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E.S. 204
Semester Project-Final Paper

A Walkability Study for Downtown Brunswick

Introduction and Problem Statement

The goal of our project was to analyze parking availability in downtown Brunswick and highlight areas that could use parking improvement to increase walkability in downtown Brunswick. We hope our project, specifically the inventory of private and public parking spaces that we created, can be used to explore new parking strategies to alleviate parking in downtown Brunswick. Our area of focus was Downtown Brunswick, which we defined as Fort Andros to the North, Union Street to the West, First Parish Church to the South, and Federal Street to the East.

Data used

We used data provided by the Maine Office of GIS and the Town of Brunswick for our analysis:

- *Roads Data*- Roads data from the Maine Office of GIS, was clipped to our defined study area of downtown Brunswick. We noted that Roads dataset didn't match up with our buildings and aerial imagery and as a result edited the data so it corresponded with our complete data set.
- *Buildings*- We used the buildings data from the Town of Brunswick to represent the buildings in downtown Brunswick. During our analysis we only used the buildings on Main Street.
- *Parking*- This was a point file that we created, inventorying every public and non-residential private parking space in downtown Brunswick. We created this data by digitizeing parking spaces from fieldwork (individually counting

parking spaces), GPS, and using aerial images. We also represented the number of public parking spaces based upon an inventory provided by the Brunswick Police Department

- *Base Map*- Aerial imagery provided by the Maine Office of GIS used as a background for helping to display our results.
- *Walmart Parking Lot*- A polygon file that we created in order to show the outline of the Walmart parking in Brunswick Maine.

GIS Analysis

Before we could perform any analysis on the parking of downtown Brunswick we needed to create an inventory of all existing public and private parking spaces. Initially we thought we could look at aerial images of downtown Brunswick and symbolize each parking space by just looking at the images. However, the imagery had many shadows hiding parking spaces and the resolution was too low to clearly distinguish parking spaces. We employed two different methods; we walked around with printed images of each block of downtown Brunswick and counted and recorded the number of parking spaces. We also used a GPS to record parking lot locations and then counted the number of spaces. Once we had this data we digitized, or individually symbolized each parking space with a point. This parking file represented all the private non-residential parking in downtown Brunswick. Next, we used the Brunswick Police Department's data spread sheet to digitize all the public parking places and added this data to our parking data file. Once we had digitized all the public and private parking spaces in downtown Brunswick, we categorized the spaces by type, public or private spaces.

After we had created an inventory of all parking in downtown Brunswick, we next needed to determine how far people are willing to walk to get to a destination. Nicholls (2001) chose to use a maximum walking distance of .8 km when measuring accessibility of public parks. This data may be on the high end, and more typically .5 km is used. Donahue (2011) claims the average walking distance is .5 miles. Using .5 miles as the average distance people would be willing to walk from parking spaces seemed somewhat arbitrary, because this distance varies for every person. Anna Breinich suggested we measure the size of the Walmart parking lot as a reference to how far people will walk to get to the front door of the store and use this distance as a proxy for how far people would be willing to walk from parking spaces to stores downtown. Using GIS, we created a polygon of the Walmart parking lot and used the measure tool, to figure out that from one end of the parking lot to the front of the store is roughly 500 feet.

Once we had determined an estimate of the distance people would be willing to walk—the distance of the Walmart parking lot to the front of the store—we employed this distance in our analysis of parking in downtown Brunswick. In order to perform a network analysis, we created a network dataset of the roads in downtown Brunswick. Next we determined that the two analyses that would be most applicable would be an origin-destination cost matrix network analysis and a service area network analysis. These two network analyses seemed to complement our data the best and produce the outcomes that we were looking for.

The first network analysis we built was an origin-destination cost matrix for parking spaces to stores on Main Street in Brunswick. The results of this matrix are

used to identify stores on Main Street in downtown Brunswick that will be serviced by each parking space within 500 feet of that store. In order to perform this type of network analysis we represented each building on Main Street with a point, using the polygon layer provided by the town. This provided a finite destination- a point representing a store located on Main Street. The second network analysis we built was a service area analysis that shows a series of polygons representing the distance that can be reached from a parking space. We decided to calculate 250 foot (half the distance of the Walmart parking lot) and 500 foot (distance of Walmart parking lot) service areas for all the parking spaces in downtown Brunswick.

