INTEGRATING URBAN AGRICULTURE INTO AFFORDABLE HOUSING USING PERMACULTURE DESIGN PRINCIPLES

by

BEVERLY ANNE BELL

(Under the Direction of Robert A. Vick)

ABSTRACT

This thesis examines the nexus between landscape architecture, urban agriculture and permaculture to improve the health, safety, and welfare of low-income residents who lack access to fresh, locally grown food in affordable housing developments. Low-income residents of urban environments lack equal access to fresh locally grown food. The research question posits how landscape architects can integrate an edible landscape into an affordable housing development which provides the residents with access to edibles while adapting that design to the specific opportunities and constraints of the residents and the site. Research strategies include secondary description that reviews permaculture principles, precedent studies of urban landscapes that incorporate urban agriculture and permaculture into affordable housing and other landscapes. Finally, projected design illustrates and critiques the potential application of permaculture, as a form of urban agriculture, in an affordable housing site in Athens, GA.

INDEX WORDS: Landscape Architecture, Urban Agriculture, Permaculture, Affordable Housing, Urban Sustainability

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BEVERLY ANNE BELL

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BEVERLY ANNE BELL

Major Professor: Robert A. Vick

Committee: Jon Calabria
David Berle
Lynda Stipe

Electronic Version Approved:

Julie Coffield
Interim Dean of the Graduate School
The University of Georgia
August 2014

DEDICATION

I dedicate this work to my family and friends who helped me along the way.

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I would like to acknowledge my thesis committee for all the advice and help they have provided throughout the entire thesis process.

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CHAPTER 1

INTRODUCTION

Integrating sustainable agriculture into the urban fabric can alleviate negative social, economic, and environmental impacts associated with industrial agriculture (Blobaum 1987). In the United States, the population in urban areas has increased from 50% in the late 1800's to over 75% in 2001 (Blobaum 1987; Paul and Meyer 2001). To meet the demand, food is produced on industrial farms then transported long distances to reach consumer's tables (Blobaum 1987). This process diminishes the food's quality, freshness, and destabilizes food security and adversely impacts lower income residents who live in food deserts (Brown et al. 2003). Renewed interest in local food production in urban areas has fostered a desire to develop new ways of accomplishing this goal (Gorgolewski et al. 2011).

Large scale, industrial agriculture has increased yields and reduced production costs but relies on expensive machinery, growth hormones, chemicals, pesticides, and nonrenewable resources (Blobaum 1987; Horrigon et al. 2002). Major environmental problems associated with this form of food production include decreased biodiversity, soil and water contamination, air pollution, and crop homogenization (Horrigon et al. 2002). This method of food production has led to an increase in cost of food for consumers and caused concern about food security (Armar-Klemesu 2000). In the United States, 33 million people are directly impacted by hunger or the risk of hunger (Brown et al. 2003). The USDA defines insufficient food security on two levels: "low food security” which includes people who state experiencing “diminished quality, variety, or desirability of diet” with “little to no reduced food intake” and “very low food security” which refers to people who have “multiple indicators of disrupted eating patterns and reduced food intake” (USDA 2014, “Definitions of Food Security”). Even if low-income urban residents can purchase desirable food, lack of transportation may inhibit them from reaching distant grocery stores. Additionally, small neighborhood grocery stores in these areas are more likely to be lacking in regards to quality and quantity of food than larger supermarkets located outside of the area (Brown et al. 2003). Lower income urban residents lack equal access to affordable, high quality, and safe food. Site design can make safe, nutritious food more accessible to lower-income residents who lack food security.

In response to the above stresses, there is a need for landscape architects to find sustainable ways of producing food within city limits and ensuring that access to this food is equal to all urban people regardless of income level. Urban agriculture entails food that is produced within urban areas by and for local residents. Urban agriculture offers multiple benefits that address the previously listed problems pertaining to social, economic, and environmental problems that result from industrial agriculture. For example, implementing urban agriculture has shown to increase urban food security for low-income residents, enhance social capital, provide mental and physical health benefits, and provide a source of food during times of economic downturn (Smit et al. 1992, Armar-Klemesu 2000, Gorgolewski et al. 2011). Additionally, urban agriculture increases biodiversity, reduces urban soil and air contamination if proper precautions are taken, reduces pollution, and diminishes use of non-renewable resouces (Smit et. al. 1992, Brown and Jameston 2000, Deelstra and Girardet 2008).

Affordable housing landscapes provide a potential location to incorporate urban agriculture into urban areas while ensuring equal access. Affordable housing is defined as housing that accounts for “no more than 30 percent of a household’s income” (Jones et al. 1995,14). In a college city like Athens, GA where the rental population is higher than the homeowner population yet the overall home values are higher than the state average, many people lack the ability to escape the rental market and purchase a home (UGA, Carl Vinson Institute of Government and Georgia Cooperative 2013). Affordable housing seeks to alleviate this problem by providing people the opportunity to purchase their own home. Designing an affordable housing landscape to accommodate sustainable agriculture has the potential to alleviate some of the social, economic, and environmental stresses of the residents and landscape

Permaculture is a relevant sustainable agricultural design approach that offers design solutions for creating a food producing, affordable housing landscapes because the objective of permaculture is to create a landscape that requires minimal maintenance and one that is most efficient in regards to providing the homeowner with the products that he/she needs. Bill Mollison, the co-creator of permaculture, describes it as “conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems” (Mollison, 1990). Therefore, prospectively, residents at affordable housing sites will be able to benefit from a garden with minimal maintenance costs.

RESEARCH QUESTION & PURPOSE

The intention of this thesis is to answer: **how can landscape architects incorporate sustainable urban agriculture into affordable housing landscapes using the design principles of permaculture?** This question arises from the need to address the previously described social, economic, and environmental problems created from producing a large amount of urban resident's food on external, industrial, large scale agricultural methods. The intent is to devise a method for integrating sustainable urban agriculture into an affordable housing site in Athens, GA using permaculture design techniques. The site in which the design will be based is the Cannontown Neighborhood, an affordable housing community being developed by the Athens Land Trust (ALT). The neighborhood is located approximately 1.5 miles from downtown and, when completed, will consist of 15 homes.

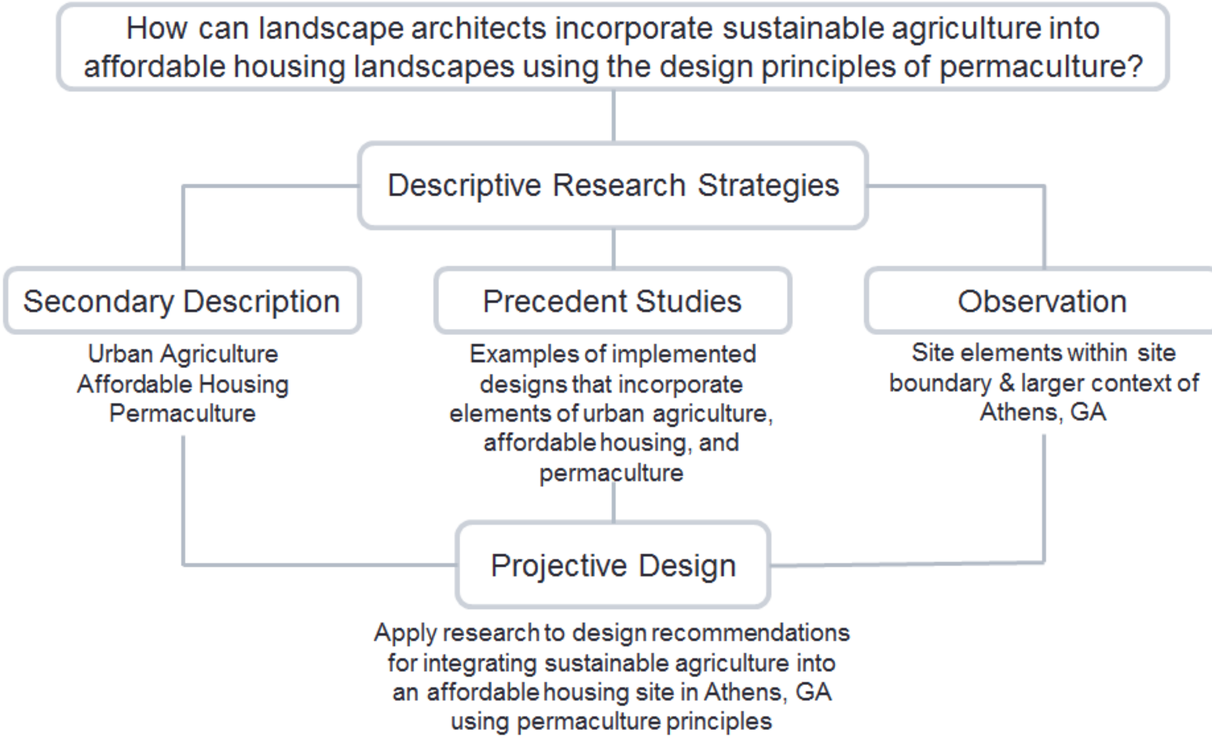
METHODOLOGY

The following methodology will be utilized to understand how landscape architects can incorporate sustainable urban agriculture into affordable housing landscapes using the design principles of permaculture. Each research strategy used is listed below and defined according to Deming and Swaffield (2011). How the strategy is implemented is also included, following the definition. Figure 1 depicts the methodology used in a diagram.

- Descriptive research strategies: compiling and writing down information gathered from readily available sources.

- *Secondary description,* which involves summarizing information from others, will be used to compile a literature review on topics pertaining to urban agriculture, affordable housing, and permaculture.
- *Precedent Studies* will be utilized to explore examples of implemented designs that incorporate elements of permaculture, urban agriculture, and affordable housing.
- *Observation* will be used to understand the site conditions for the projective design, including the surrounding context of Athens, GA.

- Projected Design: to use knowledge gained from previous research to design a solution for an affordable housing landscape that integrates urban agriculture with permaculture principles. Following a summary of the design will be a design analysis to understand the success and applicability of the design. (Deming and Swaffield 2011)



- Figure 1: Research Methodology Diagram (Adapted from Deming and Swaffield 2011)

SUBQUESTIONS

This thesis addresses the following subquestions:

1. How does living in a food producing, ecologically productive landscape affect users: Economically? Socially? Physically? Mentally?
2. How can landscape architects create sustainable landscapes that help alleviate food insecurity?
3. How can landscape architects incorporate permaculture principles into affordable housing landscape?
4. How can this landscape be designed specifically to cater to the

opportunities / constraints of affordable housing landscapes and residents?

THESIS FORMAT

The following chapter 2 includes the literature review that features a summarization of various relevant subtopics of urban agriculture, affordable housing, and permaculture. Each of these subjects is studied within the scope of how they interrelate and correspond to the specifics of this thesis.

Chapter 3 describes the precedent studies of Troy Gardens, Dr. George Washington Carver Edible Park, East Lake Commons, and the Piedmont Park Demonstration Orchard. A brief description of each site is presented in addition to applicable strategies that provide potential strategies for the design recommendations.

Chapter 4 is the compilation of the inventory and analysis completed for the design site of Cannontown Neighborhood in Athens, GA. This chapter looks at the site within in the larger context of Athens, GA in addition to specific site conditions that are applicable such as slope, aspect, and connectivity.

Chapter 5 summarizes the design recommendations for the Cannontown site. The design recommendations include a detailed planting plan, suggested future design of on-site structures, and a potential expansion proposition. It is followed by an analysis of the design.

Chapter 6 concludes the thesis by expressing final thoughts and summarizing the findings of the research and projective design. The following chapter starts off by looking at urbanization and its relation to urban agriculture.

CHAPTER 2

LITERATURE REVIEW: URBAN AGRICULTURE, AFFORDABLE HOUSING, & PERMACULTURE

URBAN AGRICULTURE

Introduction: Problems of Urbanization and Lack of Internal Food Production

In 2013, there was an urban population of 83% in the United States (World Bank 2014). Depending on the city, residential use comprises approximately 65-75% of the urban landscape (USGS). As urbanization increases, stress on existing ecological systems is exacerbated because of the high amount of natural resource consumption and waste production. High consumption of natural resources results from a variety of different sources ranging from people's unrestricted level of consumption and production, to rules and regulations that incentivize overuse or ignorance and confusion of the topic amongst populations (Walker and Salt 2006). The result of urban stressors leads to environmental issues such as urban heat island effects, degradation of urban soils, decrease in biodiversity, and infringed habitat areas (Pickett et al. 2001).

In addition to environmental issues associated with increased urbanization, social and economic issues have also arisen. One such problem is that urban residents with limited or low-paying employment opportunities face degraded food security and restricted food purchasing power (Armar-Klemesu 2000). Currently, highly concentrated urban areas result in an intensified separation between humans and the land that produces their food. A major difference between rural and urban areas is that urban residents rely more heavily on purchasing their food than rural residents who typically have the land capacity to produce their own food (Armar-Klemesu 2000). Cities require the majority of their food to be produced in distant landscapes and then transported into the city (Deelstra and Girardet 2008). This process results in high dependency on both motorized and airfreight transport, which negatively impacts the environment in relation to air pollution, fossil-fuel use, and degradation of wildlife habitats resulting from road building (SAFE Alliance 1994). From these concerns, a desire and need has emerged to limit reliance on outside food sources and to decipher new ways of producing food within city boundaries by residents and for residents.

Urban Agriculture: Definition

Urban agriculture is defined as "food and fuel grown within the daily rhythm of the city or town, produced directly for the market and frequently processed and marketed by the farmers or their close associates" (Smit et al. 1992, 141). Much of urban agricultural design incorporates community gardens, rooftop gardens, vertical walls, community involvement, elements of education, and trying to mimic natural systems in an urban setting (Gorgolewski et. al 2011; Pretty et. al 2010). In addition to vegetables grown in the previously listed forms of gardens, urban agriculture may also extend to include aquaculture, live-stock (mostly micro-livestock which can be raised in backyards or similar small areas), orchards which may include "orchards, street trees, and backyard trees" (Smit et al. 1992, 141). Gardens are designed for personal, community, or entrepreneurial benefit. The scale of these gardens ranges from pocket gardens to large industrial sizes. Urban gardens may be located on vacant or under-utilized lots and surfaces or in backyards or windowsills (Brown and Jameton 2000).

Urban Agriculture: An Alternative to Industrial Agriculture

Urban agriculture offers an alternative to industrial agriculture which treats the farm as a factory reliant on high cost, external inputs from sources such as pesticides that increase vegetable and animal production. The main objective in industrial agricultural systems is to increase yields and minimize costs of production (Horrigon et al. 2002). This form of food production was developed after World War II as a solution that guaranteed food safety worldwide. With the adoption of the industrial agricultural model, the need for an increased number of inputs led to a drastic rise in the consumption of pesticides, fertilizers, and water and a more frequent use of monocultures and shortened crop rotation times (Lichtfouse et al. 2009). Major concerns towards industrial agricultural systems include: decreased biodiversity due to over prevalent planting of monocultures; polluted soil, water, and air from use of synthetic chemical pesticides and fertilizers that degrade both ecological and human health; depletion of soil's structure, fertility, and nutrients that are vital for nutritionally-rich food; and high consumption of natural resources such as fossil fuels and water. In addition, a high use of antibiotics in meat production is raising antibiotic resistance in humans (Horrigon et al. 2002). Industrial agricultural systems lead to a decrease in ecosystem resiliency (King 2008). The previous list provides a brief description to aid in the understanding how urban agriculture, in particular sustainable agriculture, differs from industrial agriculture; however, the focus of this thesis is not directed towards thoroughly investigating industrial agriculture.

Urban Agriculture: Social, Economic, and Environmental Benefits

The benefits of creating productive urban agricultural spaces span across the realms of our society, economy, and environment. Overall, enhancing urban agriculture can lead to enhanced health and nutrition, a better living environment, more economic opportunities, and improved social equity (Smit et al. 1992).

Social Benefits

Social benefits include better urban food security, establishment of social programs that educate people on how to grow their own food, and allowing for people of diverse economic backgrounds to have the opportunity of growing their own food, as well as, creating social bonds amongst participants (Gorgolewski et. al 2011; Pretty et. al 2010). In urban neighborhoods, gardening is said to increase social capital such as enhanced trust amongst community members, more involvement in community activities, creation and advancement of community leaders, and sharing of knowledge, services and goods like harvested vegetables. Members of communities that participate in gardens express feelings of empowerment because they play a role in improving their neighborhood and creating community cohesiveness (Bellows et al. 2003). Even by experiencing small interactions with gardens such as passing by while walking has been proven to have a positive impact on communities' residents (Brown and Jameton 2000; Brogan and James 1980). Urban gardens can provide an escape from the busyness and turmoil of city life (Brown and Jameton 2000). Urban agriculture also supports a more highly connected community by bringing people closer to each other and to the food they consume (King 2008). In all, there is a wide range of societal enhancements that urban agriculture offers; physical improvements are described below.

Physical Health Benefits of Urban Agriculture

Bellows et. al. (2003) describe how urban agriculture can be extremely beneficial in terms of improved health and nutrition. When people are exposed to the processes of growing and harvesting food in addition to identifying different varieties of produce, they begin to make more positive decisions about their food habits. For example, when people grow their own food, they are more likely to consume it because they perceive it as good for them, thus leading to higher vegetable and fruit intake than people who did not garden. Eating more fruits and vegetables leads to a higher nutrient and low calorie diet for restricted income households because they usually chose to buy grocery food in bulk with the goal of filling them up rather than achieving proper nutrient levels. When people garden or buy their food from local farmers, they state that freshness is a main sought-after quality in their food. Studies now show that a food's freshness is linked to maintaining high levels of some of its nutrients. For instance, when food underwent a 5-10 day transportation and storage time period between production and consumption, certain nutritional elements were diminished between 30-50%. Beyond nutritional value, gardening also provides a good form of exercise. The exercise benefits of gardening vary from enhancing fine motor skills through activities like cutting flowers to aerobic gross motor abilities through more physically involved activities like turning compost piles. Participating in garden activities has shown a decrease in health risks such as obesity for children and adults, glycemic control and diabetes, coronary heart disease. Exposure to gardening also aided in illness prevention (Bellows et al. 2003). Beyond physical benefits, exposure to mental health enrichment has also been documented.

Mental Health Benefits of Urban Agriculture

In addition to increasing the nutritional value of one's diet, urban agriculture also positively impacts one's mental and emotional health. For people who are suffering from mental illness, interaction with plants and gardening materials has been shown to progress self-esteem, social skills, and use of relaxation time. Horticultural therapy uses plants to promote increased relaxation which lowers blood pressure, feelings of fear and anger, stress, and muscle tension (Bellow et al. 2003).

Economic Benefits of Urban Agriculture

Specifically pertaining to economic factors, urban agriculture plays a significant role during times of economic stress in reducing hunger and malnutrition. It can be seen as a source to reduce poverty when economic downfalls are occurring (Smit et al. 1992). In urban areas, low-income people are hindered by the dominant cash economy that impacts their access to food. The major factors that influence urban residents' access to food include: macroeconomic policies, employment and cash income, markets and food prices, and finally urban agriculture (Armar-Klemesu 2000). Urban agriculture also creates a niche for a local economy (Gorgolewski et. al 2011)

Macroeconomic policies that impact urban peoples access to food include decreased employment opportunities, increased urbanization, enlargement of urban areas, high price of land, and limited availability of land that could be used for local food production. However, the most important factor remains the high price of urban food (Armar-Klemesu 2000). Employment and cash income is a pivotal aspect in determining urban people's food security levels because many urban workers face low wages and low-income families can at most spend 60-80% of their income on food (Tabatabai 1993, Maxwell et al. 1999).

Food prices within an urban food market are reliant on a variety of factors that impact the food marketing and distribution system. Because more people are moving into urban areas, the demand for food has also risen. Thus, food supply and distribution systems have accounted for this influx producing food on distant industrial farms. The resource intensive process that follows harvest includes "handling, processing, packaging, transport, storing, marketing", amongst other procedures, of which each step increases the final cost of food (Armar-Klemesu 2000, 102).

In response to the previously described economic barriers to food accessibility, urban agriculture offers an affordable alternative by providing better access to food that is separate from the costly industrial farming system (Armar-Klemesu 2000).

Ecological Benefits of Urban Agriculture

Introducing urban agriculture into cities has a diverse range of positive impacts on the environment. Practicing sustainable urban agriculture reduces the use of chemicals and non-renewable resources that are associated with industrial agriculture such as oil for transportation (Gorgolewski et. al 2011). It also can lower pollution levels in low-income neighborhoods that lack vegetation by providing additional plant material (Smit et al. 1992). Urban agriculture increases biodiversity of plant species and attracts beneficial species such as microorganisms, birds, insects, reptiles, and animals. Serving as an urban greenspace, gardens also create the potential for species preservation. For example, gardens offer resources like food, a place for rest or temporary habitat, and protection for birds and butterflies that are along migratory flight paths. If proper safety precautions are installed, urban gardens can also lessen soil erosion and ground water contamination. Plants can play a strong role in reducing urban soil and air contamination and pollution levels by filtering chemicals through their root systems and foliage (Brown and Jameton 2000). The physical climate of a city is also beneficially impacted by urban agriculture because vegetation can increase humidity, lower temperatures, provide pleasant smells, filter dust and gas polluted air, and provide shade and sheltered areas by intercepting wind and blocking solar radiation (Deelstra and Girardet 2008). Because urban agriculture shrinks the distance that food is transported, CO_2 emissions and other polluting gases are reduced. Also, the net discharge of CO_2 is lessened because vegetation added through urban agriculture captures carbon dioxide. This decrease in CO_2 is significant because it is a lead contributor to global warming (Deelstra and Girardet 2008).

