

UGA'S GREEN INFRASTRUCTURE PLAN: STUDENT ENVISIONED PLANS TO IMPROVE ECOSYSTEM SERVICES ON CAMPUS

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Abstract. Graduate students from the “Nature and Sustainability” studio course at UGA’s College of Environment and Design created Green Infrastructure Plans for UGA’s Campus. Objectives of this service learning project included gathering inventory information, analyzing existing conditions, garnering stakeholder input and crafting plans at two scales. Students individually prepared campus wide plans, and then created site plans for a specific area. These proposed interventions were based on creating or enhancing a network of linkages and hubs (corridors and patches), otherwise known as Green Infrastructure, which supports ecosystem services such as water and nutrient cycling. Unfortunately, legacy land use and substantial impermeable area on campus hinders ecosystem function. In order to reverse these trends to approach a more sustainable trajectory, students sought to preserve, enhance and/or restore critical ecosystem services. This planning process may inform future planning efforts undertaken by the Office of University Architects to improve the green infrastructure of campus and further sustainability goals.

INTRODUCTION

The University of Georgia, like many other land grant institutions, has recently implemented a variety of practices intended to approach sustainability on campus. Despite many improvements in water quality, “waste” and energy management, no overarching planning document suggesting physical forms currently guides these interventions. Students created plans by balancing ecological function and campus redevelopment.

Unfortunately, like many other campuses, land use change has resulted in defragmentation and habitat loss of natural areas. Modified soils, reduced vegetative cover and increased imperviousness threaten ecosystem services. Recently, several integrated management practices, such as rain gardens and bioswales, were constructed in conjunction with campus and municipal construction projects. However, no unifying planning strategy exists to

place these interventions into a green infrastructure context that maximizes potential ecosystem services. For example, the recently constructed Brooks Mall section of the Green Mile has many benefits such as reducing imperviousness and reintroducing vestiges of indigenous plant communities, but may not fully support green infrastructure principles. Students’ plans strengthen these existing efforts by producing overarching plans to address green infrastructure planning at the campus and site scales. Students were guided by stakeholders and the latest campus master plan when preparing green infrastructure plans.

Green infrastructure uses the terms linkages and hubs (Benedict and McMahon 2006) to describe the terms familiar to landscape ecologists: corridors and patches (Forman 1995). Either way, these terms describe the landscape mosaic that supports ecological function, which may be impaired on campus because of historic land use changes and development over the past several centuries. For example, streams and riparian buffers were channelized or filled to create much of the existing campus visible today. These modifications impact much of the stream and second growth riparian forest network that remains only in a few locations on campus.

Students prepared plans that identified and preserved remaining hubs and reconnected these fragmented landscapes with linkages to improve the ecological function of these areas. Designs at the site scale were calibrated with specific modeling of ecosystem services when feasible. Working at different scales is beneficial because both a guiding vision and site specific interventions can guide future redevelopment. Green Infrastructure Assessments have also been prepared at various scales to suggest optimum connectivity and prioritize preservation areas (Weber, Sloan et al. 2006). The overall approach seeks to harmonize many of the necessary ecological functions within the context of human settlement patterns, without mutually excluding the other (de Groot, Alkemade et al. 2010).

METHODS

The overall process of this project included the preparation of a campus wide plan bolstered by site designs that articulated how green infrastructure goals and objectives might be implemented on campus. In this graduate landscape architecture studio, students performed inventory and analysis phases to inform design development phases. Analysis informed conceptual plans and were based on integrating green infrastructure goals and objectives. Students relied on faculty and stakeholder feedback and refined their plans into illustrative campus plans. Then, each student selected an area of interest and created a site plan. Plans were then presented to stakeholders and the public.

The first phase of the project included several in class lectures and relevant reading assignments that introduced the principles of landscape ecology, green infrastructure and Low Impact Development. Students then self-organized into groups to ascertain policy (regulations) and locate case studies, while a second group conducted stakeholder input sessions. The third group gathered inventory information for subsequent analysis. Students shared information through in class presentations and also posted findings. Stakeholder information was distilled and incorporated into a draft program that guided the green infrastructure planning effort.

The next phase of the project included the analysis of the extensive inventory data compiled by the inventory group. Students were encouraged use GIS to display and analyze information that resulted in suitability plans to further specific goals and objectives as shown in Figure 1.

