Investigating + Educating about Sustainable Places in Charlottesville

Sustainability of Place: Barracks/Rugby and Greenbrier

Global Sustainability, Spring 2013
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I. ABSTRACT

In the past decade, a new paradigm has emerged in the dialogue surrounding global sustainability. Instead of emphasizing "going green," recycling, and minimizing carbon footprints, this new movement focuses on connecting human beings to the environment in a different way: through the creation of livable cities and towns that enhance both the quality of life of their inhabitants and the quality of the environment. The purpose of this report is to educate readers on the different elements of this shift in thinking and to introduce them to our project: a semester-long initiative in which we assessed the placemaking ability, livability, and sustainability of two Charlottesville neighborhoods in three steps. First, we reviewed the literature surrounding the urban sustainability movement and derived from it a comprehensive list of benchmarks from which we could measure the placemaking ability, livability, and sustainability of our two neighborhoods. Second, we collected data on a number of site visits and used our observations to assess how successfully our neighborhoods matched up to our predetermined benchmarks. And finally, we drew conclusions about the overall performance of our neighborhoods in order to highlight both areas of success and areas in which there is room for future improvement. The purpose of this project was to provide our community partner with an assessment of the current placemaking ability, livability, and sustainability of our neighborhoods, with the hope that such information will be used to help build a more sustainable future for the city of Charlottesville.

II. INTRODUCTION

Today, much of the vocabulary surrounding environmentalism and sustainability is specific, detached, and almost clinical. We talk, for example, about reducing greenhouse gas emissions, eliminating waste, and reducing storm water runoff (Project for Public Spaces). Ironically, such language effectively "dehumanizes" the relationship between human beings and the environment, and thus "fails to spark peoples' imaginations and get them thinking about how suck improvements will lead them to live a better and more enjoyable life" (Project for Public Spaces). By framing solutions in terms of consumption – for example, encouraging people to buy green products or invest in capital-intensive, pro-green projects – people have taken on the passive role of "consumer" instead of trying to truly connect with the environment and the places in which they live.

To address these issues, a new movement called "placemaking" has taken center stage in discussions surrounding sustainability. Placemaking grew from the understanding that "while the majority of the world's citizens would probably not label themselves as environmentalists, most people do care about having a safe and enjoyable world to live in" (Project for Public Spaces). This new paradigm for sustainable design aims to inspire communities to transform that desire into the creation of better human environments, thus "transforming people's relationship to the environment from abstract to concrete" (Project for Public Spaces). The elements of such "better" human environments vary from place to place, but placemaking is essentially about creating more compact, lively, and environmentally-friendly neighborhoods, streets, and cities that inspire in their inhabitants a sense of place, community pride, and community stewardship – all of which are "essential to creating truly sustainable cities and towns" (Charter of the New Urbanism).

Our community partner, Councilwoman Kathy Galvin, is working with Charlottesville's PLACE Design Task Force, which "acts as an advisory body to the Planning Commission and City Council in matters pertaining to urban design and placemaking," to bring the placemaking movement to Charlottesville. Councilwoman Galvin's role is to help the Task Force "guide the community in making decisions about placemaking, livability, and community engagement" (Charlottesville.org), and our report will provide her with information that can help guide such decision-making processes in ways that improve the sustainability of our Charlottesville neighborhoods.

Above all, placemaking gives people a reason to gather and discuss their visions for the future of their communities, and in doing so it "connects people to the environment by connecting them to each other" (Project for Public Spaces). The goal of our project is to do just that – to jump-start a discussion with our community partner about the ways in which we can not only envision but also start to build a more sustainable future for Charlottesville.

III. OUR NEIGHBORHOODS

Our project focuses on two neighborhoods in Charlottesville: Barracks/Rugby and Greenbrier. **Figure 1** depicts our neighborhoods' locations with respect to the larger city of Charlottesville.

Figure 1: Charlottesville Neighborhoods

Barracks/Rugby

The Barracks/Rugby area of Charlottesville, annexed into the city between 1916 and 1963, is a combination of small neighborhoods located in the north-central part of the city. The majority of the neighborhood consists of owner-occupied, three bedroom, single-family dwellings, with the Barracks area containing many upper income homes on larger lots, the Greenleaf area (adjacent to Greenleaf Park) containing small bungalow homes on smaller lots, and the Rugby Avenue area containing medium-sized, moderately priced homes. Whereas these areas were built in the 1930s and post-World War II lot by lot (most homes in this neighborhood were built in the 1950s), the Kellytown area, formed in 1997, includes a Planned Unit Development. Some parts of the Barracks/Rugby area have therefore been developed under unified standards (Charlottesville.org). These homes should be expected to be more cohesive in design than other homes that were built earlier on. In 2009, the average value of (78.4% of) Barracks/Rugby detached homes was $360,631 (City Data, Charlottesville).

Compared to the greater city of Charlottesville, the Barracks/Rugby neighborhood consists primarily of white, well-educated, married-couple families. In 77% of these families both spouses work, with the plurality of men and women working in education, training, and library occupations (24.5% and 20.3%, respectively). The median household income for Barracks/Rugby is $60,597, which is significantly higher than that for the entire city of Charlottesville ($39,412) (2009) (City Data, Charlottesville).

The main educational, recreational, and shopping facilities in this neighborhood are Walker Upper Elementary School, Crow Recreation Center, Greenleaf Park, and Barracks Road Shopping Center. Major thoroughfares and roads of interest include US Highway 250, Rugby Avenue, Dairy Road, and Barracks Road.

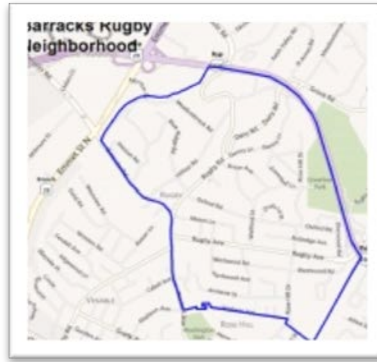**Figure 2** outlines the Barracks/Rugby neighborhood of Charlottesville.

Figure 2: Barracks/Rugby Neighborhood

Greenbrier

The Greenbrier neighborhood of Charlottesville, located in the north part of the city, consists of nearly 650 acres of area that was annexed in the 1960s. Greenbrier consists primarily of ornate, three- to four-bedroom, single-family residential homes on relatively larger lots (as compared to Barracks/Rugby) (Charlottesville.org). In 2009, the average estimated value of Greenbrier homes was $335,206 (City Data, Charlottesville).

Greenbrier residents, like Barracks/Rugby residents, are predominately white, well-educated, married-couple families. However, **Figure 3** compares median household incomes for the Barracks/Rugby and Greenbrier neighborhoods and shows that Greenbrier residents are relatively wealthier than Barracks/Rugby residents. Greenbrier residents are also older, which may explain why the percentage of married-couple families with both spouse working in this neighborhood is slightly lower than the city average (61.1% as compared to 63.6%). Finally, Greenbrier males are most likely to work in management occupations, and Greenbrier females are most likely to work in sales and office occupations (City Data, Charlottesville).
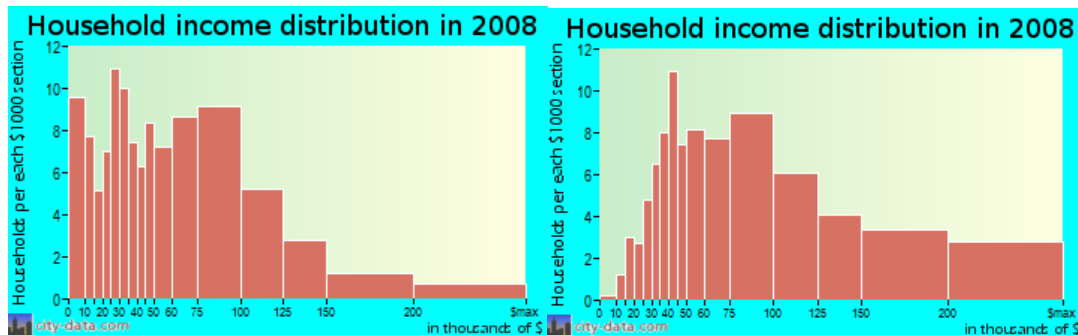

Figure 3: Comparison of Median Household Income Distribution for Barracks/Rugby (on left) and Greenbrier (on right) Neighborhoods

Greenbrier is characterized by an array of prominent educational and cultural facilities, including Greenbrier Elementary School, Charlottesville Elementary School, and the Martin Luther King Jr. Performing Arts Center. The neighborhood is also home to two natural recreation areas, Greenbrier Park and McIntire Park, and the Seminole Square Shopping Center. Major thoroughfares in Greenbrier include Rio Road and US Highway 250.

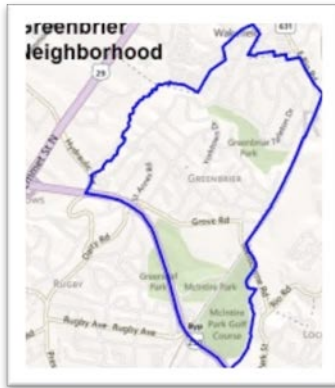**Figure 4** outlines the Greenbrier neighborhood of Charlottesville.

Figure 4: Greenbrier Neighborhood

IV. PROJECT APPROACH

At the beginning of the semester, Councilwoman Galvin expressed to us her need to better understand how the city of Charlottesville is performing in terms of its placemaking ability, livability, and overall sustainability. We decided to break down our project into three phases in order to successfully deliver our findings to Councilwoman Galvin at the end of the semester: Research, Analysis, and Drawing Conclusions.

Our first steps were to perform preliminary research on our neighborhoods and extensively review the literature surrounding the recent shift in sustainability rhetoric, which involved studying placemaking, livability, and New Urbanism. The benefit of Phase One was threefold. First, our research ' serves as an informational tool for our community partners and readers, providing them with an introduction to the literature that surrounds the new sustainable design paradigm on which our project focuses. Second, we used our research to determine what "makes" a place, what makes a city or town "livable," and what makes a neighborhood sustainable, and translated this knowledge into objective criteria and metrics that could be used to guide our assessment of the sustainability of Greenbrier and Barracks/Rugby. Third, our research gave us insight into how best to approach Phase Two. Rather than pursue our original idea of analyzing our neighborhoods by specific location (school, park, etc.), our review of the literature led to our decision to structure our analysis in terms of five overarching "areas of focus" relating to sustainability.

Our five areas of focus are: Density; Neighborhood Layout and Block Size; Transportation, Mobility, & Walkability; Housing & Community Places; and Green Spaces. We chose to visit our neighborhoods and make observations with these overarching themes in mind, so that our assessments would be consistent across team member and between neighborhoods and so that our assessments would be as comprehensive as possible. In Phase Two of our project, we assessed our neighborhoods' performance on a variety of indicators within each area of focus by comparing our observations with the ideal benchmarks adopted from the literature.

The final phase of our project involved interpreting our analyses and drawing conclusions, first about the sustainability of our neighborhoods within each area of focus, and then about the sustainability of our neighborhoods overall. We drew conclusions based on the number of criteria met by each neighborhood and, when applicable, positive results on different metrics and indicators. We then synthesized our results and highlighted areas of success as well as areas in which there is room for improvement, so that Councilwoman Galvin and the PLACE Design Task Force can learn from both the neighborhoods' strengths and weaknesses. We have shared our findings in a final poster, this report, and a final presentation with the hope that our findings will inform decision-making in ways that will positively influence Charlottesville's sustainability performance in the future.

V. LITERATURE REVIEW

Today, we are witnessing a great shift in thinking about sustainability: more and more people are beginning to believe that "environmentalism can perhaps best accomplish its goals for humans to impact *less* by leading the conversation on how to impact *more*" (Project for Public Spaces). The focus is now on what people can do to create the places and communities they want to live, work, and play in – in other words, what they can do to effectively build the world they hope to see in the future. **Figure 5** shows the ways in which the Green Movement is evolving.

The Natural Evolution of the Green Movement

Current Environmental Agenda	Next Environmental Agenda
Minimize impact	→ Maximize quality of life & of environment
Enlightened Consumers	→ Engaged Citizens
Sustainability: Sustain life	→ Creativity: Enhance life
Design repairs the environment	→ Design serves ecosystems & communities
Celebrate nature as objects	→ Celebrate nature as something of which we are a part
Technical solutions for existing systems	→ Develop new creative systems for broader solutions
Emphasis on cost-benefits & efficiency	→ Emphasis on resilience & natural abundance
Ecological Capital	→ Place Capital

Figure 5: The Natural Evolution of the Green Movement

The first phase of our project involved reviewing the literature surrounding this evolution, namely placemaking and its related subjects, in order to understand how to approach and perform our neighborhood analysis.

What Makes a Place Successful?

At the heart of this evolution is the notion of placemaking, which is "a multi-faceted approach to the planning, design and management of public spaces" (Project for Public Spaces). We introduced this concept earlier in this report. But what, exactly, "makes" a place successful and sustainable?