Discussion

From our inventory of parking in downtown Brunswick, we learned that there are roughly 1,075 public parking spaces and roughly 1,506 private non-residential parking spaces. We also concluded that the most unutilized private parking spaces are located at banks and churches, which have large parking lots—offering many parking spaces. We overlaid the representation of the Walmart parking lot on top of downtown Brunswick showing as a proxy to show how far people are willing to walk (500 feet) to get to a destination. Looking at the overlaid Walmart parking lot (Figure 1), one can see how large the parking lot is and that

using the length of the parking lot as the distance people are willing to walk in our analysis is not a far-fetched assumption.

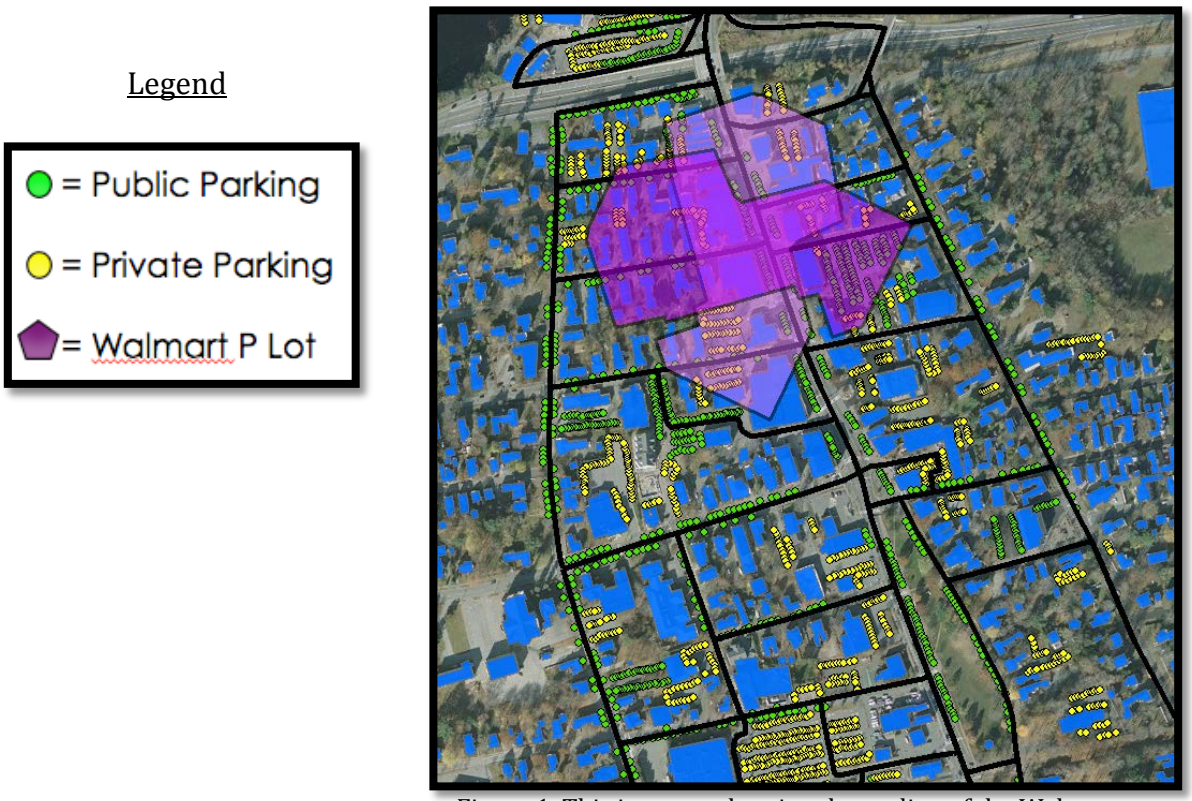

Figure 1. This is a map showing the outline of the Walmart parking lot oriented in two directions centered on Main Street.