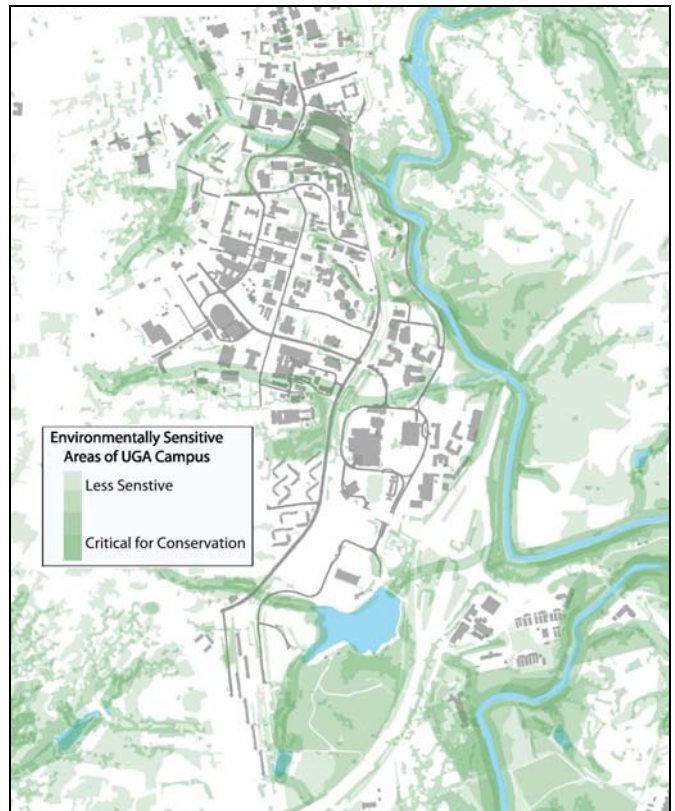


Figure 1. Suitability analysis illustrating existing conditions for environmental suitability (Illustration by R. Johnson, 2010).

Suitability analysis relies on analyzing characterizing environmental attributes that may or may not support planning goals (McHarg and American Museum of Natural History, 1969). By either combining or weighting different attributes (Lyle 1985), students were able to identify existing hubs and linkages and then propose opportunities to recreate or connect these areas (Weber and Allen 2010).

Students utilized this information to prepare campus plans. Each student created criteria for their individual planning effort consistent with green infrastructure goals. Hubs were identified and then a network of linkages were envisioned to reconnect many of these fragmented landscapes and promote human health (Benedict and McMahon 2006; Tzoulas, Korpela et al. 2007) in the campus environment. These criteria were merged with site constraints and opportunities using gestalt synthesis to create a campus plan (Ndubisi 2002). Plans were presented to stakeholders and peers during studio critiques. Plans were revised on feedback and then central elements of each individual site plan were distilled into a single conceptual campus plan.

Site plans focused on preparing a plan for the year 2050. A time span of almost two generations from now would enable the students to reconfigure buildings and associated gray infrastructure such as utilities and

parking. And this timeframe would also allow for envisioning solutions that can adapt to climate change (Mooney, Larigauderie et al. 2009). Site design elements were rough graded and when feasible, footprints of rain gardens or water harvesting were verified using sizing models (Jones 2008) to lend authenticity to the plan.

These planning documents were shared with stakeholders in a poster style presentation where students interacted with stakeholders who offered feedback. Students then reflected on the feedback as the final part of this service learning project.

RESULTS AND DISCUSSION

The three student groups assembled abundant data to inform the campus and site green infrastructure plans. The policy group was able to compile municipal, state and federal regulatory and planning frameworks. They also reviewed other campus master plans and selected five case studies to ascertain what other institutions have compiled. Although students were unable to locate any campus case studies for less urban campuses that specifically addressed green infrastructure, similar themes were selected and included either sustainability or stormwater plans based on Low Impact Development (Prince George's County (Md.) Dept. of Environmental Resources 2000).

The inventory group assembled information such as soils, hydrology, existing impervious areas (buildings, roadways, sidewalks and plazas) and utility locations. Much inventory and analysis information was extracted from the various GIS databases skillfully maintained by the UGA Office of Architects. Local, state and federal data sources included Athens-Clarke County and the Georgia GIS Clearinghouse. Additional data, such as high resolution imperviousness, which seem uncommon in many municipal data sets in the southeast, were also utilized. Typical analyses included hydrologic properties for soils, aspect and slope mapping in addition to other data synthesis that underpins suitability mapping.

The basis for suitability mapping relied on class lectures and relevant literature to combine these data for meaningful output. For example, students compiled a variety of impervious surfaces with utility corridors to analyze fragmentation patterns. An example using hand drawn overlays produced similar results as shown in Figure 2.

