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Proctor Creek's Boone Boulevard Green Street Project Health Impact Assessment (HIA)

Atlanta, Georgia

Executive Summary of Main Findings and Recommendations

Office of Research and Development and Region 4
U.S. Environmental Protection Agency

Acknowledgements

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This document provides a summary of the main findings and recommendations of the HIA. The full HIA report is available online at EPA's HIA website and in hard copy (by request).

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About the Health Impact Assessment (HIA)

Most areas within the City of Atlanta, Georgia use a combined sewer system in which stormwater and sanitary sewer discharge flows together, through an underground conveyance system, to a treatment facility. During periods of heavy rainfall or snow, however, these systems bypass the treatment facility and discharge directly into a nearby waterbody. This event is called a combined sewer overflow (CSO) event. Many rivers and streams in the Atlanta metropolitan area are on the state's impaired waters list due to CSO events and stormwater runoff from urban areas [1]. Proctor Creek is one of the most impaired waters in metro-Atlanta and drains a watershed of approximately 10,198 acres of urban area before discharging into the Chattahoochee River. A watershed is the area of land where all of the water that is under it or drains off it goes into the same place.

In-ground planter box, a type of green infrastructure technology, along an urban street.

An urban street with permeable pavement, a type of green infrastructure technology.

The U.S. Environmental Protection Agency (EPA) is evaluating tools and technologies that support communities becoming more sustainable. Implementing green infrastructure, an EPA-supported technology, is an example of using sustainable solutions to an array of environmental issues. In 2012, the EPA awarded funding to the City of Atlanta Department of Watershed Management (DWM) for technical assistance to develop a conceptual plan to implement green infrastructure in a distressed neighborhood. The purpose of the technical assistance was to provide support for water quality and revitalization improvement efforts. Tetra Tech, a contractor to the EPA, developed a conceptual plan, titled the Boone Boulevard Green Infrastructure Conceptual Design (i.e., green street project), located in an at-risk community in the headwaters of Proctor Creek [2]. As a demonstration project, the proposed project plans to convert underutilized roadway into in-ground planter boxes and permeable pavement and redirect stormwater runoff from the roadway into rain gardens prior to entering the combined sewer system.

Why was a Health Impact Assessment performed?

EPA's Office of Research and Development (ORD) is considering health impact assessment (HIA) as one of the many tools to provide science-based resources and information for community-driven initiatives. This HIA is informing DWM's decision on implementing the proposed Green Street Project as they move forward in the planning process.

Who performed this HIA?

Staff in EPA ORD and Region 4 (Southeast) partnered to lead the HIA. These partners established the HIA Core Project Team, which was made of EPA staff and contractors, an HIA advisor, a staff member from the Fulton County Department of Health and Wellness, two researchers from the Centers for Disease Control and Prevention, and a university student who was also a resident in the community. The HIA Core Project Team conducted the HIA with input and guidance from community residents and an HIA Technical Advisory Group, which was made up of representatives from several stakeholder groups.

What methods were used in this HIA?

HIA is "a systematic process that uses an array of data sources and analytical methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on health of a population and the distribution of those impacts within the population. HIA provides recommendations on monitoring and managing those effects" [3]. HIAs follow a systematic, six-step process– S*creening, Scoping, Assessment, Recommendations, Reporting,* and *Monitoring and Evaluation*.

The assessment utilized:

- ✓ Pre-existing and publically available data (e.g., Census data, crime data, reports, etc.)
- ✓ Standardized and rigorous analysis methods
- ✓ Geographic information systems (GIS) support for modeling, mapping, and performing spatial analyses
- ✓ Review of empirical, science-based literature
- ✓ Expertise from local public health professionals, researchers, and other stakeholders
- ✓ Measureable (quantitative) and relative (qualitative) characterization of impacts

Community residents prioritizing their identified interests and/or concerns regarding the proposed project and its potential impact in their community.

What was the scope of this HIA?

This HIA evaluated how the proposed project would influence twelve determinants of health (i.e., factors that affect health), including water quality; flood management; climate and (surface) temperature; air quality; traffic safety; exposure to greenness; exposure to urban noise; accessibility to goods and services, greenspace, and healthcare; crime, including both perceived and actual security; social capital, including both cognitive and structural capital; household economics, specifically cost of living and employment; and community economics, specifically business performance. A half-mile radius around the proposed project site represented the study area in which the health impacts were appraised.

Main Findings and Recommendations of the HIA

Who would be affected by the proposed project?

According to the 2010 Census, there were 13,194 people living within a half-mile radius of the proposed project site- a 15.6% decrease from a decade earlier, indicating movement out of the community. The population was almost exclusively African American (82.3%), with Caucasian being the second most populous (12.4%) [4]. Information on the health status of this population was only available at the county level. According to the Community Health Needs Assessment Dashboard [5], the most common reasons for emergency room visits in Fulton County, Georgia (2008-2012) were related to mental and behavioral disorders (#1), asthma (#2), and assault (#3). For children, ages one to nineteen years, the most common cause for emergency room visits was unintentional injury. The most common causes of death among African Americans in Fulton County were hypertension and related chronic disease (#1), mental and behavior health disorders (#2), and human immunodeficiency virus (HIV; #3). The leading causes of death among African American children in Fulton County were assault and injury from motor vehicle crashes. The leading causes of death among Caucasians in Fulton County were mental health and behavioral disorders (#1), Parkinson's disease (#2), and HIV (#3). The most common causes of death for Caucasian children were motor-vehicle crashes, congenial disease, cancer (i.e., malignant neoplasm of the nervous system), and HIV.

How would the proposed project affect health in the community?

The twelve health determinants included in the HIA scope were organized by their sector of impact– the physical (natural and/or built) environment, social environment, or economic environment. Once the potential impacts were identified, the extent of the effects was evaluated based on six criteria– likelihood, direction, magnitude, permanence, distribution, and strength of evidence. The *likelihood* that the impact would occur because of the project was evaluated. Whether the impact would improve, detract, or have no net effect on health outcomes was described by the *direction* of impact. How many people the impact would affect and its distribution among sub-groups in the population were described by the *magnitude* and *distribution* of the impact, respectively. *Permanence* was used to refer to how long the effects were expected to be experienced or observed. Lastly, the *strength of evidence* upon which the impact characterization was made was also identified. The following table provides a summary of the potential health impacts of the proposed project.

Table 1. List of characterized health impacts of the Green Street Project

Health Determinant	Likelihood	Direction	Magnitude	Permanence	Distribution	Evidence
Water Quality	Highly Likely	Positive	Low	Quickly and Easily Reversed	Vulnerable Populations Benefit	Limited
Flood Management	Highly Likely	Positive	Moderate	Moderate	Vulnerable Populations Benefit	Limited
Climate and Temperature	Highly Likely	Positive	Moderate	Long Lasting	Vulnerable Populations Benefit	Strong
Air Quality	Highly Likely	Positive	Moderate	Long Lasting	Vulnerable Populations Benefit	Limited
Traffic Safety	Highly Likely	Positive	High	Long Lasting	Vulnerable Populations Benefit	Limited
Exposure to Greenness	Highly Likely	Positive	Moderate	Long Lasting	Vulnerable Populations Benefit	Limited
Exposure to Urban Noise	Plausible	Positive	Moderate	Long Lasting	Vulnerable Populations Benefit	Strong
Access to Goods and Services, Greenspace, and Healthcare	Highly Likely	Positive	Moderate	Moderate	Vulnerable Populations Benefit	Strong
Crime	Plausible	Positive	Moderate	Quickly and Easily Reversed	Vulnerable Populations Benefit	Limited
Social Capital	Plausible	Positive	Moderate	Moderate	Vulnerable Populations Benefit	Limited
Household Economics	Plausible	Both Positive and Negative	Moderate (Positive), Low (Negative)	Quickly and Easily Reversed	Both Benefits and Harms for Vulnerable Populations	Limited
Community Economics	Plausible	Positive	Moderate	Quickly and Easily Reversed	Vulnerable Populations Benefit	Limited

What should DWM do to manage these impacts?