Deelstra and Girardet (2008) conclude that, in all, the knowledge of and direct interaction with food growing processes increases one's environmental awareness. Urban dwellers often have no interaction with the way their food was grown other than when they purchase it at the grocery store. Therefore, they are ignorant of the impact that growing their food may have on the land such as decreasing its fertility. However, when people begin to understand the process of growing and harvesting food, they grow more aware and interested in how the food that they consume was produced and its environmental impact. When that environmental impact is negative, it can be learned of more easily and therefore acted upon more efficiently. In turn, the knowledge and experiences of growing one's own food aids in the understanding of urban dwellers and their role in natural food chains (Deelstra and Girardet 2008).

The Need for Urban Agriculture

The concern for and interest in urban agriculture has greatly increased over the past few years due to several factors. These include climate change, an emphasis on more equitable economic models that consider access to local, sustainably produced food, and a concern for healthier diets, amongst others. While the ideas of producing fruits and vegetables close to a city's core is not new (emerging in 1826 via Johann Heinrich von Thunen), there is a need to reestablish productive agricultural space in cities (Gorgolewski et. al. 2011).

Challenges of Urban Agriculture

Landscape architects are designing innovative ways of bringing agriculture into the city within the constrictions of space, limited green areas, and high density of people and structures. (Gorgolewski et. al 2011). Integrating agriculture into urban areas may come into conflict with a range of factors. First, many people who participate in urban agriculture are not the owner of the land being used to grow food. Brown et al. (2003)

explain that this is problematic because “without title, or three to five year leases”, the land may be seized for other uses and thus the farmers lose their investments of time and resources. For people with lower incomes, start-up costs that would cover labor, site management, tools and equipment, water, labor, rent and insurance, “processing, packaging, and marketing materials” may cause a barrier to moving forward with installation (Brown et al. 2003, 14-15). Also, people may have little to no previous experience working with agricultural systems and therefore lack the knowledge and skills that help ensure successful yields that contribute to overall food security. Seasonal restrictions such as harsh winters may limit the year-long availability of food access. A counter to this predicament is food preservation but again users may not have knowledge or resources to preserve their harvested foods. Finally, while there are many positive health benefits that urban agriculture can bring to users, there are some possible negative impacts that may result from growing food in urban areas such as contamination. For example, soils may contain harmful heavy metals like lead or from run-off of polluted surfaces like roads (Brown, Carter et al. 2003). Therefore, it is crucial to be careful when choosing a location for the garden and also performing necessary soil tests. In contrast, agricultural products like chemical fertilizers and pesticides may be transferred on accident to surrounding areas and people. For example, during a storm event, run-off from one’s garden could potentially infiltrate storm drains contaminating rivers and city water supplies (Brown and Jameton 2000). However, if organic gardening practices are implemented then this issue is reduced.

Urban Agriculture in Low-Income Neighborhoods

Research has shown that low-income communities exceedingly value the positive benefits of community building achieved through urban agriculture (Bellows et al. 2003). While low-income urban residents are not the only people who participate in urban agriculture, it can play a more vital role in acquiring nutrition and supplementing income (Deelstra and Girardet 2008). There is already a significant number of low-income families that rely on produce obtained from their gardens to support their daily diets. If more people were equipped with the knowledge, skills, resources, and land then they too would participate in gardens (Brown and Jameton 2000). Urban agriculture plays an important role in empowering low-income neighborhoods through increasing community participation and perpetuating social change which instills a sense of place and enhanced community pride (Brown and Jameton 2000; Lewis 1992). Smit et al. concluded through their studies that low-income neighborhoods serve as the best place to begin installing urban agriculture infrastructure that would lead to more ecologically sustainable cities because the environmental conditions in these communities are exceedingly worse in comparison to other wealthier neighborhoods. The poor environmental conditions of these neighborhoods then transfers to the surrounding city areas and bioregion (Smit et al. 1992). Urban agriculture serves as an important tool in improving ecological, social, and economic conditions in low-income neighborhoods because it is “low-capital and high-labor” (Smit et al. 1992, 152). It not only enhances the ecological health of these neighborhoods such as decreasing pollution with the addition of more vegetation but it also provides food, physical and social well-being, and economic security through creation of jobs and reduced food costs (Smit et al. 1992).

Ecosystem Services and Urban Agriculture

Urban agriculture provides cities with integral ecosystem services. Ecosystem services refer to "the benefits people obtain from ecosystems" (Sandhu and Wratten 2013). Ecosystem services support human populations through four service types: "supporting" services such as water and nutrient cycling, "provisioning" such as food production, "regulating" such as water filtration, and finally "cultural" services like providing aesthetic value. In relation to ecosystem services, ecosystem functions pertain to the ability of "natural processes and components to provide goods and services that satisfy human needs, directly or indirectly" (de Groot 1992). In most urban areas, nature and ecosystems are often more severely degraded because of overuse in relation to non-urban areas. They can be so greatly hindered that eventually no services are provided in these urban areas (Breuste et al. 2013). Integrating agriculture into urban areas can provide a means for repairing some of these degraded or lost ecosystem services. The following chart summarizes the ecosystem services that agriculture provides.

Regulating Services:

Ecosystem Service:	**Example:**
Gas Regulation	CO_2/O_2 balance
Climate Regulation	Greenhouse gas regulation
Disturbance Regulation	Flood control; drought recovery
Water Regulation	Irrigation
Water Supply	Watersheds, reservoirs, aquifers

Erosion Control & Sedimentation	Erosion control; reduction of run-off
Waste Treatment	Detoxification; pollution control
Refugia	Habitat for migratory species

Provisioning Services:

Food Production	Production of fish, crops, nuts, fruits
Raw Material	Production of lumber, fuel, or fodder
Genetic Resources	Products for materials science
Ornamental Resources	Horticultural products, flowers
Medicinal Resources	Products used in medicines

Supporting Services:

Aesthetic Information	Landscaping of gardens
Recreation	Outdoor activities
Cultural and Artistic Information	Aesthetic, artistic, education, spiritual value
Spiritual and Historic Information	Associated history of farming practices
Science and Education Information	Research and development

Supporting Services:

Pollination	Reproduction of plant populations
Biological Control	Control of prey species

Carbon Accumulation	Regulation of chemical composition
Mineralization of Plant Nutrients	Nitrogen fixation
Soil Formation (Maintenance of Soil Health)	Structure maintenance
Nitrogen Fixation	Legumes fixing nitrogen
Services Provided by Shelterbelt	Windbreaks

Table 1: Ecosystem Services & Examples Chart (Adapted from Wratten et al. 2013)

Conclusion

In conclusion, urban agriculture offers a variety of benefits that span across our society, environment, and economy. As mentioned above, implementation of urban agriculture can be specifically positive for people in low-income situations, such as providing community strengthening opportunities, economic assistance by offering alternatives to high urban food prices, and creating a healthier and aesthetically pleasing landscape to live in. Thus, affordable housing will be discussed in the next chapter to better understand it as a potential location where urban agriculture can positively impact the lives of lower income urban residents. In addition, affordable housing specific to Athens, GA will be addressed to provide a background for the projected design site.

AFFORDABLE HOUSING

Figure 2: Affordable Housing (Jones et al. 1995)

Affordable Housing: Overview

In the 21st century, approximately 100 million people located in the United States live in housing that is located in unsafe areas, too small for the number of residents, beyond budget, or in poor physical condition (Bratt et al. 2006). The 1949 Housing Act, which was passed by congress, aimed at ensuring that every American family had a decent home and suitable living environment. However, this has not been achieved. Besides the physical necessities of providing shelter, emotional and physical health components are also associated with proper housing. Housing problems have occurred because of widening income inequality, housing discrimination, overdependence on debt and capital markets, and incompetent public policies (Bratt et al. 2006).

Affordable housing refers to housing that “consumes no more than 30 per cent of a household’s income” (Jones et al. 1995, 14). It was established to assist families who are in need of government assistance in paying for their housing to prevent rent from draining a majority of a family’s income. When people pay more than 30 percent of their income towards housing, they often struggle to acquire other essential needs like clothing, food, transportation, and medical care. It is estimated that 12 million renter and homeowner households are paying over 50 percent of their annual incomes towards housing (U.S. Department of Housing and Urban Development: http.www.portal.hud.gov, 2014). Inflated local housing markets are often too expensive for people with low paying job salaries to rent or own a home, especially in urban areas. As the number of people with restricted salaries has risen, the amount of low-cost housing has decreased. This decrease has been the result of wealthier home-seekers creating a highly competitive housing market as well as destruction of existing buildings and expiration of HUD subsidies on current buildings. Many people who are limited by their low income level are forced to rent their homes instead of owning them (Jones et al. 1995).

People who live in affordable housing developments typically hold jobs in their communities producing goods and services for that area and surrounding region. These jobs are typically low-paid service jobs that are essential for the community such as police officers, nurses, entry-level firemen, teachers, farmworkers, restaurant workers, and mechanics (Jones et al. 1995).

Jones et al. (1995) describe a range in family structure’s present in affordable housing developments. However, single-parent families are increasingly in need of affordable housing because there are fewer sources of income within these families and they often have young children. Additionally, families may be in need of additional support systems such as job training tools and childcare services. Currently, almost one-third of single-mother families are in poverty. Alternatively, large families are another form of family structures that are limited by opportunities within the private housing market. It is difficult to find affordably priced four- or five-bedroom units that have the space required for large families. It is much more common to find one- or two-bedroom homes, which would be too small for larger families who may only have two or three children but who are also housing grandparents or other extended family members have moved in. When large families are unable to find suitable housing, they are often subject to overcrowding within homes until children are old enough to gain enough financial support to acquire a home of their own (Jones et al. 1995).

Affordable Housing: Athens, GA

Affordable housing options are offered to residents through several different organizations in Athens-Clarke County: Athens Land Trust, Athens Housing Authority, and Habitat for Humanity. The Athens Land Trust (ALT) is a private, non-profit 501(c)(3) corporation that was founded in 1994. The intention of ALT is to promote “land preservation, affordable, energy efficient housing, and neighborhood revitalization”. In addition, ALT aims at addressing sustainable development by meeting “environmental, economic, and community needs” (Athens Land Trust: www.athenslandtrust.org, 2014). ALT sells affordable homes to families or individuals and offers the homebuyer a 99-year renewable ground lease for the land. Many of the houses that ALT offers as an affordable housing option have been renovated from previously vacant homes. In turn, this rejuvenates neighborhoods and reduces crime. Also, it helps increase a sense of community interest because homeowners feel an obligation to pay careful notice to their investment and thus the upkeep of the surrounding neighborhood. Creating affordable housing opportunities is also beneficial to those residents in need because in many neighborhoods throughout Athens, rental rates are continuing to rise making it very difficult for people with lower-incomes to keep up with the rental market prices. Thus, by participating in the affordable housing program, people can remain in the neighborhood in which they grew up. ALT's affordable housing program also contributes to the overall preservation of the historic character of Athens by renovating historic homes that would else be demolished (Athens Land Trust 2014).

The average monthly payments for ALT affordable homes, which include taxes and insurance, range between $500-$725 at current interest rates. Overall, ALT wants to help residents of Athens-Clarke County towards purchasing their own home to avoid the inefficient process of renting a home for their entire lifespan (Athens Land Trust 2014). In order to be eligible to purchase a home through ALT, a family or individual cannot make more than 80% of the area's median income. Table 2 defines the income limitations for affordable housing in Athens-Clarke county.

Number of Family Members	1	2	3	4	5	6
Maximum Family Income	$31,100	$35,550	$40,000	$44,400	$48,000	$51,550

Table 2: Affordable Housing Income Chart (Athens Land Trust 2014)

Athens Housing Authority also offers affordable housing options for people of various incomes who lack the ability to purchase a home within the current housing market. They have established two programs that address a diverse range of incomes. First, their ACT I Homes program is targeted towards moderate-income families who have previously only been able to afford rental homes. Their ACT I Homes program is in conjunction with Athens-Clarke County's Department of Human and Economic Development (HED) and it offers long-term property tax benefits to the overall community in addition to enhancing homeownership rates. Their goal is to contribute to the development of "healthy, viable neighborhoods" (Athens Housing Authority: http://www.athenshousing.org/affordable-homeownership, 2014). Athens Housing Authority has put much effort towards rejuvenating downtown neighborhoods using funds from both Community Development Block Grants (CDBG) and HOME funds administered by HED. Athens Housing Authority in addition to the ACT I Homes program has also established the Protector Program for homebuyers with higher incomes that carry jobs in the following: Athens-Clarke County (ACC) Police Officers, ACC Fire Fighters, Clarke County Sheriff Deputies and Correctional Officers, Clarke County School District Employees, and UGA Police Officers. Finally, Athens Housing Authority additionally offers teachers, health employees, and first responders assistance towards down payments and homebuyer incentives through the Georgia Department of Community Affairs (DCA) (Athens Housing Authority 2014).

According to the Athens Housing Authority, the typical ACT I Homes buyers are working families with a moderate yearly income, averaging between $25,000 and $35,000. These homebuyers are predominately school district employees, state employees, health care professionals, retirees, and retail managers. Thus, homebuyers are from various private or public sectors. The monthly payments per home in the ACT I Homes program, including property taxes and insurance, range from $600-$750. The following requirements must be met by any potential homebuyer interested in an ACT I home:

1. “Have a household income of no more than 80 percent of the median income for Athens-Clarke County (see chart below) but at least $22,000 annually in order to have sufficient funds for mortgage payments, taxes, insurance, and other household and family expenses.”
2. “Attend housing counseling.”
3. “Have a credit score of 600 or more.”
4. “Have a minimum down payment of $1,000.”
5. “Be financially qualified to obtain a mortgage.” (Athens Housing Authority 2014)

Athens Area Habitat for Humanity is a division of a global, nonprofit housing organization that aims at providing decent, safe, and affordable homes for the Athens community. Habitat for Humanity offers affordable homes to people who are living in below standard housing situations such as under roofs that leak, without heat, or not enough room for one’s family to live comfortably. In order to be eligible for one of their homes, one must demonstrate that there is a need for a house because one is currently in a poor living situation, that they will be able to afford a monthly mortgage payment (must still fall within the income ranges set in Athens Area Habitat income guidelines), and also “sweat equity” meaning that the homeowner must commit 500 hours of helping to complete a habitat home. Habitat for Humanity has been building affordable homes in Athens for 25 years (Athens Area Habitat for Humanity: http://www.athenshabitat.com/, 2014).

Conclusion

In all, affordable housing offers an outlet for people who do not have a high enough income to afford buying a home within the current high housing market. A variety of people in both private and public job sectors consisting of multiple family structures meet the previous description. Athens, GA provides residents with various means for acquiring an affordable home. For the purpose of this thesis, an affordable housing community developed by the Athens Land Trust will be focused on in the projected design. As previously mentioned, affordable homes present a unique opportunity for lower income urban people to engage with agriculture in their landscape. Taking urban agriculture a step further, permaculture will be discussed in the following chapter as a potential design approach.

Permaculture

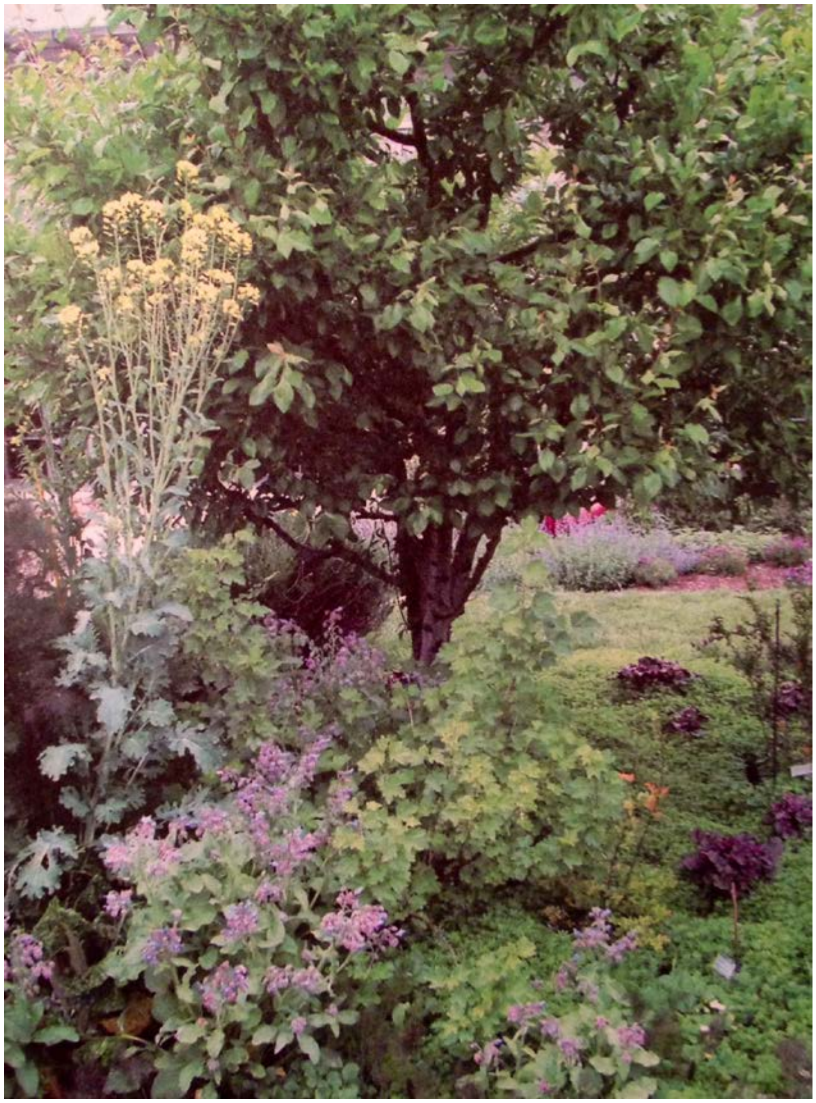


Figure 3: Permaculture Landscape (Jacke and Toensmeier 2005)

Sustainable Agriculture

Sustainable agriculture encompasses a variety of ideas and techniques but overall, it is agricultural practices that produce systems that are capable of sustaining themselves over an extended period of time, are economically feasible, ecologically supportive, and socially equitable (Lichtfouse et al. 2009). There are a diverse range of types of sustainable agriculture. Certain forms of urban agriculture fit under the concept of sustainable agriculture.

Sustainable agriculture coincides with the principles of sustainable development because they are both centered on healthy economies, societies, and environments. The Brundtland Report defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission 1987). Sustainable agriculture supports this definition via two approaches. First, it is based on the principle that the agricultural system is capable of supporting itself for a lengthy period of time through the protection of the resources that sustain it, such as soil, groundwater, and energy sources. The previously described approach relies on farming as a closed loop system. The second approach sees the intent of sustainable agriculture as much broader and addresses the sustainability of both land and society. For example, sustainable agriculture has a duty to provide solutions to issues caused by urban areas such as waste management or employment for people outside of cities (Lichtfouse et al. 2009).

Permaculture: Definition and Principles

Permaculture is one form of sustainable agriculture and the design method used in the projected design of this thesis. Permaculture is a design approach that was first created through the collaboration of Australians Bill Mollison and David Holmgren in the mid-1970s. Their first book, *Permaculture* One, was completed in 1978 and was produced as an attempt to help think through and address the environmental catastrophe of modern society (Holmgren 2002). Permaculture accesses a set of guidelines that aims at achieving both permanent agriculture and permanent culture (Veteto and Lockyer 2013). Permaculture is defined as "an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man" (Mollison and Holmgren 1981). While the previously mentioned definition remains integral, a more current definition describes permaculture as "consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs" (Mollison and Holmgren 1981). Therefore, permaculture is centered on how a landscape can cater to its human inhabitants. The people, architecture, and social structures present in those landscapes are inherent to the success of the designs (Holmgren 2002). Overall, permaculture aims at caring for both the land and people while restricting external inputs and reallocating surplus (Holmgren 2002). Permaculture sees the system as a whole and looks into the relationships between individual components, the functions of those components, and the humans who participate within the system (Flores 2006).

Permaculture is a desirable form of landscape design for those seeking to develop systems that are based on self-sufficiency and resiliency. It creates a productive relationship between people and their landscape such that the land provides "food, energy, shelter, and other material and non-material needs in a sustainable way" (Mollison 1990, ix). As mentioned previously, industrial agriculture relies heavily on high external energy inputs rather than efficient or sustainable sources (Horrigon et al. 2002). Permaculture may offer an outlet for people who want to break from the industrial food system and especially for residents that are challenged by increasing food costs.

Some key characteristics of permaculture include that it is typically designed to be highly intensive in regards to the planting elements. In addition, it uses diverse, long-term, wild species for planting so the resiliency and self-dependency of the plants is high. Also, it relies on the integration with disciplines and strives to be adjustable to a variety of land types (Mollison and Holmgren 1981).