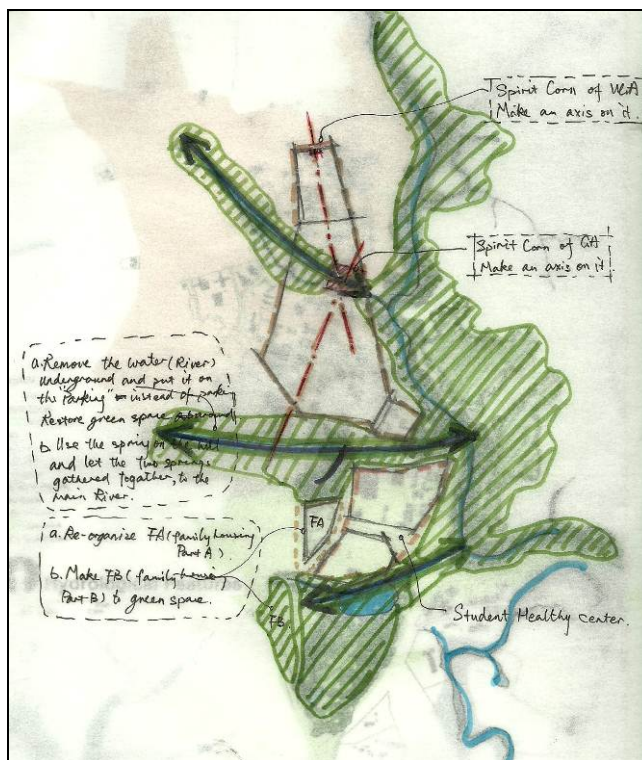


Figure 2. Process sketch illustrating possible connectivity using riparian corridors as an armature in the Green Infrastructure Process (Illustration by Y. Sun, 2010).

Then, in the design phase, students identified hubs and suggested linkages to reconnect fragmented landscapes as shown in Figure 2. Although the ability to create linkages and reconnect hubs was mediated by the likelihood of relocating infrastructure and structures, such as the seventh largest college football stadium that straddles a culverted stream section, students produced campus wide plans as shown in Figure 3.

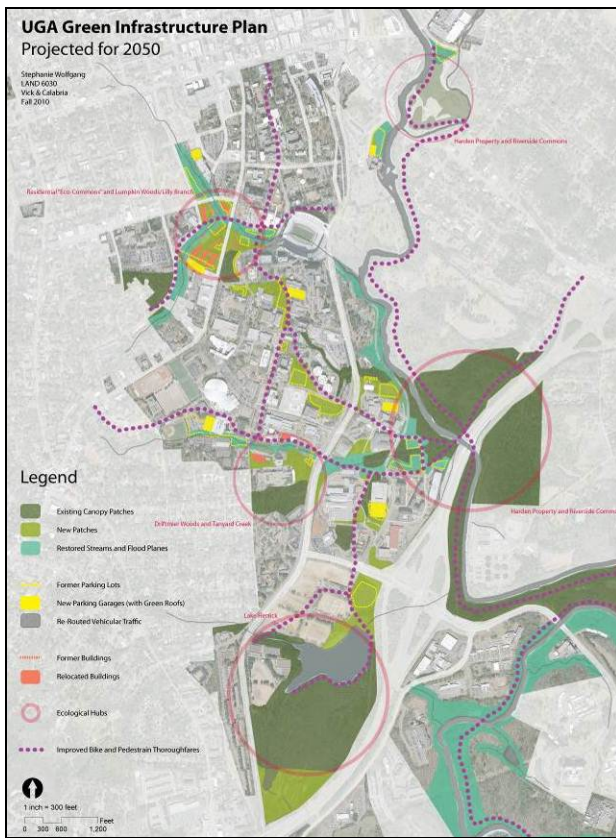


Figure 3. Campus Plan representing hubs (illustration by S. Wolfgang, 2010)

Students also designed site plans as shown in Figure 4. Many students choose to incorporate stormwater practices to improve water quality and encourage infiltration to augment stream baseflow. Although students struggled to mitigate impacts from impervious areas, they ran several models to quantify ecosystem service changes as a result of their design interventions when feasible.

Students calculated the measurable change in ecosystem services resulting from the proposed interventions with various models. Examples of specific metrics included before and after measures of: volume of stormwater runoff infiltrated on-site, volume of stormwater runoff filtered or re-used on-site, area of native vegetation, site imperviousness, floodplain storage provided, and species diversity. Students were also aware that monitoring should be an integral component to truly assess interventions (Windhager, Steiner et al. 2010). The implementation and monitoring also corresponds with the land grant institutions' responsibility of demonstrating these projects for a larger audience.

