



COOPERATIVE EXTENSION
College of Agriculture, Forestry and Life Sciences

UTILIZING GI MAINTENANCE FOR SERVICE-LEARNING & DEMONSTRATION ON A UNIVERSITY CAMPUS

Haley Parent
Water Resource Agent
Clemson University Cooperative Extension

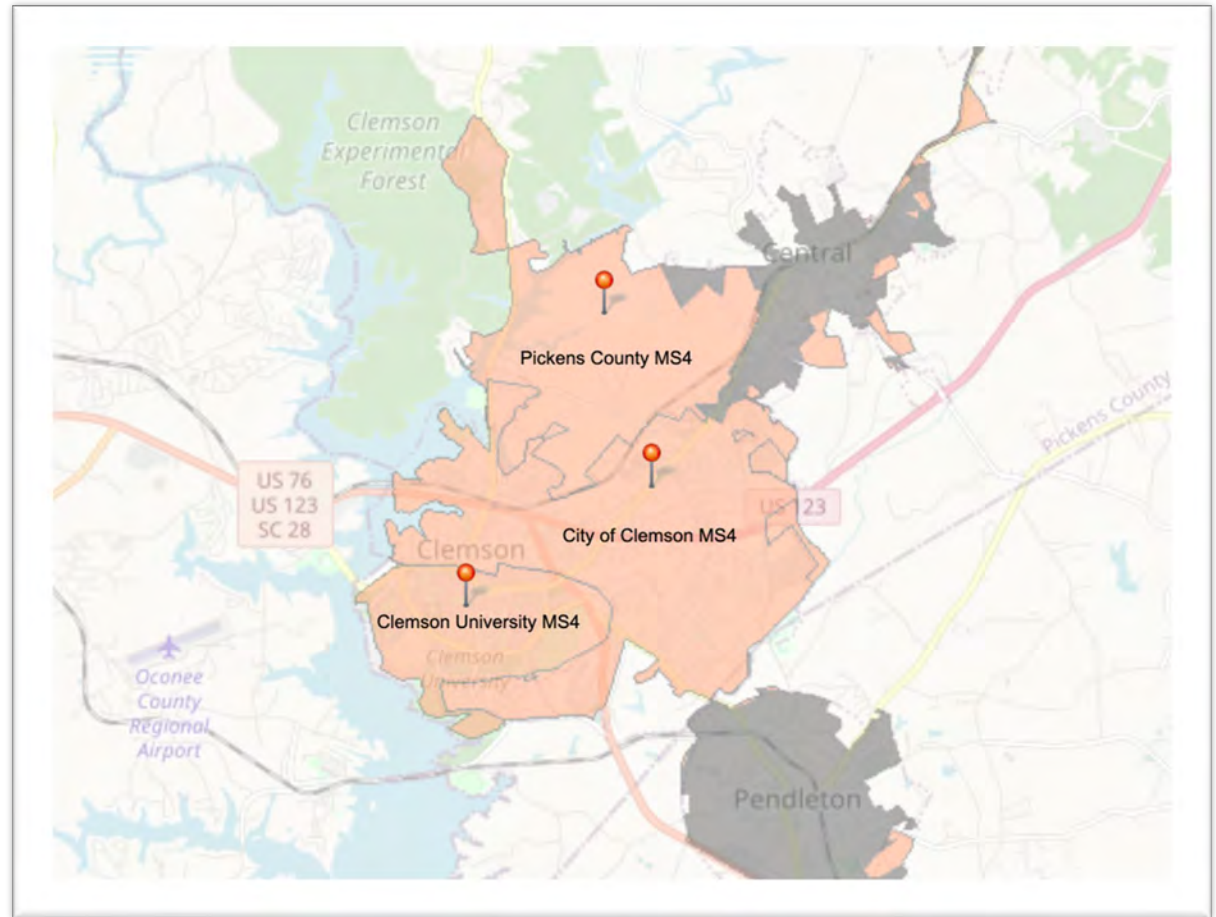


Clemson University: SMS4

2010 Census established Clemson University as a small MS4

SCDHEC requires six MCMs be incorporated into the stormwater management program of an SMS4:

1. **Public education and outreach**
2. **Public participation / involvement**
3. Illicit discharge, detection and elimination
4. Construction site runoff control
5. Post-construction runoff control
6. Pollution prevention / good housekeeping



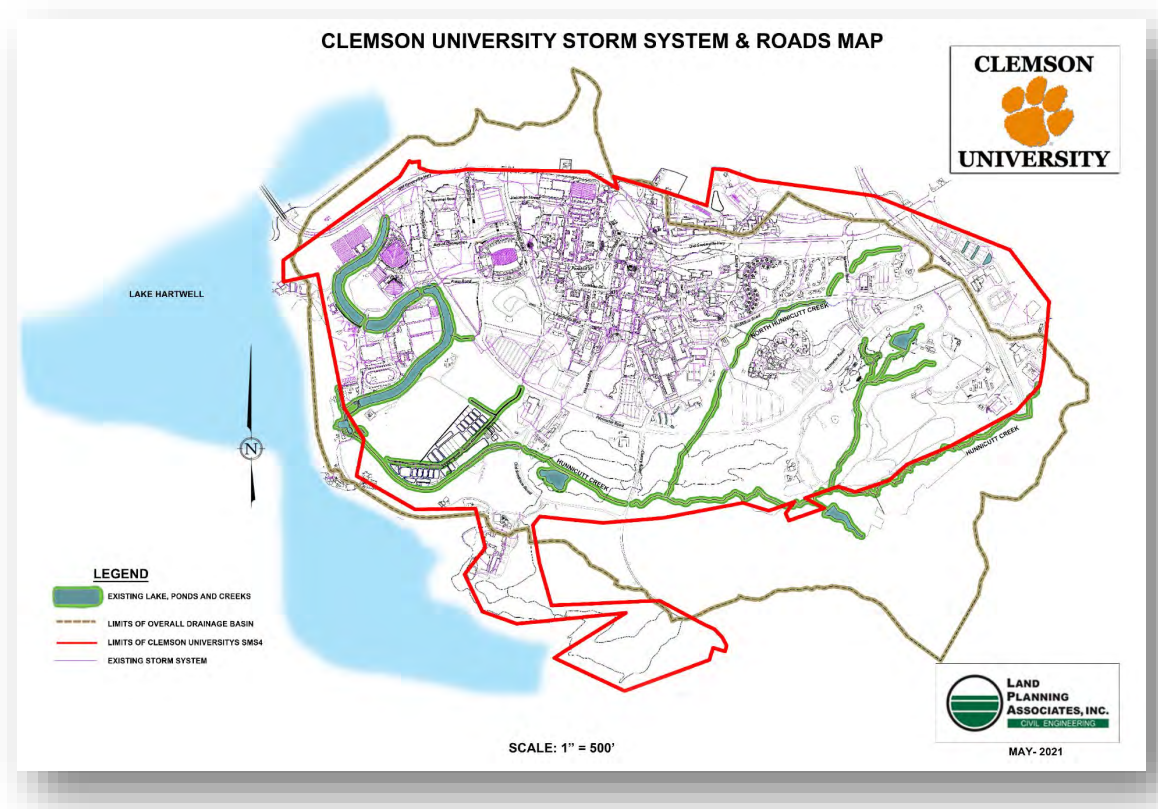
SCDHEC Watershed Atlas: Local MS4 Boundaries

