ISSUES AND OPPORTUNITIES: CLIMATE, ECOSYSTEM AND SOCIAL EQUITY

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1. INTRODUCTION

This section presents an overview of issues and opportunities regarding Carrboro's terrestrial and aquatic ecosystems within the contexts of climate change and social equity. This includes climate projections for the Carrboro region, climate resilience and social vulnerability to climate change impacts, as well as ecosystems and natural areas, and a summary of goals and strategies. Note, further information related to stormwater infrastructure (e.g., drainage systems and green stormwater infrastructure) can be found in the Transportation, Water, and Energy Infrastructure chapter.

Carrboro's future does not come without its challenges. Carrboro has experienced extreme weather events, like flooding from Hurricane Fran, Florence, and Michael, and droughts between 2000-2002 and in 2007, which will likely increase in the future. Stormwater management practices, used in older developments prior to the current land use ordinance, inadequately address stormwater issues today[i]. In addition, non-native turf grass lawns continue to contribute to stormwater runoff[ii] and negatively impact local biodiversity.

Carrboro residents care deeply about the environmental ecosystems within Carrboro and the impact of climate change on the community. One of the six strategic goals of Carrboro's Capital Improvement Plan is to "incorporate energy and climate protection strategies." The town regularly updates its greenhouse gas inventory and as of March 2019 has calculated a 14% reduction in total community greenhouse gas (GHG) emissions from 2012. Residents actively volunteer to maintain natural areas and support nature-based solutions in response to climate change concerns. With an active base of residents, Carrboro desires to implement community initiatives to preserve and enhance its natural systems as demonstrated by the recent green neighborhoods initiative.

This chapter reviews regional climate trends and delves into issues of climate resilience, preservation and restoration of ecosystems, and their intersection with social equity. Equity must be at the forefront of the planning process to ensure that climate change, natural preservation, and proposed solutions do not disproportionately harm Black or other people of color, refugees, disparate gender identities, or low-income communities. This chapter underscores the importance of a comprehensive plan that protects and restores the quality of life for each Carrboro resident.

2. OVERVIEW AND DATA TRENDS

Carrboro is situated within beautiful natural areas and is taking ambitious efforts towards mitigating climate change to protect and enhance its ecosystem and its people.

A. CLIMATE TRENDS AND IMPACTS

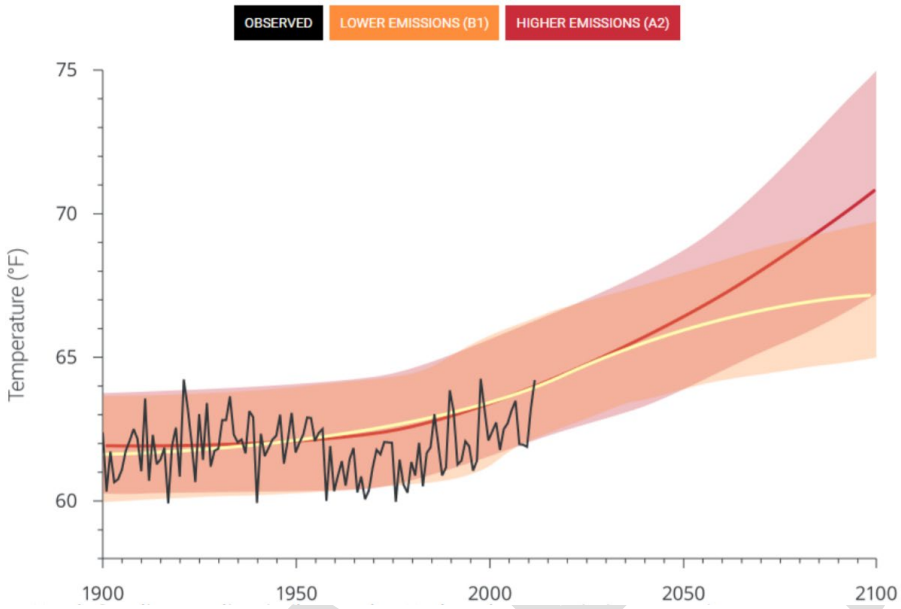
Around the country, communities are facing climate impacts. According to the National Climate Assessment by the U.S. Global Change Research Program, higher temperatures and heavy downpours have been increasing nationally, especially over the last three to five decades.[iii] Coastal flooding, due to sea level rise, is putting the very existence of some communities at risk. Powerful hurricanes fueled by warming oceans can destroy neighborhoods. Severe droughts are threatening water supplies. Longer, dryer summers are leading to deadly and destructive wildfires. Experts warn of other coming threats from climate change, such as tropical diseases and food system disruptions. Ecosystems are being threatened too. Species around the world are stressed by a changing climate that threatens their habitats, their food chains, and their natural rhythms. This change can be noticed at home when we see trees blooming earlier and earlier each year.

