GREEN INFRASTUCTURE CONCEPTUAL PLAN FOR THE ATLANTA UNIVERSITY CENTER (CATCHMENT ONE)

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Table of Contents

Introduction

This conceptual plan concentrates on the western part of the Clark Atlanta University (CAU) campus, plus a few small areas of Morehouse College, and parts of the community surrounding the Atlanta University Center (AUC) to constitute Catchment # 1. Boundaries of the catchment must extend beyond CAU campus boundaries to include all of the watershed that drains stormwater onto the CAU campus. Catchment #1 is divided into Zones for planning purposes -- Zones A, B, C, D -- which are depicted on the map below. The goal of this catchment analysis is to capture approximately 8.0 million gallons of stormwater during a 100-year rain event. This goal aligns with the overall goal which is a developing a comprehensive conceptual plan that will potentially capture 22.4 million gallons of stormwater from the AUC institutions including Clark Atlanta University, Spelman College, Morris Brown College, the Interdenominational Theological Center (ITC), and the Atlanta Housing Authority.

Background

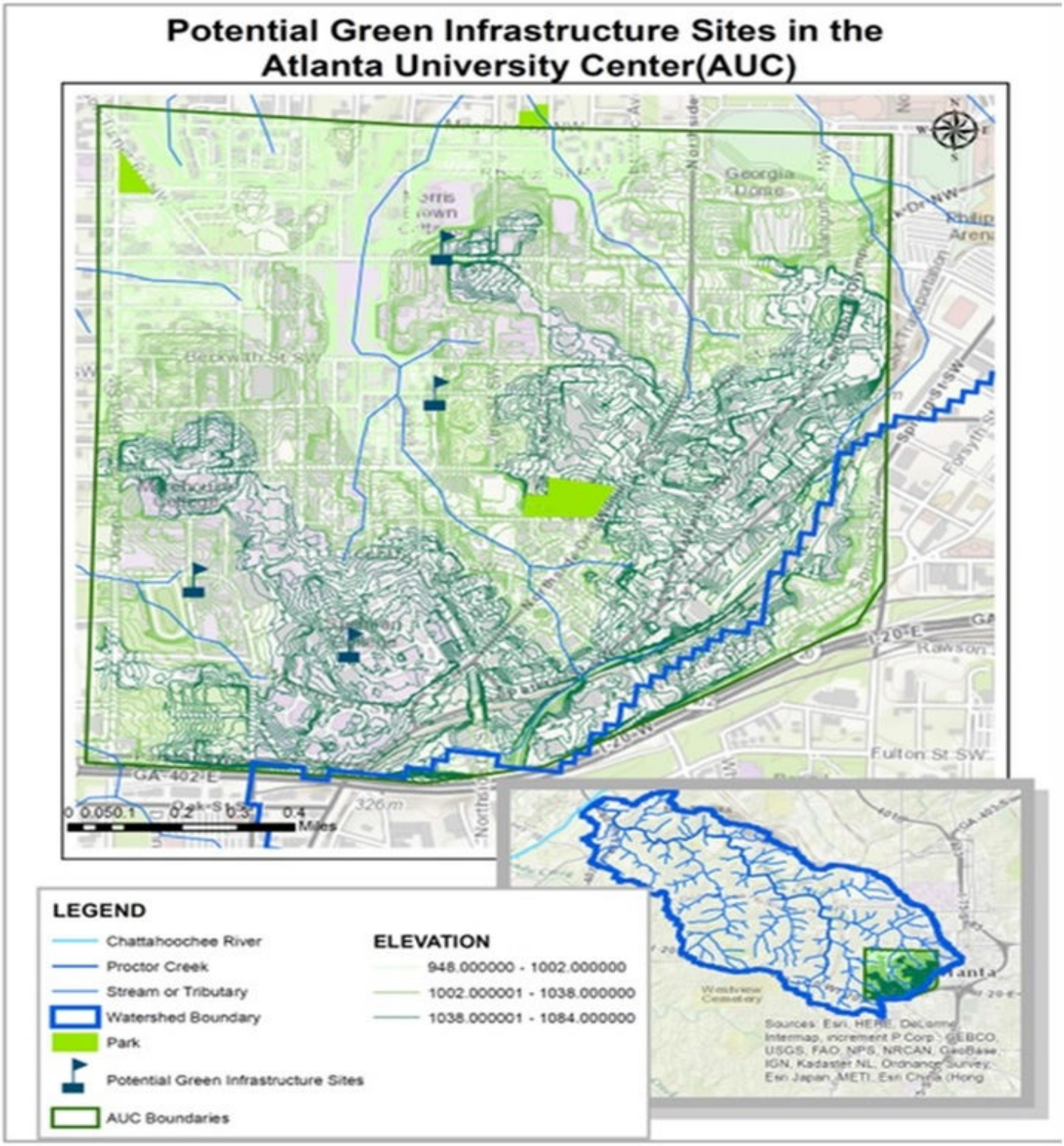
United States metropolitan areas have experienced enormous population and economic growth within the last century. Infrastructure was originally designed to collect precipitation and convey it out of the watershed, typically via existing surface water channels such as streams and rivers. Roads, sidewalks, parking lots, commercial and residential structures were added during land development and have continually made this infrastructure inadequate (Gobel, Dierkes, and Coldewey, 2007). The rapid expansion in the oldest part of U.S. urban areas led to placing these surface water channels in a network of underground pipes, known as combined sewer systems, that was designed to keep streets dry by collecting the storm runoff as well as domestic sewage. However, during major rain events stormwater overloads these aged sewer systems causing the mixed sewage and stormwater runoff to discharge into waterways. Combined sewage systems adversely impact several inner city areas in Atlanta.