The HIA Core Project Team and community stakeholders identified short-term and long-term recommendations to maximize the potential positive health impacts and mitigate and/or avoid the potential negative health impacts identified in the assessment. There were two overarching themes that came from stakeholder-identified recommendations: a) keeping the community engaged in the planning, implementation, and monitoring phases of the project; and b) helping support community advocacy groups in addressing the community's needs. The short-term recommendations are shown on the following pages, under their respective health determinant. The long-term recommendations, which are described in more detail in the HIA Report, support further expansion of green infrastructure projects in the watershed; ongoing monitoring activities; and re-evaluation or development of policies aimed at promoting environmental and/or public health and improving sustainable development, stakeholder coordination and/or collaboration, and opportunities for advocacy. The following pages summarize how the proposed green street project could potentially affect the health of individuals in the community directly or indirectly through changes in the twelve health determinants. A review of the literature-based evidence, describe existing conditions, outline the predicted health impact, and provide short-term recommendations by phase of implementation (i.e., before construction, during construction, after construction) are provided under each health determinant.

Water Quality

Review of the Literature-based Evidence

Water quality is characterized by its physical, biological, and chemical properties, including the health of organisms living in the water [6]. Factors that influence water quality include precipitation (e.g., volume, intensity, etc.), presence of pollutants, land use and land cover (e.g., surface permeability), topography, presence of plants and animals, and soil characteristics (e.g., composition, type, size, and layering). Water quality affects both ecosystem health and human health. Living and non-living substances in the water, including pathogens (i.e., bacteria, viruses, parasites, and other agents that cause disease) and toxic substances (e.g., heavy metals, pesticides, chemicals, etc.) can cause illness in humans via ingestion or contact with the skin [6]. Typical symptoms of waterborne illness manifest as changes in the gastro-intestinal tract (e.g., diarrhea, vomiting, and abdominal pain), but can become more severe and even lead to death.

Green infrastructure affects water quality by reducing stormwater runoff volume and flow and reducing nutrient and pollutant loading through increased filtration and absorption. Stormwater best management practices (BMPs) include using elements of green infrastructure. A few good studies found that BMPs were highly efficient at filtering out heavy metals (e.g., copper, nickel, lead, etc.,), oil, and grease from stormwater runoff [7-11]. Over time, BMPs were found to reduce total nitrogen and phosphorous from runoff, which are two naturally-occurring nutrients that in abundance can disrupt the ecosystem and lead to an overgrowth of harmful bacteria and algae in water. Persons more susceptible to waterborne illness include young children, older adults, persons with compromised immune systems (e.g., persons with HIV), and low-income households.

Existing Conditions

Water quality, which was one of the most discussed topics among community residents and HIA participants, was a contributing force behind ranking the physical environment as a top interest and/or concern. Stakeholders cited the conditions that contributed to the perceived poor water quality in the Proctor Creek Watershed, including stormwater runoff, illegal dumping of trash and tires, and impaired streams.

Proctor Creek is on Georgia's impaired waters list for exceeding the state's water quality standards for fecal coliform, an intestinal bacterium, in a body of water used for fishing [1]. The suspected causes for Proctor Creek's impairment are combined sewer overflow events and urban runoff [1].

Combined sewer overflow (CSO) events, overflowing manholes, and/or breaks and leaks in the underground combined sewer system will lead to the release of potential waterborne pathogens into the environment. It is important to note that the combined sewer outflow is located outside the half-mile radius around the proposed project site.

Predicted Health Impact

Predicted health impacts from changes in **Water Quality** because of the proposed project:

- The proposed project is **highly likely** to improve the quality of stormwater going into the conveyance system.
- Improving water quality is a **positive impact** because it will help protect people from waterborne illness.
- The changes in water quality will affect a **low number** of people, considering the small size of the proposed project.
- The improvement in water quality can be **quickly and easily reversed** if the proposed project site is damaged, not properly maintained and/or installed; or if a CSO event occurs.
- Improving water quality in this area will help **benefit vulnerable populations** by reducing the risk of waterborne illness in a predominantly low-income area burdened by an impaired stream.
- There is **limited evidence** (i.e., a few, but strong, studies) supporting the prediction that the proposed project will improve water quality, by reducing pollutants and pathogens going into the combined sewer system, if implemented as designed.

Short-term Recommendations

Before Construction

- Increase law enforcement of nuisance laws in regards to abandoned properties, illegal dumping, and property maintenance.
- Improve "water quality hazard" warnings for water contact.
- Strictly follow the recommendations outlined in section 6.1 of the project design regarding selection of soil media, mulch, and fertilizer use (i.e., use soil media low in phosphorous and nitrogen content, avoid manure- or compost-based mulch, and limit the use of fertilizers).
- Increase soil media height of planter boxes from 2 feet to at least 2.5 feet (30 in) to improve pollutant removal efficiency.
- Remove (address) foul ("sewage") smell from Proctor Creek/North Avenue combined sewer outflow.

During Construction

- No recommendations identified for this phase.

After Construction

- Ensure that routine maintenance and monitoring plan for green infrastructure elements are followed as directed.
- Utilize multiple strategies to increase the magnitude of the Green Street Project's impact, such as community outreach, policy development, ordinance enforcement.
- Have DWM and/or EPA conduct soil and water quality testing further upstream in the headwaters of Proctor Creek (starting in this community) and invite residents to participate in future studies.

Flood Management

Review of the Literature-based Evidence

Urban flooding is typically caused by stormwater runoff that is not captured as it moves across an impervious surface [12-13]. Flood management is important to health because flooding can influence health through several pathways. A large volume of stormwater over a short amount of time can cause flash flooding and increase the risk of injury from slips, falls, and floating debris. Flooding can damage homes and buildings leading to mold and bacterial growth. When the home is damaged from flooding, impacts can include displacement of persons living in the home, mold and bacterial growth, and pest infestations. If issues persist over time, long-term impacts could include high percentages of blighted and/or vacant properties in the area. The presence of derelict and vacant properties have been associated with poorer perceived health and deteriorated mental health and social capital among nearby residents. Flooding can also cause damage to sewer systems and lead to CSO events [14]. In addition to the risk of exposure to waterborne pathogens, pooling water after a flood event can create a habitat suited for insects that can carry disease, such as mosquitoes [15-16].

Green infrastructure technology, specifically stormwater best management practices (BMPs), capture and retain runoff before it goes into the combined sewer conveyance system. BMPs help slow the flow of runoff as it moves through the system and increase the amount of pervious surfaces, which helps to reduce pooling and standing water.

Existing Conditions

Flood management was arguably the second highest interest and/or concern among stakeholders (behind jobs) due to the frequent flash flooding in the area. Over half (53.6%) of the surface area in the half-mile radius around the project site was impenetrable to water [17]. Modeling was used to determine the average amount of stormwater runoff coming from the project site, the most likely pathways for overland flow, and the areas expected to stay wet after a rain event.

