DECEMBER 2018

SUSTAINABLE CITIES STUDIO FINAL REPORT

Prepared for Central Atlanta Progress

Acknowledgements

The studio would like to thank CAP for their continuous support throughout the process of creating this report, specifically, Jennifer Ball, Audrey Leous and Andyan Diwangkari. Additionally, the studio would like to thank our invaluable guest speakers and interviewees for graciously providing our studio with constructive insight into their experiences in their fields of study:

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CH.1: INTRODUCTION

Intro to Sustainable Cities Studio

The Sustainable Cities Studio is the capstone for Georgia Tech's Sustainable Cities minor. The program is in the School of Urban and Regional Planning in the College of Design and is associated with the Serve-Learn-Sustain initiative. This course provides students with a faculty-supervised community engagement experience in developing a sustainability-related project for a non-profit, business, or government agency.

For the purpose of this report, the studio will borrow Julian Agyeman's Just Sustainabilities concept to define sustainability: "the need to ensure a better quality of life for all, now and into the future, in a just and equitable manner, whilst living within the limits of supporting ecosystems."

Team Roles

The studio was divided into three teams, and the roles of each team are described below.

Science and Technology Team

The Science and Technology (S&T) team's role primarily used technical data to identify areas vulnerable to intense heat and/or excessive flooding in Atlanta's Downtown. Their strategy included using GIS mapping of relevant data to determine Downtown's areas of high vulnerability. The data they mapped was collected through public resources found online and through their own collection using temperature sensors in conjunction with GPS.

Engineering and Design Team

The Engineering & Design (E&D) team primarily determined best practices for green infrastructure interventions and highlighted the challenges that each intervention method can address. From their research they identified examples of successful green infrastructure in Atlanta, important considerations for designing solutions, and general best practices for designing with green infrastructure and "blah-za" activation in mind.

Public Engagement and Communications Team

The Public Engagement and Communications team (PE&C) primarily gauged how stakeholders' experiences with Downtown would be impacted by the introduction of green infrastructure enhancements. Their strategy included surveying passerby in the area and searching through prior data for surveys of Downtown residents and visitors.

Green Infrastructure will be defined as "a network of natural and semi-natural areas, features and green spaces in ... urban ... areas, which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ecosystem services" (Botanic Gardens of South Australia).

Central Atlanta Progress

For this year's studio, the client is Central Atlanta Progress (CAP), a private nonprofit community development organization providing leadership, programs and services to preserve and strengthen the economic vitality of Downtown Atlanta.

Downtown Atlanta Master Plan

CAP has commissioned the studio to provide recommendations for improving Downtown Atlanta through implementation of the goals highlighted in Chapter 5 of CAP's Downtown Master Plan. The Master Plan defines a holistic strategy to develop Downtown Atlanta into a sustainable, functional and attractive destination in anticipation of the city's expected population growth.

The main focus of Chapter 5 of the Downtown Master Plan is creating a vibrant and active urban forest to improve air and water quality, create shade, mitigate health risks and improve the aesthetic experience in Atlanta's Downtown.

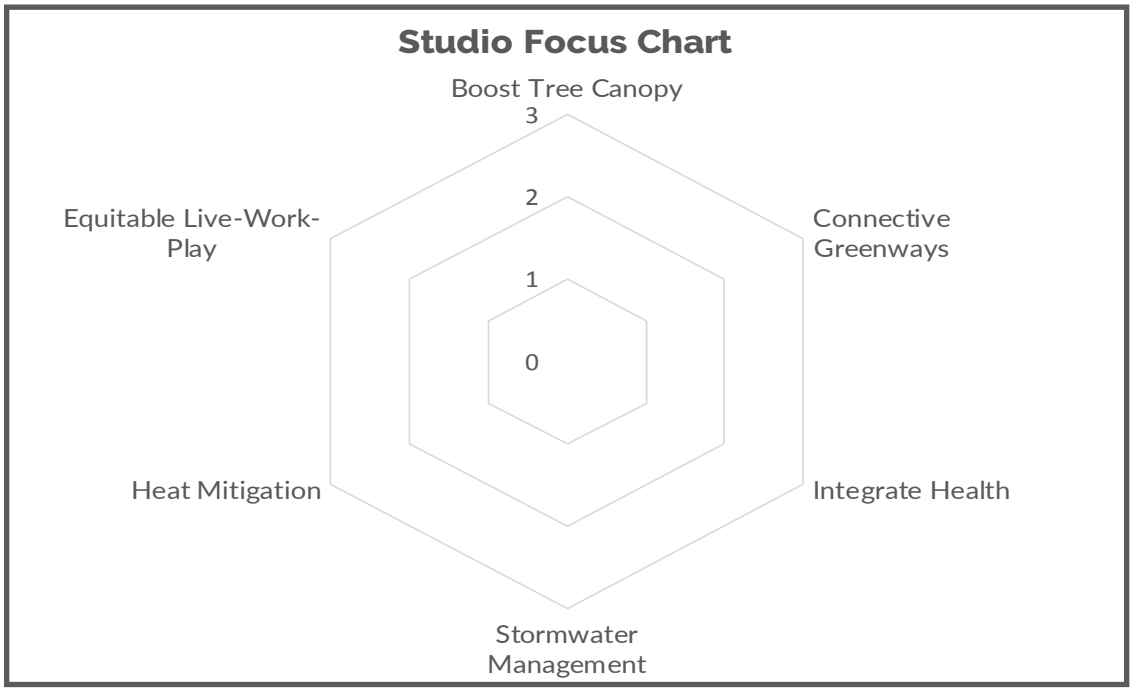
Our final plan will primarily seek to meet Chapter 5's subgoals, but also strive to account for goals mentioned throughout other chapters within the master plan.

The studio's final recommendations to CAP will provide feasible and sustainable solutions to advance goals discussed in the master plan, and to those that our studio teams have discovered.

The studio specifically targeted the following concerns as ones that should be solved with intervention: excessive heat, stormwater, human discomfort, and perceptions of public safety throughout Downtown. To keep a consistent direction, the class members chose six overarching goals to guide the work of our studio. These are: boost the Downtown Atlanta tree canopy, create connective greenways that link green spaces together, integrate public health into the landscape and architectural elements, manage Downtown's stormwater runoff, mitigate heat caused by the urban heat island effect, and improve Downtown's reputation as a live, work, play community.

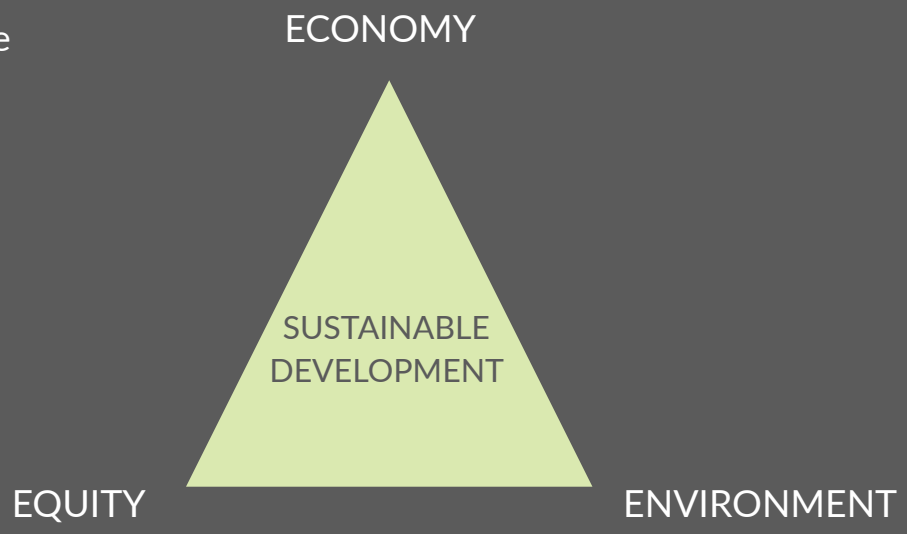
Chapter 5 Goals:

- 5.1 Boost the tree canopy
- 5.2 Integrate green infrastructure
- 5.3 Develop a program to re- design “blah-zas” as vibrant plazas
- 5.4 Integrate play and active green spaces at MARTA stations
- 5.5 Create green gateways
- 5.6 Increase linear connectivity to create green ribbons around the City
- 5.7 Integrate health into the Downtown experience
- 5.8 Develop with a commitment to sustainability

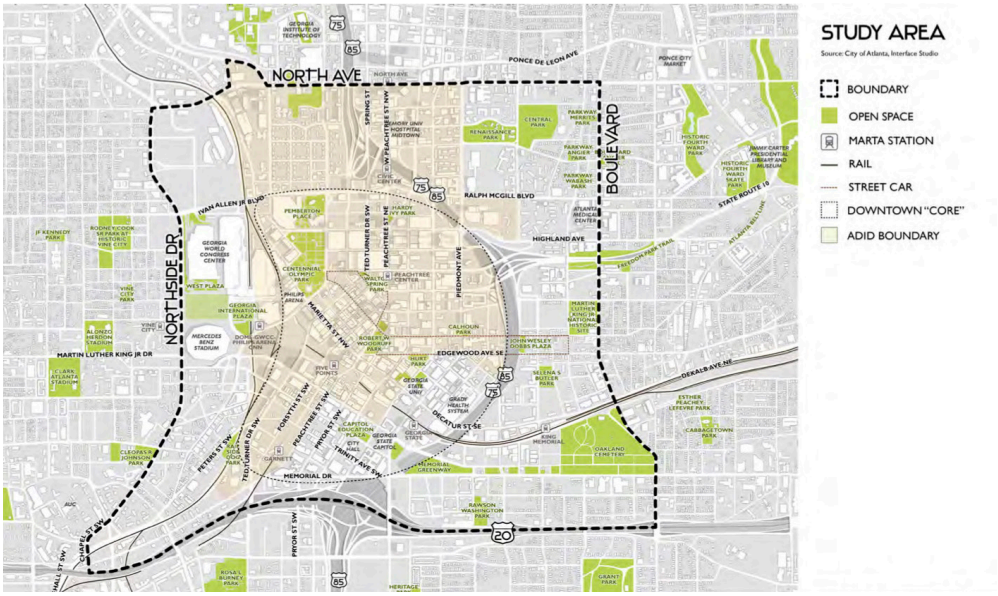


The studio chose these goals due to the potential that each has in planning for a community with increased sustainability. Additionally, the studio wants to ensure that our efforts contribute to outcomes in enhancing the 3 corners of the planners' triangle: equity, environment and economy.

Right:
The planner's triangle represents the three conflicting goals of ciity planning, with the ideal result of sustainable development in the middle.



Woodruff Park (Erin Santos)



Left: CAP defines Downtown to be the area North of I-20, South of North Ave, East of Northside Drive, and West of Boulevard Ave.

Primary Focal Points

Boost the Downtown Tree Canopy

Trees bring cooler summer temperatures, improve air quality, enhance walkability, lessen noise and visual pollution, and brings economic benefits, crime reduction, and health impacts to areas where they are planted.

Create Connective Greenways

With Atlanta's current lack of street activity, there is a need to attract people away from their private cars and toward alternative modes of travel. Connective greenways are a great method to enhance pedestrian activity while also fulfilling Atlanta's need for increased greenery.

Integrate Health

Atlanta and particularly its Downtown performs poorly in health status and risk factors when compared with state and national averages. Through design, health and wellbeing can be better incorporated into the culture and experience of Downtown.

Gene Phillips, CAP

Primary Focal Points

Manage Stormwater

The high amount of impervious surfaces within Downtown disrupts the natural cycle of water in the region, causing rain water to run off rather than infiltrate soil. Increased flooding as a result can cause structural damage to buildings and endanger human life.

Mitigate Heat

Heat plays an integral role in how individuals interact with an outdoor space. Downtown is impacted by the Urban Heat Island Effect, which can lead to a number of negative health ffects, including dehydration, death, and skin conditions.

Make Downtown a live/work/play environment

Atlanta's Downtown currently serves as a commercial center during the day, but can seem almost uninhabited at a work day's end. Downtown must appeal to future residents, business patrons, and people interested in participating in street-level events.

CONCLUSION

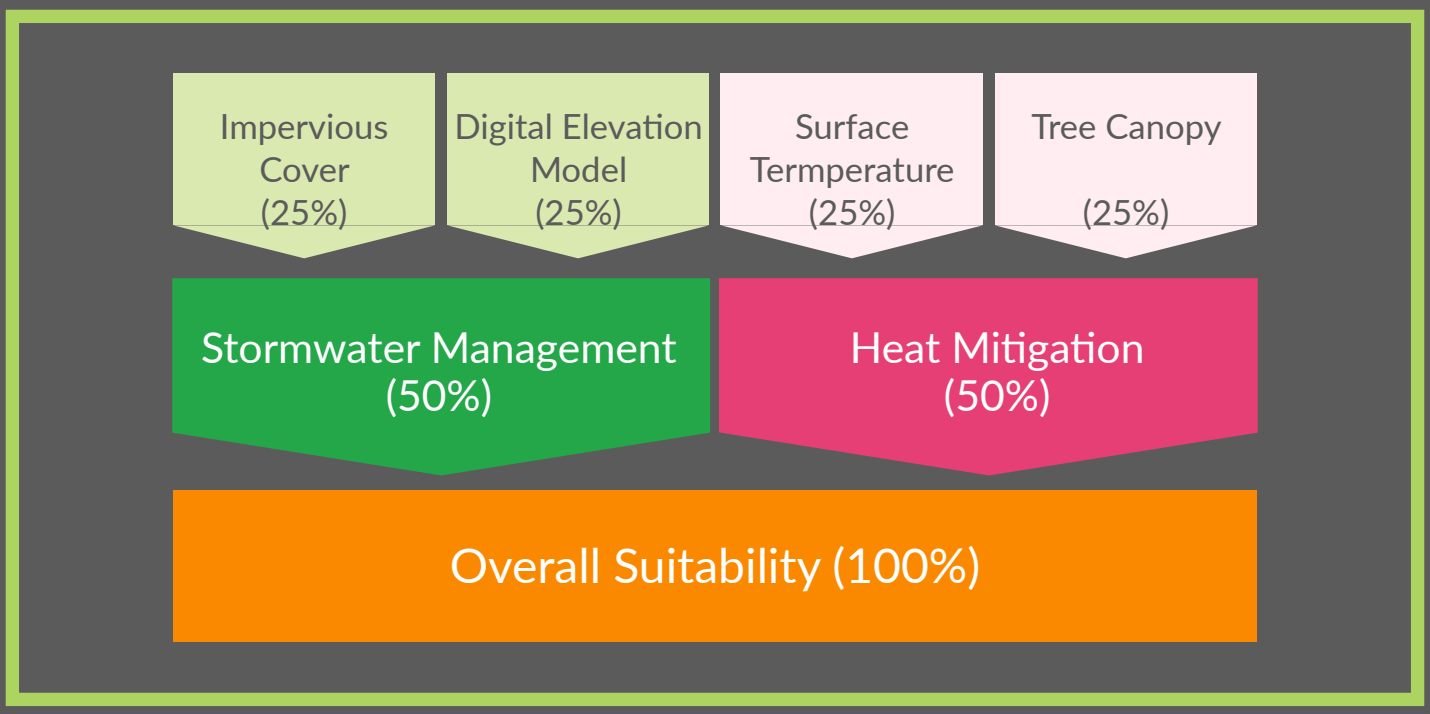
This report will describe the processes this studio pursued to develop green infrastructure recommendations for CAP. In the following three sections, this report will discuss the development of site and strategy suitability, intervention recommendations, and potential next steps. The suitability section will provide an in depth description of the tools and strategies developed to determine suitable sites. The intervention section will describe the intervention solutions that the studio recommends for CAP along with the tools developed to reach said conclusions. The final section will summarize the report and provide strategies that CAP can adopt to inform future sustainable development projects.

CH.2: SITE AND STRATEGY SUITABILITY

This section will discuss the tools and strategies that the three teams developed to determine the most effective sites to provide green infrastructure recommendations. The Science and Technology team created suitability analyses that utilize stormwater management and urban heat considerations. The team also collected ambient temperature data with a black globe sensor that replicates human experience of temperature. The Public Engagement and Communications team collected site preference data from surveys and conversations at Atlanta Streets Alive. They also aggregated relevant public engagement data from CAP's 2017 Open House events to determine how survey respondents perceived certain areas. The Engineering and Design team researched and put together a Best Practices Spreadsheet and created a Decision-Making Flowchart to determine how input from each team would contribute to the final product. This section concludes with the studio's choice of two focus areas determined with the help of these tools. The areas include the Grady Memorial Corridor and the Georgia World Congress Center surface parking lots.