One Atlanta area affected by this massive amount of combined sewage runoff is the Proctor Creek/North Avenue Watershed. Proctor Creek is a waterway that originates in downtown Atlanta. The communities surrounding Proctor Creek suffer from public health threats related to flooding and disease causing organisms such as viruses, bacteria, and protozoa, released during sewer overflow discharges, especially the communities at lower elevations. Affected communities include English Avenue, Vine City, Mozley Park, West Highlands, Grove Park, Center Hill Park, Carey Park and Bankhead neighborhoods, and many others.

The Atlanta University Center is at higher elevation than most of the communities in the Proctor Creek Watershed. Therefore, it has the potential to mitigate the amount of stormwater runoff that impacts lower elevation neighborhoods by implementing Green Infrastructure

throughout the AUC. For this reason, it is necessary to develop Green Infrastructure, which can capture this runoff with cisterns, ephemeral streams, and floodplains.

The topographical map below is based on studies performed by Georgia State University to help locate green infrastructure at the Atlanta University Center campuses.



The GSU study was based on 2ft interval elevations, but we show 10 ft. interval elevations in this map. The markers indicate institutions such as Spelman College, Clark Atlanta University, Morris Brown College, Interdenominational Theological Center (ITC), the Atlanta Housing Authority and the communities that surround these campuses.

Green Infrastructure is a more suitable than the controversial alternative such as developing separate water runoff and sewer systems. Stormwater runoff can be retained in cisterns for re-use and detained on floodplains thus not overloading the sewer system. In addition, stormwater detention floodplains can serve as recreation space, add a beautiful amenity to the community, and to a limited extent infiltrate into the ground.

Field Work

In the preliminary stages of our research, we did an extensive walkthrough of our study area, Catchment #1, to survey the landscape topography and to determine the expected flow patterns of stormwater runoff. We then began working with Clark Atlanta's Facilities Management because almost all of our Catchment is on Clark Atlanta's Campus. We worked directly with the CAU Facilities Project and Utilities Manager who was able to provide us with underground electrical lines and combined sewer lines. We conducted several additional walkthroughs to better assess the land within our catchment and to investigate areas that were not well detailed on our collected maps. Furthermore, we noted areas that would be best suited for Green Infrastructure construction.

Since our catchment was relatively large we determined it would be best to place large cisterns to serve those areas prone to flooding. We identified five potential cistern sites, two of the sites were located in Zone A of our Catchment; we identified two areas which experienced major flooding, CAUs Sacred Grass and CAU's Freshman Quad. We identified another location

to place a double cistern in Zone B beneath CAU President's Parking Lot, an ideal place to capture stormwater before it flows to lower elevation near the CAU Parking Deck and Lawshe Street. The fourth cistern is located in Zone C near or in the AUC Robert W. Woodruff Library's Greenspace which already captures some water in its rain garden; we propose to increase its potential rain water storage capacity by placing a cistern in this space. Finally, our fifth cistern site is behind Ware Hall's parking lot at its far northern extremity.

We also recommend adding a recreational park/floodplain next to CAU's Parking Deck and The CAU Student Center, the stretch of vacant green area next to the Rush Memorial Congregational Church and down to Lawshe Street in Zone B. This recreational park would include a small stormwater retention pond for aesthetic reasons.

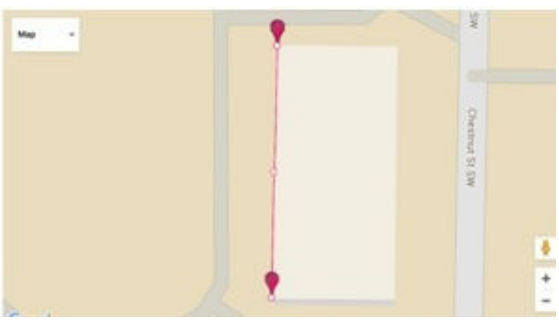
In addition, we recommend development of an ephemeral stream running alongside Lawshe St. (the street east of CAU's Parking Deck) to divert the very largest stormwater flows, perhaps 100-year flows, in order to keep them from flooding campus buildings and the Atlanta Housing Authority Property. This ephemeral stream would run to the stadium and then drain into a floodplain north of Martin Luther King Jr. Dr. SW on the old Morris Brown Campus (see Sunset Avenue Greenway Conceptual Plan). This is another example of the need for all stakeholders to collaborate to mitigate the flooding of lower elevation residential communities with combined sewage. Another collaboration would allow excess stormwater from ITC to flow via an ephemeral stream behind CAU's baseball field to the Sunset Avenue Greenway.

