

Proposal for:

Design Build Services for Water Quality Improvement Projects at Three Stormwater Detention Basins in the Hunt at Louviers



Submitted to:



Submitted by:



September 25, 2012

In association with:

CGC Geoservices, LLC
North Creek Nurseries



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September 25, 2012

Ms. Cenise Wright
Purchasing Assistant
City of Newark
Municipal Building
220 Elkton Road
Newark, DE 19711

RE: Request for Proposals 12-03
Design Build Services for Water Quality Improvement Projects
Three (3) Stormwater Detention Basins in the Hunt at Louviers

Dear Ms. Wright:

Duffield Associates, Inc. (Duffield Associates) appreciates the opportunity to provide this proposal for professional services related to the renovation of three existing stormwater management basins in the Hunt at Louviers in Newark. We are enthusiastic about the prospect of working with the City and our partners on this important demonstration project.

We have carefully considered the circumstances of this project and believe we are uniquely qualified to perform these services due to the following:

- **Multi-disciplinary Approach.** Stormwater management in today's environment necessitates expertise from a wide range of professionals. Duffield Associates' Water Resources and Civil Engineering staff are comprised of professional engineers as well as ecological restoration specialists and landscape architects. Our collaborative approach will result in technically sound, creative, and cost-effective solutions. Our proposed solution will retrofit these basins to optimize stormwater infiltration and improve water quality in basin outflows.
- **Use of Specialized Contractors.** Duffield Associates will perform the retrofit designs for the three basins. For the construction phases of the project, we will utilize CGC Geoservices, LLC (CGCG), a growing provider of geoscience related field and construction services, and North Creek Nurseries, a propagation nursery that supplies starter plugs to wholesale and retail nurseries. CGCG is led by LEED accredited professionals who specialize in projects that represent sustainable initiatives. North Creek is best known for their innovative Landscape Plugs™ that provide native planting solutions for ecological restoration and enhancement projects. Our firm's and partner firms' approach is clearly aligned to produce the innovative water quality improvement goals of this project.
- **Depth of Experience.** We have professional and technical experience working on stormwater management and other NPDES and TMDL-driven projects, including detention pond failure identification and retrofit for public and private sector clients, ranging from New Castle to Sussex Counties. Several of these projects were very similar to the characteristics observed at the Hunt at Louviers; dry basins with little or no stormwater quality management features. We have a proven record of performance, innovation, technical application, budget adherence and schedule achievement on past projects with clients engaged in stormwater management, including New Castle County and all three State conservation districts. Furthermore, our branch office in Philadelphia has supported the Philadelphia Water Department on many of its *Green City Clean Waters* initiatives.

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Duffield Associates is an award winning engineering and sciences consulting firm established in Delaware in 1976. We have since grown to include a professional and technical staff of over 90 located in six offices in four states. These include our headquarters in the Pike Creek area of New Castle County. Since its founding, the firm has had an extensive practice in the areas of:

- Water Resources,
- Natural Resources,
- Civil Engineering,
- Geotechnical Engineering,
- Coastal Engineering,
- Environmental Services,
- Structural Engineering, and
- Construction Review and Testing Services.

As a Delaware-headquartered firm, we have developed an in-depth understanding of the State of Delaware's stormwater management issues, and can comprehensively address regulatory, water quality, and physiographic requirements and parameters necessary for successful retrofitting of existing basins. We pride ourselves on staying on the cutting edge of our disciplines; applying innovative approaches, sound new technologies, and science to our projects. Our reputation is based on our ability to solve tough problems through innovative, pragmatic, and cost-efficient methods and solutions. The breadth of our experience results in the long-term client relationships that we have established through providing value and service. For over 35 years, we have provided consulting services requiring a multidisciplinary approach for a variety of clients, public and private, large and small.

Duffield Associates has been a leader in innovative and sustainable site design, storm and wastewater management, conservation, and preservation since our founding in 1976. Our extensive experience in the natural resources and geosciences form the core science behind today's sustainable design principles. We have 17 LEED Accredited Professionals on staff to assist our clients in identifying sustainable opportunities and approaches, and incorporating sustainable design principles into their projects.

Duffield Associates' affiliate company, CGC Geoservices, provides construction services and stormwater management facility maintenance services. Through the affiliation of our two companies, we are able to provide cost-effective design/build solutions for our clients, and can take Duffield Associates' design expertise all the way through construction. CGC Geoservices has the equipment and experience necessary for working on sites where minimal site disturbance and impact on neighbors is desired. Our staff has experience with stormwater management retrofit and maintenance, and implementing innovative and creative engineering designs. CGC Geoservices staff have proven their ability to provide the site preparation necessary for successful plant establishment. CGC Geoservices is based in Hockessin, Delaware, in close proximity to the project site. If the Duffield team is chosen to retrofit the three detention basins in the Hunt in Louviers, CGC Geoservices would submit the surety bond required.

