

3-D Residential Land Use and Downtown Parking: An Analysis of Demand Index

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Abstract

The need for downtown revitalization is a growing concern for community stakeholders who are attempting to make their communities more sustainable and minimize urban sprawl. One strategy to make the downtown more active is to increase the attractiveness of the downtown for street-level customers and residential development. Success in this strategy attracts more people to the downtown; however, the challenge is to provide adequate parking. This study examines parking and its spatial dimensions in downtown Laramie, Wyoming. A parking inventory of both on- and off-street parking revealed the uneven spatial distribution of parking in the downtown area. Street interviews provided information on length of parking, purposes for coming downtown, and the location of destinations once downtown. A three-dimensional land use inventory supplied detailed locations of all activities in each building and floor for the 28 blocks of downtown Laramie. A bubble analysis of each parking space identified the spatial dynamics of the downtown parking demand and its distributional inadequacy for downtown residents.

Introduction

The downtown of most cities is considered the heart of the community. Not only does the downtown have a substantial concentration of businesses and employment, it is also the cultural and social center of the community, with museums; historic sites; theatres; and social events such as festivals, parades, and ceremonies. The involvement of the people makes the downtown area a thriving pulse of the community. Wilson et al. (2012) examined the patterns of population change in metropolitan and micropolitan areas and found that metropolitan areas generally grew the fastest between 2000 and 2010. Along with this finding, Wilson et al. (2012) also concluded that downtown areas in the metropolitan counties had some of the fastest growth rates; for example, Chicago increased by 48,000 people within 2 miles of City Hall (the U.S. Census Bureau-designated center of the downtown area). Small towns, however, are experiencing some of the same types

of population increases. The Census Bureau identified San Marcos, Texas, as one of the fastest growing communities in the United States, with a population increase of more than 20 percent between 2010 and 2013 (U.S. Census Bureau, 2014). Greenfield (2012) similarly identified that small towns are growing across the United States. The downtown areas are becoming the hallmark of regrowth and the core of the city (Glaeser, 2012). The trends in redevelopment of downtowns have been an ongoing process for the past 60 years, starting with the urban renewal projects in the early 1960s. Robertson (1999) identified a number of strategies to revitalize downtowns, specifically for small towns. In a study of 57 small-town development strategies, the following 9 strategies were identified by most of the communities: (1) historic preservation, (2) downtown housing, (3) waterfront development along with nightlife and entertainment, (4) new office development, (5) pedestrian improvements, (6) tourism, (7) traffic circulation changes, (8) Main Street approach, and (9) parking facilities and a convention center (Robertson, 1999). Several other studies demonstrated that it is imperative to reinvigorate the downtowns in communities (Faulk, 2006; Filion et al., 2004; Leinberger, 2005; Rypkema, 2003). The development of the downtown area provides a number of challenges for the local community, depending on the strategies it pursues.

A vibrant downtown is marked by mixed-use activities and a sense of place. These two characteristics are part of the increase in residential activities in downtowns (Birch, 2009; Cook and Bentley, 1986). The higher population densities in the downtown provide a potential market capture for retail, entertainment, and cultural activities (Ferguson, 2005). Wachs (2013: 1162) found that “[y]oung, highly educated professionals move downtown to consciously reject the suburban cul de sacs where they grew up. Millions of senior citizens of means are choosing to retire in central city locations increasingly served by Starbucks, Whole Foods, and Trader Joe’s markets.” In an earlier study by Filion et al. (2004) on the revitalized downtown areas, however, the most successful areas had several elements in common: university campus nearby, seat of government, and historical character. If the community does not have these characteristics, however, the downtown can be a central place for employment and provide housing options for the local citizens. Wachs (2013) believes a number of downtown development activities are enhanced by the importance of transportation connectivity. As important as connectivity is as an element in downtown development, the availability of parking for both customers and residents is even more critical. The American Planning Association (APA) report on off-street parking (Bergman, 1991: ii) states that “...there is tremendous citizen concern about the availability of parking, its effect on the transportation network, and, ultimately, on the quality of life in a community.” With increasing population growth in downtown areas, the impetus to revitalize the downtown, and the concerns for parking and transportation, several factors need to be analyzed.