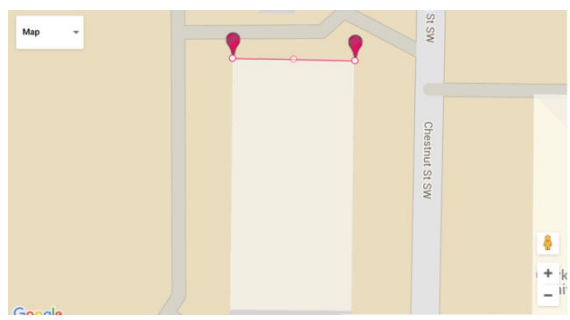
Overall we chose the following solutions for capturing stormwater: **6 major cisterns, 6 greenways (recreational parks and rain gardens), 2 ephemeral streams, 2 culverts, and a berm and swale combination.**

Methodology

Our methodology for determining the amount of stormwater we wanted to capture began with calculating the surface areas of the impervious surfaces such as buildings, parking lots/decks, roads, and walkways, e.g. The Promenade. For example, using DaftLogic.com, we were able to identify individual impervious areas in Catchment # 1 on Google Maps and place "pins" to find the lengths and widths of each space. Then, we populated an Excel spreadsheet for each designated runoff collection area, noting the dimensions, calculating the surface areas and acres, and determining the storage for each selected rain-event (10, 25, 100-year).

To illustrate, DaftLogic.com was used to find the dimensions of each building and greenspace on campus. The following images displays how Daft Logic can be used:





Calculations

The following calculation was used to find the surface areas of each space :

$$(length\ x\ width) = area\ in\ square\ feet.$$

To calculate the acres for each area, we used the following equations:

$$Acres = \frac{calculated\ area\ in\ sq\ ft}{43{,}560 \frac{sq\ ft}{acre}}$$

Then, we determined the volume of precipitation that falls during any given rain event using the following equation as an intermediate step for determining gallons:

$$Acre\ Ft(1\ ft.deep\ with\ storm\ water\ runoff) = \left(\frac{acres\ x\ rain\ water\ event(inches)}{12\frac{inches}{ft}}\right)$$

Finally we converted acre ft. to gallons as follows:

$$Gallons = acre\ feet\ x\ 325{,}000\ \frac{gals}{per\ acre\ ft}$$

To determine the amount of rainfall that occurs for each rain event, we used the data from the Green Infrastructure Conceptual Plan for Spelman College. The rain gauge that recorded the following rain events has been located in Newnam, Georgia since 1891. Dr. Dhakal, an Associate Professor of Environmental and Health Sciences Programs at Spelman College, provided the following data for each rain event:

Rain Event (years)	**Precipitation (inches)**
2	3.15
5	4.15
10	4.81
25	5.65
50	6.26
100	6.87

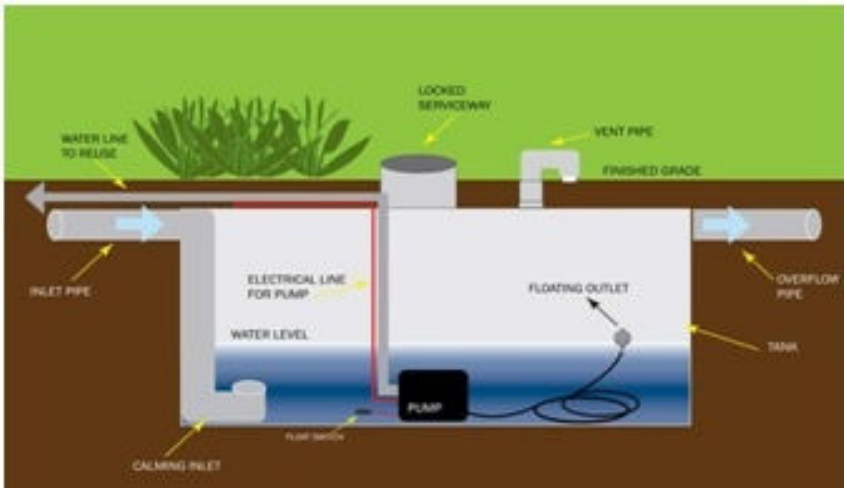
Source: USHCN (United States Historical Climatological Network)

From there, we calculated capacities by distinguishing which buildings' runoff would go to each cistern and then computed the necessary storage for each cistern.

Green Infrastructure Conceptual Plan

There were several different types of green infrastructure used to develop this conceptual plan such as cisterns, an ephemeral streams, culverts and a berm and swale combination. All of these types of structures serve a unique role in capturing stormwater and fit best in particular zones of our catchment.

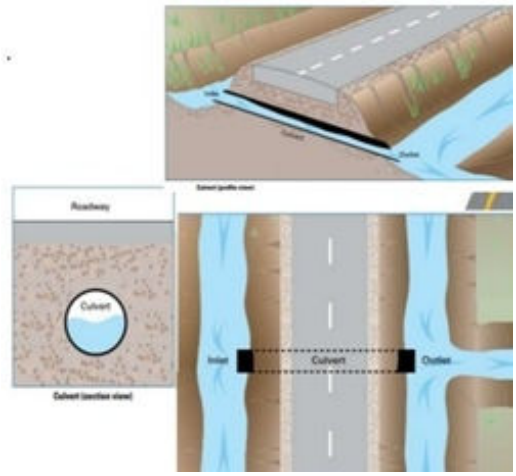
A **cistern** is an underground storage tank that is used to capture rainwater or stormwater runoff from impervious surfaces. Cisterns come in various shapes and sizes, see the image below to see an example of the type of cistern we proposed to have in our conceptual plan:



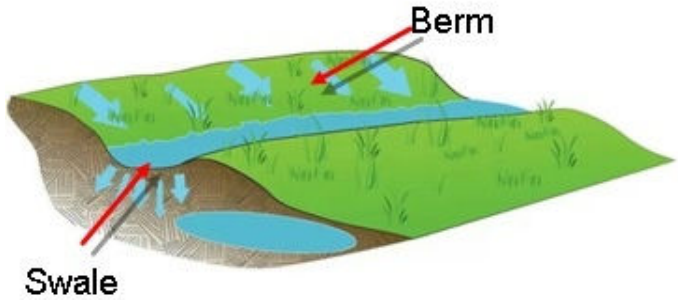
A **greenway** is a play space recreation area that does double duty as a floodplain to occasionally capture and temporarily detain stormwater runoff, only during major rain events such as the 25-year to 100- year rain events. See image next page.

An **ephemeral stream** is a stream that flows only briefly during and following a period of rainfall in the immediate locality. The stream fills up during intense rainfall or rain events exceeding the 25-year rain event with excess stormwater. The illustration below depicts an embossed concrete roadway that acts as an ephemeral stream in the 100-year rain event.

A **culvert** is a structure that allows water to flow under a road, railroad, trail, or similar obstruction from one side to the other side. It may be made from a pipe, reinforced concrete, or other materials. Roadway runoff, or even an ephemeral stream, can drop through a roadway drainage structure into an underground culvert. See illustrations below.



Berms are the equivalent of a "hog back" slope in a road used to divert water off the middle of the road toward the curbs. Berms or mounds may serve one or a combination of functions such as add interest to a flat landscape, direct drainage, and more. **Swales** are simply shallow, low depressions in the ground designed to transport rain during major rain events. Swales ideally are tree-lined and help cleanse the water as it flows past and percolates down.



ZONE A

CAU's Sacred Grass Cistern – Zone A

The Sacred Grass Cistern will have dimensions of 100 ft. x 100 ft. = 10,000 sq. ft. With a depth of 10 ft., it will have the capacity to store **745,000 gallons** of stormwater under CAU's Sacred Grass located near the south end of CAU's campus. The stormwater will be collected from Harkness Hall, Wright-Young Hall, Clement Hall, Thomas Cole Research Center and parking lot,

CAU's Utility Building, Sage–Bacote Hall, Trevor Arnett Hall, Merrill Hall, the Promenade stretching from Greensferry Avenue to Atlanta Student Movement (ASM) Blvd., and the all of the nearby streets and sidewalks.

Sacred Grass Greenway – Zone A

The excess rain will overflow onto the greenspace in front of Harkness Hall and Morehouse green area adjacent to the sacred grass which will become a greenway. Dimensions will be 267 ft. x 129 ft. yielding 34,443 sq. ft. With a peak depth of 2 feet, the greenway will capture approximately **500,000 gallons** of excess stormwater from the 100-year rain event. The greenway will consist of small pathways with various plants and flowers that lead into the already existing walkways in this area. It will also act as a play space for students to study, relax and conduct outdoor activities. It can include an Harkness Arch Bridge as part of the walkway between Wright-Young Hall and Harkness Hall and span across to Morehouse College Merrill Hall.

Freshman Quadrangle Cistern – Zone A

The Freshman Quad Cistern will measure 80 ft. x 130 ft. = 10,400 sq. ft. With a depth of 10 feet, it will have the capacity to store **780,000 gallons** under the Freshman Quad. The stormwater will be collected from McPheeters-Dennis Hall and parking lot, Haven-Warren Hall, Kresge Hall, Holmes Hall, Pheiffer Hall, Merner Hall, Thayer Hall, Tanner-Tenner Building and parking lot, Carl Mary Ware Academic Center and parking lot, and the nearby sidewalks and streets.

Excess rain will flow into the Tanner-Tenner Rain Garden which is adjacent to Atlanta Student Movement which will then flow into the Lawshe St. Ephemeral Stream.

Freshman Quad Rain Garden – Zone A

The Freshman Quad rain garden dimensions are 150 ft. x 90 ft. with a total of 13,500 sq. ft. With a peak depth of 2 feet deep it can detain **200, 000 gallons** of excess stormwater runoff from the 100-year rain event from the Freshman quad cistern. It will also act as an outdoor learning space for students who have an interest in biology, botany, horticulture, and more.

