</td>
<td>174.93</td>
</tr>
<tr>
<td>0.65</td>
<td>100</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>558</td>
<td>0.67</td>
<td>0.23</td>
<td>30 of 33</td>
<td>70.67</td>
</tr>
<tr>
<td>0.85</td>
<td>200</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>279</td>
<td>0.78</td>
<td>0.12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0.65</td>
<td>200</td>
<td>2747</td>
<td>316</td>
<td>0.90</td>
<td>757</td>
<td>0.60</td>
<td>0.30</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7: On-Street Parking Summaries for Each Scenario

Figure 30: Number of RPP Blocks in Each Occupancy Rate Range
PART III -- DESIGNING FOR SHARED PARKING

Business Models 3.1
Building Retrofits 3.2
Financial Scenarios 3.3
Conclusion 3.4
Introduction

This section discusses the West End’s multifamily buildings at a more site specific level, particularly those found to have 50 or more vacant parking stalls. Each of the 46 properties is first grouped into one of four building typologies found throughout the West End. By establishing four basic building typologies (center core towers, concrete slabs, tower & podiums, and lowrise/midrise), more site specific recommendations can be made about how each building could better utilize their vacant parking stalls. After categorizing each building, background statistics are explored, comparing: building ages, building tenures, parking supplies, parking occupancy rates, number of units, FSR, and amount of surface parking. These findings determine which building typologies are best suited for starting a shared parking program. Through this analysis, it was found that the center core tower and concrete slab typologies are likely the best suited because of their abundance of surface parking and consistently low parking occupancy rates.

Next, the West End’s current parking situation is discussed, noting the current supply of registered vehicles, number of on-street and off-street parking stalls, and parking occupancy rates for both categories. These numbers reveal consistent on-street parking congestion, despite a large oversupply of both on-street parking (~2700 stalls) and off-street parking (~22,000 stalls) for the ~15,000 registered vehicles in the West End. To address this issue, different shared economy businesses models are examined. The business models first demonstrate how the proposed shared parking program could be structured, ranging from totally privatized models to publicly operated models and also a hybrid model under which the city partners with surrounding building managers to provide an expanded parking service. Each of these models is described, noting potential strengths and weaknesses, current legal barriers, and how each business model is currently being used. After examining the current physical and legal constraints for each business model within the West End, it was found that public and hybrid models could offer the most immediate impact, while encountering the fewest legal barriers.

Lastly, each business model is tested through a series of hypothetical financial scenarios. These scenarios are used to determine what the potential costs and earnings may be for those operating the program and also how each of the business models might impact on-street RPP congestion and short term visitor parking supply. While these scenarios rely on current parking utilization trends and existing off-street parking costs in the West End, these generalizations can still give broad estimations as to how much it would cost to expand the RPP program to private properties. Through these scenarios, it can be seen that options to open surface parking on rental properties have the fewest physical site constraints and may have the largest immediate impact, by potentially adding over 400 new off-street parking stalls to the program. Assuming zoning bylaws were amended to permit the leasing of parking stalls hybrid models may offer the largest potential gains. Under this model, the public RPP program would expand to private surface lots, while also allowing building owners to sell short term parking to West End visitors. In doing so, parking shortages in both the existing RPP program and visitor parking could be addressed by better utilizing the existing stock of off-street parking stalls.
3.1 Building Retrofits

3.1.1 Current Parking Trends in the West End

Today, there are roughly 16,000 cars registered in the West End neighborhood. 15,000 of the 16,000 have access to one or more of the 22,000+ off-street parking stalls in the neighborhood’s residential properties. Despite the majority of residents having access to off-street stalls, 6,000 RPP permits have been issued for the neighborhood’s 2747 on-street RPP parking stalls. This imbalance of supply and demand has resulted in frequent on-street parking shortages throughout the West End, with parking occupancy rates averaging around 90%. Through these figures, it would seem apparent that this issue could be rectified if the City limited access to only those who did not have off-street parking. If this were enacted, only 1,000 West End vehicles would be competing for the limited number on-street RPP stalls, and the rest of the stock could be used for expanding short term parking supplies or used for neighborhood visitors.

For various political reasons, ranging from a desire to ensure all West End residents have equal access with local public resources to plans for expanding the supply of RPP facilities, limiting RPP permits to only those without off-street parking access is unlikely. As such, the following section will outline how the existing glut of excess off-street parking in the West End can expand RPP access while also creating potential revenue streams in the area.