Site Suitability

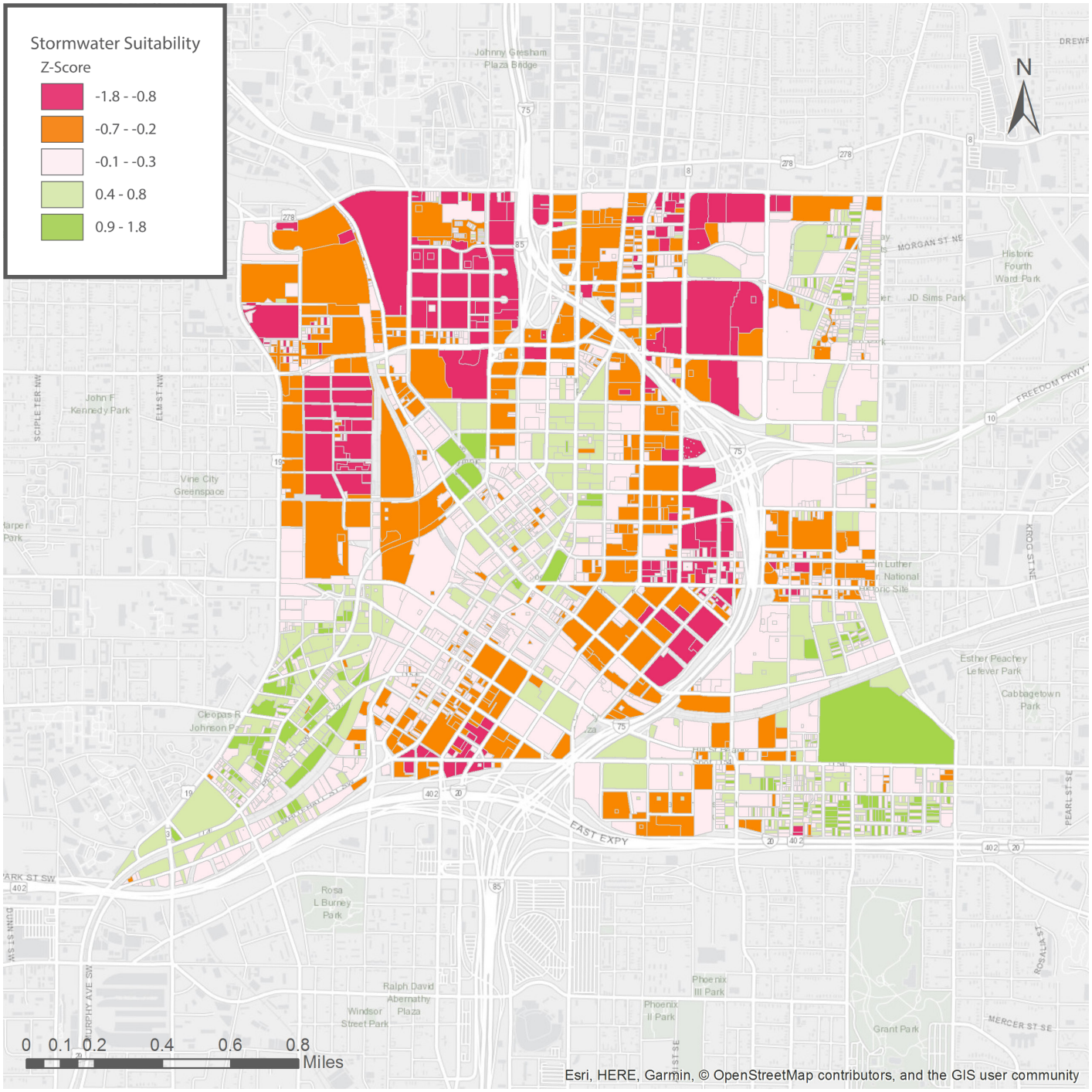
In order to determine focus areas to recommend for redevelopment, the Science and Technology team utilized both quantitative and qualitative analyses in Downtown. They performed suitability analyses utilizing stormwater management and urban heat considerations to measure and identify the vulnerable regions Downtown.



The chart above indicates the relative weight of each quantitative factor within each suitability analysis and how they compound to represent an overall suitability analysis of Downtown. Impervious cover, elevation, surface temperature, and tree canopy were scored on a normal distribution to indicate relative vulnerability by parcel, reflected by its z-score.

Methodology

The suitability analyses were completed in GIS on a parcel level to compare relative risks of problems relating to stormwater management and heat. The stormwater management analysis included the percent of impervious cover, an elevation model, and qualitatively, the Federal Emergency Management Agency's (FEMA) moderate flood hazard zones with a 0.2% flooding chance using a 500-year storm reference. For the urban heat data, the team utilized surface temperature and percent tree canopy, while qualitatively considering the location of urban trees from the Georgia Tech Center for Spatial Planning Analytics and Visualization's Tree Inventory. In the maps ahead, a lower z score is correlated to greater vulnerability.



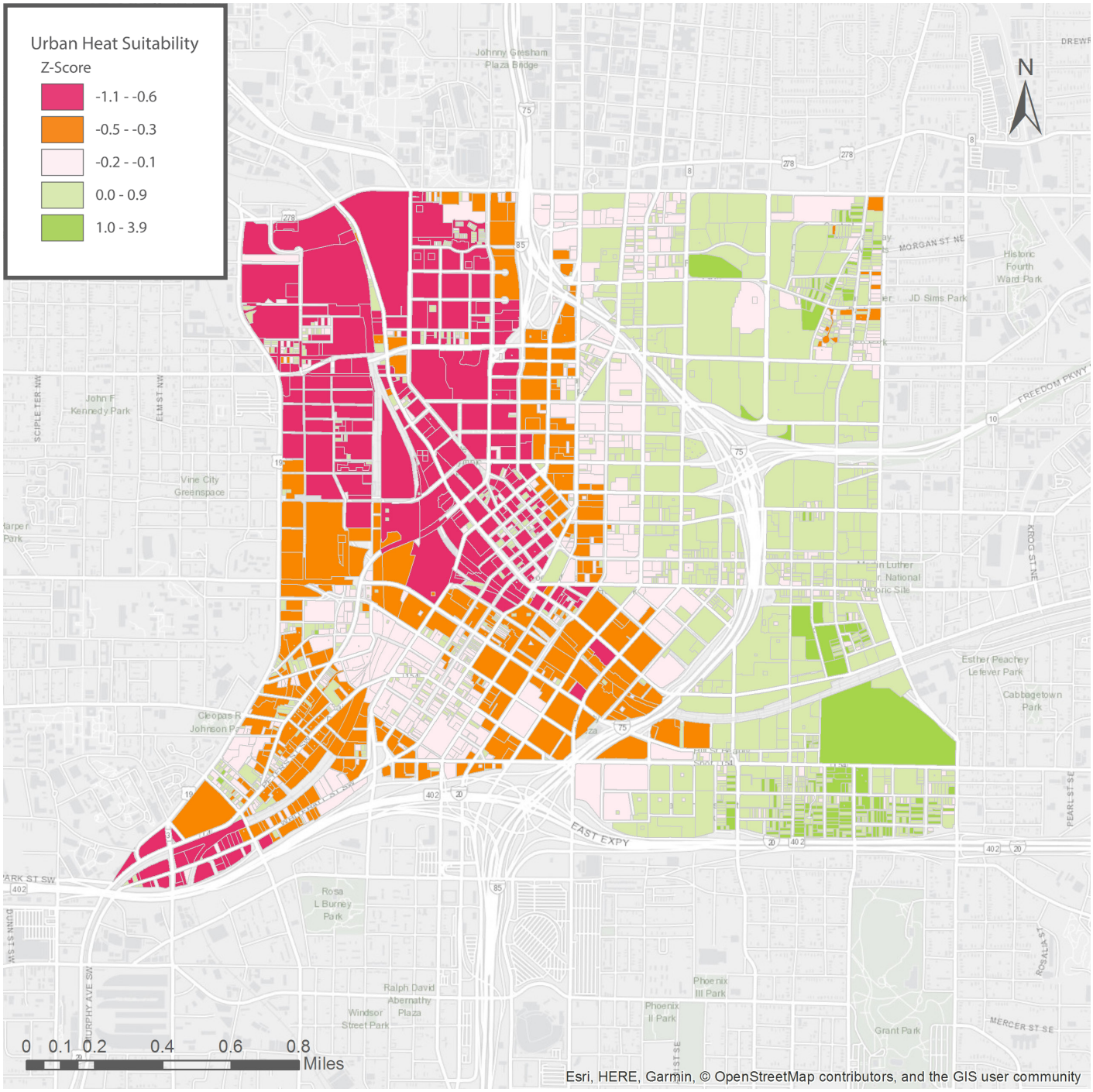
STORMWATER MANAGEMENT SUITABILITY MAP

STORMWATER MANAGEMENT ANALYSIS

The stormwater management suitability analysis utilizes percent impervious surface per parcel (National Land Cover Database) relative elevation (Advanced Spaceborne Thermal Emission and Reflection Radiometer) by parcel to determine each parcel's need for intervention relating to stormwater management. Surface imperviousness is an indicator of vulnerability as impervious cover leads to runoff and environmental degradation. Low elevation is indicative of areas susceptible to flooding and overwhelmed stormwater management systems. Additionally, the studio considered areas determined by FEMA as having 0.2% Annual Flood Hazard.

This analysis identifies parcels in a few focus areas as highest priority for intervention relating to stormwater management as:

- The northwest corner of Downtown along Lucky Street and Centennial Olympic Park Dr
- North of the Downtown Connector and south of North Avenue
- Around Grady Memorial Hospital directly north of the Downtown Connector



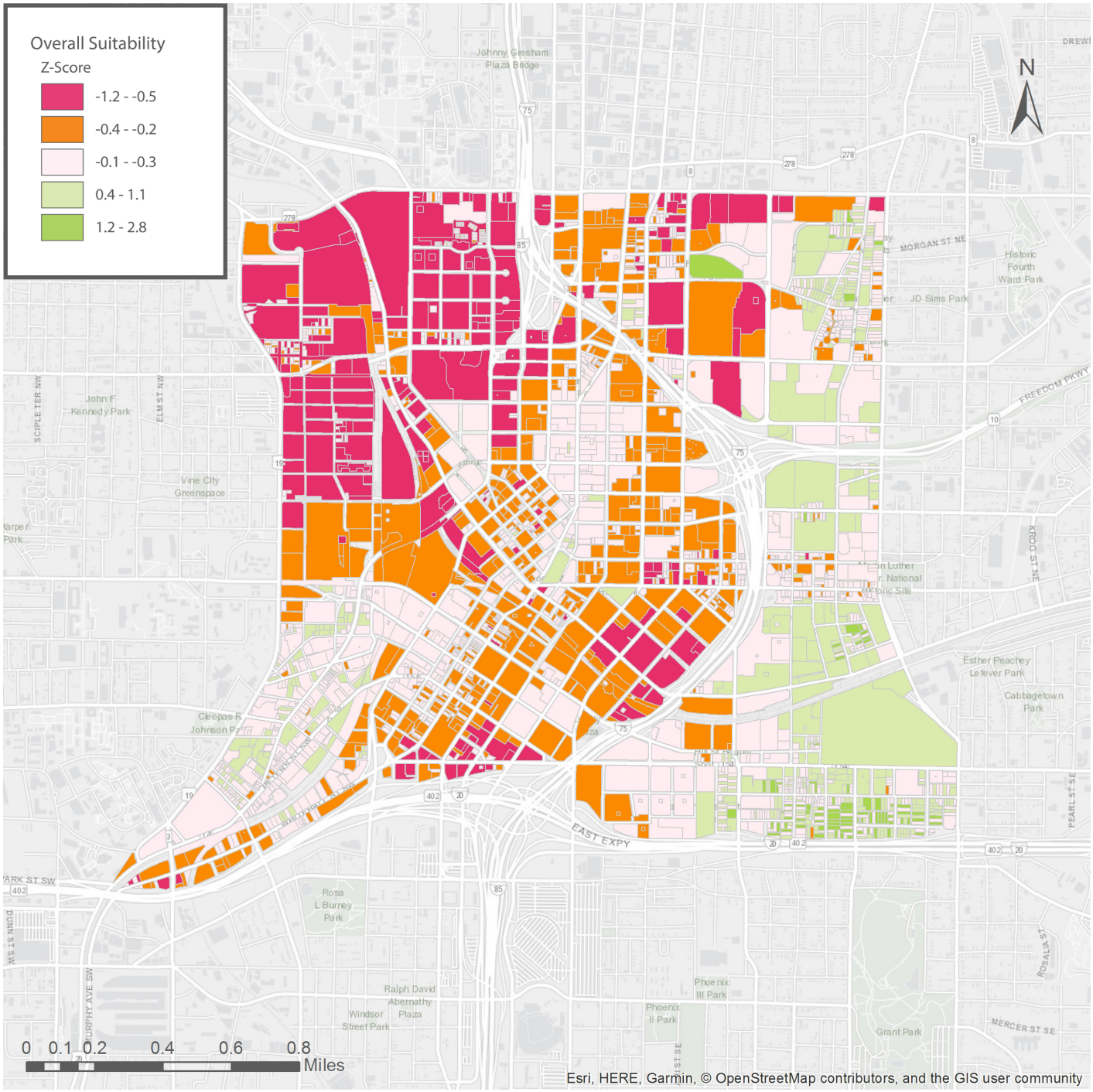
URBAN HEAT ISLAND EFFECT SUITABILITY MAP

URBAN HEAT ISLAND EFFECT ANALYSIS

The heat mitigation suitability analysis uses relative surface temperature (Landsat Satellite) and percent canopy per parcel (National Land Cover Database) to determine parcels with the greatest need for intervention relating to urban heat.

This analysis identifies parcels in a few regions as highest priority for intervention relating to urban heat as:

- A large portion of parcels in the northwest corner of Downtown from the corner of North Avenue and Northside Drive to the center of Downtown
- The southwest tip of Downtown near Castleberry Hill
- In the southern part of Downtown along Piedmont Avenue



OVERALL SUITABILITY MAP

OVERALL SUITABILITY ANALYSIS

The overall suitability analysis equally weights the two separate suitability analyses to determine each parcel's relative need for intervention. From this analysis, the Science and Technology team identified vulnerable regions which became our primary focus areas for intervention.

Potential Focus Areas:

- The Georgia World Congress Center surface parking lots between Lucky Street and Northside Drive in the northwest corner of Downtown
- The residential area in the northwest corner of Downtown between North Avenue and Ivan Allen Jr Boulevard
- The southern border of Downtown along Memorial Drive
- Between Central Avenue and the Downtown Connector near Georgia State University and Grady Memorial Hospital

Foundations for Analysis

Once the Science and Technology team determined which potential focus areas of Downtown were most vulnerable to excessive heat and flooding, the Public Engagement and Communication team looked at how residents and visitors would be affected by the redevelopment of the vulnerable areas. The team looked at how people typically interacted with the focus areas.

To put equity at the forefront of the site redevelopment, the Public Engagement and Communication team sought to gain a better understanding about how populations in and around the potential focus areas perceived their environments. This helped us understand what interventions the public wished to see in these areas.

Tools and Data Collection Method

Prior to the completion of Science and Technology's data collection, the Public Engagement and Communication team collected data at a public event to determine the desired enhancements the public wished to see in Downtown.

The survey, included in Appendix II, was issued at Atlanta Streets Alive, an event series where miles of Atlanta roads are closed off to cars so that bicyclists and pedestrians can travel freely for an afternoon.

Data was collected through two methods. One, a paper survey with 6 questions, and the other, a facilitated discussion on how to enhance the urban experience.

The paper survey asked passersby 5 questions: how often they interact with Downtown, in what areas have they encountered unbearable heat and/or flooding, what areas do they think need the most overall improvement, what causes them discomfort as they move throughout Downtown, and what factors play in the comfort of their mobility throughout Downtown.

The discussion portion of the team's data collection was facilitated by posters with four images of areas in and around Atlanta's Downtown. The studio had conversations with young couples, artists, and homeless people. From the conversations, the team gained insight on what practices and urban design suggestions respondents believe make for comfortable places. Responses stated that wooden benches and patios create a homey ambiance and restaurants with outdoor tables provide a welcoming atmosphere to the public.

An issue with this data is that because Atlanta Streets Alive is a bicyclist and pedestrian focused event so it can be assumed that the sample population is not representative of all people who interact with Downtown. Nevertheless the team gained insight from its nearly 100 survey respondents.

Findings

From the data collected, most From the data collected, most respondents did not name an area of Downtown which they found to suffer from unbearable flooding or excessive heat. However, an overwhelming majority of respondents claimed that Atlanta's excessive homeless population caused them the most discomfort throughout Downtown.

The question on which areas need overall improvement was provided as a multiple choice question with an "other" option. While most respondents chose a provided choice, the Gulch and 5 Points Marta Station were the only other answers within the borders of downtown which respondents provided.

In ranking factors that affect people's experience with mobility throughout Downtown, quality bike lanes and sidewalks were ranked as highest priority, trees for aesthetic and shading purpose ranked in the middle, and flood prevention ranked lowest.

