Urban Sustainable Parking Lots

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Thesis:

Permeable parking lots can exist within the urban environment, benefiting people and the natural ecosystems.

Abstract:

This scientific research paper aims to address urban heat islands caused by parking lots. This paper argues using permeable surfaces as a more environmentally friendly option for parking lots instead of traditional concrete and asphalt. First, the paper will dive into the problems with the current structure of parking lots, explaining why these urban designs harm both people and the natural environment. The project will be followed by looking into the concept of permeable surfaces and the kinds of existing permeable surfaces. Afterward, a research study will evaluate several parking lots alongside West Gate City Boulevard. These lots will evaluated on location, size, property ownership, and more. Finally, the paper will conclude with several options for a permeable parking lot in each location used for the study and what it will take to achieve the goal of a permeable parking lot.

Intro:

Walking down a major city street should signify joy for people. They see many specific sections that are usually too fast to observe when driving through a car. The problem with this is that Greensboro has many vacant lots sitting idly every year. Most of these lots have occasionally been used as extra parking, and some belong to empty lots that have yet to be redeveloped. These areas do not benefit the ecosystem because their materials are mostly made up of concrete and asphalt, which cause natural weather like rain to wash over and fall into sewer systems that pollute major river streams. As these lots continue to go unused, they contribute to one of the most significant climate change effects known as Urban Heat islands and flooding. However, every problem has its solutions. There is room for these vacant parking lots and empty developed areas to have something that genuinely benefits the community of Greensboro and the natural environment. Similar studies have proven to work across the US (EPA- Experimental Permeable Pavement Parking Lot and Rain Garden for Stormwater Management). These impermeable surfaces can become permeable and sustainable with suitable materials and proper planning. To the City Council of Greensboro, I present research that will help the planet and the communities that call this city their home. This research paper will be aimed as a starting point for a project, aimed at re-designing Greensboro's urban parking lots for permeable surfaces to help protect the lives of the people and the planet.

Background:

There are two main issues regarding non-permeable surfaces: urban heat island effect and stormwater runoff. Heat Islands are urbanized areas experiencing warmer temperatures than other places nearby (EPA Heat and Islands). This consequence results from human-made activities that can stem from roads, buildings, sidewalks, and parking lots. These human-made

designs comprise asphalt and concrete that absorb heat due to the lack of vegetation and green canopy. This can cause significant health problems for communities near these areas of heat stress (Chun and Goodman 2018, 1). Urban heat islands are also typical in neighborhoods with little vegetation or greenery. These neighborhoods also sit close to urban areas with high urban heat levels from impermeable surfaces.

In addition to urban heat islands, impermeable surfaces prevent rainfall from infiltrating the soil and becoming groundwater. Runoff has become a significant threat in urban areas due to the number of impermeable surface areas. Communities and neighborhoods that live near areas with impermeable surfaces are at a higher risk of their areas being flooded. They are also more at risk of experiencing pollutant substances from impermeable surface runoff with organic waste, oil, grease, and phosphorus (Scholz and Grabowiecki 2006, 4). Both urban heat islands will continue to see more floods and other natural disasters with the growing effects of climate change (Antunes, Ghisis, and Thieves 2018, 1).