Objectives and Approach

This study examines downtown residential land use and its demand on parking. In the process of analyzing downtown residential parking demand, this research project has several objectives.

1. Locate and inventory all land uses in downtown Laramie, Wyoming.
2. Locate and inventory downtown Laramie’s on- and off-street parking.

3. Create a spatial residential parking demand model based on the land uses within a set distance from each parking area.
4. Identify transportation and parking strategies that promote downtown residential development.

Unlike most land use studies and parking demand analyses, however, this study uses a different approach. First, the land use downtown is inventoried and analyzed using three-dimensional (3-D) spatial referencing. Each building downtown is inventoried floor by floor to record all land uses on each floor and their relative location on the floor. In the past, land use was recorded only for the first floor or a total count of land use was identified for a whole building without any spatial reference. Second, unlike most parking studies, which analyze the demand for parking based on the land use (ITE, 2010), the count of currently available off-street parking spaces, and the count of additional spaces needed to accommodate the new land use, this study assumes that the number of downtown parking spaces is fixed and that the probability of creating new spaces is low to none. Thus, this research attempts to calculate the parking demand generated by the land uses around each individual parking space and views demand from the parking space perspective, not from the land use perspective. This study is specifically concerned about downtown residential parking, its availability, and demand competition.

Parking demands generally are based on the zoning and the amount of parking required for each land use type within the zone. The Institute of Transportation Engineers (ITE) created a guide (2010) that presents the parking demand for more than 105 different land uses. Most transportation engineers, consultants, and planners use this guide to determine parking demands. The guide, however, was developed from studies of isolated land uses in suburban areas (ITE, 2010). To represent the full range of land areas, the fourth edition identifies five different area types: (1) central business district, (2) central city (not including the central business district), (3) suburban centers, (4) suburban, and (5) rural (ITE, 2010). The demand model used in this analysis used the available information only for the central business district or central city uses.

Parking Demands in Downtown Laramie, Wyoming

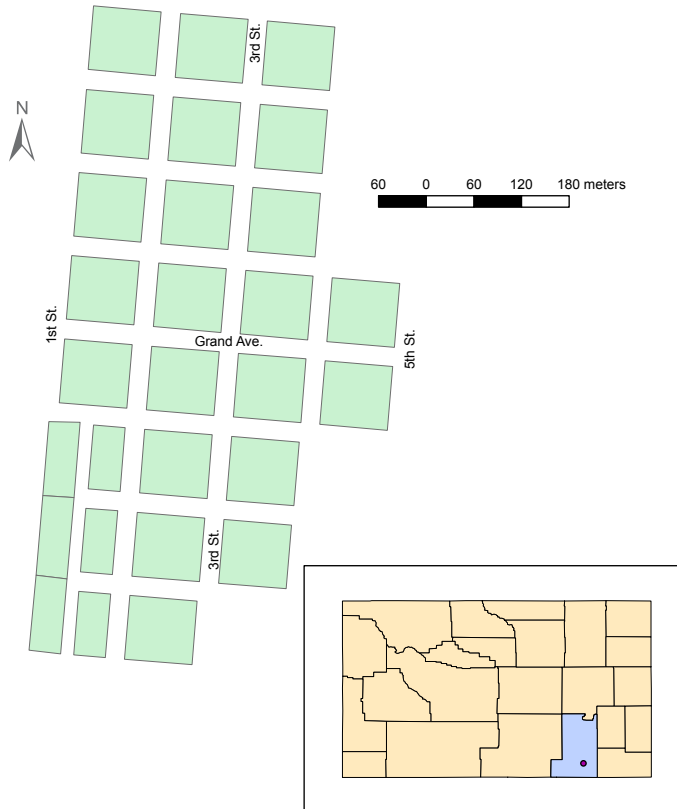
This study is concerned with residential parking demands in the Downtown Commercial (DC) zone district of Laramie, Wyoming. The DC zone district encompasses 25 blocks covering 29.6 hectares (73.1 acres; exhibit 1). Laramie is the third largest city in Wyoming, with an estimated 2013 population of 31,814 (<http://quickfacts.census.gov>). The home of the University of Wyoming (UW), Laramie has a fluctuating population but one of the most stable economies in a state noted for its boom-bust cycles of energy development. The city is attempting to encourage growth in the downtown area. In the City of Laramie's *Comprehensive Plan* (2007), a major goal for the downtown area is—