North Creek Nurseries (North Creek) was founded in 1988. Their mission is to propagate and market plants that develop the relationship between people and sustainable outdoor environments. They have

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a large selection of perennials, grasses and ferns with an emphasis on new varieties and Eastern North American natives and their cultivars. Their plants are used regionally by wholesale growers and landscape contractors. As an industry leader delivering consistent, reliable, and superior quality plant solutions, their understanding, experience, and knowledge has contributed to the success of thousands of landscape projects nationwide. The information and expertise provided is based on over 20 years of real-world experience, extensive plant trialing, critical evaluation and feedback from customers, and global collaboration with scientific research entities and individuals.


North Creek has successfully developed planting plans and installed native landscape plugs for numerous storm water management, soil stabilization, landscape restoration and habitat establishment projects. North Creek's vision is to be a leader in the development and practice of sustainable horticultural systems. Extensive trial and demonstration gardens at their Landenberg, Pennsylvania farm provide research and development staff with detailed cultural information for the propagated plants. As a result, North Creek stands by its planting selections and plan knowing the ecological functionality as well as aesthetic value is appropriate for each site.

In summary, the Duffield Associates team is ideally suited for projects that necessitate specialized expertise in difficult situations. We believe our blend of engineering with natural resources sets us apart from firms that will approach this job as a straight-forward drainage project.

We are excited about the prospect of working with the City of Newark and are confident that the qualifications of our team will enable us to not only meet, but exceed expectations. The opportunity to further discuss the project and your needs would be greatly appreciated. Please contact us if you have any questions or need additional information. Thank you.

Very truly yours,

DUFFIELD ASSOCIATES, INC.



David C. Gosse
Project Manager



Deirdre S. Smith, P.E., LEED AP BD+C
Water Resources Division Director

INNOVATIONS AND VALUE ENGINEERING

Duffield Associates' reputation is based on our ability to solve tough problems through innovative, but pragmatic, methods and solutions. We have a proven record of performance, innovation, technical application, budget adherence and schedule achievement on past green stormwater infrastructure projects at the Federal, state, and local levels.

We have been a leader in innovative stormwater management, and green infrastructure, sustainable site design, and Low Impact Development (LID) for over 30 years. With 17 LEED Accredited employees, Duffield Associates recognizes the relationship between the built and natural environments, and we continuously seek innovative design solutions that will protect, restore, and enhance both.

Our areas of expertise in sustainable site design/build projects span our service areas and include the following:

- **Sustainable Stormwater Management** - stormwater management for runoff volume and water quality. Best Management Practices (BMPs) include:
 - Bioretention Areas,
 - Infiltration Systems,
 - Porous pavements,
 - Water Quality ponds,
 - Green Roofs,
 - Rain Gardens,
 - Capture and Reuse Systems, and
 - Pollutant source controls.
- **Low Impact Development Site Design** - smart-growth site analysis that considers floodplains, wetlands, endangered species, and riparian buffers to plan a project sensitive to the existing environment. Engineering designs promote open space and protect, restore, and enhance natural environments.
- **Brownfield Redevelopment** - environmental analysis, site characterization, remedial design and implementation, and assistance with environmental indemnification and grant funding to redevelop brownfield sites.
- **Water Efficient Landscaping Design** - native species plant selection for minimal water usage. Designs may incorporate stormwater and gray water systems to provide irrigation.
- **Innovative Wastewater Technologies** - drip/spray system and Rapid Infiltration Basin (RIB) modeling, design, construction and management.
- **On-site Renewable Energy** - environmental analysis and engineering support for the design of geothermal heating and cooling systems.
- **Materials Reuse and Recycled Content** - engineering design to maximize the use of recycled materials (e.g. fly ash, recycled concrete) and promote recycling rather than disposal.
- **Construction Waste Management** - engineering support to plan, review, manage, and assist with separation and recycling of construction waste.



The three basins at the Hunt at Louviers were each apparently designed as dry basins. Though fairly typical in the day, this type of facility may mitigate storm flows but does little for stormwater quality.



The Hunt at Louviers Detention Basin No. 2 (middle basin) is currently dry throughout most of the year and drains quickly after storm events.

As a consulting firm with a large civil and water resources group, Duffield Associates' staff includes Water Resource Engineers, Civil Engineers, Hydrologists, Hydrogeologists, Environmental Engineers, GIS Specialists, Coastal and Hydraulic Engineers, Geotechnical Engineers, Construction Engineers, Structural Engineers, Geologists, Landscape architects, habitat restoration experts, natural resource planners, and a seasoned technical support staff. These professionals are supported by state-of-the-art analytic tools including Haestad Methods Pondpack (TR-55 and Rational Method), Culvertmaster, Flowmaster, and StormCAD; HydroCAD; U.S. Army Corps of Engineers HEC-2, HEC-RAS, and HEC-GeoRAS; AutoCAD; and ArcGIS as well as sophisticated laboratory and field equipment. Our water resources team is recognized for its expertise in

watershed and drainage studies, stormwater management, water quality analysis, flood plain management and habitat restoration/protection. Duffield Associates has successfully completed numerous engineering assignments for DNREC, conservation districts, Delaware cities, counties and others that have conceptualized and designed drainage improvements including open channel designs, storm drains, bank stabilization and erosion control projects.