According to The Project for Public Spaces, an organization that has evaluated thousands of public spaces around the world, successful places have four main qualities that can be supported by intuitive, intangible criteria, which can be supported in turn by quantifiable metrics. **Figure 6** depicts this conceptualization, which the key attributes in orange, the intangible criteria in green, and the quantifiable measurements in blue.

Figure 6: What Makes A Place Successful?

The first key attribute of successful places is that they are **accessible**. Accessibility of a place can be judged "by its connections to its surroundings, both visual and physical": they are easy to get to and through via a variety of transportation options, and are visible from a distance and up close (Smart Mobility). The second key quality is comfort and image. In order to be successful, places must be **comfortable** and **have a good image**. Comfortability includes perceptions about safety, cleanliness, and the availability of places to sit, and image can include both intangibles (does the place make a good impression?) and tangibles (are there many photo opportunities available?). The third key quality of successful places is their use. Because people go to places in order to do something, **activities** are the basic building blocks of a place. The more activities going on and the more inclusive they are, the better. The final key quality is **sociability**. Places that provide opportunities for social interaction and cohesion are more likely to encourage a stronger sense of place and promote people's attachment to their communities – two elements that are key to the placemaking movement (Project for Public Spaces).

What Makes a City "Livable"?

Placemaking strives to transform cities and towns into "livable" cities and towns. Livable cities are "urban systems that [contribute] to the physical, social, and mental well being and personal development of [their] inhabitants" (CSCD). They emphasize the need for both sustainable environments and sustainable livelihoods, combining efforts to improve both the physical and non-physical in order to improve the overall quality of life of their inhabitants. Again, the question is: what makes a city or town "livable"?

The Partnership for Sustainable Communities outlines five livability principles that should be present in all livable cities and towns. First, livable cities must **provide more transportation choices**. They must develop safe, reliable, and cost-effective transportation choices and promote walking, bicycling, and public transit in order to decrease household transportation costs, reduce the nation's dependence on foreign oil and vulnerability to the economics of oil price, improve air quality, reduce greenhouse gas emissions, and promote public health. Central to this principle are the notions of accessibility and mobility: transportation must be easily accessible to all users in order to increase and promote their mobility. Second, livable cities must **promote equitable, affordable housing options**. They must "expand location- and energy-efficient housing choices for people of all ages, incomes, races, and ethnicities" in order to lower the combined cost of housing and transportation and ensure a racial, ethnic, and socio-economic mix (PSC). Third, livable cities **enhance the economic competitiveness of community members** "through reliable and timely access to employment centers, educational opportunities, services and other basic needs" (PSC). They also promote cost-effective transportation and service systems in order to boost local economies. Fourth, livable cities **support existing communities and environments** by promoting transit- and pedestrian-oriented, mixed-use development and efficient land and resource use. And finally, livable cities **value communities and neighborhoods**; that is, they "enhance the unique characteristics of communities by investing in healthy, safe, [beautiful] and walkable neighborhoods" (PSC). They also value the participation, socialization, and knowledge of all community members. Livable cities, therefore, are also by definition "sustainable cities": they attempt not only to enhance the quality of life of current inhabitants but also that of future generations.

Urban Form: Moving from Drivable Suburban to Walkable Urban

Urban form refers to the physical layout and design of cities. **Figure 7** provides a visual interpretation of urban form and how it can vary by location and by scale (individual building, street, urban block, neighborhood, and overall city).

Figure 7: Urban Form

There are five elements of urban form, each of which has significant impact on the livability and sustainability of neighborhoods and cities: density, transportation infrastructure, housing/building type, land use, and layout (Dimensions of the Sustainable City).

Density is both an objective, spatially-based measure and a subjective social interpretation: it is used as a measure of the number of people (or buildings) in a given area, and is also "closely linked with the configuration of the social environment and interaction within residential neighborhoods" (Dimensions of the Sustainable City). Livable, sustainable cities are **compact**: high densities encourage walking, cycling, and efficient public transport as well as social interaction and accessibility. **Transportation infrastructure** refers to not only the range of transportation options available to community members but also the transportation systems themselves. Sustainable transportation systems are reliable, safe, cost-effective, and accessible to all users in the community. They promote both the economic vitality of the city and its environmental sustainability. Above all, transportation infrastructure should be **multi-modal** and encourage walking, bicycling, and use of public transit. **Housing** should be affordable and equitable, with a variety of options available to citizens. Housings and buildings should be compact and **location efficient (Figure 8)**. Location efficiency refers to the idea that "locating housing near employment, schools, and commercial amenities in transit-rich and pedestrian-friendly environments shifts people's travel behaviors toward less energy-intensive and more healthful transportation options such as public transit, walking, or biking" (U.S. Department of Housing and Urban Development). Homes and buildings should also be energy- and water-efficient to reduce their impact on the environment. **Land use** can be divided into single-use and **mixed-use development**. Single-use development is development that is primarily residential, with commercial and recreational facilities isolated in separate parts of the city. Mixed-use development refers to neighborhoods that integrate diverse building and service types together, so that retail and commercial areas are combined with residential areas instead of being separated **(Figure 9)**. Livable and sustainable cities are characterized by mixed-use development as well as efficient land and resource use. **Layout** is a key component of urban form in cities. Connectivity and accessibility are main characteristics of sustainable cities. Therefore, streets should lie in an **interconnected** pattern that maximizes the number of alternative routes available to street and sidewalk users. **Figure 10** shows how uniform, connected grid layouts shorten travel distances and improve connectivity when compared with non-uniform, disconnected random layouts.
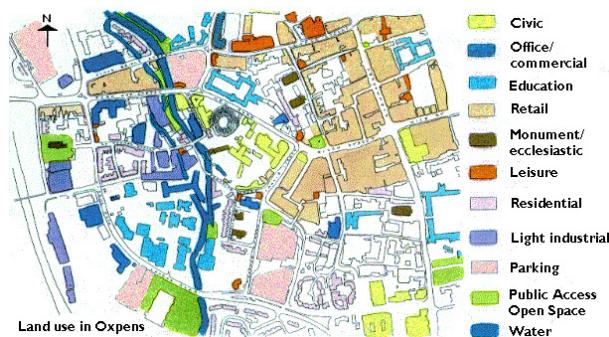
Figure 8: High vs. Minimum Location Efficiency

Figure 9: Example of Mixed-Use Development

Figure 10: Non-Uniform, Disconnected Layout vs. Uniform, Connected Layout

Taking into consideration these elements of urban form, one can distinguish between "drivable suburban" and "walkable urban" neighborhoods (Nation's Capital: Model for Walkable Urban Places). Over the past fifty years, cities and towns have been dominated by the automobile, evidenced by the existence low-density, single-use development neighborhoods with wide streets. These "drivable suburban" neighborhoods distort the relationship between human beings and the environment and act as an obstacle to livability and sustainability. Instead, towns should strive to become "walkable urban": integrated, mixed-use, and high-density locales with multi-modal transportation systems and walkable, pedestrian-oriented environments.

New Urbanism and Our Evaluation Criteria

The literature summarized above can be grouped under the single heading of "New Urbanism." New Urbanism emerged in the late 1980s and early 1990s as a new approach to urban sustainability, with an emphasis on designing walkable, safe, and environmentally friendly neighborhoods, towns, and cities (CNU). The chart in **Table 1** lists New Urbanism principles outlined by the Congress for New Urbanism. Adherence to these principles leads to the creation of sustainable and livable urban centers and towns (CNU).

Table 1: New Urbanism Principles, By Level of Urban Form

The region: Metropolis, city, and town:	The neighborhood, the district, and the corridor:	The block, the street, and the building:
1) Metropolitan regions are finite places with geographic boundaries derived from topography, watersheds, coastlines, farmlands, regional parks, and river basins. The metropolis is made of multiple centers that are cities, towns, and villages, each with its own identifiable center and edges.	**10)** The neighborhood, the district, and the corridor are the essential elements of development and redevelopment in the metropolis. They form identifiable areas that encourage citizens to take responsibility for their maintenance and evolution.	**19)** A primary task of all urban architecture and landscape design is the physical definition of streets and public spaces as places of shared use.
2) The metropolitan region is a fundamental economic unit of the contemporary world. Governmental cooperation, public policy, physical planning, and economic strategies must reflect this new reality.	**11)** Neighborhoods should be compact, pedestrian friendly, and mixed-use. Districts generally emphasize a special single use, and should follow the principles of neighborhood design when possible. Corridors are regional connectors of neighborhoods and districts; they range from boulevards and rail lines to rivers and parkways.	**20)** Individual architectural projects should be seamlessly linked to their surroundings. This issue transcends style.
3) The metropolis has a necessary and fragile relationship to its agrarian hinterland and natural landscapes. The relationship is environmental, economic, and cultural. Farmland and nature are as important to the metropolis as the garden is to the house.	**12)** Many activities of daily living should occur within walking distance, allowing independence to those who do not drive, especially the elderly and the young. Interconnected networks of streets should be designed to encourage walking, reduce the number and length of automobile trips, and conserve energy.	**21)** The revitalization of urban places depends on safety and security. The design of streets and buildings should reinforce safe environments, but not at the expense of accessibility and openness.
4) Development patterns should not blur or eradicate the edges of the metropolis. Infill development within existing urban areas conserves environmental resources, economic investment,	**13)** Within neighborhoods, a broad range of housing types and price levels can bring people of	**22)** In the contemporary metropolis, development must adequately accommodate automobiles. It should do so in ways that respect the pedestrian and the form of public space.

23) Streets and squares should be safe, comfort- able, and interesting to the pedestrian. Properly configured, they encourage walking and enable neighbors to know each other and protect their communities.

24) Architecture and landscape |

and social fabric, while reclaiming marginal and abandoned areas. Metropolitan regions should develop strategies to encourage such infill development over peripheral expansion.

5) Where appropriate, new development contiguous to urban boundaries should be organized as neighborhoods and districts, and be integrated with the existing urban pattern. Noncontiguous development should be organized as towns and villages with their own urban edges, and planned for a jobs/housing balance, not as bedroom suburbs.

6) The development and redevelopment of towns and cities should respect historical patterns, precedents, and boundaries.

7) Cities and towns should bring into proximity a broad spectrum of public and private uses to support a regional economy that benefits people of all incomes. Affordable housing should be distributed throughout the region to match job opportunities and to avoid concentrations of poverty.

8) The physical organization of the region should be supported by a framework of transportation alternatives. Transit, pedestrian, and bicycle systems should maximize access and mobility throughout the region while reducing dependence upon the automobile.

9) Revenues and resources can be shared more cooperatively among the municipalities and centers within regions to avoid destructive competition for tax base and to promote rational

diverse ages, races, and incomes into daily interaction, strengthening the personal and civic bonds essential to an authentic community.

14) Transit corridors, when properly planned and coordinated, can help organize metropolitan structure and revitalize urban centers. In contrast, highway corridors should not displace investment from existing centers.

15) Appropriate building densities and land uses should be within walking distance of transit stops, permitting public transit to become a viable alternative to the automobile.

16) Concentrations of civic, institutional, and commercial activity should be embedded in neighborhoods and districts, not isolated in remote, single-use complexes. Schools should be sized and located to enable children to walk or bicycle to them.

17) The economic health and harmonious evolution of neighborhoods, districts, and corridors can be improved through graphic urban design codes that serve as predictable guides for change.

18) A range of parks, from tot-lots and village greens to ballfields and community gardens, should be distributed within neighborhoods. Conservation areas and open lands should be used to define and connect different neighbor- hoods and districts.

design should grow from local climate, topography, history, and building practice.

25) Civic buildings and public gathering places require important sites to reinforce community identity and the culture of democracy. They deserve distinctive form, because their role is different from that of other buildings and places that constitute the fabric of the city.

26) All buildings should provide their inhabitants with a clear sense of location, weather and time. Natural methods of heating and cooling can be more resource-efficient than mechanical systems.

27) Preservation and renewal of historic buildings, districts, and landscapes affirm the continuity and evolution of urban society.

coordination of transportation,
recreation, public services,
housing, and community
institutions.

VI. ANALYSIS

The second phase of our project involved analyzing how Greenbrier and Barracks/Rugby performed when compared to the criteria we established after synthesizing all of the information we gathered in our literature review. These criteria and analyses are listed below, organized according to the area of focus to which they relate.

A. DENSITY

One of the most critical parts of measuring an area's sustainability is carefully measuring its density. Density is the structural landscape built in the particular neighborhood or city. An increased area of high density structure usually indicates a higher level of sustainability due to the emergence of walkability, less dependence on automobiles and energy, mixed-use development, and cultural diversity. Additionally, a higher quality of life is provided to those who live in a high density municipality. Experts suggest that density "allows for beautiful public spaces, for lots of people walking, low car use, and makes life convenient and enjoyable by providing many amenities within close proximity of each other" (*Density*). Thus, in order to create a more sustainable community, a high level of density should be anticipated in order to provide a more thriving area that promotes non-automobile transportation methods, convenience, and diversity.