Clemson University: SMS4

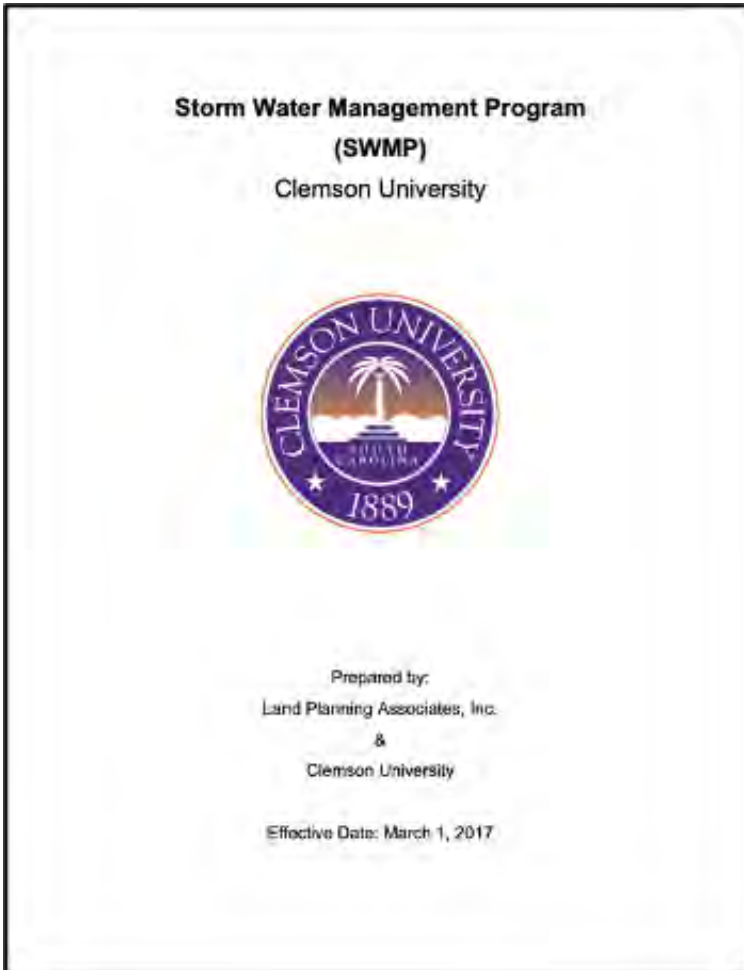
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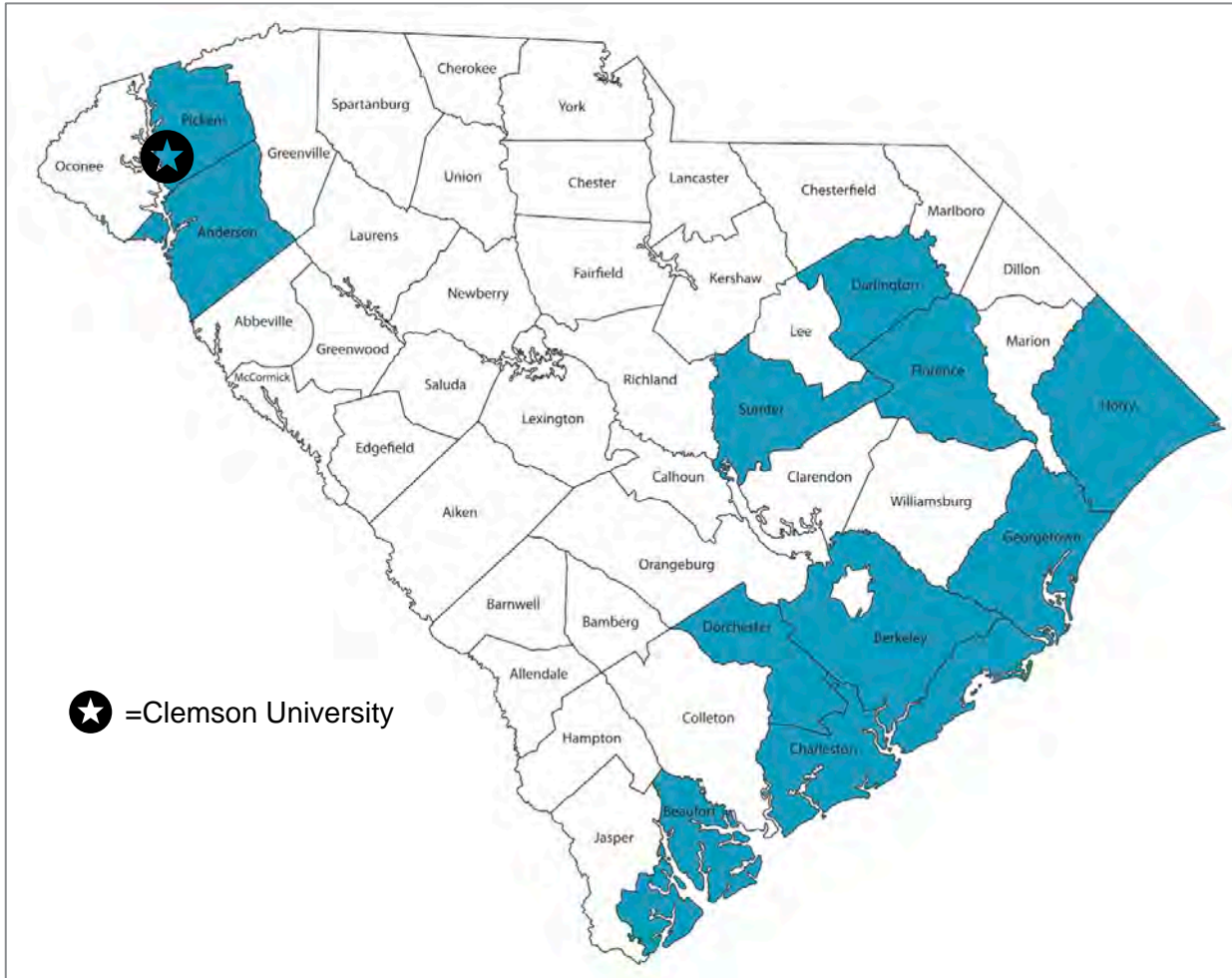
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Clemson Universities' Stormwater Management Program



Carolina Clear



Carolina Clear Consortium Regions



ANDERSON & PICKENS COUNTIES
stormwater
PARTNERS
A PUBLIC SERVICE OF CLEMSON UNIVERSITY



ANDERSON & PICKENS COUNTIES stormwater PARTNERS



Annual Report of Activities

YEAR 8 / JANUARY - DECEMBER 2021

MARCH 2022



ANDERSON & PICKENS COUNTIES stormwater PARTNERS

A CLEMSON EXTENSION SERVICE

Education Plan

Created with input from partners at a strategic planning meeting on June 18, 2018 at the Department of Natural Resources facility in Clemson, SC. Partners included city and county staff and a council member, representatives from non-profits, Clemson University staff and students, and Clemson Extension agents. Input included prioritizing pollutants of concern, developing a list of contributing behaviors, and brainstorming barriers and benefits for each behavior. This education plan will guide the efforts of the Anderson & Pickens Counties Stormwater Partners from July 1, 2018 to June 30, 2023.

Top Three Pollutants of Concern (POCs) and Their Contributing Behaviors

Pollutant of Concern	Contributing Behaviors
Sediment	<ul style="list-style-type: none"> Construction companies who do not properly install and maintain BMPs for erosion prevention and sediment control are contributing sediment to the local waterways. Homeowners with sediment issues who do not properly install and maintain BMPs are contributing sediment to local waterways.
Litter	<ul style="list-style-type: none"> People who contribute to roadside littering or improperly dispose of household items. People who dump their trash illegally in business dumpsters, causing them to overflow.
Bacteria	<ul style="list-style-type: none"> Septic systems that are not properly maintained/repared. FOG (fats, oils, and grease) that are not disposed of properly. Dog owners who don't pick up and dispose of their pet waste.

Public Education & Outreach

The goal of the Public Education and Outreach MCM is to connect with individuals of the Clemson University community to inform them of the impacts they can have on stormwater runoff. Ultimately, sustained behavioral changes as an effect of increased environmental awareness is strived for in the Clemson University community.

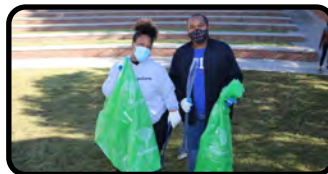
The following three pollutants have been identified as POCs in the Clemson University SMS4:



1. Sediment



2. Fats, Oils, and Grease (FOGs)



3. Litter

Public Participation/Involvement



The goal of the Public Involvement and Participation MCM is to encourage public involvement in activities related to stormwater pollution prevention.