Current Stock of West End Vehicles and their Corresponding Parking Access

Figure 31: Number of Vehicles and Off-Street Parking Stalls in the West End
3.1.2 Building Typology Background

After finding the 46 properties believed to have 50 or more parking vacancies, each building is grouped into one of four building typologies. These four typologies, center core towers, concrete slabs, tower & podiums, and lowrise/midrise, are determined by examining the footprints and form of each building, and then properties were categorized based on their characteristics. The similarities in building form is assumed to be a result of the buildings’ similar ages. Of the 46 target properties, 33 were built between 1960 and 1989. The following pages analyze each typology, detailing the general form, age, tenure, number of units, and various parking metrics. From these findings, it is determined which buildings to target and how each typology can be retrofitted to accommodate RPP users.
3.1.3 Building Typology: Center Core Tower

The center core tower is ubiquitous throughout most of the West End neighborhood and, unsurprisingly, is the most common typology for buildings believed to have 50 or more parking vacancies. This typology is generally 20m x 25m, with ample lawn or surface parking space within the rest of the property. These 24 buildings were predominantly built between the 1960s and 1980s (17 of the 24) and many have on-site surface parking (16 of the 24). As such, many of these buildings may be ideal for accommodating a shared parking program. Further, many of the buildings are rental properties and may face fewer challenges implementing a program. By allowing RPP users to occupy some or all of the surface lots, buildings would be able to profit from this program without having to incur the security risks of allowing users into a building’s underground parking.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Count</th>
<th>Construction Year</th>
<th>Units</th>
<th>FSR</th>
<th>Parking Stalls</th>
<th>Parking Occupancy Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOWER</td>
<td>24</td>
<td>Average</td>
<td>1976</td>
<td>139</td>
<td>3.9</td>
<td>158</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>1971</td>
<td>132</td>
<td>3.4</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range</td>
<td>1958 - 2007</td>
<td>58-264</td>
<td>2.75-6.6</td>
<td>84-336</td>
</tr>
</tbody>
</table>

Table 8: Center Core Tower Parking Figures

Tenure Makeup
- Strata (7)
- Rental (16)
- Other* (1)

Other*: Market Coop, Non-Market Rental, & 99-Year Leaseholds

Surface Parking
- None (8)
- Present (16)
- 10+ (10)
Required Alterations: Center Core Tower

-- Open Surface Parking Access for RPP Users
-- Add Security gate for below-grade residential parking

Proposed RPP Stalls: Surface Stalls

Total Surface Parking - 405  
Rental Property Surface Stalls - 295  
Average Surface Parking Spaces - 17

Remaining Residential Stalls: Sub-grade Stalls

Parking Occupancy Post Retrofit: Average -61%  Median - 53%  Range - 36% - 123%

Figure 32: Center Core Tower Proposed Parking Retrofit
3.1.4 Building Typology: Concrete Slab Tower

The concrete slab typology is the second most common typology within the selected properties and, like the previous tower typology, was predominantly constructed between the 1960s and 1980s (11 of the 14). This typology generally features buildings with double loaded corridors and are generally much longer than the tower category. Like the towers, these buildings often feature surface parking (11 of the 14), but at a lower rate since many of these buildings cover a larger proportion of their associated parcel. As with the first typology, shared parking would be most easily implemented by dedicating the surface parking to non-residential users. The wide distribution of this typology across the West End would also allow for users to easily access additional off-street parking facilities within a short walk of their destination.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Count</th>
<th>Construction Year</th>
<th>Units</th>
<th>FSR</th>
<th>Parking Stalls</th>
<th>Parking Occupancy Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAB</td>
<td>14</td>
<td>Average</td>
<td>146</td>
<td>3.06</td>
<td>156</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>158</td>
<td>3.18</td>
<td>150</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1960 - 2014</td>
<td>52-265</td>
<td>2.03-3.47</td>
<td>118-193</td>
<td>18-66%</td>
</tr>
</tbody>
</table>

Table 9: Concrete Slab Parking Figures
Required Alterations: Concrete Slab Proposed Parking

-- Open Surface Parking Access for RPP Users
-- Add Security gate for below-grade residential parking

Proposed RPP Stalls: Surface Stalls

Total Surface Parking - 249  Rental Property Surface Stalls - 122  Average Surface Parking Spaces - 18

Remaining Residential Stalls: Sub-grade Stalls

Parking Occupancy Post Retrofit: Average - 56%  Median - 56%  Range - 18% - 77%

Figure 33: Concrete Slab Proposed Parking Retrofit
3.1.5 Building Typology: Tower & Podium

Predominantly built between 1980 - 2010, the tower and podium typology is a more recent typology that features 1 or 2 levels of townhomes or retail beneath a residential tower. Because of the ground levels cover much of the parcel, none of these buildings feature surface parking. As such, these buildings would need to make larger retrofits in order to accommodate RPP users. These retrofits might include moving the gated entrance to lower levels of underground parking or adding an additional gate that could only be operated by residents. While these retrofits are less straightforward than what could be implemented when surface parking is present, these buildings are still promising because of the large number of median parking stalls and the comparatively low parking occupancy rates. Demonstrating potential retrofits will also be useful if this program, or other shared parking strategies, were to be expanded.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Count</th>
<th>Construction Year</th>
<th>Units</th>
<th>FSR</th>
<th>Parking Stalls</th>
<th>Parking Occupancy Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOWER &amp; PODIUM</td>
<td>5</td>
<td>Average 1999</td>
<td>128</td>
<td>4.52</td>
<td>184</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median 1994</td>
<td>126</td>
<td>3.28</td>
<td>151</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range 1989 - 2013</td>
<td>61-256</td>
<td>3.2-5.27</td>
<td>111-317</td>
<td>42-58%</td>
</tr>
</tbody>
</table>

