

**The University of North Carolina at Chapel Hill's
Battle Grove Regenerative Stormwater Conveyance**

In 2016 the University of North Carolina at Chapel Hill (UNC-CH) completed a project to improve downstream water quality by restoring a stream on campus. The stream, located in a low-lying landscaped area on the campus, was filled in and replaced with a pipe in the 1930s. This project removed the pipe to daylight the stream, enhanced the buffer, and constructed a regenerative stormwater conveyance (RSC). The RSC technique straddles the fields of stormwater management and stream restoration by providing flow conveyance and water quality treatment in a constructed network of sand seepage berms, vegetated pools and stone weirs. The project reduces nitrogen, phosphorus, and sediment loading from the upstream, existing development, to Battle Branch and downstream water bodies, including impaired segments of Bolin Creek, Little Creek and the Upper New Hope Arm of Jordan Lake. Jordan Lake serves as a water source for several Triangle-area communities and has been identified as impaired due primarily to nutrient over-enrichment.

A secondary objective of the project was to provide data to support the use of Regenerative Stormwater Conveyances in North Carolina and quantify pollutant removal provided by the practice. UNC-CH partnered with North Carolina State University (NCSU) to implement a paired watershed monitoring study that compares the 20-acre watershed treated by the RSC to the adjacent 19-acre watershed. Pre-project monitoring was completed in 2015, with post-project monitoring starting the fall of 2017 and continuing through mid-2018. Due to dry conditions, no post-project monitoring data are available at this time. UNC-CH has also established a long-term macroinvertebrate monitoring station downstream from the site.

Other project objectives included creating a natural corridor between the Coker Arboretum upstream and Battle Park downstream which reduces long-term maintenance, creates a habitat for pollinator species and adds edible landscaping. UNC-CH has a dedicated grounds and stormwater maintenance staff that will ensure the successful establishment this naturalized corridor with maintenance of plantings and removal of invasive species. Maintenance and engineering staff work together to monitor the function of the RSC and adjust and repair components as needed.

As part of its outreach and education program, UNC-CH stormwater staff regularly work with students from UNC-CH, NCSU and the greater community to provide hands-on educational experiences. The Battle Grove Project site now serves the campus as a living-learning laboratory where students can learn about watersheds, the impacts of urbanization on streams, rivers and lakes, and mitigating these impacts with engineered stormwater control measures. Since the project was completed in 2016, several class tours and a class project have been completed on the site. In addition, an undergraduate intern developed an informational sign that has been installed on the site, posters and pamphlets, and a lesson plan to be used by Morehead Planetarium staff for afterschool and summer programs.

Over the past 15 years, UNC-CH has constructed innovative stormwater control measures- such as green roofs, permeable pavement and cisterns - and provided access to them as examples for the professional community. This will also be done with the RSC. Additionally, NCSU plans to offer RSC design workshops that combine findings from this and other sites.

It can be particularly challenging to manage stormwater from the 220-year-old ultra-urban campus that was developed long before stormwater regulations came into place. UNC-CH is completing retrofit and restoration projects to improve water quality as opportunities arise, partnering with other federal, state, and local agencies to leverage funding. The Battle Grove RSC project was completed with funding from a Clean Water Act Section 319(h) Grant and the UNC-CH Energy Services Stormwater Utility.