GREEN INFRASTRUCTURE PRACTICES



Wilbur O. and Ann Powers College of Business

Bioretention & Bioswales: Treatment Train







Permeable Pavement



Green Roofs



Lee Hall Green Roof





Watt Family Innovation Center Green Roof and Patios



SERVICE-LEARNING & MAINTENANCE

“In service learning, students learn educational standards through tackling real-life problems in their community.”
–George Lucas Educational Foundation

Solid Green Day 2021



Photo credit: Kristy Pickurel

Campus-wide service day focusing on:

- **Stormwater education**
- Litter prevention
- Compost education
- Recycling education



Photo credit: Kristy Pickurel

Bioretention Maintenance Project



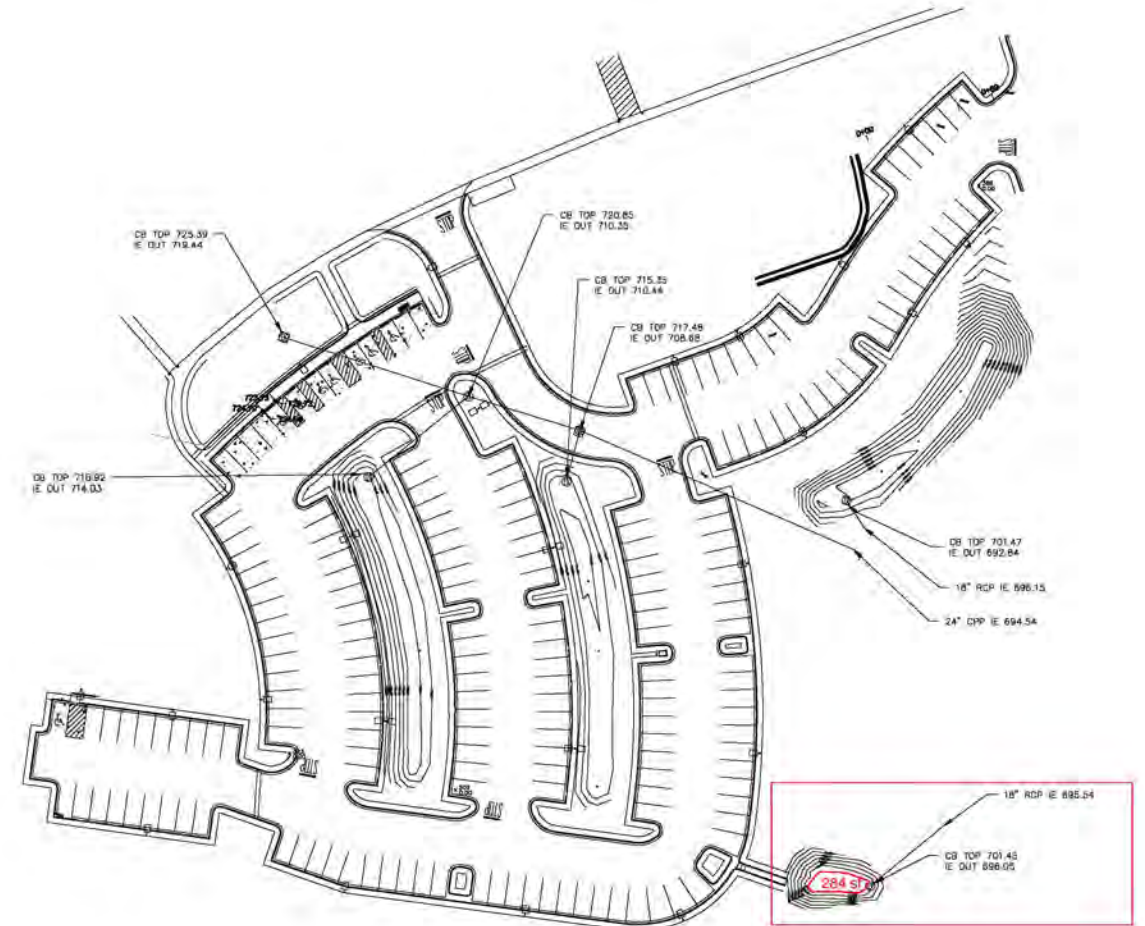




Photo credit: Kristy Pickurel



Maintenance items:

- Clearing out dead vegetation
- Spreading new sand/soil mix
- Installing native plants
- Planting grass seed for bank stabilization
- Securing EC matting

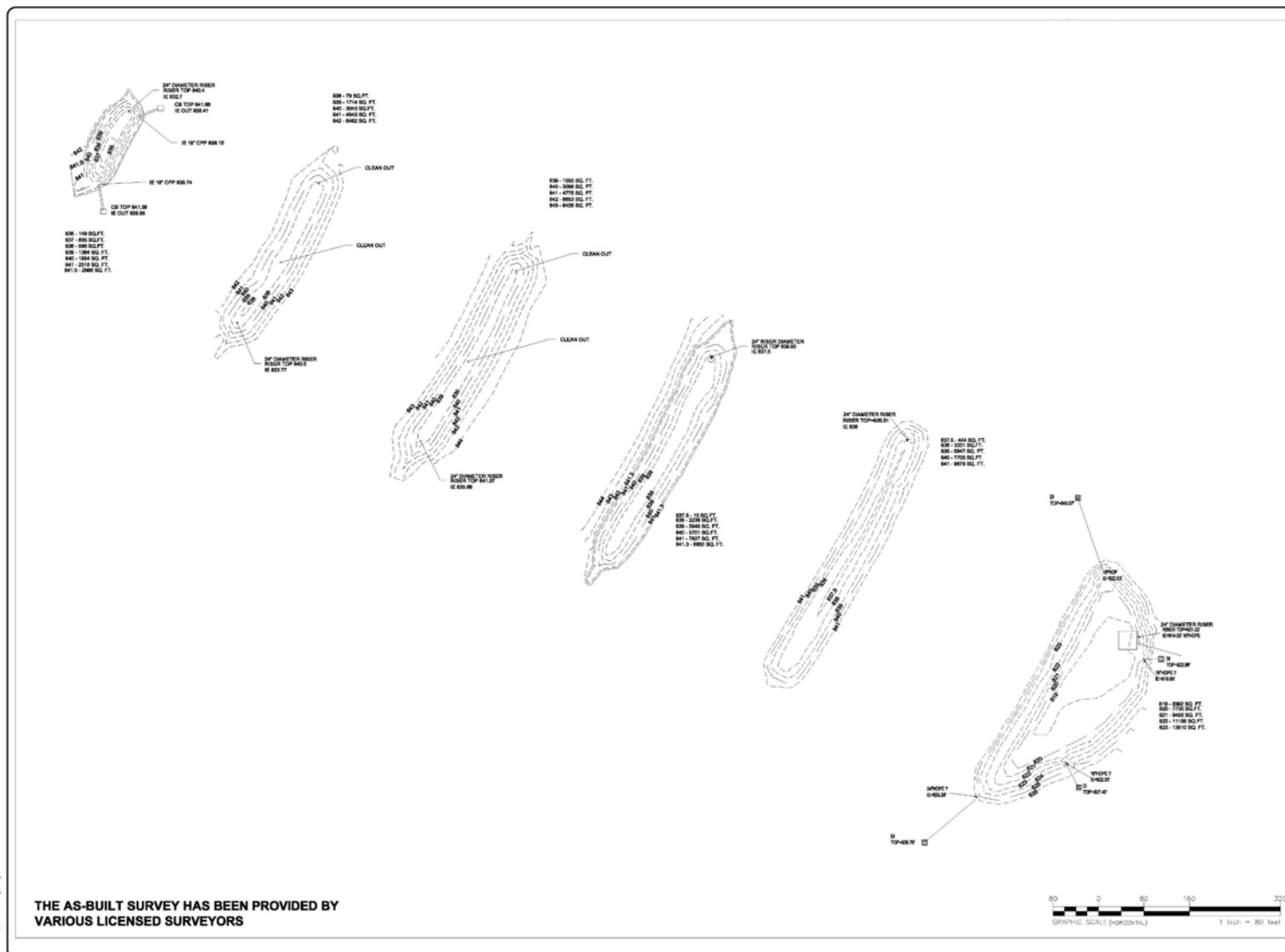


EXPERIENTIAL LEARNING & DEMONSTRATION

“Experiential learning is an engaged learning process whereby students ‘learn by doing’ and by reflecting on the experience.”
–Boston University Center for Teaching & Learning

Solar Canopy Lot

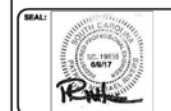




THE AS-BUILT SURVEY HAS BEEN PROVIDED BY
VARIOUS LICENSED SURVEYORS

REVISIONS:

NO.	DATE	DESCRIPTION	BY



LAND PLANNING ASSOCIATES
INC. ENGINEERS

LAND PLANNING ASSOCIATES, INC.
119 WEST 187 AVENUE - SUITE A
EASLEY, SC 29648
864.242.8072 FAX 864.733.8214
design@lpa-inc.net

CLEMSON UNIVERSITY
HWY 76 PARKING LOT

ISSUE FOR CONSTRUCTION:

PERMIT DATE: _____

BID DATE: _____

DRAWN BY: SLC

DESIGN BY: SLC

CHECKED BY: PMR

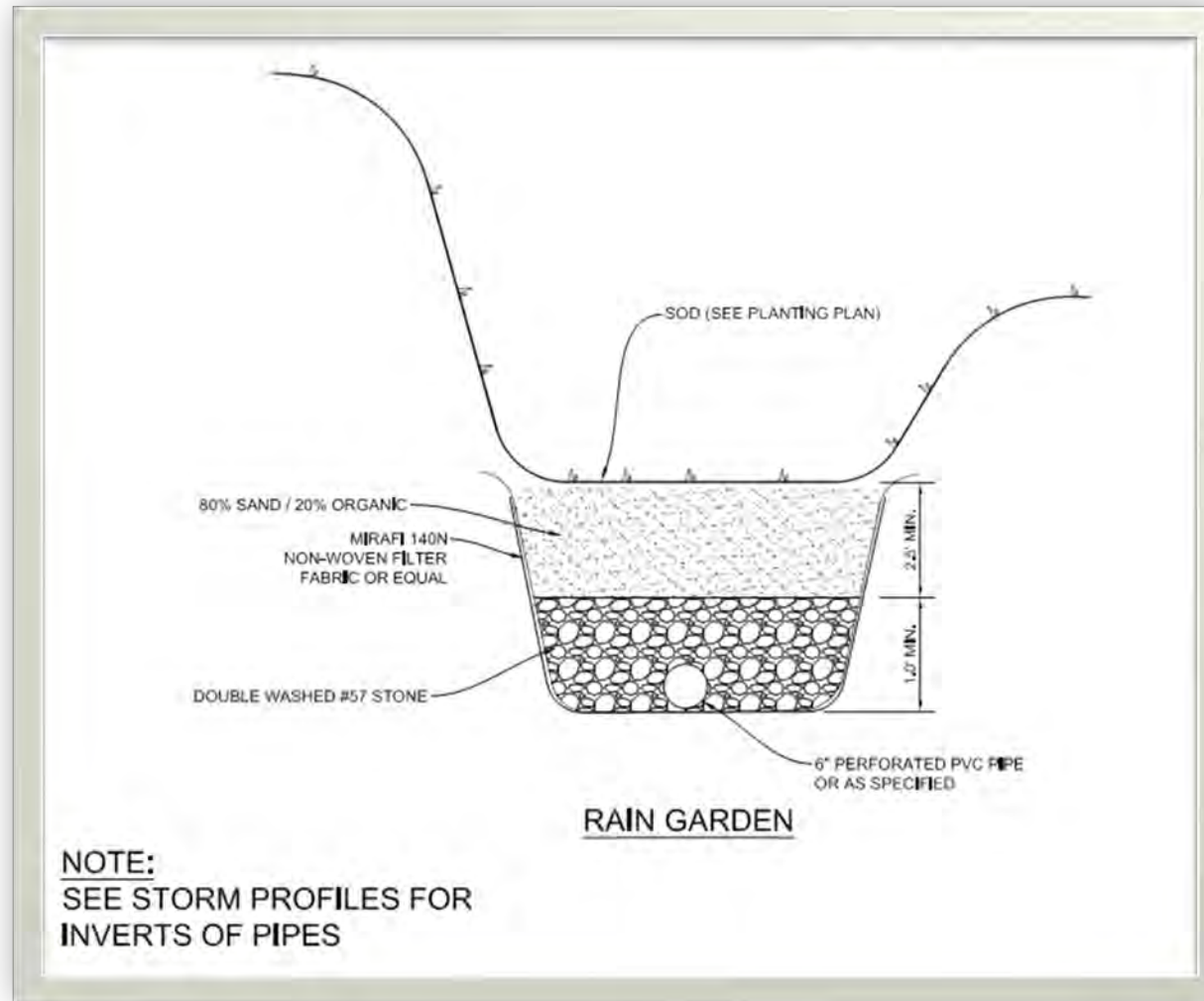
DATE: 6/8/2017

SCALE: HORIZ 1"=80' VERT _____

JOB NUMBER: 14.048/16.047

**HWY 76 PARKING LOT
POND AS-BUILT**

EXHIBIT 1



NOTE:
SEE STORM PROFILES FOR
INVERTS OF PIPES









Existing Maintenance Plans

Clemson University Site Renovations Highway 76 Parking Lot

Rain Garden Maintenance Plan

1. Replanting. If grass covers less than 40% of the soil surface, lime, fertilize, and grass in accordance with the current regulations. If grass covers more than 40% but less than 70% of the soil surface, lime, fertilize and infill with additional grassing to match to meet current regulations.
2. Removing trash and sediment. Trash and litter will be removed as needed to prevent obstruction to the flow of water, prevent degradation of downstream properties, to maintain the integrity of the structure and to provide an attractive appearance.
3. Repairing slides, slumps, and eroded areas. Slopes which have been impaired by slides, slumps, and erosion will be repaired within 30 days. Burrowing and digging by rodents and other animals will be controlled and damaged areas will be repaired within 30 days.
4. Repairing and other components. Pipes, headwalls, etc. will be maintained, repaired and/or replaced as needed to maintain the integrity of the structure.
5. Maintenance inspections. Once each year, a representative of the owner(s) and a representative of the local jurisdiction will jointly inspect all stormwater management structures; appropriate action will be taken to ensure proper maintenance. All Maintenance costs will be borne by the owner(s).



Planting Design Class, Landscape Architecture Dept.

Goals of project:

- Redesign bioretention cells with beneficial plant species
- Stabilize erosion due to solar canopy runoff
- Increase cell efficiency for infiltrating water
- Add to existing energy demonstration site



Water Resource Agent discussing project considerations for design



Associate Director of Utilities explaining stormwater features of the site's design



Landscape Services Director discussing water tolerances of plants to consider in selection based on heavy runoff

STUDENT DESIGNS

Concept Statements

CONCEPT STATEMENT

A successful bioretention swale planting plan that has been designed/curated to be low maintenance, and budget-friendly with primarily native vegetation meant to capture, treat, and infiltrate stormwater runoff.