Table 10: Tower & Podium Parking Figures
**Required Alterations:** Tower & Podium

- Open First Floor of Subgrade Parking to RPP Users
- Add A Second Security Gate for Residential Floors

**Proposed RPP Stalls:** First Floor of Subgrade Parking

**Remaining Residential Stalls:** Remaining Floors Dedicated to Residential Parking

**Figure 35:** Tower & Podium Proposed Parking Retrofit
3.1.6 Building Typology: Lowrise & Midrise

The final typology features lowrise and midrise buildings. These three buildings feature similar constraints seen in the tower and podium, as they cover the majority of parcels and do not have surface stalls to lease to potential users. While these buildings do have very low parking occupancy rates, their strata and conglomerate housing tenures may involve more legal barriers that may make them less ideal candidates for a shared parking program. As such, this building typology will likely not be an immediate priority for potential shared parking programs, but may hold value as laws are amended and demand for shared parking facilities increases.

<table>
<thead>
<tr>
<th>Typology</th>
<th>Count</th>
<th>Construction Year</th>
<th>Units</th>
<th>FSR</th>
<th>Parking Stalls</th>
<th>Parking Occupancy Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOWRISE / MIDRISE</td>
<td>3</td>
<td>Average 1983</td>
<td>69</td>
<td>2.59</td>
<td>101</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Median 1973</td>
<td>75</td>
<td>2.54</td>
<td>93</td>
<td>30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range 1972 - 2003</td>
<td>36-97</td>
<td>2.03-3.2</td>
<td>70-142</td>
<td>6-33%</td>
</tr>
</tbody>
</table>

Table 11: Lowrise & Midrise Parking Figures

Tenure Makeup
- Strata (2)
- Rental (0)
- Other (1)

Other*: Market Coop, Non-Market Rental, & 99-Year Leaseholds

Surface Parking
- None (3)
- Present (0)
- 10+ (0)
Required Alterations: Lowrise & Midrise

- Open First Floor of Subgrade Parking to RPP Users
- Add A Second Security Gate for Residential Floors

**Proposed RPP Stalls:** First Floor of Subgrade Parking

**Remaining Residential Stalls:** Remaining Floors Dedicated to Residential Parking

**Figure 35:** Lowrise & Midrise Proposed Parking Retrofit
3.1.7 Retrofit Options Summary

Each of these retrofit options offer a potential solution for how to address on-street parking concerns at the building level. While those buildings identified to have large amounts of excess parking and ample surface parking opportunities are particularly advantageous for hosting RPP users, exploring how each building typology can be more effectively used is essential for reducing the West End’s need to build parking in the future. The following matrix demonstrates how different tenures and typologies can be combined to unlock different amounts of off-street parking and what these newly available stalls could do for current on-street parking occupancy rates in the surrounding neighborhood. As seen below, rental properties offer some of the best opportunities between the sheer number of vacancies and the large quantities of surface stalls. Further, this would also mean that many buildings would little to no physical alteration, as non-residents could simply be given access to surface parking lots. This could save property managers from large capital costs, which may reduce initial apprehension towards participating in the program. According the available parking data for the area, in just the 46 residential buildings with 50 or more parking vacancies, there are over 650 surface parking stalls that could potentially designated for RPP use. Adding these stalls to the RPP program would increase to the neighborhood’s current parking supply by nearly 25% and would dramatically reduce the consistently high rates of congestion in the area. While induced demand would likely reduce overall impact of the addition, adding these sparsely used stalls to the program could open up many new opportunities for the City of the Vancouver to meet the West End’s transportation needs.

![Figure 36: Off-Street Surface Parking Supply](image-url)
Table 12: Off-Street Parking Matrices

Other*: Market Coop, Non-Market Rental, & 99-Year Leaseholds
Subgrade Surplus**: Total Number of Parking Stalls on Property - (Number of Registered Vehicles+ Number of Surface Stalls)

