CHARLOTTE-MECKLENBURG STORM WATER SERVICES

Little Sugar Creek Stream and Floodplain Restoration

Charlotte, North Carolina

The restoration took advantage of re-claimed floodplain by designing a unique restoration with high sinuosity and low width/depth ratio.

Biohabitats provided Charlotte-Mecklenburg Storm Water Services with turn-key services to design North Carolina's first urban wetland/water quality basin Best Management Practices (BMP) in the headwaters of Little Sugar Creek. This degraded, urban stream had been impacted by channelization and the encroachment of development upon the floodplain. The team's approach to improving water quality involved the restoration of Little Sugar Creek, and the creation of a series of floodplain riparian wetlands using a natural systems approach.

Key components of this 2,000 linear foot project included an aggressive schedule, the need for a creative and innovative BMPs, and communication of the benefits of the demonstration project to the public, media, regulators and elected officials. Biohabitats met these challenges by designing an integrated system using natural channel design principles and wetland restoration techniques relying on a self- supporting hydrologic regime. Riparian and wetland revegetation included the use of soil bioengineering and native trees, shrubs and ground cover indigenous to the Piedmont province of North Carolina.

Biohabitats' responsibilities included fluvial geomorphologic assessment, development of concept alternatives, final design and construction documents for the restored stream and floodplain, permitting, and construction oversight.

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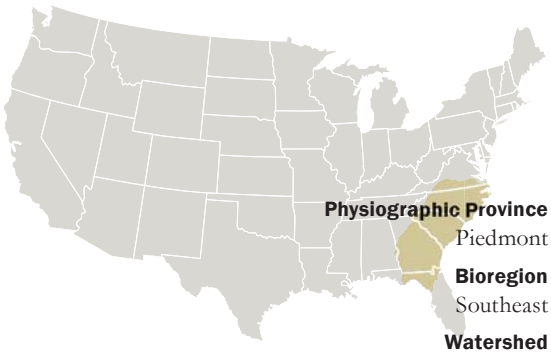

Physiographic Province
Piedmont
Bioregion
Southeast
Watershed
Lower Catawba

NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

Brown Branch Stream Restoration

Caldwell County, North Carolina

The restoration of Brown Branch incorporates a holistic approach to reconnecting the ecological processes of the floodplain with the geomorphological process of the stream channel.

Biohabitats worked with the North Carolina Ecosystem Enhancement Program to restore approximately 6,000 linear feet of Brown Branch, a tributary to Mulberry Creek. Brown Branch was historically ditched and relocated to one side of a grazed alluvial valley. Entrenched into its former stream deposits, the stream had lost connectivity with its floodplain and proceeded to widen via chronic bank erosion.

Biohabitats' restoration design involved re-meandering the channel through the open valley fields, establishing a low floodplain surface, and revegetating the riparian area with native species. The design also sought to preserve existing recreational opportunities at a 4-H camp on site.

Restoration strategies incorporated natural channel design, fluvial geomorphologic principles and soil bioengineering techniques. Biohabitats' plan included in-stream design techniques such as log vanes, J-hooks, root wads, rock cross vanes, log bank protection and log J-hooks. To create a mosaic of wetland and forested communities, complex floodplain grading included depressions left where the existing channel was abandoned. Standing snags, brush piles and downed logs were also left along the floodplain to increase habitat diversity and wetlands. Permanent fencing and watering facilities were installed to restrict livestock access to the restored channel.

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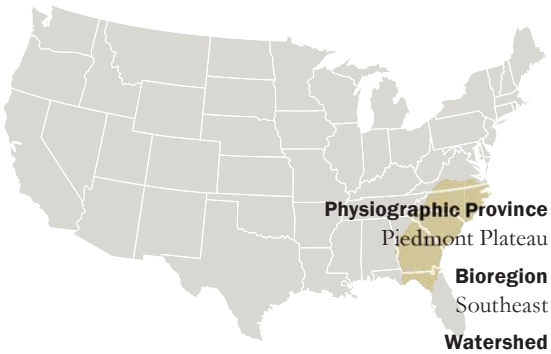

Physiographic Province
Piedmont Plateau

Bioregion
Southeast

Watershed
Upper Catawba

U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT
CITY OF PITTSBURGH, DEPARTMENT OF CITY PLANNING

Nine Mile Run Aquatic Ecosystem Restoration

Pittsburgh, Pennsylvania

"Perhaps the most striking opportunity noted for a large park is the valley of Nine Mile Run," wrote renowned landscape architect Frederick Law Olmsted Jr. in his 1911 Master Plan.* Over the next 90 years, the Nine Mile Run valley was under constant assault from both urban and industrial development. Crumbling and leaking infrastructure, encroaching urban development and over 20 million tons of slag all found their way into the Nine Mile Run stream valley.

A two-mile reach of a highly degraded urban stream in the heart of Pittsburgh has been transformed into a riverine park with thriving natural systems and enhanced recreational amenities.