Modeling pathways for overland flow of stormwater and relative wetness of areas around the proposed project site shows areas surrounding Boone Street are likely to have standing water after a rain event.

Of the properties adjacent to the proposed project site, almost half are in deteriorated or poor condition (i.e., derelict) and 43% are vacant and/or abandoned [18-19]. Although there was some overlap of derelict and/or vacant homes and areas that stay wet after a rain event, these properties were so numerous it was inconclusive whether or not this was related to flooding.

Predicted Health Impact

Predicted health impacts from changes in **Flood Management** because of the proposed project:

- The proposed project is **highly likely** to improve flood management by retaining 17.6% of all runoff and reducing stormwater coming from the site by 20%.
- Improvements to flood management is a **positive impact** because it helps protect people from injury and illness.
- The predicted changes will affect the safety of a **moderate number** of people, including pedestrians, cyclists, and others who travel in and immediately around the street.
- The predicted changes are expected to last a **moderate length of time** (for a few years), given that the BMPs are properly maintained and functioning.
- Improving flood management in this area will **benefit vulnerable populations** by reducing the risk of injury and/or illness in a predominantly low-income area overburdened by flash flooding, mosquitoes, and vacant and/or derelict properties.
- There is **limited evidence** (i.e., a few, but strong studies) supporting the prediction that the proposed project will reduce the volume and flow of stormwater going into the combined sewer system, if implemented as designed.

Short-term Recommendations

Before Construction

- Increase law enforcement of nuisance laws in regards to abandoned properties, illegal dumping, and property maintenance.
- Increase community awareness of environmental factors that can lead to mosquitoes and preventative measures against vector-borne pathogens in the area.
- Improve “flood safety hazard” warnings in flood-prone areas.

During Construction

- No recommendations identified for this phase.

After Construction

- Ensure that routine maintenance and monitoring plan for green infrastructure elements are followed as directed.

Climate and Temperature

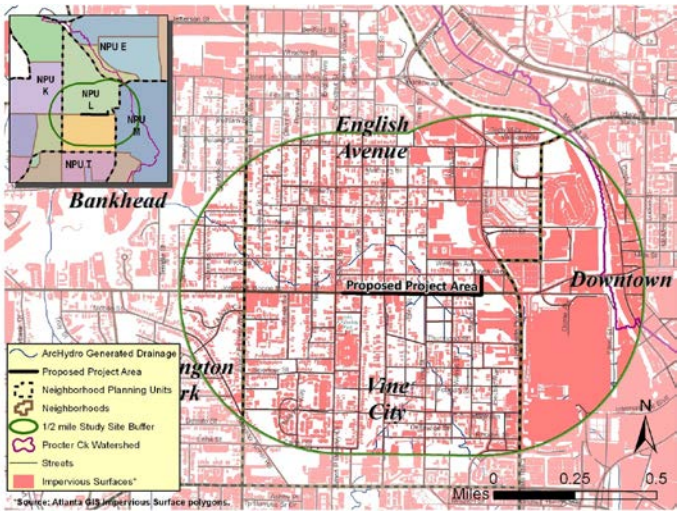
Review of the Literature-based Evidence

Infrastructure, such as concrete, pavement, and metal, typically stores more energy in the material and reflects less energy back to space [18]. Warm surfaces can transmit heat to the surrounding air causing an increase in surface air temperature. Expansive development can lead to a more widespread change in microclimate, a phenomenon otherwise known as the urban heat island (UHI) effect. UHIs occur when developed regions experience warmer temperatures than less-developed regions [18]. Surface UHIs refer to the relatively high temperatures in the layer of air from the ground to the top of trees. UHIs exacerbate the effects of heat waves or relatively long periods of extreme heat. Living in areas that experience UHIs predisposes residents to health impacts of extreme heat events, which include general discomfort, heat-related illnesses, and complications with pre-existing health conditions (e.g. heart disease, behavioral disorder, metabolic disorder, etc.) [19]. Children, older adults, and persons with certain health conditions that predispose them to heat-sensitivity are more vulnerable to extreme heat events.

Green infrastructure reduces impervious surfaces through the introduction of soil and vegetation (i.e., trees, bushes, and grasses), which play an important role in regulating surface and air temperature. Trees, especially leafy trees provide shading for surfaces and blocks energy absorbed from the sun. Plants also release water into the surrounding air via evapotranspiration, which dissipates ambient heat and lowers air temperature.

Existing Conditions

Stakeholders identified a need in the community to address and/or provide relief from heat stress. Boone Street is located in an urban, highly developed area in the southern region of the United States. This region experiences relatively higher average annual temperatures than other regions of the U.S., with temperatures that usually range from 40–80°F [20].



Expansive areas of impervious surfaces along Boone Street and in the industrial/ commercial areas to the east are likely to have higher surface temperatures than areas with pervious surfaces and shading.

Only one bus stop in the project area provided cover/shade from the sun (at the eastbound intersection of Boone Street and Vine Street). No other areas along the proposed project site provide sufficient shading.

Predicted Health Impact

Predicted health impacts from changes in **Climate and Temperature** because of the proposed project:

- The proposed project is **highly likely** to reduce surface temperatures by decreasing impervious surfaces and increasing shading.
- Reducing surface temperature is a **positive impact** because it helps protect against heat-related illness in areas affected by urban heat islands.
- The predicted changes will only provide relief from the heat and sun for a **moderate number** of people, specifically those using the sidewalks or cycle lanes, waiting at the bus stops, and/or idling at a traffic light.
- The predicted changes are expected to last a **long time** (for many years). If deciduous trees are used, they will only contribute to shading during leaf-on seasons.
- The predicted changes will **benefit vulnerable populations** by reducing the risk of heat-related illness on a stretch of unshaded street.
- There is **strong evidence** to support the relationships between impervious surfaces, increased surface temperatures, and heat-related illness.

A long stretch of unshaded impervious surface area along the proposed project site.

Short-term Recommendations

Before Construction

- Select native tree species that have tall, broad canopies that could increase the shading of surface area (especially over impervious surfaces).

During Construction

- Place trees with larger canopies near bus stops or other areas where people may congregate.

After Construction

- No recommendations identified for this phase.

Air Quality

Review of the Literature-based Evidence

Air quality is often described by the presence of and risk of exposure to harmful pollutants. Sources of air pollutants can be natural (e.g., volcanic eruptions, plants releasing seeds) and from human activities (e.g., motor vehicles, factories, etc.) [21]. The EPA monitors and regulates six harmful air pollutants (i.e., criteria air pollutants) for the protection of public health and the environment: particulate matter, ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide and lead [22]. There is enough evidence worldwide that adequately supports the causal relationship between the presence of these pollutants in the outdoor air and health status. Exposure to harmful air pollutants can increase respiratory symptoms, difficulty breathing, and risk of heart, lung, and respiratory disease; decreases the ability to ward off respiratory infections; and damages lung tissue [23-24]. Persons more sensitive to the presence of air pollutants, include young children, elderly, and those with respiratory conditions, such as asthma.

Motor vehicles release harmful gases and particles into the air that travel and react to form other harmful pollutants. The addition of plants, such as grasses, bushes and trees, along a street can influence the levels of ambient air pollutants by filtering pollutants from the air, absorbing pollutants (e.g., using carbon from gases in the atmosphere to build mass– a process known as carbon sequestration), and providing a physical barrier to the dispersal of pollutants. It is important to note that some plants release pollens and volatile organic compounds, which can also contribute to pollutants in the air.