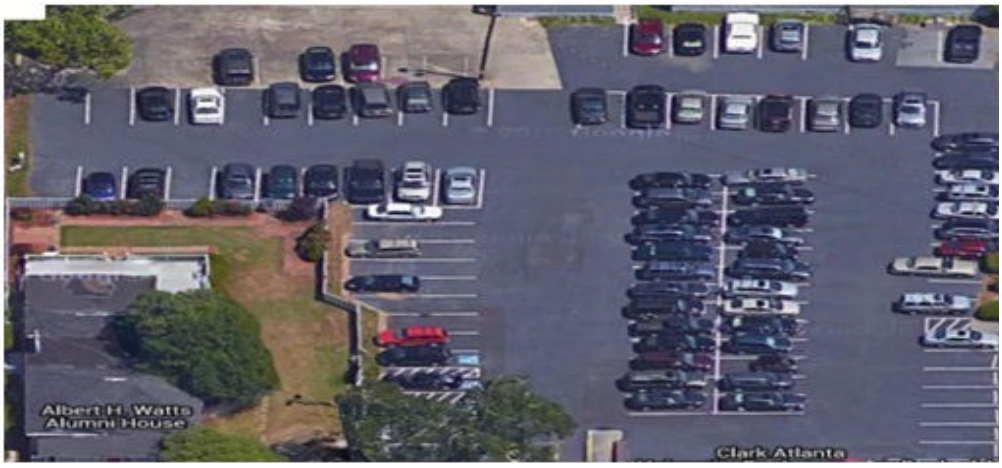
Tanner-Tenner Greenspace – Zone A

A rain garden will cover the entire area of the Tanner-Tenner Greenspace. Dimensions are 209 x 116 ft. for a total of 24,244 sq. ft., with a peak depth of 2 ft. The rain garden will capture approximately **360,000 gallons** of excess stormwater from the 100-year rain event. It will also act as an outdoor space for students to innovate, study, and relax. The space can be equipped with electrical outlets powered by solar panels.

ZONE B

CAU President's Parking Lot – Zone B

The CAU President's Parking Lot Cistern will be built to capture the 25-year rain event



in two cisterns. We recommend that each of the two cisterns under the CAU President's Parking Lot should measure 80 ft. x 80 ft. or 6,400 sq. ft. with a depth of 10 feet. Each will have the capacity to store **480,000 gallons** for a **total of 960,000 gallons**.

Stormwater runoff will be collected from the President's Parking Lot, CAU Trailers Parking Lot, Albert Watts Alumni House, Purdue Hall and parking lot, Morehouse ROTC, Morehouse College's President's House and parking, The Promenade stretching from ASM Blvd. to Parsons Street, and the surrounding houses, streets, and sidewalks. Excess rainfall will flow into the Rush Memorial Park, described below.

Rush Memorial Recreational Park – Zone B

Rush Memorial Park will consist of three large green areas where AUC students can engage in outdoor activities such as exercising, outdoor sports, and more.

The first two higher elevation greenways will be located next to and behind the historic Rush Memorial Congregational Church down to Mildred Street. Allowing for a wide earthen wall which will make it possible to keep existing trees in place next to the CAU Student Center, the first greenway will measure 110 feet x 200 feet = 22,000 sq. feet. At six feet deep during a peak 100-year rain event it will capture 132,000 cubic feet or **1.00 million gallons** of runoff.

Behind the Church the second of these two high elevation greenways will measure 90 feet x 100 feet = 9,000 sq feet. At six feet deep it will capture 54,000 cubic feet or **0.40 million gallons** of runoff.

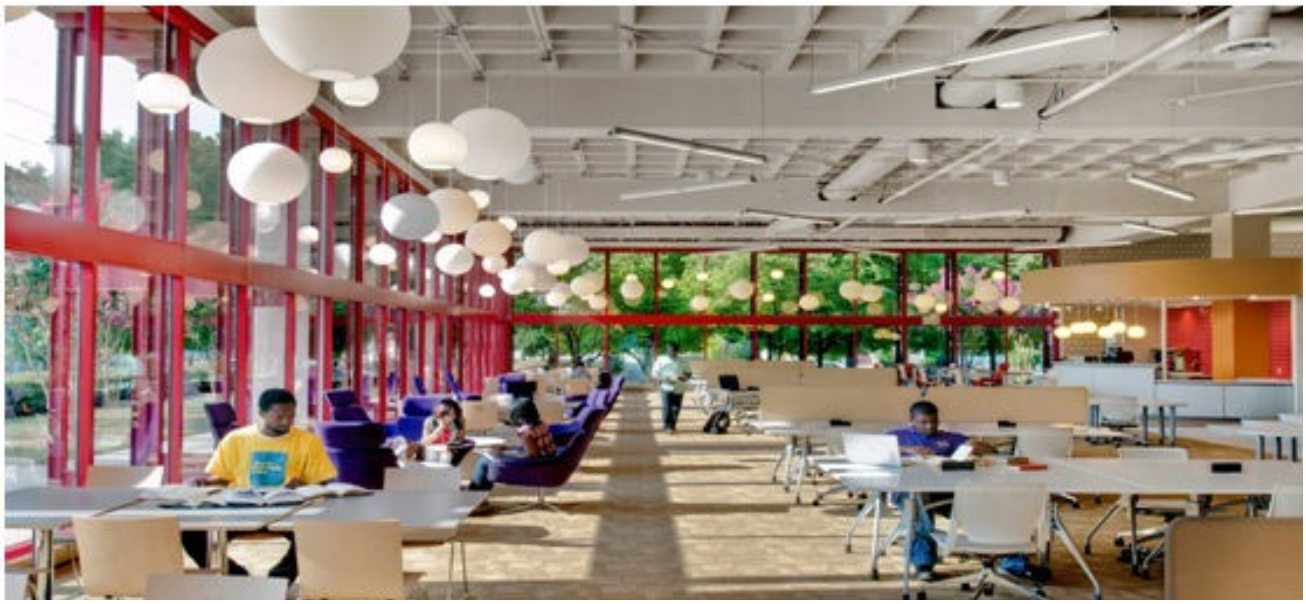
From these higher elevation greenways a culvert will cross under Mildred Street to the empty green area next to the CAU Parking Deck.