In the early 2000s, Pittsburgh City Government officials began exploring new uses of the site. One of the products of this exploration was a bold vision to restore the ecological integrity of Nine Mile Run and establish a permanent greenway connection between Frick Park and the Monongahela River. Under the U.S. Army Corps of Engineers Section 206 Ecosystem Restoration program, Biohabitats was commissioned to develop a comprehensive ecological restoration plan for Nine Mile Run and its riparian corridor.

Biohabitats helped prepare an Ecosystem Restoration Report and Environmental Assessment and then developed a comprehensive ecological restoration design and construction package for the project. The project included stream channel restoration, stream channel daylighting, wetland restoration, riparian habitat restoration, invasive species management, water quality best management practices, and park infrastructure improvements including athletic fields, trails and interpretive signs.

**Frederick Law Olmsted, Jr. (1911) Pittsburgh Main Thoroughfares and the Down Town District; Improvements Necessary to Meet the City's Present and Future Needs. Pittsburgh Civic Commission Report.*

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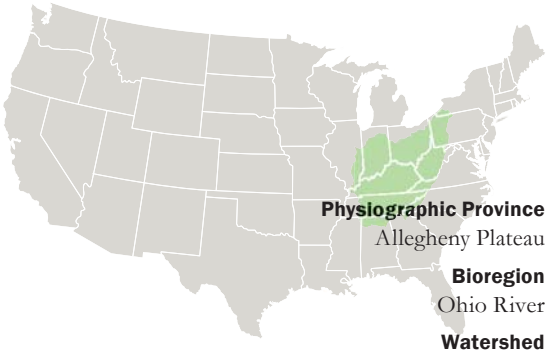

Physiographic Province
Allegheny Plateau

Bioregion
Ohio River

Watershed
Monongahela River

THE UNIVERSITY OF VIRGINIA

Stream Daylighting at the Dell

Charlottesville, Virginia

Nelson Byrd Woltz Landscape Architects

Over 1,200 feet of stream were daylighted and brought back to life in combination with an integrated stormwater management strategy.

The University of Virginia sought to be on the cutting edge of stormwater management. As a responsible neighbor to the City of Charlottesville, the University had a stormwater master plan prepared. The plan was unique in Virginia in that it addressed stormwater on a regional, rather than site-specific basis. Stormwater management techniques implemented at the Dell were part of an overall plan to minimize flooding downstream of the University grounds. This approach was the first of its kind to be approved by the Virginia Department of Conservation and Recreation.

The purpose of the Stream Daylighting Plan at the Dell was to provide water quantity and quality benefits and to refurbish a multipurpose recreation area at one of the "front doors" of the University of Virginia. Specifically, the plan addressed stormwater quality and quantity issues as part of a campus-wide regional stormwater master plan. It allowed for the preservation of a forested floodplain corridor downstream at the new basketball arena site and daylighted approximately 1,100 linear feet of stream channel through the site. The daylighting project provided improved recreational amenities such as tennis, basketball, picnicking, and space for informal lawn games. It also created an educational resource and learning laboratory for students in the School of Architecture and College of Arts and Sciences.

Biohabitats, in collaboration with Nelson Byrd Woltz Landscape Architects, restored The Dell to a natural condition so that it cascades into a precisely calibrated stormwater pond whose geometries reflect both the order of the University and the meander of the piedmont stream hydrology.

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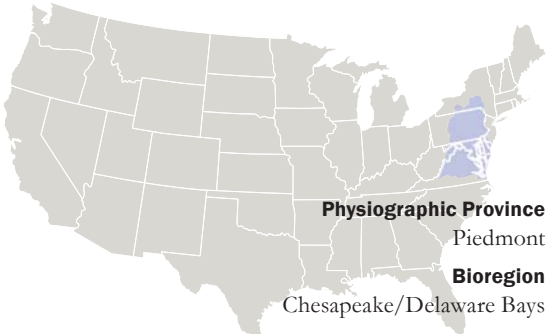

Physiographic Province
Piedmont

Bioregion
Chesapeake/Delaware Bays

Watershed
Rivanna

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CITY OF AIKEN PLANNING DEPARTMENT

City of Aiken Environmental Inventory

Aiken, South Carolina

Upper Three Runs Creek, near Aiken, has been identified as having one of the most diverse populations of aquatic macroinvertebrates in the world.

The City of Aiken, South Carolina is located in the Sandhills region, with the Piedmont to the north and the Coastal Plain to the south. This convergence of physiographic provinces supports a very unique suite of habitats, and contains a stream with possibly the most diverse assemblage of macroinvertebrates documented anywhere in the world.

In an effort to preserve its open spaces and valuable natural resources, the City of Aiken initated a planning effort to identify and assess environmental areas as well as historic and educational points of interest. Biohabitats assessed the planning area, identified valuable natural, historic, cultural and educational resources, ranked their importance and recommend a strategy to maximize open space and habitat quality.