The labor input of permaculture gardens is to be minimal after the establishment of the garden. After establishment, the majority of labor tasks are limited to pruning, harvesting when needed, and minimal weeding in the annual beds (Mollison and Holmgren 1981). The challenge of permaculture is "to design an integrated system in which individual component support and help to sustain the other pieces of the system (Patterson 60). Overall, permaculture changes people's role in agricultural systems and focuses on a long-lasting mutually benefitting relationship between people and the land that minimizes external inputs.

The twelve overarching permaculture design principles that include:

1. Observe and Interact
2. Catch and Store Energy
3. Obtain a Yield
4. Apply Self-regulation and Accept Feedback
5. Use and Value Renewable Resources and Services
6. Produce No Waste
7. Design from Patterns to Details
8. Integrate Rather than Segregate
9. Use Small and Slow Solutions
10. Use and Value Diversity
11. Use Edges and Value the Marginal
12. Creatively Use and Respond to Change (Holmgren 2002)

The Concept of Resiliency

The concept of resiliency refers to “the capacity of a system to absorb disturbance and still retain its basic function and structure” (Walker and Salt 2006, 1). This is also a desirable goal for permaculture designs. By encouraging a resilient system, the various components of that system including humans, vegetation, and animals amongst others are all positively affected. Examples of attributes that indicate resiliency of a system include self-reliance, economic capability, health, community strength, and productivity (Falk 2013).

Permaculture Design Process: Observation

The first step in developing a design to transition the current landscape of the affordable housing development according to the methods of design of permaculture is observation of the different components interplaying in your specific site ad what resources are accessible for the project before acting (Hemenway 2009). These components include human resources, site components, outside resource components, social components, and abstract components. Site components include elements such as water, earth, landscape, climate, existing vegetation, and successional stage of ecosystem present on site which includes both plants and animals. Outside resource components include money, energy, technologies, and materials available or intact. Social components are legal aids, people, culture, trade and finance, as well as desires of neighbors and other people in the region. Finally, abstract components refer to timing, data, and ethics. (Mollison 1990). Falk (2013) lists many of the site conditions to be taken into consideration:

Land Analysis Attributes

Context

- Soils and geology
- Climate
- Ecology, wildlife, forest cover
- Economic / social / cultural / legal

Site Scale

- Slope and topography
- Aspect
- Microclimate
- Soils
- Vegetation
- Wildlife
- Views
- Water / hydrology
- Access and circulation
- Infrastructure
- Soundscape
- Historical and exceptional features (Falk 2013)

After listing characteristics of each component for the project, connections must be drawn so that there is a "beneficial assembly of components in their proper relationships" (Mollison 1990, 37). For example, when given the components of a rain barrel with rain chain, chicken, and seed baring tree, one might place these in close proximity so that the chicken can drink water from the rain barrel and eat the seeds while his manure fertilizes the tree and the rain barrel saves the owner money on his water bill (Mollison 1990).

On-site observation should be value-free and non-interpretive. (Mollison 1990) Important factors to note include climate, microclimate, and landform of the site. Climate can be a limiting factor in design choices like plant palettes. It is crucial to look at average winter lows and summer high for temperature (Mollison 1990). One can decipher the array of plants that can successfully survive in one's climate by looking at those temperature ranges.

Minimizing the scale to the specific site will begin to expose the microclimate conditions. A microclimate refers to any specific area within a greater area of a different climate (Falk 2013). At the microclimate level, environmental conditions are "affected by local factors rather than climatic ones", which include topography, soil, vegetation, water masses and man-made structures" (Mollison and Holgrem 1981, 37). Then by overlapping these characteristics with the regional ones of climate, one can measure temperature and temperature ranges; wind speeds, ranges, regularity and direction; relative humidity and its range; and types of precipitation (Mollison and Holgrem 1981).

Several factors affect microclimate, one of which is vegetation. For example, typically vegetated microclimates tend to be mild because of the increased amount of radiation intake and lower wind impact (Mollison and Holgrem 1981). Each type of specific vegetation situations have various effects on microclimate; however, overall having a largely diverse set of plant communities that have wide-ranging microclimates promotes an environment where many plants can thrive and the benefits of multiple systems emerge. As for affordable housing developments, diversity of plants are typically low, therefore, it would be important to focus on amplifying the diversity of the vegetation present. This can be done through several methods including designing a mix of “forest, clearing, hedgerow, field, woodland and intensive crop cultivation” (Mollison and Holgrem 1981). One way of designing this is through “zoning” which will be discussed later.

Water masses can also moderate microclimate. However, on a small scale like affordable housing developments, ponds and dams are more important for their reflection of light. In the design phase, if no ponds are present on site these could be added strategically to serve as bioretention areas in order to mitigate storm water (Mollison and Holgrem 1981).

Finally, observation of man-made structures is also very important when analyzing a site. Taking note of where these are located on site and how people move about the site helps dictate where certain plants should be planted. If possible, a greenhouse may be useful for an added structure in order to extend the growing season and provide a place to grow transplants. Mollison and Holgrem (1981) also state that a greenhouse can serve as a means for heating an adjacent house. Looking at the microclimate of north-facing walls is significant because they act similar to a north-facing forest edge, providing shelter from potentially damaging cold southerly winds and reflective winter sun. Walls also capture and hold heat which is then radiated out at night, thus minimizing frost risk. The most efficient walls for this process are dark, rough stone walls (Mollison and Holgrem 1981).

Landform refers to the mostly unchangeable characteristics of a site. It has great influence on water retention, microclimate, soil depth and character, and drainage (Mollison and Holgrem 1981). When analyzing topography, note the aspect of the site which refers to the orientation of the on-site slopes. This can affect the amount of sunlight that reaches plants. For example, northeast aspects culminate the most direct sunlight in the morning, while northwest slopes gather heat slowly throughout the day while still reaching high temperatures, which can be good for plants because it slowly defrosts them rather than rapid defrosts. Different plants prefer different conditions so it is important to learn what plants are necessary to place in an affordable housing development and on what part of the site those plants will receive the amount of sun necessary for success. Topography can also affect wind, including changing direction of prevailing winds, providing shelter from wind, or increasing speed of winds. (Mollison and Holgrem 1981).

Soils are one landform characteristic that can be improved soil quality through adding mulch and compost (Mollison and Holgrem 1981). Sowing legumes is also beneficial because they are nitrogen fixers. Specific site factors that can hint towards the condition of the soil include depth, water reserves, pH, mineral status, fire frequency, frost, drainage, mineral deposits and rock type, compaction of soil, and animal effects. (Mollison 1990).

Permaculture Design Process: Design Criteria

Ben Falk (2013) describes that the next step in the design process is to integrate design goals into the previous observations and inventory of site conditions and the form “design criteria” (Falk 2013). This is also referred to as the “visioning” step (Hemenway 2009). Falk explains that the intent of setting such design criteria is to assess what the design needs to accomplish within the confines of the site context and desires of the client. Another important purpose for setting design criteria in the onset of the design process is for reference throughout the design process in order to ensure that the design is achieving one’s initial goals. An efficient way to organize design criteria is through dividing them up into what aspect of the design is being addressed. For example, a large commercially oriented farm with education and research elements might have three broad categories of vegetation, infrastructure, and social spaces. Next within those broader categories individual design criteria such as using self-maintaining plants (vegetation category) or ensuring wheelchair accessibility (social spaces category) can be listed out. It is integral to think of the design criteria as “quality control points” by which you can gage the success of your design (Falk 2013, 61). After listing out all of the design criteria, then the designer should prioritize the criteria based on most pressing issues or most adamant requests of the client (Hemenway 2009).

Permaculture Design Process: Schematic Design

After setting criteria goals and exploring the existing interplaying site conditions, Falk states that the designer may begin a schematic design process where many different options are explored. Start by visualizing the various possibilities through mapping and drawing them out both in plan-view and cross-sectional views. Through a study process, the designer can begin to narrow the range of possibilities into those that crucially address the specific goal and site circumstances of the project. Elements to consider when working through the schematic design include implementing measures that create microclimates that benefit the conditions one is designing for and maximizing diversity and connectivity. Creating a desired microclimate can be accomplished through site design of elements such as bodies of water, walls, trees, and roofs. Diversity and connectivity can be achieved through choosing a wide range of crops which includes varieties of plants that can withstand temperature fluctuations, whether colder or warmer (Falk 2013). During this portion of the design process, the designer begins to synthesize the criteria goals and the resources available. Patterns and a framework begin to outline how the goals will become reality and organize individual pieces of the project into a comprehensible whole (Hemenway 2009). Permaculture offers design techniques such as permaculture zones and sectors and forest gardening that help organize design elements.

Figure 4: Permaculture Zone 1 (Falk 2013)

Permaculture Design: Zones

Permaculture design principles think of the site in a series of “zones” when deciding where the plants and other elements of the design should be located. When implementing this system to affordable housing, some alterations may be necessary. First, the standard zone system will be described. Mollison states the zones should be viewed as a “series of concentric circles, the innermost circle being the area we visit most frequently and which we manage most intensively” (Mollison 1990, 49). Zones are useful because they allocate energy and resources used on site most efficiently to the occupants. There is slight variation between permaculturalists as to what each zone entails and sometimes the number of zones fluctuate. The following is a summary of the variety of zones found through research of various sources:

Zone 00 refers to the human being component and all that it entails such as one's mental, physical, and spiritual self (Falk 2013)

Zone 0 consists of the house or village, with special attention to the location of the kitchen. Here is where the main living unit is located which can also include an attached greenhouse. This zone is occupied the most frequently throughout the day. Additional components include vines, trellis, potted plants, green roofs, and companion animals (Mollison 1990).

Zone 1 includes the components of the site that will need the most attention and maintenance and receives a high level of use. This zone is typically sited within the first 20 feet of the home. This is where annual vegetable gardens and rainwater harvesting systems occur as well as trees that require intensive pruning and nutrient recycling systems for household wastes (Mollison 1990). Parking is also located here (Falk 2013).

Zone 2 requires less upkeep and maintenance than zone 1 and includes main-crop annual beds such as potatoes, perennials like berries and fruit tree orchards, domestic animals that need land to roam such as milk cows, goats, or poultry, and mushroom growing areas (Falk 2013).

Zone 3 is visited only a few times a week and would contain the "hardy permaculture" of the site. This would include products that are mostly for animal sustenance and consist of a "tough understory and self-perpetuating herb layer or pasture" (Mollison & Holgrem 1981, 56). This zone could also consist of a commercial crop or animal that could be used to generate sales profit. (Mollison 1990, 50). Another source also uses this zone for mushroom yards and remaining orchards and nut producing plants (Falk 2013).

Zone 4 requires very little maintenance and is rarely visited. Here is where an “extensive tree culture” is planted. This area borders the forest but is still maintained to provide “wild gathering, forest and fuel needs of the household”, and grazing land. The trees here should be “hardy, unpruned, or volunteer trees” (Mollison 1990, 50). Some forest garden area can also extend into this zone (Falk 2013).

Zone 5 is considered the unmanaged portion of the site which consists of the natural vegetation unmanaged by humans. Occasional uses may be hunting and light timber gathering. (Mollison and Holgrem 1981). Overall, this zone is only used for observation and is not cut, harvested, or foraged in any impactful manner. However, depending on site conditions, zone 5 may be nonexistent or very limited (Falk 2013).

When looking at how these zones can be applied to affordable housing, some zones might need to be altered or changed to better suit the residents. For example, instead of a commercial crop, each family would be given a small plot area to do what they want with in zone 3. Also, another important element to integrate would be some kind of community space or central gathering area for social events or community teaching events. Figure 8 depicts how the zone design technique has been adapted to a typical ¼ acre suburban lot. The zones are no longer concentric and elements have been shifted into different zone areas to better adapt to suburban residents’ needs. Overall, the zones provide a strong basis and design structure to adapt to the specific needs of the affordable housing development.

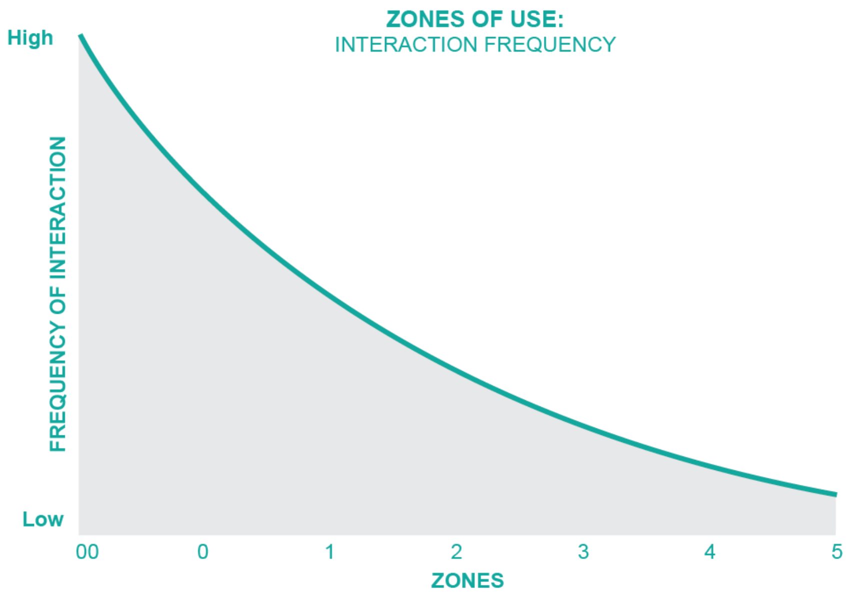


Figure 5: Permaculture's zones in relation to level of interaction (adapted from Falk 2013)

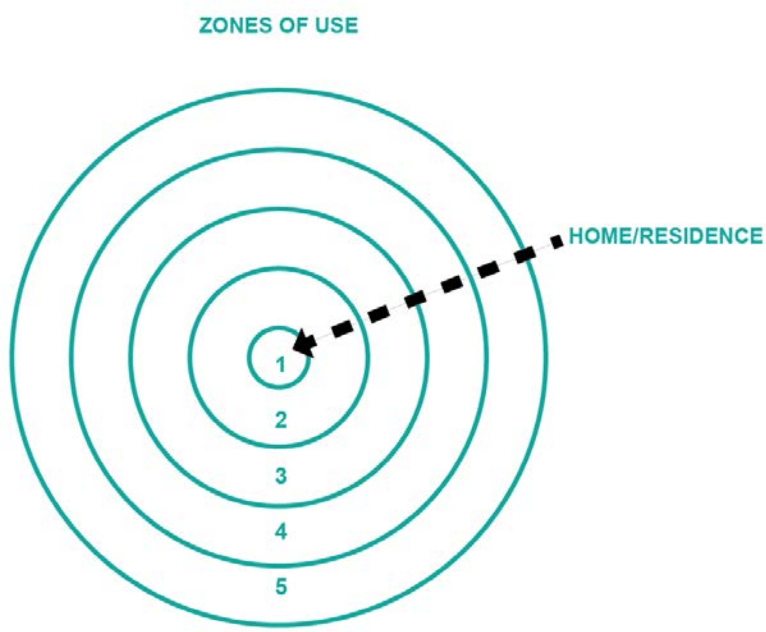


Figure 6: Zones Layout (adapted from Falk 2013)

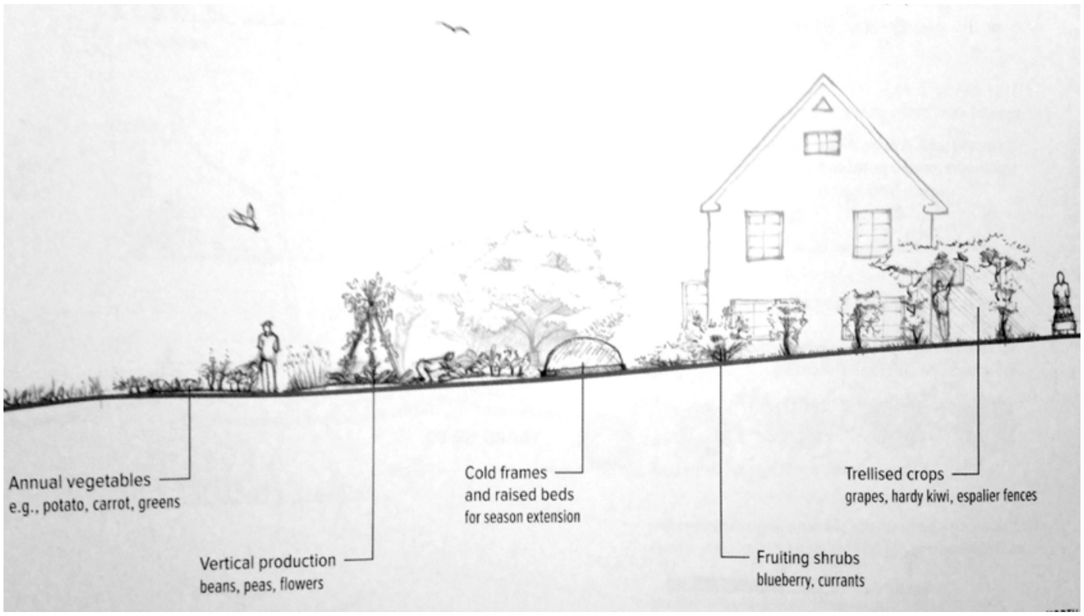


Figure 7: Section of Zone 1 (Falk 2013)

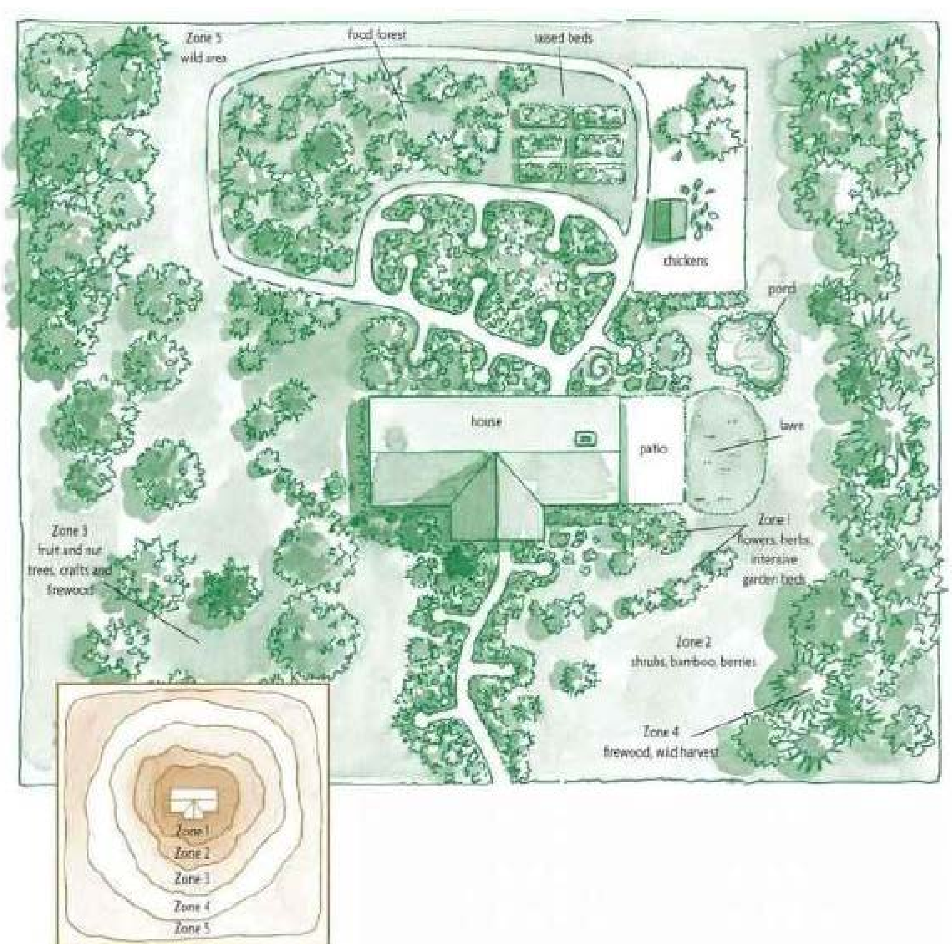


Figure 8: Zones adapted to suburban lot (Hemenway 2009)

Permaculture Design: Forest Gardening

"Forest gardening" is a design approach that is integrated within the theories of permaculture and offers benefits within a design of an affordable housing landscape. A forest garden is "a largely self-regulating, developing ecosystem that requires minimal maintenance" (Hart 1996, 51). In order to achieve the effect of little human upkeep, one designs the garden into a series of "stories":

1. Canopy: standard or semidwarf fruit trees
2. Low-tree layer: fruit and nut trees on dwarfing rootstocks and bambo;
3. Shrub layer: such as currant and gooseberry bushes and Rosa rugosa
4. Herbaceous layer: herbs and perennial vegetables
5. Vertical layer: climbing berries, nasturtiums, runner beans, and vines, trained up trees, over fences, and over a shed
6. Groundcover layer: creeping plants such as Rubus species
7. Rhizosphere: shade-tolerant plants and winter roots vegetables

(Hart 1996, 51)

As a subset of permaculture, forest gardening relies on the functions of each individual component working to benefit all the others. A benefit of forest gardening that would apply to affordable housing is its efficient use of space. Because space can be limited in affordable housing landscapes, creating an efficient spatial management plan is critical.