North Carolina-based researchers have confirmed similar trends for the Piedmont region of North Carolina, where the Town of Carrboro is located.[iv] Climate change impacts in the Carrboro region are likely to be significant over the next century. Extreme heat, flooding, and droughts are among the most important climate risks for the region. Local ecosystems may also be negatively impacted, including the loss of native animal and plant species.[v]

TEMPERATURE TRENDS

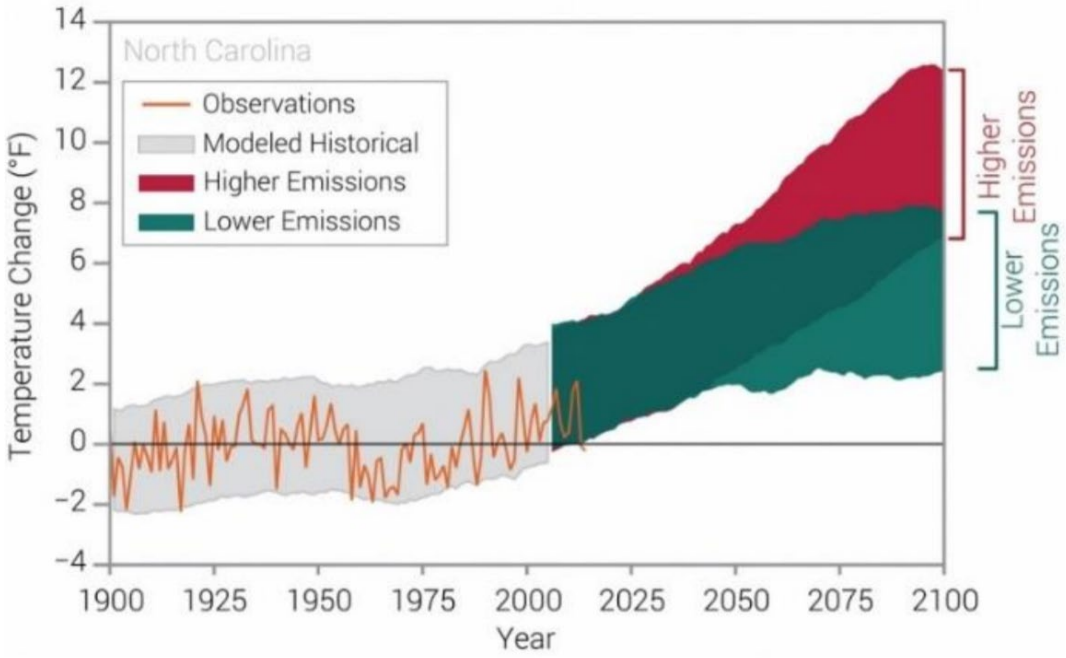
Climate modeling indicates that temperature impacts in the Piedmont region will worsen due to climate change. By the end of the century, the average temperature is projected to increase by 2°–6°F under the lower impact scenario, and by 6°–10°F under the higher impact scenario. Climate models project a substantial increase in the number of very hot days and very warm nights by mid-to-late century under both scenarios. By the end of the century, the number of very hot days is projected to increase between 9 to 99 days depending on the scenario. The number of very warm nights is projected to increase between 7 to 79 days depending on the scenario. It is likely that the number of cold days and cold nights will eventually decrease. Consequently, this indicates an increase in energy needed for cooling residences and buildings.

Figure 1: Southeast Temperature: Observed & Projected[vi]



(Carter et al., 2014)

Figure 2: Temperature Change: Observed & Projected[vii]



(Frankson et al., 2017)

CLIMATE IMPACT: EXTREME HEAT AND IMPAIRED AIR QUALITY

Urbanized areas are more prone to heat waves because of the urban heat island effect. Cities can be more than 5 degrees warmer than surrounding rural areas, and as much as 22 degrees warmer on still nights.[viii] Urban heat island results from a loss of vegetation, removing shade and natural cooling, and an increase in heat-absorbing building materials, such as asphalt parking lots and building rooftops.