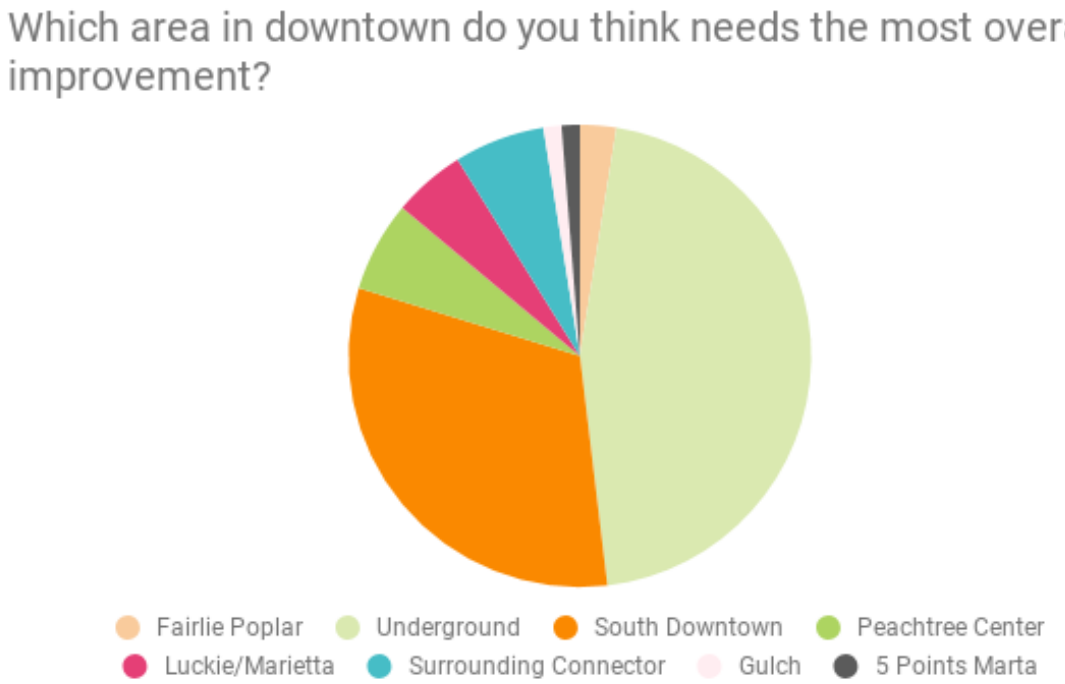
PE&C Team at Atlanta Streets Alive

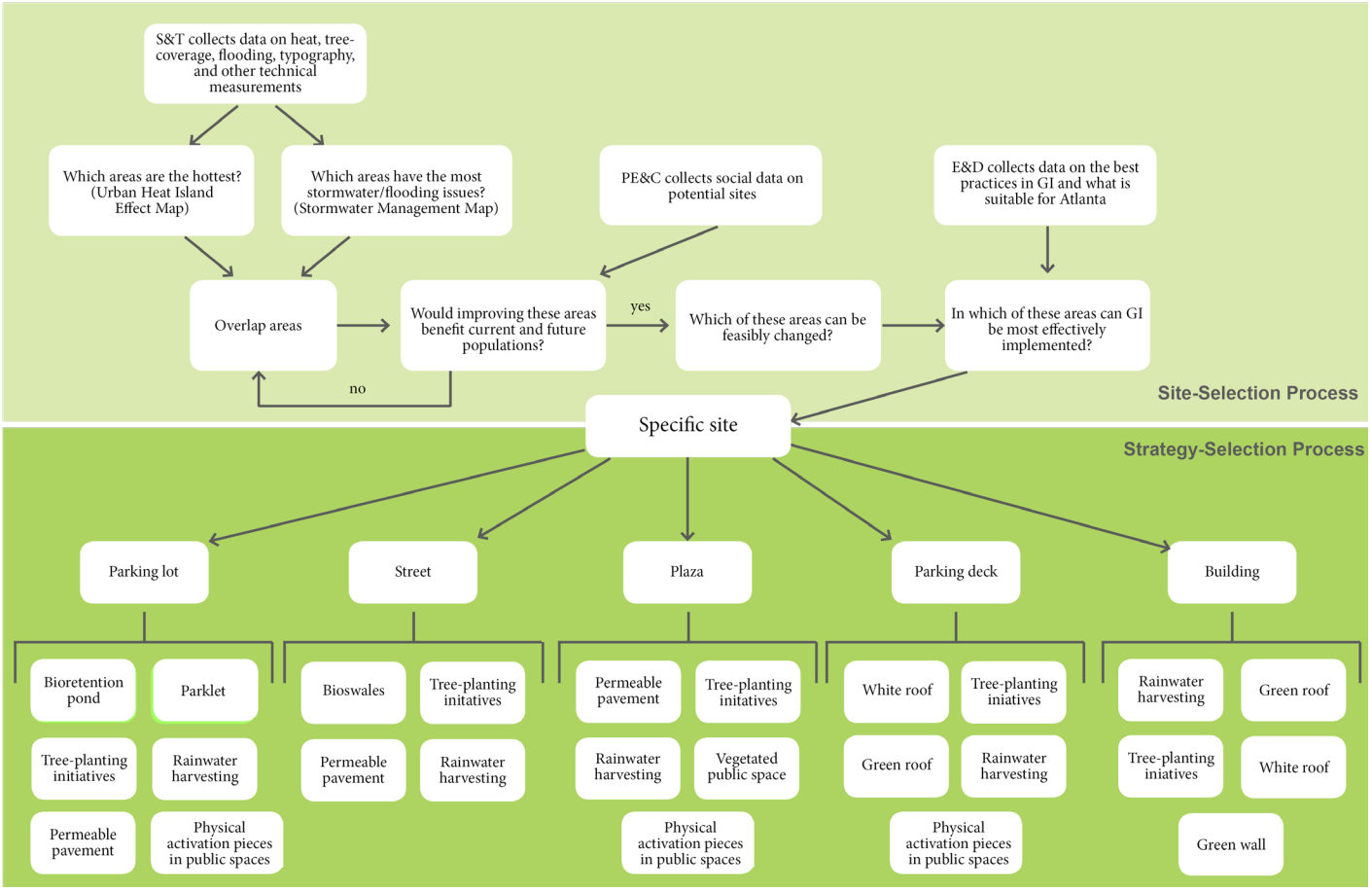
Other Supporting Data Sources

In addition to the team's public engagement effort at Atlanta Streets Alive, the team also aggregated the responses to CAP's outreach collected in the Open House events in the development of their Downtown Master Plan. CAP's data pointed to areas respondents thought should be redeveloped, the changes they want to see in Downtown, and their preferred methods of green infrastructure interventions.

Looking at the data collected at Atlanta Streets Alive and that collected by CAP, the Public Engagement team and Science and Technology team looked to see if any overlap existed between both teams' discovered problem areas. Additionally, the data collected on respondents' preferences of design practices helped inform the Engineering and Design team's understanding of best green infrastructure intervention practices.

While there was not much overlap in the areas respondents suggested to need overall improvement and the areas which S&T found to be of high risk, our studio chose to prioritize the development of environmentally high risk areas. It can be assumed that respondents only suggested areas with which they often interact, but may have failed to acknowledge areas with greater environmental risks because said areas are less attractive or vice versa may be of greater environmental risks because no attention has yet been put towards efforts of ridding the hazards which exist in said areas.





The Engineering and Design Team created the flowchart above which guided the studio's process for determining a site(s) and for determining intervention strategies for the site(s). The flowchart was made in Adobe InDesign and can be used for future site and strategy selection.

At top, the chart describes our process for narrowing down an intervention site(s), starting with data from the Science and Technology Team. After a few general areas have been chosen, input from the Public Engagement and Communications Team is considered regarding benefits to the Downtown population. This process is recursive and can continue until an appropriate set of sites is found. Input from the Engineering and Design Team is then used to determine which of the sites in consideration have opportunities for effective intervention. This leads us to a determine site or set of sites. The flowchart then outlines general intervention strategies based on the type of site. The Engineering and Design Team assigned these strategies based on interviews with experts in green infrastructure.

For this studio, we decided the final focus areas would be the **Grady Memorial Corridor** and **Georgia World Congress Center surface parking lots**.

Strategy Suitability

The S&T team developed the Overall Suitability map that revealed where the stormwater impacts and urban heat island impacts overlap. This drew their attention to two areas, the Northwest and South central regions of CAP's map of Downtown. The E&D team then determined what sites would be optimal for Green Infrastructure interventions. The PE&C team determined the sites that would most impact residents and visitors.

Best Practices

In order to fully capture practices that could be feasibly implemented in Downtown Atlanta, the E&D team conducted several interviews with local experts highlighted in intro. These interviews provided examples of successful green infrastructure in Atlanta, important considerations to keep in mind when designing a solution, and potential unforeseen challenges to address in the design stage.

Furthermore, the E&D team relied on scholarly research (including, but not limited to, the Environmental Land Use Planning and Management textbook by John Randolph) surrounding stormwater management quantitative analyses and nationally-based case studies with successful implementations of projects similar to the studio's to guide the studio's intervention decisions.

The Engineering and Design team compiled a set of best practices appropriate for Downtown through a literature review and a series of practitioner interviews. These resources helped inform the development of a Best Practices diagram mapping green infrastructure (GI) practices to the challenges they address. Some challenges, however, require a fusion of solutions. According to their findings, the best practices for stormwater management involve slowing, storing, using, and diverting runoff. These can be achieved through a combination of GI tools listed in the

best practices spreadsheet. Furthermore, the team determined from existing resources that public spaces must be continuously inviting to a variety of people and be flexible for mixed-use purposes. Essentially, a public space must not only achieve an adequate physical performance, in terms of ambient temperature and stormwater processing, but also must meaningfully engage the community so that they may contribute to Downtown Atlanta's vitality.

Below: a snapshot of the Best Practices spreadsheet developed by the E&D team

	CAP Goal						Studio Goal	
Practice	**Boost Tree Canopy**	**Integrate Green Infrastructure**	**Redesign Blah-Zas**	**Green Gateways**	**Integrate Health**	**Energy & Water Conservation**	**Stormwater Management**	**Reduce Urban Heat Island**
White Roof					X	X		X
Vegetative/Green Roof	X	X	X		X	X	X	X
Tree-planting initiatives (TPI)	X	X	X	X	X	X	X	X
Bioswales (Street Bumpouts)		X	X	X	X	X	X	X
Bioretention Pond		X		X	X	X	X	X
Vegetated Public Space	X	X	X	X	X	X	X	X

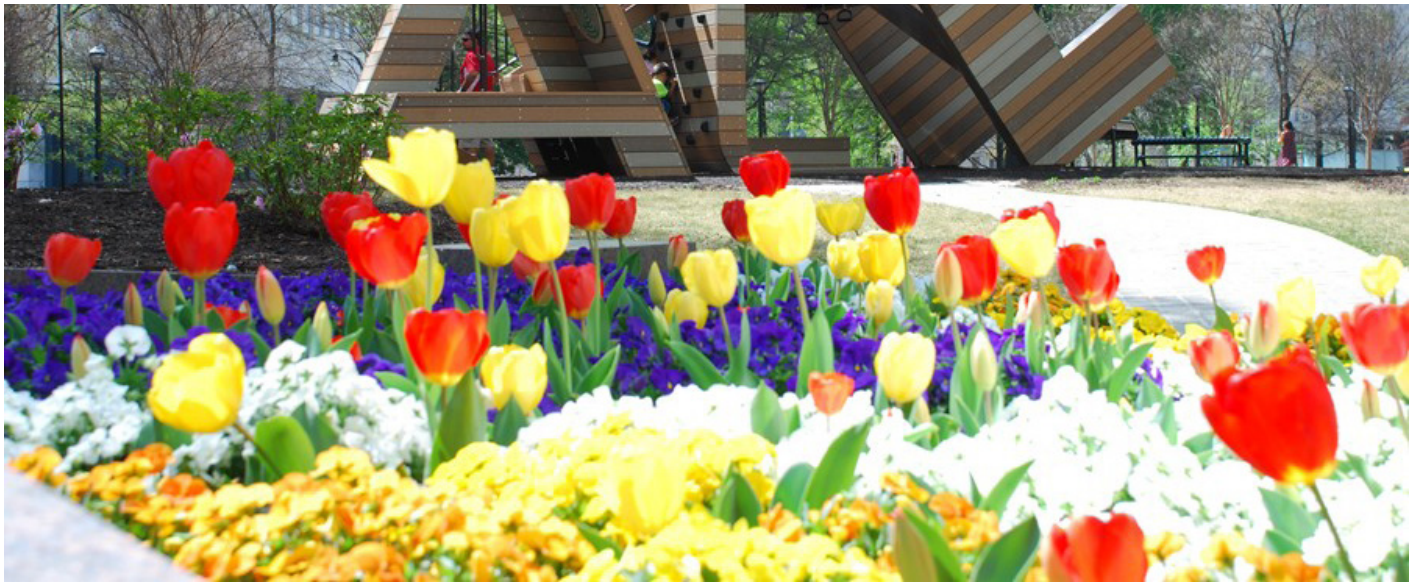
Focus Area Data Collection

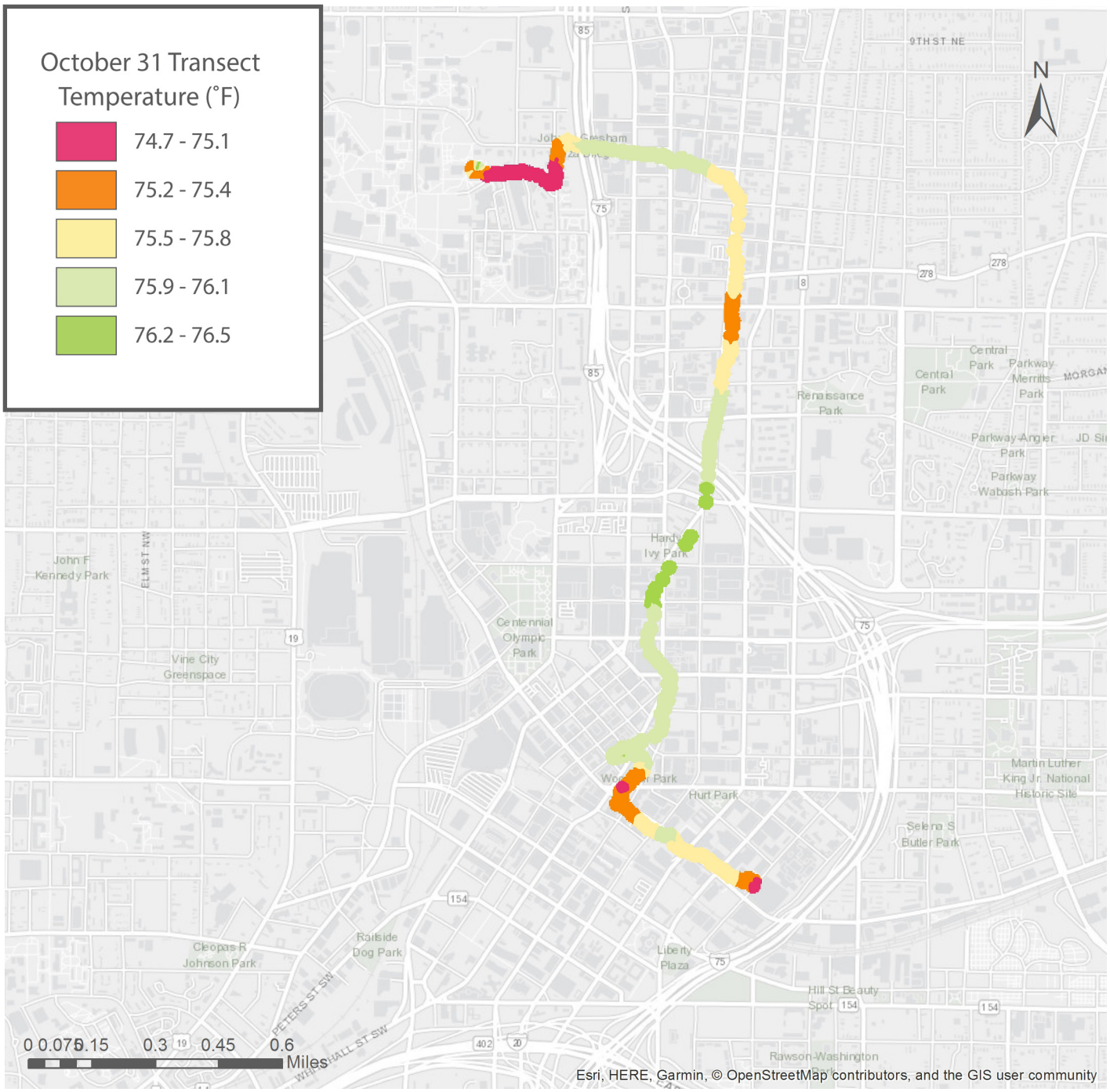
The Science and Technology team conducted site visits throughout this phase to experience the Downtown environment and further understand the ambient temperature data as this data type was missing from existing data sources. During all site visits the studio tracked location using a GPS at the same interval as the temperature collections (5 seconds) so that the ambient temperature and location data could be combined and analyzed in GIS. The studio collected ambient temperature data during two site visits each on relatively warm days to enhance Urban Heat Island Effect signal.

The first transect on October 16th was biked along the west side of Downtown to determine ambient temperature using a black globe temperature sensor, which replicates a human experience as the black globe better reflects thermal comfort by measuring radiant heat. The data collected confirmed that the ambient temperature in the northwest corner of downtown near the Georgia World Congress Center surface parking lots was hotter than other nearby locations Downtown, but did not play into the later intervention design techniques.

Then, on October 31st, the team collected temperature data from a second transect from Georgia State Marta Station back to Georgia Tech and used black globe temperature at specific sites within the identified corridor between the Georgia State Marta Station and Grady Plaza.

During this site visit, the team walked through the corridor between Georgia State Marta Station and Grady Plaza in an attempt to replicate and analyze the experience of doing so while wearing a black globe temperature sensor. The S&T team created a table comparing the black globe temperatures at different sites within the Grady Memorial Corridor.





SECOND TRANSECT MAP

Location	Temperature (°F)
GSU Marta – Jessie Hill Exit	75.8
Decatur Street (b/w Piedmont and Jessie Hill)	76.7
Piedmont Ave (b/w Marta and Decatur St)	78.2
GSU Marta – Piedmont Exit	78.4
Grady Parking Deck	80.1
Jessie Hill Jr. (b/w Grady Parking and Grady Plaza)	81.7
Grady Blah-za	81.7
GSU Parking Deck	81.8
Jessie Hill Jr. (b/w Grady Parking and Marta)	80.8

The data shows the higher temperatures closer to Grady in comparison to Georgia State Marta Station. Furthermore, the sites surrounding grady were visited later in the afternoon as Downtown should have been cooling off, but still represented the hottest data due to a strong urban heat island effect in these areas.