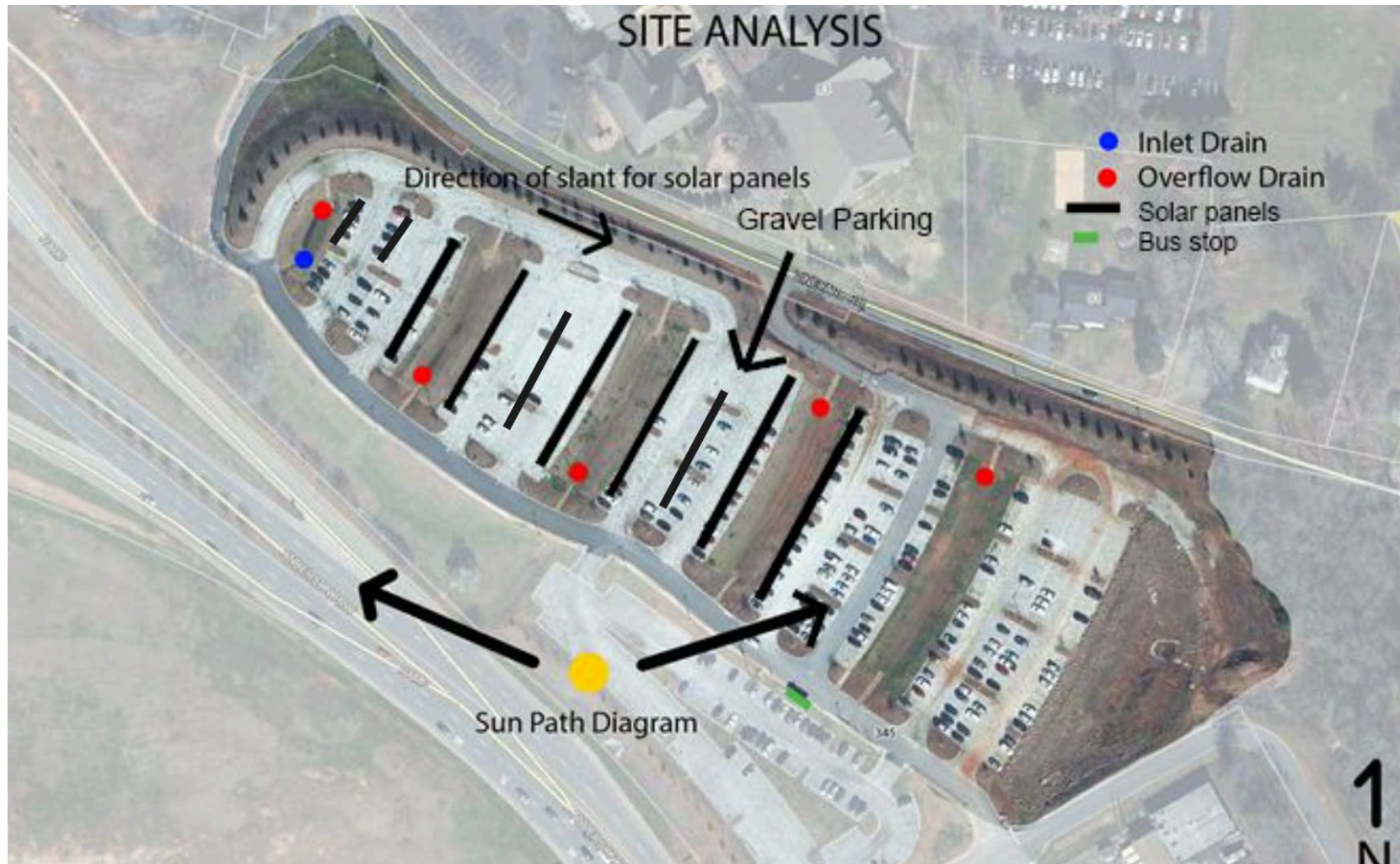
Concept Statement

In the bioretention areas located in Clemson University's solar parking lots, our goal is to infiltrate native plantings into our design to create a sustainable landscape. Using the storm water runoff from the solar panels, we will create an inexpensive, low-maintenance site that allows for groundwater infiltration within the landscape. Incorporating vertical layering of dense vegetation into the bioretention areas will control overflow of surface runoff and create an educational experience for students and other users of the site. In addition, using plantings such as River Oats and Daylily as well as a graveled drip line will benefit our drainage system greatly. Our themes of rich diversity and color of plantings will allow for a long-lasting landscape that will control and contribute to the ecological balance of the storm water cycle.

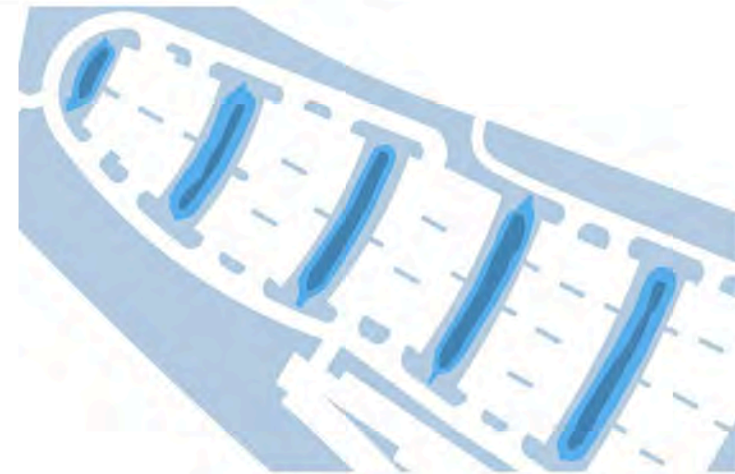
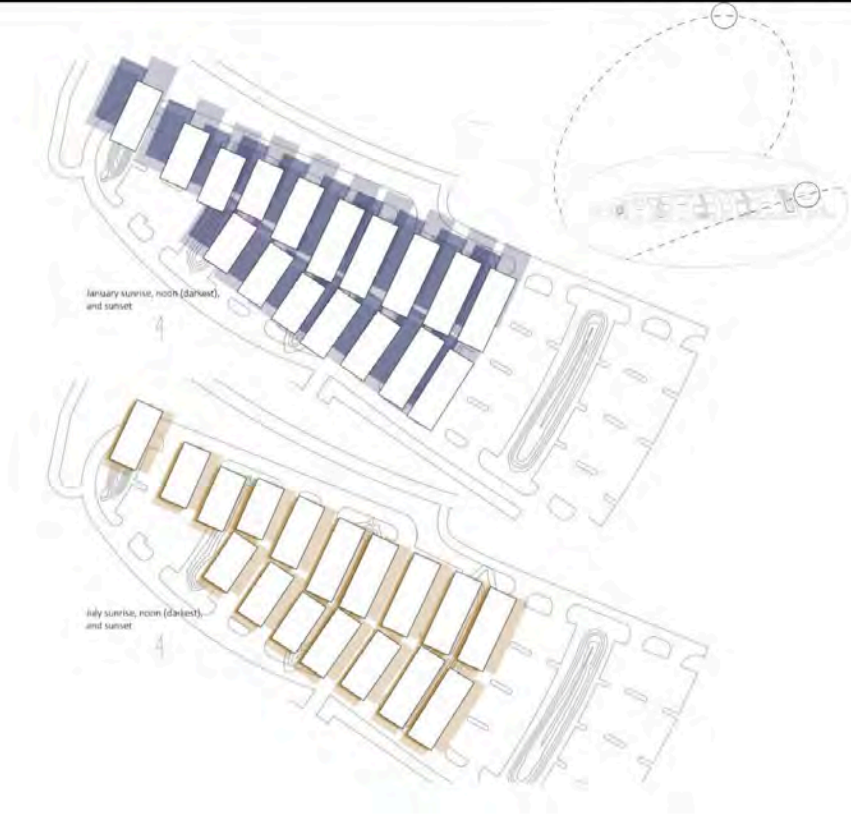
Concept

Aiming to enhance several **low-maintenance** bioretention areas in the parking lot, we focused on topography, sunlight, and moisture to create **sustainable plantings** at the site. These plantings will add color, dimension, ecological benefits, and educational opportunities to the current commuter parking lot.

Site Analyses



Solar and Moisture Diagrams



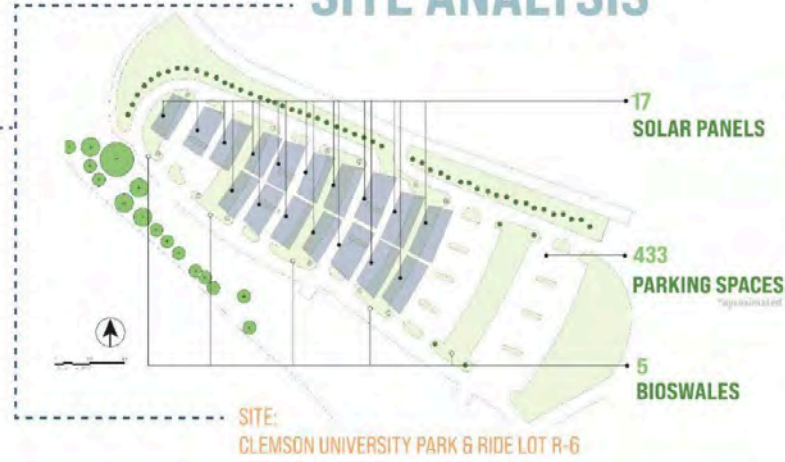
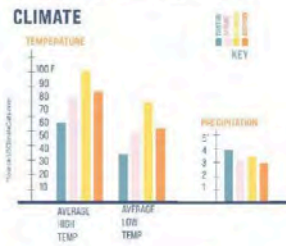
Planting Partitions

- R1: Median Sun Exposure
- R2: Most Sun Exposure
- R3: Least Sun Exposure

- S1: Least Saturation
- S2: Median Saturation
- S3: Most Saturation

TIGER SWALES

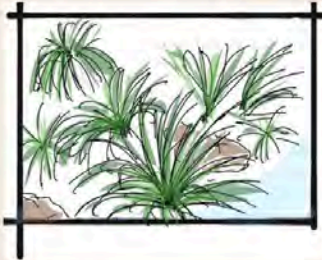
SITE ANALYSIS



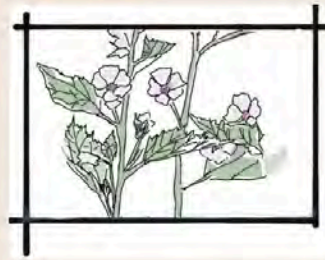
Plant Palettes

GRAPHIC PLANTING PALETTE

ZONE: PONDING AREA



Acorus gramineus - Sweet flag Iris Grass



Alcea officinalis - Marsh Mallow



Iris virginica - Blue Flag Iris



Eupatorium perfoliatum - American Boneset

ZONE: SIDE SLOPE



Carex cherokeensis - Cherokee Sedge

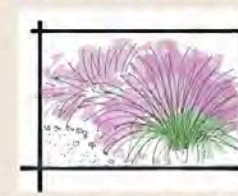


Hemerocallis fulva - Orange Daylily



Physostegia virginiana - Obedient Plant

ZONE: SUBSTRATE



Muhlenbergia capillaris - Pink Muhly Grass



Hosta spp. - 'Blue Wedgewood' Hosta



Chasmanthium latifolium - River Oats



PLANT PALETTE



01 ZONE: PONDING AREA

- MW *Acorus gramineus* - Sweet flag Iris Grass
- MW *Althea officinalis* - Marsh Mallow
- !MW *Eupatorium perfoliatum* - American Boneset
- !MW *Iris virginica* - Blue Flag Iris