The results of our service area network analysis show polygons that represent the service area or walkable distance that the parking spaces in downtown Brunswick provide. We ran this analysis using polygons or service areas of 250 feet (half the Walmart parking lot) and 500 feet from all the public and private parking in downtown Brunswick. This service area analysis showed that downtown Brunswick has insufficient parking service areas in the north and south ends of downtown. Looking at Figure 2 the southern end of downtown (bottom of the image) there is lots of white space which symbolizes areas of downtown that are

not serviced by public or private parking within a 500-foot radius. Furthermore the dark and light purple polygons represent the service area that the private parking provides, and again looking at the southern end of downtown, a large portion is comprised of private parking (purple polygons). This shows that the southern portion of downtown lack sufficient parking, however converting some of the private parking into public parking helps alleviate some of the parking shortcomings. The light and dark brown/tan polygons represent the service area of public parking in downtown. Notice the upper right region of downtown is serviced very well by public parking, however this is mostly because of the school, police station, and facility parking are located there. Furthermore the northern end (top portion) of downtown has some noticeable gaps where neither the public nor private parking service areas reach.

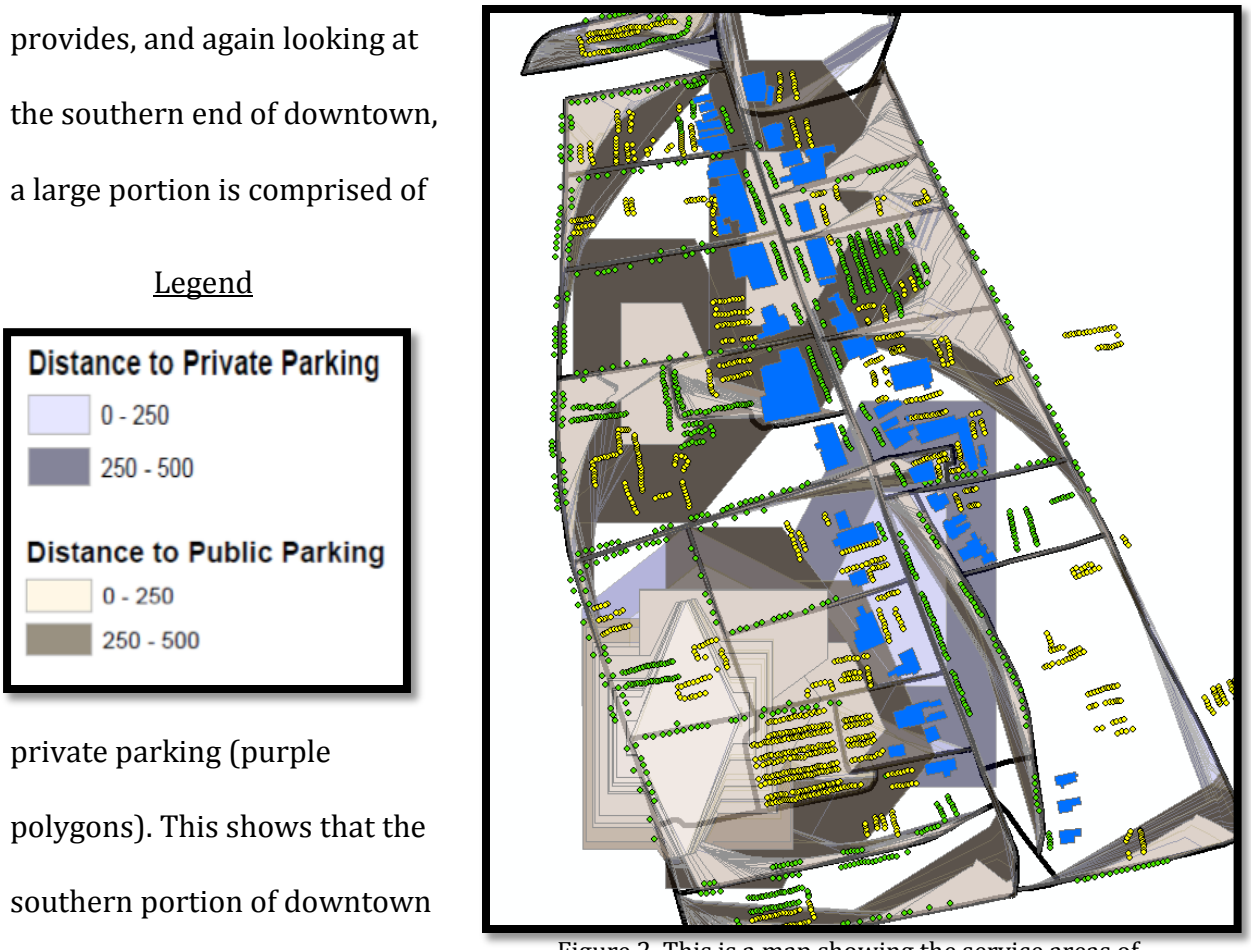

Figure 2. This is a map showing the service areas of public and private parking.