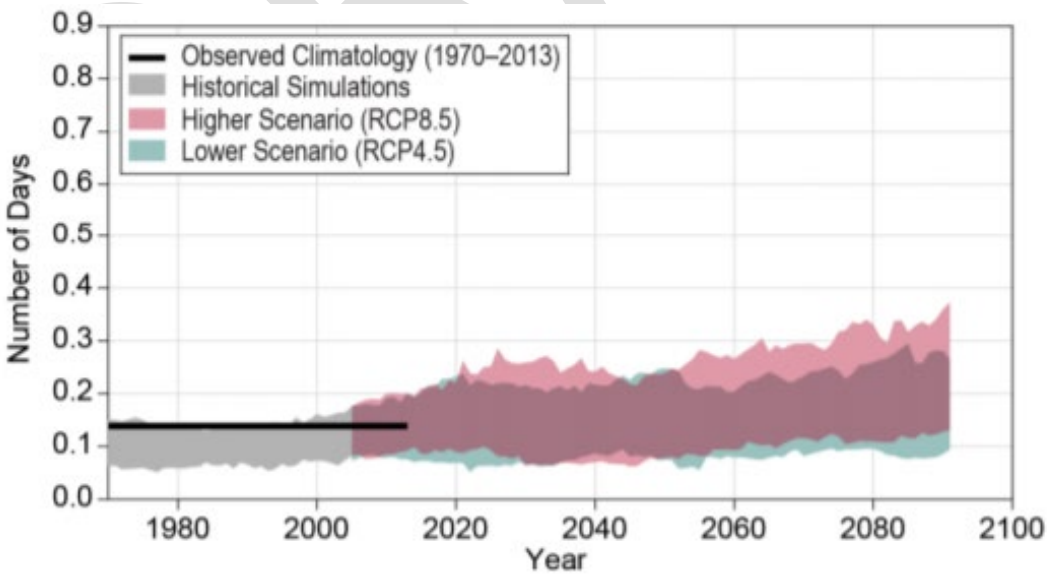
From 2000 to 2009, extreme heat was the leading cause of weather-related deaths in the U.S.[ix] Extreme heat degrades air quality.[x] Heat also interacts with mental health conditions: suicide rates rise with heat waves; some medications interfere with body temperature regulation; and dementia is a risk factor for heat-related death making older populations especially vulnerable.[xi]

Extreme heat also has economic and follow-on climate impacts. Extreme heat triggers greater use of air conditioning, which raises energy bills for households. In turn, the demand for energy increases the amount of GHGs and other pollution released by power plants,[xii] which contributes to climate change.

PRECIPITATION TRENDS

Climate modeling indicates that precipitation impacts will also worsen due to climate change. It is likely that severe thunderstorms will increase in frequency. By the end of the century, the annual number of days with extreme precipitation (3 inches or more) is projected to increase by up to 115% under the lower scenario, and 200% under the higher scenario. Conversely, future droughts are projected to be warmer than historical events, with more severe impacts on rainfed agriculture and natural vegetation.[xiii]

Figure 3: Observed and Projected Extreme Precipitation Events: Piedmont Region of NC (1970-2100) Annual Days with Precipitation ≥ 3 Inches[xiv]



(Kunkel et al., 2020)

CLIMATE IMPACT: FLOODING AND IMPAIRED WATER QUALITY

Certain areas within Carrboro are vulnerable to both riverine and urban flooding. Urban flooding occurs outside of FEMA-designated floodplains and is defined as the inundation of property or streets by stormwater runoff. It can include impacts ranging from water entering living spaces or seeping through foundation walls, to erosion, to undesirable ponding of water. In Carrboro, flooding can generally be attributed to the following factors.[xv, xvi]

- Climate
- Geology
- Land Use and Development
- Stormwater Infrastructure

Flooding is a consequence of changes in precipitation patterns, characterized by more high-intensity storms due to climate change, as discussed in the previous section. In addition, soils in some areas have limited infiltration capacity, due both to local geology and historical land use, resulting in loss of topsoil and compaction.

Flooding is exacerbated by historical and current patterns of land development. Today, Carrboro's land use and development patterns include the subdivision of land and location of some buildings in lower lying, flood-prone areas; buildings with living and accessory space (e.g., split-levels and basements) constructed "below grade" (i.e., underground) or "at grade" (i.e., at ground level); land conversion to impervious and less pervious surfaces; and development in many areas that preceded federal, state, and local regulation, supporting analyses, and standards. Impervious surfaces prevent the natural processes of stormwater management. Consequently, rain becomes stormwater runoff and contributes to local flooding and ecosystem issues.

The health and economic impacts of flooding are significant. In a survey of Illinois flood victims, 84% reported stress; 13% reported ill health; 41% lost the use of part of their property; 63% lost valuables; and 74% lost work hours in order to handle repairs to their home.[xvii] Flooding, especially when coupled with warmer temperatures, can create indoor air quality problems, such as mold, and result in respiratory problems. One national study estimated that 21% of asthma cases are related to building dampness.[xviii] Warmer temperatures and changes in rainfall patterns may also increase the risk of contracting diseases carried by pests[xix] and is linked to asthma caused by a longer pollen season.