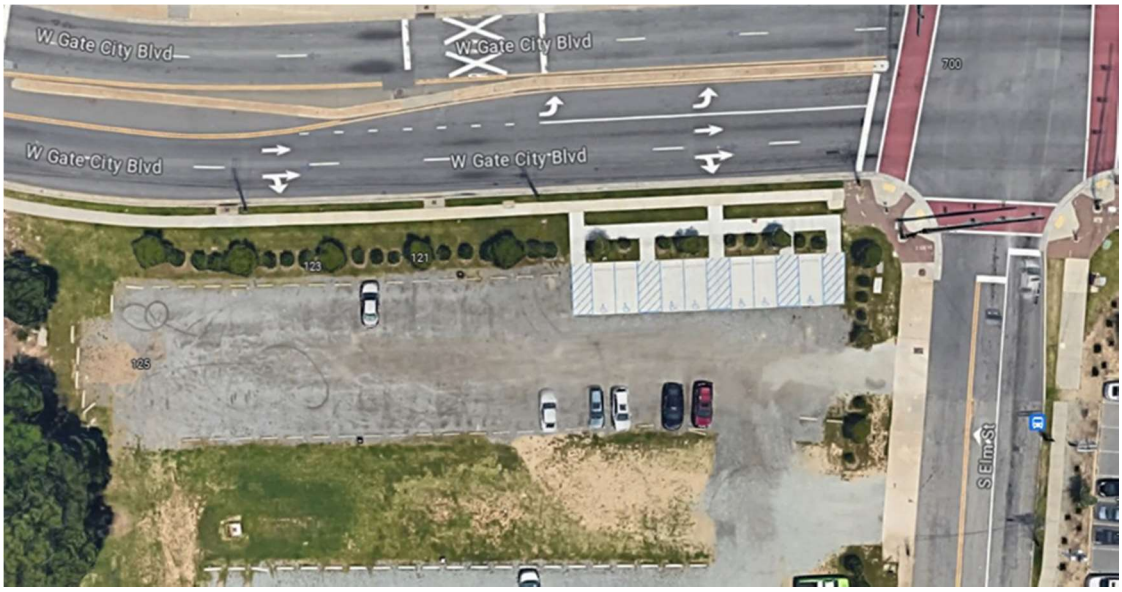
A permeable surface is a surface that allows weathered material to seep into the ground and be used as a source to enhance the surrounding environment. Permeable pavements are suitable for various residential, commercial, and industrial spaces. Even ordinary streets can be designed into streets for both vehicles and other modes of transportation (Scholz and Grabowiecki, 2). Unlike impermeable surfaces, permeable surfaces can remove chemical pollutants and metals that could end up in larger rivers, such as diesel, oil, and copper (Scholz and Grabowiecki, 5). Aside from improvements with stormwater, permeable surfaces are also great for reducing the urban heat island effect. Permeable surfaces have a lower surface temperature compared to asphalt and concrete, making them ideal for combating the growing effects of urban heat islands (Wang et al., & L, 2). If urban design areas were covered with

permeable surfaces, the overall temperature would drop, making people start to enjoy the outdoors more.

Methods:

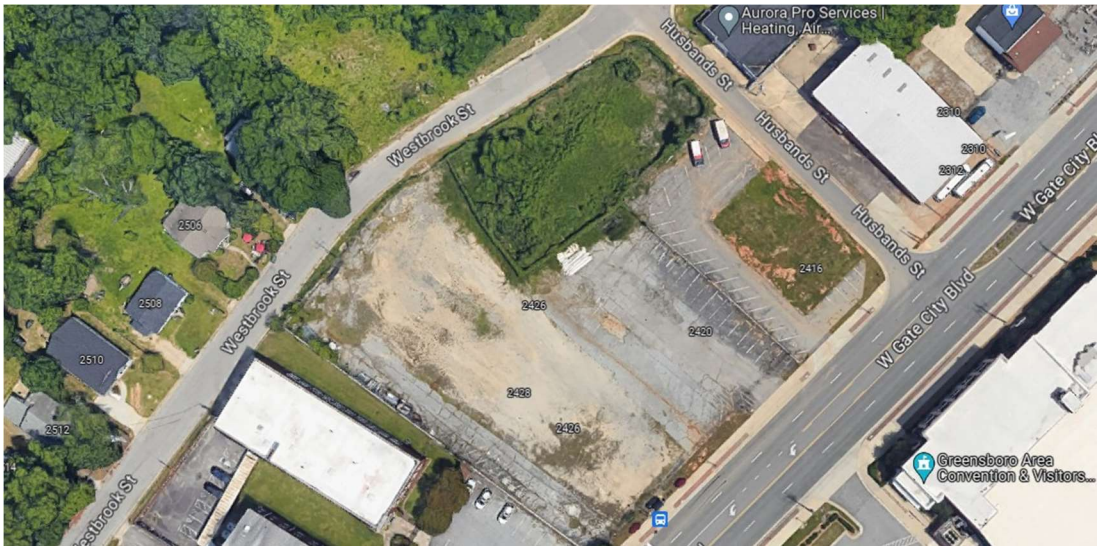
For this research project, I wanted to look at a few parking lots alongside West Gate City Boulevard that would greatly benefit from installing permeable surfaces. I chose West Gate City Boulevard because of several stores, businesses, and empty lots. The residential communities near West Gate City Boulevard tend to be underprivileged, low-income, and people of color. The University of North Carolina at Greensboro is located between the street, and the Greensboro Coliseum sits alongside a nice chunk of the street. A lot on the west side of Gate City Boulevard could significantly improve with permeable surfaces, improving the lives of everyone around the area.