There, a lower elevation greenway, staying comfortably within the bounds of the Mildred to Lawshe block, will measure 200 feet x 150 feet = 30,000 sq. ft. At six feet deep this greenway can capture 180,000 cubic feet or **1.37 million gallons** during a peak 100-year rain event.

Rush Memorial Park will consist of all three of these greenways. They can include pathways, trees and small retention ponds for aesthetic reasons. Total detention capacity for the Rush Memorial Recreational Park will be **2.77 million gallons.**

ZONE C

AUC Robert. W Woodruff Library Cistern – Zone C



The AUC Robert W. Woodruff Library Cistern will measure 100 ft. x 110 ft. = 11,000 square feet. With a depth of 10 feet, it will have a capacity to store **820,000 gallons** of stormwater under the current library Greenspace where the rain garden is located.

The image below shows the Greenspace and the area of interest:

The stormwater will be collected from the Robert W. Woodruff Library and parking lot, CAU Suites Girls and Boys, Beckwith Hall and parking lot, the promenade stretching from Parsons St to Beckwith St, and the surrounding homes, streets, and walkways.

ZONE D

Ware Hall Parking Lot Cistern - Zone D

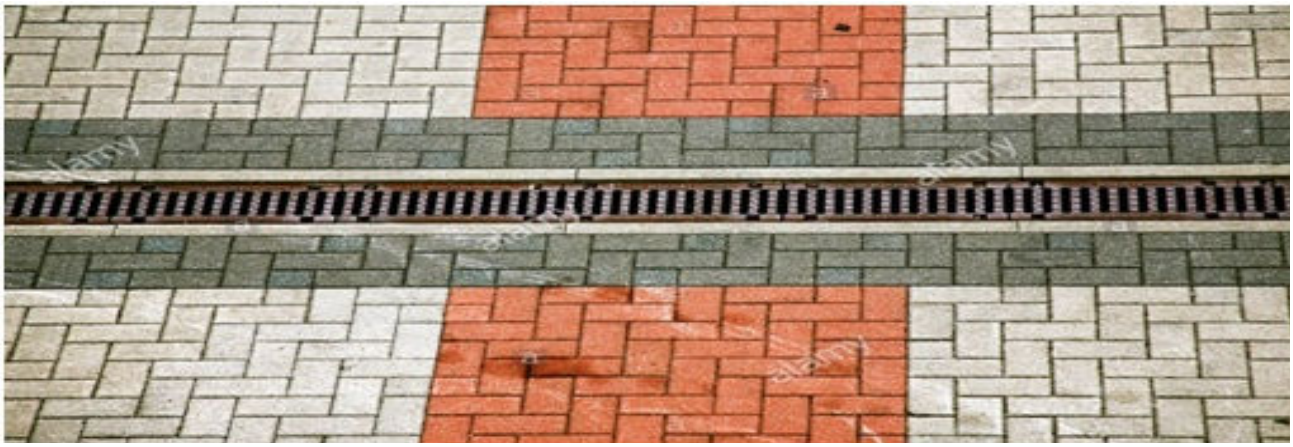
The Ware Hall Parking Lot Cistern dimensions will be 90 ft. x 100 ft. yielding 9,000 sq. ft. With a depth of 13 ft. it will have a capacity to store **875,000 gallons** of stormwater under the northern end of Ware Hall parking lot. The stormwater will be collected from University Barbershop, Brawley Hall, Heritage Commons, Bumstead Hall, Ware Hall and parking lot. The

excess rain overflow will go into the ephemeral stream which will be flowing on the west side of the stadium field.

Lawshe Street Ephemeral Stream – Zones A through D

The Lawshe Street Ephemeral Stream will flow down Lawshe Street from Greensferry Avenue toward the CAU Stadium. The stream will be dry most years but may carry two to three inches of runoff during 25- to 100-year rain events that overflow from Zones A, B and C and the Atlanta Housing Authority. This stream will only flow during large rain events when excess stormwater cannot be completely captured by the proposed cisterns and greenspaces. Some of the water captured in the ephemeral stream can be diverted to the Rush Memorial Greenway, which was described earlier in this plan. This stream will be joined by a second ephemeral stream running from the ITC rain garden next to the northern end of the CAU Stadium and flow under MLK Jr. Dr. in a culvert to Sunset Avenue Greenway which is explained further in Catchment 2 Conceptual Plan.

Beckwith Culvert – Zone D



The Beckwith Culvert would begin at the low point of Lawshe St. opposite Beckwith Hall. The Lawshe St. ephemeral stream will flow into the Beckwith Culvert and flow under Beckwith Street and then flow into the ephemeral steam running along the western side of the CAU Stadium. The portion of the ephemeral steam at the western edge of CAU Stadium will use the berm and swale approach discussed below.