Increase residential population in the Downtown through changes to the current zoning regulations to encourage mixed-use buildings and upper floor rental or condominium units. (City of Laramie, 2007: chapter 7, page 9)

Thus, an emphasis in the plan is to restructure planning policies and governmental regulations to lessen the barriers to downtown residential development.

Exhibit 1

Laramie's Downtown Commercial Zone, 2014



Note: The inset shows the location of Laramie on a map of Wyoming.

An understanding of the current downtown land use structure is critical to any development process. To assist in acquiring that knowledge, a complete inventory of land use downtown was completed. The inventory consisted of a complete survey of every building and every floor, identifying and recording the location of each individual activity. The use of 3-D spatial referencing made it possible to integrate the land use data into a Geographic Information System (GIS; Doner and Biyik, 2011). Overall, 36 different land uses in the 388 activity spaces were established, dominated by retail businesses and professional services (exhibit 2). Land use was recorded using a modified version of the North American Industrial Classification System (U.S. Census Bureau, 2013). The modifications included adding new codes for residential, parking lots, and vacant lands and buildings. Residential land use in Laramie's DC zone district totaled 133 units and consists primarily of second story apartments above office or retail businesses (exhibit 3). The area also has 14 homes, 1 converted five-story hotel with 36 apartments, and 1 five-story building with 16 apartments. The 14 homes are a mix of single-family dwellings and converted multifamily housing. The 2010 Census listed 297 people living in the DC zone district (<http://www.census.gov>). Laramie is a college town, however, and the capture rate of people listing Laramie as their primary residence could be suspect.

Exhibit 2

Downtown Laramie, Land Use, 2014

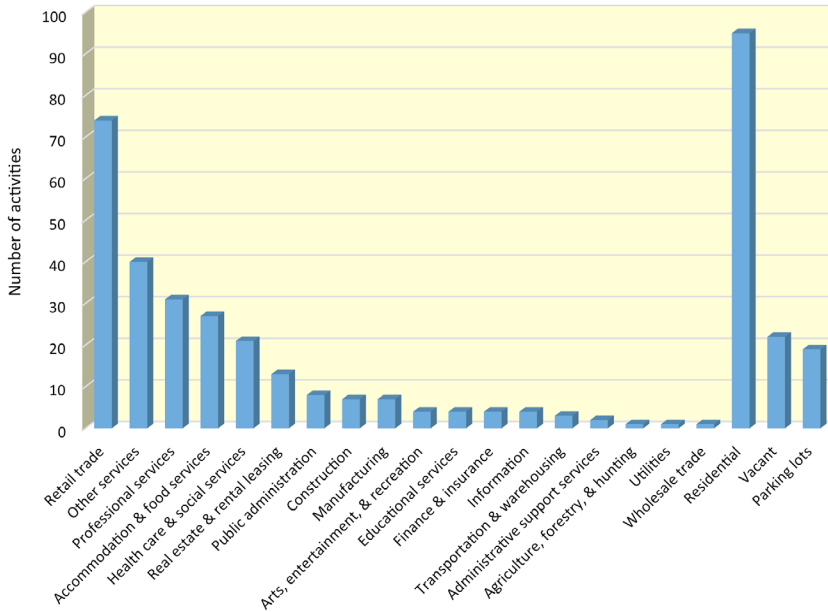
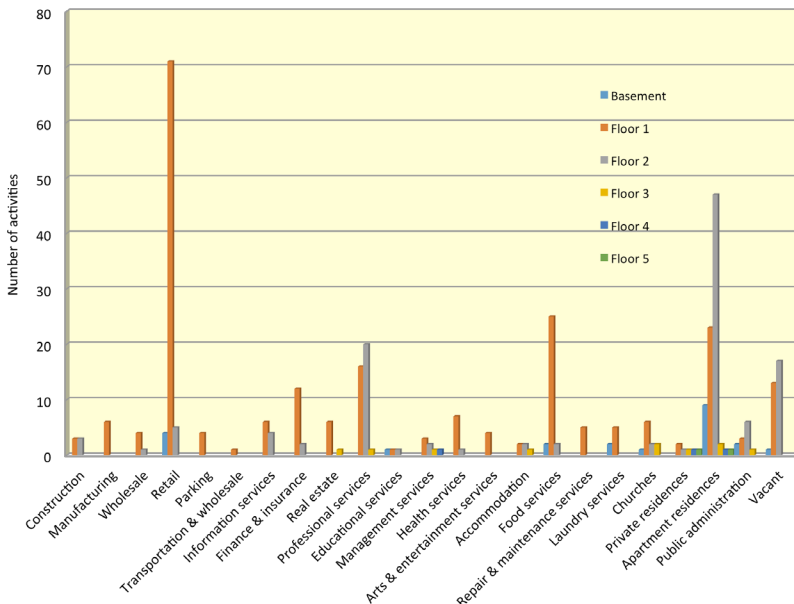