Duffield Associates has conducted hydrologic/hydraulic modeling and mapping and stormwater engineering for public entities in many of the major watersheds throughout the state. Our modeling, mapping and design projects have been reviewed and approved by DelDOT, all three Delaware counties, all three Delaware conservation districts, the U.S. Army Corps of Engineers, FEMA and many others. On the following pages are profiles of selected projects that demonstrate our experience in stormwater design, hydrologic and hydraulic modeling, computer modeling and mapping, and preparation of construction documents in Delaware. These projects are summarized below:

H.O. Brittingham Elementary School Rain Garden – Duffield Associates worked with approximately 500 students at H.O. Brittingham Elementary School in Milton to plant 3000 native flowers, shrubs, and trees in two newly installed rain gardens at the front of the school property. The 2011 planting was the culmination of a 4-year project that included a regional watershed plan, state and local collaboration, federal and state funding, and private and public contributions.

Seaford Central Middle School Stormwater Basin Retrofit – We designed stormwater management for the school site that included intercepting the existing storm drain line, expanding and lowering the existing pond bottom to reach infiltrating soils, and tying in the historic runoff system to the modern detention area. The improved basin will infiltrate runoff and remove pollutants to the Nanticoke River.

TD Bank Stormwater Management Basin Design – Duffield Associates received the *Storm Water Solutions* Magazine Top Project for 2008 and an Honors Award from the American Council of Engineering Companies Delaware for our innovative, comprehensive stormwater management design in a regulated Water Resource Protection Area. Duffield Associates designed and implemented on-site stormwater management practices that included a large rain garden and rain harvesting of rooftop runoff which was stored in underground tanks for use as irrigation water.

Fox Hollow Stormwater Basin Retrofit and Regenerative Step Pool Design – Duffield Associates is among the first design engineering firms in Delaware to successfully retrofit stormwater outfalls using regenerative step-pool design. Pioneered in Maryland, the design is intended to replicate coastal plain streams feeding detention basins. The result will provide a more physically stable and aesthetically pleasing alternative to traditional piping conveyances.

Dartmouth Woods Stormwater Basin Retrofit – The Dartmouth Woods basin was overgrown with invasives and underperforming. Duffield Associates calculated peak runoff rate and designed a sustainable, tiered reconfiguration utilizing native plants that conform to pending regulations.

New Castle County Stormwater Management Pond Retrofit Evaluation – Duffield Associates analyzed and described conditions at two sets of non-performing or under-performing stormwater detention systems and recommended creative, innovative retrofits using on-site materials and minimally disturbing methods.

University of Delaware Wilmington Campus Stormwater Ponds – We provided hydrologic and hydraulic modeling and design of wet and dry stormwater ponds for the University's Wilmington Campus and prepared the construction documents for public bid and construction administration.

Emily Bissell and Delcastle Stormwater Management – Duffield Associates led the design of four significant stormwater basins in New Castle County. The project included assessing flood conditions, identifying solutions and probable implementation costs, and working with the public to educate benefits of the stormwater facilities.

Estes Property Stream Restoration – Duffield Associates, CGCG and North Creek teamed on this small stream restoration project. Duffield designed stabilization and CGCG constructed the stabilization, including channel restoration and bank grading, and North Creek designed the planting plan and supplied the native plants.

Tweeds Park Green Technology / Sustainable Design – Duffield Associates developed creative green technologies to control stormwater runoff from the Tweed's Tavern park and upland drainage basin that included reforestation, wetlands creation, bioretention and bioswale installation.

Water Quality Improvement Plan Pike Creek Watershed – Duffield Associates worked with University of Delaware's Water Resource Agency and led the assessment and characterization of key watersheds, then provide recommendations to reduce runoff volumes and pollutant loads within the watershed.

Watershed Assessment Plans St. Jones and Broadkill Rivers – Duffield Associates characterized the watersheds, identified potential sources/ types/ location of impairments, and made recommendations for potential restoration/improvement opportunities. Duffield identified numerous restoration, enhancement, and preservation opportunities, including urban stormwater retrofits.

A project recently performed by CGC Geoservices is summarized below:

Owl's Nest Stream Stabilization & Enhancement – CGCG was contracted to provide sediment and erosion controls, excavation and backfilling, placement of boulders and planting of native vegetation.

Projects recently performed by North Creek Nurseries are summarized below:

Wolf Trap Park for the Performing Arts – North Creek converted a one acre turf grass site into a flourishing native meadow that functions as a stormwater drainage basin. The native meadow now infiltrates all runoff from the surrounding impervious surfaces, and infiltrates stormwater on site. The plant palette was based on East-coast short grass prairies.

Rittenhouse Park – North Creek and Johnston Associates developed a creative drainage alternative for the City of Newark in the fall of 2010 with the installation of large bioswales planted in full shade. The vegetated bioswales replaced compacted turf grass and invasive Japanese Stilt Grass. Two years later the area is covered in an attractive mix of native ferns, sedges and woodland forbs, providing stormwater infiltration and evaporation functionality efficiently and aesthetically.

North Creek Landenberg Site – North Creek's Landenberg, Pennsylvania property has been the site of experimental creative sustainable test plots, including rain gardens, bioswales, meadow, and vegetated wetlands. All systems are replanted on a regular schedule to test a new set of native species for their performance in a functional landscape.