Existing Conditions

In 2011, the metro-Atlanta region did not meet the National Ambient Air Quality Standards (NAAQS) for ozone or particulate matter [22]. Since 2004, Atlanta was declared a non-attainment area for not meeting NAAQS for particulate matter and is currently implementing a plan for reducing particulate matter levels. All other criteria pollutants remained well below harmful levels. The number of emergency room visits related to respiratory diseases (including asthma) among residents living around the proposed project site ranged from among the lowest to higher percentiles in the county, although visits related to chronic lower respiratory disease appeared to be among the lowest compared to surrounding areas.

Number of emergency room visits related to respiratory illness around the proposed project site, shown by Census tract, ranged from the lowest to higher percentiles in the county.

Predicted Health Impact

Predicted health impacts from changes in **Air Quality** because of the proposed project:

- It is **highly likely** that the plants and soil added along the corridor will improve air quality by capturing and/or filtering harmful air pollutants from the ambient air.
- Improving air quality along an urban corridor will provide a **positive impact** because it helps to reduce the risk of respiratory illness and premature death.
- Due to the projects size, changes to the ambient air quality will only affect a **moderate number** of people, specifically street users (but will not be experienced by the larger community due to the project's size).
- The ability for the plants to capture and/or filter pollutants from the air will last a **long time** (for many years).
- Improving local air quality will **benefit vulnerable populations** in a predominantly low-income, urban area.
- There is **limited evidence** (i.e., a few, but strong studies) supporting the ability for green infrastructure to improve air quality along a street corridor.

Short-term Recommendations

Before Construction

- Select native plant species that have low volatile organic compound (VOC) emissions and have higher capacity for filtering pollutants out of the air. NOTE: for any planting of vegetation in urban areas, it is recommended that a minimum of three species be selected.

During Construction

- Place plants that are lower to the ground (especially grasses and bushes) in areas where vehicles are likely to idle so they can filter air pollutants from vehicle emissions. Taller trees should be spaced so that vertical mixing of pollutants is minimized.

After Construction

- No recommendations identified for this phase.

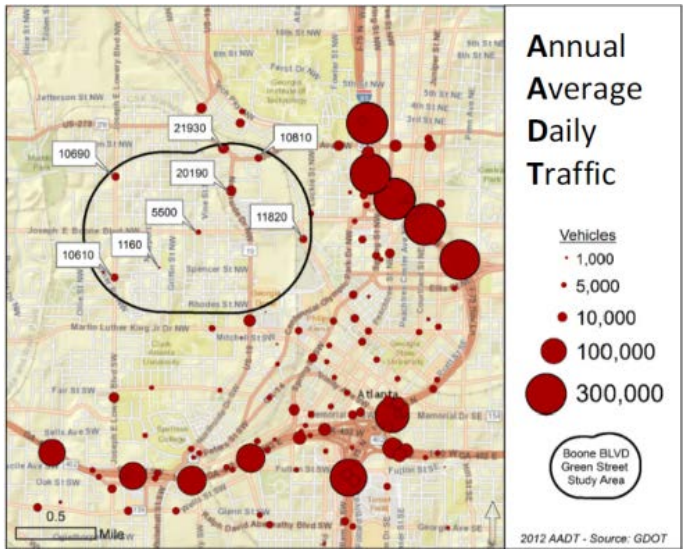
Traffic Safety

Review of the Literature-based Evidence

Transportation routes are traditionally designed to move people and goods efficiently, which may or may not include the safest measures for pedestrians and cyclists. The National Highway Traffic Safety Administration (NHTSA) conducted a national telephone survey in 2012 and found that poor quality of street facilities was the leading cause of pedestrian injury. There is growing awareness that transit corridors should be designed to promote safety for all roadway users, in addition to meeting transportation needs. Safety measures can include reduced speed limits, speed bumps, pedestrian crossing infrastructure (e.g., painted crossing zones, crossing counters, street lighting, etc.), separated bike lanes, safety signage, and traffic calming practices (e.g., streetscaping, circular intersections, etc.). Implementing a road diet (i.e., reducing the number of motorized traffic lanes) is another strategy used to increase traffic safety for drivers, pedestrians and cyclists. The Federal Highway Administration (FHWA) evaluated road diet measures and their impacts on injuries from motor vehicles and found that road diets reduced the overall number of motor vehicle crashes overall [25]. However, they did caution against implementing road diets on routes that have an annual average daily traffic (AADT) volume above 20,000 vehicles a day, because of the increased chance of traffic congestion. Road diets also help reduce road maintenance costs by eliminating excess roadway.

Existing Conditions

Boone Street is a four lane, bi-directional roadway that travels east to west. The road functions as a major collector, connecting neighborhood roads with main arterial roads. The road functions well below its designed capacity, which was a contributing factor to the proposal for a road diet. In 2013, Boone Street saw an AADT of 5,090 vehicles per day (approximately four cars per minute) a 7.45% decrease from the year before [26-27].



Annual average daily traffic (AADT) volumes for roadways around downtown Atlanta, Georgia shows traffic volumes of 5,500 vehicles per day along Boone Street in 2012. Northside Drive, a nearby urban corridor saw an AADT of over 20,000 vehicles per day in the same year.

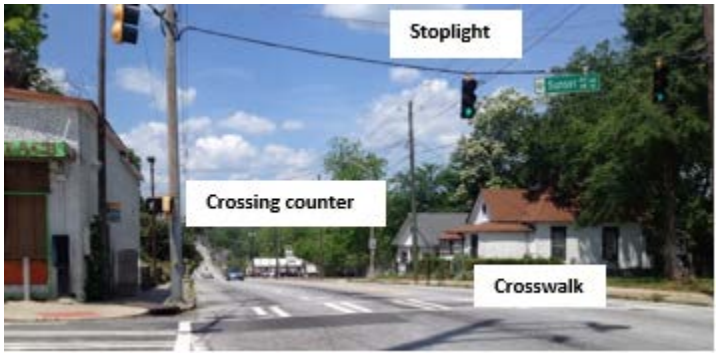
Several safety measures exist along the site, including a speed limit of 35 miles per hour, stoplights and pedestrian crossings at every intersection, and crossing counters at most intersections.

Predicted Health Impact

Predicted health impacts from changes in **Traffic Safety** because of the proposed project:

- The proposed project is **highly likely** to reduce risk of injury from motor vehicle crashes and improve perceived and actual traffic safety.
- Improving traffic safety along an urban corridor will provide a **positive impact** by preventing injury and remove barriers to active living (e.g., walking and bicycling).
- The predicted changes may will affect a **high number** of people traveling along the street, which includes an average 5,000 vehicles per day.
- The predicted changes are expected to last for a **long time** (for many years), since permeable pavement has a long use-life.
- The predicted changes will **benefit all street users, but especially vulnerable populations**, such as children and elderly who are more at risk for injury from motor vehicle crashes.
- There is **limited evidence** (a few, but strong, studies) that support implementing road diets, streetscaping, and adding bicycle infrastructure as, as effective ways to improve traffic safety.

There are no speed humps/bumps present. The outside travel lanes are also shared bicycle lanes. The road surface showed signs of low to moderate pavement wear and areas of degraded pavement and striping.



Existing traffic safety measures at the intersection of Boone Street and Sunset Avenue include a stoplight, crossing counter, and crosswalk.

Short-term Recommendations

Before Construction

- Add infrastructure that promotes safety for pedestrians and cyclists (e.g., street lighting, traffic calming approaches, designated and protected bike lanes, bike traffic signals, cycling greenways, etc.).

During Construction

- Ensure that placement or selection of vegetation does not impede or obstruct visibility of pedestrians for drivers.