Our final analysis was the origin-destination network analysis, which displays the allocation of parking places no further than 500 feet from stores on Main Street. We symbolized the results from this analysis by how many parking spaces are within 500 feet of each store on Main Street. For example, one parking space might be in within 500 feet of four different stores on Main Street, so that parking space would count once toward each building. Looking at Figure 3 we can

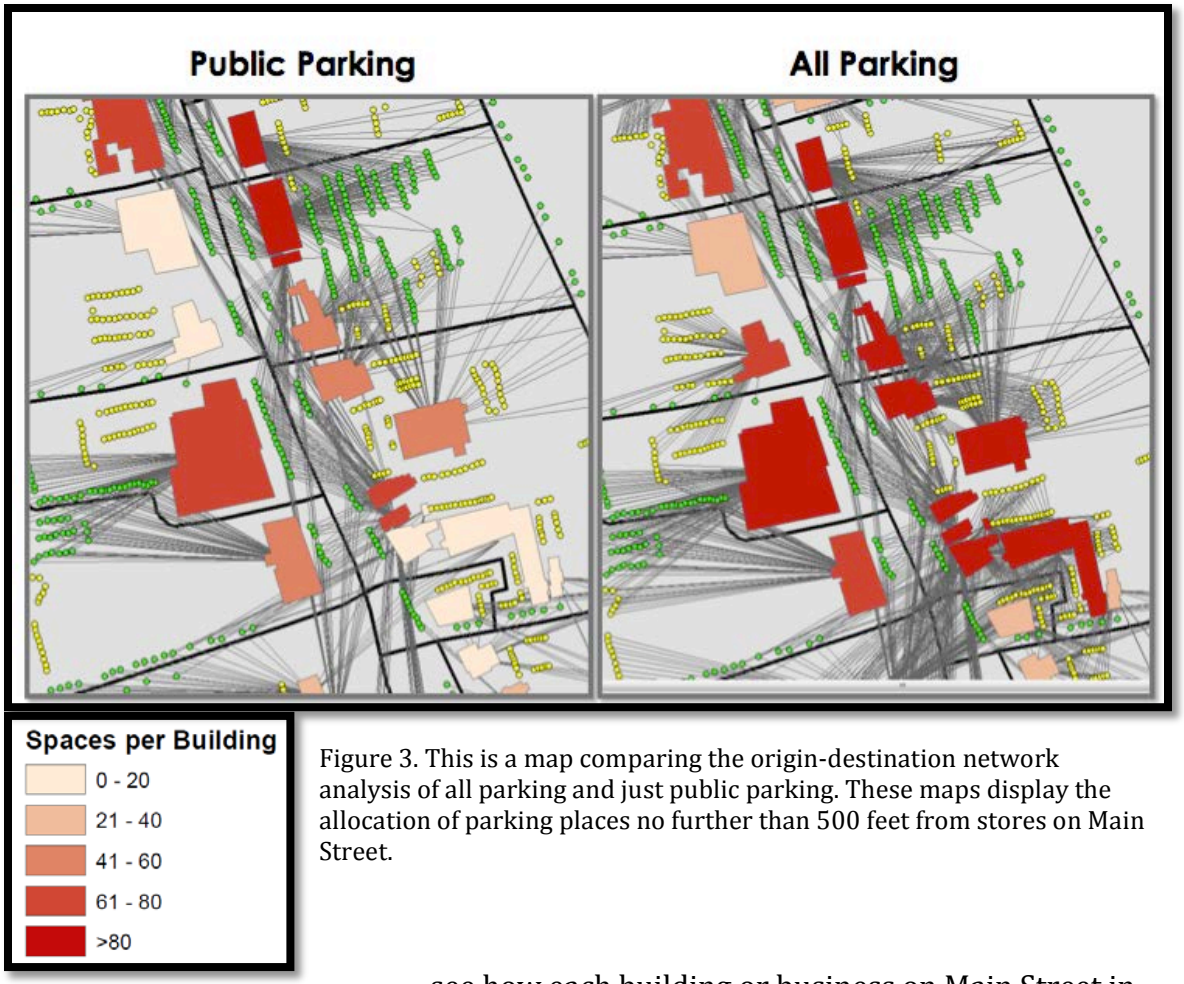

Figure 3. This is a map comparing the origin-destination network analysis of all parking and just public parking. These maps display the allocation of parking places no further than 500 feet from stores on Main Street.