<table>
<thead>
<tr>
<th></th>
<th>Strata</th>
<th>Rental</th>
<th>Other*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface Parking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(For 50+ Vacancy Properties)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tower</td>
<td>7</td>
<td>295</td>
<td>103</td>
<td>405</td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>8</td>
<td>122</td>
<td>119</td>
<td>249</td>
</tr>
<tr>
<td>Tower &amp; Podium</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lowrise / Midrise</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Surface Parking Sub-Total</strong></td>
<td>15</td>
<td>417</td>
<td>222</td>
<td>654</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Strata</th>
<th>Rental</th>
<th>Other*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subgrade Surplus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(For 50+ Vacancy Properties)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tower</td>
<td>437</td>
<td>1060</td>
<td>-40</td>
<td>1457</td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>341</td>
<td>371</td>
<td>247</td>
<td>959</td>
</tr>
<tr>
<td>Tower &amp; Podium</td>
<td>475</td>
<td>0</td>
<td>0</td>
<td>475</td>
</tr>
<tr>
<td>Lowrise / Midrise</td>
<td>160</td>
<td>0</td>
<td>66</td>
<td>226</td>
</tr>
<tr>
<td><strong>Subgrade Surplus Sub-Total</strong></td>
<td>1413</td>
<td>1431</td>
<td>273</td>
<td>3117</td>
</tr>
</tbody>
</table>

Figure 37: Off-Street Subgrade Surplus Supply
3.2 Business Models

3.2.1 The Current Business Model for Vancouver Parking

Presently, the City of Vancouver treats parking as an utility. In areas where the city charges for parking, residents are permitted to use public streets for on-street parking, so long as they pay an hourly rate or subscribe to an annual service fee. Historically, like many other cities, Vancouver did not charge for street parking all in most parts of the city. As a result, street parking is residential areas has been seen as a right, and, while Vancouver has started to charge modest fees for parking in some residential areas, rates remain much lower than the surrounding off-street parking rates. Because these prices have remained comparatively low to the surrounding off-street parking costs at both businesses and residential properties, street parking is heavily used. In turn, building owners are often left with large sums of vacant parking stalls, as they cannot compete with the low rates found for RPP zones. Further, building owners and strata residents face legal barriers through both provincial and municipal restrictions barring the commercial sale of parking in certain areas and restricting the separation of parking stalls from their intended strata unit. Despite being surrounded by a seemingly latent demand for vehicle parking, building owners are left unable to sell the glut of parking they were originally required to build.

3.2.2 Supplementing Current Supplies with Shared Economies

The City of Vancouver has already identified in its Transportation 2040 document that new capital expenditures to increase parking supply are not in the City’s best interests (City of Vancouver, 2012). Between the large upfront costs, and the negative impacts dedicating large areas for vehicle storage, Vancouver is now looking to address its parking issues by decreasing demand and utilizing existing stocks of parking. To address on-street parking congestion, the City is now searching for strategies to establish a more even distribution between on-street and off-street parking supplies. Shared parking stands to offer potential solutions for this specific parking issue, along with many other transportation issues in the West End. Shared parking, like all forms of the sharing economy, revolves around people wanting to monetize their property or services to the fullest possible extent. Sharing economies, or collaborative consumption, is a market model under which the owner offers access to a good or service that is not currently in constant use. This form of shared economy includes various strategies under which residents with unused, or underused, parking agree to give access to an individual or group for a fixed rate. While these business models are not necessarily new, they have become increasingly influential over the past decade as a direct result of improved technology and access to technology. Having the ability to constantly buy or sell products or services through smartphones has simplified transactions, and shared parking services will likely benefit in a similar manner. These business models offer the flexibility that can easily supplement Vancouver’s existing parking infrastructure, without needing to invest in pricey capital expenditures. The following paragraphs detail the different types of shared economy models in order to demonstrate how the system can be structured to either work within Vancouver’s current legislative framework or respond to revised regulations.

3.2.3 Current Obstacles for Shared Economy Models the West End

Like many existing shared economy services, these new businesses will face legal scrutiny. To date, the Province of British Columbia and the City of Vancouver have both disallowed...
ride sharing business models, such as Uber, to operate within Vancouver. Most recently, the Vancouver City Council rejected the recommendations of a policy report suggesting to explore the potential risks and rewards of bringing rideshare services to the region (Vancouver City Council, 2015). Further, current provincial law surrounding strata properties creates issues for interested sellers. Through the BC Property Strata Act, strata owners are prohibited from selling unit amenities, such as parking stalls, independently from the residential unit (Province of British Columbia, 2015). Without the ability to lease parking stalls independently from residential units, strata owners will be left with excess parking but no way to lease spaces to the unmet parking demand in the surrounding area.

Specifically in the West End, current zoning does not permit the commercial sale of vehicle parking. Without this designation, residential buildings in the area would not be able to lease excess parking stalls. The majority of the West End’s parking stock is also located within structured or underground parking facilities with gated access. This specific site design detail would potentially cause additional hurdles for residents and owners to share their excess parking through a digital marketplace. Interested sellers would need to take extra steps to deliver keys or access codes to potential buyers, creating one additional layer of complexity to the operation. Even if this could be addressed, and sellers could share access to their buildings with interested parties, neighboring residents may have legitimate concerns about sharing access to non-building residents. Without addressing these legal and site design concerns, shared parking would only be able to have a limited impact on the area.