"By strategically increasing the number of dwelling units per acre," Brent Toderian and Mark Holland note in their article "The Case for Density", "cities not only will go a long way toward meeting their sustainability objectives, but also will be competitive, resilient, and great places to live" (Toderian). Much of America lives in the aftermath of sprawl, which are low density areas that are commonly masked in suburbia. Currently, the national average for dwelling count per acre for a low density area is 4-5 units per acre (DeGrove). Based on our observations, Charlottesville's Greenbrier and Rugby/Barracks Road areas currently average about 3-4 units per acre, which is very close to the national average. Many zoning conditions for particular neighborhoods forbid density from increasing above this 4-5 unit per acre condition, but with an increased desire for sustainable living places, it is hoped that dwelling counts per acre could increase up to 15-20 units per acre (*Density*).

Increasing density levels by 300-400% will not come without conflict. Many homeowners prefer living in a low-density environment so that their family may have space of their own that is only for their residence. However, quality of life could absolutely increase with the amenities that high-density spaces provide, as environmentalists strongly suggest that "density that is well designed and assembled makes transit and retail more viable, supports more schools and services close to homes, and supports the clustering of development so as to better preserve natural areas. Higher densities make walkability possible and great design makes it enjoyable" (Toderian).

To evaluate whether or not the density in Barracks/Rugby and Greenbrier contributes to their livability and sustainability, we looked at the criteria in Table 2.

Table 2: Density Criteria

Neighborhood design is compact, with block sizes small enough to promote walkability and connectivity. . Compact urban form (approximately one mile diameter) allows for a walkable, pedestrian-oriented environment with walking distances of five to ten minutes. . The neighborhood is limited in physical size with well-defined edges and a center. . Design reduces dependence on the automobile and promotes walking, bicycling, and the use of public transit.

. Compact development increases residential densities.

Neighborhoods have clearly defined boundaries.
• Edges and corridors are visible, clearly defined, and incorporate natural features such as bordering natural areas, open space, or parks.
• Clearly defined boundaries reduce the potential for urban sprawl and preserve open space from further development.

Homes in the Barracks/Rugby neighborhood are sprawled about and appear to have substantial yards for each residence. There is often ample room for a driveway, garage, multiple cars, and yard space in the front and back of the homes. Additionally, the homes rarely interact, as fences or lines of natural intervention (i.e. bushes) are built to separate property lines. The areas are often heavily shaded with large trees. These trees or plant life are not condensed to one significant area, but are often scattered about the properties. Based on estimates made by our team, an average of three houses per acre has been measured in the residential areas of Barracks/Rugby neighborhoods. This is slightly less dense than the national average and the criteria set forth to qualify as a "low density" neighborhood.

The Greenbrier neighborhoods are very similar to their Barracks/Rugby counterparts. Though slightly more dense at about 4 units per acre, the area compares almost exactly to the national average. Greenbrier has mostly single family homes, with small yards and driveways. Fences and bushes are also utilized in this area to separate property lines and provide distinct plots of land for each individual dwelling.

Both of these neighborhoods fall into the "low density" criteria based on national averages. Defenders of this type of low-density living are pro-dispersal, and claim that "low densities can be sustainable and that the quality of life within them is much higher in comparison with contained high density developments" (*Density*). However, a slight increase in density could create incredible strides in sustainability for any particular neighborhood. By converting to a compact form that is more walkable and less dependent on automobile use, not only will quality of life increase (with the introduction of physical activity through a walkable commute), but energy use and gas consumption will decrease. Additionally by allowing these neighborhoods to be more compact, clearly defined boundaries will emerge that indicate the end of a particular neighborhood or city and will introduce a simpler city grid to understand.
Increasing the density of these areas could promote a better quality of life overall. Even switching from single family homes to townhomes with communal yards and green space could increase density by 200-400% and create a much more sustainable community. By switching to apartment complexes, this density could increase by up to 1000%. See **Figure 11.**
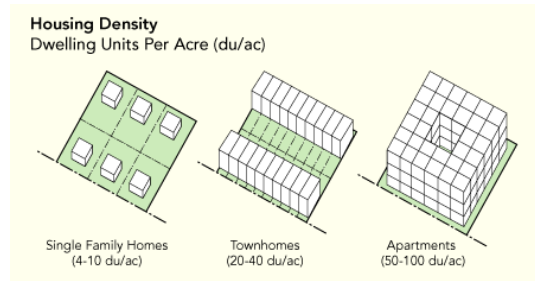

Figure 11: Building Healthy Communities 101

Environmentalists state that to even begin creating more dense neighborhoods, we must increase the density of the neighborhoods we have to at least 15-20 du/ac (dwellings per acre) (*Density*). In order to do

this, suburbia will drastically transform into a less sprawled area with individual lawns and fences into denser, communal areas. **Figures 12-15** are examples of high-density communities across America, and display what communities of particular du/ac look like, and how they may be implemented into the Barracks/Rugby and Greenbrier areas.

Figure 12: This is an example of a community that boasts a 20 du/ac density. Homes are closer together, often connected, but green space still exists prominently and individual family homes still exist. (Building Healthy Communities 101: What Does Density Look Like in my Neighborhood?)

Figure 13: Another example of a community with a 20 du/ac density shows each individual family dwelling with yard space and driveways. (Building Healthy Communities 101 What Does Density Look Like in my Neighborhood?)

Figure 14: This community has a density of 40 du/ac. Though homes are closer together, a mixed use zoning code is implemented to allow for many amenities within walking distance. Additionally, a highly modern design is introduced to provide a higher aesthetic quality within a community living space. (Building Healthy Communities 101 What Does Density Look Like in my Neighborhood?)

Figure 15: This community houses 80 du/ac and is a high density living area. Though the units are incredibly close together, they are within close walking distance to other neighbors and amenities and still allows for green space and community space to exist. (Building Healthy Communities 101 What does density look like in my neighborhood?)

Major cities often have density levels that far exceed the density levels displayed above. The following figures display the density levels, plan views, and street layouts, of particular high-density American cities.

Figure 16: These cities all have du/ac levels that exceed 100 (Campoli).
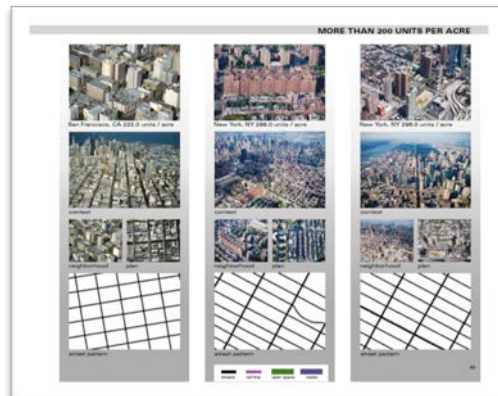

Figure 16: These cities, America's densest, all have above 200 du/ac (Campoli).

Future design plans in Charlottesville should focus on creating more densely compacted development complexes and neighborhoods.

B. Neighborhood Layout & Block Size

Neighborhood layout is another critical part of the sustainability of a particular neighborhood or area. When analyzing the neighborhood, one of the first criteria an analyst would notice is the physical layout of the built environment. The layout of a neighborhood can drastically affect the sustainability of the area in both a positive and negative light.

Environmentalists suggest some of the effects of neighborhood layout on sustainable communities include:

· Levels of tranquility, safety, and security
· Connectivity
· Traffic control
· Impact to environment through land use (up to 35% of space in a neighborhood)
· Addition of impermeable surface
· Addition of urban heat affect which requires energy for cooling
· Impact on water quality
· Can aid or impede on pedestrian traffic and bike traffic (The Fused Grid)

A high number of wide, overbearing streets that connect at confusing intersections impede on connectivity, walkability, the ability to bike, and tend to promote bottlenecks and traffic congestion. Unfortunately, curved, windy roads with cul-de-sacs and unpredictable intersections tend to be included in the model for the typical suburban neighborhood layout, as they are anticipated to provide privacy, tranquility, and safety. In order to create a more sustainable model, a pattern that incorporates mixed use zoning, promotes walkability, lessens environmental impacts, prevents congestion, and all the while promotes tranquility and safety must be created (The Fused Grid).

One of the more famous suggestions for this model is called the Fused Grid. This model implements mixed-use areas, alongside housing, parks, and walkable or drivable roads. It implements uniform block sizes so that intersections are predictable and a grid is utilized to create an easy to understand layout for pedestrians and bikers looking for particular destinations. Communal green space is provided so that houses may be more condensed and the community can fit more dwellings per acre, increasing density. Additionally, the street patterns have been proven to decrease traffic accidents as they implement T-intersections, which is known to be a safer alternative for a neighborhood layout (The Fused Grid).

Figure 17 demonstrates the Fused Grid Street Pattern Model. It incorporates high density along with mixed-use zoning to allow walkability and decreased automobile use.
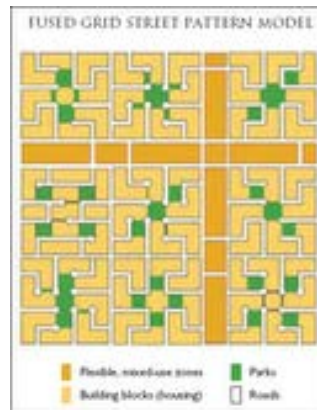
Figure 18: Another View of the Fused Grid Model

This is one example of a grid system that successfully implements a grid system that incorporates walkability, bike paths, mixed-use zoning, traffic decongestion, and safety. This model has been incorporated into many communities in Canada quite seamlessly, and would be a good alternative to the sprawled nature of the Greenbrier and Barracks/Rugby communities in Charlottesville.

To evaluate whether or not the layouts and block sizes in Barracks/Rugby and Greenbrier contribute to their livability and sustainability, we looked at the criteria in **Table 3**.

Table 3: Neighborhood Layout & Block Size Criteria

Street layout is based on a modified grid system.
- Streets are laid out on a modified grid system and evenly disperse local traffic throughout the neighborhood, slows traffic, and provides pedestrians with links to all uses and destinations.
- Grid layout is (fairly) uniform throughout the neighborhood.
- Street layout promotes public transit and reflects appropriate road widths and turning radii for transit vehicles.
- Streets are designed to calm traffic and efforts are being made to "rightsize" streets.
- Grid system respects the natural landscape and conserved lands.
- Layout reduces the need for large surface parking lots by providing space for on-street parking.
- Block size is uniform and small enough to promote walkability and high density.

Neighborhoods are designed to maximize connectivity.
- Streets are interconnected so as to reduce the number and length of automobile trips, promote walking and biking, and maximize the number of alternative routes available to users.
- Street layout connects all mixed uses in the neighborhood.
- There are several high frequency, four-way, safe and walkable intersections.

The Barracks/Rugby neighborhoods utilize a spontaneous road system that does not uniformly fit to a predictable grid system. However, the streets are somewhat safe and tranquil and allow for pedestrian traffic throughout the individual neighborhoods. Unfortunately, mixed-use zoning is hardly implemented, so walkability is restricted to neighboring homes. Throughout the neighborhoods, green space is highly respected and utilized in the individual residential properties and along roads and walkways. However, in the commercial parts of Barracks, green space is not utilized. Walkability is severely restricted due to high

traffic and unpredictable intersections. Block size is not uniform and the business space is sprawled, making walkability more difficult.

Greenbrier's neighborhood is smaller and quainter, and does not have the commercial aspect that Barracks/Rugby has. It is a mostly residential neighborhood with schools and parks. However, Greenbrier's residential areas compare closely with the Barracks/Rugby residential spaces in terms of the characteristics of the neighborhoods. The streets do not follow a uniform block size or grid, and are often windy and curved. Intersections are unpredictable, but walkability is promoted in the neighborhoods by utilizing sidewalks, green space, and pedestrian crosswalks. Walkability is again restricted to neighboring homes, as mixed-use zoning is not implemented. Schools and parks are accessible to the homes that directly neighbor it, but are often hard to find for those living outside of the neighborhood.

By setting forth a set of criteria that will be influential in correcting the neighborhood layouts of the current Barracks/Rugby and Greenbrier neighborhoods, we can effectively move forward in making these more sustainable communities. A checklist for appropriate measures to better these neighborhoods is as follows:

Planning Checklist: Neighbourhood Design and Street Layout

1. Encourage walking, cycling and public transport use (where applicable) through permeable, well-connected, 'traditional' grid street networks.