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Supporting Information**



Figure 1. Late Summer Blooms at the Recently Completed Battle Grove RSC

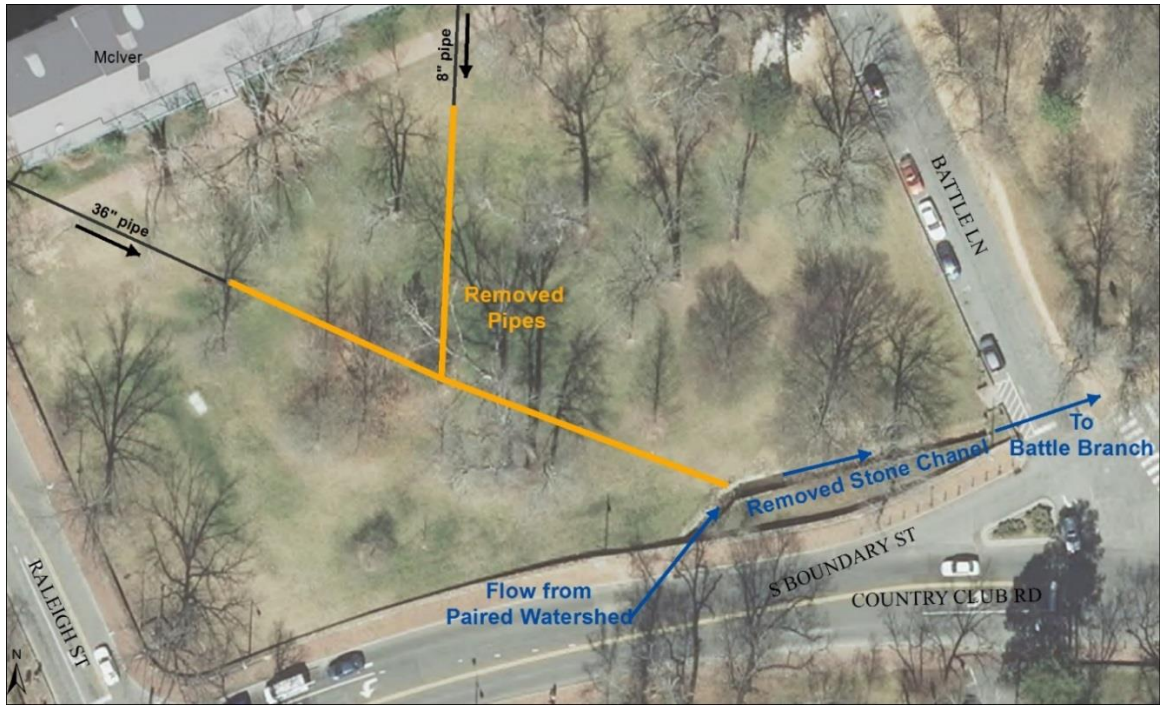


Figure 2. Several pipes and stone channels were removed from the site (shown here in pre-project condition).



Figure 3. While the pool and riffle complex was constructed, the stream was routed through a side-channel.



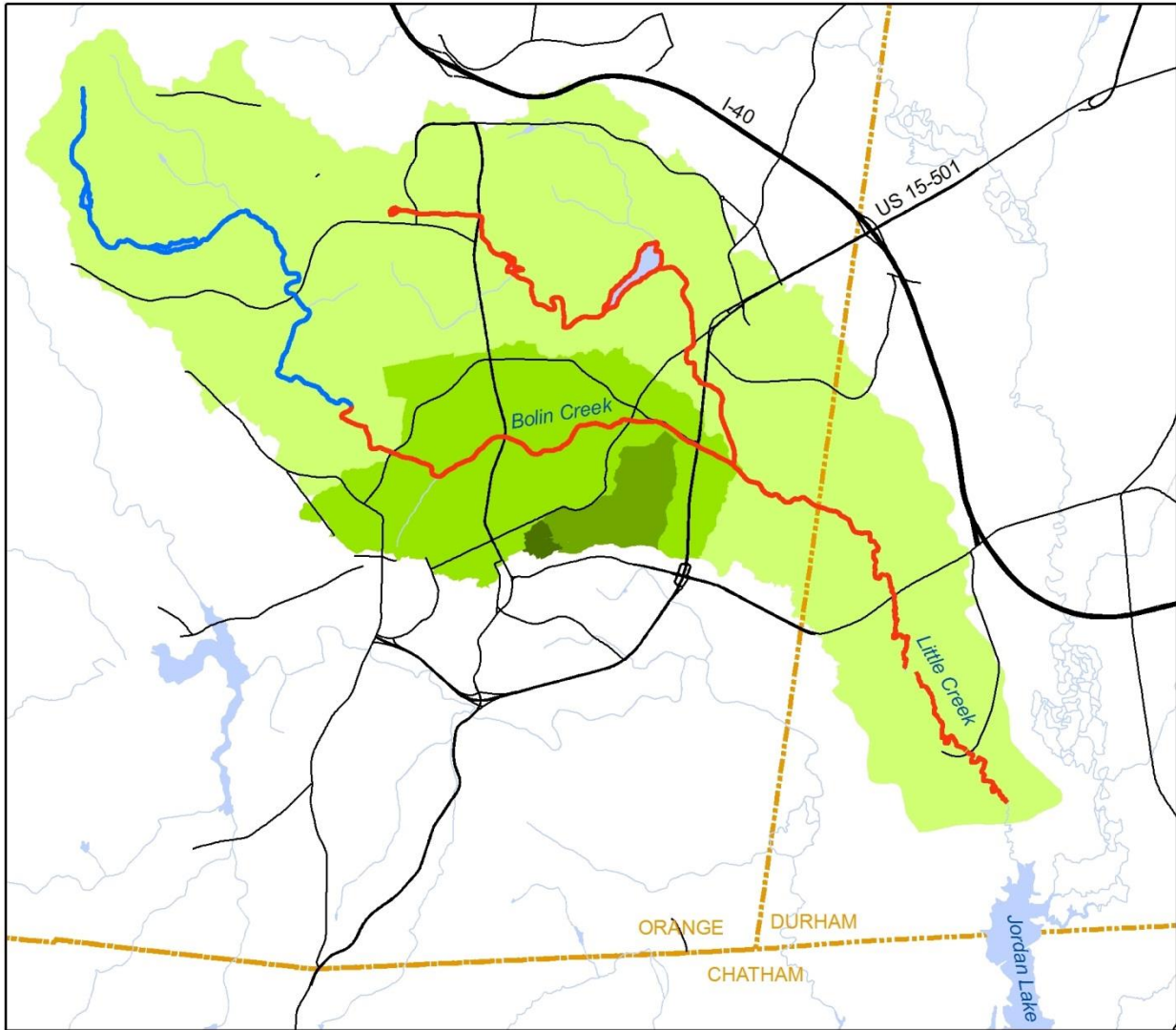
Figure 4. Pre-project (left) and post-project (right) views of the Battle Grove Site.