3.2.4 Private Sharing Economy Business Models

Exemplified by companies like, Uber and AirBnB, private forms of the sharing economy allow users to connect directly with potential trading partners to buy or sell products and services. The prevalence and practicality of these services has rapidly increased in conjunction with improved technology. This can be seen through Uber’s rapid growth. Uber, a ride-sourcing platform for users to list their location and desired destination in order to find potential drivers, has directly benefited from the ubiquity of smartphone use. Through this improved technology, companies like Uber can easily facilitate transactions by using smartphones’ GPS features to share locations and user information between potential buyers and sellers. The process is further simplified by having a credit card attached to each account, eliminating any payment interaction between the two parties. These private companies, in turn, earn a portion of the revenue generated through the various transactions. This simplified buying and selling experience has been the stimulus for many sharing economy businesses. This platform has not only generated wealth for those now able to monetize a wide variety of products that previously had little to no market but also the service providers that facilitate the transactions.

Similar services are now being used to establish shared parking marketplaces. Companies such as JustPark, Rover, and SPOT offer platforms for users to monetize their unused parking spaces by creating a listing and then allowing buyers agree to purchase the space for a certain duration. Like other private models, these shared parking companies benefit from improved technology and simplified user interfaces. By allowing sellers to easily list the location and asking price of their product, and clearly displaying all potential options for buyers to choose, these informal trading agreements have become increasingly
straightforward. These private models also offer a fair amount of flexibility when it comes to set up. The programs could be established on a building level, through a building manager or strata corporations, or the individual tenants could post their own parking stall listings. This flexibility also allows listings to be more temporary. Buyers could elect to lease stalls by the hour as opposed to needing a monthly or annual membership. In doing so, the program can offer a wider variety of services, and reach audiences that are only looking for one-time, short term parking. Recent King County Metro parking rate occupancy studies demonstrated that this addition of short-term leases can make a large impact to the amount of stalls a building could potentially lease on a day-to-day basis. Buildings that were around 70% occupied at night were consistently found to only be around 30-40% occupied during the day (VIA, 2015). Adding these short term parking options could, in some cases, double the supply of leasable stalls, giving buildings and residents the most flexibility on how to share their unused parking.

3.2.5 Public Sharing Economy Business Models

At their roots, governmentally run programs are collaborative consumption models. Public agencies construct infrastructure and utilities like roads and sewage systems, and then residents pay taxes and usage fees in order to gain access to the systems. Unlike private companies, public systems are better able to control pricing by subsidizing services if the market price far exceeds what users are willing to pay, as seen through road and bridge construction which are often free or do not entirely recoup the capital costs through usage fees. This allows the public agency to offer a potentially equitable service for something that currently too expensive for many users. Additionally, public models can quickly establish a service rather than having to wait for a market to materialize privately.

In the case of parking infrastructure, government agencies can purchase or lease excess spaces from private properties and, in turn, make them available for public use. Private buildings would agree to section off agreed upon areas of their parking facilities, and grant access to program users. In doing so, this form of shared parking not only increases the amount of publicly available parking supply, but it can control costs and utilize previously wasted space. By having a governmentally operated shared parking system, each facility would act as part of a larger system. This singular system would provide an easy to use experience for users by having one service provider to coordinate with, and the program could act as an extension for already existing parking services. Building owners, who may not have otherwise offered their parking, could also benefit from this publicly operated service, as they could agree to receive a monthly or annual payment instead of having to establish their own parking program and worry about recovering all of their expenses individually. Having one, holistic system may also reduce the overall operation and maintenance costs, as one security provider could monitor all the properties as opposed to an individual building having to arrange for their own surveillance. Through this governmentally run alternative, cities can expand publicly available parking supplies and free up on-street parking for additional visitor parking.

3.2.6 Hybrid Sharing Economy Business Models

Hybrid business models are scenarios in which public agencies

![Figure 42: Potential Shared Parking Business Models]
partner with a private company or NGO in order to offer a service that cannot be delivered by only the public sector. These include services like community gardens or bike share programs where a government agency might have the land or funds to operate the service, but does not have the expertise. These models offer the flexibility described in the private model, while maintaining the marketing and unified system benefits of an expansive public system. While these models often limit the public agency’s ability to produce a profit for the service, the service is likely to be able to offer new or added features that would not be available through just a public entity. This type of model can be seen through various public private partnerships and New York City’s bike share program, Citi Bike. Citi Bike is the official bike share of the NYC DOT, but is operated by Motivate, a private bike share company. Through this partnership, Motivate can provide knowledgeable service while gaining the benefits of being in direct partnership of the NYC DOT and all of its available resources (coordination with city transportation plans, operate on public property, etc).