Kennett Square Rain Gardens – North Creek installed two well-received rain gardens located at the Kennett Square Country Club. The rain gardens efficiently absorb stormwater runoff and with a simple plant palette, offer an attractive and creative alternative to traditional stormwater design.



H.O. BRITTINGHAM ELEMENTARY SCHOOL RAIN GARDEN MILTON, DELAWARE

Client The Milton Community Foundation
Contact Emory West, (302) 684-4110

Project Description

In May 2011 approximately 500 students at H.O. Brittingham Elementary School in Milton participated in planting over 3000 native flowers, shrubs, and trees in two newly installed rain gardens at the front of the school property. The road to this event took nearly 4 years and included a regional watershed plan, state and local collaboration, federal and state funding, and private and public contributions.

In 2007, Duffield Associates was retained by the Delaware Department of Natural Resources and Environmental Control (DNREC) to perform a watershed plan of the Broadkill River. As a result of this plan, one of the many recommendations was that pollutants from stormwater runoff be reduced into the river. One way of treating pollutants is to slow the runoff and to filter the water through rain gardens. After receiving grants to treat water quality from the State of Delaware Clean Water Advisory Community Grants program and the federal Clean Water Act Section 319 Non-Point Source (NPS) program, DNREC sought to construct rain gardens on public properties where stormwater runoff could best be treated. Duffield Associates identified four possible locations, two of which were located at the H.O. Brittingham Elementary School.

Duffield Associates designed the rain gardens and collaborated with the principal and teachers at the school. The Milton Community Foundation (MCF) served as the local grant recipients for administering funding for the projects, and Environmental Concern, Inc. of St. Michaels, Maryland provided native plant stock and educational expertise. The Sussex Conservation District constructed the rain gardens.

As a result, the rain gardens remove nutrients and sediment from stormwater flows that discharge to the Broadkill River, improve the aesthetics of the school, and create a unique educational opportunity for students and teachers to utilize in outdoor learning activities and lessons.

Representatives from the UD Sea Grant Program, Environmental Concern and Duffield Associates helped facilitate the school-wide rain garden planting event. All participants in the planting project were very enthusiastic about the new gardens, learned a great deal about gardening practices, water quality and had an overall great time.

Projects



**SEAFORD CENTRAL ELEMENTARY SCHOOL
STORMWATER IMPROVEMENTS
SEAFORD, DELAWARE**

Client Sussex Conservation District
Contact Jessica Watson (302) 856-2105

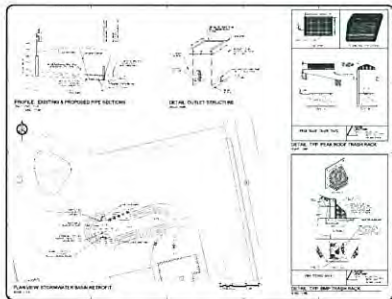
Project Description

The Seaford Central Elementary School was constructed in 1959, prior to the development of Delaware Sediment and Stormwater Regulations, and had experienced flooding during heavy storms when the adjoining street, Delaware Place, would flood over the curb and into the building. The Seaford School Administration Building was constructed on site in 1999 and included a grass-lined dry stormwater pond to manage the new impervious area, as required by code, but the existing storm drain system continued to flow unabated into the street drainage system.

Duffield Associates collaborated with the Sussex Conservation District and the Seaford School District to obtain Community Water Quality Improvement Grant funding administered by the Delaware Department of Natural Resources and Environmental Control (DNREC) in 2011. Duffield Associates provided infiltration testing, stormwater modeling and preparation of construction plans, including sediment & stormwater permitting through DNREC. The proposed improvements were to expand the basin to detain the existing storm drain system runoff and upgrade the design to current stormwater design standards.

The existing storm drain system included direct stormwater runoff from impervious parking lot, roadway and rooftop areas, as well as landscaped areas, into catch basins with sumps and hoods over the outlet pipe for debris removal, but no quantity or quality management. The proposed design included intercepting the existing storm drain line and expanding and lowering the existing pond bottom to reach infiltrating soils.

As a result, the improved basin will infiltrate some of the site runoff and provide additional storage capacity below the elevation of the roadway, removing pollutants to the Nanticoke River and lessening flooding of the buildings.



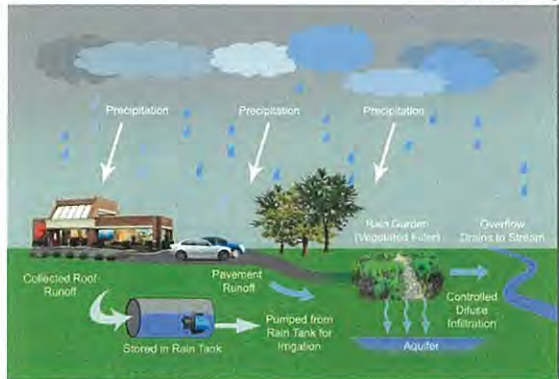
Projects



Before



After Rendering



Award-Winning

WATER RESOURCE PROTECTION YOU CAN COUNT ON HOCKESSIN, DE

Client TD Bank
Contact Clarence Pollard, 856-776-3385

Services Provided

Water Resource Protection Area Evaluation & Environmental Impact Assessment, Subsidence Evaluation, Stormwater Management Support and Regulatory Assistance

Project Description

The Hockessin Fire Company (HFD) purchased an adjacent abandoned gas station as part of a plan to redevelop their four acre campus. The site redevelopment included reconfiguration and expansion of HFD's parking facilities, as well as development of a portion of the site for lease to TD Bank as a branch office.