Exhibit 3

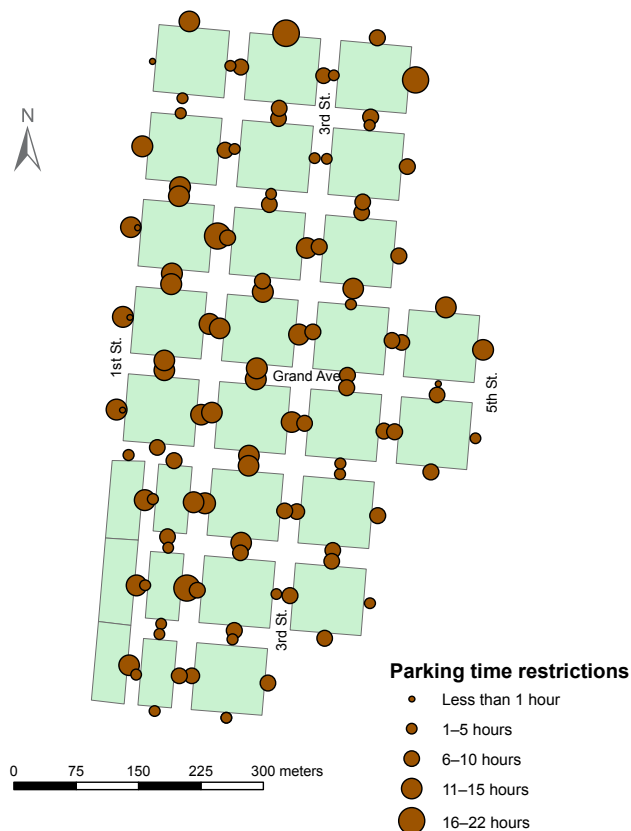
Downtown Laramie, Land Use by Floor, 2014



Parking has been a major issue in downtown development, with either not enough parking or too much (Jakle and Sculle, 2004). Parking is a major concern for expanding any residential activities downtown (Robertson, 1999). To alleviate some of the parking problems downtown, Edwards (1994) presented several strategies to alleviate the parking needs and to assist in small town downtown growth. The first step in the process, however, is to inventory and collect information on parking (Shields and Farrigan, 2001). To accomplish this task, a complete survey of both on- and off-street parking was completed in the DC zone district. Using a GPS, each on-street parking space was located and data were collected on its orientation, time restriction, and its handicap accessibility. Similarly, information collected for off-street parking included GPS location, time restriction, and ownership status (public, private, or business-related). Overall, 834 on-street parking spaces are available, with time restrictions varying from 15 minutes to unlimited (exhibit 4). Most of the parking downtown is limited to 2 hours (63.9 percent); however, some locations at the north and south ends of the downtown have no signage and thus have unlimited parking (4.0 percent).