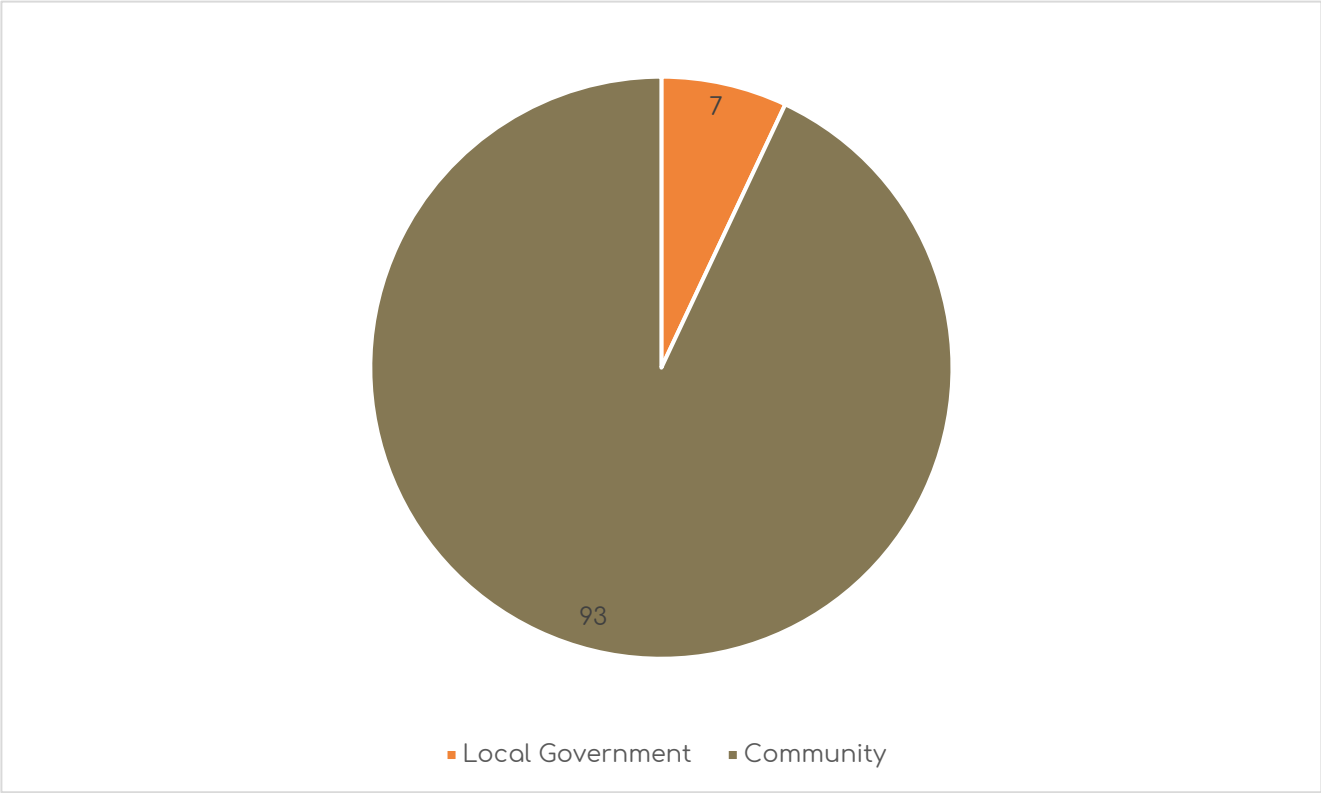
GREENHOUSE GASES

Climate change impacts are mainly driven by greenhouse gas emissions (GHGs). GHGs enter the atmosphere and trap heat absorbed by the earth, thus warming Earth and affecting climate systems. The 2017 Community Climate Action Plan (CCAP) recommended the Town adopt the goal of a 50% reduction per capita GHG emissions by 2025. In 2019, the Environmental Advisory Board recommended changing the CCAP and the 2014 Energy and Climate Protection Plan (ECP) goals to an 80% community reduction of 2010 GHG levels by 2030.

The Town has completed a baseline Greenhouse Gas Inventory and updated it regularly since 2012.[xx] As of March 2019, the Town has achieved a reduction of approximately 14%.[xxi] Carrboro has pursued strategies such as performing energy audits, installing higher efficiency ballasts and bulbs,

installing programmable thermostats, supporting a community solar project at the Town Commons, contributing to NC Green Power for renewable energy, converting street lamps to LED lights, the Green Neighborhoods Initiative, reducing municipal fleet emissions,[xxii] and energy efficiency retrofits for municipal and residential buildings.[xxiii]

Figure 4: Comparison of Community vs Local Government GHG Emissions in 2012 [xx]



(Agudelo-Frankel et al., 2015)

B. ECOSYSTEMS

Carrboro's residents strongly value ecosystems as a part of Carrboro's sense of place. Interviews with stakeholders in 2020 cite the importance of nearby lakes, creeks, and forests, for the purposes of recreation, conservation, and businesses. In 2000, the town created a 20-year vision, part of which emphasized strong interest in environmental protection. Two decades later, the recently adopted Climate Action Plan for Carrboro continues this effort by focusing on alternative energy systems and development patterns to mitigate climate change, keep ecosystems intact to maintain biodiversity, and protect natural resources.[xxiv]

The Town of Carrboro previously partnered with the Center for Neighborhood Technology (CNT) to conduct RainReady Carrboro, a study in Upper Toms Creek for constraints and opportunities regarding "green infrastructure" on residential properties. According to a recent pilot study of Tom's Creek in Carrboro, the increase in impervious surfaces, such as roads and rooftops, and compacted soils often found in lawns and other portions of suburban landscapes, have increased risk of stormwater runoff, flooding, interfered with ecosystems, and created an artificial barrier for wildlife. [xxv]

CLIMATE CHANGE'S THREAT TO ECOSYSTEMS

The damage of climate change to ecosystems cannot be overstated. In the North Carolina Climate Science Report, the threat climate change poses to ecosystems, particularly forests, is significant because over half of North Carolina consists of forests.[xxvi] Drastic weather events, such as heatwaves and droughts, threaten already fragile ecosystems across North Carolina, including Carrboro.