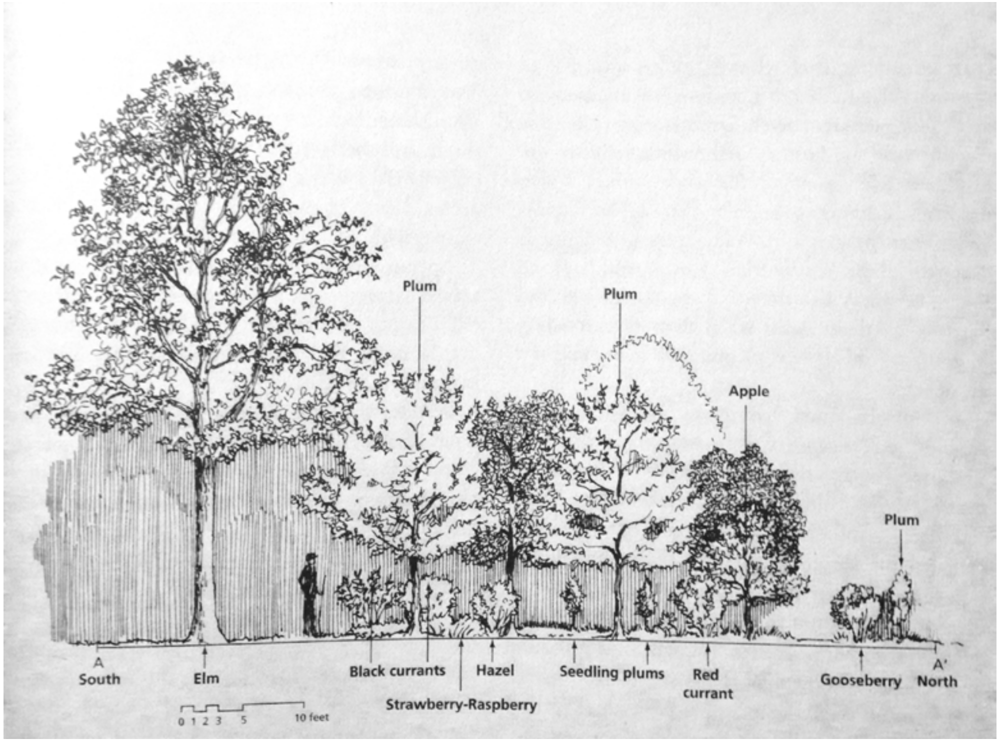


Figure 9: Orchard Layers Section (Jacke and Toensmeir 2005)

Permaculture: Possible Limitations / Concerns

The dense nature of permaculture may raise concern as to the potential to create unsafe areas for crime. Hynes and Howe describe a study which concluded that vegetation that allows for easy viewing and does not inhibit visibility (for example trees and low shrubbery) actually leads to reduced crime. It was found that building structures that had a high amount of vegetation had 52% less number of crimes than other buildings that lacked greenery. This is likely because in situations where non view inhibiting vegetation is around the building, residents were more inclined to spend time in those outdoor places therefore and keep a watchful eye on the activities occurring (Hynes and Howe 2004). Therefore, the projective design for the Cannontown

Neighborhood should take into consideration that the vegetation should not block visibility for the residents in order to not diminish safety parameters.

In addition to the safety concerns of dense vegetation, people may also not find the dense design aesthetically pleasing (Kevin Clyde Yates, pers. comm.). Joan Nassauer (1995) describes that landscapes that serve ecological functions often differ from the standard culturally accepted "neat appearance of landscapes" (Nassauer 1995, 162). Additionally, because of lack of knowledge of the landscape's beneficial ecological function, people do not feel inclined to value or help to care for that landscape. In response to this negative occurrence, a designer can create "orderly frames" of functional landscapes by implementing techniques such as including flowering plants and trees, architectural elements, planting in organized rows and keeping shrubs trimmed, and foundation planting that hide the foundation of the home but do not block windows or doors (Nassauer 1995).

Other concerns may include lack of knowledge of plants or of how prepare the plants for eating purposes (Yates, pers. comm.) To address this concern, one may want to plant culturally well-known plants and edibles that can be consumed through easy application such as raw fruits

Permaculture Design Process: Finalizing Design

After devising conceptual ideas of what the design should entail and what the priority of components to include, it is time to finalize the location and layout of the site elements. Extensive research must be completed on plant species and varieties. Connectivity and relationships amongst site elements should also be completed. Finally, it is integral to create clear and pertinent drawings of the site in plan-view and cross-sectional view to facilitate the implementation stage (Hemenway 2009). These drawings range from a complete and detailed master plan to explicit drawings and documents that outline to the person implementing the design of how to actually create the design on site through planting, building, installation, or any other relevant instructional drawings (Falk 2013).

Conclusion

Permaculture is a way of thinking and designing that takes into consideration care for people and the environment while reducing impact through efficient reuse of surplus of materials and energy. It poses possible benefits as a design technique for affordable housing landscapes because it maximizes space efficiency and mimics natural relationships to minimize inputs in terms of labor, materials, and time. Most affordable housing developments are limited in space and have limitations of the previously listed inputs. Thus, permaculture provides solutions for integrating urban agriculture into affordable housing landscapes. The following chapter looks into precedent studies that have successfully incorporated sustainable agriculture and elements of permaculture into various urban developments.

CHAPTER 3

PRECEDENT STUDIES

TROY GARDENS: MADISON, WI

Figure 10: Troy Gardens (Gorgolewski et al. 2011)

Troy Gardens is a housing development located in Madison, Wisconsin consisting of 31 acres which incorporates mixed-income cohousing, an organic community-supported agriculture farm (CSA), community gardens, restored prairie and woodland open space, and overall edible landscape elements (Gorgolewski et al. 2011).

In 1995-96, opposition amongst the community arose when the state of Wisconsin placed the site on its surplus land list for the purpose of selling for future development. The community already utilized four acres of this site for gardening and the additional land was considered a community amenity. The Troy Gardens Coalition was formed out of community-invested not-for-profits including the Madison Area Community Land Trust (MACLT) and the Urban Open Space Foundation (UOSF), and representatives from the University of Wisconsin-Madison. After developing a proposal for integrated land use, the Troy Gardens Coalition and the state settled on a 50-year lease to the Coalition with an opportunity to buy the land. First off, the MACLT and UOSF agreed to place the 26-acre open space area of the site under a conservation easement to protect it from being developed in a way other than urban agriculture or parkland. Design concepts were created through the involvement of UW-Madison landscape architecture classes with participation from the surrounding community. Using inputs from the participatory design charrettes, Zeigler Design Associates finalized the design and put together a plan for the restoration and management of the natural areas (Gorgolewski et al. 2011).

Agricultural elements of the design include 330 garden plots that are tended to by surrounding neighbors, a 5-acre farm that participates in a CSA, providing a supply of fresh produce to over one hundred families in the area. There are also open-space park areas that consist of native tall grass prairie land and maple woodlands. These areas are cared for by volunteer stewards. Other edible landscape components include the “Edible Woodlands” that feature a “multilayered system of canopy trees, understory trees, shrubs, and ground cover” (Gorgolewski et al. 2011). Plants that remain on site from previous site conditions include mulberry, walnut, hackberry, black cherry, black raspberry, sumac, Russian olive, and asparagus, as well as, mature sugar and silver maples. In addition, a variety of edible and ornamental species were planted to provide a diverse range of edibility and food production including nut trees and shrubs, berries, fruit trees, and perennials. The species were also chosen for their “colonization and woodland development” and capacity for self-maintenance (Gorgolewski et al. 2011). The final edible landscape element on-site is the herb garden which was initially formed by schoolchildren. The herbs that were chosen for this garden were based on their uses in relation to cooking food, teas and drinks, traditional medicinal herbs, plants that can be used for health and body repair, textile dyes, and perennial fruits and vegetables (Gorgolewski et al. 2011).

The housing was designed to be located compactly in a small area of the site. This was done so that the majority of the land could be used for conservation and food production. In addition, the close proximity of individual homes was intended to help foster a sense of neighborhood community. The MACLT still owns the land where the housing is located in addition to the surrounding open space areas. Because the land is alleged to a trust, low-income families are able to purchase the homes below market price making these homes very affordable to those who may not have enough income to compete with average housing market prices.

The success of this project is accountable to the safeguarding ownership of the land by the MACLT, the conservation easement, and the committed involvement and vision from the neighborhood community and Community GroundWorks (the non-profit organization that grew from the Troy Gardens Coalition). Community GroundWorks also holds environmental education programs that teach community’s children and teenagers about gardening and food production on-site. Zeigler Design states that the true intention of Troy Gardens is

> "about feeding a community with a culturally and economically diverse population and teaching residents --- both young and old --- the skills to grow, prepare, preserve, and sell their own food, and to care about the environmental resources around them…it is about community residents and local institutions working together to preserve, sustain, and strengthen their community" (Gorgolewski et al. 2011)

In conclusion, pertinent information of Troy Gardens in regards to the projected design component of this thesis include designing an urban site to feature affordable housing, urban agriculture, and ecological restoration areas. The involvement of a land trust similar to the Athens Land Trust and their ownership of the land is also relevant. Additionally, the design fuses concepts that are related to permaculture including the multi-layered orchard, use of edible trees, plants, shrubs, and perennials that are mostly self-maintaining and incorporating woodland and prairie areas and all other elements into a landscape that also adheres to human interests. Overall, Troy Gardens provides a strong example of how the combination of these elements can be successful and provide services back to the community and ecosystem of the site. Nonetheless, the acreage of the Troy Gardens site is significantly larger than the design site, Cannontown neighborhood (31 acres versus 2.64 acres). Thus, the design components of Troy Gardens must be adjusted and rethought to fit within the specific constraints of a much smaller site.

DR. GEORGE WASHINGTON CARVER EDIBLE PARK: ASHEVILLE, NC

Figure 11: George Washington Carver Park (Bountiful Cities 2014)

In 1997, a lot that previously consisted of trash was transformed into an edible park by local volunteers and the Asheville, NC Parks and Recreation Department. The project's intent was to create an urban orchard that was open to the public for harvesting. Presently, George Washington Carver Park is located on the former site of Stephens-Lee High School (Warren Wilson College: http://www.warren-wilson.edu/~service/Students/agency_directory/FoodSecurity/Edible_Park.php, 2014). The park was designed following permaculture principles that influenced the planting of over forty fruit and nut trees amongst edible wild plants (No Taste Like Home:www.notastelikehome.org/ CarverEdiblePark.php, 2014). Some of the species include apples, chestnuts, figs, pears, plums, hazelnuts, peaches, paw paws, and grapes. Because it was planted over 15 years, the trees are now fully mature and bearing fruit. Additional site elements include an annual vegetable garden and butterfly garden. The park is owned by the City of Asheville and the city has partnered with Bountiful Cities, a non-profit, to help keep the park viable and open to the public. Volunteers and The Buncombe Fruit Nuts Club also help manage the park (Bountiful Cities: http://www.bountifulcities.org/gardens/ediblepark/, 2014).

In conclusion, the example of the Dr. George Washington Carver Edible Park shows that an edible garden that integrates permaculture principles associated with forest gardening can be successfully managed and provide community members with free edibles to supplement their diets and provide opportunities for impromptu knowledge on growing edibles. Again, the success of this project is associated with a joint commitment in management between the public, the city, and invested non-profits (Bountiful Cities 2014).

EAST LAKE COMMONS: ATLANTA, GA

Figure 12: East Lake Commons Farm (East Lake Commons 2014)

East Lake Commons is a 20 acre cohousing community located 4 miles from downtown Atlanta in Dekalb County. There are 67 units on site with 12 acres (60%) of the site preserved for open space consisting of gardens, woodlands, a play field, and a pond. Each lot that the duplexes are located on is 7500 sq. ft. In order for the homes to be located on less than half of the total land area, a zoning variance had to be acquired. The site was designed by Village Habitat Design in conjunction with a future residential group that played a crucial role in planning their community (Village Habitat Design: http://www.villagehabitat.com/project_menu/east_lake/east_lake.htm. 2014).

Edible landscape elements on-site are featured as part of Gaia Gardens, a 3 acre certified organic farm, which is owned by East Lake Commons but rented out to

Love is Love Farm. The farm consists of 1.5 acres of growing space in addition to forest fragments, hillsides, a greenhouse, acre spring-fed pond, and orchard areas which include figs, muscadine grapes, and blueberries. The produce that the farm yields is available for purchase to East Lake Commons residents and surrounding communities through a CSA program in addition to a farmer's market (East Lake Commons: www.eastlakecommons.org, 2014). It is reported that 6-20% of the resident's food is grown on-site through the Gaia Gardens farm (Fellowship for Intentional Community: http://www.ic.org/directory/east-lake-commons-cohousing/, 2013).

This scenario of integrating urban agriculture is interesting because the farming area is rented out to another farm and is not managed specifically by residents. Instead, busy residents can just pay for a CSA and receive fresh produce that was grown on-site without having to commit the time and labor of producing that food. This offers many benefits but may limit the amount of interaction that residents have with the actual food growing process.

PIEDMONT PARK DEMONSTRATION ORCHARD: ATLANTA, GA

Figure 13: Piedmont Park Demonstration Orchard Image A

The demonstration orchard is located in Piedmont Park in Atlanta, GA. The Piedmont Park Conservancy in conjunction with Northwood Garden Club established the orchard project to show park visitors the possibilities of establishing an orchard and food productive landscape even in constricted urban spaces. The techniques used include raised beds, espalier, and trellising. Additionally, layering of plants was used such as planting strawberries as a ground cover for apple trees. Plants included figs, apples, blackberries, peach trees, muscadines, and strawberries. Produce of the orchard is grown organically and is available for anyone walking by to harvest.

Figure 14: Piedmont Park Demonstration Orchard Image B

Figure 15: Piedmont Park Demonstration Orchard Image C

Conclusion

Each of the previously described precedent studies offers insight into how agriculture can be successfully assimilated into urban landscapes that benefit people of diverse income levels. Troy Gardens and East Lake Commons placed the edible landscape directly within the constraints of the site boundary; whereas, Dr. George Washington Carver Park and Piedmont Park are located on public land and open to all. Troy Gardens provides more opportunity for residents to partake in growing their own food through individual family plots than East Lake Commons. In all, pieces of successful strategies can be pulled from the previous precedent studies and implemented into the design component of this thesis. The following chapter will implement the previously described concepts and implications of urban agriculture, affordable housing, and permaculture into the site context of an affordable housing development in Athens, GA called Cannontown Neighborhood.

CHAPTER 4

SITE ANALYSIS

INTRODUCTION

The site chosen for the projective design is Cannontown Neighborhood in Athens, GA. This is an affordable housing development established by the Athens Land Trust. It is located approximately 1.5 miles from downtown Athens. In this chapter, the site will be analyzed from a variety of different aspects ranging from surrounding context to specific landscape features of the site such as slope.

SITE CONTEXT: ATHENS, GA

The city of Athens is located in Northeast Georgia within Athens-Clarke County. The vibrant downtown area is situated next to the University of Georgia. Population consisted of an estimated 118,999 people in 2012 and a female population of 52.6% in 2010. According to 2010 census data, Athens-Clarke County contains a land area of 116.36 square miles with 992.2 persons per square mile. The following table 3 describes demographics of Athens-Clarke county:

Ethnicity:

Category	Athens-Clarke County	Georgia
White alone	61.8%	59.7%
Black or African American alone	26.6%	30.5%

American Indian and Alaska Native, alone	0.2%	0.3%
Asian alone	4.2%	3.2%
Native Hawaiian and Other Pacific Islander	0.1%	0.1%
Two or More Races	2.2%	2.1%
Hispanic or Latino	2.2%	8.8%
White alone, not Hispanic or Latino	56.9%	55.9%

Housing:

Category	**Athens-Clarke Co.**	**Georgia**
Housing Units, 2010	50,475	4,088,801
Homeownership rate, 2008-2012	44.7%	66.0%
Housing units in multi-unit structures, 2008-2012	44.8%	20.5%
Median value of owner-occupied housing units, 2008-2012	$161,300	$156,400
Households, 2008-2012	40,394	3,508,477
Persons per household, 2008-2012	2.60	2.70

Income:

Category	**Athens-Clarke County**	**Georgia**
Per capita money income in past 12 months (2012 dollars), 2008-2012	$19,605	$25,309

Median household income, 2008-2012	$33,596	$49,604
Persons below poverty level, 2008-2012	35.3%	17.4%

Table 3: Athens, GA Demographics (UGA, Carl Vinson Institute of Government and Georgia Cooperative 2013)

As the previous charts demonstrate, Athens-Clarke County differs from the overall Georgia standards in several important categories. Most importantly, the number of persons below the poverty level (35.3%) is significantly higher in Athens-Clarke County when compared to the overall Georgia percentage of 17.4%. Also, the homeownership rate in Athens (44.7%) is lower than the overall of Georgia (66.0%) meaning that there are more people that rent in Athens. On the other hand, the median value of owner-occupied housing units is actually $4,900 higher than the overall GA statistic.

Urban Agriculture in Athens, GA

Athens, GA has a variety of urban agriculture forms including school gardens, market gardens, community gardens, personal home gardens, and nearby local farms that sell their produce to the public through farmer's markets, CSA programs, and an online market called Athens Locally Grown (P.L.A.C.E: www.localplace.org, 2014). In CSA programs, clients pay an upfront cost for a share of a farm's harvest that is distributed on a desired frequency such as weekly or bi-annually. Athens Locally Grown is an online market place where local farms that practice sustainable agricultural practices are allowed to place their weekly products online and then members may place individual orders. It differs from a CSA program because each person has the ability to select which products they receive versus allowing the farm to decide (Athens Locally Grown: http://athens.locallygrown.net, 2014).

In addition to the previously listed forms of urban agriculture, programs exist that help facilitate the knowledge of and distribution of locally grown food to residents such as P.L.A.C.E. which stands for “Promoting Local Agricultural & Cultural Experiences”. P.L.A.C.E. aims at developing “a strong local food culture through educational programs, networking opportunities, and increased availability of locally grown food” (P.L.A.C.E 2014). Also, the Athens Land Trust has worked hard to establish support for those interested in community agriculture. ALT received a grant in November 2010 from the National Institute of Food and Agriculture (NIFA) Community Food Projects program that helped dedicate money towards projects that address lack of access to food and hunger through establishing community food systems. This grant consisting of $149,000 was used to create the Athens Community Garden Network (CGN). The goal of CGN is “to provide healthy, nutritious food for low-income families (including children, the elderly, and minority populations) by providing opportunities and support for them to grow their own” (Athens Land Trust 2014). ALT also established the West Broad urban garden that hosts an accompanying farmer’s market. The garden is situated on a vacant plot of land that was previously a part of an Athens Clarke county school.

Finally, residents of Athens, GA also have the opportunity to purchase food grown locally by either buying it at high-end grocery stores that feature local food or by choosing to eat at local restaurants that buy from local farms such as Heirloom Café or The National. In all, Athens, GA offers a diverse range of opportunities for residents to participate in urban agriculture. These existing structures that support urban agriculture in Athens suggest that there is a strong desire to further incorporate agriculture into this urban area.

Permaculture in Athens, GA

Permaculture is intentionally practiced in a small number of Athens gardens. In addition to the active community garden efforts of ALT and others, and the training provided by the University of Georgia, private firms have emerged to help meet the growing demand for local and sustainable food production.

Hungry Gnome, founded by Kevin Clyde Yates, is a garden design and consulting firm helping to educate people on the practices of permaculture and design food productive landscapes in Athens. Hungry Gnome's designs focus on edible landscapes, organic gardens, and permaculture gardens. They offer services including consulting, maintenance, installation, design, and garden support. Their mission "is to empower people to grow their own food…[and] help create sustainable, regenerative, and interactive landscapes that feed people and steward Creation" (Hungry Gnome Gardenscapes: www.hungrygnome.org, 2014).

Through his experience with implementing permaculture and edible landscapes in Athens, Yates offers insight into how permaculture fits within Athens' ecology, culture, and society. Yates states that the main reasons why people are interested in redesigning their landscape into an edible landscape include wanting to live in a food productive landscape, to increase biodiversity to benefit pollinators and wildlife, and to have a landscape that requires lower maintenance. Yates describes his typical clients as middle to upper class families and parents. His client's leading reason for wanting an edible landscape is to engage their children and give them the opportunity to learn about growing food and interacting with the outdoor landscape. Overall, Yates describes that there is an interest in the Athens community to grow their own food and this can be seen by the increasing number of clients and projects that Hungry Gnome has been acquiring over the years (Kevin Clyde Yates, personal communication). While Yates' typical client is not a lower-income resident, his information provides examples of potential reasons for why a resident in Athens may be interested in implementing permaculture.

SITE DESIGN PROCESS: OBSERVATION

The projected design site is Cannontown neighborhood which is being developed by the Athens Land Trust as a part of their affordable homes program. Athens Land Trust desires to create a community that is integrated with the land and the surrounding community. As shown in Figure 16, Cannontown is located approximately 1.5 miles from downtown Athens, GA. The neighborhood is a cul-de-sac with 5' sidewalks that line the road. Currently phase I has been completed, which consists of 3 built homes on-site. Phase 2 is currently undergoing construction which when completed will add three more homes to the site (Lynda Stipe, personal communication).