2. Avoid circuitous, 'suburban', cul-de-sac street networks with few access points and lengthy routes to nearby locations.
3. In new developments, provide safe and high-quality walking and cycling environments throughout. In existing developments, consider retrofitting footpaths and adding cycle lanes to improve the travel experience of walkers and cyclists. Sustainable modes can be given priority in terms of journey length and time (sometimes known as 'filtered permeability').
4. Ensure integration between new development and adjacent built-up areas in terms of street network, public transport services, footpaths/cycle routes and design standards.
(*Neighborhood Design and Street Layout*)

By ensuring that these criteria are met within these neighborhoods, Charlottesville will be able to create more sustainable neighborhoods in the Greenbrier and Barracks/Rugby communities that will allow for a more thriving physical community as well as a better quality of life for the residents living within it.

C. Transportation, Mobility, & Walkability

Transportation systems have direct and significant impacts on the daily lives of all U.S. citizens. However, America's transportation system faces several challenges today that "threaten to undermine the economic, social, end environmental future of our cities" (Smart Mobility). In the Charlottesville context, most of these transportation concerns arise from the fact that suburban communities like Greenbrier and Barracks/Rugby are dependent on the automobile. Automobile ownership and use has grown and continues to grow worldwide, especially in urban areas, due to the association between car usage and a variety of advantages such as "comfort, status, speed, and convenience" (Rodrigue). Especially in areas of suburban sprawl, "most individuals will prefer using an automobile when given the choice" (Rodrigue). While the benefits of widespread car usage are clear, the disadvantages are not. However, these disadvantages have serious impacts on individuals, communities as a whole, and the environment, and range from broad issues (environmental impact, energy consumption, and contribution to climate change) to practical issues (traffic congestion, longer commute times, parking difficulties, and accidents and safety issues).

The transportation challenges facing cities like Charlottesville may vary, but they all boil down to one alarming fact: current trends in transportation are not sustainable. Fortunately, several ideas have emerged in recent years that promote the design of sustainable transportation systems – from sidewalks to streets to public transit and everything in between – that enhance the livability of the communities and the quality of the environments in which they operate.

Smart Mobility, for example, is a new ideology that promotes the movement of people and freight "while enhancing cities' economic, environmental and human resources" (Smart Mobility). The Smart Mobility movement arose as a response to congestion and emphasizes convenient and safe multi-modal travel, speed suitability, accessibility, and efficient land use. Livable and sustainable neighborhoods that comply with Smart Mobility principles provide citizens with a variety of transportation options and facilities that are reliable, safe, clean, attractive, convenient, efficient, cost-effective, and accessible. Benefits of a Smart Mobility multi-modal transportation system that encourages walking, bicycling, and the use of public transit include reduced automobile dependency and congestion; reduced number of car accidents and therefore better public health; reduced rates of obesity and diabetes and their related diseases; reduced dependence on foreign oil and vulnerability to the economics of oil price; and reduced carbon emissions and impact of climate change. In addition, multi-modal systems are more economical for households.

Although these benefits are real and it may seem obvious that "the less people drive, the less oil they consume and the less pollution they emit" and "therefore the more resilient their communities will be," the transition from an automobile-oriented society to one that embraces multi-modal, environmentally friendly transportation options is not easy (Parapari). To evaluate whether or not the transportation options in Barracks/Rugby and Greenbrier contribute to their livability and sustainability, we looked at the criteria in **Table 4**.

Table 4: Transportation, Mobility, & Walkability Criteria

Neighborhoods provide a range of transportation options that increase their mobility and reduce their dependence on the automobile.
- Emphasis on multi-modal options serves to manage, reduce, and avoid congestion.
- Walk, bike, and transit options allow people to choose reliable travel modes and opt out of congestion.
- The transportation system provides mobility for people who are economically, socially, or physically disadvantaged in order to support their full participation in society.
- Walk, bike, and transit trips are available, affordable, and competitive with driving.

Streets are the preeminent form of public space in the neighborhood and are designed to promote a pedestrian-oriented environment.
- Alignment, scale, and character of thoroughfares promotes a pedestrian-oriented, walkable environment and discourages car usage.
- Streets are well maintained, clean, well-lit, and lined with trees whenever possible.
- Streets have a good image and sense of place.
- Streets are connected to a wide range of destinations and amenities and are linked to public transportation options.
- Streets have active edge uses.
  - o Building bases should be human-scaled, sidewalk activity should be welcomed, and the edge connection should be visual and active year-round.
  - o Diverse uses along a street can create activity and a sense of security.
- Thoroughfares are narrow, not wide, to slow traffic speeds and protect pedestrians and calm traffic.
- Streets are easy to get to and through and are visible both from far away and up close.
- Discontinuous streets (loops, cul-de-sacs) are limited because they make it difficult or impossible for buses to travel through neighborhoods.
- Streets have necessary turning radii, width, and pavement depths to provide bus service.
- The disruption of views and visual pollution created by utility lines and equipment are minimized.

Neighborhoods are walkable.
- A majority of the homes are within a five-minute walk of the town center and all basic amenities, as well as some office buildings and home-based businesses.
  - o Studies show that people are willing to walk an average of 1320 feet (one-quarter mile, or 5 to 10 minutes) to destinations. Therefore neighborhoods should be designed to make every effort to make most destinations within that threshold distance.
  - o The pedestrian "shed" is approximately one-quarter of a mile.
- A safe, clean system of sidewalks and crosswalks connects all uses and is designed for convenience of the pedestrian.
- Landscape, street furniture, and on-street parking create a buffer between pedestrians and moving vehicles.
- Sidewalks are wide enough to accommodate pedestrians.
- Sidewalks are clearly identifiable and illuminated.
- Most sidewalks are predominately continuous.
- Street crossings are safe, easy to use, and well-marked.
- White markings, signage, and lighting make pedestrian crossings visible to moving vehicles day and night.
- Pedestrian crossings are designed to create the shorting possible crossing distance on wide streets. Devices that decrease crossing distances include mid-street crossing islands or curb extensions/bump outs.

Neighborhoods provide access to a sustainable public transit system.
- Public transit systems are predictable, reliable, and clean, with service available every day.
- Public transit systems are both actually and perceived to be safe.
- Management acts to reduce the transportation system's emission of greenhouse gases that contribute to climate change.
- A sufficient amount of people live or work close to a transit stop: within a five to ten minute walk (measured by time) or within a ¼ to (at max) a ½ mile walk (measured by distance).
  - o Densities of 12-20 single-family homes or two-story townhouses per acre are generally

required to support bus service.
- Transit stops are located closest to highest density development, with densities gradually declining with distance from the stops.
- Transit system provides access to hospitals, employment centers, shopping facilities, schools, core areas, and other popular and appropriate destinations.
- Transit stops are well maintained, clean, safe, and well-lit.
- Transit users are made comfortable by provision of comfortable waiting and seating areas and protection from inclement weather.
- Transit stops are visible and integrated within neighborhoods and centers rather than located at the edge of activity centers.
- Transit is accessible to the elderly, the young, and those with disabilities, and benefits and burdens are equitably distributed among all users.

Neighborhoods are bikeable.
- Use of bikes as an alternative mode of transportation is encouraged by the existence of an accessible, safe, and convenient system of bike lanes and pathways in the neighborhood.
- Studies show that an ordinary cyclist would be willing to bike roughly 1.33 to 2.66 miles (10-20 minutes) to destinations. Therefore neighborhoods and bike systems should be compact enough to accommodate that threshold.
- Bike routes are linked with all uses of the neighborhood and public transportation systems.
- The bike system is safe and accessible to users of all experience levels.
- Bicycle storage facilities are conveniently located throughout the neighborhood at all transit stops and major centers of activity.
- Local businesses and schools provide bike racks, lockers and showers to encourage employees and students to bike to work or school.

Parking options are designed to minimize visual and environmental pollution.
- Parking is located behind buildings and homes and away from streets and is accessed via laneways.
- The amount of land devoted to parking does not exceed average capacity.
- Parkways are planted with ground cover, low-growing vegetation.
- On-street parking acts as a buffer between pedestrians and cars in residential and commercial areas, but is eliminated adjacent to cross walks.
- Angled or parallel on-street parking is provided wherever possible.
- The width of each driveway is limited.
- Planting and landscaping is used to screen headlights and mitigate the impact of parking visible to the street.
- All parking areas and pedestrian walkways are illuminated.

Automobile Dependency

When analyzing Charlottesville's transportation system, the first thing we considered was automobile dependency. There are several levels of automobile dependency, and among the most relevant indicators are the level of vehicle ownership and the proportion of total commuting trips made using an automobile (Rodrigue). These indicators for Charlottesville can be seen in **Figure 19 and Figure 20**.

Figure 19: Automobile Ownership in Charlottesville

5 or more vehicles: 3%
3 vehicles: 9%
2 vehicles: 29%
1 vehicle: 43%
0 vehicles: 14%

Figure 20: Charlottesville Resident Transportation Usage by Mode

Bicycle: 2%
Public Transit: 6%
Carpool: 10%
Walk: 16%
Worked at Home: 5%

Most households in Charlottesville own between one and two automobiles, and only 14% don't own a car at all (City Data, Charlottesville). Moreover, when given the option of how to get from one place to another, an overwhelming proportion of Charlottesville residents (61%) prefer driving alone over biking, carpooling, walking, or using public transit (City Data, Charlottesville). Indeed, the fact that too many trips occur in motor vehicles occupied by only one driver is the number one issue facing the city, according to the Charlottesville Master Plan Working Committee (Comprehensive Plan). The second is the fact that these motor vehicles operate on non-renewable fuel and emit too much greenhouse gas (Comprehensive Plan).

What is surprising about these figures is that people who consistently decide to drive to nearby destinations are wasting both time and money as compared to those who opt for alternative transportation options. **Figure 21** shows that the average amount of time spent commuting to work for Barracks/Rugby and Greenbrier residents is about fifteen minutes (City Data, Charlottesville). If neighborhoods are designed to be compact enough to promote walkability, connected enough to reduce travel times, and accessible by bicycle and public transit, residents could reduce this travel time by five minutes or more. **Figure 22** shows how residents living in neighborhoods with more mobility options save money by reducing their transportation expenses as opposed to those living in neighborhoods (like Greenbrier and Barracks/Rugby) with designs that encourage automobile dependency (Smart Mobility).
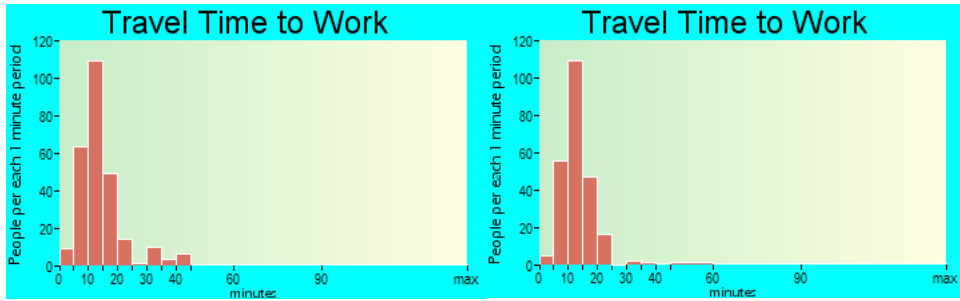
Figure 21: Travel Time to Work for Barracks/Rugby (left) and Greenbrier (right) Residents
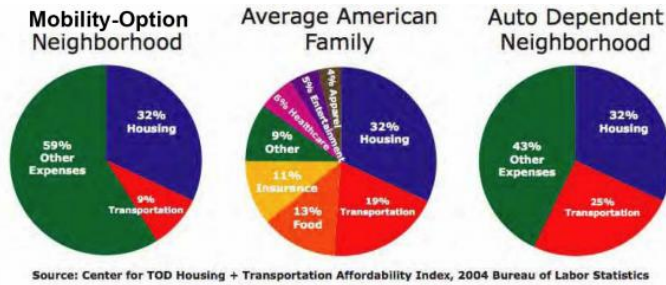

Figure 22: Household Expenses in Mobility Option vs. Auto-Dependent Neighborhoods

Beyond saving residents time and money and reducing environmental impact, moving away from automobile usage also leads to more social interaction and a better quality of life. Charlottesville has committed to trying to reduce automobile usage to 50% of total transportation by 2050 (Charlottesville.org). Key to the success of a transition from automobile-dependent to multi-modal friendly is the availability of a system that promotes connectivity, walkability, bikeability, and public transit usage.
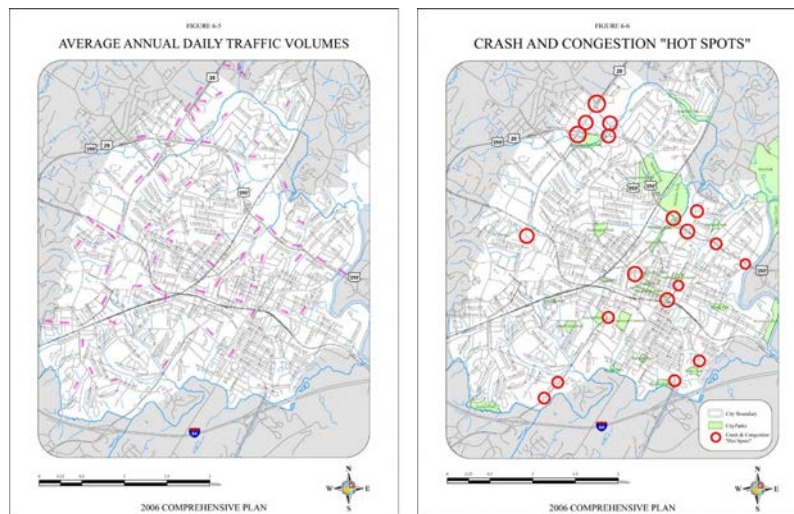
Streets

For Charlottesville, this transition will not be easy because "the majority of the roadway network within the City was designed to accommodate vehicular travel and does not adequately address safety and user comfort for pedestrians, bicyclists or citizens with disabilities" (Comprehensive Plan). Charlottesville's street system is classified into four functional subsystems: principal arterial, minor arterials, collectors and local streets (**Figure 23**) (Comprehensive Plan).