After Construction

- No recommendations identified for this phase.

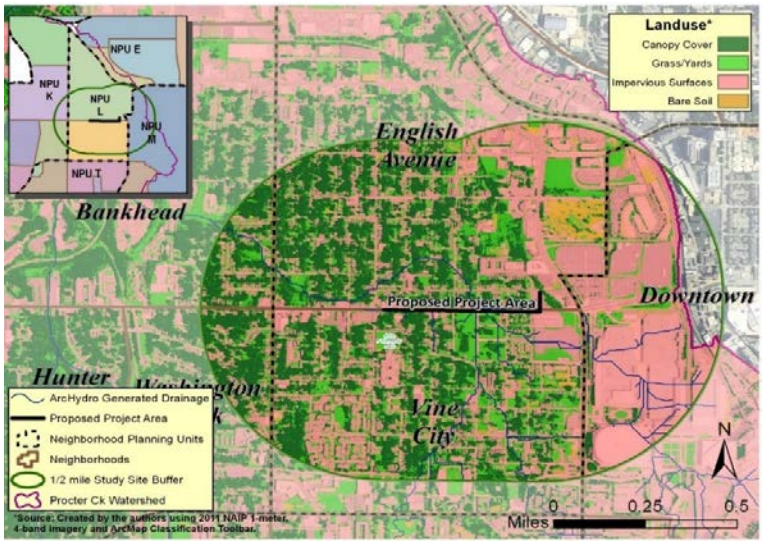
Exposure to Greenness

Review of the Literature-based Evidence

The amount of natural environment in a geographic area can be measured by the percentage of vegetation-covered land (i.e., greenness). Research has shown a relationship between exposure to a natural environment and human health status [28-30]. Natural environments provide a source of "serenity" or peacefulness and provide space for reprieve from a stressful environment. Stress and mental health were the most commonly reported health outcomes associated with exposure to greenness and the natural environment. Exposure to greener areas has been linked to enhanced recovery from mental fatigue; improved cognitive function; increased social cohesion and physical activity; higher perceived health and wellness; and reduced fear, stress, anxiety, aggression and violence [31-33]. Epidemiological studies have shown that residents who live in areas with higher percentage of greenness had lower rates of premature death and lower prevalence of certain diseases and symptoms (e.g., heart disease, respiratory symptoms, anxiety, depression, migraines, etc.) [29-30]. Patients recovering from surgery that had views of nature were linked to reduced hospitalization days and less pain medication needed compared to those without views of nature [34]. Populations particularly sensitive to the benefits of the natural environment include persons with lower socioeconomic status (e.g., low income and/or educational attainment), children, and the elderly [29, 35].

Existing Conditions

Modeling showed that impervious surfaces covers 53.6% of the study area, leaving 46.4% as either bare soil or vegetation. Only 4.3% of the study area was open, public space.



Areas directly adjacent to the proposed project site include impervious surfaces, canopy cover, and grass.

Fulton County has higher rates of hospitalization for mental and behavioral health disorders than the state average [36]. At the county level, mental and behavioral disorders were higher among African Americans, compared to their Caucasian counterparts, and among men compared to women. The age group with the highest rate of hospitalizations for mental and behavioral disorders were individuals aged 45–59 years.

Predicted Health Impact

Predicted health impacts from changes in **Exposure to Greenness** because of the proposed project:

- The proposed project is **highly likely** to increase the amount of greenness in the area.
- Increasing exposure to and/or the amount of natural environment in an urban area provides a **positive impact** by reducing stress and improving perceived overall wellness.
- The predicted changes will affect a **moderate number** of people, given its small size.
- The predicted changes are expected to last **a long time** (for many years).
- The predicted changes will **benefit vulnerable populations** by providing a more "serene" and natural landscape along an urban corridor.
- The evidence supporting a strong relationship between the amount of greenness and health status is **limited**. There is no clear evidence showing that the relationship is causal or how much exposure to the natural environment contributes to health.

From 2006 to 2010, the number of emergency room visits related to mental health and behavioral disorders among residents in the Census tracts around the proposed project site were among the lowest to highest percentiles in the county.

Number of emergency room visits related to mental health and behavioral disorders around the proposed project site, shown by Census tract, ranged from the lowest to highest percentiles in the county.

Short-term Recommendations

Before Construction

- Maximize "greenness" for the proposed project site to increase the potential for psychosocial improvements (e.g., reduced stress, improved mental health, and reduced aggression).

During Construction

- No recommendations identified for this phase.

After Construction

- Ensure a "visible change" takes place that aesthetically improves Boone Street along the proposed project site.

Exposure to Urban Noise

Review of the Literature-based Evidence

The literature suggested that ambient noise in urban residential communities was a growing concern and more public health professionals were including "soundscape" or the acoustic setting in their investigations of environmental factors that influence community health. The main contributor to ambient levels of noise in urban communities was road traffic [37]. Traffic noise was found to impact the number of residents reporting frequent annoyance and sometimes and/or frequent sleep disturbance at noise levels above 50 decibels [38], and the desire to stay outdoors above 48 decibels [39]. Exposure to constant ambient noise or periodic levels of noise above 55 decibels have been associated with changes in behavioral and mental activities, as well as lowered cognitive performance among school-aged children [40-41].

Vegetated barriers, such as rows of trees and bushes, offer a unique solution that is aesthetically pleasing and blocks sound waves from moving out through a neighborhood, albeit with varying results [42]. Greening urban areas has been found to influence traffic noise-related health problems among residents. Prominent health problems associated with noise include hypertension and stress. Researchers have found that greener areas had fewer residents who perceived traffic noise as a neighborhood problem [39]. Residents who lived by noisy streets and had no access to a "quieter side" of a residence benefited more from greener areas, reporting less symptoms of being very tired, irritated/angry, and stressed [39]. Designing residences with more grass or lawn between the residence and the street, compared to using pavement or concrete, can reduce the reflection of road sounds towards the residence [43].

Existing Conditions

A previous noise exposure study in Fulton County, Georgia collected traffic data, modeled noise levels, and estimated the number of people exposed to noise throughout the county, including the designated study area [44]. Based on the modeling, traffic-related ambient noise levels along the proposed project area ranged from 56–67 A-weighted decibels (dB(A)) during the day and 51–65 dB(A) at night. The neighborhoods around Boone Street (i.e., English Avenue and Vine City) had lower levels of ambient traffic noise levels (under 40 dB(A)). In regards to health, hypertensive morbidity rates in Fulton County are consistently higher than the state average [36].

Predicted Health Impact

Predicted health impacts from changes in **Exposure to Urban Noise** because of the proposed project:

- It is **plausible** that the proposed project will help to reduce ambient noise from the street by adding vegetated barriers, after construction. However, it is important to note that noise will be generated (temporarily) during construction.
- Improving the quality of the urban environment by controlling noise is a **positive impact** because it will help reduce resident disturbance and annoyance.
- The predicted changes will affect a **moderate number** of people, particularly those in the 29 properties along the project site and in close proximity to the street.
- The reduction in noise coming from the street, after the project is implemented, will last a **long time** (for many years).
- **Vulnerable populations** would **benefit** from improved protection against traffic noise, especially in an urban neighborhood that is also a stadium community.
- There is sufficient **strong evidence** linking urban noise levels to increased sleep disturbance, reduced cognitive function, and increased stress.

Short-term Recommendations

Before Construction

- No recommendations identified for this phase.