Exhibit 4

Downtown Laramie, On-Street Parking, 2014



Although the on-street parking inventory was completed and the locations recorded, 64 percent of the 834 parking spaces had a 2-hour limit and would not be convenient for the downtown residents. The 220 spaces that did have all-day parking were generally some distance from the residence locations. A distance search function found that the average all-day parking spaces were 189.3 meters on average (standard deviation = 79.0 meters) from the residential units. This distance equates to slightly more than two city blocks from a unit. In the southeastern corner of the DC zone district, however, two multifamily housing units had building frontage adjacent to on-street parking with no signage.

Off-street parking has two areas: a larger parking lot and a small space on the backsides of buildings adjacent to an alleyway. Overall, 1,294 parking spaces are distributed across the DC zone district (exhibit 5), classified as public, private, or business-related (exhibit 6). Public off-street parking spaces are open to everyone and have a limited time span, whereas the private off-street parking spaces are signed as reserved parking for specific users—for either a specific apartment or business. The business-related parking spaces are those spots adjacent to a business without any specific restrictions; however, it is assumed those spaces are for the related business. If the spaces have signs, they usually identify the spaces as customer parking for the business.

Exhibit 5

Downtown Laramie, Off-Street Parking, 2014

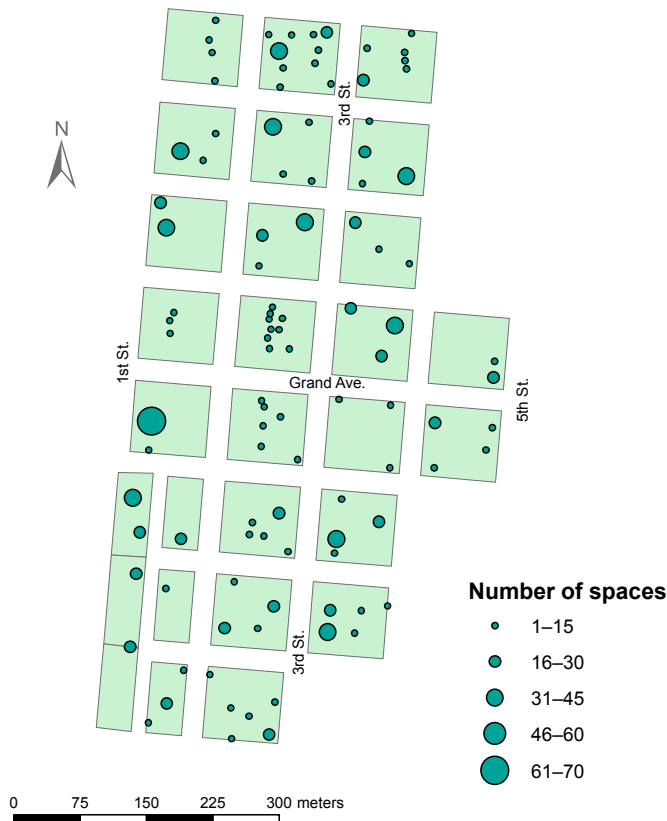
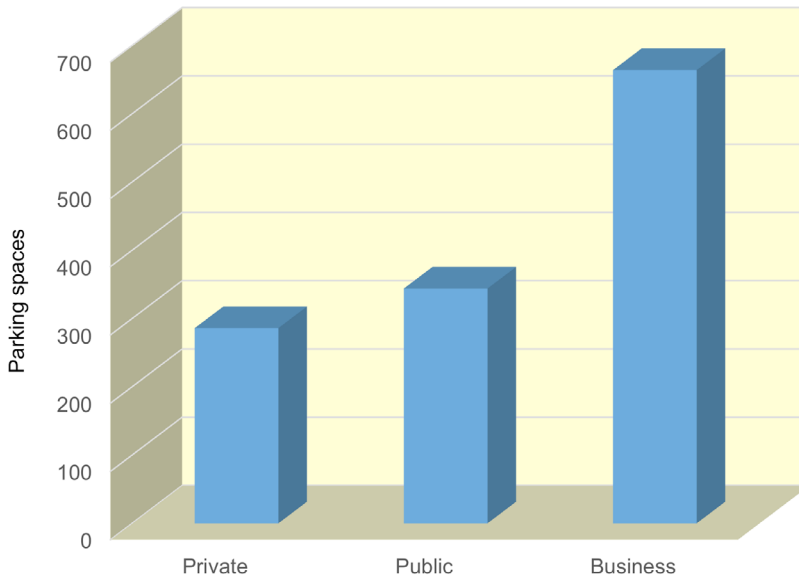
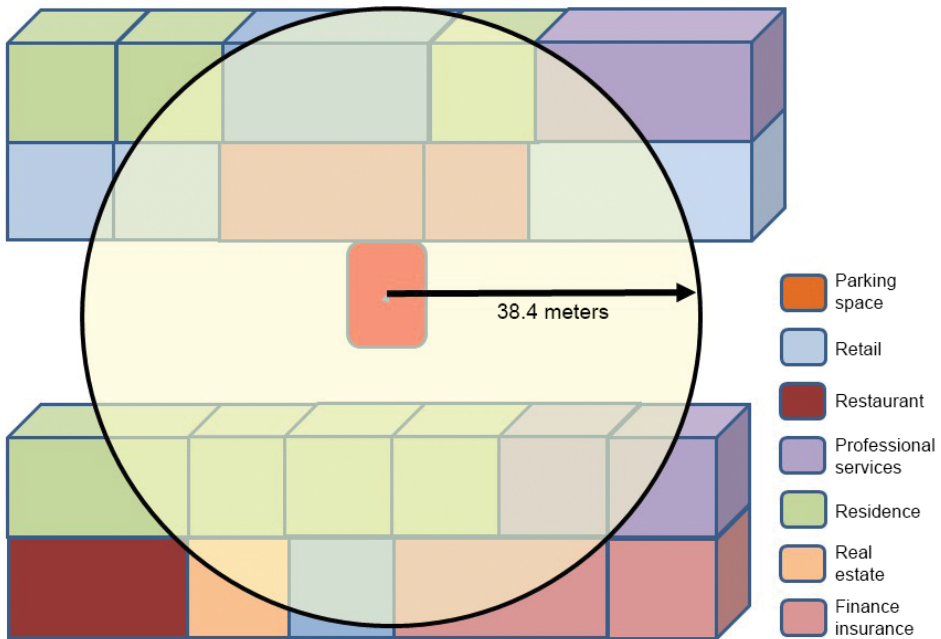


Exhibit 6**Downtown Laramie, Off-Street Parking, 2014**

For the downtown residential inhabitants, two off-street parking options are available, either an assigned parking space or the use of public parking. Downtown Laramie does not have a parking garage or current on-street city permitting zones. As displayed in exhibit 5, most of the private parking spaces are at the rear of the residential units, within 15 meters of the dwelling unit entrance and exit. Of the residential units, 38 percent (51) do not have assigned overnight parking. To accommodate their parking demand, the residents have to use public parking spaces; thus, they are in competition with other parking space users—retail shoppers, restaurant and bar patrons, and so on. In addition, the public parking has time limits, either 2 hours or all day. The all-day parking, however, in most cases, does have a no parking restriction between 2:00 a.m. and 6:00 a.m.