Figure 5. NCSU staff installing monitoring equipment at the site.



Figure 6. Several UNC classes have toured the Battle Grove site.



Legend

Watersheds

- Project Drainage Area
- Battle Branch
- Bolin Creek
- Little Creek

Water Quality Ratings

- Impaired
- Supporting

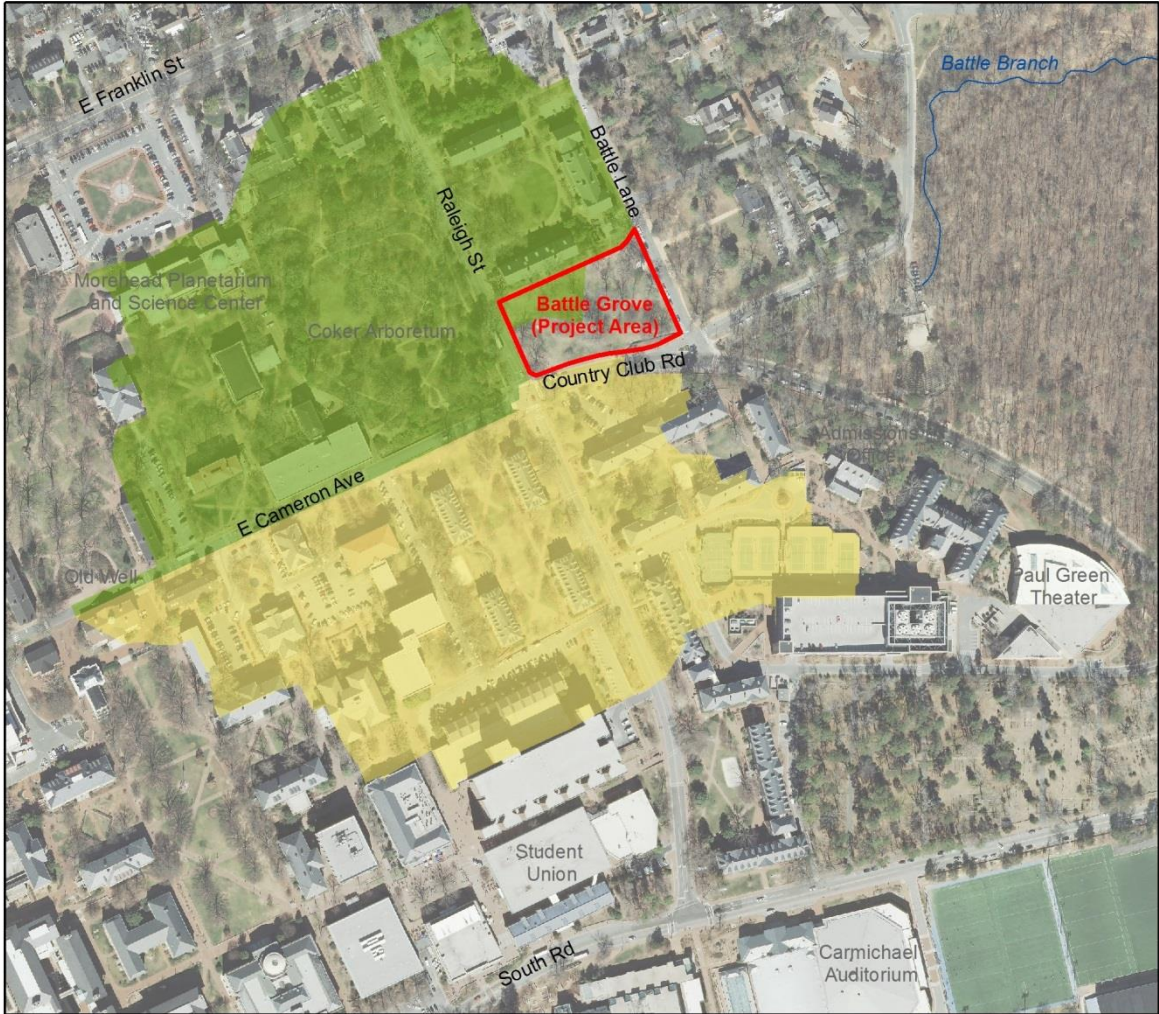
Waterbodies

- Waterbodies
- Streams
- Interstates
- Major Roads
- County Boundaries

N

 1 inch = 8,000 feet

Figure 7. The Battle Grove site discharges water to impaired streams before eventually reaching Jordan Lake.



Legend

- Treated Watershed
- Paired Watershed

2013 Aerial Photo



1 inch = 400 feet

Figure 8. Watershed for the RSC (treated watershed) and adjacent, paired watershed for water quality study.