During Construction

- Place low brush/grasses in planter spaces near residences to block/absorb some of the noise from the roadway.
- Implement best practices to reduce the amount of noise or time of noise being generated from construction.

After Construction

- No recommendations identified for this phase.

Access to Goods and Services, Greenspace, and Healthcare

Review of the Literature-based Evidence

Accessibility relates to "the amount and diversity of places that can be reached within a given travel time and/or cost" [45]. Accessibility, regardless of public or private transportation use, was identified as an influential factor in the behavior to seek and acquire healthcare and utilize greenspace (i.e., an open, public space with natural elements that can be used for recreation, relief, or social interaction) [35, 46-47]. Travel burden, both perceived and actual, was found to be a key element in defining access to goods and services. The time it takes to reach a destination was found to be more influential than the distance between the place of origin and the destination.

Having a better-connected network and increased transit safety is assumed to improve access to goods and services, greenspace, and healthcare. Researchers found that community-scale and street-scale urban planning and land use policies and practices were the most effective interventions for increasing walking and bicycling to destinations [48]. Street designs that are more compact and include infrastructure for pedestrians and cyclists (e.g., wide sidewalks and cycle lanes) encourage walking and bicycling by improving feelings of safety and accessibility and discouraging motorized transport. Positive health outcomes associated with walking and bicycling include reduced risk for obesity and cardiovascular disease and improved mental health and perceived overall wellness. Access to healthcare can affect all health outcomes, as it determines the ability of a person to manage health, and seek and receive treatment for illness and injury. Access to greenspace has the potential to lead to positive health outcomes, such as increased well-being, cognitive functioning, mental health and physical activity; higher neighborhood satisfaction and social cohesion; and decreased stress, fear, anxiety, and violence [29, 33, 49-54]. The relationship between access to greenspace and health status was found to be stronger among children, the elderly, and persons in low-income households.

Existing Conditions

The HIA Advisory Group strongly felt that the community needed improvement in accessibility for residents and visitors to the area. Boone Street was ranked by Walkscore® (www.walkscore.com) as being somewhat walkable, which means that some errands could be accomplished on foot, and having good transit due to the many nearby public transit options.

Boone Street is in close proximity to downtown Atlanta (to the east) and has access to the metro bus line used to travel within the city.

Predicted Health Impact

Predicted health impacts from changes in **Access to Goods and Services, Greenspace, and Healthcare** because of the proposed project:

- It is **highly likely** that the proposed project will reduce perceived and actual barriers to accessibility by improving traffic safety; providing shading; and improving the overall walkability and bike-ability of the street.
- Removing barriers to access goods and services, greenspace and healthcare is a **positive impact** because it promotes active and healthy living.
- Improving accessibility will affect a **moderate number** of people, specifically people who travel along Boone Street or live in close proximity.
- The predicted changes are expected to last for a **long time** (for many years), as long as the site is well-maintained.
- Improving perceived and actual accessibility will **benefit vulnerable populations**, specifically people who are more dependent on public and self-transport modes (i.e., physically disabled and children).
- There is **strong evidence** linking higher accessibility to better health outcomes.

Short-term Recommendations

Before Construction

- Incorporate EPA's Smart Growth Principles in the Green Street Project design. Refer to the Smart Growth America– Complete Streets in the Southeast Case Studies for examples.
- Coordinate with local active transport groups (e.g., Atlanta Bicycle Coalition) to ensure that implementing the project does not impede or discourage walking or bicycling.
- Consider (in the project design) connecting/expanding walking and cycling paths to reach broader bike/pedestrian routes (e.g., PATH foundation, Beltline, etc.).

During Construction

- No recommendations identified for this phase.

After Construction

- Provide clear signage and way-finding infrastructure for pedestrians and cyclists (e.g., directions to the Beltline, bike zone, share-the-road, etc.).
- Ensure that routine maintenance and monitoring plan for green infrastructure elements are followed as directed.

Crime (Perceived and Actual)

Review of the Literature-based Evidence

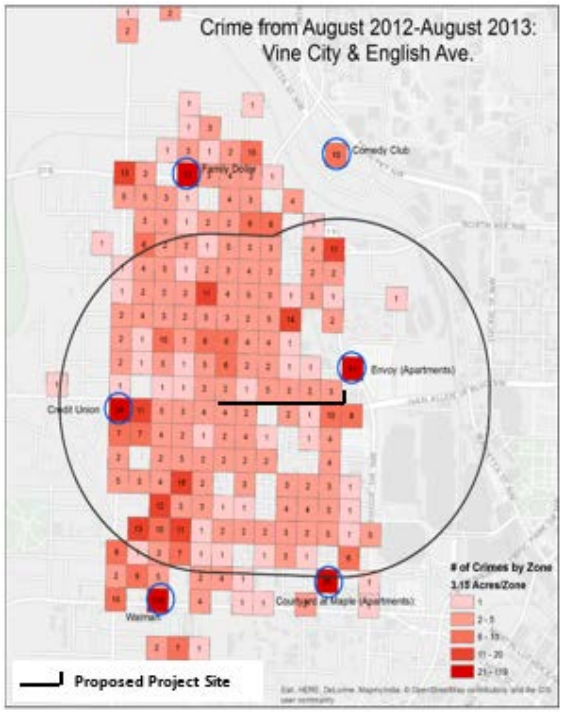
The way a community looks and feels influences perceptions of that neighborhood and how people behave in that area. Crime and insecurity (i.e., risk of injury or loss by the motives of another individual) are social factors that contribute to physical and mental health. Researchers have found strong evidence linking higher levels of crime to injury, perceived social disorder in the neighborhood and self-rated health, risk of mental health disorders (e.g., anxiety and depression), distress among residents, and decreased outdoor physical activity in the area [55-62]. Observations of antisocial behaviors (e.g., public drunkenness, harassment, etc.) and crime were associated with feelings of lower safety and/or security in an area and avoidance of that space [55, 64-66].

Researchers are finding that the design and management of natural elements in a community can be an important aspect to crime prevention and perceived safety and/or security. The amount of greenness in an urban community has been linked to the amount of crime that is committed in that area [67]. Furthermore, not maintaining natural elements in an urban community can provide opportunities for crime. Crime Prevention through Environmental Design (CPTED) is a crime management strategy that utilizes natural elements.

Existing Conditions

Crime and the perceived safety and/or security of the community was a major concern among residents and other stakeholders. Although crime in the City of Atlanta has been on the decline since 2011, residents are concerned that the perception of high crime in the area is negatively contributing to the community's identity.

From August 2012 to August 2013, there were 557 reported crimes in the study area (i.e., about 40 crimes committed for every 1,000 people per year), which represents 1.6% of crimes reported in the City of Atlanta.



Zones along the proposed project site experienced between 0 and 10 crimes from August 2012-August 2013. There appears to be a clustering of crimes committed around the Credit Union to the west of the project site and Emory Apartments to the northeast of the project site.

Predicted Health Impact

Predicted health impacts from changes in **Crime (perceived and actual)** because of the proposed project:

- It is **plausible** that the proposed project will improve security (reduce crime) by improving corridor aesthetics and reducing surface temperatures.
- Reducing perceived and actual crime is a **positive impact** because it protects against injury from crime, reduces stress from lack of security, and removes barriers to using outdoor public space.
- Improving perceived and actual security will affect a **moderate number** of people, specifically those who pass along Boone Street and can visibly see the changes made to the area.
- The improvements in crime can be **quickly and easily reversed,** if the plants are not properly maintained or if they impede visibility between the street and sidewalk.
- Improving security will **benefit populations more vulnerable** to crime, specifically young women, children, and the physically disabled.
- There is **limited evidence** (a few, but strong, studies) that support the relationship between implementing and maintaining natural elements and improved security.