Biohabitats' inventory provided the City with valuable information that will help guide future land use decisions.

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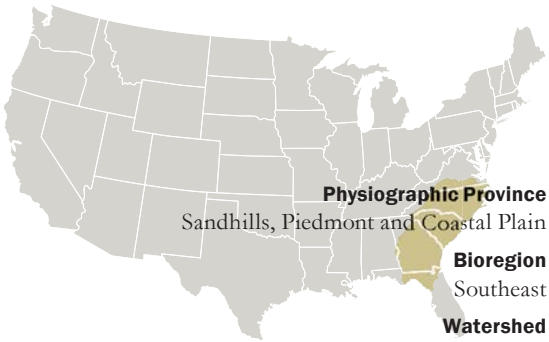


Physiographic Province
Sandhills, Piedmont and Coastal Plain

Bioregion
Southeast

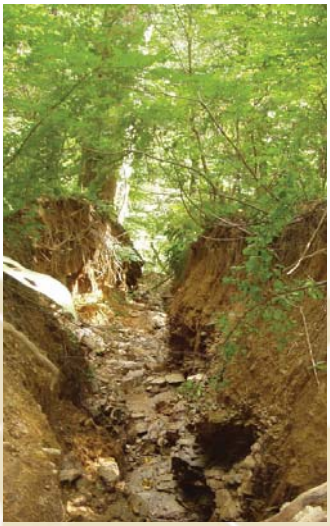
Watershed
South Fork Edisto & Middle Savannah

FAIRMOUNT PARK

Fairmount Park Wissahickon Watershed Gully Restoration Design-Build

Philadelphia, Pennsylvania

Restoration solutions not only repaired erosion gullies, but improved park aesthetics and visitor experiences, reduced operation and maintenance costs, preserved areas of historic significance, and enhanced the ecology of the Wissahickon watershed.



top & above: Initial conditions

This project is focused on fixing gully erosion on steep slopes in Wissahickon Park. The erosion was largely the result of two factors: stormwater discharge from impervious areas outside of the park; and well-used trails that were acting as conduits for runoff and providing for shorter, steeper flowpaths. These factors were converting upland trails into eroded gullies which delivered high energy water, sediment, and associated pollutants to the Wissahickon and its tributaries. The stormwater-dominated flow also caused erosion and degradation within the same tributaries. This contributed additional sediment and associated pollutants to the Wissahickon.

Biohabitats' approach was to first address stormwater in the watershed through source controls (e.g., raingardens and infiltration practices) and then restore the eroded gullies and tributaries using natural, recycled materials available from Fairmount Parks (e.g., surplus soil and rock from other projects, woody debris, shredded hardwood, etc.). The third step of the restoration approach was to make sure that trails which were contributing to the problem were redesigned and reconstructed in a fashion that reduced their role in degradation yet still provides value to trail users.

After evaluating five gully projects, Biohabitats developed restoration designs for each. Once vetted through Fairmount Park and its stakeholders, the designs were implemented by the Biohabitats team.

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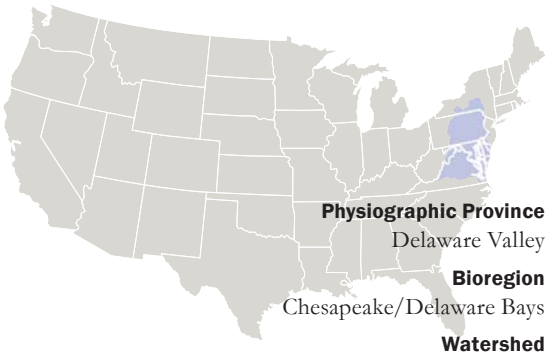

Physiographic Province
Delaware Valley

Bioregion
Chesapeake/Delaware Bays

Watershed
Wissahickon

NEW YORK CITY DEPARTMENT OF PARKS & RECREATION

Fresh Kills Park Landscape Restoration

Staten Island, New York

James Corner Field Operations

James Corner Field Operations

The transformation of what was formerly the world's largest landfill into a series of ecologically productive landscapes is a major step in restoring ecological integrity to Staten Island.

At 2,200 acres - almost three times the size of Central Park - New York's Fresh Kills Park will be one of the most ambitious public works projects in the world, combining state-of-the-art ecological restoration techniques with extraordinary settings for recreation, public art, and facilities for many sports and programs that are unusual in a city. While nearly forty-five percent of the site was once used as a landfill, the remainder of the site is currently composed of wetlands, open waterways, and unfilled lowland areas.

As part of a multi-disciplinary team, Biohabitats led the ecological components of the project. The many facets covered included soils standards and specifications, restoration of native and indigenous plant communities, and control of invasive species. Other design contributions included innovative stormwater practices utilizing native vegetation.

Biohabitats' ecological restoration efforts also emphasized the restoration of regionally-important fresh water and tidal wetlands, as well as stream and shoreline.

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Hudson River

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