DROUGHTS AND HIGH TEMPERATURES

Carrboro is no stranger to droughts, and the threat of severe droughts continues due to climate change. As climate change increases the severity of droughts, ecosystems are placed in greater danger. The North Carolina Climate Science Report indicates the increased likelihood of severe high temperatures and droughts. This increase will raise the risk of more frequent forest wildfires than usual, threatening wildlife and the ecosystem.[xxvii] Another key threat from abnormally high temperatures and droughts is the "savannahfication" of forests, or their transformation into open (less dense) woodlands, in southeastern United States.[xxviii]

PATTERNS OF DEVELOPMENT

Over the years as Carrboro has continued to grow and develop, the landscape has become more and more impervious. However, the Town of Carrboro requires through their land use ordinance that 40% of open space be preserved in all new developments (since 1995). A large portion of development in Carrboro, particularly near downtown, was completed prior to the implementation of floodplain management regulations. [xxix] Land management practices resulted in looking at a loss of trees, conventional lawn care, increasing impervious surfaces such as paved roads, and historical development in flood-prone areas threaten the biodiversity and health of Carrboro's ecosystems.

Trees are important for managing climate impacts, they reduce stormwater run-off by reducing erosion, and through stormwater infiltration and evapotranspiration. Between 2002 and 2010, Carrboro lost approximately 4% of its tree canopy.[xxx] This decline of tree canopy threatens biodiversity, air quality, and heat and stormwater management. Birds and pollinating insects that rely on trees can suffer a decline in population, with follow-on environmental and economic repercussions. Trees reduce heat in urban areas through shading and evapotranspiration, and improve air quality by absorbing carbon dioxide and other gases/pollutants. In 2014, the town approved updated tree canopy coverage standards, which requires that residential land uses include at least 40% canopy coverage.[xxxi]

The conventional household lawn can contribute to the endangerment of ecosystems' biodiversity. Residents may, without realizing, plant invasive species which can pose a threat to native plant species, with follow-on effects to the ecosystem and local economy. For example, native plant species are often where native insects lay their eggs, and these insects are a primary food source for 96% of native birds in North America. By increasing competition for soil nutrients, invasive plant species endanger native plant species, threatening not only native insects populations, but ultimately, also native bird populations.[xxxii] Economically, the loss of these native insects will cost more than $9 billion in lost pollination.[xxxiii] The average lawn also lacks the ability to effectively absorb rain during storms. The common turfgrasses used for lawns, like Bermuda, Fescue, Zoysia, have a shallow root system, which makes them much less efficient at absorbing rain and can contribute to stormwater run-off and urban flooding.[xxxiv] Furthermore, lawn care fertilizers and other chemicals can create polluted run-off, damaging local waterbodies.[xxxv] By contrast, native species are better adapted to the climate, more effectively absorb stormwater, and require less watering.

Carrboro's Community Climate Action Plan cites development pattern impacts that can be modified to reduce ecosystem damage. Development along creeks and in floodplains has also contributed to increased stormwater runoff. Increased stormwater runoff leads to flooding, erosion, and nonpoint source pollution.[xxxvi] Planning for and installing riparian buffers, vegetated areas along creeks, can mitigate these negative impacts.

Carrboro's land use ordinance includes open space requirements. Stated goals of these requirements include preservation of open vistas, environmentally sensitive lands, habitat for wildlife, historically or archaeologically important areas, and passive recreation.[xxxvii] Generally, when intentionally planned to support local ecosystems, open space requirements can provide economic and health benefits, support local water infrastructure, and create opportunities for community development.[xxxviii] With careful planning and consideration of social equity impacts, open space can achieve these goals, while furthering equity goals and avoiding disproportionate harm or costs to marginalized populations.

RETHINKING DEVELOPMENT

Carrboro's strong interest in protecting ecosystems is reflected in the capital improvements and budget of Carrboro, which cites climate protection strategies as one of the six strategic goals for a ten-year Capital Improvement Plan (CIP). Interviews with residents indicate an interest in promoting infrastructure that does not threaten Carrboro's ecosystem. Green infrastructure uses natural strategies, such as plants and soil mixes, to provide infrastructure services such as stormwater infiltration and conveyance[xxxix]. A recent study for a flood-prone area of Carrboro recommended small-scale distributed green infrastructure, such as home gardens, as a strategy for natural stormwater management.