In total, there are plans to complete fifteen homes on-site. Each home includes 6' deep porches that face the street to further encourage interactions amongst community members. The total acreage of the site is 2.64 acres. There is also a communal open space area of 0.565 acres encircling a stormwater detention pond consisting of 9,716 sq. ft. Phase II has been cleared of vegetation, graded, and walls have been put up for one home. Overall, the landscape consists strictly of bare dirt of clay consistency. Phase I has an installed a landscape plan of which details will be covered later in this chapter. Surrounding the site is a mix of hardwoods, pines, and invasive plants such as privet.

As shown in Figure 33, the site is adjacent to the properties of Howard B. Stroud Elementary School, Boys and Girls Club of Athens, as well as other ALT affordable homes, and private residents. Cannontown is located 0.5 miles from the nearest shopping center which contains a BP gas station, CVS Pharmacy, Belle Foods grocery store, and various restaurants, as shown in Figure 33. As shown in Figure 18, because Cannontown is located in an area with “low-income census tracks where a significant number or share of residents is more than ½ mile from nearest supermarket”. USDA Economic Research Service has classified it as having restricted food access (USDA ERS Food Access Research Atlas 2014). Figure 17 and Figure 18 demonstrates that the site is located close to a grocery store; however, because of the low quality of food it offers, it did not qualify as satisfactory for the USDA’s study. Therefore, Cannontown is located in a food desert which is an area where access and availability of fresh food is limited or restricted. This reinforces that low food security can occur even if a family is located close to a grocery store; the store may contain insufficient food in terms of quality and quantity (Brown et al. 2003). Figure 19 shows that proper transportation is another limiting factor for residents of the area to purchase high quality, fresh, local produce (USDA 2014). This reinforces that even if low-income urban residents can purchase desirable food, lack of transportation may inhibit them from reaching distant grocery stores (Brown et al. 2003). Therefore, a need exists to increase access to food resources.

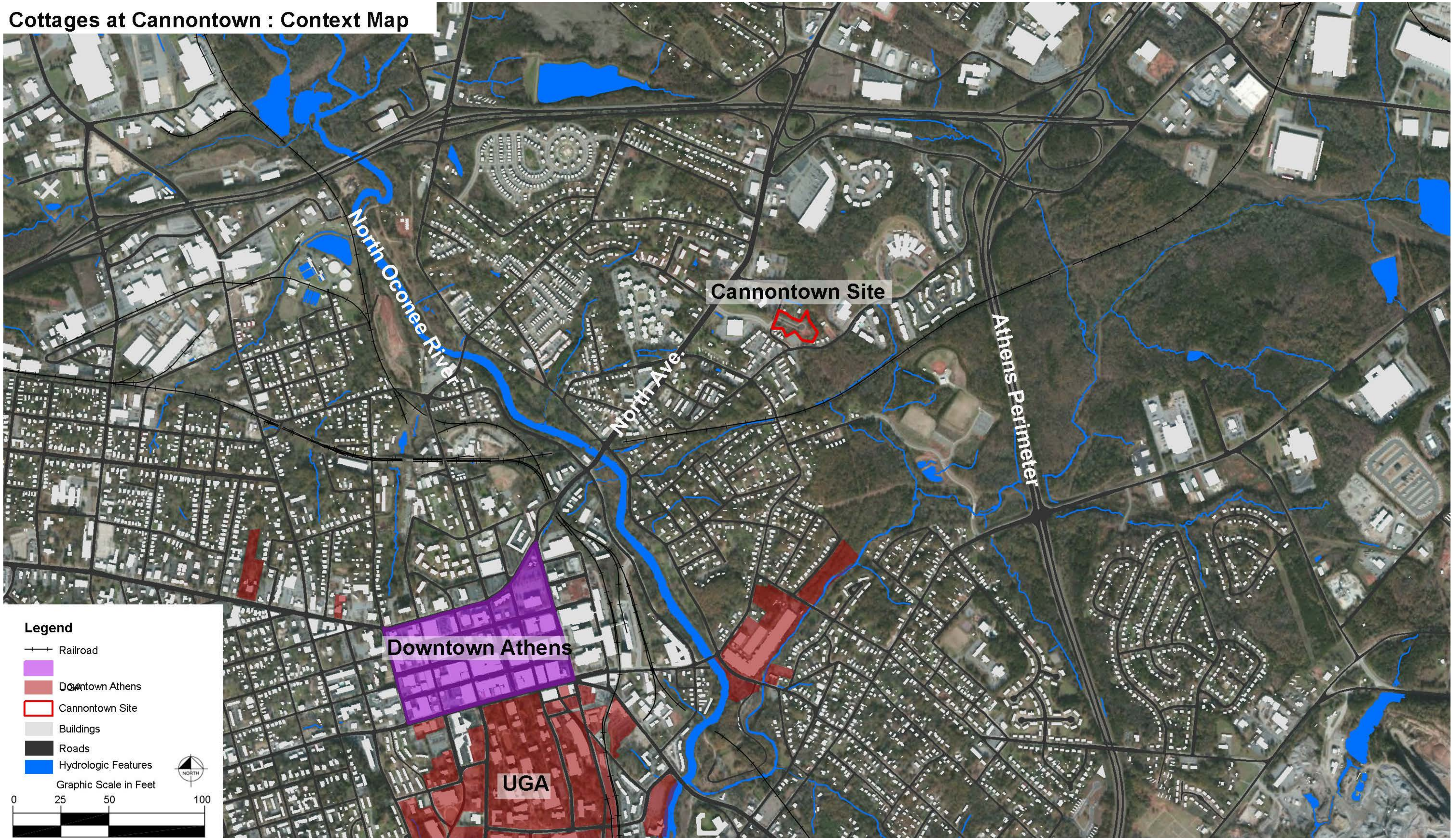


Figure 16: Site Context (Athens Clarke County, Esri Maps)

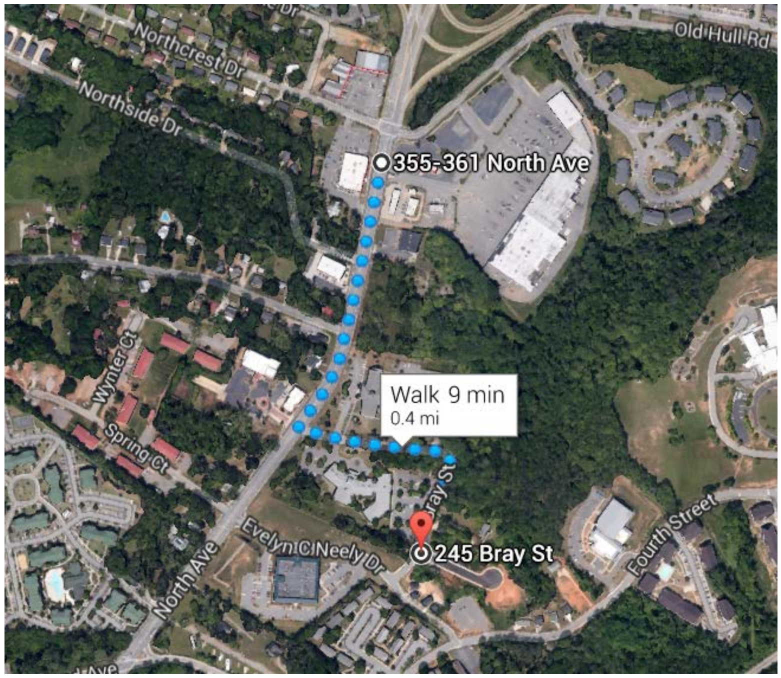


Figure 17: Walking Distance to Shopping Center (Google 2014)

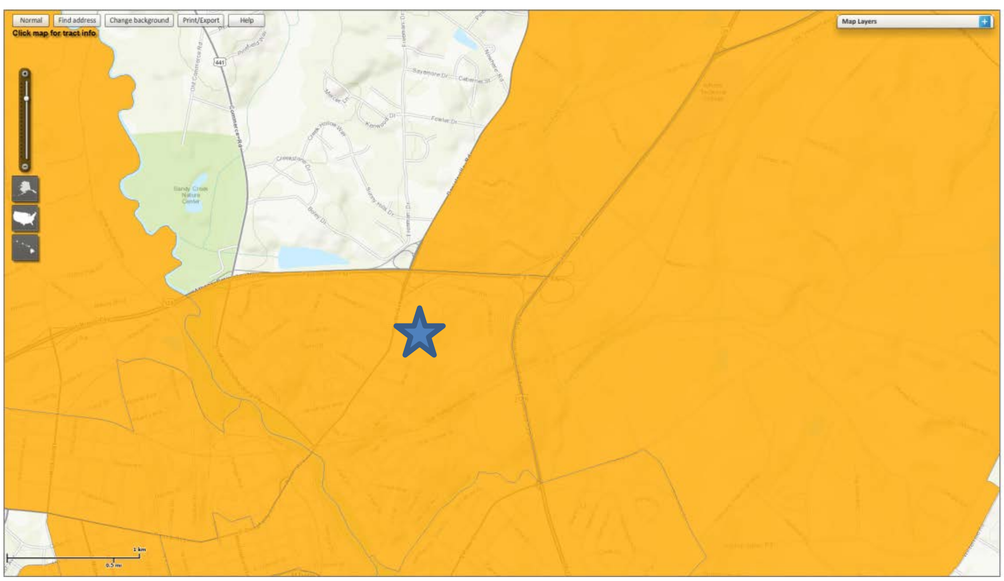


Figure 18: USDA Economic Research Service: Food Access Research Atlas Map of Athens Clarke County. Orange areas depict “low-income census tracks where a significant number or share of residents is more than ½ mile from nearest supermarket.” Star indicates Cottages at Cannontown (USDA ERS Food Access Research Atlas 2014)

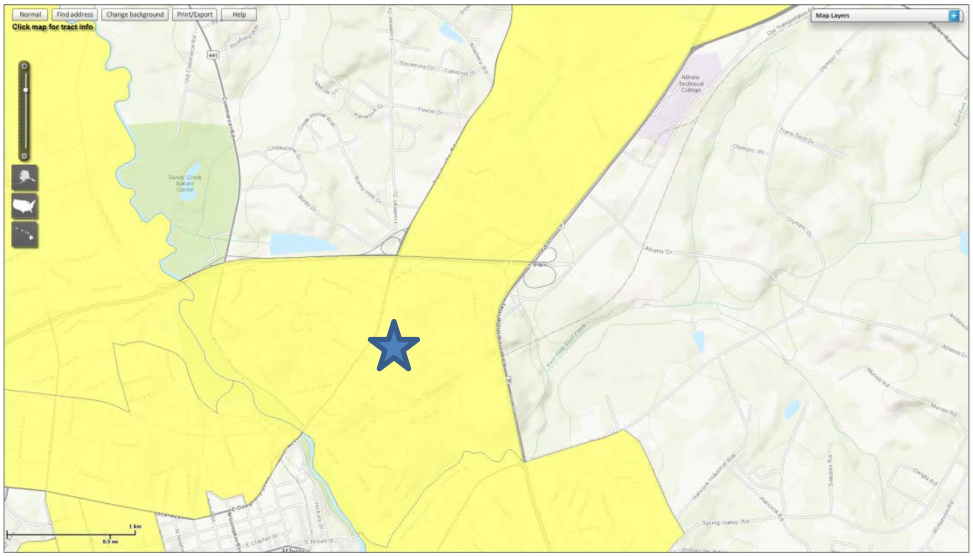


Figure 19: USDA Economic Research Service: Food Access Research Atlas Map of Athens Clarke County – Low Vehicular Access. Yellow areas depict "low-income census tracks where a significant number or households have low vehicular access". Star indicates Cottages at Cannontown (USDA ERS Food Access Research Atlas 2014)

Phase I: Site Observations

All homes on-site are designed according to the EarthCraft House program. EarthCraft House is a residential green building program that was established to meet the unique climate conditions of the Southeast. Homes built in accordance with this program are designed such that they are energy- and resource-efficient (www.earthcraft.org/house). The three Phase I built homes consist of Lot 2: 0.083 acres with 2 bedrooms / 1 bath house that is ADA accessible and includes a solar water heater; Lot 3: 0.098 acres with 3 bedrooms / 2 baths house; and Lot 4: 0.078 acres with 4 bedrooms / 2 baths house. All homes in Phase I are occupied by homeowners. The profile of homeowner for Phase I is very diverse with a variety of ethnic backgrounds and family structures. Cannontown is one of the most diverse ALT affordable housing developments (Lynda Stipe, pers. comm.)

There is currently vegetation already planted on Phase I. The plants are ornamental natives and do not serve as a functional resource in terms of edibles. The plants were chosen based on native origin, availability, and affordability. Additionally, because the landscape was designed post-owner occupancy, the homeowners were involved in choosing the vegetation. Although the plants are native, some are not positioned in the correct location. For instance, Refer to Figure 23 for detailed planting plan for Phase I. The plant list was includes:

Street Trees: (2" Cal.)

Quercus Shumardii, Shumard Oak

Quercus phellos, Willow Oak

Liriodendron tulipifera, Tulip Poplar

Acer saccharum 'Legacy', Legacy Sugar Maple

Shrubs:

Hydrangea quercifolia, Oakleaf Hydrangea

Illicium floridanum, Anise

Rhododendron 'Admiral Semmes', Azalea Admiral Semmes

Fothergilla major, Fothergilla Mt. Airy

Callicarpa americana, American Beautyberry

Itea virginica 'Henry's Garnet', Virginia Sweetspire

Ilex glabra, Inkberry

Groundcover:

Panicum virgatum, Dallas Blue Panicum

Rudbeckia 'Goldstrum', Black-Eyed Susan

Eupatoria dubium 'Baby Joe', Dwarf Joe Pye Weed

Chasmanthium latifolium, Upland Seaoats

(Athens Land Trust 2014)

Figure 20: Existing Conditions. Refer to Figure 23 for detail of existing species.

Phase I : Site Photos

Figure 21: Phase I – Site Photos

View of Stormwater Detention Pond

View from end of Cul-de-sac

Figure 22: Photos of Stormwater / Cul-de-sac Area

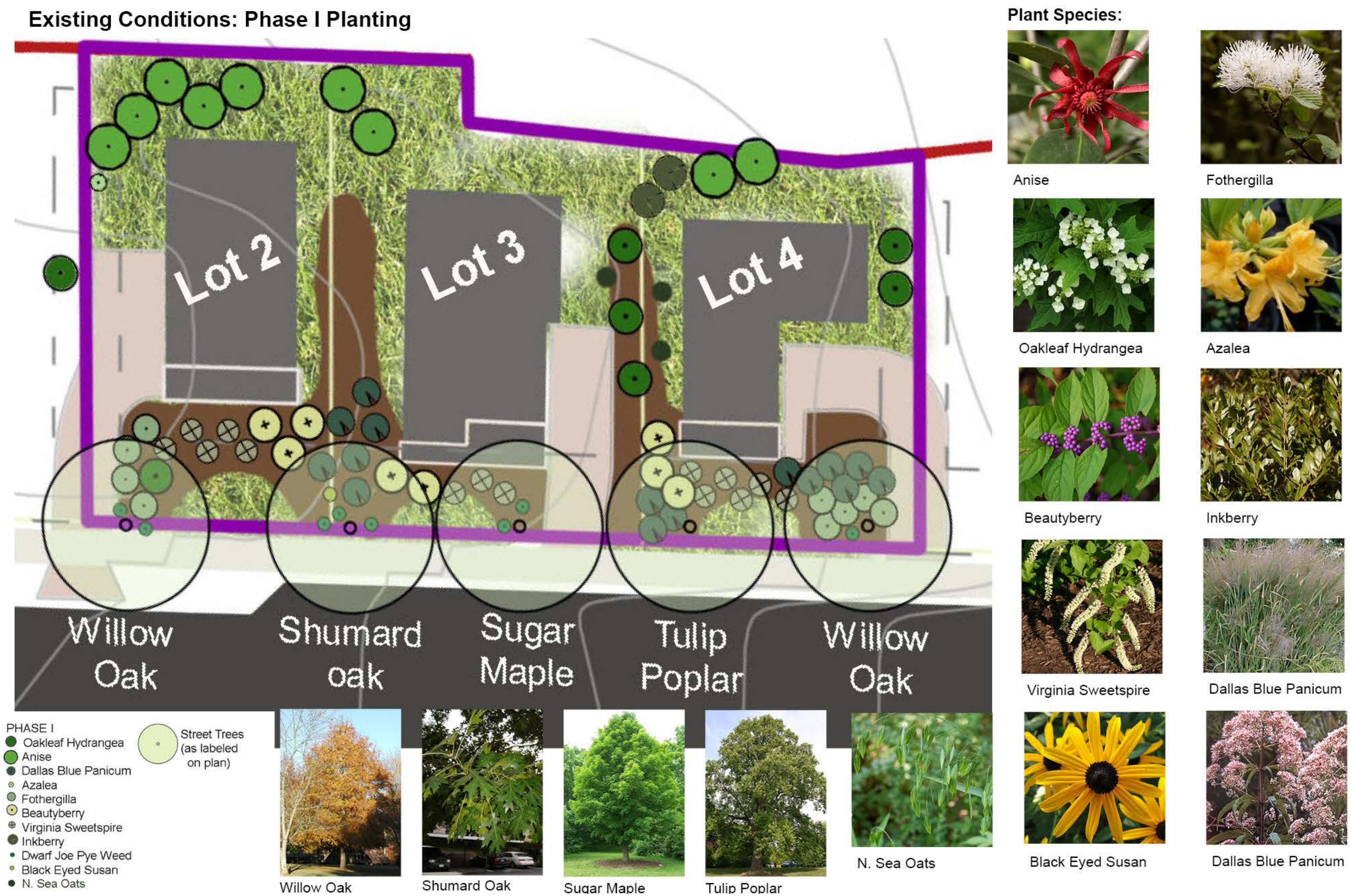


Figure 23: Existing Conditions - Phase I Planting (Wikipedia: www.wikipedia.com; Hort.net: www.hort.net, UGA Extension: http://extension.uga.edu, Miller and Miller 2005)

Phase II: *Site Observations*

Phase II consists of three homes to be built: Lot 13: 1,356 sq. ft with 3 bedrooms and 2 baths two-story house; Lot 14: 1,584 sq. ft with 2 bedrooms and 1.5 bath house; Lot 15: 2,059 sq. ft 3 bedrooms and 2 baths home. Like Phase I, these homes are also EarthCraft design.

Lot 13

Price: $99,000

1.5 Story Home

3 Bedrooms & 2 Full Baths

Payments around $725 / month

Figure 24: Lot 13 House (Athens Land Trust 2014)

Lot 14

Price: $85,000

1 Story Ranch Style Home

2 Bedrooms & 1.5 Baths

Payments around $575 / month

Figure 25: Lot 14 House (Athens Land Trust 2014)

Lot 15

Price: $95,000

1 Story Ranch Style Home (Corner Lot)

3 Bedrooms & 2 Full Baths

Payments around $675 / month

Figure 26: Lot 15 House (Athens Land Trust 2014)

Phase II: Site Conditions

Slope – In reference to Figure 29, Phase I and Phase II consist of gentle slopes (0-8%). The land has recently been graded to be flat for the new construction of the three homes. The site overall slopes downward into the stormwater detention basin at the end of the site, past the cul-de-sac. Lot 1 contains mostly gentle slopes but some areas that may have moderate slopes that are slightly over 8%. The land in front of Phase II slopes down slightly towards the street.

Aspect – Figure 30 demonstrates that Phase II slightly faces the south in terms of aspect. Phase I faces the south / southeast in the front of the lot and faces north / northeast in the back of the lot. Lot 1 and area around the stormwater detention pond have a variety of direction facing slopes. Thus, it will be important to refer to the aspect map when considering planting in these areas.

Hydrology – Figure 31 shows that the water from all lots on-site flows towards the stormwater detention pond, which is 9,716 SF. The stormwater detention pond was already constructed prior to the purchase of the land by the Athens Land Trust. Total impervious area on-site for Phase I and Phase II is equal to 40,065 SF.

Soil – The soil on site is Pacolet sandy clay loam (PgC3), 6 to 10 percent slopes, severely eroded. The land is also not prime farmland. The hydrologic soil group (HSG) is B. (SSURGO 2014). Soils that fall into HSG B have moderately low runoff when they have been fully soaked. Thus, they have moderate infiltration rates (USDA 2007). However, the soil on Phase II has been graded and compacted due to human and tractor traffic.

Vegetation – There is no existing vegetation on Phase II. Vegetation for Phase I is shown in Figure 23. Lot 1 has turf grass and a large hardwood tree. The area surrounding the stormwater detention pond is grasses into mixed hardwood / pine forest. There is also existing *Rubus* spp. located around the detention pond area.

Wildlife – The habitat for wildlife on the Cannontown site is limited. The plants that have been planted in Phase I are all native which could provide a good source of habitat value. Forage value is high for the Upland Sea Oats, Itea, Beautyberries, Inkberries, Oaks, and Tulip Poplars (Miller and Miller 2005). Figure 32 depicts ecological connectivity.

Connectivity – Cannontown is located close to Athens transit. 3 bus lines run along North Avenue which is a short walk from the site. These bus lines provide access to the shopping center north of the site which includes a grocery store. Also, it connects to downtown and UGA. Within walking distance are previously mentioned community areas such as Howard B. Stroud Elementary School, Athens Boys and Girls Club, Springfield Baptist Church, and East Athens Community Park. Refer to Figure 33 for more detail.