This type of business model can also be applied to shared parking programs in which a public agency would use an existing program to attract potential users and private company would be contracted to operate and maintain the system. Like the previous public model, a public agency would lease a dedicated area within a set of private buildings, but then a private company would be in charge of coordinating the operation. In doing so, the city could connect the program to its existing residential parking program and control the pricing (subsidizing building owners if need be), but would gain the efficiencies of the private marketplace. As seen through Citi Bike’s example, a private company, such as SP+, JustPark, or another parking service provider, could offer outside knowledge by establishing an online marketplace for listing parking stalls and providing security services to participating buildings. Through this partnership, the public agency would be able to offer their existing customers larger parking supplies and new, secure options without having internally develop and operate a potentially costly system.

3.2.7 Recommendations for the West End

Each of the listed business models comes with their own challenges, but, after taking into account the identified legal constraints and site specific issues, public and hybrid models appear to have a clear advantage. While private models could be easily established and offer more short term leasing opportunities, the logistical and security barriers of granting facility access to non-building residents would cause operational headaches. Additionally, different buildings would likely have different requirements and procedures for gaining access, adding additional confusion for users. Without buy-in from the building owner or strata corporations, these programs would likely see similar backlash to what AirBnB has seen from neighbors in buildings concerned about strangers occupying their building (Gallagher, 2014).

Public or hybrid models would also face legislative challenges in order to allow the leasing of residential parking stalls, but these changes could be made relatively quickly if the City found that it would be a benefit to existing public programs. In the West End, the program would benefit from being directly connected to the already successful Residential Parking Permit program. Users would already recognize the system and would benefit from only having to manage one service. Further, users would be able to
easily access the facilities as the City would lease certain parking facilities from the building owners. Private models would also face issues with being able to offer similarly competitive low pricing options. While a public option would likely still charge a premium on top of the annual RPP membership for the new, secure off-street parking, it is likely that the price would still be substantially lower than the current monthly rates offered by West End properties (~$6 per month compared to upwards of $125-$300). Although public programs would likely only be able to lease consistently unoccupied stalls, and in doing so, miss the opportunity to sell short term, hourly leases, hybrid models would likely be able to offer this private model flexibility. Adding this potential revenue could entice a larger audience of owners to participate in the program and allow off-street parking to have a greater impact towards alleviating the West End’s on-street parking shortage. Through these various benefits, it can be seen that the proposed West End Shared Parking Program would likely benefit from a publicly operated or hybrid business model.

**Changes Required For Each Business Model**

- Added building security and retrofits to separate residential and RPP User parking
- City of Vancouver Bylaw Amendments (Permit Commercial Sale of Parking Stalls in Residential Zones)
- Recommend alterations to the BC Law Strata Property (Allow Parking stalls to be sold separately from residential units)

<table>
<thead>
<tr>
<th>Business Model</th>
<th>Ease of Use - (Seller)</th>
<th>Ease of Use - (Buyer)</th>
<th>Affordability - (Buyer)</th>
<th>Profitability - (Seller)</th>
<th>Short Term Leases</th>
<th>Current Legal Standing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private (User to User)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Private (Build to Users)</td>
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<tr>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

- Strong ○ Medium ○ Weak

**Table 13**: Business Model Comparison Table
3.3 Financial Scenarios

3.3.1 Private (User to User):  

Knowledge and its application

Technological Changes:
-- App for listing and purchasing parking stalls

Physical Changes:
-- Signage for available surface parking stalls

Legal Changes:
-- B.C. Property Strata Act
-- RM-5 Zoning Restrictions

Description:
Under this option, strata residents rent their unused stalls to those looking for parking, either monthly to RPP members looking for a reliable place to park or visitors looking for short-term parking. This option is predominantly confined to strata properties with surface parking, where the residents are the direct owners of the parking stalls and lessees would not have access to inside the building. While tenants of rental properties could potentially list their vacant stalls, building managers would likely ban this practice. Building managers would be unlikely to support the risks involved with granting strangers building access and may want to lease parking themselves. Currently, only 15 surface stalls within the target properties belong to strata buildings. With such a small number of stalls, and prices likely to be much higher than the current RPP program, this model is unlikely to have a large impact on the neighborhood’s RPP program. Further, this option would still face the previously mentioned legal constraints. Without major investment to secure building access, and support to let non-residents park within a building, resident run shared parking is unlikely to offer substantial relief to the West End’s parking congestion.
Public Model: Potential Earnings for Leasing an Off-Street Parking Stall

<table>
<thead>
<tr>
<th>Hourly Price</th>
<th>Utilization Rate</th>
<th>Hours/ per Day</th>
<th>Days/ per Year</th>
<th>Annual Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>$4.00</td>
<td>0.75</td>
<td>12</td>
<td>250</td>
<td>$9,000</td>
</tr>
</tbody>
</table>

