Green Infrastructure Curriculum Guide (Mini)
A Resource for Infusing Green Infrastructure into AUC Coursework
Version 4 – April 2015

A. Learning Objectives:

With the completion of this curriculum, students will be able to:

1. Define and describe green infrastructure. Identify the key processes and elements of green infrastructure that address stormwater issues, reduce stormwater runoff, and improve water quality.
2. Identify sites where green infrastructure has been (or is planned to be) employed and some of the best practices of its technologies
3. Understand the process of green infrastructure design and be able to apply some of them to complete a design to capture and retain stormwater.

B. Learning Resources

This guide provides a series of resources that will help CAU faculty/staff infuse Green Infrastructure concepts into CAU Engineering Coursework. For each learning topic, resources are provided in the following areas:

- Classroom lecture materials and discussion topics
- Supplemental Readings
- Case Study Material
- Potential Guest lecturers
- Learning Activities (Service learning projects)

Resources available for each of the four course objectives are provided below.

Objective 1: Define and describe green infrastructure . Identify the key processes and elements of green infrastructure that address stormwater issues, reduce stormwater runoff, and improve water quality.

Questions for investigation: What is Green infrastructure? What are the key processes and elements of green infrastructure that address stormwater issues, reduce stormwater runoff and improve receiving water quality?

Classroom lecture materials and discussion topics

Basic Concepts

1. Water runs down hill (carried by gravity), Water is powerful and insistent. Water remembers historic paths. Learn where water's paths used to be - avoid building on those areas. Look around - let the site/land tell you the solutions.
2. Storm sewer pipes all across the country are under-sized for today's demands. Yet, we have spent decades directing every drop of rain into those pipes as quickly as possible. That practice is no longer working, and the effects are becoming evident.

3. Huge costs associated with putting rain into sewage pipes - infrastructure costs and treatment costs. This practice is not sustainable. Falling water tables all across the country – disastrous Do what you can to keep rain out of sewers.
4. Be creative – there is a multitude of solutions: Reconstruct historic streams/flows where possible, Use cisterns to capture water, Consider ponds as amenities that also slow, infiltrate water. Infiltrate, Slow, Capture, Use water - many many ways are possible.
5. Water is a valuable resource, not a waste product.
6. A million teacups will capture enough water. All of them are important. One huge teacup is not likely to exist in developed neighborhoods, such as the AUC.

Core Elements (from Georgia Coastal Stormwater Supplement Chapter 7)

1. Soil Restoration
2. Site Reforestation/Re-vegetation
3. Green Roofs
4. Permeable Pavements
5. Undisturbed Pervious Areas
6. Vegetated Filter Strips
7. Grass Channels
8. Simple Downspout Disconnection
9. Rain Gardens
10. Stormwater Planters
11. Dry Wells
12. Rainwater Harvesting
13. Bioretention Areas
14. Infiltration Practices
15. Dry Swales

Supplemental Readings

Sharon Moran. Cities, Creeks and Environmental Justice, Environmental Justice. June 2010, 3(2): 61-69. doi:10.1089/env.2009.0036. T his article is available for purchase here : http://online.liebertpub.com/doi/abs/10.1089/env.2009.0036

Growing Green: How Green Infrastructure Can Improve Community Livability and Public Health
http://www.americanrivers.org/assets/pdfs/green-infrastructure-docs/growing-green-how-green-infrastructure-can-improve-community-livability.pdf

Green Infrastructure 101 – Resources for the Sustainable Cities Institute:
http://www.sustainablecitiesinstitute.org/topics/water-and-green-infrastructure/green-infrastructure-101

EPA Webcasts: http://water.epa.gov/infrastructure/greeninfrastructure/gi_training.cfm

Elements of Green Infrastructure

Villanova Stormwater Partnership: Research on Green Infrastructure Stormwater Control Measures (SCMs)
http://www1.villanova.edu/villanova/engineering/research/centers/vcase/vusp1/research.html

Section 7, Coastal Supplement to Georgia Stormwater Management Model (pages 166-341)
http://atlantaregional.com/environment/georgia-stormwater-manual (entire manual)

https://epd.georgia.gov/georgia-epd-coastal-stormwater-supplement-stormwater-management-manual link to download Section 7 alone.

Case Study Materials

Not applicable

Potential Guest Lecturers and Site Visits

Walt Ray, Park Pride

Learning Activities

Service learning projects to be performed by engineering classes and campus sustainability clubs.