Climate –

Monthly Precipitation:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
4.43	4.27	5.05	3.65	3.88	4.02	4.64	3.57	3.69	3.18	3.67	3.92	48.03

Table 4: Monthly Precipitation – Athens, GA (SERCC, 2012)

Average Maximum Monthly Temperature:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
53.10	56.99	64.85	73.70	81.08	87.67	90.07	89.05	83.14	73.80	63.87	54.81	72.66

Table 5: Average Maximum Monthly Temperature – Athens, GA (SERCC, 2012)

Average Minimum Monthly Temperature:

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANN
33.32	35.42	42.00	49.62	58.17	65.96	69.37	68.70	62.86	51.15	41.61	34.82	51.07

Table 6: Average Minimum Monthly Temperature – Athens, GA (SERCC, 2012)

Athens, GA falls under the USDA plant hardiness zone of 8a. The average annual extreme minimum temperature from 1976-2005 is 10-15 degrees Fahrenheit (USDA).

Phase II : Site Photos

Lot 13 **Lot 14** **Lot 15**

Sidewalk adjacent to Phase II, facing Bray St.

Sidewalk adjacent to Phase II, facing end of cul-de-sac

Figure 27: Phase II – Site Photos

Phase II : Site Photos

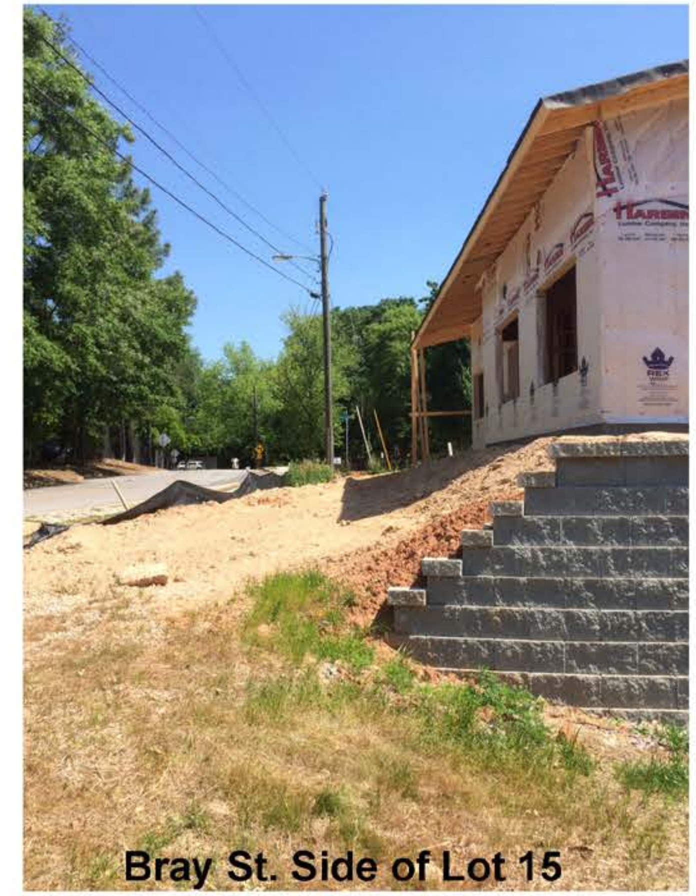


Figure 28: Phase II – Site Photos B

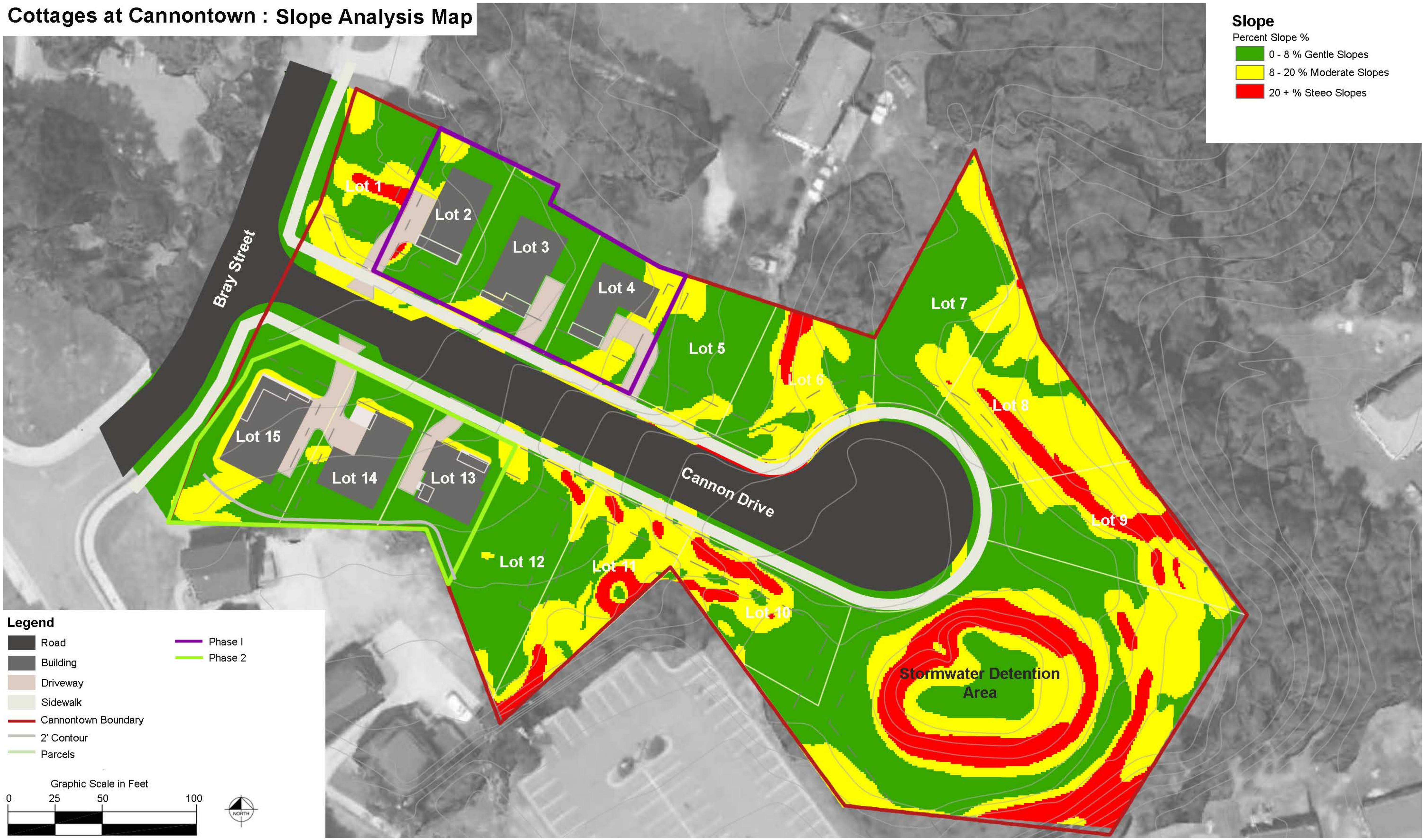


Figure 29: Slope Analysis Map (Athens Clarke County; ESRI Maps)

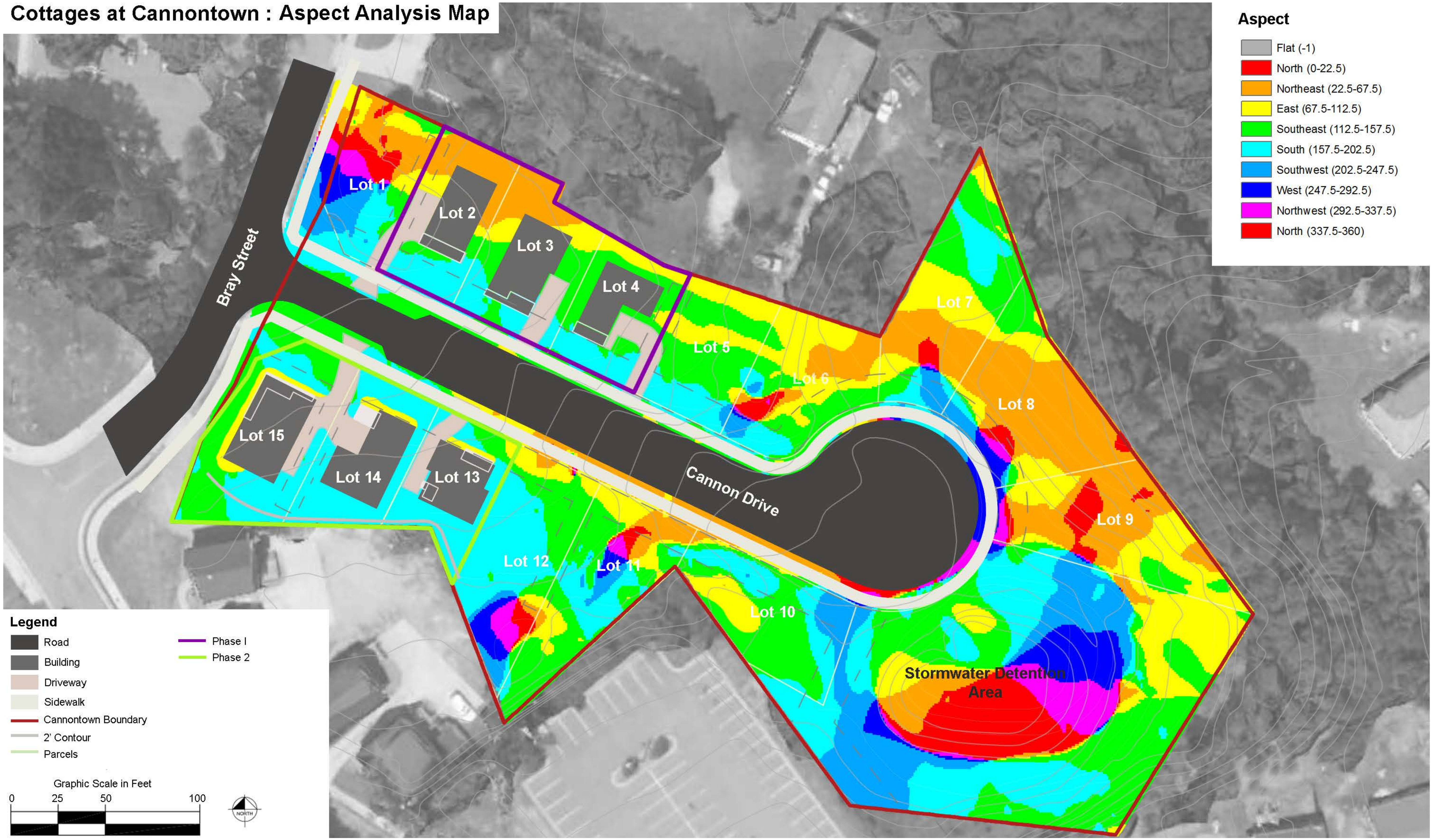


Figure 30: Aspect Analysis Map (Athens Clarke County; ESRI Maps)

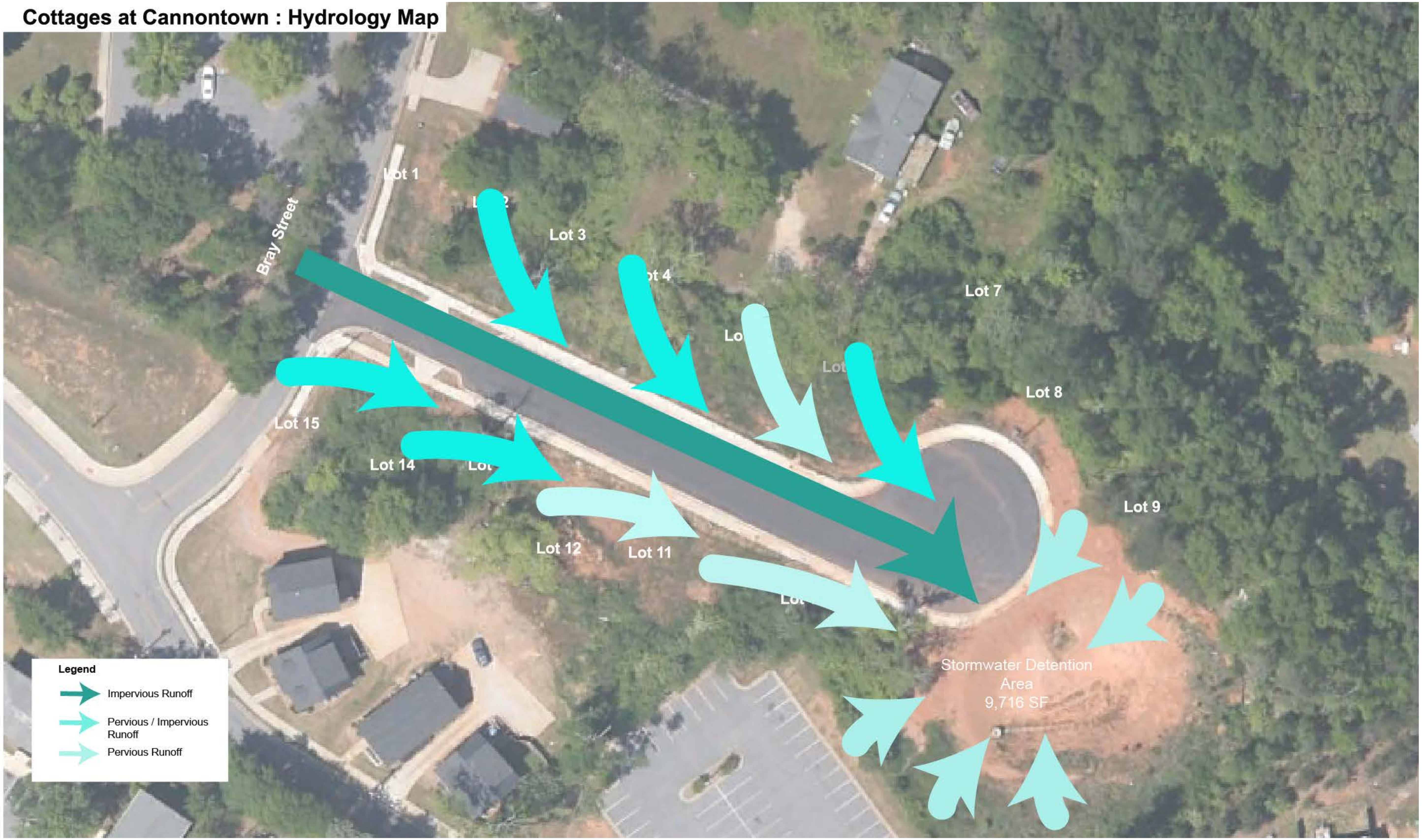


Figure 31: Hydrology Analysis Map (Athens Clarke County; ESRI Maps)

Figure 32: Ecological Connectivity Map (Athens Clarke County; ESRI Maps)

Figure 33: Connectivity Map (Athens Clarke County, Esri Maps)

CHAPTER 5

DESIGN RECOMMENDATIONS

INTRODUCTION

The following chapter summarizes the design process, design recommendations for Phase II, the orchard & detention area, future house design, and site expansion. Additionally, a recommended plant species chart is included that summarizes relevant plant characteristics and information. Finally, an extensive analysis is conducted that evaluates the design based on several factors including cost, integration of permaculture principles, and adaption to site elements and requirements.

DESIGN PROCESS: DESIGN CRITERIA

Site Considerations

The following challenges exist for this site in relation to creating an edible landscape via permaculture principles.

1. Constricted budget: Street trees ($600) + plant materials ($500) + mulch and soil amendment ($350) + labor ($600) = Total ($2,050). In comparison to a comparable site budget, this budget is limiting.
2. Time constraints of residents for maintenance and care of garden
3. Limited space on-site for growing food on small house lots
4. Possible limited knowledge of how to grow food
5. Possible limited access to materials needed such as shovels and rakes.

6. Residents are required to maintain yards.
7. Currently no homeowners association.
8. Homeowners have the ability to change their landscape but must first check in with the Athens Land Trust. This poses a challenge because homeowners have the ability to remove the installed vegetation; however, it is rare that homeowners remove any vegetation (Lynda Stipe, personal communication)

Providing the limitations listed above, the overall goal of this thesis design is not to provide the residents with a landscape that will fulfill their daily needs of food by 100%. Rather, it is to install an edible landscape that is sustainable within the restrictions of an urban affordable housing development. The design should feature plants which serve multi-functional purposes for the residents that provide opportunities to engage with agricultural practices while still maintaining positive aesthetics. The goal is to create a landscape that could, if properly managed and cared for provide supplement the resident's annual intake of fruits by 50%. The intent of providing an edible landscape is supported by the stated goal of creating "a space for community interaction" that took the form of a community garden area that emerged from a charrette conducted in December 2010 that gathered input from potential home owners, local designers, and UGA students to create a design for the Cottages at Cannontown. Reasons for wanting a community garden area included providing access to low cost, nutritious, and fresh produce and also providing an opportunity for strengthening community ties (UGA Center for Community Design and Preservation 2011). With this desire from the community in mind, the following lists contain the design criteria for this project.

Vegetation

1. Affordable in terms of staying within Athens Land Trust's budget

2. Self-maintaining whenever possible

3. Can grow within the site's size constraints

4. Does not require extensive gardening knowledge to be maintained or set up a system that educates residents on how to care for plants on site

5. Plants have multi-functional purposes – i.e. aesthetic/edible/medicinal/wildlife benefit

6. Native when possible

7. Easy application i.e. edibles can be eaten raw or with simple cooking techniques

8. Well-known by majority of people when possible

9. Complies to Athens Tree Ordinance requirements

10. Design in such a way that they can thrive for extended period of time i.e. placing plants in correct sun exposure/wetness areas of site

Site Components

1. Elements are located based on required frequency of interaction (reference zones)

2. Relationships between components support each component and system as a whole

3. Provide opportunities for knowledge and interaction with natural elements on-site

4. Provide connectivity opportunities that extend beyond the site i.e. connect wildlife corridors

5. 2 Hose hook ups on opposite sides of house

6. Long homeowner occupancy, may increase stewardship, commitment to the landscape. (Lynda Stipe, pers.comm.)

Site Considerations in Relation to LEED – Sustainable Sites

LEED's (Leadership in Energy & Environmental Design) section of Sustainable Sites provides guidance for designing sustainable landscapes that protect and provide habitats, reduce pollution from transportation, develop the site wisely, manage stormwater runoff quantity and quality, lessen heat island effect, and lower light pollution. The following considerations relate to the site of the projected design:

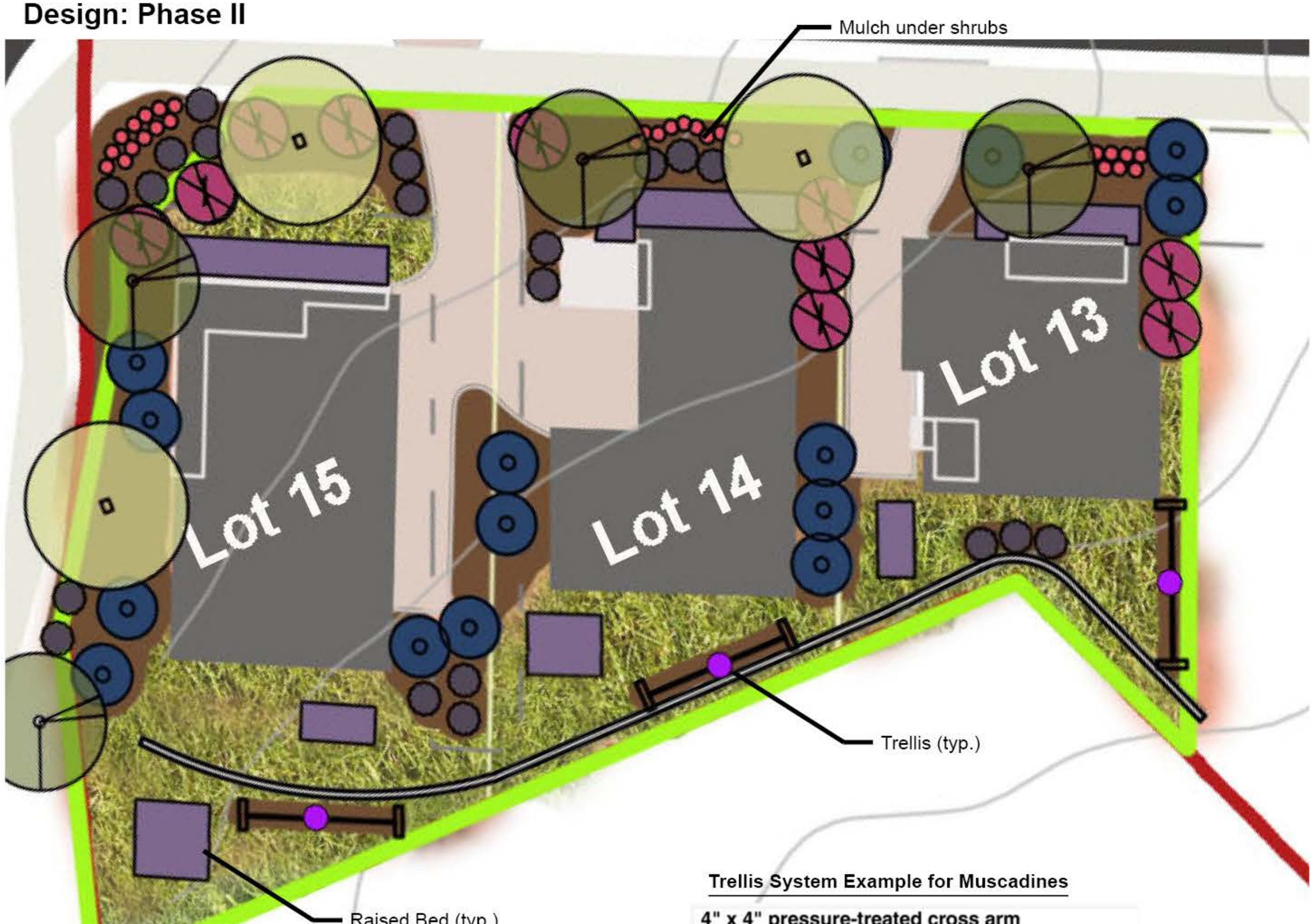
1. Credit 2: development density (community connectivity)
2. Credit 4.1: public transportation access
3. Credit 5.1: protect or restore habitat
4. Credit 5.2: maximize open space
5. Credit 6.1: stormwater runoff quantity control
6. Credit 6.2: stormwater runoff quality control (LEED 2009)

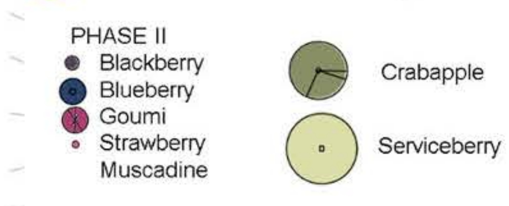
DESIGN GRAPHICS

The following pages depict graphically the projected design.