The site was located in an area susceptible to sinkhole formation, within a regulated Water Resource Protection Area (WRPA), and near key public drinking water supply wells. County code required a WRPA Evaluation with Environmental Impact Assessment, as well as a Subsidence Evaluation. Duffield Associates' team performed these evaluations. The WRPA Evaluation was required to demonstrate that the proposed development would not impact recharge to critical area groundwater supplies. However, traditional stormwater management facilities were required to have an impermeable bottom to prevent rapid infiltration which could promote sinkhole formation. Furthermore, water quality standards required treatment of the stormwater runoff for water quality prior to any discharge from the site.

As the site stormwater consultant, Duffield Associates' team worked with TD Bank's site designer to develop a stormwater management program that utilizes diffuse recharge stormwater management practices to mitigate the potential for the development of sinkholes at the site while still protecting groundwater recharge volume and quality. Faced with this challenge, Duffield's designers designed and implemented on-site stormwater management practices that included a large rain garden and rain harvesting of rooftop runoff which was stored in underground tanks for use as irrigation water.

The rain garden accepts and treats run-off from the adjacent parking area for water quality. Stormwater that doesn't recharge exits the rain garden into rain tanks underneath the parking lot. These tanks manage peak rate discharges from the site and are underlain by an impermeable liner to avoid unmanaged high volume recharge. "Rain harvesting" of rooftop runoff utilizes a separate series of tanks to capture rainfall runoff from the TD Bank branch. The captured rainfall is then used to irrigate the rain garden and landscaped areas to promote diffuse infiltration. Infiltration testing was performed by Duffield Associates prior to site disturbance and after site grading was complete to insure natural recharge was maintained.

This project is a Storm Water Solutions Magazine Top Project for 2008 and an Honors Award Winner from the American Council of Engineering Companies Delaware.

FOX HOLLOW STORMWATER BASIN RETROFIT AND REGENERATIVE STEP POOL DESIGN:

Client: New Castle County Department of Special Services
Contact: Mr. Michael Harris, 302-395-5700

Services Provided

Hydrologic and hydraulic evaluations, wetlands delineation, permitting, stormwater design, development of plans and specifications

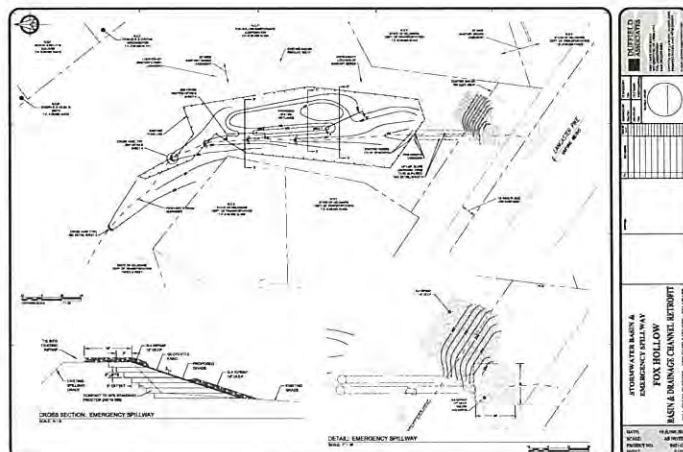
Project Description

The in-line basin at Fox Hollow was believed to have been designed as a dry basin but over the years evolved into a pond. Due to the accidental nature of the pond development, it lacked features commonly associated with designed wet ponds and had become a maintenance problem. Duffield Associates was selected by New Castle County Department of Special Services to design the conversion of the pond to a more effective and sustainable use.

Initial phases of work included a wetlands delineation and evaluation of permitting issues as well as soil explorations to better understand subsurface conditions not only around the pond perimeter but at the emergency spillway which was eroding away. Engineering work included an assessment of the nearly 200 acre upstream watershed and the determination of runoff rates anticipated for various storm events.

Plans were prepared which will realign the stream eliminating the in-line characteristic of the structure. A constructed wetlands will be placed adjacent to the stream and an overflow weir will direct stream flows resulting from lower-intensity storm events into the wetlands area for water quality treatment while flows from higher-intensity events will remain in the stream. The two existing corrugated metal outlet pipes will be sliplined extending their service life for many years. Finally, the portion of the spillway that had eroded will be rebuilt and armored.

Part way through the project, it was discovered that discharges from an outfall unassociated with the pond was causing significant erosion in the downstream rip rap channel. Duffield Associates designed a regenerative step pool which is intended to better dissipate energy associated with storm events and recharge flows back into the groundwater.