Three parking lots, all scattered across West Gate City Boulevard, were examined for this project. I measured the area of each lot in square feet, so I knew how large each of my lots was. Afterward, I evaluate which permeable material will be the best fit to replace the current material, asphalt. Additionally, I factor in financial cost and maintenance for each area with its location and surroundings. The first area is a parking lot located at the intersection between West Gate City Boulevard and South Elm Street. The smaller portion of the lot is 265.77 Ft by 52.92 Ft, equaling up to 14,064 Ft in total area. The lot has three distinct known addresses. The lot is currently made up of gravel with paved handicapped parking. Vegetation grows alongside the edges of the lot in a sparse amount. Additionally, there is a grass divider between the small and more oversized lot.



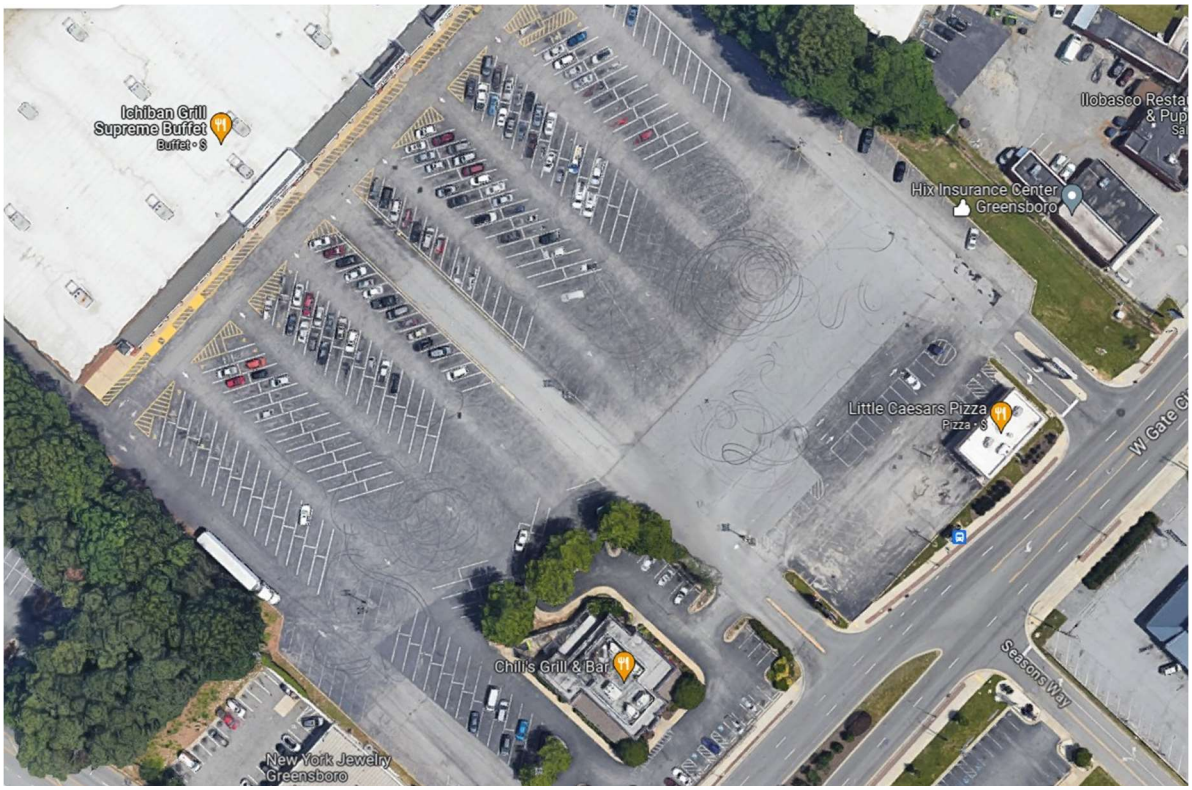
Parking Lot #1

The second parking lot is between West Gate City Boulevard and Husband Street. There are five known addresses, with two in visible parking spaces. With 48 parking spaces, this section is 173.10 Ft. by 179.56 Ft., equaling 31,081.836 ft. The parking lot mainly comprises broken asphalt and heavy vegetation in various block areas.



