



**Title:** Stream Ecology, Restoration and Aquatic Education

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**Organization:** Clemson University

**State:** SC

**Region:** Southern

**Year of Funding:**

**Theme:** Environmental Restoration

**Situation:** South Carolina was beginning to consider stream restoration projects. Concern developed because few of the agency personnel involved in stream restoration permitting, mitigation crediting, or evaluation had training in stream restoration techniques. Academically, no universities in South Carolina had taught courses covering stream restoration using natural design and no stream ecology courses had been taught that addressed the biological, chemical and physical assessment of altered streams. No outreach efforts had been made to Extension or private land managers.

**Objectives:** To train agency and Extension personnel in stream restoration that uses natural channel design including the evaluation of stream bank stability, erosion potential, restoration options, surveys, design, permitting, construction, riparian planting and monitoring. To educate graduate and undergraduate students in Stream Ecology and Landscape Design courses on how natural streams and their riparian zones function. To provide outreach programs for private and public land managers on restoration, riparian management, and stream water quality protection.

**Methods:** A five part series of 2-3 day workshops was provided. Each workshop was 80% hands-on and covered every aspect of stream restoration. Workshop participants evaluated a restoration site, developed a design, participated in permitting, were on site for two days of construction and participated in monitoring, and riparian zone design and planting. Graduate students and students of the Stream Ecology class monitored sediment transport, fecal coliform contamination, biological integrity and macroinvertebrate colonization of the restoration reach. Landscape Design classes located and planted trees and shrubs. One hundred water oaks were planted in the Strom Thurmond Oak Grove on Strom Thurmond's 100th birthday. We are developing a self-guided tour of the restoration site and a web page is active that provides most of the Power Point presentation from the workshops and time-lapse photos of the channel since construction.

**Partnerships:** University based workshop trainers were from Clemson University departments of Forest Resources, Aquaculture Fisheries and Wildlife, Biological Sciences and Baruch Institute. Workshop trainers from North Carolina State University came from the departments of Agricultural Engineering and Landscape Architecture and Extension. South Carolina Agency trainers were from the Department of Natural Resources and Department of Health and Environmental Control. The restoration project was constructed on Clemson University Simpson Experimental Farm. We are initiating a partnership with NRCS to construct a cattle crossing above the restoration site. We also partnered with two private consulting companies. One assisted with education and design. The other directed restoration construction.

**Research:** Research goals were to determine if the stream restoration would: 1. Reduce erosion and improve sediment transport, and improve biological integrity and functioning of this stream. Research started at the restoration site one year before construction. Sediment transport, fecal coliform contamination, fish and macroinvertebrate community structure have been evaluated for two years and will be followed for three more. Two graduate students have been working on this project. Three presentations have been presented by students at professional meeting. The restoration site was the focus and main field laboratory for graduate and undergraduate courses in Stream Ecology. Four members of the graduate level class conducted a special project at this site and presented their findings to a meeting of the Clemson Facilities Managers. Private consultants, mitigation bankers, short course participants from other states, Clemson University classes from the Departments of Aquaculture, Fisheries and Wildlife, Geology, Environmental Systems Engineering, Agriculture and Biological Engineering and Environmental Toxicology are touring the restoration site. Clemson University students attended the series of workshops on stream restoration and assisted in the field and workshops with training. Workshop trainers also provide lectures and field training to the Stream Ecology courses and served as an invited speaker to the Biocomplexity course.

**Resources:** Because of our involvement with this project our lab is well known for our monitoring capabilities of restoration sites and we have secured several contracts to evaluate mitigation work. We were invited to become part of the Changing Land Use and the Environment project (CLUE). This project funds a technician trained in stream restoration, to apply principles such as channel stability and erosion evaluation, fecal and biological assessments to changing landscapes. Because of requests for our services the university has allowed us to become a state certified laboratory in fecal coliform monitoring and macroinvertebrate bioassessment.

**Results:** In the stream restoration using natural channel design project, we have formally trained approximately 30 regional agency personnel, 5 people with extension responsibilities, and 19 graduate and undergraduate students. We have had over 100 site visits with tours lasting approximately one hour. We have provided five workshops, a Stream Restoration Using Natural Channel Design Workbook, a web site and a demonstration site with self-guided tour. A graduate student has written a M.S. thesis on her work and submitted two articles for publication. Two graduate students have presented research on the restoration site at two different professional meetings. The project director has presented two papers at professional meeting on the restoration project. The restoration project site continues to be used as a classroom for many different disciplines. Because this restoration site is located near Clemson University it will be frequently used as a demonstration site for agricultural outreach education focusing on grazing animal management, riparian zone management, water quality and stream restoration.



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