Parking Space Demand Model

The basic parking space demand model is a bubble (exhibit 7). The radius of the bubble is the average distance a person walks to his or her destination; in this case, how far a resident walks to his or her residential unit. The model is a bubble because the capture area is three-dimensional; it encompasses all the land uses on every floor within that walking distance, including across the street and diagonally across corners. Using the ITE (2010) guidelines for central business districts and the central city, each land use parking demand can be identified and assigned to each downtown business. The demands are a ratio of the number of spaces per square footage of use; for example, office space—2.8 parked vehicles per 1,000 GFA (gross floor area). The Albany County Assessor's parcel data (Albany County, Wyoming Assessor's Office, 2013), which contains information on the square footage of each building downtown, was coupled with the land use inventory

Exhibit 7**Basic Parking Space Demand Model**

data, which counted the number of floors in each building and determined the location of each land use. Thus, a calculated spatial demand for each parking space can be generated based on the radius of walking from the parking space and the parking generation of all of the land uses within that distance. The demand is strictly cumulative and is not weighted by day of the week, time of day, parking time restrictions, or vacancy rates. A complete parking study would capture this information, but a use and full vacancy rate analysis unfortunately was beyond the scope of this study.

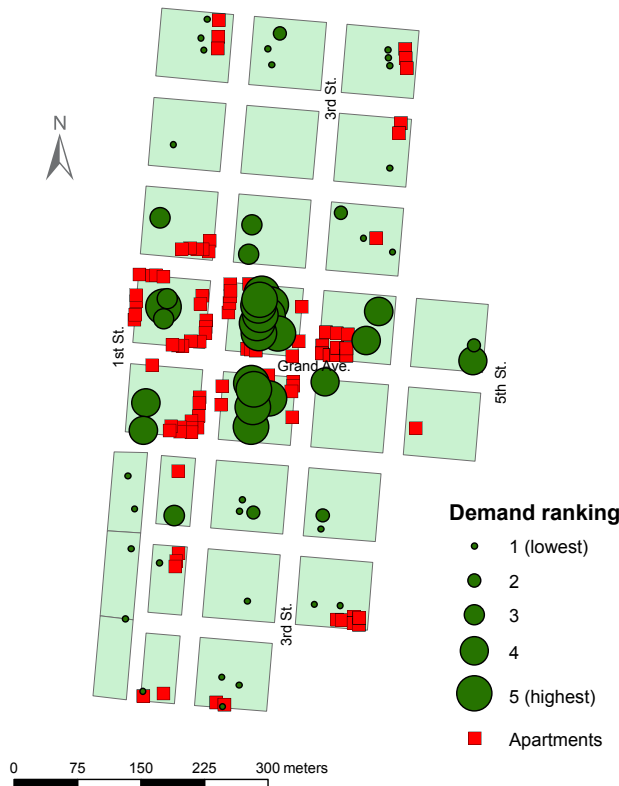
The walking radius is based on the responses from a random questionnaire conducted in March 2007 (Gibb, 2007). More than 280 individuals responded to an on-street parking survey that included questions concerning how long they parked, what the distance was to their first destination, how many additional destinations they had, and what the purpose was for each stop. The survey also included a number of questions concerning parking safety, aesthetics, and convenience. The average distance to the first destination was 38.4 meters, which in Laramie is nearly one-half of a block. This distance is considerably less than the 71.3 meters identified in Jakle and Sculle (2004), the distance people would walk from parking to shopping in a small town. With this information, a concentric circle search radius could be employed in ArcGIS (ESRI v.10.2) to capture the spatial parking demand for each type of off-street parking.

A simple additive calculation based on the search radius was performed in ArcGIS (ESRI v.10.2). After calculating the spatial demand for each parking space, the Jenk's natural breaks classification method (Jenks, 1963) was employed to create a demand ranking (1 = lowest, 5 = highest) to classify the spaces. The ranking method is a method to compare parking space demand, instead of using the actual demand index value. As would be expected, the parking spaces on the fringe of the DC zone district have the lowest demand rankings, whereas the parking spaces in the central portion of the downtown have some of the highest (exhibit 8). It is not a uniform distribution, however; some areas downtown do not have the same density of land uses and do not have multi-story buildings, thus creating a reduced parking demand.