The Public Engagement and Communications team also participated in the October 31st site visit to make observations about public utilization. The team noted that Grady Parking lot was heavily utilized and the top level was full of cars whereas the Georgia State University parking decks had empty top levels. Additionally, the team noted that Grady Plaza was highly utilized, but lacked seating, shade, and other design amenities that would make it a comfortable space to spend time in. Many people were sitting on the shallow concrete steps or on the ground. There was a noticeable variety of population demographics interacting with the area, Georgia State students, professional employees, and bystanders of diverse racial backgrounds. This suggests that an intervention here would affect a diverse population consisting of workers, students, patients and potential residents. The area surrounding the station and lots also had a noticeably sizeable homeless population, directly affected by extreme flooding and heat. Due to the noticeable homeless population and the public perception of safety many correlate to areas with visible homelessness, it is possible that people avoid using the services available, such as the nearby transit station, if they have the means to do so. In combination with the Science and Technology team's temperature measurements, this site visit helped to prioritize sites within the Grady Memorial Corridor, particularly Grady Plaza due to its public utilization and higher temperatures.

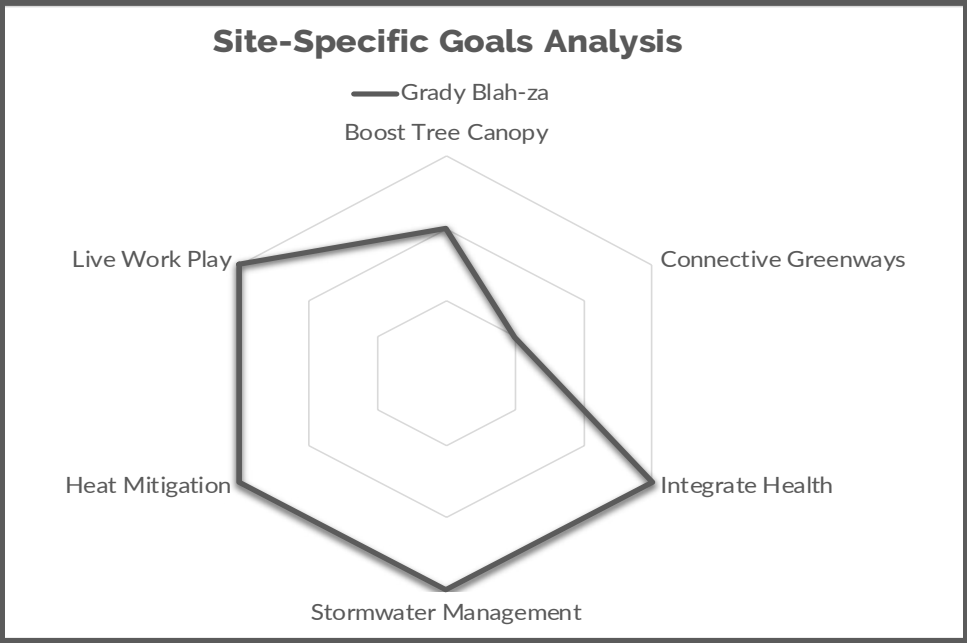
CONCLUSION

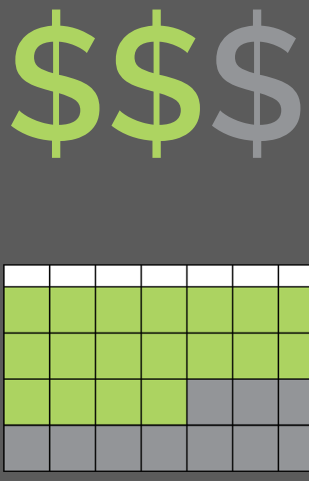
In this section each team described the tools and strategies they developed to determine the most suitable sites to provide green infrastructure solutions. The Science and Technology team developed suitability analyses that show the areas most affected by stormwater runoff and urban heat island effect. They also collected ambient temperature data. The Public Engagement and Communication team surveyed residents and visitors and collected prior CAP survey results to determine how people perceive certain areas. The Engineering and Design team developed a Decision-Making Flowchart and Best Practices Spreadsheet to find the best suited areas to provide green infrastructure. These tools and strategies helped determine the studio's two focus areas: Grady Memorial Corridor and the Georgia World Congress Center surface parking lots. The following section will describe the interventions that the studio recommends for five targeted sites in these focus areas.

CH. 3 SITE INTERVENTION

The tools described in the Site and Strategy Suitability chapter led the studio to determine two focus areas to develop: the Grady Memorial Corridor and the Georgia World Congress Center surface parking lots. Within these two areas the team narrowed down 5 sites to provide intervention recommendations for that include: the Grady Blah-za, the Jesse Hill Junior Drive Corridor, a Georgia State University parking deck, the Georgia State University Marta Station,

SUMMARY



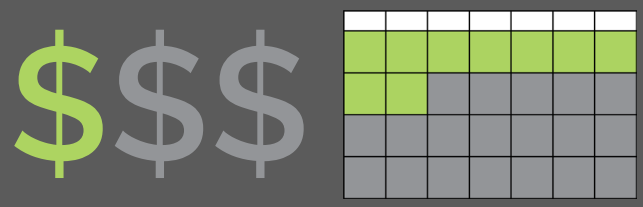


and the Georgia World Congress Center parking lot. These sites are suitable for CAP's chapter 5 goals and the studio's goals of urban heat mitigation, stormwater management, and equity. Each of these goals are addressed by the studio's intervention recommendations which are displayed visually in the accompanying spider charts. The studio aggregated the CAP goals and its own studio objectives into six overall goals. The spider chart shows the level (from 0-3) of how effectively the intervention addresses each of those six goals.

Intervention plans in the following sections also include rankings regarding costs of initial investment and time required for implementation. Ranges for both scales are listed in the table below. These two rankings were obtained from comparative case studies where similar work was completed in other projects around the United States.

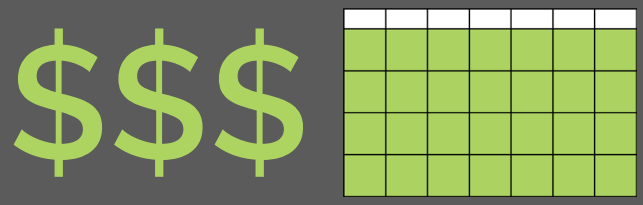
Throughout Chapter 3, we will provide a summary for each site, which includes a goals analysis, cost measurement, and timeframe metric. The goals analysis is represented by a spider chart, while the cost measurement is represented by one to three dollar signs. The timeframe metric is given through a calendar icon.

LOW



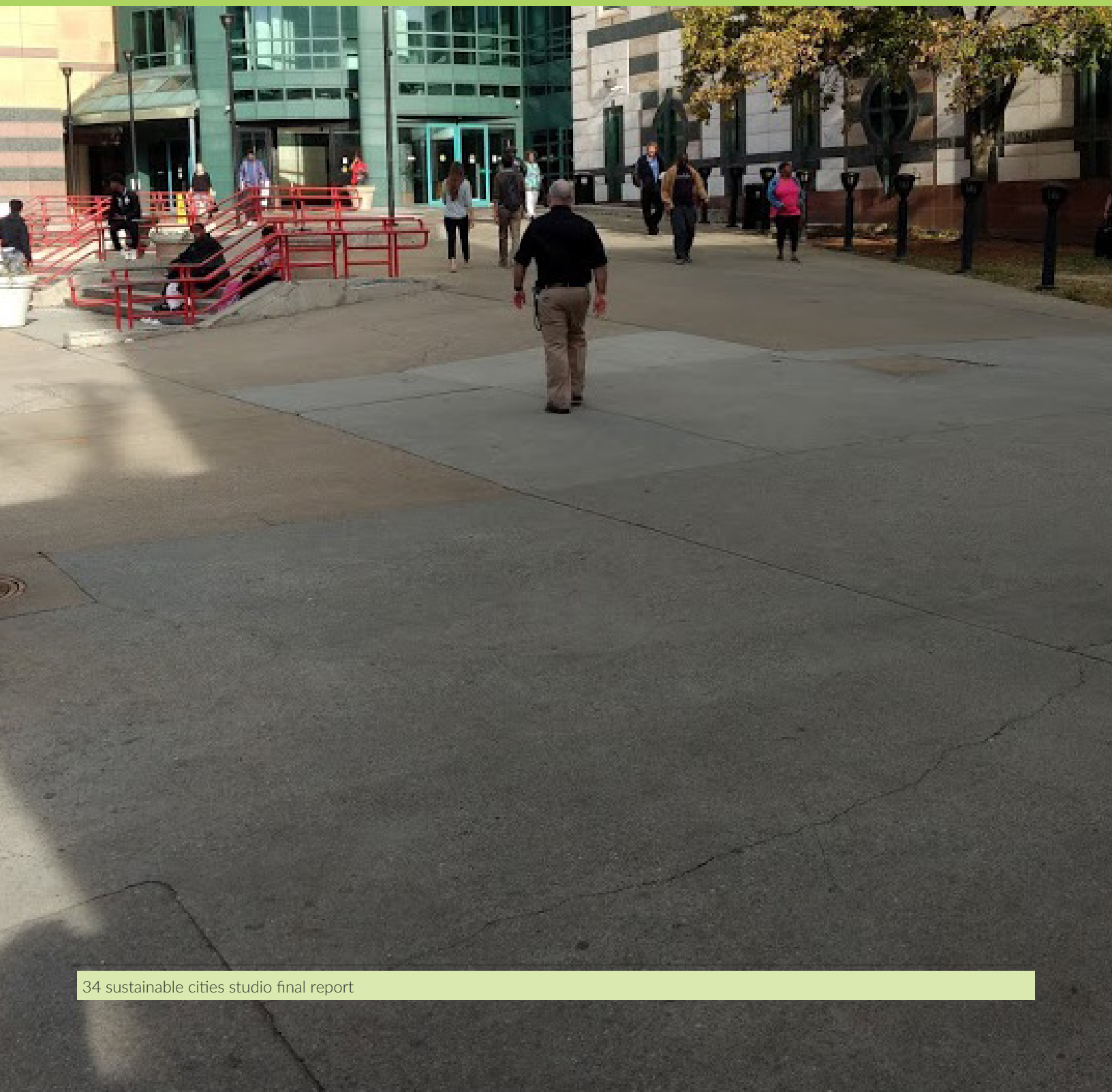
MEDIUM

HIGH



	Low	Medium	High
Cost Level	< $100,000	$100,000 - $500,000	> $500,000
Time Scale	< 6 months	6 months - 1 year	> 1 year

Grady Blah-za



EXISTING SITE DESCRIPTION

The Grady Memorial Hospital Plaza is an active space adjacent to the hospital. Visitors can access the plaza by car, bus, walking, or bycling on Jesse Hill Jr Dr or Gilmer St. The space is surrounded by tall buildings and parking decks, and is used by hospital staff, patients, and visitors passing through to enter the hospital, as well as by others who actually remain in the area. The lack of seating and other features within the plaza, with the expection of red stair railings, leaves the area feeling empty and barren.

INTERVENTION

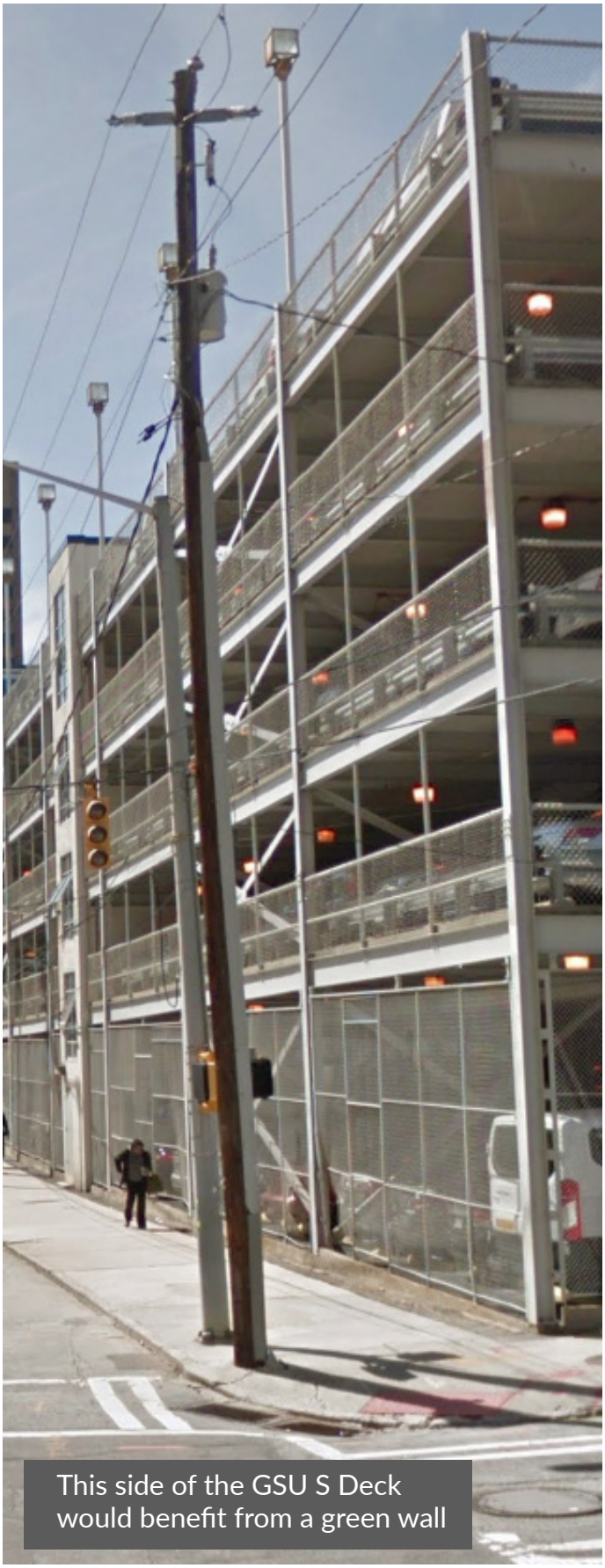
The Sustainable Cities Studio proposes that the space should include trees to provide shade, a vegetative green wall to improve the air quality, a bioswale to manage stormwater, and a canopied seating area to accommodate guests.

BENEFITS

By implementing these interventions, the Grady Blah-za can be redesigned into a welcoming space that addresses numerous health and environmental concerns.

The Grady Blah-za redevelopment provides the greatest benefits in live-work-play, heat mitigation, stormwater management, and health integration. The trees and canopied seating will reduce the urban heat island effect, while the bioswale will implement stormwater management technology. The conglomeration of these features will not only reduce the heat and flooding issues of the surrounding area, but will also improve the apparent hospitality of the health facility.

By providing a welcoming space that provides seating and activity, it enhances a live-work-play environment. Additionally, the presence of natural features, such as the suggested green wall, markedly improves patient satisfaction with overall quality of care by reducing suffering and expediting recovery, while also ameliorating stress for staff which in turn reduces absenteeism and employee turnover. Research suggests that natural features will

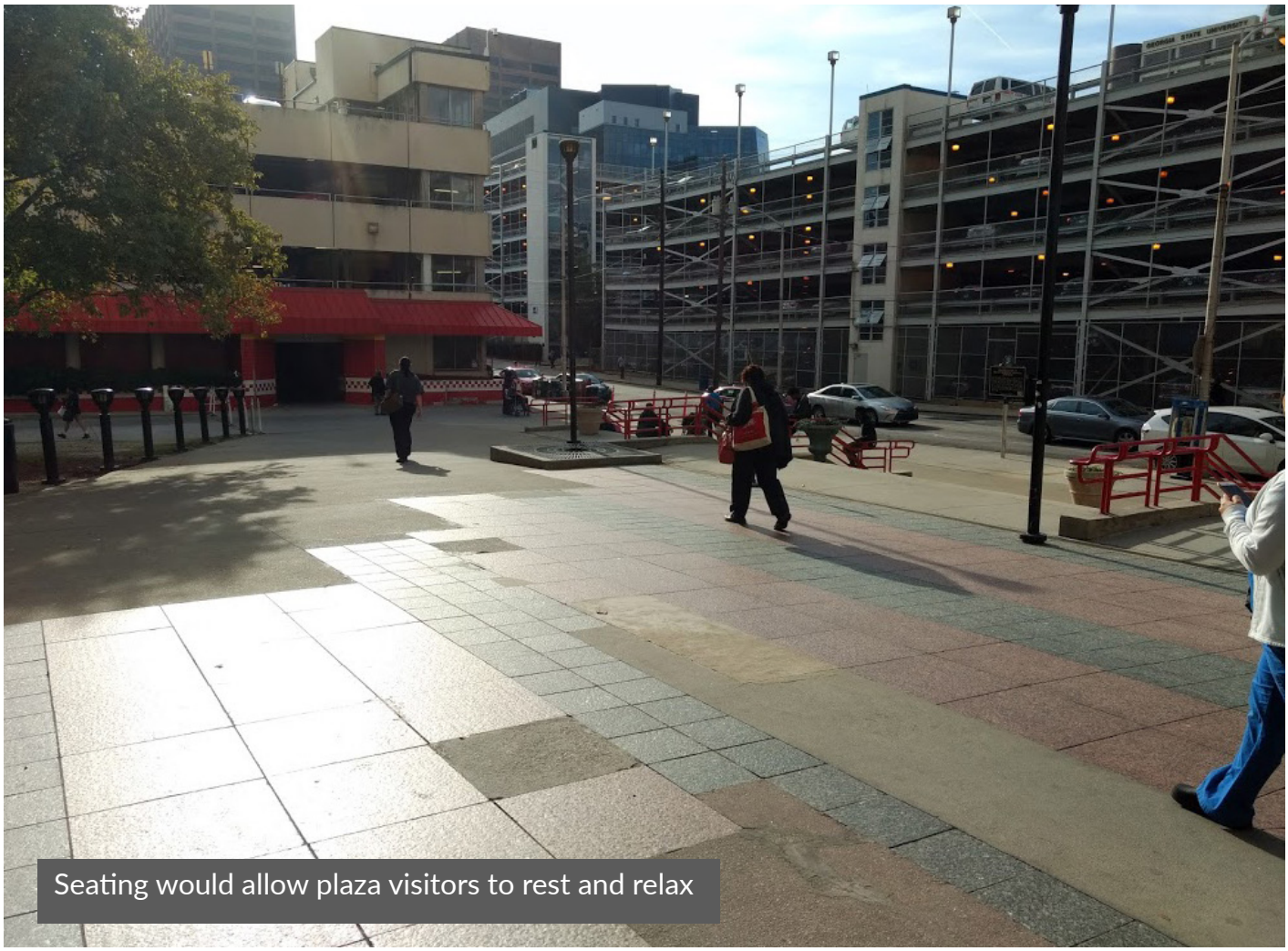


This side of the GSU S Deck would benefit from a green wall

Bioswales are "storm water runoff conveyance systems that provide an alternative to storm sewers. They can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters." (USDA NRCS) Bioswales absorb and filter storm water, thus enhacing the water quality and reducing the volume entering the sewer.

improve the human performance of the health facility while addressing the environmental concerns of Downtown.