Short-term Recommendations

Before Construction

- Increase street lighting along the proposed project site.
- Utilize the CPTED (Crime Prevention through Environmental Design) elements in the Green Street Project design. For example, the lowest branches on trees should be taller than 5 feet from the ground and the bushes/grasses should be no taller than 3 feet from the ground to permit a "window" for onlookers at eye-level.
- Increase police presence on the ground (i.e., walking or on bicycles) in the area with a focus on crime "hot spots."
- Maximize "greenness" for the proposed project site to increase the potential for psychosocial improvements (e.g., reduced stress, improved mental health, and reduced aggression).

During Construction

- No recommendations identified for this phase.

After Construction

- Ensure that routine maintenance and monitoring plan for green infrastructure elements are followed as directed.

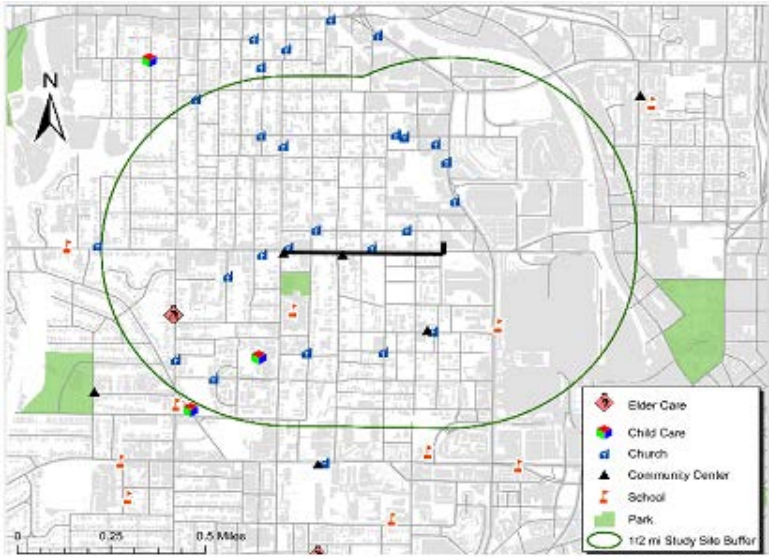
Social Capital (Cognitive and Structural)

Review of the Literature-based Evidence

Social capital refers to the social bonds and connections among residents in a community that can be used to address community needs [68]. Structural social capital, also known as bridging capital, is the existence of networks and connections. Cognitive social capital, also known as bonding capital, concerns the appreciation of trust, mutual help, and reciprocity in the community [69]. Residents that are well connected in the community and invested socially have greater chances of survival, regardless of social status. Social capital can provide a protective buffer to hardships, such as financial instability and other environmental challenges. Communities that have highly developed social capital also have a greater capacity to address issues and/or needs in the community. Many researchers believe the effect of social capital on health is mediated through health behaviors, specifically physical activity [70]. Persons who are more sensitive to social conditions and connectivity to other people and services, include children and the elderly. A green street project may be considered a strategic investment for stormwater management, but it can also be an opportunity to build social capital in a community. Efforts that supports more sustainable transport modes, including walking and bicycling, increase the opportunity for residents and visitors to interact, and develop social ties and bonds, which is the first component in developing social capital.

Existing Conditions

The HIA Advisory Group identified aspects of the social environment (identified later as social capital) that needed improvement in the community, such as improved relationships among residents and more opportunities for developing social and/or emotional support. Asset mapping identified two schools in the community, which provide common space for students and their families to engage with other families, learn, and be physically active; and abundance of churches where people can congregate, seek help, and develop social ties and bonds; and an elder care and childcare center within the study area.



A map of the various community assets that provide space to build social capital shows the study area is abundant in churches and has two schools, a child care center, elder care center, and a park.

Predicted Health Impact

Predicted health impacts from changes in **Social Capital (cognitive and structural)** because of the proposed project:

- It is **plausible** that the proposed project may improve social capital as a demonstration project for revitalization and improving community identity. However, it is not likely that the project alone will produce a significant change, due to its small size.
- Strengthening social capital is a **positive impact** because it can protect against hardships and build capacity to address issues in the community.
- Increasing opportunity to develop social capital will affect a **moderate number** of people, specifically those who travel along the corridor.
- The social benefits of the proposed project are expected to last for a **moderate length of time** (a few years), as long as the elements are maintained.
- Increasing opportunities to build social capital will **benefit vulnerable populations**.
- The **evidence** linking social capital to health is **limited.** There are a few studies with strong associations, but there are potential confounders (i.e., other influential factors).

Short-term Recommendations

Before Construction

- No recommendations identified for this phase.

During Construction

- Install public benches at local hangouts, bus stops, areas often populated to provide infrastructure that supports social interaction.

After Construction

- Make clear distinction between private and public space (i.e., define open public areas).
- Coordinate with "Atlanta Streets Alive" to host a community festival after completion of the project.
- Ensure that routine maintenance and monitoring plan for green infrastructure elements are followed as directed.

Household Economics (Cost of Living and Employment)

Review of the Literature-based Evidence

There are some benefits to implementing green infrastructure projects in residential communities. Green infrastructure projects stimulate the creation of jobs that contribute directly to preserving and/or enhancing environmental quality (also known as "green" jobs) [71]. Planting trees near homes can help save money by reducing cooling costs, and implementing green infrastructure has been shown to increase the value of nearby properties [72-75]. However, increased property values and housing market revitalization can have adverse impacts on individual household economics, especially for those already cost burdened (i.e., spending more than 30% of their income on housing costs). Households that are cost burdened may already have difficulty affording basic needs, such as food, clothing, transportation, and healthcare [76]. With increased property values comes higher property taxes and (in some cases) increased rent, both of which raise the cost of living.

The cost of living can dictate the ability of a household to meet basic needs, such as purchasing healthy foods, clothing, and healthcare. The inability of a household to meet basic needs can increase the risk for chronic disease, such as heart disease, hypertension, and diabetes; infectious disease; poor mental health, and even mortality [77-81]. Financial insecurity can lead to residents living in overcrowded and substandard housing conditions and even displacement, which occurs when residents must move because the cost of living becomes higher than they can afford. Displacement can result in the loss of jobs, social support, and feelings of belonging; childhood development issues; and stress and its associated impacts [77, 81-83].

Existing Conditions

Economy/Jobs/Poverty was the highest ranked interest and/or concern among stakeholders, especially concerning employment and costs of living. There are 36 residential properties abutting the proposed project site that have an average value of $19,936; average property values in the study area increased the further they were from the site [84]. Approximately 16.3% of the work force in the study area was unemployed; and of those unemployed, 20% were living below poverty level [85]. Those who were less likely to be unemployed were women (compared to men) and those with more education (compared to those with less education) [85].