Figure 23: Classification of Charlottesville Streets
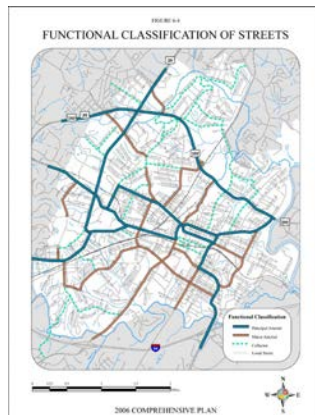
Our neighborhoods consist primarily local streets, which provide residents with direct access to property, and secondarily of collector streets that connect traffic within our neighborhoods with commercial and industrial areas. However, because our neighborhoods include links to US 29, US 250, Emmet Street, and Hydraulic Road and usage on these arterial roadways often exceeds their capacity, residents in Greenbrier and Barracks/Rugby are often exposed to congestion. Congestion on the Bypass, for example, is particularly high, stemming from "the lack of transportation facilities outside of the City connecting housing and employment centers" (Comprehensive Plan). Another example is Barracks Road, which has traffic volumes in excess off 20,000 vehicles per day where it meets 250 (Comprehensive Plan). When congestion on arterial and connector roadways is high, commuters and other drivers often spill over into local streets. This spillover results in increased traffic of vehicles traveling at high speeds, which reduces the safety and seclusion of neighborhood residents. **Figure 24** shows the average daily traffic volumes for the city of Charlottesville alongside congestion (and, linked to congestion, crash) "hot spots" (Comprehensive Plan).

Figure 24: Charlottesville Traffic Volume, Congestion, and Crash Hot Spots

Road development in Charlottesville "is typical for a colonial land system state, with many roads having profiles and alignments that strongly reflect the rolling topography of the area" (Comprehensive Plan). Because local streets reflect the land's topography, the residential streets in Barracks/Rugby and Greenbrier are of various grades, have high levels of curvature, and are not aligned to a street grid. They oftentimes do not connect, "resulting in through streets receiving most of the traffic" (Comprehensive Plan) and limited routes to popular destinations. Discontinuous streets and cul-de-sacs are common, which hinders both connectivity and the ability of public transit to access all parts of the neighborhoods. An improved street network would be aligned on a modified grid system, with high levels of intersections to maximize connectivity.

Another manifestation of the fact that Charlottesville's street system was built to accommodate vehicular travel is road width. In order to be safe, thoroughfares should be narrow enough to require reduced travel speeds and protect pedestrians. However, most roads in Barracks/Rugby and Greenbrier were wide. Fortunately, each neighborhood has alternative safety measures in place to combat the issue of having streets that are too wide. Two examples of these – low speed limits and speed humps – can be seen in **Figure 25**.

Figure 25: Speed Precautions in Greenbrier

The existence of a road system in Greenbrier and Barracks/Rugby that is car- rather than pedestrian-oriented translates to a need to continuously maintain and improve the safe, efficient flow of traffic on the streets. In an effort to do so, the City of Charlottesville has been formally providing traffic calming solutions for residents since 1996 (Charlottesville.org). According to the Town of Christiansburg, Va., "traffic calming is a proactive attempt to improve the livability of residential neighborhoods and promote pedestrian activity that involves various engineering techniques to physically change the characteristics of streets, improve pedestrian safety and encourage drivers to obey speed limits" (Town of Christiansburg). Traffic calming devices are used and integrated into a comprehensive system of improvements to alter the geometry of the street and to slow traffic. Examples, seen in **Figure 26**, include speed humps, curb extensions and narrowings.

Figure 26: Traffic Calming Examples

In addition to calming traffic, streets in the Greenbrier and Barracks/Rugby neighborhoods could be "rightsized." Rightsizing streets is the process of "reconfiguring the layout of streets to better serve the people who use them," or "reallocating a street's space to better serve its full range of users" (Project for Public Spaces). The goal of rightsizing streets is to increase safety and access to all users while also encouraging alternative forms of transportation and creating places that foster community livability. Rightsizing strategies include converting vehicle travel lanes to other uses, narrowing vehicle lanes, adding bike lands, improving pedestrian infrastructure, changing parking configurations, and adding roundabouts

and medians. The most common type of rightsizing converts a two-way, four lane street into a three lane street with a center turning lane (**Figure 27**). Removing one of the lanes frees up space to add or expand pedestrian and bike infrastructure or on-street parking. This type of rightsizing reduces "road diet" and has been shown to reduce car crash risk by 29% (Federal Highway Administration).

Figure 27: Rightsizing A Street
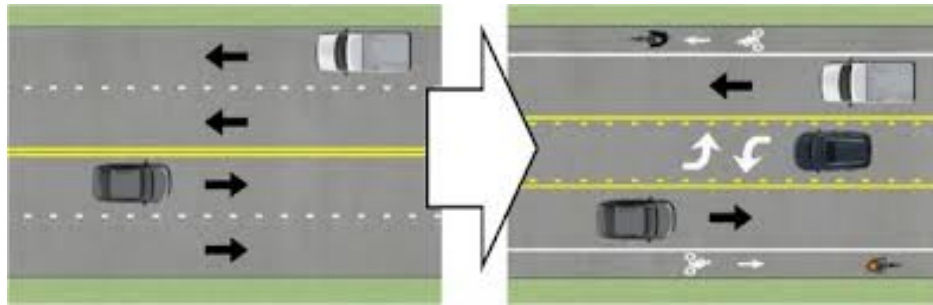
Finally, it is important to note that "while an efficient transportation system is desirable, neighborhoods do not want to lose their character due to transportation improvements" (Comprehensive Plan). Yet at present, most streets in the Greenbrier and Barracks/Rugby neighborhoods are not designed to be places in and of themselves – they are simply ways to get from one place to another (by car). They are well enough maintained to not have noticeable cracks, but potholes were visible in both neighborhoods. Residential streets are typically lined with cars and little is done to minimize the visual pollution of power lines and utilities. However, steps are being made to improve the quality of Charlottesville's streets: in 2010, the city adopted a model Complete Streets policy. Complete streets are "designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities" (American Society of Landscape Architects). They are designed to make crossing the street, walking to shops, and biking to work easy and convenient, and they allow buses to run on time. Complete streets may include sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable and accessible public transit stops, frequent and safe crossing opportunities, median islands, accessible pedestrian signals, curb extensions, and narrower travel lanes. Most importantly, complete streets are designed to be enjoyable places in and of themselves, with active edge uses and street furniture. **Figure 28** provides an example of a complete street.

Figure 28: A Complete Street

Public Transit

Charlottesville has been providing residents with public transportation since the 1890s (Comprehensive Plan). However, like other suburban communities the city has struggled to provide services that compete with the automobile. Moreover, "as development has sprawled outside the core of the city, efficient delivery

of public transit has become increasingly difficult" (Comprehensive Plan). Although the transit system (Charlottesville Transit Service, or CTS) faces obstacles, it is one of the highlights of the city's transportation system.

Public transit in Charlottesville is highly available. CTS operates 18 fixed routes on every day of the week except for Sunday, with 12 routes operating during the day, 4 at night, and two both daily and nightly. It also provides general service to community events, such as UVA football games (Charlottesville Transit Study). It is also highly accessible: "transit is available within a ¼ mile of 95% of the population" (Walk Friendly Communities). The system is designed to be highly reliable, with a fixed-route service that operates like a "pulse" ("all routes are scheduled to arrive and depart from a common location at approximately the same time" to facilitate transfers between routes). However, in practice this pulse is often difficult to maintain if traffic congestion causes delay (Comprehensive Plan).

Public transit is also affordable and accessible to all users in the community, with Lifeline Services provided "in limited areas were there are demonstrably high levels of special need – for example, very high proportions of elderly residents, low income residents, or households without automobiles" (Charlottesville Transit Study). Indeed, annual ridership has been increasing every year since 1997, the majority of CTS users have annual incomes below $30,000, and "a large proportion of riders are drawn from households that do not own an automobile" (Charlottesville Transit Study). There are also Express/Commuter routes that link users with "designated areas such as major commercial locations, park & ride facilities, and regional transit centers" (Charlottesville Transit Study).

The CTS is designed to be convenient, with a simple route structure and simple schedules, stops located on arterial and collector streets and around major landmarks, symmetrical routes, service that is well coordinated so as to provide short connection times, stops that are spaced closely together, and high frequency service (Charlottesville Transit Study). Most importantly the system links residential areas with nearly all important destinations in the Charlottesville area, including employment and shopping centers, hospitals, the University of Virginia, schools, and transportation centers (like the Amtrak station). **Figure 29** shows a map of public transit routes, and **Figure 30** shows people waiting for service at a transit stop in Barracks Road Shopping Center. Note that although the transit system excels in terms of the geographic area covered, frequency of service, and connectivity, comfort of stops can be improved in the Greenbrier and Barracks/Rugby neighborhoods. As seen in Figure Y, the majority of stops, especially those located within the residential realm of our neighborhoods, don't have seating areas or provide shelter in the case of inclement weather.

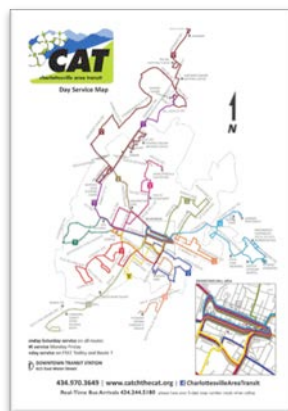**Figure 29: Public Transit Service Map**

Figure 30: Barracks Road Shopping Center Stop

Although the public transit system is a viable option for Charlottesville residents as a whole, residents living in the Greenbrier and Barracks/Rugby neighborhoods use the system much less than other city residents. This is because of the lower population and employment density of these neighborhoods in comparison to other locations of the city. Because "areas that have higher employment and population densities can support higher frequency transit service," the Greenbrier and Barracks/Rugby neighborhoods fall behind other Charlottesville neighborhoods both in number of stops and percentage of weekday ridership (Charlottesville Transit Study). CAT routes 8 and 9, for example, which link to Wal-Mart to Barracks Road Shopping Center and various locations to Charlottesville High School, represent only 4% and 2% of overall CAT weekday ridership (respectively) (Charlottesville Transit Study). **Figures 31 and 32** show population density, employment density, and ridership in Charlottesville, and demonstrate that our neighborhoods have relatively lower densities and ridership levels than other neighborhoods in the city.

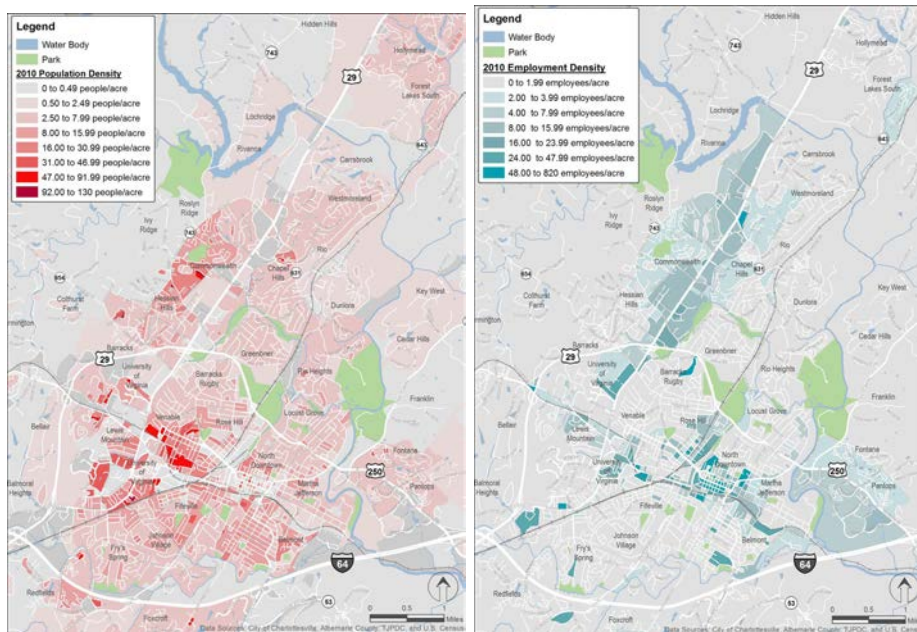**Figure 31: 2010 Charlottesville Population and Employment Density**

Figure 32: Public Transit Ridership

Walkability

Because public transit is not used as often in Barracks/Rugby and Greenbrier as in other Charlottesville neighborhoods, it is that much more important that these neighborhoods be walkable.