Table 14: Private Option - Potential Earnings

Assumptions:
- City expands current zoning bylaw to allow for the leasing of surface parking in RM-5
- Only Strata properties participate
  *The resident leasing the stall should be the primary owner
- Buildings charge around $4 an hour for their off-street parking, and it is utilized 75% of the time
  *Off-street parking in the West End is between $3-6/ per hour
3.3.2 Private (Building to Users):

Description: In this scenario, private building owners in the West End begin selling excess surface parking for short term use to neighborhood visitors. Knowing they cannot compete with the low monthly prices of the RPP program, buildings look to capitalize on the lack of short term parking in the area. Prices vary between buildings and lengths of use, and each building is in charge of its own operation and maintenance. Assuming rental properties only lease their surface parking stalls, 417 parking stalls would be made available. If buildings were to charge $4 per hour (off-street parking in permitted areas in the West in ranges from $3-6) for 12 hours a day during the working week at a 75% occupancy rate, each stall could potentially earn upwards of $9,000 per year, without including additional revenue collected from ticketing. If building managers made the necessary changes to allow guests to park on the first level of underground parking, an even larger supply would become available. Even by conservatively estimating that the first level of underground parking would only make up 20% of the over 3300 underground rental parking stalls, an additional 660 stalls could become available. This option would likely have a noticeable impact on short term parking by potentially adding hundreds of new metered options, but since it is unlikely that the program would offer competitively priced long monthly leases, it would not provide new spaces for RPP users. While this option may provide an additional revenue stream for building managers, and add to the limited supply of short term parking, it would not likely have a sizable impact on current RPP congestion.

Figure 44: Predicted impact of a Building to Users model on the West End’s RPP Program - Minor relief from new short term parking
### Public Model: Potential Earnings for Leasing an Off-Street Parking Stall

<table>
<thead>
<tr>
<th>Hourly Price</th>
<th>Utilization Rate</th>
<th>Hours/ per Day</th>
<th>Days/ per Year</th>
<th>Annual Revenue</th>
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<tbody>
<tr>
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<td>$9,000</td>
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</tbody>
</table>

### Table 14: Private Option - Potential Earnings

**Assumptions:**

-- City expands current zoning bylaw to allow for the leasing of surface parking in RM-5
-- Buildings charge around $4 an hour for their off-street parking, and it is utilized 75% of the time
  *Off-street parking in the West End is between $3-6/ per hour*
-- Buildings are only permitted to lease the first floor of underground parking to customers
-- 20% of parking is located on the first floor (this is likely a conservative estimate, but it would be the most a building owner could offer since parking rates in residential properties are believed to range from 35-75%).
Under this option, the City of Vancouver leases surface stalls from rental properties in the West End. This currently includes 417 stalls, with the possibility of adding 237 more stalls if non-market and strata properties would be included. The 417 stalls would become part of the existing RPP program and all members would be able to utilize these new spots on the existing first come / first served basis. In return, each property owner receives the same monthly rate ($50, $75, $100) and subscribes to the program for an annual basis. RPP membership pricing could be established in three ways:

1. Maintain current rate and subsidize the remaining costs of acquiring the new off-street stalls
   - $125 / per month / per stall
   - $100 / per month / per stall
   - $75 / per month / per stall

2. Divide the cost of the off-street parking leases by the number of anticipated RPP permits
   - $125 per stall = $104 per month / per resident
   - $100 per stall = $83 per month / per resident
   - $75 per stall = $63 per month / per resident

3. Replace 100 existing on-street RPP stalls with metered parking
   - $125 per stall = $781,720 in revenue
   - $100 per stall = $906,000 in revenue
   - $75 per stall = $1,031,920 in revenue

Utilization of new and existing RPP stalls will likely vary based on the determined pricing structure, but under existing conditions the 417 new surface stalls stand to increase the program’s supply of parking stalls by 15%.

**Figure 45:** Predicted impact of a Public Model on the West End’s RPP Program - **Potentially 417 RPP stalls**
Table 15: Public Option - Potential Earnings

Assumptions:

-- City expands current zoning bylaw to allow for the leasing of surface parking in RM-5
-- RPP users remains constant (new users are assumed to be offset by those who no longer find it financially advantageous)
  *The cost is evenly distributed among the 6000 RPP Holders
-- New metered stalls were estimated to earn $15,000 per year
  **$4 per hour with an 80% occupancy rate over 365 days
  **This does not include the additional revenue from ticketing
### 3.3.4 Hybrid Model:

**Technological Changes:**
- App for listing and purchasing parking stalls

**Physical Changes:**
- Signage for available surface parking stalls
- Move garage gate to lower levels in order to secure residential parking

**Legal Changes:**
- RM-5 Zoning Restrictions

**Description:**
The hybrid option combines a public model leasing option with the ability for building managers to profit from short term leases. This option involves the city’s RPP program expanding to the 417 surface stalls on rental properties and also permits rental properties in the area to lease the first level of their underground parking to area visitors. Under this model, the city would pay properties for their surface stalls, but the buildings would need to operate and maintain the program. Users would benefit from the new surface stalls operating interchangeably with the existing program, and, as such, would only have to buy a single permit to use the new facilities. By combining an RPP expansion with increased short term parking, the hybrid model is likely to have the largest positive impact for RPP users and West End visitors.