see how each building or business on Main Street in Brunswick benefits from the existing parking. The map on the left displays the allocation of just public parking places no further away than 500 feet from stores on Main Street, and the map on the right displays the allocation of all parking places within 500 feet of stores on Main Street. Looking at the public parking allocation

(left map) we can see that there are six buildings that have 20 or fewer parking places within 500 feet of them, however when looking at the same buildings with private parking included (right map), the number of spaces is greater than 20 for each building. This shows that some businesses located on Main Street benefit greater from public parking than others; there are more public parking spaces allocated around their store. However when including private parking spaces these benefits even out, and there is a more equal distribution of parking for Main Street businesses, and a greater number of parking places.

The results we found were informative but created new questions as well. One question that we have to ask when evaluating the validity of these results is the degree to which people will consider the study area "walkable". If the community is walkable than each additional parking space will have a higher impact on local business. But if people do not find the community to be walkable than regardless of how close the parking spots actually are to the businesses then people will not be willing to walk that distance. More parking spaces will do little to help the problem.

By conducting a review of the walkability literature, we found that it is possible to use GIS to determine the walkability of a community. In early analyses, it was not clear that GIS could be used to determine something as subjective as walkability of a business district. Many studies employ resource intensive surveys, asking residents to estimate how long it took them to get to various nearby places. Salelens and Owen (2005), indicated that GIS may be an effective alternate approach to evaluating walkability. This analysis constructed an objective measurement of walkability using GIS. To test the measure's relative accuracy, the authors

performed the new analysis on two communities that it expected to have different walkability quotients. It then performed the traditional survey method on these communities and compared the results. They found that their objective measures yielded the same relative results as the more expensive survey method. Nicholis (2001) attempted to define the maximum that people were willing to walk. This study showed the disadvantage of the simple radius method and showed the benefits of the network analysis using GIS.

Having developed the parking inventory, we feel that further analyses could be conducted that could highlight better parking strategies including a walkability analysis to determine how walkable Brunswick downtown is, and what sections need improvements. Expansion of this project could include the incorporation of parameters of walkability that are described in Maghekak and Capp's paper *Walkability: A review of Existing Pedestrian Indices* (Maghekak and Capp, 2011). The authors outline a list of environmental measures that have been either 'perceived or empirically tested to have an association with walking' and it could be beneficial to choose one of these measures and run an analysis displaying walkability in downtown Brunswick. Hackley and Thurstain-Goodwin (2001) developed a network analysis examining walkability using raster data. Using raster data, Hackley and Thurstain-Goodwin measured walkability by all non-building surfaces. For example, parking lots and sidewalks were identified as highly walkable and roads less so. Using this approach, it might be informative to determine how walkable different parts of downtown Brunswick were, and see if there is a correlation between walkability and parking.

Conclusion

Our project provides the Town of Brunswick and the Brunswick Police Department with some ideas and the necessary data to explore different parking strategies that would enable more people to travel downtown. It is our hope that the Town of Brunswick and the Brunswick Police Department can use our results to develop parking strategies that will better serve residents and tourists of downtown Brunswick. We have highlighted and identified areas of downtown that may lack sufficient public parking (northern and southern sections) and have shown that if it were possible, converting private parking spaces into public parking spaces could alleviate the parking problem to enable more people to travel downtown.

There may also be simpler strategies than converting private parking into public parking. First, many of the public parking spaces and lots are poorly marked or not marked at all. Increasing signage for public parking will help alleviate the demand for the 'well known' public parking areas. Furthermore, making public parking more friendly—by adding security cameras to some lots and lighted sidewalk, and even simple street art to distract the traveler from their parking lot walk. Ultimately there are many solutions for the Town of Brunswick from acquiring private parking spaces to increasing signage to make parking in downtown Brunswick a more friendly, accessible, and fun experience.

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