Charlottesville has a Walk Score of 63, which indicates that the city is "somewhat walkable" (Walk Score). We find this to be true for our neighborhoods as well: performance is high on some indicators and low on others. For example, while our neighborhoods are small enough in diameter to ensure that nearly all residential homes are located within ¼ mile of most neighborhood parks, elementary and middle schools, and transit stops, most shopping centers, hospitals, and other basic services are located beyond the ¼ mile or 5-10 minute threshold for walkability. A visual of this pedestrian shed, within which only some destinations in our neighborhoods fall, is depicted in **Figure 33**.

Figure 33: Example of Pedestrian Shed (5 and 10 Minute Walks)

An issue for Charlottesvile residents is that although "many [of them] live within a reasonable walking or biking distance to retail and commercial destinations within the city, [they] choose to drive rather than walk

due to a lack of paths, sidewalks, and bike lanes connecting the residential and commercial areas" (Comprehensive Plan). **Figure 34** shows the distribution of pedestrian thoroughfares in Charlottesville. Note that the largest concentrations of sidewalks and intersections are located in the central and southern part of the city (while our neighborhoods are farther north). While the sidewalk system is grid-like and well connected in many areas of Charlottesville, the sidewalks in the residential areas of our neighborhoods simply line streets rather than link all uses of the neighborhood.

Figure 34: Pedestrian Facilities in Charlottesville
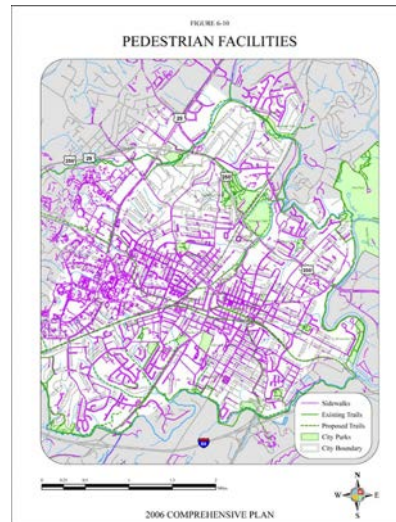
The sidewalks in the residential areas of Greenbrier and Barracks/Rugby are also too narrow to be safe for use. **Figure 35** depicts varying sidewalk widths. The sidewalk at the bottom is most representative of the sidewalks in the residential areas of our neighborhoods. This width is too narrow to accommodate two users who are jogging or walking in opposite directions, and offers little protection from passing cars. Sidewalks of this width have difficulty when accommodating parents with strollers or handicapped residents as well. The sidewalk in the middle is most representative of sidewalks that link residential neighborhoods to other areas. Most are wide enough to accommodate two people, but not wide enough to protect them from the cars that are passing at higher speeds on such connector laneways. Finally, the top width represents the sidewalks located along storefronts in Barracks Road and Seminole Square Shopping Centers. These sidewalks are wide enough to have active edge uses and provide safe places for people to congregate and socially interact.

Figure 35: Varying Sidewalk Widths
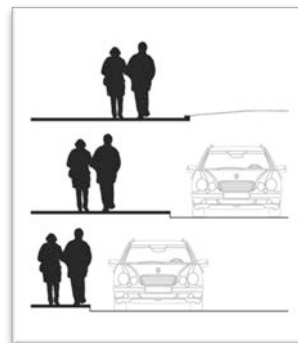
Sidewalks in both neighborhoods were also predominately curved rather than straight, with cracks and uneven grades that limited comfort and pedestrian safety. Crosswalks are another area in which quality was inconsistent across each neighborhood. Although "an impressive 100% of signalized intersections [in Charlottesville] have been converted to push-button signals with downtown timers" and in-ground LED crosswalks have been installed at seventeen locations, these crosswalks are few and far between in the residentially-oriented Greenbrier and Barracks/Rugby neighborhoods (Walk Friendly Communities). **Figure 36** depicts a comparison of a crosswalk in Barracks/Rugby (unmarked and difficult to see) and a safer crosswalk in Greenbrier (clearly marked, but also with a long crossing distance). **Figure 37** shows an ideal crosswalk with a limited crossing distance, landscaping, handicap access, and clearly marked, illuminated endpoints.

Figure 36: Crosswalks in Barracks/Rugby (left) and Greenbrier (right)

Figure 37: Ideal Crosswalk

Bikeability

In recent years, efforts have been made to make Charlottesville neighborhoods more bikeable for the five kinds of cyclists identified by the Master Working Plan Committee: skilled recreational, skilled commuting, less skilled, family recreation, and youth cyclists (Comprehensive Plan)**. Figure 38** shows all current and planned bicycle facilities in the city, including bike routes, on-road bike lanes, bike racks, and off-road multi-use paths. It also shows a picture of bike racks available outside of Charlottesville High School, which promotes biking to school.

Figure 38: Bicycle Facilities in Charlottesville
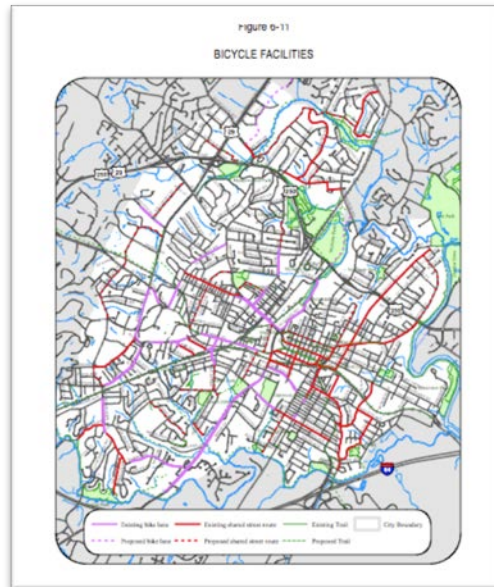
Availability of bicycle facilities, placement of racks at schools, shopping centers, and other areas of interest, and availability of bike racks on the front of CTS buses and trolleys are steps in the right direction for Charlottesville (Comprehensive Plan). However, even though these elements are in place and "the physical distances of bicycling in Charlottesville are not an issue for most people, the road system can be intimidating to most bicycle owners" (Comprehensive Plan). On connector and arterial roadways, "the combination of narrow pavement widths, scarce shoulders, and abrupt drop-offs into adjoining ditch lines with significant volumes of traffic and poor sight lines in curvy areas makes roads such as Rugby Road and Hydraulic Road challenging to many bicyclists" (Comprehensive Plan). Other streets with steep hills are unfriendly to bikers who are unskilled or not physically fit. And in residential areas, nearly all streets lack bicycle lanes. **Figure 39** shows a cyclist in Barracks/Rugby riding on streets with no crosswalks or bike paths.

Figure 39: Biker in Barracks/Rugby Neighborhood

In order for bicycling to become a viable mode of transportation for Greenbrier and Barracks/Rugby residents, bike routes should be created to link residential neighborhoods with external uses along safe, wide bicycle lanes with adequate lines of sight.

Parking

There is significant room for improvement when it comes to parking in both the residential and commercial areas of our neighborhoods. The first issue surrounding parking in Charlottesville is "maintaining the parking supply to meet demand" without damaging the community land use vision (Comprehensive Plan). This is a concern in areas like Barracks Road Shopping Center and Seminole Square, where parking lots are filled to capacity at some parts of the year and nearly empty otherwise. The second issue regarding parking is that "parking site development should be aesthetic, accommodate pedestrians, bicyclists and transit users and minimize impacts to sensitive environmental resources' (Comprehensive Plan). In these two shopping centers, while the congestion and automobile usage in their lots is problematic, they have been designed to promote pedestrian safety as much as possible. **Figure 40** shows crosswalks, speed humps, and fire lanes in these center's parking lots.

Figure 40: Safety Precautions in Shopping Center Parking Lots (Seminole Square, left, and Barracks Road Shopping Center, right)

In addition, most commercial parking lots in our neighborhoods offer at least some parallel and diagonal parking spaces and make an effort to plant low-rise vegetation and trees to combat urban island heating **(Figure 41).**

Figure 41: Planted Vegetation in Barracks Road Shopping Center

Parking in the residential areas of Greenbrier and Barracks/Rugby can be improved by mandating that cars be parked in driveways and behind homes in order to reduce visual pollution. However, the fact that most homes have cars parked in front along the street is not entirely bad; this on-street parking can act as a buffer for pedestrians using sidewalks and help to slow traffic by effectively narrowing the streets on which they are parked. **Figure 42** shows an example of such on-street parallel parking located at Greenbrier Elementary School. Note that when cars are parked in those spaces, children using sidewalks are protected from moving cars and the width of the street is reduced.

Figure 42: On-Street Parking at Greenbrier Elementary School
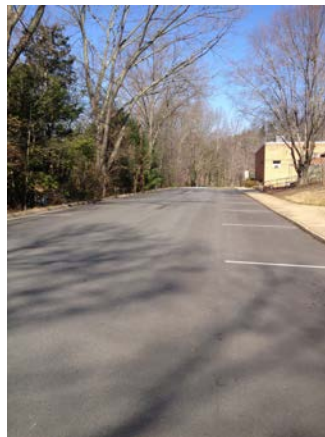
Finally, it is important to note that parking lots should always be built on even grades to ensure safety of vehicle users. **Figure 43** shows an example of an uneven grade parking lot that could be improved in the future.

Figure 43: Uneven Grade Lot at Greenbrier Park

D. Housing & Community Places

Sustainable communities are designed to generate more energy than they need. They are open, affordable, have a universal design, produce local food, offer public transit, create places to live, work, create, and celebrate in a healthy waste-free environment (PLACE). The most common community places are schools, shopping centers, and houses. These are places that people congregate in every day; therefore, they deserve to be scrutinized the most on their sustainable efforts.

Schools

Schools are vital for providing kids education, activity, and community. They are looked up upon very highly and therefore deserve to be treated with the highest honor to their appearance. Since being sustainable is what must happen for the world going forward, then schools should be catalysts to spur this movement on. They should embody sustainability in all aspects of it; the design, materials, geographic location, use, and energy use. All schools need to strive to be sustainable in order to help conserve energy as well as teaching kids about how to live sustainably. This will enable the current generation to become more sustainable in order to affect the lives in future generations.

Across the country there are already many schools that are committing to becoming sustainable. Jim French says that in order to make a school sustainable, a sustainable plan must be made and presented to the staff, students, and parents. A buy-in from these members of the school is mandatory in order to having success.

In Tennessee, Oak Ridge High School has focused their plan on making lighting more sustainable. There are occupancy sensors in each room to regulate light to only being used when someone is in the room. Also, there are three lighting options in the room from dark to bright. In the corridors of the school the lighting has been set to only be on during high occupancy times, which is only about three hours a day, opposed to a full 10 hour school day. These lighting changes are possible through the master clock system, which is connected to the intercom system and controls the bell system. The heating and cooling of the school is regulated through a special geothermal system that is installed in buried pipes beneath the school. Water temperature is regulated by the temperature of the earth through geothermal wells below the school. This system is 40 percent more efficient than a standard system, but it is only possible if sites have the capability of having geothermal wells. (French)

In Minnesota, Woodland Elementary School focused their plan on regulating heating and cooling like Oak Ridge. Instead of using geothermal pumps they used a hybrid ground-source pump system, which also decreases the energy used to heat and cool the building. Another way the school reduced its energy use was by increased insulation of the walls, roof, and windows. (French)

In Washington, Pioneer Middle School received a $350,000 grant to be designed with an educational sustainable approach in mind. The team decided that they wanting to connect lessons that the kids are learning directly with elements that are apart of the school. There is a "green touch screen" at the entrance of the school that displays the energy-consumption of the school in real time. This promotes physical movement and activity of kids throughout the school to see this data. (French)

Sustainable schools are necessary for sustainable practices to really take affect in communities. If communities are on board with the school that their children attend as being sustainable, then community members will be more likely to want to be sustainable as well. As this information is pertinent to overall making schools sustainable, it is not relevant for the scope of this project. This information goes too in depth to the specific breakdowns of schools than is necessary for the understanding of Charlottesville schools.