Right: plants such as the Cardinal Flower, Cinnamon Fern, and New England Aster would be appropriate to use in a bioswale in Georgia, and can be seen in the Grady Blahza bioswale rendering.



Seating would allow plaza visitors to rest and relax

Cardinal Flower

- Native to most of North America
- Prefers morning sun, afternoon shade, and moist soil

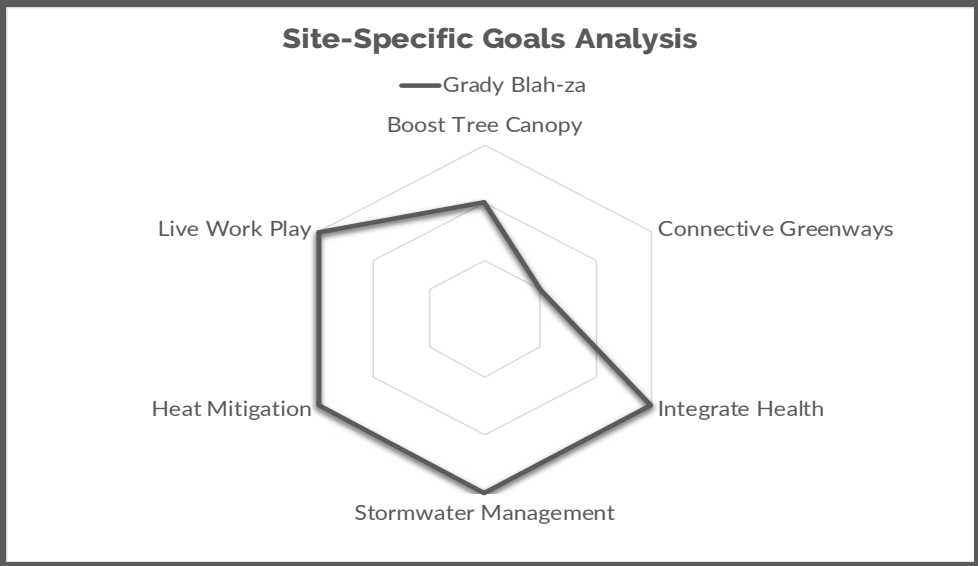
Cinnamon Fern

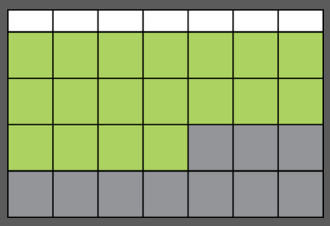
- Native to North America and can be found throughout Georgia
- Prefers wet, acidic soil

New England Aster

- Native to most of North America
- Prefers moist soil and full sun to partial shade

SUMMARY

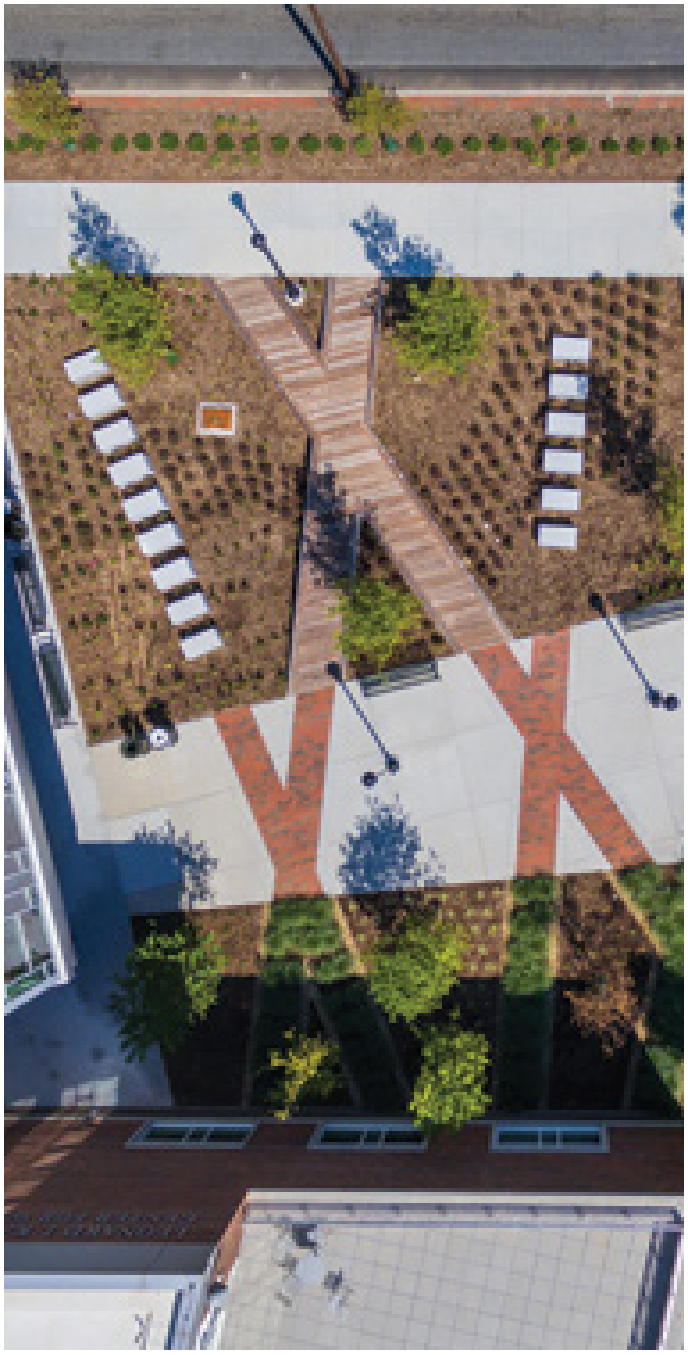




CASE STUDY

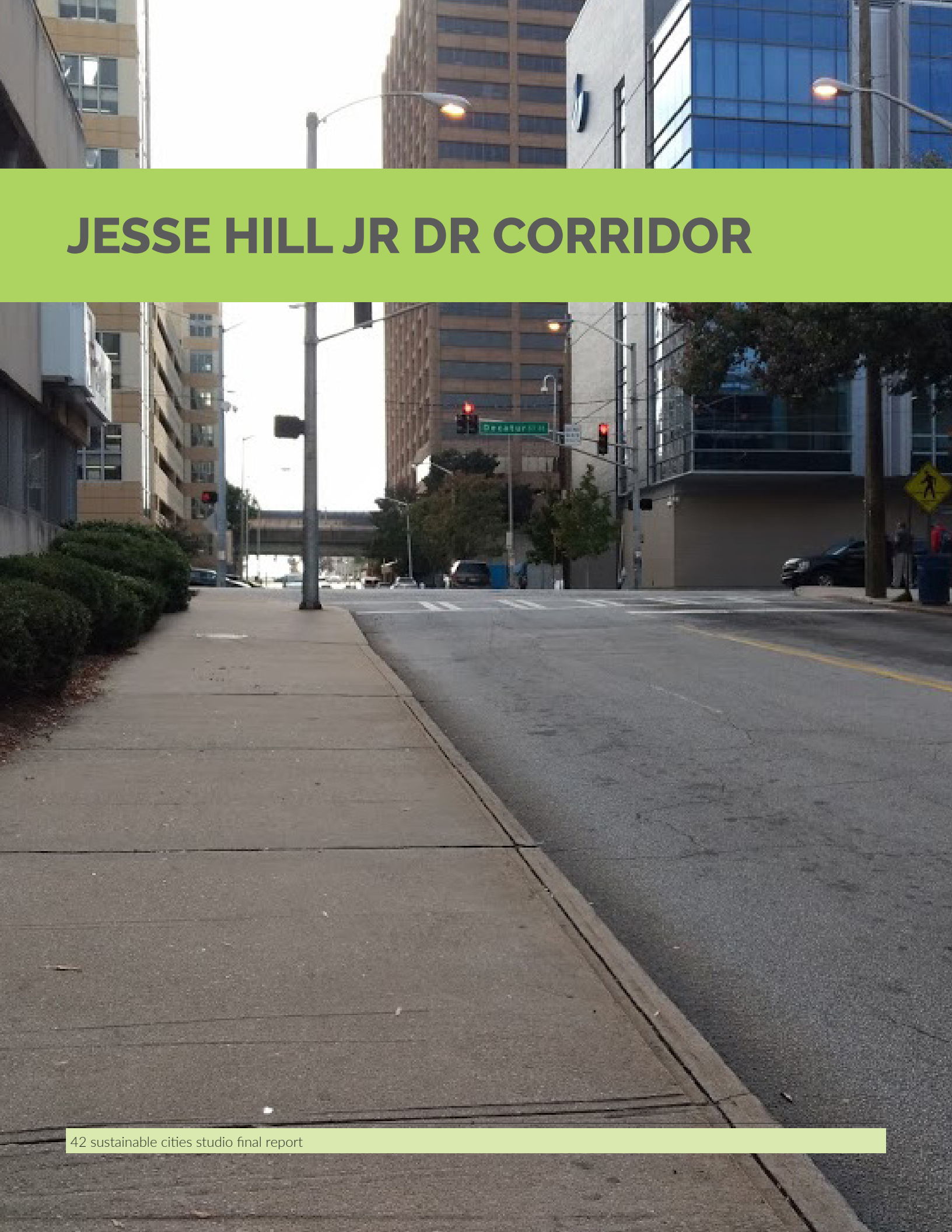
UNC Greensboro Plaza

The entrance plaza of the Leonard J. Kaplan Center for Wellness at the University of North Carolina Greensboro was built with a sustainability mindset. In order to adhere to stormwater requirements, the builders implemented large, multiple tiered bioretention cells which are essentially bioswales. The bioswales more than met the requirements for the removal of total suspended solids (85% removal) and reduced the peak runoff discharge from the developed site. Additionally, a variety of hardscape materials and vegetation were arranged to increase biodiversity and a visual appealing landscape. The site was rounded out with numerous options for public seating. All of these interventions mentioned are included in the studio's vision for the Grady Blah-za. The studio estimated the cost of the plaza's bioswales and seating to be around $170,000 with a medium length timeline required for implementation.



Estimated cost: $170,000

JESSE HILL JR DR CORRIDOR



EXISTING SITE DESCRIPTION

Jesse Hill Junior Drive is the optimum pedestrian route from the GSU MARTA Station to Grady Memorial Hospital. However, the pathway is often high in temperature, lacks interesting vegetation, and largely consists of impervious surface. Shrubs and trees line the sidewalks along Jesse Hill Jr Dr, but do little to manage on-street stormwater and fail to create a unique environment. Thus, the opportunities for improving this pathway are numerous.

INTERVENTION

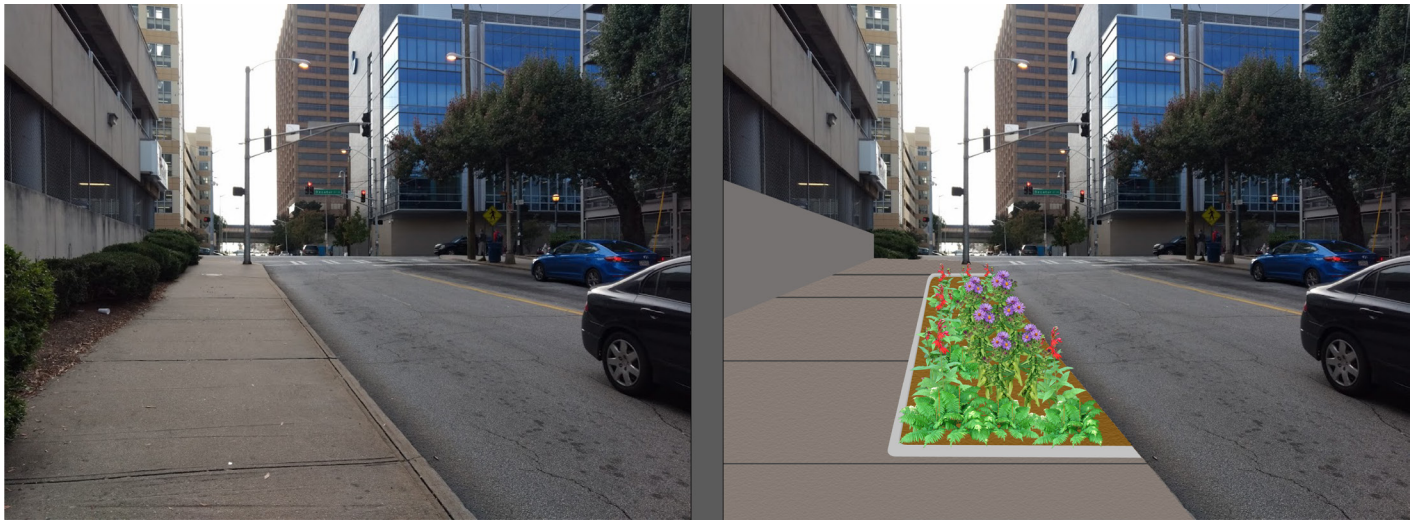
The Sustainable Cities Studio proposes that the sidewalks, shrubs, and planters of Jesse Hill Junior Drive be relocated to act as a buffer between the street and the passersby. The vegetation should be placed in bioswales to mitigate stormwater surges in addition to encouraging pedestrian use. Additionally, the studio proposes to add vegetated metal canopy structures above the sidewalks that provide greenery as well as shade for pedestrians. The improvement of pedestrian infrastructure complements the repurposing of the GSU parking deck roof and promotes alternative transportation as a more viable option for the people of Downtown

BENEFITS

By redesigning Jesse Hill Junior Drive into a more pleasurable walkway, multiple benefits will be realized.

These intervention plans will transform Jesse Hill into a connective greenway, utilizing vegetation and safety measures to connect the GSU MARTA station with the Grady Plaza. These improvements will also mitigate stormwater runoff and integrate health into the environment for the public by creating a more calming and safe path. The connective greenway of Jesse Hill ties into the overall goal of transforming Downtown into a live-work-play community.

Alley in Cyprus with grapevine-covered pergola (Etan J. Tal, 2006)



Above: a before and after rendering in which the shrubs hugging the parking deck are removed and a bioswale is installed. The bioswale contains Cardinal Flower, New England Aster, and Cinnamon Fern, and would help filter and stormwater runoff from the street.

SUMMARY

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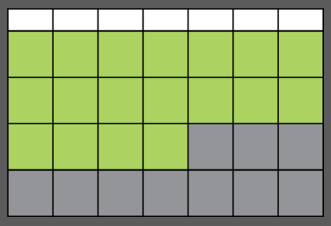


CASE STUDY

SW 12th Avenue Green Street in Portland

The SW 12th Avenue Green Street in Portland, Oregon has been transformed to sustainably manage street stormwater runoff. This “green street” project converts the previously underutilized landscape area between the sidewalk and street curb into a series of landscaped stormwater planters designed to capture, slow, cleanse, and infiltrate street runoff.

This is a comparable strategy to what the studio has proposed for Jesse Hill Jr Dr. The retrofit of SW 12th Avenue Green Street with landscaped stormwater planters cost approximately $30,000 to construct with a medium time scale for implementation.