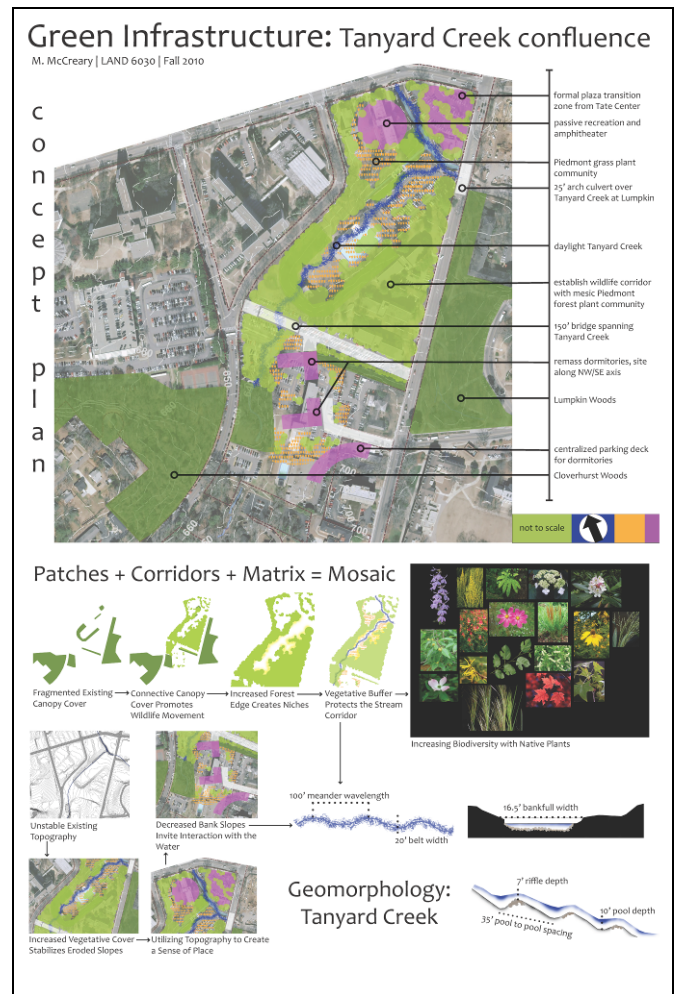


Figure 4. Example of GI Site Plan suggesting GI intervention (illustration by M. McCreary, 2010).

Students anonymously indicated on course evaluations that they were challenged to not only design interventions to improve ecosystem services, but also quantify proposed changes on a 'real' site with involvement from stakeholders who have the potential to implement components of their designs.

CONCLUSION

Under the direction of their professors and with meeting facilitation from the Center for Community Design and Preservation, students produced meaningful plans that integrated green infrastructure concepts within campus planning opportunities and limitations. Although these challenging interventions might remain unfunded; components of each of these plans might be implemented over the next several decades as new campus projects emerge and "conventional" infrastructure is upgraded or replaced. The student based plans may underpin many of these improvements.

ACKNOWLEDGEMENTS

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LITERATURE CITED

- (U.S.), F. I. S. R. W. G. (1998). Stream corridor restoration : principles, processes, and practices. [Washington, D.C.?], Federal Interagency Stream Restoration Working Group.
- Benedict, M. A. and E. T. McMahon (2006). Green Infrastructure: Linking Landscapes and Communities, Island Press.
- de Groot, R. S., R. Alkemade, et al. (2010). "Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making." Ecological Complexity 7(3): 260-272.
- Forman, R. T. T. (1995). Land mosaics : the ecology of landscapes and regions. Cambridge ; New York, Cambridge University Press.
- Jones, M. (2008). Rainwater Harvester. Raleigh, NC, Biological and Agricultural Engineering Department, NCSU.
- Lyle, J. T. (1985). Design For Human Ecosystems: Landscape, Land Use, and Natural Resources. New York, Van Nostrand Reinhold.
- McHarg, I. L. and American Museum of Natural History. (1969). Design with nature. Garden City, N.Y., Published for the American Museum of Natural History [by] the Natural History Press.
- Mooney, H., A. Larigauderie, et al. (2009). "Biodiversity, climate change, and ecosystem services." Current Opinion in Environmental Sustainability 1(1): 46-54.
- Ndubisi, F. (2002). Ecological planning : a historical and comparative synthesis. Baltimore, Johns Hopkins University Press.
- Palmer, M. A. and J. D. Allan (2006). "Restoring Rivers." Issues in Science & Technology 22(2): 40-48.
- Prince George's County (Md.) Dept. of Environmental Resources, P. a. P. D. (2000). Low-Impact Development Design Strategies, Prince Georges County, MD.
- Schrijnen, P. M. (2000). "Infrastructure networks and red-green patterns in city regions." Landscape and Urban Planning 48(3-4): 191-204.
- Tzoulas, K., K. Korpela, et al. (2007). "Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review." Landscape and Urban Planning 81(3): 167-178.
- Weber, T., A. Sloan, et al. (2006). "Maryland's Green Infrastructure Assessment: Development of a comprehensive approach to land conservation." Landscape and Urban Planning 77(1-2): 94-110.
- Weber, T. C. and W. L. Allen (2010). "Beyond on-site mitigation: An integrated, multi-scale approach to environmental mitigation and stewardship for transportation projects." Landscape and Urban Planning 96(4): 240-256.
- Windhager, S., F. Steiner, et al. (2010). "Toward Ecosystem Services as a Basis for Design." Landscape Journal 29(2): 107-123.