Shopping Centers

Shopping centers are rooted within communities and are necessary for purchasing food, clothing, and other products. They generally provide for a quick, convenient place to buy needs for daily life. Shopping centers are useful to people and are not going to be going away; therefore they need to have their flaws pointed out in them to restructure them to be sustainable. Shopping centers have many negatives associated with them. First, they contain a large parking lot, which leads to increased amounts of surface runoff, pollution, and overcapacity of sewers. Second, they consume a large amount of energy and are not built with the thought of saving energy. Third, some stores give off higher emission rates than others based on what they are used for, such as certain dry cleaners. The side effects of shopping centers need to be reduced to a minimum and through examples of successful sustainable shopping centers positive results are found.

The Porter Square project was a project that involved the sustainable restructuring of the Porter Square Shopping Center in Cambridge, Massachusetts. This project had the following goals in mind:
. Urban redevelopment (smart growth)
. Community involvement
. Energy efficiency – insulation, roofing, lighting, HVAC systems, refrigeration, day-lighting, automated
        energy management
. Healthful indoor air quality
. Using non-toxic and low-toxic interior and exterior materials
. Use of sustainable (renewable) energy
. Encouraging retailers to increase sustainability
. Prevention-based safety and health plan
. Public education

This listing of criteria that went into the modification of The Porter Square project was successful in making this shopping center sustainable.

Another example of sustainable shopping centers comes from the company EDENS. EDENS is a developing, owning, and operating company that focuses on designing community-oriented shopping centers throughout the East Coast. They have a deep passion for creating spaces where people can interact in a living, working, and shopping community setting. An example of an EDENS shopping center that was recently developed in Charlottesville is The Shops at Stonefield, which is located on US 29/Emmet St (EDENS).

Figure 44: The Shops at Stonefield

Neighborhood Style Development

Bringing the pleasures and convenience of urban life to the suburbs.

They call Charlottesville the Napa Valley of the East Coast - and we couldn't imagine a better place to locate The Shops at Stonefield. The neighborhood features an elegant blend of retail, entertainment, dining, residential living, and a boutique hotel. By focusing on community connection, we've created a retail space where relationships thrive.

The center's signature EDENS design, from architecture to aesthetics, has been carefully crafted to be both innovative and appealing as it blends with the individual look of each retailer and intimate gathering places for neighbors to sit and reconnect. It's another way we build a vibrant environment that invites shoppers not only to visit - but to return, again and again.

The Shopping Experience

- 229,973 square feet
- Retail now open Trader Joe's, Regal Cinema with IMAX, Pier 1 Imports, Noodles & Co., Burtons Grill, Travinia Italian Kitchen, Flatiron/Brooks Brothers
- New retail includes Pasture, Williams-Sonoma, Pottery Barn, Brooks Brothers, Blue Ridge Mountain Sports, Orvis, Love Londons, Alex and Ani, Spoon & Berry
- A mixed-use development located in award-winning Charlottesville, Virginia - the "Napa of the East Coast"
- An elegant mix of Main Street retail, residential living, and boutique hotel
- Located at the intersection of Hydraulic Road and Route 29 - the major retail corridor of Charlottesville
- 61,000 CPD pass the site on Route 29/Seminole Trail
- 2 million tourists visit the area each year - wineries, golf, Monticello and UVA are the highlights.

Sustainable & Responsible

- Walkable, highly ammenitized pedestrian-friendly streets
- Smart lighting control systems to reduce energy usage and lamp replacement
- Accessible public plazas that facilitate connectivity and community engagement
- Significant investment in community infrastructure

Site Plan

Sustainable shopping centers need to start becoming more mainstream throughout the United States. There is a great ability for shopping centers to be public centers of excellence where people will want to start living their lives more like these sustainable shopping centers. Shopping centers have the power to set an example for the rest of the community through their actions. From this research much information was concluded that is not relevant to the scope of this project. There are many ways to be sustainable, some are larger than others, but what were taken from this research were the simple forms of being sustainable.

In order to determine whether or not the housing and public spaces in the Greenbrier and Barracks/Rugby neighborhoods contribute to their livability and sustainability, we looked at the criteria in **Table 5.**

Table 5: Housing & Community Places Criteria

Uses are integrated.
• Town center, commercial and retail areas, and residential neighborhoods reflect a mix of uses.

- A variety of housing options exists.
- Housing units are placed above retail and office uses in the town center.

Neighborhoods offer a range of public spaces and support of the public realm.
- Town center acts as a focal point of the neighborhood and, as a place for community events and activities, promotes social interaction and cohesion.
- Recreation areas exist for informal, non-programmed outdoor and indoor activity.
- All public spaces are physically and visually accessible, located along major pedestrian thoroughfares.
- Public spaces are designed to be attractive, interesting, distinctive, and memorable, and their atmospheres are friendly and hospitable.
- Concentrations of civic, institutional, and commercial activity are embedded in neighborhoods, not isolated in remote, single-use complexes.
- Health centers, employment centers, schools, and other basic amenities are sized and located to enable inhabitants to walk or bike to them safely and conveniently.
- Inhabitants have access to a wide variety of employment choices.

Neighborhoods have a variety of residential housing types.
- Diverse housing opportunities and price levels ensure a socio-economic and racial/ethnic mix.
- Neighborhoods provide a mix of single detached, semi-detached, and street-oriented town homes.
- Housing is affordable and equitable.
- Homes are situated close together and characterized as medium- to high-density to help foster a tighter sense of community.

Neighborhood design fosters a sense of place and community.
- Design promotes social interaction and opportunities for active engagement in community life and civic activities.
- Community character is enhanced by memorable, unique design elements and architecture.
- Public places and civic buildings are distinctively designed to reflect their special status as community centers.
- Placemaking elements are in place to ensure that neighborhoods provoke a sense of place and community pride in inhabitants.

In order to analyze our observations in a concise, clear, understanding way, we decided to focus on some of the major points that were discovered through our research of sustainable community centers. Overarching conclusions we can draw about the sustainability of Greenbrier and Barracks/Rugby when it comes to community centers include the fact that nearly all development in the neighborhoods are single-use, and that the majority of houses are single-family dwellings. Because these conclusions were easily drawn, we decided to focus in this report on the accessibility, design, atmosphere, and location of the shopping centers and schools. Using these criteria, we broke down the Greenbrier and Barracks/Rugby community places.

Walker Upper Elementary School/Crow Recreation Center (Barracks/Rugby)

Accessibility. Walker Upper/Crow Center are accessible by walking, biking, and car from the surrounding Barracks/Rugby residential area. Walking and biking are not strongly emphasized because there is only a sidewalk on one side of the street, there are no cross walks, pedestrian signs, or designated bike paths. To improve this, either a wider sidewalk or bike path should be constructed.

Design. The school is a large two-story building, with the second story at grade, and is brick with few windows. Although it falls within a small pastoral landscape, the area lacks abundant plant life. A few potted plants are found on school property but haven't been well manicured. The school has a soccer field, an outdoor basketball court, and picnic tables and the entrance to the school is painted with an extensive mural. The Crow Center has an indoor basketball court and indoor pool. All of these amenities are regularly maintained, which provides for an attractive design. The only room for improvement would includes maintenance to potted vegetation and addition of bike racks.

Atmosphere. The large amount of outdoor activities combined with education creates a pleasing environment to learn in. There is an inviting feeling to participate in communal activities at Walker Upper and the Crow Center.

Location. Walker and Crow are located in Greenbrier neighborhood, which is directly next to U.S. 250. With this location, both of these buildings function well as community centers.

Barracks Road Shopping Center (Barracks/Rugby)

Accessibility. The Shopping Center is accessible by Charlottesville Area Transit, UVA University Transportation Service, and sidewalks, on both sides of US 29-Business/Emmet St. provide visitors with the option to walk to and from the Shopping Center. There are also bike lanes on either side of US 29/Emmet providing a sustainable way to travel. Driving is by far the most common method of accessibility, though.

Design. Aesthetically, the design is pleasing and welcoming to people passing by the shopping center. There is wide range of stores from retail, to food, to commercial goods, which makes Barracks a prime shopping center to go to. The Shopping Center offers acres of free parking, which serves as a draw for Charlottesville residents and visitors who prefer to drive. However, this results in consistent high traffic congestion within the parking lot and in surrounding areas. To counteract this, part of the parking lot should be transformed into a green space, which would be a communal meeting place of vegetation.

Atmosphere. There is a welcoming effect that is produced while being at Barracks from the energetic customers that are there. People enjoy going to Barracks for their wide range of amenities and that creates for a positive vibe in the shopping center.

Location. Barracks Road Shopping Center is located on US 29/Emmet Road, directly across the street from the Barracks/Rugby residential area. Drivers prefer this location because it is easy to access from the road, but for convenience it is not located directly next to any residential areas. To respond to this dilemma, residential areas should be constructed next to or above the shopping center. This would provide for a complete community experience by combing shopping, eating, and living all in one.

Greenbrier Elementary School (Greenbrier)

Accessibility. The school is easily accessible by foot, bicycle, or bus. There are sidewalks, crosswalks, and pedestrian crossings throughout the neighborhood, which provides for a safe experience while walking to school. There is not a distinguished bike path on the roads through the neighborhood, but biking is encouraged through the placement of bike racks at the school.

Design. The building design is simple with the materials of brick and steel, but there are no exciting elements to the school that make it stand out or make you want to go out of your way to see it. The overall design of the school includes a kickball field, track, open field, basketball courts, and jungle gym. The open field is extremely run down and is mostly all dirt. This is not an attractive feature for kids to want to play on. Even though the budget for elementary schools probably is not that high, if the field was maintained better, then other people from the community would be drawn to the field for activities. This space would be transformed into a multi-purpose field, which is much more sustainable since it is getting its maximum use out of it. The addition of lighting to the field and basketball courts would also enhance the versatility of this school.

Atmosphere. The coming together of students and teachers in a learning environment generally comprises a safe inviting experience.

Location. The school is centrally located inside of Greenbrier Neighborhood, but the school does not appear to be used at other times than school hours. The school does not function as a community center.

Charlottesville High School (Greenbrier)

Accessibility. Charlottesville High School (CHS) is located on the other side of Greenbrier neighborhood from Greenbrier Elementary School (GES). There is the same amount of accessibility to CHS as there is to GES, but CHS contains more parking than GES since there is a higher rate of people with the ability to drive.

Design. The school was designed in 1974 after Lane High School was overpopulated and could not handle the population anymore. The building design is outdated compared to today's standards, but there have been many modifications to improve it. There's been the addition of a new gym, auditorium, and asbestos-free floor tile. There have also been renovations to the classrooms, restrooms, ventilation, and lockers. (Charlottesville City Schools) The outdoor sports complex is fairly new as well and is maintained regularly. The main stadium field, which is for the sports of soccer, lacrosse, field hockey, and football, is consisted of Astroturf. Astroturf is synthetic grass, which is much easier to maintain because it not able to wear like regular grass. This material is very sustainable because of its versatility. There are also open fields around that school with grass that is kept cut and are able to be occupied for community activities.

Atmosphere. The overall atmosphere of the school is positive and motivating because the school is very diverse and this leads to an increased educational experience. Students and teachers are able to learn from one another because each student brings a different perspective to the classroom.

Location. The school is located in the corner of the neighborhood. On one side of the school is McIntire Municipal Park and on the other is the neighborhood. This location is amiable to the community because it brings together exercise and education.

Seminole Square Shopping Center (Greenbrier)

Accessibility. Seminole Square is difficult to access by foot or bicycle, but it is easily accessible by car from Route 29/Emmet St. and U.S. 250/Hydraulic. The parking large is large, but the volume of traffic in and out of the shopping center is minimal. To increase accessibility a walking/biking path should be put in the Rivanna Trail, which is a tree line that divides Greenbrier from Seminole Square. This would increase activities and provide for a healthy means of getting to the shopping center.

Design. Aesthetically, the Shopping Center falls short of its counterpart at Barracks, perhaps due to its concrete infrastructure and ill-maintained storefronts. Plant life is very minimal, with only a few trees planted on dividers throughout the parking lots. To improve the quality of the shopping center more vegetation should be planted, the building should be renovated, and the parking lot should be decreased and transformed into a public gathering location.

Atmosphere. The current atmosphere is uninviting and unpersuasive. There is no yearning desire to attend Seminole Square and take place in its retail experience. This would be improved if a transformation of the design and accessibility were to occur.

Location. The shopping center is located on Route 29/Emmet. St. It is divided from the neighborhood by the forest line of the Rivanna Trail.

E. Green Spaces

Figure 45: GIS Map of Parks in Barracks/Rugby and Greenbrier

When measuring the sustainability of a place, green areas are a key factor. Green areas bring a lot to the table. From pollution control to building community, green spaces provide a myriad of positive environmental effects. Some are more tangible than others. For example, it is easier to recognize or to put a finger on pollution reduction whereas preventing nature deficit disorder in children is not as recognizable.