Clark Atlanta Stadium Berm and Swale – Zone D

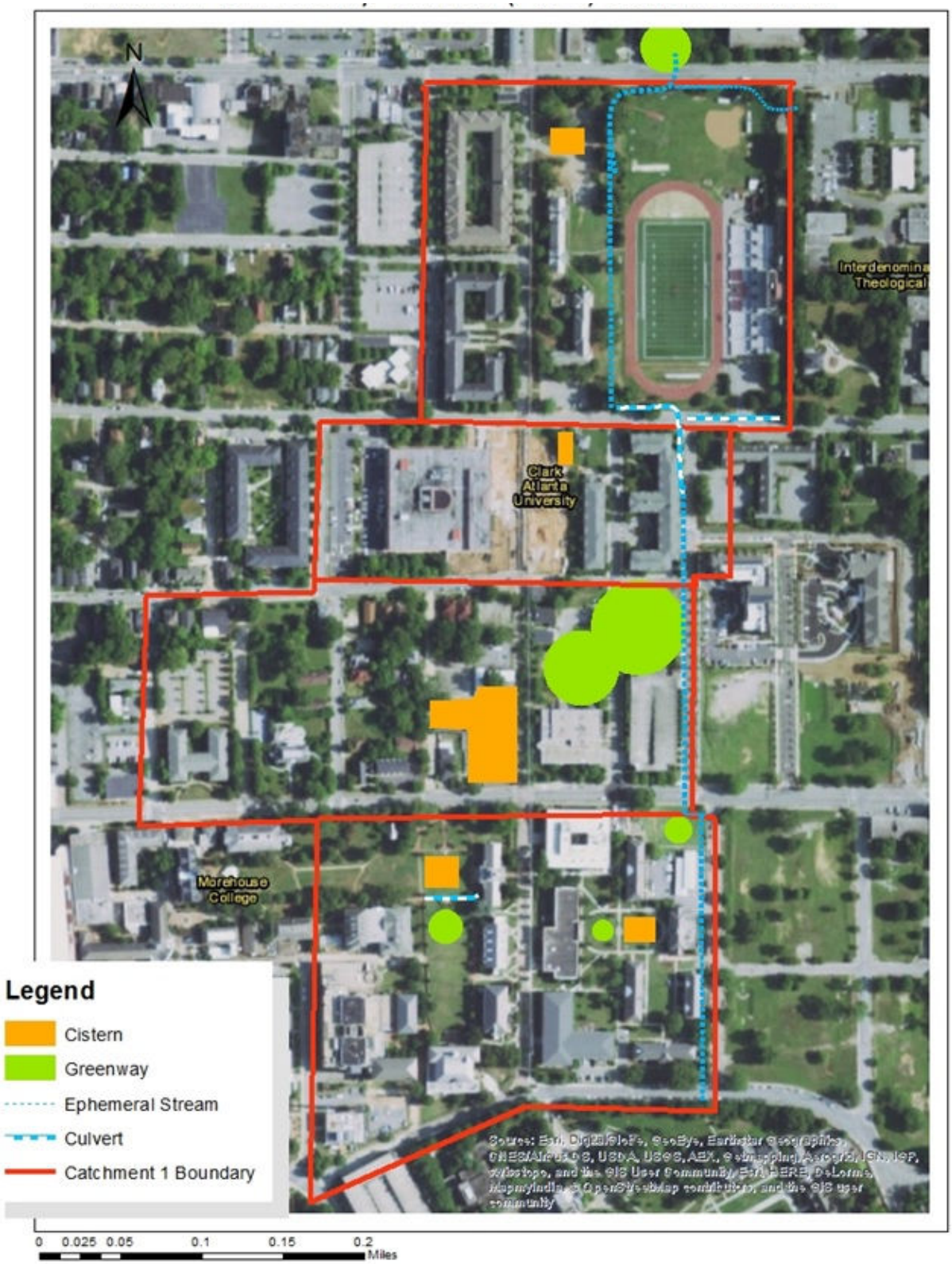
The Clark Atlanta Stadium Berm and Swale will extend along the western edge of Clark Atlanta Stadium. It will be directly behind Bumstead and Ware Hall where there is extreme drop in elevation down to the playing field level at the stadium. There is already a natural berm that exists because of this difference in elevation; therefore only minor modifications will need to be made to ensure it is effective. Only during the largest storms exceeding the 25-year rain event, will it carry water from the Lawshe St. ephemeral Stream. It will be joined by the overflows from the Ware Hall cistern and then flow to the Sunset Avenue Greenway as described earlier.

SUMMARY OF RESULTS

Type of Green Infrastructure	Dimensions (in feet)	Cistern Capacity (gallons)	Greenway Park and Rain Garden Capacity (gallons)
Sacred Grass Cistern	100 x 100 x 10	745,000	
Sacred Grass Greenway	267 x 129 x 2		500,000
Freshman Quad Cistern	80 x 130 x 10	780,000	
Freshman Quad Rain Garden	150 x 90 x 2		200,000
Tanner-Tenner Rain Garden	209 x 116 x 2		360,000
Two CAU President's Parking Lot Cisterns	80 x 80 x 10 80 x 80 x 10	480,000 480,000	
Rush Memorial Recreational Park	110 x 200 x 6 90 x 100 x 6 200 x 150 x 6		1,000,000 400,000 1,370,000
Robert W. Woodruff Library Cistern	100 x 110 x 10	820,000	
Ware Hall Cistern	90 x 100 x 13	875,000	
Totals		**4,180,000**	**3,830,000**

Total stormwater capture capacity 4,180,000 + 3,830,000 = 8,010,000 gallons

OVERALL MAP OF CATCHMENT 1 CONCEPTUAL PLAN



Benefits to AUC Community and Student Learning Experiences

The purpose of this research is to develop capacity relief for sewer systems in order to mitigate the negative health impacts associated with flooding. Some long-term benefits include system resiliency capacity enhancement, improved community livability, cleaner air and water, retained water for reuse and for drought, and lessening the impact of climate change.