Figure 5: Green Infrastructure and "Co-Benefits"[xl]

Benefit	Reduces Stormwater Runoff				Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Community Livability					Improves Habitat	Cultivates Public Education Opportunities
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding								Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture		
Practice																		
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	◒	●	◒	◒	●	●
Tree Planting	●	●	●	●	○	◒	○	●	●	●	●	●	●	●	●	◒	●	●
Bioretention & Infiltration	●	●	●	●	◒	◒	○	○	●	●	●	●	●	◒	◒	○	●	●
Permeable Pavement	●	●	●	●	○	◒	●	◒	●	●	●	○	○	●	○	○	○	●
Water Harvesting	●	●	●	●	●	◒	○	◒	◒	◒	○	○	○	○	○	○	○	●

● Yes ◒ Maybe ○ No

CNT

https://www.cnt.org/publications/green-values-strategy-guide-linking-green-infrastructure-benefits-to-community

(Center for Neighborhood Technology, 2020)

The Community Climate Action Plan recommends modifications to landscaping methods to support ecosystems and their biodiversity. The plan recommends the creation of a community initiative to promote action and education on the importance of expanding and preserving Carrboro's tree canopy. The plan also recommends promoting native species through an information campaign for residents, and removing invasive species in public spaces.[xli] Carrboro has committed to improving urban forestry and native pollinator habitats, and its actions have led to recognition as a Tree City by Arbor Day Foundation and as a Bee City by Xerces Society, both most recently in 2019.

Figure 6: Bolin Forest and Quarterpath Trace Subdivision Urban Forest Stewardship Efforts (2015)[xlii]

(J. Wesley Aycock IV & James M. Clark, 2015)

C. SOCIAL EQUITY

Environmental impacts may not occur equally across a community. Localized conditions may mean that one neighborhood experiences more flooding, perhaps because it is at a lower elevation or has more impervious area. Some neighborhoods may have less-well maintained or undersized sewer pipes or lack vegetation that can infiltrate runoff. In communities where neighborhoods are segregated by race, class, or other population characteristics, flooding can be an environmental justice issue. Some neighborhoods of color experience "municipal underbounding" — a condition in which municipal limits do not include a location that would otherwise be considered within the boundary due to the historical context. The Roger Eubanks Community, where a landfill was sited, advocated for decades to be provided with sewage infrastructure.[xliii]

Some populations have been shown to be more susceptible to heat-related illness and death, including older individuals, children, homeless individuals, and outdoor workers.[xliv] Studies also show differences in heat impacts according to race, ethnicity, and socioeconomic status. Nationally, non-citizens are more likely to die of heat exposure than citizens.[xlv] Several factors may contribute to higher heat-related deaths and illnesses, including quality of housing, social, cultural, or linguistic isolation, and access to cooling strategies, such as operable windows, cool public spaces, and air conditioning.[xlvi]

The historical federal housing policy of redlining was a practice in which Home Owners' Loan Corporation evaluated city blocks for their mortgage risks, with several factors including racial make-up of the neighborhood impacting risk level.[xlvii] These maps were used in cities across the U.S. to deny home loans or insurance to neighborhoods based on racial characteristics. Other communities, that did not have specific redlining maps, often practiced racial restrictive covenants, in which the deed included a clause the prevented certain races from ever owning the property.[xlviii] While evidence has not been found of specific redlining maps for Carrboro, patterns of housing discrimination impacted where Blacks could rent or buy homes. The patterns of segregation persist in environmental and economic conditions that can still be seen today, in communities across the nation. For example, a study of 108 cities consistently demonstrated that formerly redlined areas were warmer than non-redlined neighboring areas by up to 7 degrees Celsius.[xlix]

3. KEY ISSUES AND OPPORTUNITIES

Various opportunities and impediments were identified during the analysis of existing plans and commentary from Town staff and committees. The findings are listed below.

A. CLIMATE RESILIENCE

Carrboro is a largely built-out community seeking to become resilient to uncertain social, financial, and ecosystem impacts of climate change. Carrboro's necessary response is two-fold: 1. Preparing for the inevitable impacts of climate change with resiliency measures and 2. Reducing GHG emissions.

Preparation has included newer developments built to updated code requirements, but older areas are not being retrofitted at the same pace. The higher cost of new development and infrastructure must be balanced against the benefits of enhanced resilience.

The town's land use regulatory authority is a key tool to unlock opportunities. The Land Use Ordinance can be refined to direct development, transportation, and infrastructure, in such a way to improve the community's climate resiliency.

The financial cost to fully implement the 2017 Climate Action Plan over the next ten years is high. The town only has direct control over municipal emissions. Plan implementation should not unduly burden residents with property taxes or fees, but residents should actively participate in reducing their own GHG footprint. Carrboro's climate action strategy depends heavily on broad community participation. For example, the town does not have authority over vehicles, all roadways or transit, limiting the ability to reduce GHGs from vehicles. Many residents have taken on responsibility by expressing concern about climate change, desiring to learn about nature-based small solutions, and serving as valuable volunteers.