DARTMOUTH WOODS STORMWATER BASIN RETROFIT:

Client: New Castle County Department of Special Services
Contact: Mr. Michael Harris, 302-395-5700

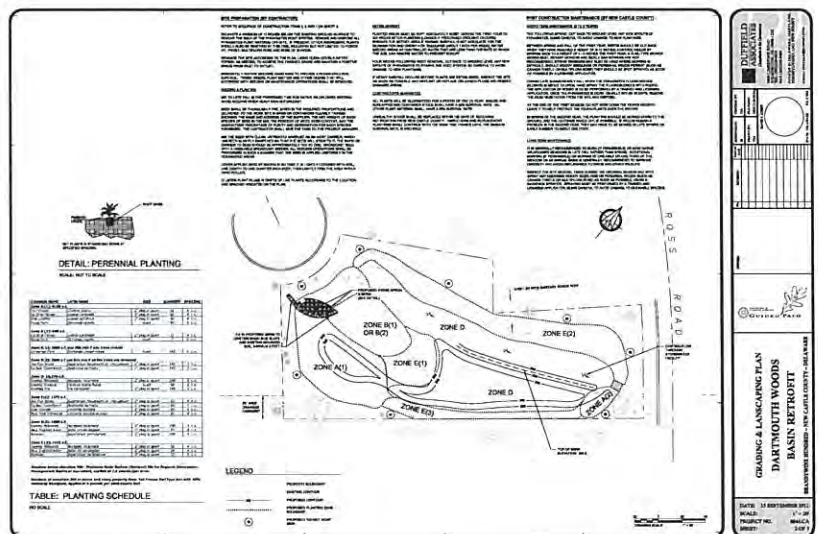
Services Provided

Hydrologic and hydraulic evaluations, stormwater design, landscape design, development of plans and specifications

Project Description

The basin at Dartmouth Woods in Brandywine Hundred had become overgrown with invasives due to lack of maintenance. This was resulting in maintenance problems and the lessening of the basin's ability to mitigate storm flows. Duffield Associates was retained by New Castle County to prepare plans for the renovation of the basin.

Utilizing storm sewer information provided by the County along with publically available GIS information such as land uses and topography, we calculated the estimated peak runoff rate and volume for the "resource protection" or 1-year, "conveyance" or 10-year, and "flooding" or 100-year events as defined in the pending Delaware Sediment and Stormwater Regulations updates. Using a previously prepared topographic map, we prepared plans that included provisions for clearing of the existing vegetation, replacing the soil with a more suitable composition, planting of appropriate vegetation, and installation of a new riser at the outfall. Engineering analyses were performed to evaluate the performance of the reconfigured basin based on the proposed modifications and retrofits. Final plans were developed along with documents for bidding and construction as well as an engineer's estimate of probable costs.



Projects



NEW CASTLE COUNTY STORMWATER MANAGEMENT POND RETROFIT EVALUATION

Client New Castle County
Department of Special Services

Contact Michael Harris, 302-395-5806

Project Description

Duffield Associates was retained by the New Castle County Department of Special Services to evaluate existing stormwater management ponds at two subdivisions. At each location, the existing pond had been designed as a “dry pond”, but was not functioning as designed due to an apparent lack of maintenance and “clogging” of the basin outlet structures. The purpose of the evaluations was to review the existing surface and subsurface conditions at each location through a limited field program, in order to provide recommendations regarding the potential for converting the existing stormwater management basins into permanent “wet ponds” or other alternative stormwater management practices, such as a “constructed wetland”.

Duffield Associates evaluated the general conditions of the ponds, including a review of the pond habitats, as well as the outfalls and embankments, performed hand auger borings to review the embankment and subsurface conditions, and conducted a handling capacity analyses to evaluate the potential impacts from increasing the permanent pool elevations. Based on these observations, recommendations were provided for conversion of the subdivision’s stormwater management basins into permanent “wet ponds”. These recommendations included the following:

- Conversion of the “temporary” riser structures to “permanent” structures.
- Construction of post-outfall “wetland cells” to provide additional storage detention and handling of peak flows.
- Repair of the eroded areas around the basins’ outfalls and rock outlets through a program of grouting and stabilization.
- Use of soil fill permanent turf reinforcement materials (TRM) and low ground cover vegetative (grass) stabilization to repair the depressions located on the embankments’ surfaces and the animal burrows located on the embankment’s slope in the vicinity of the spillway.
- Installation of seepage blankets in the vicinity of the seepage observed through the embankment, as well as the eroded areas to help prevent soil piping through the embankment, and facilitate sheet flow of the stormwater runoff generated from the drainage area.

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Projects



UNIVERSITY OF DELAWARE - WILMINGTON CAMPUS STORMWATER MANAGEMENT PONDS

Client New Castle Conservation District
Contact Larry Irelan, 302-834-3560 x111

Services Provided

Hydrologic and hydraulic analysis, design of wet and dry stormwater ponds, preparation of construction documents for public bid and construction administration.

Project Description

Duffield Associates was retained by the New Castle Conservation District to provide hydrologic and hydraulic modeling and subsequent design services for two stormwater ponds at the University of Delaware's Wilmington Campus. These services were provided through the federal ARRA funding program to provide improved stormwater management in the vicinity of the campus, including enhanced stormwater quality.