Parking Lot #2

The third and final parking lot for examination is located by the intersection of West Gate City Boulevard and West Meadowview Road. This area is on the larger side of parking lots, containing multiple retailers and eateries. There is very little vegetation other than what is surrounding the eatery on the left. The lot is 471.55 Ft. x 563.66 Ft., equaling an area total of 265,793.873 Ft. For this examination, we will mostly be looking at the area with the more significant amount of parking spaces, which is 224 to be exact.



Parking Lot #3

Results & Discussion:

When looking at the first lot, the parking section is divided into two halves. The left half measures 64.54 Ft X 173.10 Ft. with the right half measuring 93.96 Ft by 173.10 Ft. With a total measurement of 27,436.35 the permeable surfaces I recommend using a concrete grass grid pattern as a permeable Grass grid is a porous paver allow for the evaporation of rainwater and

the evapotranspiration of grass (Peluso, Persichetti, & Moretti, 2). The design of a grass grid is shaped in the form of a honeycomb. Each singular grid is filled with dirt, gravel, or sand, allowing vegetation to grow through the open honeycomb cells. A grass-permeable surface would work best with this area due to the vegetation growing right next to the empty lot, helping the vegetation continue to grow and supporting natural ecosystems. Aesthetically, it would be cohesive with the nearby vegetation existing with the block, adding more greenery. The total cost for a grass grid permeable surface comes down to the number of parking spaces and materials; the total amount it would cost to install a grass grid permeable surface will be $172,800, with $90,000 on the right and $82,800 on the left—the price accounts for the average parking space size, which is 320 square feet. Maintenance must also be considered to keep the concrete grass grid pattern in good condition.

The best permeable option for parking lot number 2 would be to have a permeable brick pavement. Bricks are a type of permeable stone paver, a more common type due to their aesthetic value. Their aesthetic value can be more commonly found near architectural buildings in downtown areas (Peluso, Persichetti, & Moretti, 2). The location of this parking lot is near one of the intersections that enter commuters into Downtown Greensboro. There, you can find brick walking pavements for pedestrians and several sidewalks incorporating permeable bricks as their design.

Additionally, permeable stones are great for heavy traffic, which would make perfect sense as this parking lot is on the edge of Downtown Greensboro. With the number of parking spaces for this lot, the amount it would cost to install bricks would equal up to $459,000. Compared to the first lot, bricks cost more than the grass grid, making lot number 2 more

expressive. There is also the maintenance of keeping the bricks from getting clogged and the replacement of singular brick stone to be considered when financing this as a potential project.

Lot 3 would work best if the permeable alternative were previously concrete. Pervious concrete is similar to regular pavement but does not include fine-grain materials like sand, making it permeable. This allows for stormwater to soak into the ground. Pervious concrete is also made of stones, allowing tree roots and other microbes to interact. Aesthetically speaking, pervious concrete would easily blend in if only the parking spots were redone in this material if we wanted to be creative. To continue with the concept, if the 224 parking spots for the more significant portion of this block were a section, the total cost would be around $1,075,200 alone. This does not include the parts of the lot that are not parking spaces. In addition to the previous cost, maintenance will need to be considered as pervious concrete needs to be vacuum swept and pressure washed if deeply clogged.

Conclusion:

Based on the calculations made, it is no wonder why cities like Greensboro still need to choose to replace their current surface material with permeable options. Impermeable surfaces are easy to install and require less cost to fix a road, parking lot, or sidewalk. This paper has only scratched the surface of what will come on an even bigger scale. The project only covered three parking lots along West Gate City Boulevard when, in fact, there are at least 40 parking lots on the given street filled with jobs and businesses. More research is required to get a full scope of what we need to focus on. Things like considering which parking lots are in more need of having a permeable makeover. How much heat would these parking lots reduce if the three examples were put into fruition? These are the questions I continue to ask myself, as I do not have all the answers. I hope this project is seen by the people who work for the city and inspires them to use

this project as a starting point example of what can also be much broader. It may be more costly, but the ending results will be gratifying.

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