B. PRESERVATION OF NATURAL AREAS

Preserving Carrboro's natural ecosystems was a pronounced interest across many of the conducted interviews. The threat to ecosystems, particularly forests and creeks, is important to the community because they recognize the forest and trees of Carrboro as a part of the town's identity. Many are open to taking action that would preserve and protect these natural areas and their ecosystems from further damage.

Interviewees shared a positive attitude towards consideration of the environment in future infrastructure decisions. The Carrboro's Community Climate Action Plan suggests increasing the tree canopy through a community initiative and would likely be met with support due to community interest in preserving Carrboro's trees and ecosystems. Furthermore, initiatives to educate the community on the negative effects of lawns on ecosystems and how to plant native species are small scale initiatives that the community would be open to considering and participating in based on their conservation driven responses. Additionally, the town could benefit from a long-term forest replanting plan that accounts for climate change benefits.

Stakeholder interviews cite local ecosystems and the economic impact of Carrboro's natural areas as vital for Carrboro. Accessibility to natural areas, including the Carolina North Forest, nearby University Lake, creeks, and greenways, is a positive feature mentioned by many interviewees. These features are a beneficial asset both for recreational purposes and local ecosystems, as well as

attracting visitors to town. Carrboro can capitalize on these benefits by partnering with agencies and entities that own the natural areas to preserve them, foster responsible recreation in these areas, and manage nearby new development to protect the fragile ecosystems in these areas.

C. SOCIAL EQUITY

Carrboro is home to diverse residents, including historically Black community areas, Latinx, Burmese, and Korean populations, served by a variety of grassroots organizations and community institutions. Some areas and populations within Carrboro are disproportionately impacted by climate change. A more inclusive community conversation around climate resilience requires integration of affordable housing, environmental justice, and racial equity contexts.

Particular areas of flooding concern include older developments built without stormwater facilities and the Rocky Brook Mobile Home Park, a development at the confluence of two creeks. The Town has explored options for increasing affordability to underserved residents with the new stormwater utility fee, and strategies for balancing infrastructure needs against social equity and affordable housing priorities. By State statute, fees must be based on stormwater impact without socioeconomic consideration, but the plan may explore other innovative tools within local authority.

Other potential areas of social inequity include proximity to pollution sources, energy burden, access to healthy food, and neighborhood traffic calming and sidewalk improvements. The Town is currently partnering with the Government Alliance on Racial Equity (GARE) to examine its plans and programs and develop new strategies for equity.

4. SUMMARY GOALS AND STRATEGIES FROM EXISTING PLANS AND INITIATIVES

Carrboro remains committed to protecting its natural areas and implementing actions that increase the town's resilience to climate change. The following plans highlight recommendations that reflect their values, environment, and people. For a more descriptive context, please see the full documents.

A. FACILITATED SMALL AREA PLAN FOR CARRBORO'S NORTHERN STUDY AREA 1999 TOWN OF CARRBORO

Preservation of Natural Areas

i. Goal 1: Patterns of growth which minimize negative impacts and maximize positive impacts on the community and the natural environment. Recommended measures included the following. Set standards for conservation lands in addition to wetlands and steep slopes, and by offering a range of densities with rise in relation to the percentage of land which is to be conserved. The contents of plans submitted for review should be required to provide greater detail about the natural and cultural features occurring on the proposed development site and – to a lesser extent – on any adjoining undeveloped properties.

ii. Goal 3: Conservation of natural and environmentally sensitive areas, and the protection of environmental quality. Recommended measures include the following. Amend the streamway buffer ordinance to incorporate site-specific impacts on water quality. Create a Conservation Overlay District. Encourage the active participation of land trusts in conserving environmentally sensitive areas. Support statewide enabling legislation to allow the transfer of development rights.

iii. Goal 6: Adequate provision of publicly accessible parks and recreation facilities. Recommended measures include the following. Require conservation land to inter-connect.

iv. Goal 9: Continuation of the character and natural beauty of the Study Area. Recommended measures include the following. Recommended measures include the following. Adopt town-wide design measures to ensure that new development is harmonious with the attractive features of existing development. Farmland Preservation: Work with the County to encourage the preservation of active farmland, and to limit the conversion of farmland to developed uses outside the Transition Areas.

B. LITTLE CREEK WATERSHED 2003 ASSESSMENT

Preservation of Natural Areas

i. Implement feasible and cost-effective stormwater retrofit projects to mitigate the hydrologic effects of existing development. Priority should be given to areas with the most density. Long-term retrofits should be considered during infrastructure improvements. Additionally, implement effective stormwater management for all new development to prevent further channel erosion and habitat degradation, for example infiltration practices and low impact development practices.
ii. Develop a strategy to address toxic inputs such as source reduction and stormwater treatment methods. Additional methods may include stormwater and dry weather sampling strategies to target pollutant removal and installation of best management practices for stormwater volume control and velocities. Furthermore, organic loading must be addressed by identifying and eliminating illicit discharges, education of residents about fertilizer use and installation of features to remove excess nutrients.
iii. Implement stream channel restoration activity in conjunction with stormwater retrofit best management practices to improve aquatic habitat. Additionally, the Town of Carrboro should consider rapid establishment of stabilizing vegetation in new construction.
iv. Cooperate with OWASA and Town of Chapel Hill to improve riparian vegetation condition along sanitary sewer rights of ways and greenways. All partners should commit to limiting disturbance of riparian areas to the minimum extent necessary to maintain infrastructure.