After modeling the associated subwatershed, improvements were designed to convert an existing stormwater pond to a "wet" pond, with perimeter wetlands to provide additional quality management. A new dry pond was also designed to provide stormwater management to another portion of the site, for which stormwater management previously did not exist.

As part of this project, Duffield Associates provided a variety of services, including base mapping and hydrologic and hydraulic modeling; wet and dry pond design, review of the site for existing wetlands; performance of subsurface testing to evaluate the soil and groundwater conditions in the vicinity of the two ponds; preparation of design drawings, bid documents and cost estimates for the proposed improvements, including the wetlands landscaping.

Duffield Associates also provided construction phase services on these projects, including field review and construction administration during construction, submittal review, post-construction survey review on behalf of the Conservation District.

Projects



EMILY BISSELL AND DELCASTLE STORMWATER MANAGEMENT

Client New Castle County
Contact Michael T. Harmer, P.E.

Services Provided

Stormwater mitigation, geotechnical evaluation, construction administration and review and stormwater facilities construction.

Project Description

Duffield Associates was retained by New Castle County following the county-wide flooding event of September 2004, to participate in and manage a flood mitigation program. This 100 to 500-year storm event resulted in substantial flood damage to a number of residential and commercial communities, and followed 2 similarly large events during the preceding 5 years.

The Duffield team included our internal water resource, geotechnical, and environmental engineers and scientists as well as two engineering sub-consultants and a contractor. Duffield responded on an emergency basis to catalog reported flooding conditions, conceptually identify solutions and associated estimated costs, and assign priorities for future remediation. A substantial public outreach program was undertaken to supplement government records of flooding, understand historical flooding patterns and gauge public support for various solutions. Simultaneously, Duffield reached out to the local, state and federal regulatory agencies to establish protocols for permitting the proposed improvements, with significant attention placed on operating under pre-existing "blanket" permits, or similar permits, with some modification. The extent of duration of permitting was factored into prioritization.

As part of the flood mitigation project it was proposed to reduce storm flow rate in the Hyde Run Watershed by constructing stormwater management facilities within the former lands of the Emily P. Bissell Hospital property, within New Castle County's Delcastle Recreation facility, and within drainage easements in the Duncan Glen subdivision.

The services provided by the Design/Build Team included the completion of the design of a SWM facility to mitigate the 100-year frequency storm flow rates by approximately one half through the construction of a SWM basin and transporting and regrading excess excavated soils from the construction at Emily P. Bissell to the Delcastle Recreation facility in a grading configuration to be mutually agreed upon with New Castle County.

Four additional, and more substantial regionally focused projects were identified for design build approaches by the Duffield team:

- Emily Bissell - 5 acre regional detention basin was constructed on public property to divert and detain high flow runoff from an 45 acre suburban area that had been developed prior to stormwater management requirements.
- Delcastle – 3 acres upgradient detention from 3 stormwater contribution residential communities to reduce stormwater flows on a tributary to Hyde Run.
- Duncan Woods – Design of improved stormwater system to mitigate localized stormwater drainage within portion of referenced subdivision.
- Laurel Glen – Design of improved stormwater system to mitigate localized stormwater drainage within portion of referenced subdivision.

Projects



Before



After

TWEEDS PARK GREEN TECHNOLOGY / SUSTAINABLE DESIGN HOCKESSIN, DELAWARE

Client Delaware Department of Transportation
Contact Michael Hahn, 302-760-2131
michael.hahn@state.de.us

Project Description

Duffield Associates was retained to assist the Delaware Department of Transportation in planning, designing, and constructing a recreation park that includes the addition of multi-purpose athletic fields and the relocation and restoration of the historic two-story 1796 Tweed's Tavern. Duffield Associates devised "Green Technologies" for control of stormwater runoff from the park and upland drainage basin, such as reforestation, wetlands creation, bio-retention and bio-swales. This design build park project consists of an historic village, a regional stormwater management facility, three multi-purpose athletic fields, a Tot-lot, parking and access improvements for an adjoining health and fitness complex also designed by Duffield Associates.

Duffield Associates responsibilities on this unique project included complete design, construction and construction management services. The key components of this project included:

- Site design of the park and stormwater management areas.
- Design and layout for 3 multi-purpose athletic fields including turf specifications.
- Design of irrigation system for the athletic fields.
- Phase I and II Environmental Site Assessments.
- Coordination of permitting and interface with local, state, and federal authorities.
- On-site wetlands creation and mitigation.
- Stream restoration.
- Forested riparian buffer restoration.
- Open field meadow and Piedmont forest restoration.
- Selective demolition of the 1970's structure encapsulating Tweeds Tavern.
- Disassembly, relocation and historically authentic reconstruction of the two-story historic Tweeds Tavern.
- Demolition of the existing structures on the former parcels and site restoration.
- Overall site development and construction management.
- Architectural and engineering design, and archaeological studies.

Projects



ESTES PROPERTY STREAM STABILIZATION AND RESTORATION, LANDENBERG, PA

Client/Contact: Mrs. Keitha Estes, Landenberg, PA.
610-274-1360

Services Provided

Stream restoration design, construction and planting services

Project Description

Duffield Associates was hired by Mrs. Estes, a private landowner, when the stream running through her back yard, which had been incised for years, began eroding the bank next to her house. When it became clear that continued erosion would endanger the house and deck, Mrs. Estes requested a solution that would stabilize the stream, protect her house, and restore some of the beauty to the banks.