02 ZONE: SIDE SLOPE

- !* *Carex cherokeensis* - Cherokee Sedge
- !DMW *Hemerocallis fulva* - Orange Daylily
- M *Physostegia virginiana* 'Miss Manners' - Obedient Plant





03 ZONE: SUBSTRATE












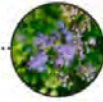



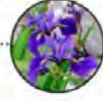


- !*DM *Muhlenbergia capillaris* - Pink Muhly Grass
- DM *Hosta spp.* - 'Blue Wedgewood' Hosta
- !*M *Chasmanthium latifolium* - River Oats

KEY	
D	Dry Zone
M	Moist Zone
W	Wet Zone
!	Native
*	Drought tolerant
highlight	Shade tolerant



COLOR PALETTE

	<i>Physotegia virginiana</i> Obedient Plant	
	<i>Astilbe chinensis</i> 'Purple Candles'	
	<i>Lobelia Cardinalis</i> Cardinal Flower	
	<i>Caltha palustris</i> Marsh Marigold	
	<i>Carex cherokeensis</i> Cherokee Sedge	
	<i>Andropogon ternarius</i> Mountain Stonecrop	
	<i>Hexastylis arifolia</i> Wild ginger	
	<i>Andropogon ternarius</i> Split-beard Bluestem	

	<i>Amelanchier x grandiflora</i> 'Ballerina' Serviceberry	
	<i>Amelanchier canadensis</i> Serviceberry	
	<i>Chelone glabra</i> Turtlehead	
	<i>Rhododendron viscosum</i> Swamp Azalea	
	<i>Muhlenbergia capillaris</i> Pink Muhly Grass	
	<i>Eupatorium coelestinum</i> Mist Flower, Hardy Ageratum	
	<i>Iris Crista</i> Dwarf Crested Iris	
	<i>Iris Virginica</i> Southern Flag Iris	
	<i>Lobelia siphilitica</i> Great Blue Lobelia	

Seasonal Diagram

Label	Botanical/Latin Name	Common Name	Spring	Summer	Fall	Winter
Grasses	<i>Ilex 'HL10-90'</i>	Christmas Jewel Holly				
	<i>Carex cherokeensis</i> Schwein	Cherokee Sedge				
Trees	<i>Chasmanthium latifolium</i>	River or Inland Sea Oats				
	<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush				
Large Shrubs	<i>Callicarpa americana</i>	American Beautyberry				
	<i>Hydrangea quercifolia</i>	Oakleaf Hydranga				
Median Shrubs	<i>Itea virginica</i>	Virginia Sweetspire				
	<i>Ilex verticillate</i>	Winterberry 'Little Goblin Red'				
	<i>Clethra sinifolia</i>	Clethra 'Summersweet'				
Perennials	<i>Iris versicolor</i>	Larger Blue Flag				
	<i>Baptisia australis</i>	Baptisia				
	<i>Physostegia virginiana 'Vivid'</i>	Obedient Plant				
	<i>Symphotrichum novae-angliae</i>	New England Aster				