- Identification of sanitary and storm sewer lines on the AUC campuses- Develop map showing sewer lines with photos, descriptions of major storm sewer-intakes and estimated flows during 1 year, 10 year and 100 year storm events;
- Identifying the relationship between topography and sanitary/ storm sewer alignment on the AUC campuses Walking around the campus to identify how sanitary and storm sewer lines align with low and high elevations on site;
- Indentifying locations of major impervious areas and ratios between pervious and impervious areas at various locations on the campus. Walking around the campus to document downspouts and stormwater inlet locations.
- Identifying the impact of flooding on Proctor Creek neighborhoods through interviews with members of the Proctor Creek Stewardship Council and residents;
- Site visits, visual verification and documentation of the impact of flooding (mold, mildew, stain) in homes in Proctor Creek community; (A series of projects could document impacts of homes and apartments so that the impact on all affected properties in the neighborhood would be eventually documented.)
- Follow-up on ongoing Emory funded project of survey of 150 residences in flood plain areas of English Avenue and Vine City;
- Locating existing springs on the Atlanta University Center college campuses.
- Visual documentation of conditions at the Creek during and after storm events. (when storm begins, 15 minutes after storm begins, 30 minutes after, 1 hour after, 4 hours after, 8 hours after etc.)

(After first run of projects, a complete description of the activity will be added to the curriculum.)

Objective 2: Identify sites where green infrastructure has been (or is planned to be) employed and some of the best practices of its technologies.

Questions to be investigated: Where are some of the sites where green infrastructure has been employed? What are some of the best practices of its technologies? Where might green infrastructure be employed for community benefit?

Classroom lecture materials and discussion topics

To be inserted

Supplemental Readings

Benepe, Adrien. "Parks as Green Infrastructure, Green Infrastructure as Parks: How Need, Design and Technology Are Coming Together to Make Better Cities." *The Nature of Cities*. Sound Science LLC, http://www.thenatureofcities.com/2013/04/17/parks-as-green-infrastructure-green-infrastructure-as-parks-how-need-design-and-technology-are-coming-together-to-make-better-cities/ 17 Apr. 2013. Web. 26 Aug. 2014.

United States. Environmental Protection Agency. Office of Sustainable Development. Enhancing Sustainable Communities with Green Infrastructure. By Melissa G. Kramer. N.p.: n.p., n.d. Smart Growth. US Environmental Protection Agency, 16 Oct. 2014. Web. <http://www.epa.gov/smartgrowth/pdf/gi-guidebook/gi-guidebook.pdf>.

Case Study Materials

Proctor Creek Case Study Materials<<to be inserted>>

EPA Case Studies http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm#tabs-4

Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure
http://www.sustainablecitiesinstitute.org/topics/water-and-green-infrastructure/stormwater-management/green-infrastructure-case-studies-municipal-policies-for-managing-stormwater-with-green-infrastructure

Film Chattahoochee Unplugged. Columbus, Georgia worked to resolve combined sewer overflow (CSO) problems jointly with Phenix City, Alabama. Part of the solution developed included the removal of two small dams on the Chattahoochee which restored an original rapids near town and the creation of a Riverwalk area. http://chattahoocheeunplugged.org

Case Studies from the Green Infrastructure Center:

Case Studies in Virginia www.gicinc.org/projects.htm

Canadian U.S. Bioregion Plan: www.2c1forest.org

The Conservation Fund Green Infrastructure Network: www.greeninfrastructure.net/what_we_do

Florida Ecological Network Program (1995):
www.geoplan.ufl.edu/projects/greenways/greenwayindex.html

Greenprint for King County, WA (March 2005): dnr.metrokc.gov/wlr/greenprint

Maryland GreenPrint Program (2001): www.dnr.state.md.us/greenways/greenprint

Kinston/Lenoir County, NC Green Infrastructure Plan (2002):

www.greeninfrastructure.net/kinston-lenoir_county_profile

Mountains to Sound Project (Puget Sound, WA, 2005):
www.mtsgreenway.org/about/index_html

Massachusetts Biomap Project (2001): www.mass.gov/dfwele/dfw/nhesp/nhbiomap.htm

Metro Greenways Project (Twin Cities, MN, 1997): www.dnr.state.mn.us/greenways/index.html

Natural Connections, Green Infrastructure in Wisconsin, Illinois, and Indiana (2000):
www.greenmapping.org

Pima County Multi-Species Restoration Plan (Pima County, AZ, 2006)
http://rfcd.pima.gov/wrd/sdcp.htm

Prince Georges County, MD Countywide Green Infrastructure Plan (2005):
www.pgplanning.org/Projects/Ongoing_Plans_and_Projects/Environmental/Green_Infrastructure

Saginaw Greenways Initiative Report (Saginaw Bay, MI, 2000):
www.msu.edu/~jaroszjo/greenway/main.htm

Thomas Jefferson Planning Commission District Green Infrastructure Study:
http://www.tjpdc.org/pdf/Environment/Green Infrastructure Report 12-22-09.pdf

Trust for Public Lands Building Green Infrastructure Report:
www.tpl.org/tier3_cdl.cfm?content_item_id=915&folder_id=745

Potential Guest Lecturers and Site Visits

Bill Eisenhauer, Metro Atlanta Urban Watershed Institute (MAUWI) – Atlanta Old Fourth Ward Project

Andrew Walter (ajwalter@atlantaga.gov) with the City of Atlanta DWM. Tour of the McDaniel Branch. This is a green infrastructure project recently completed just south of University Avenue, east of the downtown connector.