In addition to calculating the spatial parking demand, a distance function was calculated to determine the average distance from each residential unit that did not have a private parking space to a public parking space. As mentioned previously, 51 residential units (38 percent) do not have assigned parking and, on average, the closest public parking is 148.9 meters (standard deviation of 63.2 meters), which is more than 1.5 blocks away. In addition, the available parking spaces within this distance generally had a ranking of 4 or 5, the highest demand classes (exhibit 8). Thus, the public

Exhibit 8

Downtown Laramie, Apartment-Off-Street Parking Demand, 2014



parking spaces that are available to the residential units are in high demand and may not necessarily be readily available. This issue is compounded by the fact that the vehicles have to be moved between 2:00 a.m. and 6:00 a.m. on select days.

Conclusion

A major complaint in most downtown areas is that not enough parking exists. Robinson (1999) in his different strategies for downtown revitalization identified parking as a major component to invigorating the downtown. Jakle and Sculle (2004) cautioned that too much or too little parking, however, could be a hindrance to downtown redevelopment. Shoup (2005) cautioned against free parking and time limits. It is not just the number of parking spaces, however, but also the type of spaces and any restrictions that may create a barrier to their use (Mukhija and Shoup, 2006). Laramie has nearly 2,130 parking spaces distributed between on- and off-street locations. Is this amount enough or too much? According to Litman (2006), most communities that follow a zoning standard for parking spaces have between 30 to 50 percent too much parking. Nearly 65 percent of the on-street parking is restricted to 2 hours, almost 25 percent of off-street parking is labeled private restricted, and another 51 percent is business-related parking. Thus, only about 25 percent of the 1,294 off-street parking spaces are available to the 51 housing units that do not have assigned or private parking.

Using a spatial parking demand index, it was possible to calculate and determine the distribution of parking demand by parking space. This method of demand analysis examines parking from the parking space perspective, not from the land use perspective. From the calculations, it was possible to determine that the available public parking spaces that are close to the residential units are in high demand and have time restrictions. The time restrictions present a major parking problem for nearly 34 percent of the residential units downtown. Manville (2013) found that development in downtown Los Angeles, California, was hampered by the parking requirements for residential units. By implementing an Adaptive Reuse Ordinance, it was possible to increase residential development in downtown Los Angeles. Litman (2006) also suggested that a variety of parking management strategies should be implemented. This same type of strategy could be employed in Laramie, by being creative in supplying parking to the one-third of the residents who do not have convenient access to parking.

Three other strategies for providing downtown parking are (1) shared parking spaces, (2) business-lease parking, and (3) on-street parking permits. APA published a document, *Flexible Parking Requirements* (Smith, 1983), that identified several methods in which daytime parking uses could be complemented by nighttime parking uses, thus eliminating the evening hour parking vacancies in those lots designed for daytime parking demands. The business-lease parking arrangement works in a similar manner: downtown businesses that have business-related parking spaces, of which 51 percent of the off-street parking is classified, could lease the spaces to downtown residential units based on vacancy rates or nighttime and daytime use rates. Finally, the city permit system would provide a permit for a fee to downtown residents to park in the on-street parking spaces beyond the 2-hour limit. This system has been implemented with great success in Amsterdam, which has a much higher density of downtown residents (van Ommeren, Wentink, and Dekkers, 2011).

In a completely different approach to the downtown development and parking problems, an investigation of alternative transportation options could be completed. The expansion of the Laramie/UW bus system could reduce the need for automobiles and their subsequent parking requirements and provide access to other areas in the city for the downtown dwellers. The bus system could conversely provide transportation for citizens from around Laramie to the downtown area, and they would not need parking. Creating a more extensive network of bicycle routes into and through the downtown would also provide the infrastructure for an alternative to the automobile and possibly reduce a barrier to more alternative transportation usage.

Downtowns are vital to the economic and social character of a community. Laramie's downtown is a vibrant place not only on football weekends, but also throughout the year because of its mixed use, residential capabilities, and availability of parking. As the downtown develops, it will be important to meet the needs of the citizens who live downtown along with the needs of the people visiting the downtown. A balance has to be created to meet the needs of these two groups so the dynamic power of the downtown continues into the future.

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