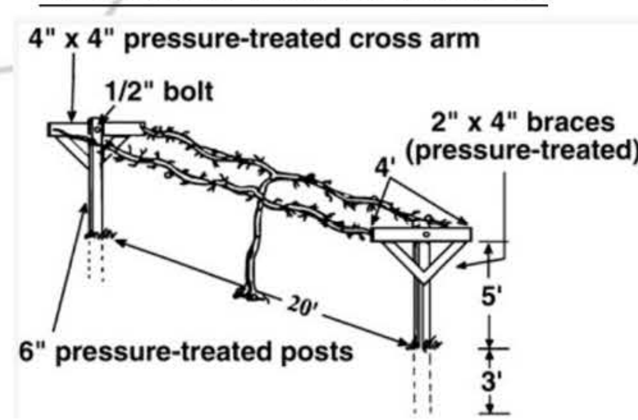
Figure 34: Design - Illustrative Plan (ESRI Maps)

Design: Phase II





Trellis System Example for Muscadines



Plant Species:


Rabbiteye blueberry


Blackberry (Upright)


Goumi


Strawberry


Muscadine


Crabapple


Serviceberry

Breakdown Per Lot

Plants:	Lot 15	Lot 14	Lot 13	Total
Blueberry	6	5	4	15
Blackberry	13	5	3	21
Strawberry	12	9	7	28
Goumi	4	4	2	10
Muscadine	1	1	1	3
Raised Bed (SF)	290	220	145	655

Figure 35: Design – Phase II (Wikipedia: www.wikipedia.com; Hort.net: www.hort.net; UGA Extension: http://extension.uga.edu)

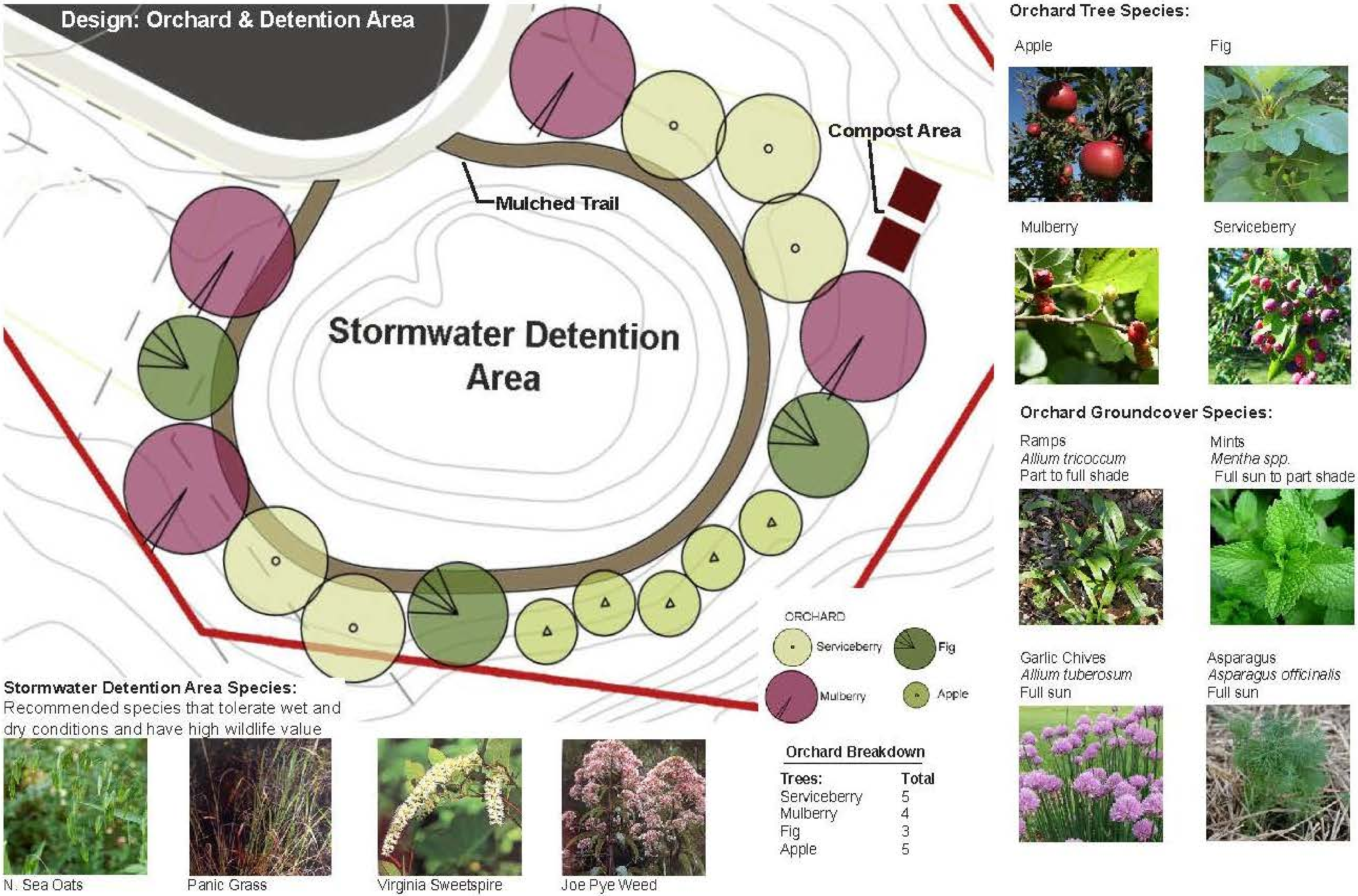


Figure 36: Design – Orchard & Detention Area (Wikipedia: www.wikipedia.com; Hort.net: www.hort.net; UGA Extension: http://extension.uga.edu; NCSU: http://nc.climate.ncsu.edu; Miller and Miller 2005)

Edible Plants Matrix - Affordable Housing Context Me = Medicinal W = Wildlife E = Edible F P S = Full Sun, Partial, Shade N = Native L M H = Low/Medium/High maintenance Sp S F W = Spring / Summer / Fall / Winter Fruit Harvest

Common Name	Scientific Name	Description	Size	Soil	Sun Needs	Native	Uses	Maintenance	Harvest Season	Other
Goumi	Eleagnus multiflora	Shrub, deciduous / semi-evergreen, plant with two selections for cross-pollination. Flowers in Spring. 3-4 year to begin bearing fruit.	6.5 - 10 ft tall/wide	Tolerates wide range of soil conditions	F P		E W	L	S	Nitrogen-fixing; possibly invasive
Serviceberry	Amelanchier arborea	Shrub or small tree; deciduous; flowers in Spring; fruit matures in late spring-early summer.	15 - 25 ft tall/wide	Tolerates wide range of soil conditions	F P	N	E W	L	Sp S	Fruit similar to blue-berries
Rabbiteye Blueberry	Vaccinium ashei	Shrub; deciduous; most heat and drought tolerant species; typ. bear fruit w/i 3 yrs and mature in 6 yrs. Harvest fruit late May - mid-July. Plant 2 species.	8-15 ft tall	Prefers acidic, well-drained, moist soil with high organic content	F P	N	E W	L	S	
Blackberry	Rubus spp.	Erect or trailing shrub, blooms mid-late July, fruit begins to ripen mid-July.	Plant erect & semi-trailing 3-4' apart; trailing: 6-8'	Withstands variety but prefers sandy loam or clay loam. pH: 6.0-6.5	F	N	E W	L	S	Benefits from trellising, Varieties: Navajo, Arapaho, Kiowa
Strawberrry	Fragaria spp.	Perennial in GA. Produces in 2 years. Fruits in April - mid-May.	Plant 2' apart	Prefers well-drained, sandy loam. Avoid heavy clay, deep sands, wet.	F	N	E Me	L	Sp S	Varieties: Cardinal, Surecrop, Earligrow, Albriton.
Fig	Ficus carica	Deciduous bush or tree, Ripens in mid-June to July. 1 gallon size leads to fruit in 1 year or larger can fruit within first year. Susceptible to cold.	5-15' tall. Plant trees 15' apart or shrubs 10' apart	Tolerates many soil types; requires site without root-knot nematodes	F		E Me	L	S	Varieties: Celeste, Hardy Chicago, Con-adria Country.
Mulberry	Morus spp.	Deciduous tree with edible berries. Some varieties are self-fertile; others require another vareity for pollination. Ripens in mid-May.	30-50' tall/wide	Best if deep, well-drained, tolerant of poorer soils.	F P	N	E W	L	Sp	Ripens over a long time period.
PawPaw	Asimina triloba	Cold-hardy small tree with short trunk and spread-ing branches. Fruit ripens Sept-frost. Self-incomp-atible - requires genetically different tree nearby.	15-20' ; 30-40' at maturity, Dwarf: 6'	Fertile, well-drained & slightly acidic with good drainage	F P	N	E W	M = 2 years L = After 2 yrs	F	High food value. Difficult to pollinate.
Apple	Malus spp.	Tree, self-incompatible - needs cross-pollination cannot pollinate itself or any flowers of same variety. Bloom dates vary on variety.	Full 20' + tall Semi-dwarf 10-15' Dwarf 6-8'	Wide range, prefers deep soil, sandy loam, sandy clay loam. Well-drained	F		E	M	F	Pick 1 yr. 4-6 ' tall with good root system. Avoid planting in frost pockets.
Pecan	Carya illinoiensis	Large tree, nut-bearing. Pollination depends on variety - some are self-fruitful, others need 2 diff-erent varieties for pollination	75-120' tall/wide	Tolerates variety but pre-fers sandy loam w/ clay subsoil, well-drained & good water holding ability	F	N	E	L	F	Long living. Varieties: Elliot, Excel, Gloria, Grande, & Sumner.
Persimmon	Diospyrus viginiana	Large tree. Fruit ripens in late fall. Dioecious.	30-40' tall/wide	Tolerate wide range	F P	N	E W	L	F	Long living. Varieties: Elliot, Excel, Gloria, Grande, & Sumner.
Plum	Prunus spp.	Tree with edible fruit, some varieties are self-fruitful but 2 varieties are recommended. Ripe fruit in June	Standard 20-25' Dwarf 15-20'	Well-drained, sandy loam	F		E	M	S	Chose later blooming species.
Muscadine	Vitis rotundifolia	Woody vine, varieties are single plant fruitful or dioecious	12'20' Space plants min 20' apart & rows 12' apart	Tolerate wide range, well-drained	F	N	E W	L	Sp	Trellis needed.
Hardy Kiwifruit	Actinidia spp.	Woody vine, yield fruit similar to kiwi, Can take a few years to est. Dioecious. Fruit mid-August. Crop in 4th season.	Max 40'. Space 8-15' Space trellis 15-20'	Sandy loam or sandy clay loam w/ good drain-age	F		E	L	F	Trellis needed. Var: A. arguta, Kolomita, polygama. Irrigation

Figure 37: Design – Recommended Plant Description Summary (NCSU Cooperative Extension: www.caes.ncsu.edu; UGA College of Agricultural and Environmental Sciences: www.caes.uga.edu; Cornell University: www.fruit.cornell.edu; Miller and Miller 2005; Jacke 2005)

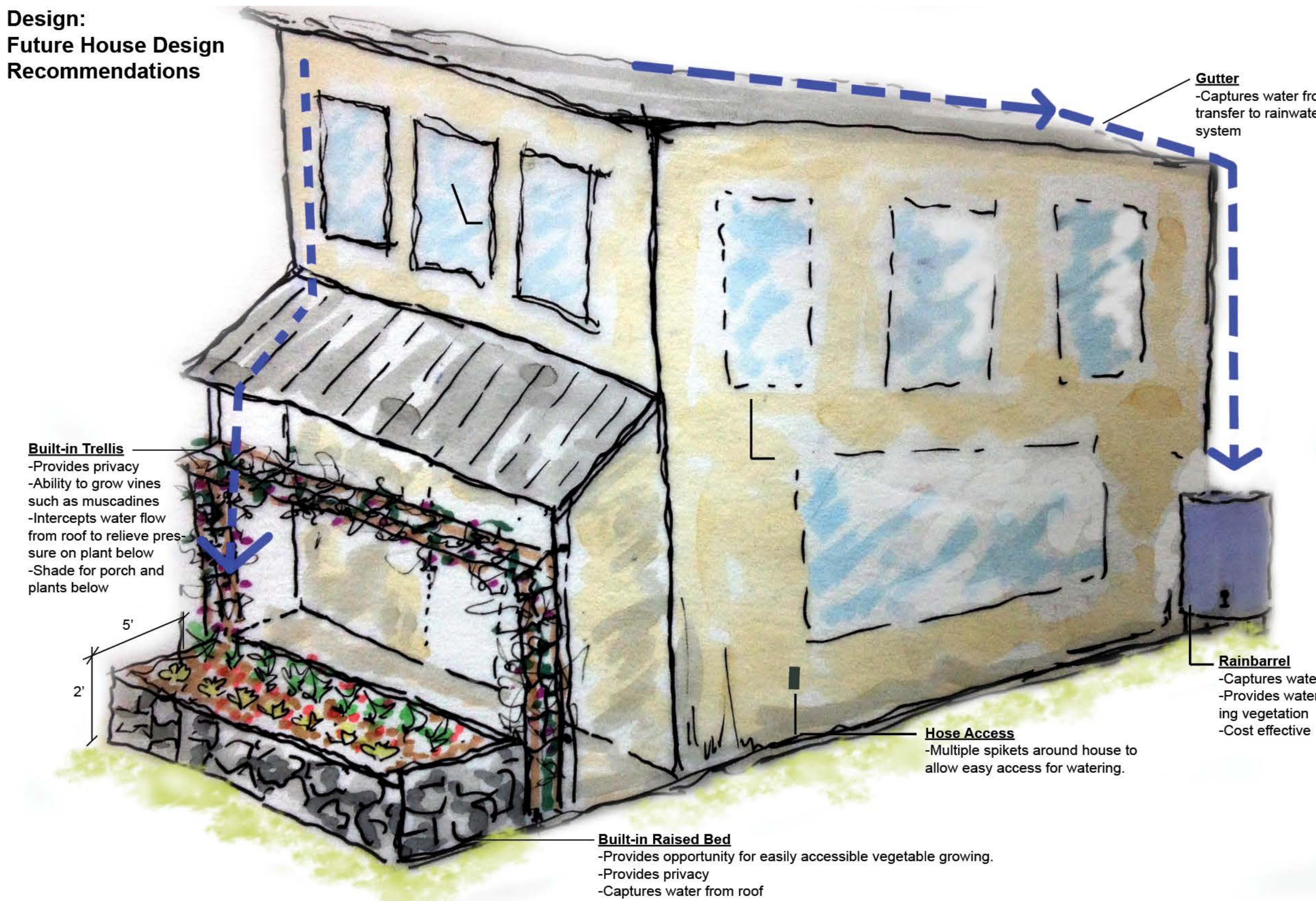


Figure 38: Design – Future House Design Recommendations

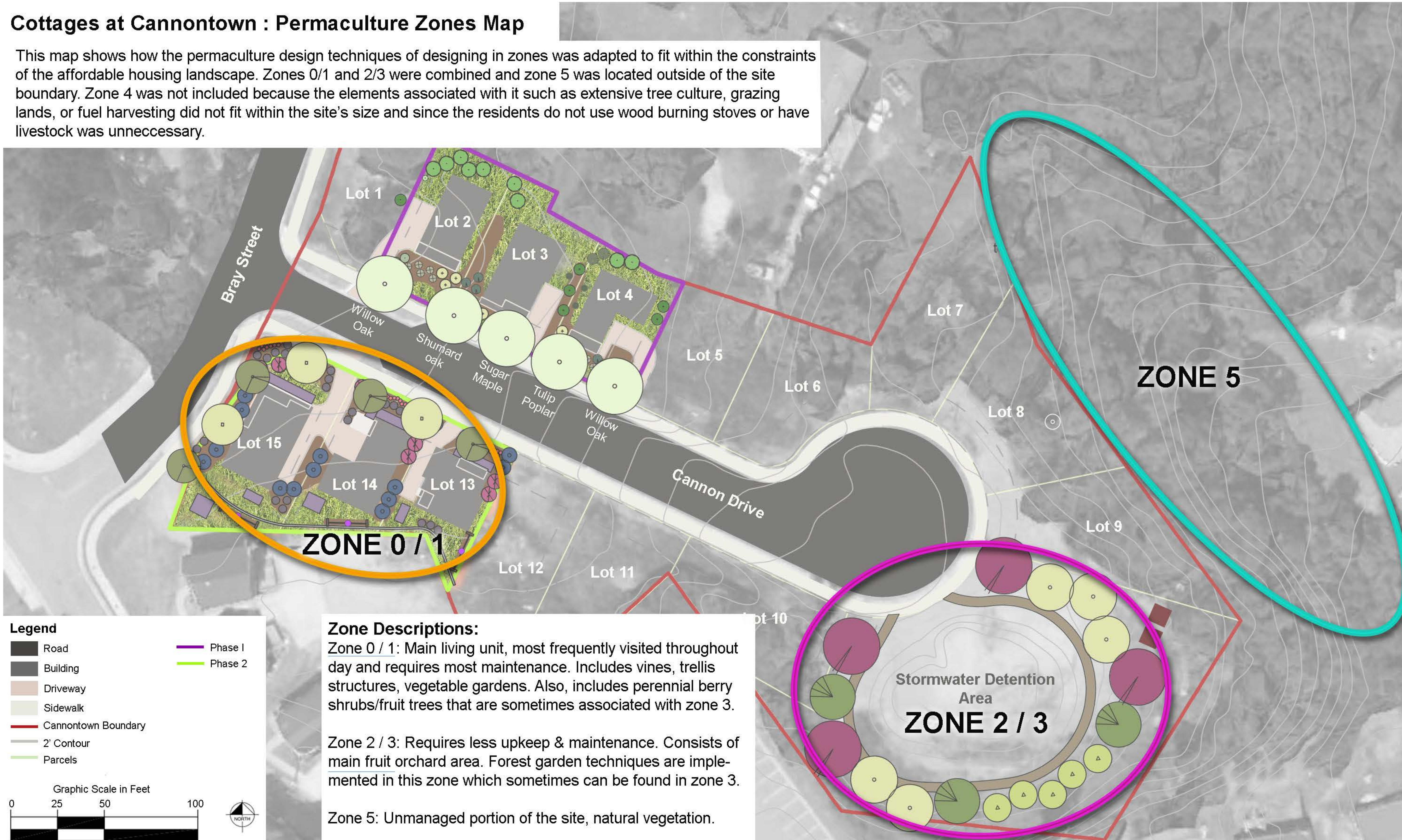
This map shows the recommended expansion should the ALT decide to allocate more land for the Cannontown site. The parcel shown is located at 243 Bray St. The land could feature more houses and also provide additional land to expand on-site food production. The following characteristics describe the properties of the site that pertain to gardening:

- -1.4 acres
- -Gentle Slopes - (Maximum 8%)
- -North/Northeast facing slopes
- -Easy access to Cannontown
- -Pacolet sandy clay loam soil

Figure 39: Design – Recommended Expanded Site Map

Cottages at Cannontown : Permaculture Zones Map

This map shows how the permaculture design techniques of designing in zones was adapted to fit within the constraints of the affordable housing landscape. Zones 0/1 and 2/3 were combined and zone 5 was located outside of the site boundary. Zone 4 was not included because the elements associated with it such as extensive tree culture, grazing lands, or fuel harvesting did not fit within the site's size and since the residents do not use wood burning stoves or have livestock was unneccessary.