C. MORGAN CREEK LOCAL WATERSHED 2004 PLAN

Preservation of Natural Areas

i. Identify best management practices for retrofitting and current designs to address the negative impacts of stormwater runoff in conjunction with natural channel design and bioengineering methods to restore aquatic habitats. Some practices may include stormwater wetlands, detention ponds, and rain gardens.

D. BOLIN CREEK WATERSHED RESTORATION PLAN 2012 TOWN OF CARRBORO

Preservation of Natural Areas

i. Implement selected strategies for watershed management and restoration (Appendix 5), including: Engineered stormwater control structures; Pollution prevention measures; Ecosystem function rehabilitation and restoration measures; Cleanup, remediation, and mitigation measures; Erosion control and soil protection or rehabilitation practices; and Infrastructure mitigation techniques.

ii. Implement policy measures, including stormwater fee credit policies, incentive programs, and reverse auctions (Appendix 5).

iii. Implement planning measures and techniques, including cluster development, site fingerprinting, low impact development/design, "new urbanism," transit-oriented development, brownfields development, preservation of existing natural area, and greenspace or "greenscape" requirements (Appendix 5).

iv. Implement targeted outreach methods and tools to address a variety of watershed management issues (Appendix 6). Select method or tool by identifying key audience groups positioned to creating positive change.

E. ENERGY AND CLIMATE PROTECTION PLAN

Climate Resilience

i. Update town's Land Use Ordinance to include provisions for tree protection and open space to foster growth of urban forestry. Additionally, explore opportunities to recognize the many benefits of urban trees such as climate protection and energy benefits.

F. COMMUNITY CLIMATE ACTION PLAN 2017 TOWN OF CARRBORO

Climate Resilience

i. Pursue watershed restoration actions to protect local streams from changing precipitation patterns due to climate change.

Preservation of Natural Areas

i. Create a stormwater utility.

ii. Study the extent to which the deer population and climate change affect natural ecosystems.

iii. Study and implement a comprehensive organics collection and composting program.

iv. Support tree preservation, protection, and conservation efforts, including the formation of a community-led tree coalition for the community forest.

v. Pursue regulatory and non-regulatory approaches to discourage non-native and invasive plants and encourage native plan use.

Social Equity

i. Support efforts to reduce utility cost to integrate climate action and social equity initiatives.

G. NPDES PHASE II: STORMWATER MANAGEMENT IN CARRBORO: COMPREHENSIVE STORMWATER MANAGEMENT PLAN 2018 TOWN OF CARRBORO

Preservation of Natural Areas

i. Implement a variety of specific stormwater best management practices (BMPs) addressing regulatory requirements, public education and involvement, detecting and eliminating illicit discharges, controlling runoff, and preventing pollution from municipal operations.

ii. Establish a program to identify and prioritize opportunities for retrofit projects that will improve water quality.

iii. Continue to identify and pursue watershed restoration activities in Bolin Creek including ecosystem monitor, partner collaboration, targeted outreach to encourage citizens to adopt BMPs, and completion of a new significant restoration project.

iv. Continue to fund retrofits and other watershed restoration measures through the stormwater utility and enterprise fund.

H. RAINREADY CARRBORO PILOT STUDY 2019 TOWN OF CARRBORO

Climate Resilience

i. Implement a targeted and multifaceted communications plan to address the varying concerns of residents experiencing different types of flooding. Identify local resident "champions" who can partner with the Town to support the development of the program and serve as a liaison to residents. Cultivate resident-led groups that can participate in program outreach and consensus building efforts.

ii. Offer a technical assistance and cost-share grant program to residents seeking to install green infrastructure as a solution for localized flooding. Partner with local organizations who can launch and deliver aspects of the program. Consider coordinating program delivery across Town departments, to support program administration tasks. Identify funding and financing mechanisms to support the long-term operation of the program.

Social Equity

i. Identify program design options that provide financial support to enable lower income residents to participate in a technical assistance and cost-share grant program to install green infrastructure.

ii. Conduct targeted outreach to owners of rental housing and consider program design options to encourage participation in the technical assistance and cost-share green infrastructure program.

I. ENO-HAW HAZARD MITIGATION 2020 DRAFT PLAN

Climate Resilience

i. Look for opportunities to mitigate repetitive loss of structures. Opportunities should include funding mechanisms to retrofit critical and municipal facilities to improve resilience against climate concerns and energy backup generators for new municipal critical facilities.

ii. Establish comprehensive framework for plans, policies, and regulations pertaining to land use and its relation to natural hazard mitigation. Relatedly, protect and conserve land with environmental and natural hazard mitigation such as open space.

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