Estimated cost: $30,000

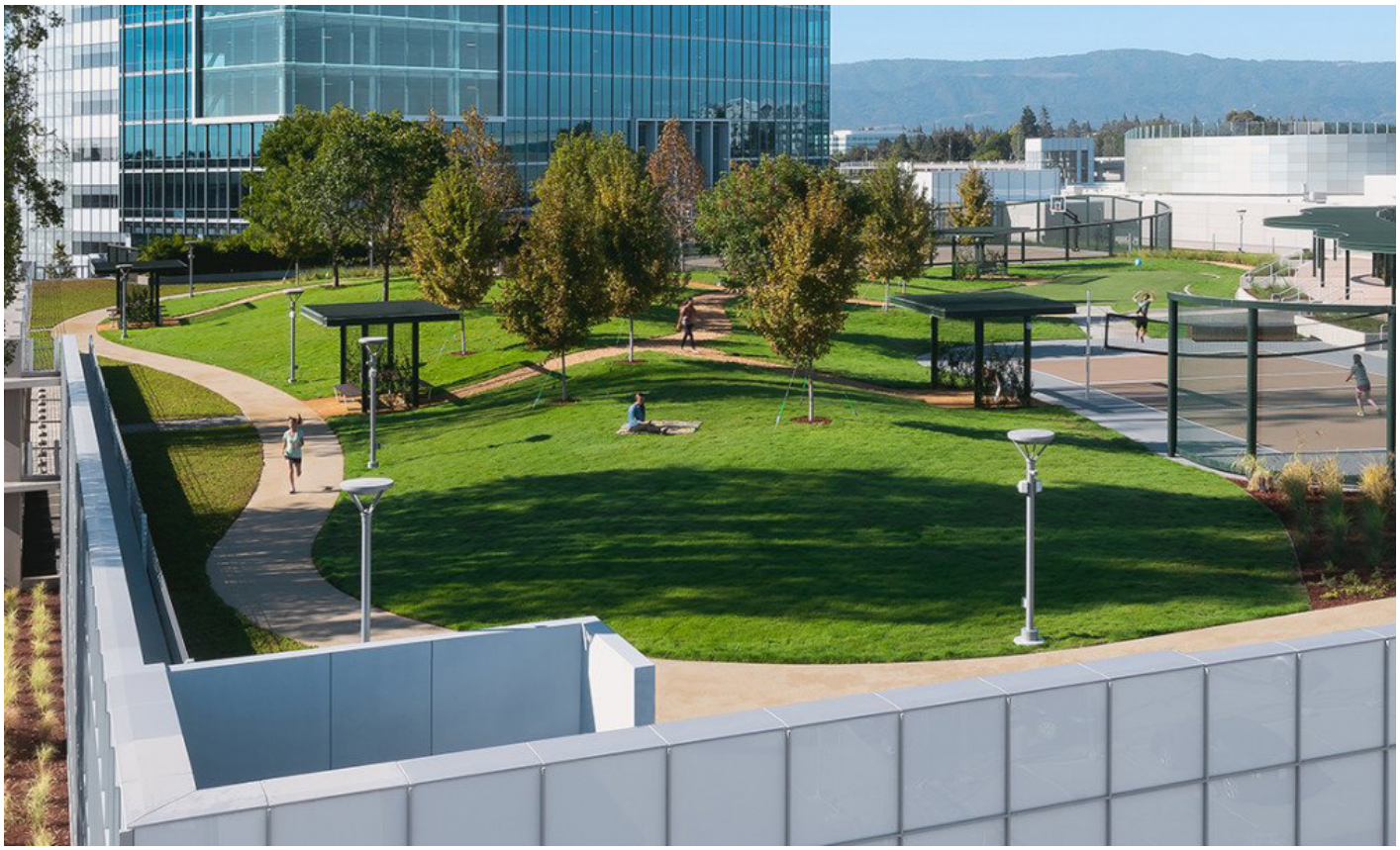
Photos by Kevin Perry, 2005

GEORGIA STATE UNIVERSITY S DECK

EXISTING SITE DESCRIPTION

The GSU Parking Deck across the street from the Grady Plaza is an underutilized space which has the capacity to be repurposed into an attractive, occupiable green roof. The parking deck is adjacent to the GSU Student Recreation Center and is accessible via a staircase which exits onto Jesse Hill Drive.

INTERVENTION



The GSU Parking Deck across the street from the Grady Plaza is an underutilized space which has the capacity to be repurposed into an attractive, occupiable green roof. The Sustainable Cities studio proposes that the space should include: planter features and trees to provide shade, improve air quality, and manage stormwater; a water cistern to reduce stormwater surges on Atlanta's sewer infrastructure; tables with benches to accommodate students and guests; lighting for night-time use; and a drivable path to allow for event activation of the space. During pleasant weather, the green roof can serve Georgia State students as one of the campus's few outdoor workspaces. Since the space is connected to Jesse Hill Drive by a gated staircase, the school can control if or when the green roof is accessible to the general public for events or otherwise.

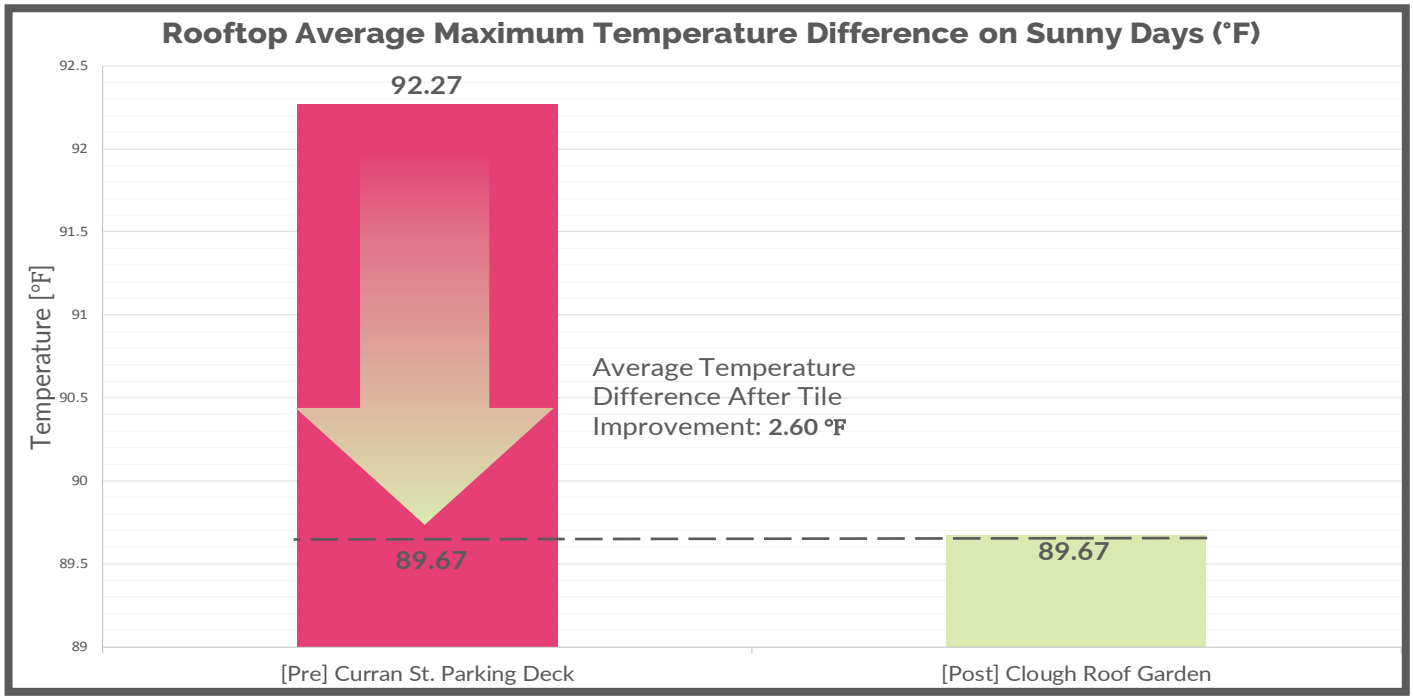
BENEFITS

The Georgia State Parking Deck has the potential to reap numerous benefits with these interventions in place. These benefits include boosting the tree canopy, promoting a live-work-play community, mitigating heat and stormwater, and integrating public health into the landscape. By planting more trees, the tree canopy will increase, shade will be increased to mitigate heat, and air quality will improve for the public. Stormwater management will be greatly improved in this area through the new vegetative features and a large-scale water harvesting system on the roof of the parking deck. During rainfall, the vegetative features and water cistern will slow and store stormwater in this location, an area that is prone to sewer backup and flooding.

Left: Moffett Place High Garden sits atop a parking deck and features recreational spaces, a community garden, and vegetation native to California (Lidija Grozdanic, 2016).

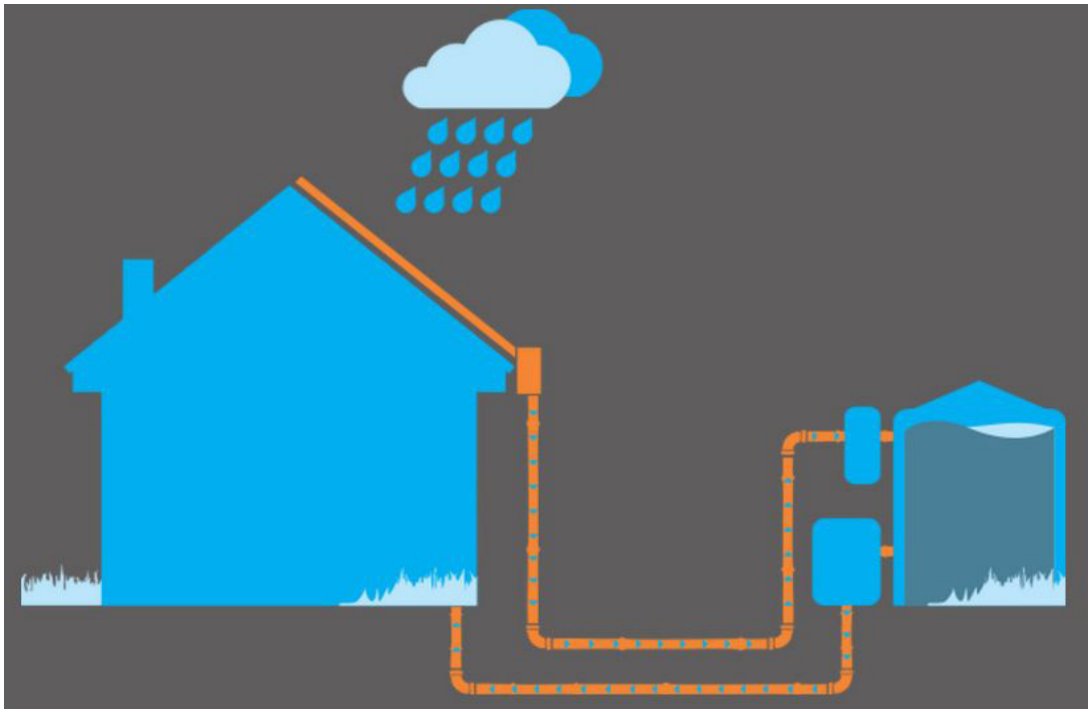
Right: currently the GSU S Parking Deck is largely unoccupied. This exhibits the potential for a better use of the space

ANALOG DATA



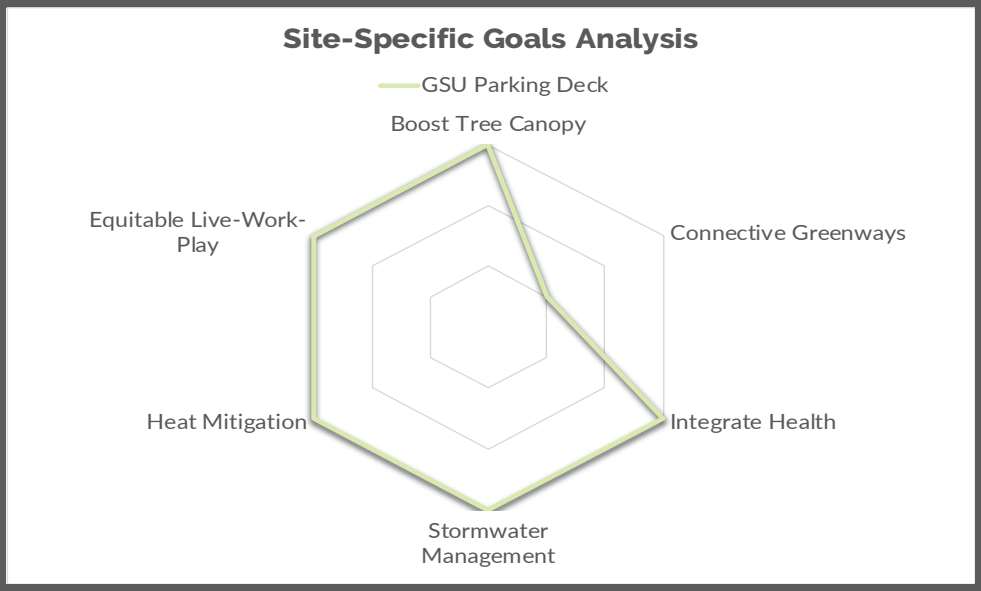
The Tech Climate Network (TCN) is a network of temperature sensors monitored by the Urban Climate Lab of Georgia Tech, which are strategically located on the Georgia Tech campus. The sensors produce temperature and relative humidity data over time at 3-meter heights to offer approximations for the human perception of temperature. Analog sites were selected from the TCN in response to the project's focus areas. Utilizing the average maximum temperature data of 'Sunny Days' from Summer 2017, a detailed temperature analysis of selected analog sites could be performed and compared to the project's focus areas with similar site types at higher temperatures.

The graph above displays the temperature difference between the highest level of Curran Street Parking deck, a standard parking deck, and the roof of Clough Undergraduate Commons, a green roof. There is a significant post intervention difference of 2.6 °F if a parking deck is transformed into a rooftop garden, indicating a similar temperature difference post intervention at the Georgia State University S Parking Deck.



Rainwater from the deck could be collected and reused by the GSU Student Recreation Center.

SUMMARY



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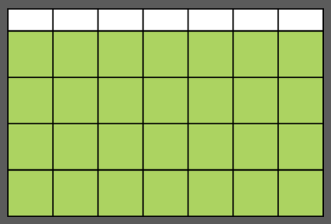


CASE STUDY

Herrity Building Parking Garage Demonstration Garden

The green roof on the Herrity Building Parking Garage in Fairfax, Virginia is a strong case study for the GSU Parking Deck intervention. The majority of the roof is an extensive green roof, and contains a 4″ soil media depth, with a variety of pathways for accessibility, along with various drought-tolerant sedum and succulent plants. The remaining square footage includes raised bed planters on two corners of the roof with new trees and perennials incorporated into the green roof system.

Although this green roof lacks substantial seating for the public as well as a water harvesting system, it still has elements that the studio suggests incorporating into the GSU parking deck. The studio estimates this green roof cost around $750,000 and it took over three years to coordinate and implement.

Estimated cost: $750,000


Fairfax County, 2007

GEORGIA STATE UNIVERSITY MARTA STATION

EXISTING SITE DESCRIPTION

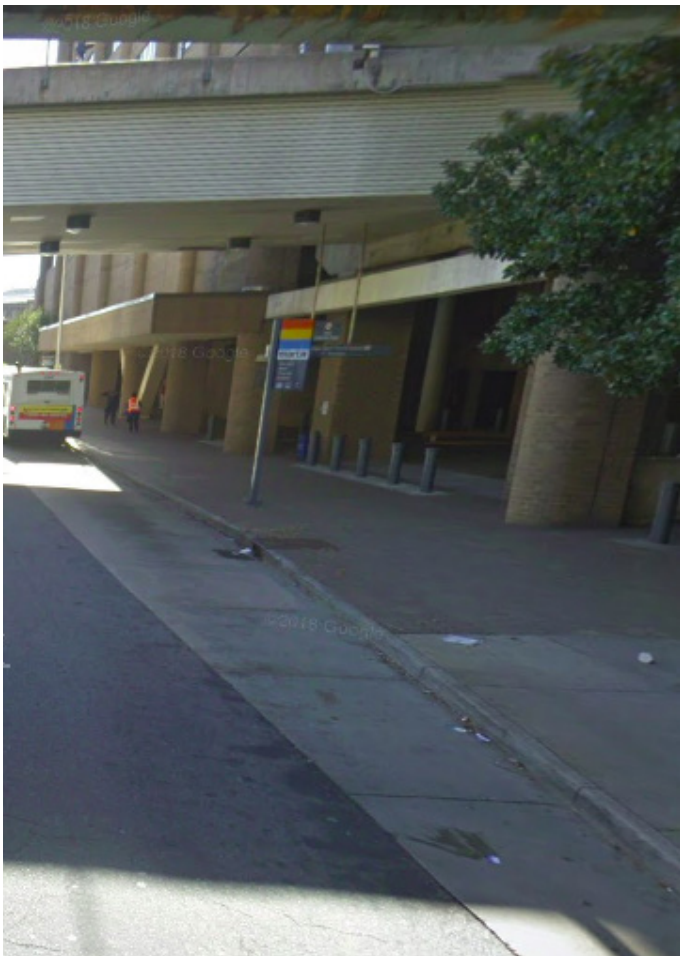
The GSU MARTA station is located a few blocks south of Grady and has the potential to serve as a significant transportation artery for Grady's visitors, hospital staff, and GSU students alike. However, the plaza outside the station does not attract passersby to use public transit.