Master Plans



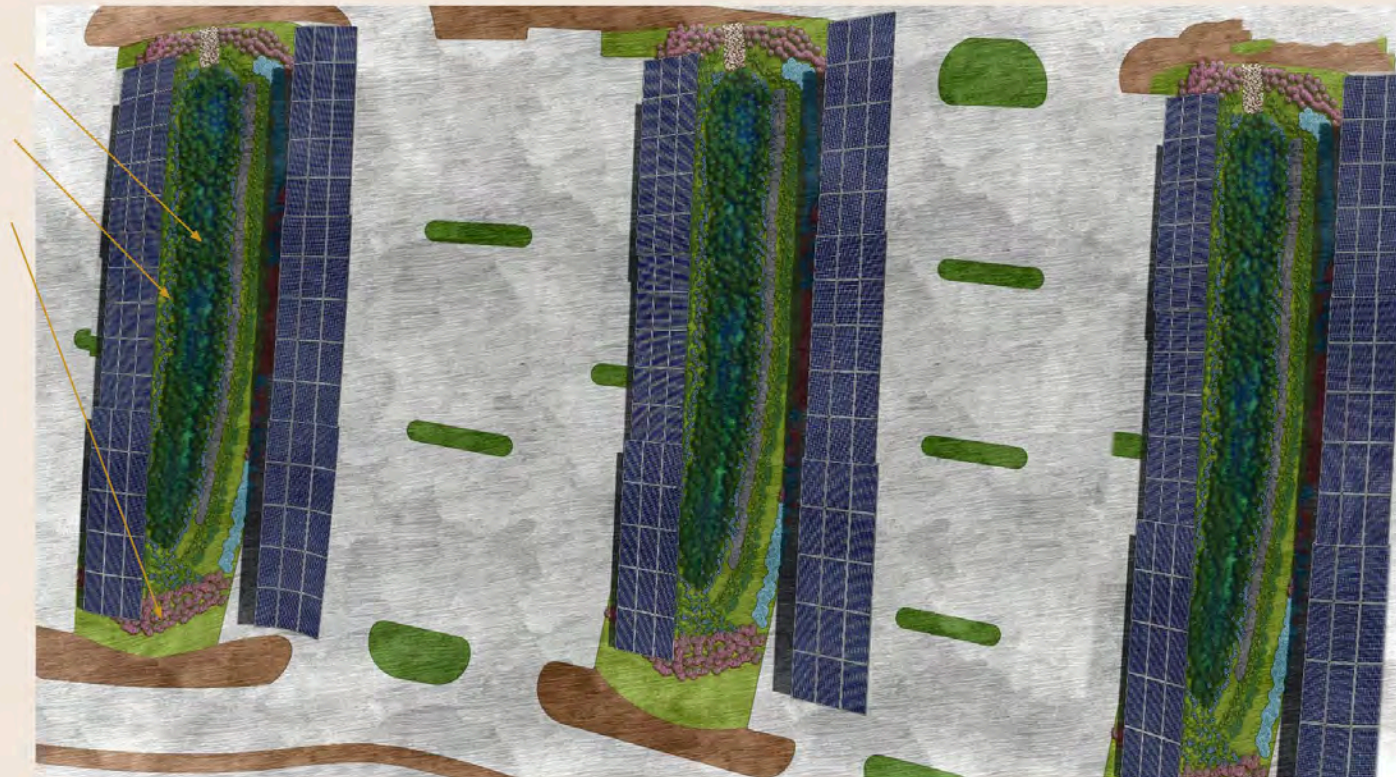


ILLUSTRATIVE MASTERPLAN

ZONE: PONDING AREA

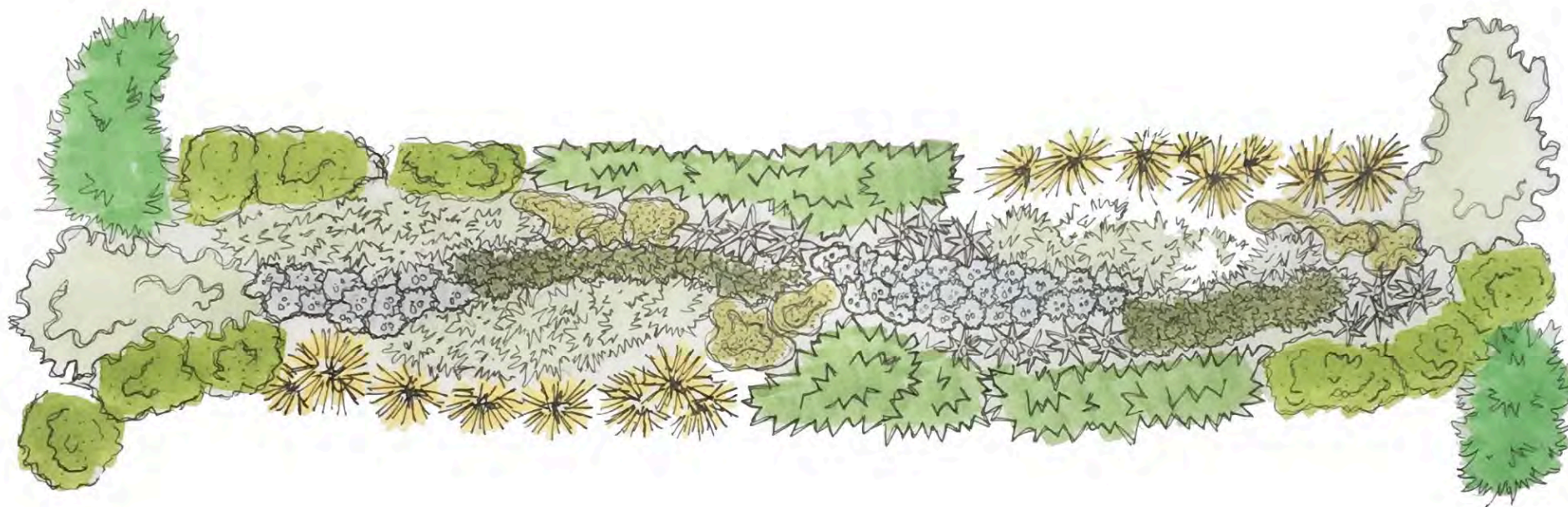
ZONE: SIDE SLOPE

ZONE: SUBSTRATE



















Bioswale 5 Enlargement



Plant Palette

-  FOTHERGILLA
-  VIRGINIA SWEETSPIRE
-  RIVEROATS
-  PURPLE TOP TRIDENS
-  SOFT RUSH
-  SHALLOW SEDGE
-  FLORIDA ANISE
-  WHITE TOP SEDGE
-  BLUE FLAG IRIS
-  SWITCH GRASS

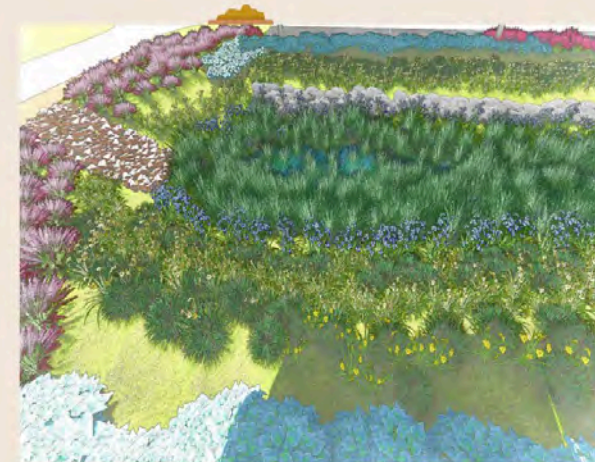
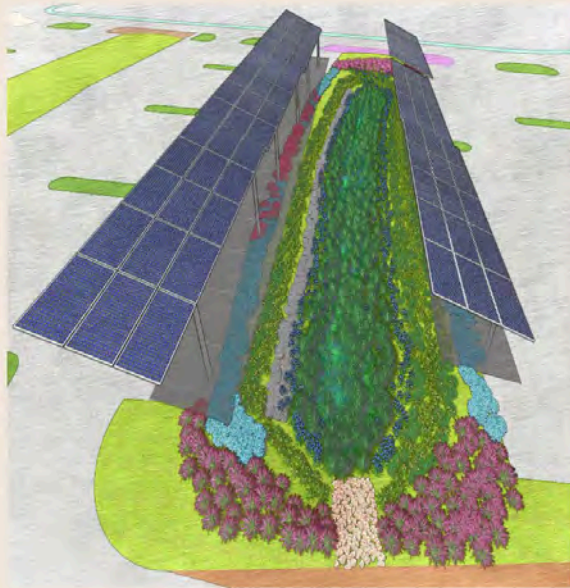


- | | | | |
|---|---------------------------|---|--|
|  | <i>Carex stricta</i> |  | <i>Iris siberica</i> |
|  | <i>Carex cherokeensis</i> |  | <i>Hermocalis fulva</i> |
|  | <i>Juncus effusus</i> |  | <i>Hermocalis fulva</i> 'Kwanso' |
|  | <i>Juncus inflexus</i> |  | <i>Physostegia virginiana</i> 'summer glow' |
|  | <i>Liriope muscari</i> |  | <i>Rhododendron</i> 'Mootum' / 'Conleo' / 'Robles' |
|  | <i>Iris versicolor</i> |  | <i>Distylium myricoides</i> 'cinnamon girl' |
| | |  | <i>Fothergilla major</i> |
| | |  | <i>Muhlenbergia capilaris</i> 'lenca' |

Conceptual Masterplan

Perspectives

PERSPECTIVES





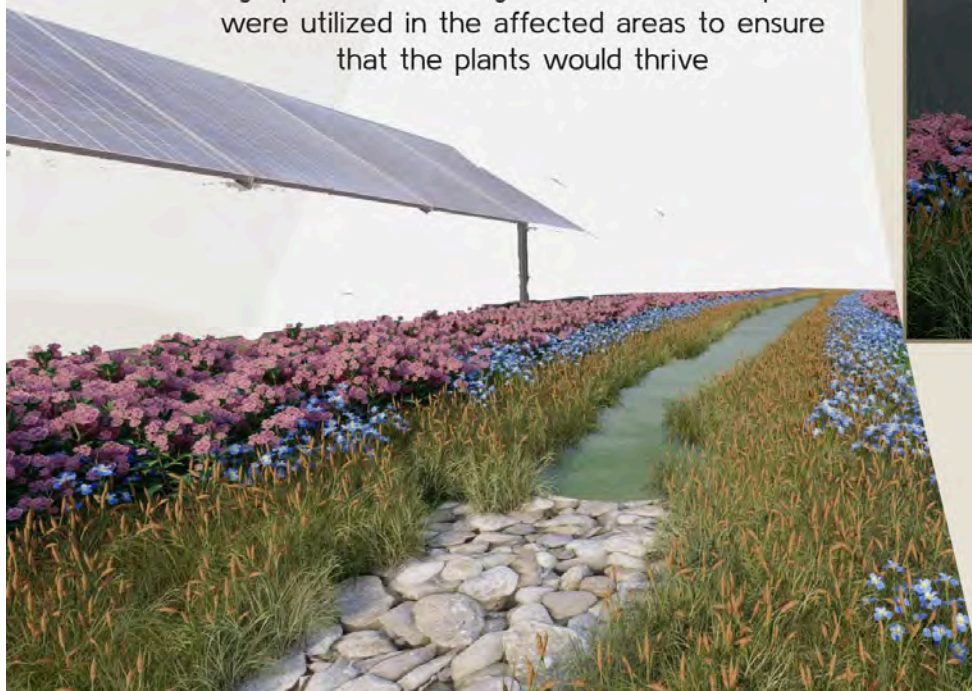


WEATHER AND CONDITIONS



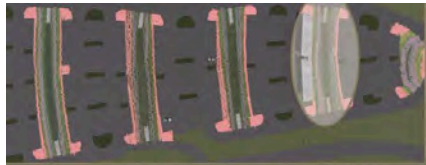
CONDITIONS

During the day, the solar panels can shade a large part of the design - shade tolerant plants were utilized in the affected areas to ensure that the plants would thrive



WEATHER

Rain plays a major part in the design - the addition of solar panels leads to ground damage and erosion which can be quelled by adding deep rooting plants



WATER VIEWPOINT



Maintenance & Education



- We selected these plants with ease of maintenance as a priority in mind.
- For this reason, native species and exceptionally tolerant cultivars comprise the plant palette which by nature are more acclimated to this region leading to increased biodiversity.
- This is beneficial as the plants will be capable of self-regulating and self-propagating on the site without much human intervention, tolerating both wet and dry periods and limited direct sunlight.
- Yearly grass trimming and rhizome redeposition for containment is included in the suggested maintenance plan.