**Figure 46:** Predicted impact of a Hybrid Model on the West End’s RPP Program - Potentially 417 RPP stalls + short term parking
Public Model: Potential Earnings for Leasing an Off-Street Parking Stall

<table>
<thead>
<tr>
<th>Hourly Price</th>
<th>Utilization Rate</th>
<th>Hours/ per Day</th>
<th>Days/ per Year</th>
<th>Annual Revenue</th>
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<td>0.75</td>
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<td>$9,000</td>
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</tbody>
</table>

Public Model: Cost to Lease Surface Stalls for Different Monthly Prices

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Revenue</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Price/ per Stall</td>
<td>Stalls</td>
<td>Annual Cost for Stalls</td>
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<tr>
<td>$125</td>
<td>417</td>
<td>$625,500</td>
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<td>$100</td>
<td>417</td>
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<tr>
<td>$75</td>
<td>417</td>
<td>$375,300</td>
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</tbody>
</table>

OR

Public Model: Different Annual RPP Prices to Cover the Cost of Leasing Surface Stalls

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Revenue</th>
<th>Income</th>
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<tr>
<td>Price/ per Stall</td>
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<td>Annual Cost for Stalls</td>
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<td>$500,400</td>
</tr>
<tr>
<td>$75</td>
<td>417</td>
<td>$375,300</td>
</tr>
</tbody>
</table>

Table 16: Hybrid Option - Potential Earnings

Assumptions:

-- City expands current zoning bylaw to allow for the leasing of surface parking in RM-5
-- RPP users remains constant (new users are assumed to be offset by those who no longer find it financially advantageous)
  *The cost is evenly distributed among the 6000 RPP Holders
-- New metered stalls were estimated to earn $15,000 per year
  **$4 per hour with an 80% occupancy rate over 365 days
  **This does not include the additional revenue from ticketing
-- Buildings are only permitted to lease the first floor of underground parking to customers
-- 20% of parking is located on the first floor (this is likely a conservative estimate, but it would be the most a building owner could offer since parking rates in residential properties are believed to range from 35-75%).
3.3.5 Financial Scenarios Summary

Three of the four shared parking business models discussed through these scenarios offer potential opportunities for improving the existing parking conditions in the West End. Depending on the targeted audience, desired impact, and cost some options hold clear advantages. If the City of Vancouver is looking to simply increase the supply of short term visitor parking, allowing private properties to sell their surface parking stalls may be the most straightforward option. If the City hopes to expand the RPP program, leasing surface parking stalls from surrounding rental properties, and then making the stalls available for program users, may be the most user friendly alternative. This public option could also include new short term parking, but it would likely require removing existing on-street parking stalls. The third option would be to lease stalls from private properties and allow these buildings to sell their excess parking, so long as the buildings maintained a high level of security for their residents.

This hybrid model would likely offer the most new parking to the area since it would involve opening both the surface stalls and the first level of underground parking on rental properties for monthly leases or short term use.

While further analysis will be needed in order to more accurately determine existing parking vacancies and potential earnings from leasing off-street parking, these scenarios demonstrate just some of the potential strategies that could be used to address the West End’s current congestion issues. Through implementing any of these three options, the West End would be able to properly identify where parking is being underused and demonstrate how it can address the area’s current needs.

3.4 Conclusion

Despite the West End’s current on-street parking shortages, shared parking remains a potential solution for how to alleviate congestion without needing to dedicate more land to parking. From the previous analysis, it can be seen that shared parking offers a variety of implementation strategies. Some strategies hold clear advantages and are more likely to produce immediate impacts. Surface lots, especially those found within rental properties, hold some of the highest potential because of the ease of access, little need for physical changes to the buildings, and have fewer predicted legal barriers. While opening unused underground parking would potentially add thousands of new public parking stalls, the costs to retrofit buildings and the anticipated apprehension from building residents makes sharing these stalls less feasible. Additionally, determining how the program should operate is vital for understanding the program’s potential impacts. Whether the program is operated publicly, privately, or jointly, will influence on the program’s cost, audience, and overall impact on the West End RPP program. As seen through the previous financial models, the public and hybrid options are predicted to have the largest immediate impacts and could offer the largest supply of new parking stalls. Future analysis will certainly be needed in order to more accurately assess current parking occupancy rates and potential earnings from a shared parking program. Despite these future needs, this study has demonstrated that a surplus of unused parking does currently exist within the West End and has identified which strategies may offer the best solution for repurposing this utility.