Zone Descriptions:

Zone 0 / 1: Main living unit, most frequently visited throughout day and requires most maintenance. Includes vines, trellis structures, vegetable gardens. Also, includes perennial berry shrubs/fruit trees that are sometimes associated with zone 3.

Zone 2 / 3: Requires less upkeep & maintenance. Consists of main fruit orchard area. Forest garden techniques are implemented in this zone which sometimes can be found in zone 3.

Zone 5: Unmanaged portion of the site, natural vegetation.

Figure 40: Design – Permaculture Zones Map

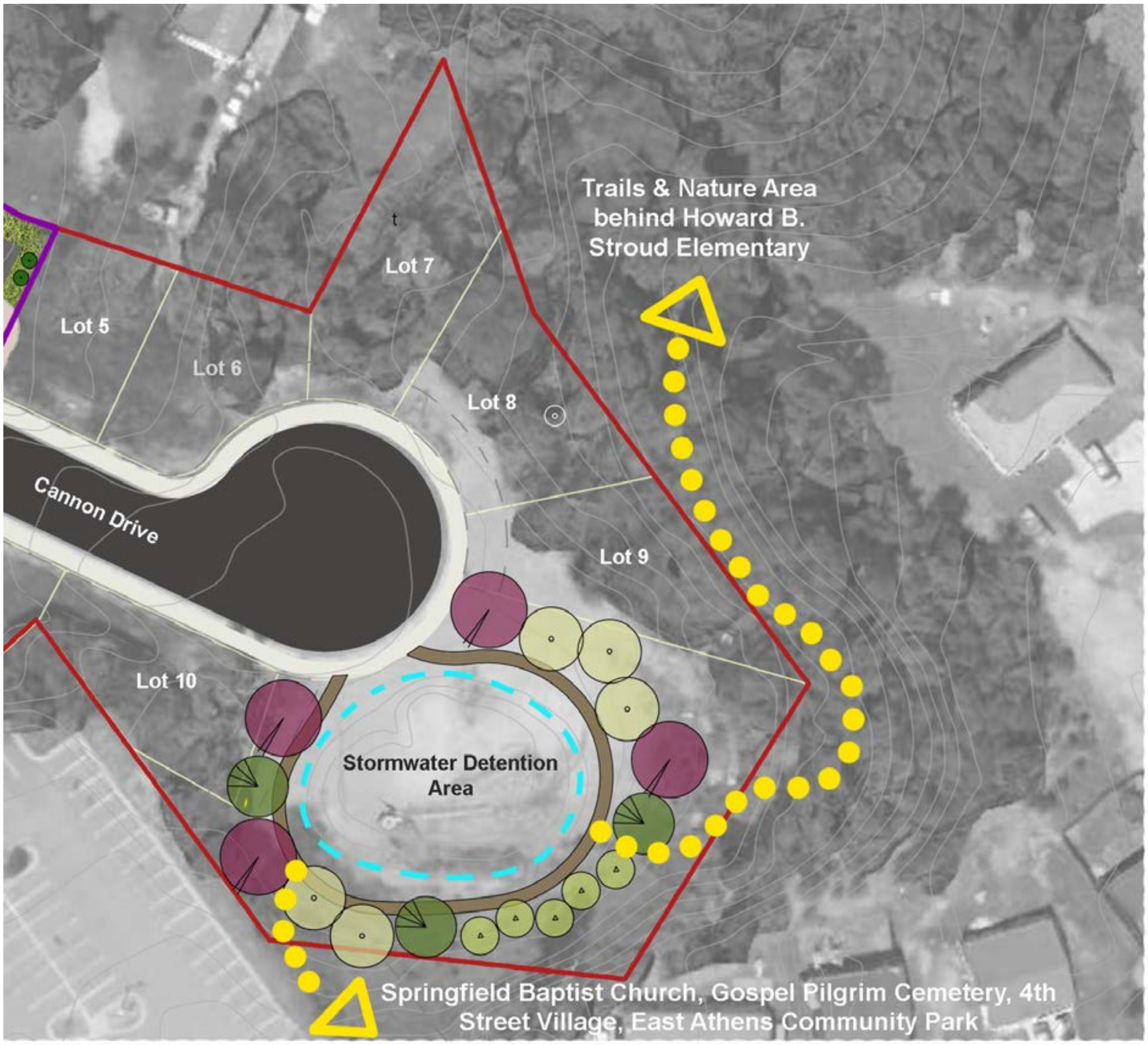


Figure 41: Design – Connection Path to Surrounding Amenities

DESIGN ANALYSIS

In all, sustainable urban agriculture was able to be implemented into this affordable housing landscape using permaculture principles. This was achieved by planting an aesthetically pleasing landscape that features low-maintenance edible plants that can serve multi-functional purposes for residents. The design approach was from the perspective that an ornamental landscape can also be edible and provides opportunities for people who live in urban affordable housing developments to grow their own food.

Design Analysis: Vegetation Choice

The plants were chosen based on several key factors that are summarized below. These characteristics were chosen because they positively correlate to the individualities of urban affordable housing developments and the resident's specificities. Refer to Figure 37 to further explain characteristics of individual plants.

1. Low-maintenance
2. Easy to get started
3. Well-known by many people
4. Able to be consumed raw (minimal food preparation)
5. Plant requirements in relation to site conditions– sun, soil type, etc.
6. Street trees were rated as desirable for street road frontage by Athens Clarke County. (Serviceberry: excellent choice; Southern Crabapple: good choice) (Athens Clarke County 2011)
7. Multi-functional purposes: edible/aesthetic/wildlife value

The quantity of vegetation was restricted by the budget set by ALT. If the budget was expanded more diverse plants could be added that increase the growing season of the vegetation. Figure 37 shows the harvest seasons of the suggested plants and also features additional plants such as pawpaw, persimmon, pecan, and hardy kiwi that could be added to the landscape to extend the growing season into the fall. However, some of these plants, like pawpaw, require more maintenance and knowledge to care for. Planting annuals in the raised beds will allow for residents to extend the harvest season. Recommended annuals for fall/winter include broccoli, cabbage, lettuce varieties, carrot, beet, radish, kale, collards, green onions, winter squash varieties, and mustard greens. Season extension techniques such as cold frames which include creating a glass frame to cover the raised beds and covering plants with landscape fabric can also lengthen the production period into winter months.

Table 7 describes the average annual yields of the various plants in the Phase II design and how much of the average American's consumption of fruit is fulfilled. Percentage of yearly consumption was found by dividing total annual yield of each lot by the number of bedrooms in the house and then deciphering what percentage that was of the average amount of fruits consumed by Americans of 279.4 lbs./year in 2000 (USDA 2000). The USDA recommended intake of fruits is 2-4 servings a day. The servings are calculated by volume not weight. Peter et al. (2003) calculated serving size of each individual fruit and converted it to weight. The average serving weight of the utilized fruits on site was 74 grams/servings, which was multiplied by 4 to find the highest recommended fruit servings which equaled to a weight of 296 grams. Converted to pounds (0.65 lbs.) and multiplied by 365, the recommended annual weight of 4 servings a day equaled 237.25 pounds. Therefore, the average amount of fruits consumed by Americans (279.4 lbs./year) is higher than the USDA recommended amount and therefore 279.4 lbs./year was the number used for the calculation of this design analysis to determine percentage of yearly consumption of fruits for each lot.

Lot 15 landscape yielded 50.3% and Lot 14, 48.0% of the average annual intake of fruits and for lot 13, 21.1%. Therefore, the design for Lot 15 achieved the goal of attaining at least 50% of the resident's annual fruit intake for any lot; additionally the yield for Lot 14 was only 2% below average annual intake. Lot 13 was unable to meet the goal because it is a three bedroom house but there is only +/- 1,500 SF of land available for growing food compared to +/- 2000 SF for Lot 14 and +/-3000 SF for Lot 5. To accommodate for this difference, residents could also rely on the fruit produced from the communal orchard which totals to 405 pounds/year as shown in table 8. It is important to note that these plants only produce during certain seasons of the year which are depicted in Figure 37. Therefore, preservation techniques such as canning, freezing, and drying can extend the consumption time frame for residents.

Yields

Plant	**Average Annual Yield (lbs./year)**	**Lot 15 Yield (lbs./year)**	**Lot 14 Yield (lbs./year)**	**Lot 13 Yield (lbs./year)**
Blueberry	17.5	105	87.5	70
Blackberry	15	195	75	45
Strawberry	2	24	18	14
Goumi	15	60	60	30
Muscadine	18	18	18	18
Serviceberry	10	20	10	0

Crabapple	N/A	N/A	N/A	N/A
Total Yield (lbs./year)		422	268.5	177
Percentage of Yearly Consumption of Fruits*		50.3% 59%	48.0% 56.6%	21.1% 24.9%

Table 7: Yields of Projected Design for Phase II
*Percentage of yearly consumption was found by dividing total annual yield of each lot by number of bedrooms in the house and then finding what percentage that was of the average amount of fruits consumed by Americans of 279.4 lbs./year in 2000 (USDA 2000).
**Yields may vary depending on potential pest, insect, animal disturbances.
***Sources: The previously listed yields were found by averaging the possible yields outlined in the available source information below.

- Rabbiteye blueberries can produce over 10 lbs. and at most 25 lbs., therefore on average 17.5 (Mainland and Cline, 2002)
- Erect and semi-trailing blackberry plants can produce between 10-20 lbs. /plant; average: 15 lbs. (Fernandez 2009).
- Strawberries: 25 transplants in a matted row can yield excess of 50 lbs.; average 2 lbs. per plant (Poling 1993).
- Goumi: mature plants yield approximately 15-17 lbs. (http://www.fruitipedia.com/goumi_eleagnus_multiflora.htm
- Muscadine: once acre yields one ton, if recommended spacing for one plant is followed (space plants and posts 20 feet apart with a row width of 10), then this equates to approximately 18 lbs. per individual plant. (NCSU 2003, "Muscadine Grape Production Guide for North Carolina)
- Serviceberry: can yield at most 10 lbs. (Crouch et al. 2014)
- Crabapples were not included in this calculation because many varieties are not considered palatable.

Plant	Average Annual Yield (lbs./year)	Quantity	Total Average Annual Yield (lbs./year)
Serviceberry	10	5	50
Mulberry	10	4	40
Fig	25	3	75
Apple	48	5	240
Total		17	**405**

Table 8: Yields of Projected Design for Orchard
*Yields may vary depending on potential pest, insect, animal disturbances.

**Sources for yields:

- Mulberry yield information unavailable. Based on observation, expected yields were comparable to serviceberry.
- Figs: 20-30 lbs./mature plant (www.pots2plots.com /Fruit/Growing Figs.htm#Expected_Yield_per_mature_tree)
- Apple: 1.07 bushel per 5 year old tree at 12'x20' spacing. One bushel = 48 lbs. (Rowlett 2001; Parker et al. 1998)

In comparison to Phase I vegetation, the benefits are maximized in the projective design. While plants in Phase II provide wildlife benefits, they do not provide any form of edibles to residents. The plants in Phase II provide a variety of wildlife benefits and also supplement the diets of residents while exposing them to the processes of growing their own food.

Design Analysis: Permaculture Principles

The following permaculture principles were able to be incorporated into the design:

1. Locating elements based on permaculture design zones and level of use. Raised bed locations are situated in close proximity to the homes because they will require the most attention. Bigger orchard trees were located in the detention pond area because of space requirements but also because they require less frequency of attention than the annuals that are located in raised beds. The zones were not fully concentric which is standard when adjusting to urban/suburban areas as shown in Figure 8. Refer to Figure 40 for a more detailed description of the design's permaculture zones.

2. Layering for the orchard includes both small to medium trees with recommended ground cover species to emphasize the symbiotic relationship between species. Refer to Figure 36 for a more detailed description.
3. Overall, the design focuses on holistically addressing the needs of the land and people of the site.
4. Features a compost area in the orchard area to help reduce surplus waste. Shown in Figure 36.
5. Design process followed is similar to that associated with permaculture.

Design Analysis: Cost Breakdown of Phase II

Phase II Plant Material:

Plant	**Average Price**	**Lot 15 #**	**Lot 14 #**	**Lot 13 #**	
Blueberry	$25	6	5	4	
Blackberry	$20	13	5	3	
Strawberry	$4.5	12	9	7	
Goumi	$25	4	4	2	
Muscadine	$15	1	1	1	
Total Price		$579	$380.50	$256.50	**Total=$1,216**

Street Trees Breakdown:

Plant	Average Price	#
Crabapple	$25	4
Serviceberry	$50	3
Total Price		**Total=$250**

Trellis Materials:

Quantity	Material	List Price	Total Price
3	4”x4”x8” pressure treated wood	$7	$21
6	6”x6”x8” pressure treated wood post	$20	$120
2	2”x4”x16” pressure treated wood	$20	$40
3	20’ 9 gage galvanized wire	$7/50’	$21
1	1 3/4" x 9-gage galvanized staples	$3.46/box	$3.46
			Total= $205.46

(Cost estimates source: Lowes: www.Lowes.com)

Mulch / Soil Amendment:

Quantity	Material	Total Price
11 cubic feet	Mulch	$300 (source Buck Jones Nursery)
3600 sq. ft.	Soil Amendment	$167
		Total= $467

(Cost estimates source: Buck Jones Nursery)

Drip Irrigation:

Quantity	Material	List Price	Total Price
7	¼" 50' porous drip soaker hose	$6.98	$48.86
1	20 pack goof plug	$2.19	$2.19
			Total= $51.05

Raised Beds:

Quantity	Material	List Price	Total Price
22	1"x6"x12' Cedar Plank	$13.52	$296.44
2	Screws – 1 lb. pack	$6.47	$12.94
			Total= $309.38

Total Cost Summary

Item	ALT Budget	Design Cost
Plant Material	$500	$1,216
Street Trees	$600	$250
Materials	$350	$1032.43
Labor	$600	Free - Volunteer
Total	**$2,050**	**$2,498.43**

Table 9: Cost Breakdown of Phase II

As mentioned above, the Athens Land Trust allotted budget for Phase II is street trees ($600) + plant materials ($500) + mulch and soil amendment ($350) + labor ($600). Therefore, the street trees total is below budget by $350. However, the plant materials for phase II is over budget by $716. Thus, the extra money saved from street tree budget can supplement plant materials by $350. Nevertheless, the plant materials for Phase II are still over budget by $366. This could be covered by trying to get plants donated by sources. Also, if a portion of the labor can be done by volunteers then the

$366 could be allocated from the $600 for labor. Finally, if none of the previous options can be attained then it is recommended that fewer plants be planted and substituted by any of the plants that are deemed appropriate by the Athens Land Trust. These plants could be some of the vegetation seen in Phase I. Mulch and soil amendments is also over budget by $372; however, again this was calculated without the consideration of a portion of the materials being donated. It is recommended to seek out arborist or tree removal companies who could possibly donate tree mulch. Also, it is recommended to speak with the Athens Clark County Landfill to get compost donated. Finally, including the cost of the trellis, raised beds, and drip irrigation adds an additional $827.43 to the budget. Possible sources for donation of these materials may include UGA's Material Reuse Program and re-use stores such as Athens Habitat Restore, which have an ample amount of materials that could be substituted for the sale price of materials from sources such as Lowes.

Overall, the design is over budget by approximately $450. Because the cost estimate did not take into account donations it is expected that the actual cost will be lower therefore reducing the additional budget cost. Nonetheless, the cost breakdown demonstrates that in order for Athens Land Trust to remain within budget, they will have to rely heavily on donation based materials and free volunteer labor possibly from UGA classes. Table 10 describes the additional cost of adding the orchard, which was not included in the total budget because the provided budget is only for Phase II.

Cost Estimate – Orchard Trees

Plant	Average Price	#
Serviceberry	$50	5
Mulberry	$20	4
Fig	$20	3
Apple	$12	5
Total Price		**Total=$450**

Table 10: Cost Estimate – Orchard Trees

Design Analysis: Maintenance Recommendations

Each plant requires minimal maintenance but still must acquire some attention when beginning. It is recommended that the Athens Land Trust either hire a maintenance company or put together a class perhaps in conjunction with UGA Department of Horticulture or the existing ALT's Community Agriculture program that educates residents on the techniques associated with caring for the various plants on site. The classes can educate residents on different plant needs such as watering, pruning, trellising, and harvesting. Helpful sources to find the previously listed information are UGA's College of Agricultural and Environmental Studies website (www.caes.uga.edu) and North Carolina State University Cooperative Extension website (www.ces.nscu.edu). Another opportunity for education is the orchard area which could be maintained by the ALT and serve as opportunity to hold educational workshops to teach homeowners how to care for and become involved with the maintenance of the edibles on site. Inviting community members may lead to an expansion of community ties and help foster a sense of ownership amongst homeowners in the landscape.

Recommended Trajectory

The projected design did not involve homeowners because the homes were unoccupied at the time. However, it would be beneficial to include homeowners in the design process in future projects if they currently reside in the residence. This would allow for a more personalized design and ensure that interest and preference were considered in terms of design elements such as plant materials. If more money is able to be allocated to expand site elements, it is recommended that more diversity of vegetation be added to the site which would extend the growing season and annual yield. Additionally, crabapples could be replaced with more serviceberry trees that are more expensive yet live longer or a medium sized tree that may not produce edibles for human but benefit wildlife and provide aesthetic benefits such as fringetree, eastern redbud, hop hornbeam, southern sugar maple, or flowering dogwood. Also, perennial groundcover species, which include ramps, mints, garlic chives, and asparagus, that were recommended for the orchard detention area could also be added to shady areas under trees in Phase II to add to the strawberry groundcover. Additionally, more trees in the orchard area would greatly add to yields and diversity of plants on site. Finally, with more money a greater quantity of the existing recommended plants could be added. When adding more vegetation, refer to Figure 37 to ensure that growing needs such as sun preference is taken into consideration when deciding placement.

Conclusion

In conclusion, while urban agriculture was able to be assimilated into the Cannontown Neighborhood site using permaculture design principles, the main restriction that arose was the restrictive budget. It is vital that certain costs be offset by volunteer labor and donated plants in order for this design to be implemented. Overall, this design creates more equal access to safe, high quality food for the residents of Cannontown Neighborhood and provides an alternative to relying on distant large scale, industrial agriculture practices.

CHAPTER 6

CONCLUSION

Integrating agriculture into urban affordable housing developments achieves the concept of sustainability on a variety of different levels. It positively affects the economy by increasing local economic niches and decreasing the cost of food for residents. Bringing food production closer to where people reside leads to environmental benefits such as reduced pollution that results from large amounts of pesticide use commonly associated with industrial agriculture and decreased reliance on nonrenewable resources for transportation of food. Socially, it provides a variety of benefits including increased community involvement and potentially enhanced physical, mental, and emotional well-being for residents. Additionally, it promotes equal access to safe, high quality, fresh food for people regardless of their income level.

The recommended design of Cannontown Neighborhood demonstrates that it is possible to design an affordable housing landscape that incorporates urban agriculture using permaculture principles. Additionally, the design creates a multifunctional landscape that is aesthetically pleasing, exposures residents to agricultural practices, creates opportunities for low-maintenance gardening, and enhances wildlife habitat. The advantage of this projective design is that the Athens Land Trust owns the land and can create a cohesive design because it is new construction. As seen in the precedent study of Troy Gardens in which a land trust played a major role in the sustained success of the edible landscape community, the Athens Land Trust also has the ability to help facilitate success of this landscape. By providing residents with the opportunity to engage with an edible landscape, benefits are accessible for not only by the people living in this community but also the land and greater society. Therefore, the future challenge will be to create an organized effort between the Athens Land Trust and the residents to help facilitate the success of this landscape and to encourage the involvement of the residents in the proper maintenance. Educational opportunities that not only educate residents on gardening procedures but also engage Cannontown residents with other members of the Athens community who are involved with urban agriculture, such as those who participate in Broad Street Market, will help sustain the edible landscape. In reality, not all of the fruit produced by these plants will be harvested; however, providing opportunities that inspire residents to learn more about home gardening can help.

Moving forward, landscape architects can find new creative ways to push their designs to go beyond providing not only an aesthetically pleasing landscape but also one that serves multiple purposes for our land and our people. Landscape architects have the ability to discover new ways of proactively designing to create positive change that benefits multiple realms of life rather than degrade it. This thesis aimed at looking at one way landscape architects can address sustainability issues that are intertwined within the realms of urban agriculture, affordable housing, and permaculture. Moving forward, by continuing to think about how we can make the landscapes in our urban areas solve multiple facets of economics, ecology, and human needs, we have the capacity to further urban sustainability.

Recommended future studies to expand upon the research completed in this thesis includes studying how these design techniques can be expanded and implemented into other urban low-income developments such as public housing landscapes. In addition, a manual that teaches homeowners how to care for specific elements of their landscape is needed and would be very beneficial in facilitating skilled involvement of homeowners in the management of their edible landscape. Finally, future research could be conducted to understand how homeowners are impacted after residing in the projected design's landscape for an extended period of time. It would be beneficial to understand how the landscape benefitted the residents economically and socially but also how it impacted their relationship with their surrounding environment. Learning what design elements the homeowner preferred over others could help determine more effective ways of designing the landscape to better suit their needs.

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