We recommend these conceptual plans will be considered over time to not only to improve the community livability in the AUC, but also to ensure improved living conditions for all affected downstream communities. It is our moral responsibility to take action that will help to prevent and reduce impact of flooding on public health. As students who have been engaged with this project, we have gained an increased understanding of green infrastructure and its application in capturing stormwater, engineering concepts, design processes, and the importance of moral responsibility.

Appendix

The five tables below show the amount of stormwater runoff flowing to each named cistern. Calculated storage capacity for each cistern may be a little more or less than the flow to it. Overflows will go to the nearest recreational floodplain or rain garden described in the report.

CAU's Sacred Grass/Grounds Cisterns	25 Year Rain Event Runoff in Gallons
Harkness Hall	36,482.09
Wright-Young Hall	35,785.85
Clement Hall	33,872.26
Thomas Cole Research Center	208,073.06
Thomas Cole Research Center Parking Lot	87,243.49
Utility Building	36,106.21

Sage-Bacote Hall	31,527.26
Trevor Arnett Hall	73,643.33
Promenade(Atlanta Student Movement-Greensferry)	38,698.95
Merrill Hall	94,278.50
Lee St SW	62,635.92
Brown St SW	37,532.86
CAU's Sacred Grass Walkway	66,420.38
Greensferry Ave SW(Sacred Grass)	45,413.60
Greensferry Sidewalks(Sacred Grass)	15,957.98
TOTAL	**743,194.37**

Freshman Quad Cistern	25 Year Rain Event Runoff in Gallons
McPhetters-Dennis Hall	90,344
McPhetters-Dennis Hall Parking Lot	13,251
Haven-Warren Hall /Davage Auditorium	65,420.27
Kresge Hall	30,337.19
Holmes Hall	23,606.52
Pheiffer Hall	22,903.94
Merner Hall	24,730.64
Tanner-Tenner Building/ Campus Police Station	21,077.25
Tanner-Tenner Building Parking Lot	69,790.29
Carl-Mary Ware Academic Center	81,983.48
Carl Mary Ware Parking Lot	41,156.84
Greensferry Ave SW(Freshman quad)	26,367.64
Lawshe St. (btw Greensferry and Atlanta student movement)	105,354.63
Promenade Sidewalks	20,683.81
Greensferry Sidewalks (Freshman Quad)	23,448.44
Lawshe St. Sidewalks	46,665.03
Freshman Quad Walkway	55,865.25
Thayer Hall	37,656.73

Freshman Quad Cistern	25 Year Rain Event Runoff in Gallons
TOTAL	**793,955**

CAU' President's Parking Lot Cistern	25 Year Rain Event Runoff in Gallons
CAU President's Parking Lot	181,675.35
CAU Trailers (1-3) Parking Lot	73,787.94
Spike Lee's Parking Lot	18,547.98
Albert H. Watts Alumni House	11,803.26
CAU Trailers (1-3)	19,770.46
Homes (#1-11,13-19) Parsons St. (2 is the standard)	137,212.90
Absalom Jones Chapel	17,978.89
Home #7	4,489.45
Home # 12	5,016.39
Home #21	5,718.96
Home(near parking deck)	11,437.92
Purdue Hall	59,799.67
Purdue Parking	125,054.84
Morehouse ROTC	15,386.39
Morehouse President House	42,765.74
Morehouse President House Parking Lot	10,946.12
Atlanta Student Movement Blvd. SW	42,442.77
SNCC Way SW (between Atlanta Student Movement Blvd. and Parsons St SW)	24,449.61
Milton St. SW	24,280.99
Webster St. SW	23,648.67

Euharlee St. SW	26,624.08
SNCC Way Sidewalks	18,266.95
Milton ST SW Sidewalks	18,091.31
Webster St. SW(sidewalk)	25,475.37
Atlanta Student Movement Blvd(sidewalk)	24,914.36
Euharlee St. SW(sidewalk)	18,126.43
TOTAL	**987,712.80**

Robert W. Woodruff Library Cistern	25 Year Rain Event Runoff in Gallons
Robert W. Woodruff Library	258,941.04
Robert W. Woodruff Library Parking Lot	238,215.08
Promenade (Beckwith-Parsons)	87,259.81
Home #22	3,021.07
Home #23	6,439.10
Parsons St SW	77,311.35
Paschal Blvd SW	21,509.33
AUC Library Sidewalks	55,643.94
TOTAL	**748,340.73**

Ware Hall Parking Lot Cistern	25 Year Rain Event Runoff in Gallons
University Barber Shop	4,721.30
Brawley Hall	128,922.51
Brawley Hall Quad/Entrance	17,156.88
Heritage Commons	149,325.29

Bumstead Hall	61,015.13
Bumstead Hall Parking Lot	53,030.36
Ware Hall	31,496.44
Ware Hall Parking Lot	67,696.61
Beckwith St. SW	72,252.81
SNCC Way SW	42,881.66
James P. Brawley Dr. SW	49,787.98
Mitchell St. SW	10,833.71
Brawley Sidewalks	38,669.73
Heritage Commons Sidewalks	37,974.18
Ware /Bumstead/ Stadium Sidewalks	73,858.20
TOTAL	**839,622.78**