EDUCATION



- Signage for Plant Identification and QR Code signage for website link, public survey, and/or app download.
- 'Bio-Lite' App as a next step information on plant species, ecological functions, and growing conditions for Clemson students and staff as well as the general public.
- Clemson Cooperative could be involved in the app, with possibilities for Master Gardener consultation and feedback for homeowners and landscape professionals.
- This app would also ideally feature information on solar energy and Clemson's solar project.



Selected Design





Demonstration & Signage

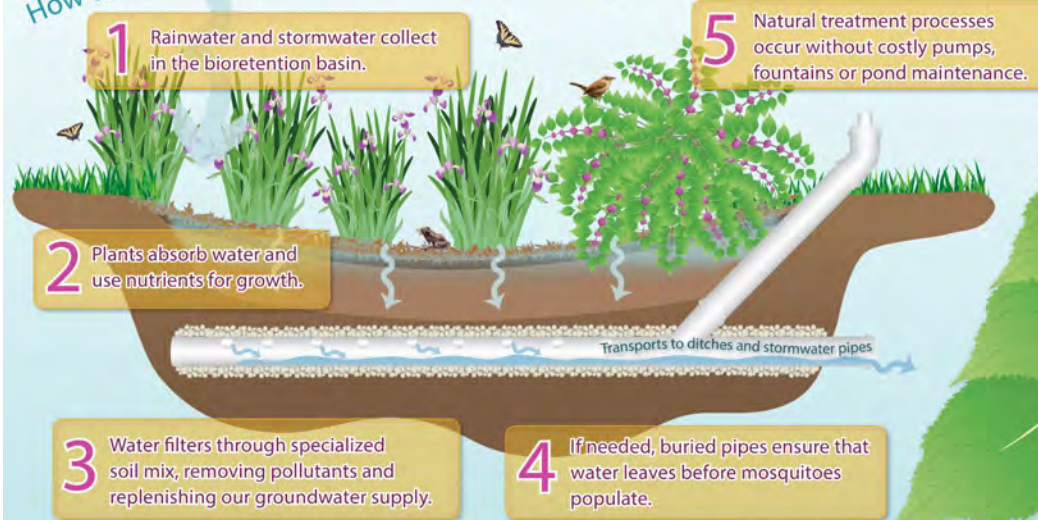
Bioretention Naturally Treating Polluted Runoff

Stormwater is water that originates from **rain events**. Stormwater that does not soak into the ground becomes surface runoff and flows to nearby ditches, storm drains and waterways. Stormwater picks up pollution from the landscape, but does not go to a treatment plant.

bioretention basins are engineered, landscaped depressions that receive stormwater runoff and improve water quality before runoff reaches ditches, storm drains and waterways, or groundwater. These pond alternatives have several benefits:

- Store and absorb water that might otherwise contribute to flooding
- Provide **habitat**
- Beautify the landscape
- Naturally **remove pollutants**:
 - Plants and soil trap metals and sediment
 - Plants use nutrients
 - Engineered drainage removes nitrogen
 - Soil microbes break down pathogens, like bacteria

How does bioretention work?



Planning for the future

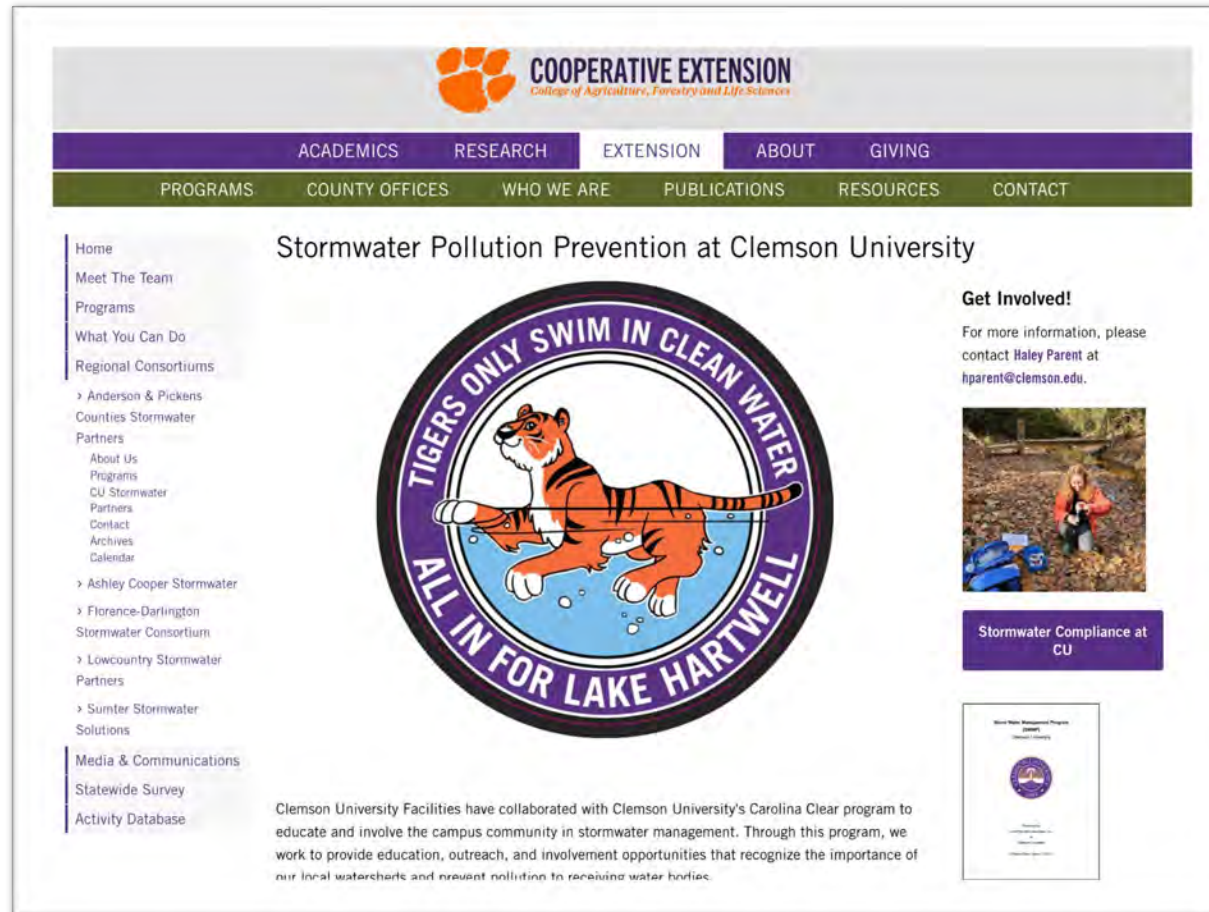


Clemson Community

Thanks to these groups and more that provide collaboration in our education, outreach and public involvement efforts!



Come visit us!



The screenshot shows the Cooperative Extension website with the following content:

- Navigation Menu:** A purple bar with links for ACADEMICS, RESEARCH, EXTENSION, ABOUT, and GIVING. Below it, a green bar contains links for PROGRAMS, COUNTY OFFICES, WHO WE ARE, PUBLICATIONS, RESOURCES, and CONTACT.
- Page Title:** Stormwater Pollution Prevention at Clemson University
- Left Sidebar:** A list of navigation links including Home, Meet The Team, Programs, What You Can Do, Regional Consortiums (with sub-links for Anderson & Pickens Counties Stormwater Partners, Ashley Cooper Stormwater, Florence-Darlington Stormwater Consortium, Lowcountry Stormwater Partners, and Sumter Stormwater Solutions), Media & Communications, Statewide Survey, and Activity Database.
- Central Image:** A circular logo featuring a tiger in the center. The text around the border reads "TIGERS ONLY SWIM IN CLEAN WATER" at the top and "ALL IN FOR LAKE HARTWELL" at the bottom.
- Text Below Logo:** Clemson University Facilities have collaborated with Clemson University's Carolina Clear program to educate and involve the campus community in stormwater management. Through this program, we work to provide education, outreach, and involvement opportunities that recognize the importance of our local watersheds and prevent pollution to receiving water bodies.
- Right Column:**
 - Get Involved!** For more information, please contact Haley Parent at hparent@clemson.edu.
 - Image:** A photograph of a person in a red jacket kneeling outdoors, possibly participating in a field activity.
 - Stormwater Compliance at CU** (Text in a purple box)
 - Small Document:** A thumbnail image of a document titled "Storm Water Management Program" with the Clemson University logo.

<https://www.clemson.edu/extension/carolinaclear/regional-consortiums/apcsp/index.html>



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College of Agriculture, Forestry and Life Sciences

THANK YOU!

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