Kevin Burke (kburke@beltline.org) with the Atlanta BeltLine Inc.. Tour of H4WP, as a counterpoint to the McDaniel Branch project. This is a much more urban project with a very different approach and result. Before restoration, the site was extremely polluted with lead and other materials, similar to sites in the PNA Study Area.

Learning Activities

Not applicable

Objective 3: Understand the process of green infrastructure design and be able to apply some of them to complete a design to capture and retain stormwater.

Questions to be investigated: What is the process for stormwater system design and how do green infrastructure elements fit into this process? What is the design basis for green infrastructure facility design? .

Classroom lecture materials and discussion topics

More to be inserted

Some Ideas:

- Basic building codes.
- Stream set-backs. 25' for State, 75' for City.
- What happens when a stream is in a pipe? No stream back buffer required. Build on top of the stream.
- Same with floodplains. It's difficult (supposed to be impossible) to build in a floodplain. But, if there's no visible creek, too often a floodplain has not been designated. So, there are no restrictions to prevent construction in vulnerable areas.
- Too often developers don't have the long-term wisdom or incentive to recognize the challenges. There are no legal restrictions to either the initial construction or the renovation of existing construction on sites that obviously should not be supporting housing.

Supplemental Readings

EPA Green Infrastructure Design Tools
http://water.epa.gov/infrastructure/greeninfrastructure/gi_design.cfm

Evaluating and Conserving Green Infrastructure Across the Landscape: A Practitioner's Guide http://www.gicinc.org/book.htm This is an item to be purchased. Design guides are avaialbe for specific states VA, AR, NY and NC.

National Stormwater Calculator (which includes GI elements) http://www2.epa.gov/water-research/national-stormwater-calculator

National Stormwater Calculator Users Guide http://nepis.epa.gov/Adobe/PDF/P100HD4J.pdf

Case Study Materials

Not applicable

Potential Guest Lecturers and Site Visits

Greg Delaney, Eberly and Associates

Site Visit to upper sites in the sub-watershed. Parsons Street at John Hope Drive (design site visit) Park Pride spoke at length with the Integral development team about the project they had planned for that site (summer, 2010 - during the PNA Study). They ended up building their new project in the low spot that we show on our study as needing to be stream bed. In fact, they dug

out the hillside next door to raise the swampy site so they could build apartments. Thus ruining the higher site, spending countless extra dollars raising the site, and prohibiting the new stream from ever being constructed. When, they could have built on the just as vacant lots next door, allowing the water to flow naturally. - It's important to learn from this lesson. Even educating good-minded developers is not enough.

Learning Activities

Development of Conceptual Designs for AUC Campus (After first run of projects, a complete description of the activity will be added to this curriculum.)

C. Evaluation Materials

<<Insert information about general evaluation process>>

Evaluation of Specific Learning Objectives

Resources for the evaluation of each of the specific learning objectives are provided below.

Evaluation of Objective 1

1A. Assuming student pre-test knowledge is essentially zero, develop post test questions to evaluate knowledge of subject area around the learning objective:

- Define and describe green infrastructure. Identify the key processes and elements of green infrastructure that address stormwater issues, reduce stormwater runoff, and improve water quality.

Evaluation of Objective 2

2A. Assuming student pre-test knowledge is essentially zero, develop post test questions to evaluate knowledge of subject area around the learning objective:

- Identify sites where green infrastructure has been (or is planned to be) employed and some of the best practices of its technologies

2B. Since a large part of this objective also involves learning activities, develop evaluation criteria (scoring) for learning activities. Elements scored might include demonstrated knowledge of technical concepts embodied in the project, creativity, student understanding of technical concepts embodied in the project.

Evaluation of Objective 3

3A. Assuming student pre-test knowledge is essentially zero, develop post test questions to evaluate knowledge of subject area around the learning objective:

- Understand the process of green infrastructure design and be able to apply some of them to complete a design to capture and retain stormwater

3B. Since a large part of this objective also involves the development of a conceptual design project as a learning activity, develop evaluation criteria (scoring) for learning activities. Elements scored might include demonstrated knowledge of technical concepts embodied in the project, creativity, student understanding of technical concepts embodied in the project.