Green spaces do a great job of mitigating pollution. The presence of trees, grass, bushes or any plant will allow for carbon dioxide to be absorbed and turned into oxygen. Carbon dioxide can be harmful to the atmosphere and oxygen is highly beneficial to all living things. Parks can act as buffer zones for pollution. If several trucks or semis drive by a road, their pollution will be heavy, however, by having a green area nearby, the concentration will be decreased. The more green areas spread around, the less likely it is to find high concentration of pollution.

Air pollution is not the only type of pollution that parks or green areas reduce. Parks provide several ecosystem services that help reduce water pollution or water runoff (Pineo). Pavement and concrete - any impermeable surface, really - does not let water percolate and as it flows it picks up more sediment or pollution that gets into the water systems (Frazer, Lance 2005). Permeable surfaces found in parks, like grass, turf, gravel, or mulch do not let water systems get overflowed because these allow for water to percolate. The water is cleansed as plants use it.

Green areas also reduce noise pollution. This type of pollution is not the most mainstream or renown one but it is still very harmful. Noise pollution can affect both humans and animals (Painter). In humans, noise pollution has been found to affect stress levels, increase sleeping disorders, and affect mental health (Benfield). In animals, it can scare animals away, confuse them, and affect their health as well. Parks do a great job of reducing noise pollution. Belt shaped parks reduce noise pollution the best. By having a section of a city surrounded by parks or green areas, the noise will be more easily reduced. If parks are square or circular it is harder for them to mitigate noise pollution. This being said, parks are not the only way of reducing noise pollution. By simply having bushes or trees near roads, noise can also be reduced.

Parks, especially ones exposed to more wilderness, or the ones with less human impact, provide even more ecological services than pollution reduction. Green areas can promote biodiversity of plants and animals and provide shelter for animals.

Parks also increase sustainability of place by affecting the people around them. Richard Louv came up with the term "nature deficit disorder" to explain the effects that lack of contact with nature has on children. In today's society, children are always in front of a TV or in front of a computer screen. This has negative impacts on their health and well being: it makes them pay less attention, reduces social skills and can even affect students' grades. Having a park or a green area allows for children to explore the outdoors and stay in touch with nature (Louv). Not only will children come to appreciate nature and possibly begin to care for it more, but also they and their parents will also avoid the down sides of staying in watching TV (Louv). The same thing applies to adults. Being in contact with nature reduces stress and make a better and healthier life (Reynolds). Having children and adults in parks will generate a greater sense of community. As adults see how much children enjoy parks, they will be inclined to save and protect these areas. And as children grow up caring for their parks, this interest tends to develop into people that care for the environment. If the park becomes part of the pride of the city, then more people will begin to start using the park and a positive feedback loop begins. More people go to the park; more people feel the benefits of parks, which in turns make people care more about it. And as more people care for it, social pressures will make other care for it more.

Parks themselves also provide jobs for the community and increase the value of land near them (Walker). Increasing the land near parks encourages planners to include more parks in cities. Not only that, but people will associate green spaces with better living - which is a huge step towards sustainability of place.

Figure 48: Greenleaf Park

To evaluate whether or not green spaces in Barracks/Rugby and Greenbrier contribute to their livability and sustainability, we looked at the criteria in **Table 6.**

Table 6: Green Spaces Criteria

Neighborhoods offer a range of green spaces and parks.
- A range of parks and public spaces encourage pedestrian activity and promote social contact.
- Secluded areas of wilderness, green places, and parks are located within the neighborhood and provide inhabitants with an opportunity to "leave city living behind."

- Parks are being used to create a sense of place, foster a love of nature, and promote an active lifestyle.
- Neighborhoods, by providing recreation areas, public spaces, and a walkable and bikable environment, incorporate physical activities into components of daily life and maximize opportunities for active lifestyle choices.
- Green areas are sufficient in size for multiple people to enjoy without feeling overcrowded.
- Parks are centrally located and accessible via walking paths and bike routes.

Neighborhoods respect local environments, heritage, and cultural traditions.
- Design is site-sensitive and works with natural systems rather than competing with them.
- Buildings, homes, and centers engage in efficient water- and energy-use and provide substantial amounts of vegetation on urban heat islands to clear air and cool temperatures.
- Design elements reflect local culture and traditions, geography, and vernacular themes of the area.

Some of the benefits that parks bring to the sustainability of a place are hard to put a finger on. It is even harder to measure how well or to what extent the park is achieving what the literature says it does. How does one measure the decrease of the nature deficit disorder in children? For this reason, instead of establishing metrics to assess how the Charlottesville parks in the neighborhoods of Barracks/Rugby and Greenbrier stack up to other sustainable places, we have established the above criteria that can be used to interpret the ways in which a particular park are contributing to the sustainability of a community in the best possible way.

Figure 47: Rivanna Trail (Greenbrier)

As a rule of thumb, the more parks and green a cities the better. However, one must be careful because by adding parks, one can decrease density, which is a key factor in sustainability of place. At the same time, if one only has one big park – for example, Central Park in New York City - this makes it hard for people to access the park if they are on the other side of town. It is important to find a balance between trying to avoid having people drive to the park and having too many parks to the point where it affects density. The Barracks/Rugby and Greenbrier neighborhoods have sufficient park area, home to Greenbrier, Greenleaf, and McIntire Parks, which cover 13.5% of the Barracks/Rugby and Greenbrier neighborhoods. The average park area coverage in the 100 most populous cities in the United States is only 12.4% (Harnik).

The parks vary in terms of their accessibility. McIntire Park is off of 250 Bypass, which connects it to more people but does not allow for much access by bike or walking. Greenbrier Park, on the other hand, is in the

middle of the Greenbrier neighborhood and is accessible by car, bike, or foot. Greenleaf Park is somewhat hidden in between the houses of Barracks/Rugby. Although it is accessible by car, the easiest access is via walking or biking. Bike racks are present to encourage such activity.

The parks also vary in terms of their ability to instill in visitors a sense of being "away from city life." Greenbrier Park performs best in this regard, providing 28.3 acres of parkland with creeks and streams far from traffic. McIntire Park performs worst in this regard because it has 250 Bypass at its southern border and as a result, a lot of traffic can be heard. And although this park has a good amount of surrounding woods, it contains mostly sports fields that might not make it feel as though one is connecting with "nature." Greenleaf Park is a special situation. The park is of good quality and consists of playgrounds, picnic areas, and open space, but given that the area right outside the park is so heavily arborized and green, it feels as though the park is simply and extension of a back yard.

Figure 48: McIntire Park

Finally, it is worth noticing is that there are a lot of green areas in Charlottesville that are not necessarily recognized as parks but that still provide the benefits of parks. The houses in the neighborhoods of Barracks/Rugby and Greenbrier have front and back yards and/or are sometimes surrounded by woods. These green areas still provide the benefits but might not be recognized as green areas or parks.

Figure 49: Typical View of a Road Lined with Trees

We can assume that these parks reduce noise pollution, reduce nature deficit disorder, build community, clean the air and provide ecological services important to both humans and animals. And most importantly, we can also assume that the parks are creating a sense of community.

Figure 50: Typical House in Greenbrier Neighborhood, Surrounded by Green Spaces

VII. RESULTS

After analyzing our neighborhoods and determining how well they performed in terms of density, layout and block size, transportation, community places, and green spaces, we have highlighted areas in which our neighborhoods were successful, areas in which they performed satisfactorily, and areas in which there is room for improvement. The conclusions we have drawn were made by determining how many criteria for each area of focus were met by each neighborhood. Councilwoman Galvin and the PLACE Design Task Force can use the following table to view our conclusions in a summarized manner and to learn from our neighborhoods' strengths and weaknesses in the future.

EXCELLENT	SATISFACTORY	NEEDS IMPROVEMENT
-Provision of multi-modal transportation options -Provision of bicycle facilities -Crosswalks -Location of schools within neighborhoods and walking distance -Safety measures in parking lots -Land devoted to parks -Public transit accessibility	-Density -Green spaces embedded within neighborhoods -Bike lanes (where they are located) -Visits to parks -Frequency of intersections -Ratio of permeable to impermeable surfaces	-Parking facilities in residential areas -Car usage -Link sidewalk and street systems to all uses -Street width -Sidewalk width

VIII. CONCLUSION

By identifying for Councilwoman Galvin the areas in which Charlottesville is succeeding in terms of livability and sustainability (and most importantly, the reasons *why* they are succeeding), we have provided her with a place to start as she guides the PLACE Design Task Force when it makes decisions that pertain to Charlottesville's future. Throughout this report we have offered concrete recommendations on how Charlottesville's design can be improved to become more sustainable and livable. However, this project is centered first and foremost on placemaking – an ideology that does not have concrete benchmarks or guidelines to follow. As a conclusion to this report, we have included below eleven key elements that the Project for Public Spaces has outlined to guide cities as they transform public spaces into vibrant community places.

First, process is important: the community must be involved in the development and design of any public space. Second, design is not enough. To make a space into a place, physical elements (such as seating and landscaping) must be put in place to make people feel welcome, comfortable, and connected to all activities going on in the public space. Third, partnerships with museums, schools, and other local institutions are "critical to the future success and image of a public space improvement project" (PPS). Fourth, city planners and placemakers can learn most through observation; by "looking at how people are using public spaces and finding out what they like and don't like about them, it's possible to see what makes them work or not work" (PPS). Notably, it is important to learn from both successes and failures. Fifth, each community needs to create a vision for its public spaces. While the vision will inevitably vary by community, visions for any public space should include the idea that the space should be comfortable, should have a good image, and should instill a sense of pride in the people who live and work in that area. Sixth, placemaking takes time: "the best spaces experiment with short term improvements that can be tested and refined over many years" (PPS). Seventh, communities can put a triangulation process in motion by choosing different elements to include within a space and arranging them in ways that link people together and promote social interaction. Eighth, communities should expect to encounter obstacles because "no one in either the public or private sectors has the job or responsibility to 'create places'" (PPS). They can overcome these obstacles by starting with small-scale improvements that will help prove the importance of "places" to other stakeholders. Ninth, the concept for a particular space is not necessarily informed by design; it is informed by the design *process* instead. Tenth, "money is not the issue": once people get on board, project benefits will start to outweigh costs (PPS). And finally, the process of creating places never ends. Over time, needs, opinions, and communities change, and city planners must be flexible and receptive to such changes in order to continuously improve public spaces, neighborhoods, and cities.

Our hope is that Councilwoman Galvin will use these principles as well as the rest of the recommendations we've made throughout this report as she guides the PLACE Design Task Force when they make decisions that have implications for the sustainability of Charlottesville in the future. We believe that our work can have both real and long-lasting implications for the future of our neighborhoods: after all, "placemaking is both an overarching idea and a hands-on tool for improving a neighborhood, city or region. It has the potential to be one of the most transformative ideas of this century" (Project for Public Spaces).

IX. LESSONS LEARNED & FUTURE WORK

The process of observing and analyzing Charlottesville with a critical eye toward sustainability was an enriching process for our group. Throughout this process, we have learned many lessons about not only the analysis we have had to make, but how to observe within our community in order to gain the most information possible.

In the beginning of this process, we thought it would be valuable to analyze each of the neighborhoods individually in order to gain a broader perspective and look at them as a whole. However, we learned in our first few weeks that measuring a neighborhood's sustainability as a whole is incredibly difficult, as each community has strengths and weaknesses that can differ greatly from neighborhood to neighborhood. Instead, we found it valuable to look at these neighborhoods with a set of criteria that we could analyze not only quantitatively but also qualitatively. This allowed us to set benchmarks for what we considered to be a sustainable community, and allowed us to more easily check to see how our communities stacked up.

Additionally, we found that some of the original criteria we set forth to measure sustainability could not practically be determined, and were out of the scope of this project. Measurements such as water use, energy use, and waste management for entire neighborhoods became areas of sustainability that could not be easily measured for the sake of this project. However, this allowed us to find benchmarks that were more set to observational standards and encouraged us to focus on those metrics more intensively as a way to analyze our communities.

Through learning these practical lessons, we feel as though future work would happen in a more efficient manner, and are confident that more valuable, thorough work could be completed for this project. In terms of future work, we feel as though a set of recommendations would be a practical addition to the observational work we have done for this project. We have provided the research of what creates sustainable communities and how our neighborhoods stack up. Moving forward, it would be valuable to synthesize this information in a way that will create a set of recommendations for these communities to become more sustainable and ecologically friendly.

Additionally, working as team allowed us to take four separate minds and think critically about our communities. Allowing each team to work with other teams would allow for even more critical thinking, and would create interdisciplinary thought in order to think more in terms of the system of sustainability in the Charlottesville area. By collaborating with teams within our own realm of study (the Placemaking team) and also with teams studying different areas of sustainability (Waste, water, education), we could create an even more comprehensive plan to enhance Charlottesville's already thriving sustainability.

This project has taught us many lessons in observation, analysis, and teamwork. The future of this project should focus on enhancing that analysis by synthesizing the information we already have, and by using the resources available to us as collective students of Global Sustainability to further understand Charlottesville's journey to sustainability.

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