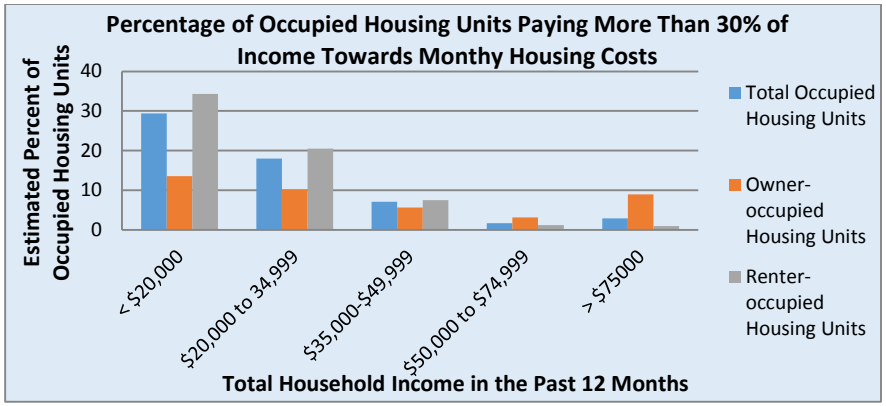
Of the total households in the study area, almost half (46.2%) live with a combined annual income less than $25,000 [85]. The average amount spent on monthly housing costs in the study area was $858 (+/- $335) [85]. Over half (59.1%) of the estimated 5,706 occupied housing units were paying more than 30% of their income on monthly housing costs [85].

Predicted Health Impact

Predicted health impacts from changes in **Household Economics** because of the proposed project:

- The potential for the proposed project to affect household economics is **plausible,** considering implementing green infrastructure can reduce costs for nearby buildings, create job opportunities, and increase property values.
- Reducing the costs to maintain a home and adding jobs are **positive health impacts** because more income will be available to meet basic needs and promote health. However, increases in property values can be a **negative health impact** because it can lead to higher property taxes and/or rent.
- The positive impacts will affect a **low number** of people, whereas the negative impact will affect **a moderate number** of people.
- Changes to household economics are **reversible**, but substantially affect a person's well-being and livelihood**.**
- The positive impacts will **benefit vulnerable populations**, specifically cost burdened households and/or those unemployed. The negative impact will **harm vulnerable populations,** specifically cost burdened households.
- The **evidence** that supports the impact pathways is **limited** to only showing a relationship exists.

Households that live on less than $20,000 a year were more likely to be cost burdened than households in the higher income brackets [85].



A graph showing the estimated percent of households that spend more than 30 percent of their income on monthly housing costs, by income and housing type.

Short-term Recommendations

Before Construction

- Incorporate employment opportunities for local residents and businesses during construction and maintenance, starting with those in Vine City and English Avenue.
- Provide funding for local entrepreneurs (e.g., small business grants, foundation, matching grants, etc.) aimed at creating jobs.

During Construction

- Develop and incorporate Green Jobs Training for local residents and community groups.

After Construction

- No recommendations identified for this phase.

Community Economics (Business Performance)

Review of the Literature-based Evidence

Communities designed to promote walking and cycling have been shown to have more successful businesses than those designed mainly for motorized traffic [86]. The increased foot and bike traffic helps increase regular patronage and the demand for goods and services. Increasing the demand for goods and services can lead to creating new jobs and attracts new businesses, entrepreneurs, and customers to the area. Research shows how adding bike lanes can improve business performance, as people who arrive by bike to a business spend less money but visit more often (i.e., become regular clients), resulting in more money spent overall [87]. These impacts, in turn, can improve health in a community by increasing access to healthcare and nutritious foods, improving mental health, and reducing the presence of chronic illnesses.

The implementation of green infrastructure has been shown to increase property values in the surrounding area and reduce costs associated with building cooling and stormwater management. Increasing the value of the property where the business is located can lead to increased property taxes and/or rent, which raises costs to operate a business. However increases in property value can also signal improvements in physical capital, which promotes revitalization and redevelopment, leading to economic growth in the community.

The Alliance for Community Trees, an advocacy group for urban trees, found that increasing the number of trees and greener streets can significantly reduce roadway maintenance and save municipal costs associated with repaving over 30 years.

Existing Conditions

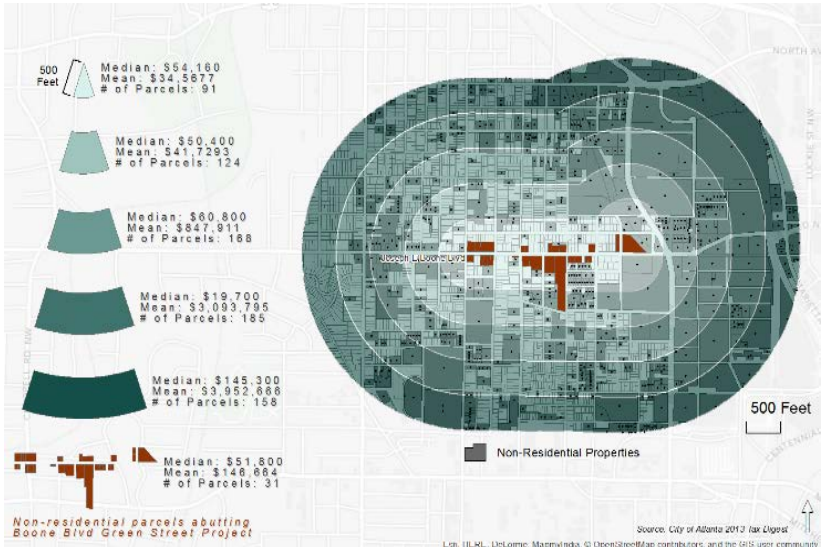
In 2010, there were 1,937 business establishments within a half-mile of the proposed project site in 2010 [88]. These included retail trade; professional, scientific, and technical services; accommodations and food services; and other services (except public administration). It should be noted that the performance of those establishments was unknown.

There were 726 non-residential properties located within 2,500 feet of the proposed project site [84]. There are 31 non-residential properties adjacent to the proposed project site, with a median property value of $51,800 [84]. The average property value for non-residential properties adjacent to the proposed project site is $146,664 [84].

Predicted Health Impact

Predicted health impacts from changes in **Community Economics (business performance)** because of the proposed project:

- It is **plausible** that the proposed project will likely improve community economics for businesses along the corridor by improving access to existing businesses, increasing investment in the area, and reducing costs associated with building cooling, heating, and storm management.
- Improving business performance is a **positive health impact** because it can lead to increased access to goods and services, job creation, and expendable income, all of which are beneficial to health.
- Improvements to business performance are expected to affect a **moderate number** of people.
- Impacts to business performance are **reversible**, but can substantially affect the well-being and livelihood of individuals in the community.
- Improvements in business performance will **benefit vulnerable populations**, specifically cost burdened households and the unemployed, through job creation and increased access to goods and services.
- There is **evidence** supporting this predicted impact pathway is **limited** to a few, but good, studies.



Mean and median property values for non-residential parcels located within approximately one-half mile of the proposed project site. The median property value of the non-residential properties in close proximity to the proposed project site are among the lowest.

Short-term Recommendations

Before Construction

- No recommendations identified for this phase.

During Construction

- Install bike racks in front of businesses along the proposed project site.

After Construction

- No recommendations identified for this phase.

Conclusion

The HIA Core Project Team and community stakeholders strongly supported the implementation of the project, due to the numerous co-benefits that could be realized as a result of the project's implementation. However, the group warned that these co-benefits would be of little magnitude due to the project's small size. Expanding the project and/or replicating the project throughout the watershed would allow DWM and the community to increase the magnitude of impact and get the most out of those benefits. The HIA Core Project Team strongly encouraged DWM's commitment to follow the HIA's recommendations as they move forward in the decision-making process.

For more details about this HIA, refer to the final HIA Report:

U.S. EPA. (2014). *Proctor Creek's Boone Boulevard Green Street Project Health Impact Assessment (HIA).* U.S. Environmental Protection Agency, Office of Research and Development and Region 4, Washington, D.C.

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