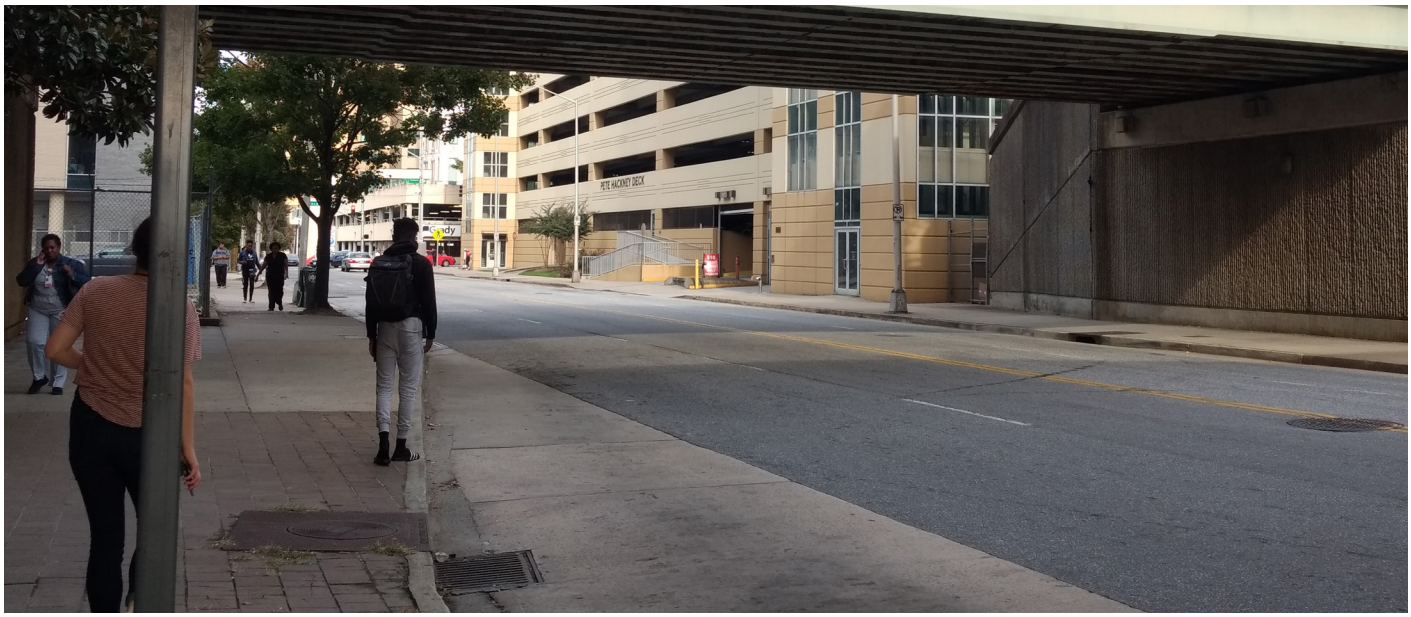
INTERVENTION

The Sustainable Cities Studio proposes that the MARTA station install an attractive moss wall with integrated lights in the shaded area under the bridge, as well as cement seating structures and planters to replace the station's bollards.

BENEFITS

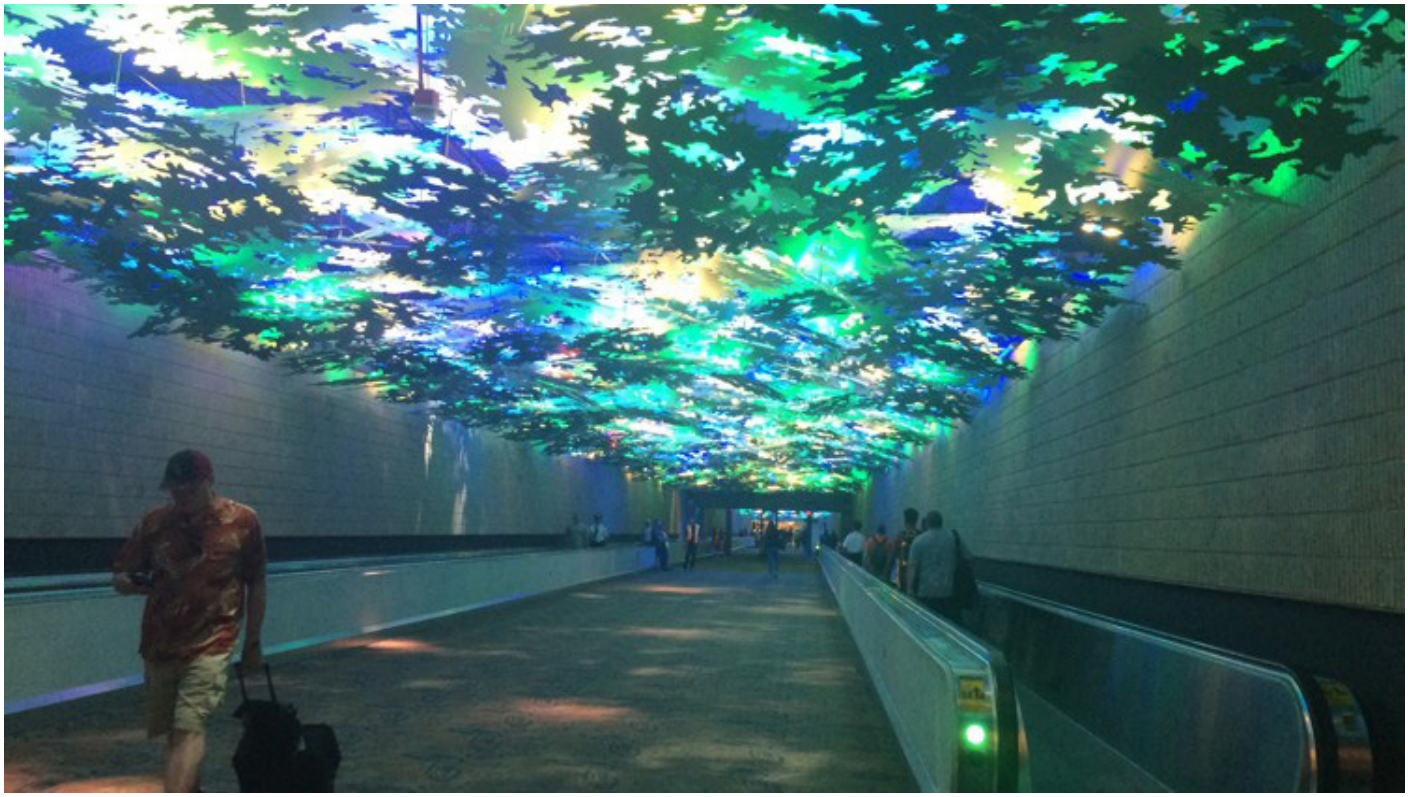
By implementing these simple interventions, the Georgia State Marta Station can be redesigned into a welcoming entrance to public transit that provides many benefits to the public. The visually-appealing seating and greenery will integrate health by creating a calming environment as well as places for the public to seat. By adding greenery, the outside of the transit station will be an extended connective greenway between public transit and Jesse Hill Jr Dr. Finally, by providing more seating and public activation, the MARTA station will be adding to Downtown's narrative of being a live-work-play community.



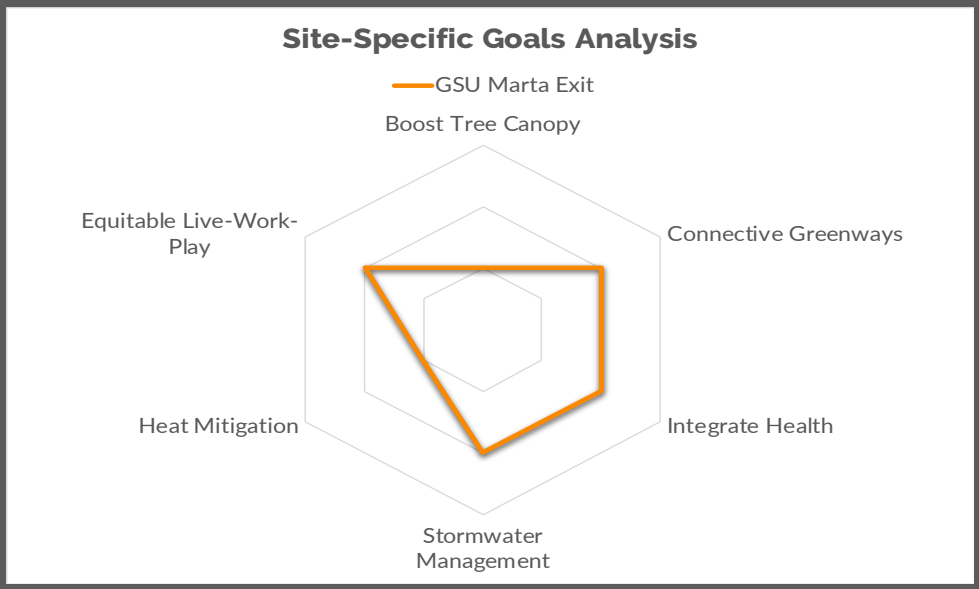


Above: Seating integrated around tree planters can add a natural and inviting feel to any plaza while improving the surrounding air quality (Streetlife).

Top right: Hartsfield Jackson International Airport's rainforest art installation inspired the idea of lights complementing a moss wall (Kelly Yamanouchi, 2016).



SUMMARY


Site-Specific Goals Analysis
GSU Marta Exit
Boost Tree Canopy
Connective Greenways
Integrate Health
Stormwater Management
Heat Mitigation
Equitable Live-Work-Play

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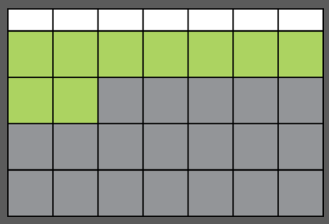


CASE STUDY

Five Points Marta Station Makeover

The Five Points Marta Station Makeover is an excellent case study for the interventions mentioned for the GSU Marta Station since it stems from the same public transit service in Atlanta. This makeover at Five Points included: adding wayfinding signage, station soccer, a community garden, station area art, and lighting. Although this was a more intense intervention, many of our ideas stemmed from this makeover (namely, the wayfinding signage, lighting, and station area art). The Five Points Marta Station Makeover cost $100,000 to complete and is estimated to have taken about a year to complete.

Estimated cost: $100,000

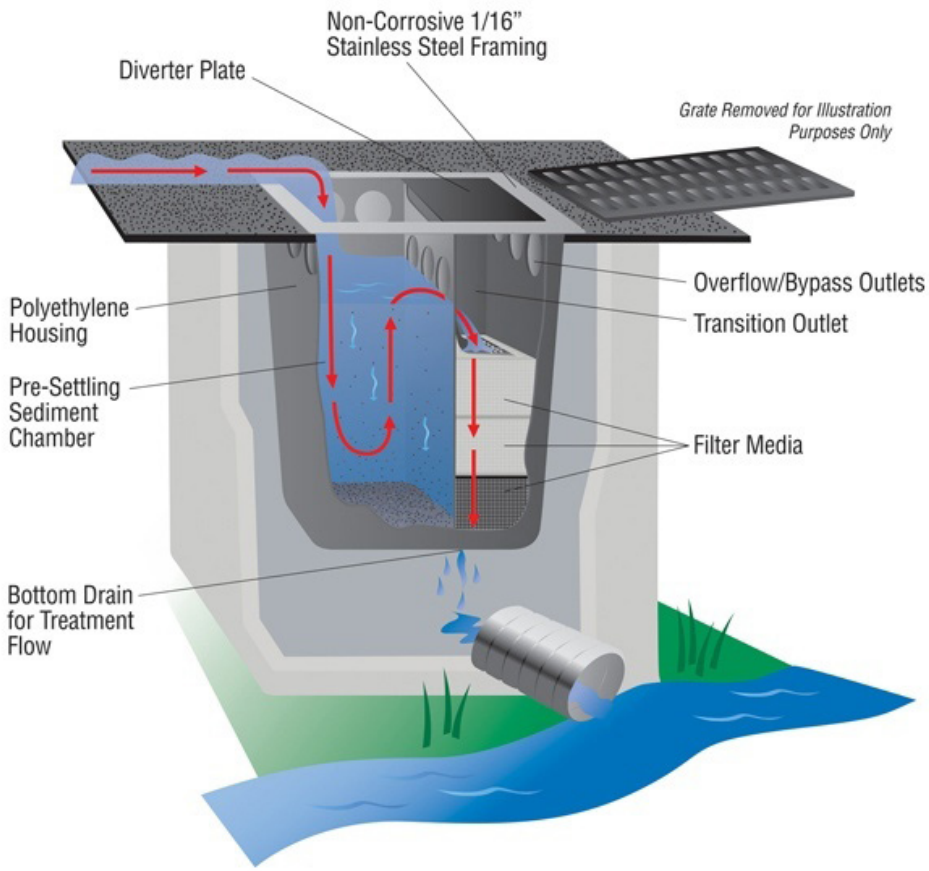

Foot Locker
stationsoccer

GWCC Parking Lot

EXISTING SITE DESCRIPTION

The Georgia World Congress Center parking lot has been identified as a problem area with regards to stormwater management. The large asphalt lot is itself the runoff destination to the surrounding impervious surfaces. Adjacent neighborhoods downhill from the lot experience stormwater surges which affect their water quality. Future construction immediately north of the lot will remove even more water-soluble acreage.

INTERVENTION

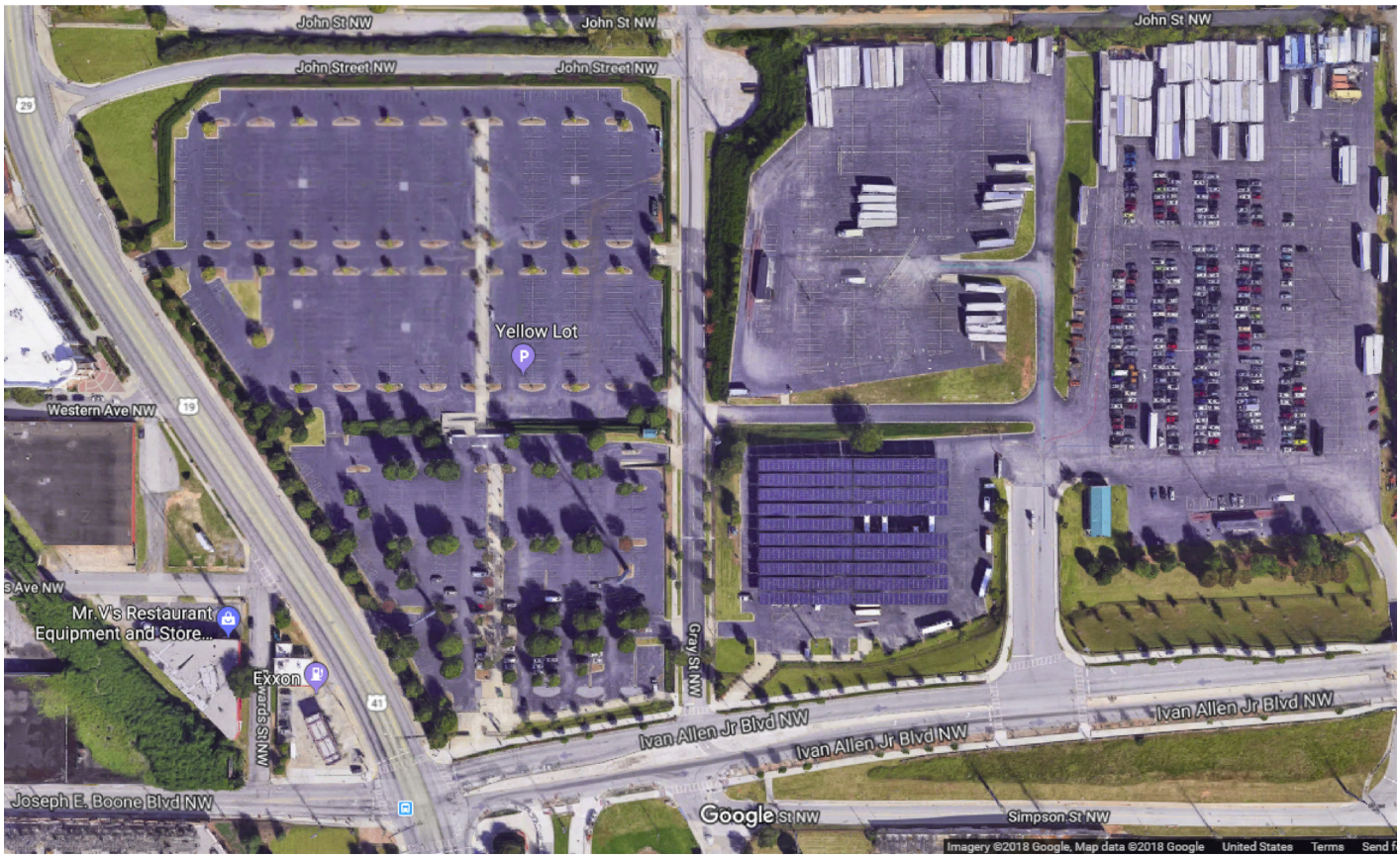


The studio suggests adding storm drain filters to prevent oil and litter from causing blockages in the existing drainage system. The initial design was to implement permeable pavement, underground water storage tanks, and an attractive wetlands feature which would hold and filter a significant amount of stormwater while providing a habitat for native fauna. However, the studio was notified that the property is built atop a sealed landfill which prevents invasive intervention at the site. Preventing sewer backup is important, but further recommendations may be required to further address the stormwater issues in this area.

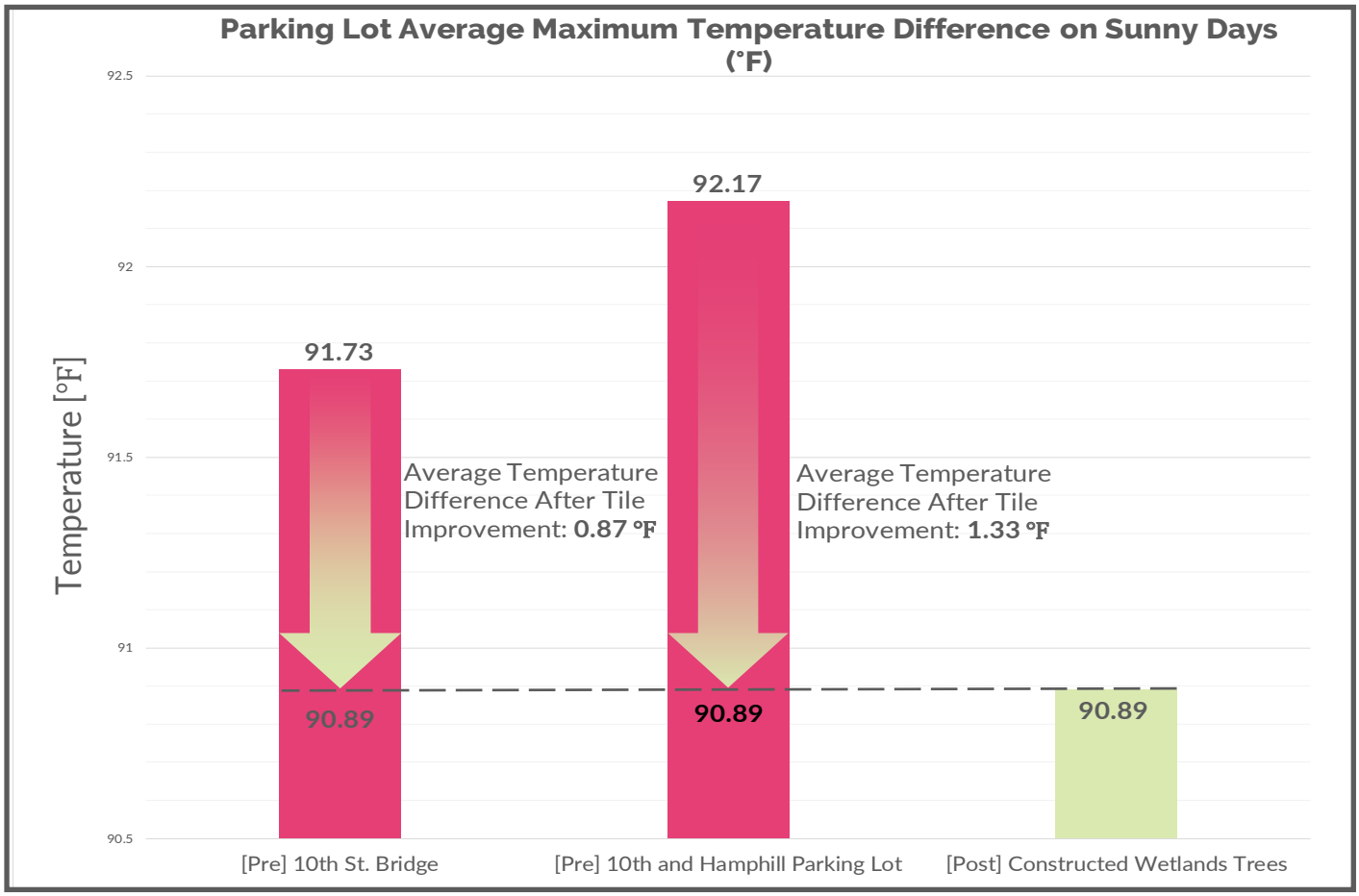
BENEFITS

Despite the restrictions on intervention opportunities, the Georgia World Congress Center still has the potential to realize several benefits with these new interventions in place. Storm drain filters will improve stormwater management by filtering the water before it enters the city's water system. Boosting the tree canopy with elevated tree boxes will help with heat mitigation. These changes will integrate health into the parking region by decreasing stormwater runoff and enhancing the currently lacking visual appeal.

Below: a top-down view of the GWCC parking lots, courtesy of Google Maps.



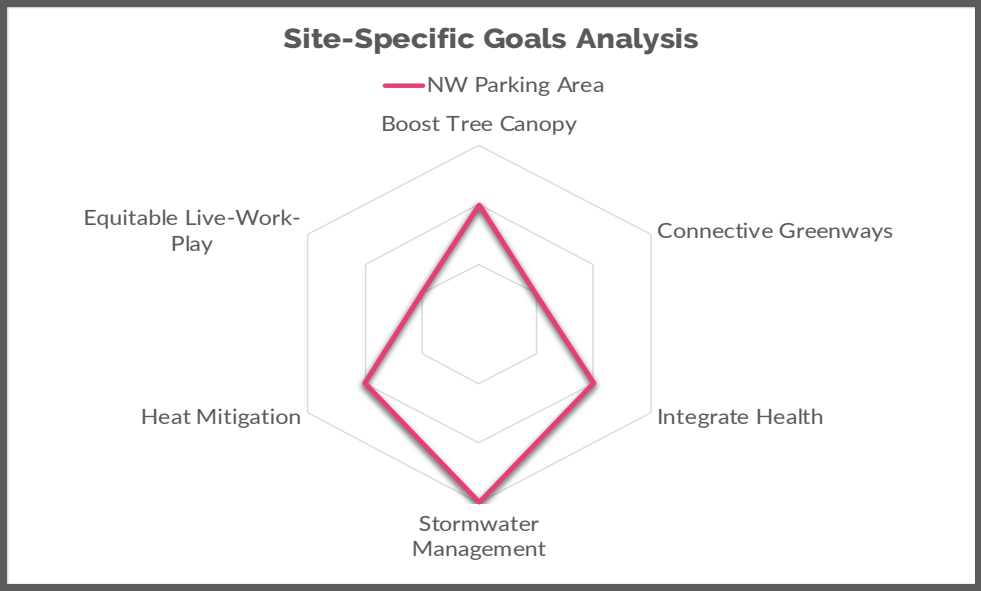
ANALOG DATA



The graph above displays the temperature difference between 10th Street Bridge, a bridge with lots of traffic but lined with greenspace and trees, 10th and Hemphill parking lot, a parking lot near a utilized road with few surrounding trees, and Constructed Wetlands Trees set back from a major road. This change is intended to indicate the post intervention ambient temperature difference aht the Georgia World Congress Center Parking Lots, varying from 0.87 to 1.33 °F based on the type of intervention.

Top right: installing additional tree canopy in a parking lot can provide shade for visitors while mitigating the urban heat island effect.

SUMMARY


Site-Specific Goals Analysis
NW Parking Area
Boost Tree Canopy
Connective Greenways
Integrate Health
Stormwater Management
Heat Mitigation
Equitable Live-Work-Play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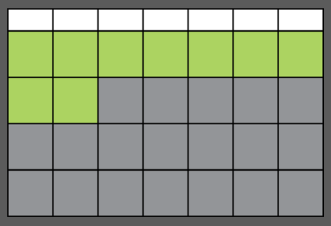


CASE STUDY

The Morton Arboretum Permeable Main Parking Lot

The Morton Arboretum Permeable Main Parking Lot case study in Lisle, Illinois replaced a former degraded retention pond and asphalt parking lot with a functioning wetland system and permeable lot. Due to the restrictions the Georgia World Congress Center Parking Lot site has with the landfill underneath, some of the interventions in this case study are no longer feasible.

However, it is still notable to mention their usage of storm drain filters to prevent oil and litter from causing blockages in the existing drainage system. The cost of these filters is estimated at $10,000 and has a low time scale for implementation.

Estimated cost: $10,000

Above and below: Photos of the Morton Arboretum Main Parking Lot before and after the redesign.

CONCLUSION

The Sustainable Cities studio proposes several interventions for the two specified intervention regions. There are many co-benefits to the interventions proposed, as illustrated above (in full spider chart). By implementing all interventions mentioned, all six of our studio's goals can be achieved in an extremely impact manner, which will further CAP's mission to implement the Downtown Atlanta Master Plan.

CH. 4: NEXT STEPS

Summary

This studio brought together an interdisciplinary team of students to collaborate on a green infrastructure plan for Downtown Atlanta for their partner, CAP. The studio pursued CAP's chapter 5 goals and their own studio goals of heat, stormwater, and equity issues. To complete the strategy suitability and intervention recommendations for the project, the instructors separated the students into three teams to focus on public engagement and communication, engineering and design, and science and technology.

To pursue the development of the intervention recommendations, the studio developed a tool to show why stakeholders may be motivated to support these changes. These motivations are benefits stakeholders will receive from these recommendations. Increasing awareness of these benefits will provide the opportunity for

Stakeholder	Relationship to Site	Motivation
Parcel Owner	Own the land	To attract more business, to make customers happy
Local Government	Have a say in what happens on the land. Own the public land. Public health	To make voters happy, public health, welfare
Developer	Will be making changes suggested, will incur costs	Will get business. Reduce utility costs
Workers	Use the area the every weekday	Use area every day, want a welcoming environment, shopping
Residents	Use the area the most	Use area every day, want a welcoming environment, shopping
Visitors	Visits occasionally, provides financial investments	Want a welcoming environment, shopping, landmarks

stakeholders to champion these interventions which will more easily enable CAP to pursue the development of these interventions. The table below details each potential stakeholder, an explanation of their relationship to the site, and motivations to entice the stakeholder to support these intervention projects.

Site and Strategy Suitability Phase

The **Public Engagement and Communications** team collected data from surveys and conversations at Atlanta Streets Alive. They also aggregated relevant public engagement data from CAP's Open House events leading up to the Downtown Master Plan.

The **Engineering and Design** team researched and put together a Best Practices Spreadsheet and created a Decision-Making Flowchart to determine how input from each team would contribute to final product.

The **Science and Technology** team created suitability analyses that utilize stormwater management and urban heat considerations. The team also collected ambient temperature data with a black globe sensor that replicates a human experience.

Intervention Phase

The **Public Engagement and Communications** team informed the Engineering and Design team about the equitable live-work-play quality of their intervention recommendations.

The **Engineering and Design** team developed intervention recommendations based on their Decision-Making Flowchart tool, Best Practices Spreadsheet, and data from the other teams.

The **Science and Technology** team informed the Engineering and Design team about the heat mitigation and stormwater management quality of intervention recommendations.

The studio created a venn diagram to explain how the tools and implementation strategies developed by each team and their application to the efforts of the other teams and the studio as a whole can be improved. If Central Atlanta Progress were to continue to provide intervention in other high risk areas, the individual sections of the venn diagram will provide recommendations for how each tool can be better applied, while also considering their existing limitations. Each individual and overlapping portion of the diagram serves to provide a recommendation for how the tools can better support individual teams or combined efforts for achieving success in wider applications of green infrastructure in future work.

To briefly explain how each team's tools should be enhanced, the Public Engagement and Communication team's individual engagement practices could provide better context for what is considered downtown. Through the engagement process, respondents highlighted a number of sites as perceived to be high risk that were not chosen as final sites for this studio, so future interventions could begin at those locations.

For Science & Technology, the suitability maps have highlighted other high risk sites that should be considered for intervention. Additionally, further temperature analyses and observations at the sites throughout the year would provide a better sense of which other sites should be intervention priorities. Engineering and Design should expand their chart creation with respect to specific locations and the effectiveness and feasibility of interventions with regard to the surrounding built environment.
The Science & Technology and Engineering & Design tools should be used to highlight if and which interventions can be applied on, Downtown-wide scale. Public Engagement and Communication should use Science and Technology's identification of high risk sites as the next places to do engagement, particularly at high traffic times of day. With a more detailed explanation of intervention possibilities, Public Engagement and Communication should use Engineering and Design's evaluated interventions to explain and ask the public what they perceive would provide the most comfort and aesthetic pleasure. Together, all tools should be tweaked to mitigate uncertainty in their application of effective and efficient green infrastructure oriented recommendations.

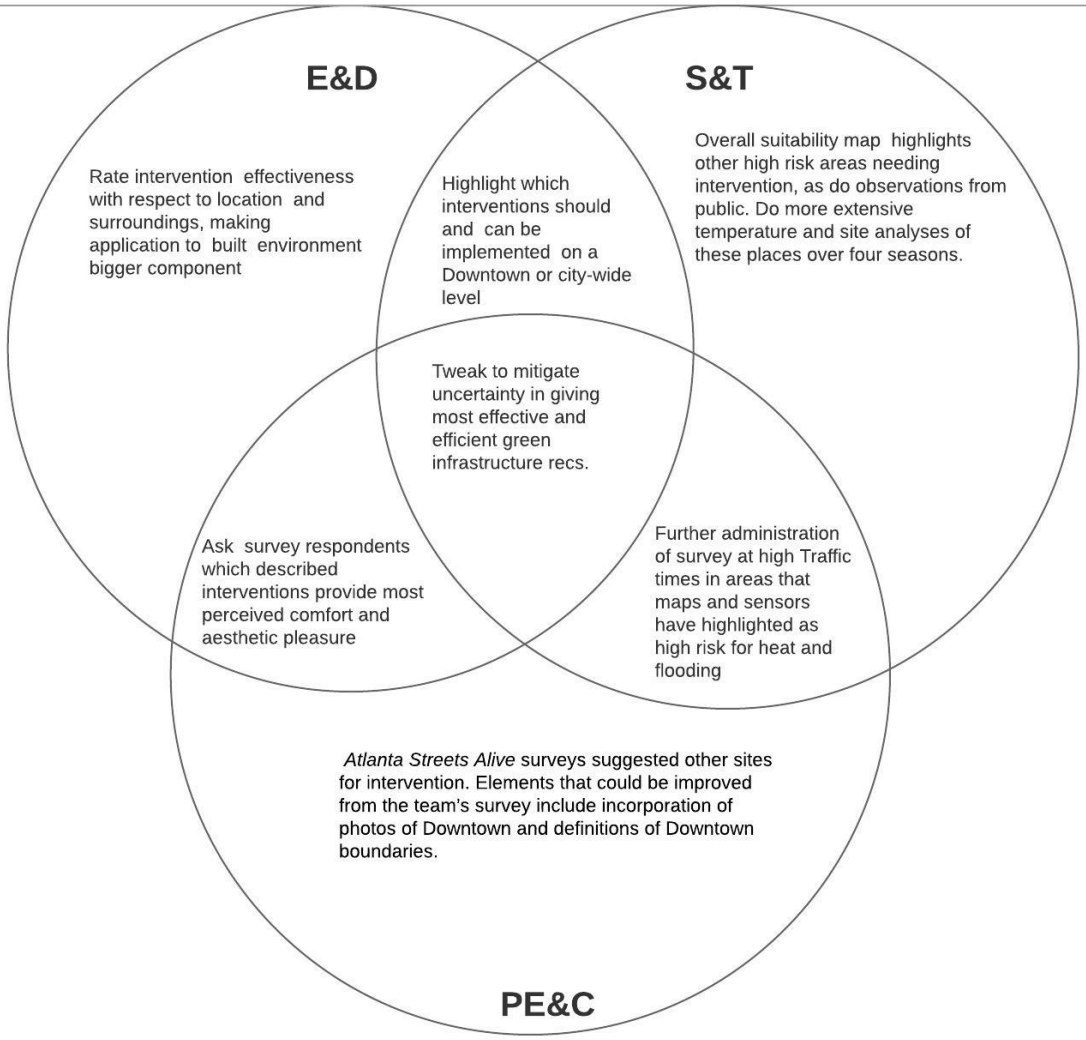
Next Steps

In addition to sharing intervention recommendations with CAP, this studio hopes to share the tools and strategies discovered to be effective for the process of redeveloping sites using green infrastructure practices. In the beginning of the studio, students were split into teams focused on concerns of public input, environmental hazards, and engineering design. The spider charts

and the Decision-Making Flowchart helped the studio incorporate these elements into every decision made from strategy suitability to intervention. Such incorporation enabled the studio to discover solutions that affect both factors of environment and people sufficiently. As the climate changes and the population of the city embraces tremendous growth, these two factors will be more and more important. Ingraining them into the decision making process from the beginning, the studio found, tackles such concerns effectively.

We hope CAP can benefit from the studio's spider charts and Decision-Making Flowchart. In addition, the suitability analysis map and black globe sensor data can be useful for future projects. The suitability map shows areas around the entire Downtown area that are mpacted by the urban heat island effect and stormwater runoff. Finally, the black globe sensor data can inform how temperature is felt on the human scale.

HOW TO BETTER MODIFY OR INCORPORATE TOOLS FOR FUTURE WORK



Appendices

APPENDIX I

Initial Investment Estimates for Site Interventions Based on Other Work

	Case Study				
Site	Name	Link	Costs	Cost Level ($-$$$)	Time Scale of Intervention (Low-High)
Grady Blah-za	UNC Greensboro Plaza	http://landscapeonline.com/articles/setting-the-tone/29843	100 ft * 100 ft * $17/sq ft = $170,000	$$	Medium
GSU Parking Deck	Virginia Herrity Green Roof	http://www.greenroofs.com/projects/herrity-building-parking-garage-demonstration-garden/	$30/sq ft * 350 sq ft/space * 72 spaces = $756,000	$$$	High
Jesse Hill Jr Dr	Portland Green Street Project	https://www.asla.org/awards/2006/06winners/341.html	$30,000	$	Medium
GSU Marta Exit	Five Points Marta Makeover	https://www.ida-downtown.org/eweb/docs/2017Awards/2017_CAP_MARTAMakeover_Summary.pdf	$100,000	$$	Low
NW Parking Area	Morton Arboretum Parking	https://www.landscapeperformance.org/case-study-briefs/morton-arboretum-meadow-lake-parking	$10,000	$	Low

APPENDIX II

Below is the survey that Public Engagement and Communication gave out at September Atlanta Streets Alive, to note a general public perception of big issues in downtown and locations with unbearable heat and flooding.

1. How often do you visit downtown?
    a. A few times a year
    b. Once a month
    c. Few times a month
    d. Every week
    e. Multiple times a week
    f. All the time, I live here.

2. When i say 'unbearable heat' Is there an area or street corner in downtown Atlanta that comes to mind?

3. When i say 'unbearable flooding' is there an area or street corner in downtown Atlanta that comes to mind?

4. Which area in downtown do you think needs the most overall improvement?

A. Underground	D. South Downtown	F. Luckie/Marietta
B. Peachtree Center	E. Surrounding Connector	G. Fairlie Poplar
C. Other _____		

5. What creates the most discomfort for you as you move around downtown?

6. Rank the following based on how important they are to your experience with downtown mobility (1 being most, 4 being least)
    flood prevention____
    bike lanes ____
    better sidewalks/crosswalks _____
    More nature for aesthetic purposes _____
    More nature for shading purposes _____

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