The stream is an unnamed tributary to the White Clay Creek. Years of suburban development, clearing, and unsustainable land use practices allowed flashy stormwater flows to downcut the stream, beginning a cycle of entrenchment and erosion.

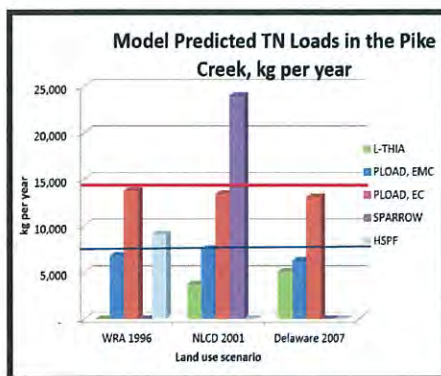
Duffield Associates developed a cost-efficient design for stream restoration and stabilization. Downcut banks were graded back and stabilized with native stone, supplemented with quarry stone similar in size and color. Riffle-pool complexes were added to the channel bed to help dissipate energy and provide instream habitat.

North Creek Nurseries partnered with Duffield Associates to design plant types and placement for the streambanks. The result is a stable, attractive back yard feature that is an asset, not a threat, to the property.

In base level conditions, the stream and banks provide natural habitat and moderate flow. In storm flows, the step-pool design and graded banks allows the stream to rise without destroying or reforming its profile, so it can return to its baseflow functionality with no negative impacts after the storm event.

The stream stabilization provides downstream benefits as well. Stabilization means less siltation downstream, and greater capacity throughout the system to absorb energy and nutrients during normal conditions.

Projects



WATER QUALITY IMPROVEMENT PLAN: PIKE CREEK WATERSHED

Client: New Castle County Department of Special Services
Contact: Mr. Michael Harris, 302-395-5706

Services Provided

Watershed assessments/characterization, pollution control strategies, stormwater best management practices, geospatial and database analysis, development of watershed loading and runoff models

Project Description

Duffield Associates obtained a grant from the Delaware Clean Water Advisory Council on behalf of the New Castle County Department of Special Services to prepare a pilot Water Quality Improvement Plan (WQIP) for the Pike Creek watershed. The scope of the project was based on requirements of the New Castle County / DeIDOT NPDES permit for stormwater discharges. Duffield worked with the Water Resources Agency at the University of Delaware (WRA) to assess and provide recommendations to reduce runoff volumes and pollutant loads within the watershed. The overall objective of the pilot project was to develop a procedure for future WQIPs once the permit is finalized.

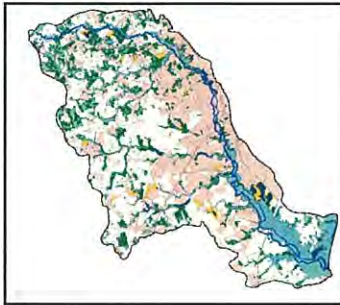
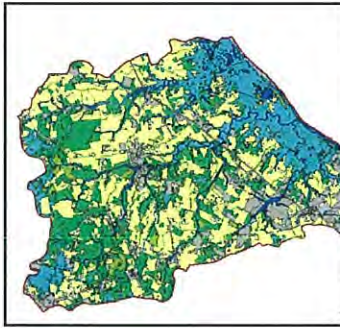
The project was managed by Duffield and involved:

- Catchment and subwatershed drainage area delineations (provided by DeIDOT's consultant)
- Assessment of various water quality modeling options and development of PLOAD model specific to the Pike Creek watershed (performed by WRA)
- Prioritization of subwatersheds and ranking of potential areas for new best management practices or retrofit of existing structures
- Field reconnaissance of 46 potential project locations including the development of site mapping and field data collection forms
- Development of a watershed scale Runoff Reduction Model which incorporated aspects of the PLOAD and DNREC's DURMM model (termed the DURMM/WQIP model)
- Preparation of recommendations

A key components of the project was the permit requirement to provide "at least a 3% decrease in untreated Effective Impervious Area (EIA)." The DURMM/WQIP model was developed to address this component of the project and is the first use of DURMM on a watershed scale.

An iterative process was utilized to identify possible BMPs involving results of the site prioritization, field reconnaissance, and the DURMM/WQIP model. The site prioritization and field reconnaissance yielded potential BMP or retrofit locations where the DURMM/WQIP model numerically demonstrated BMP or retrofit effects or impacts. Of the 46 locations visited, six existing dry basin conversions to infiltration, 16 new infiltration facilities, five vegetated channels and one constructed wetland were identified as example projects. Duffield associates estimated BMP sizes and associated runoff reduction volumes and generalized cost estimates and WRA approximated pollutant load reductions.

Throughout the project, Duffield Associates played an important role in formulating the County's positions regarding various conditions of the next NPDES permit. This included the presentation of findings at multiple meetings involving DNREC and EPA.



WATERSHED ASSESSMENT PLANS: BROADKILL RIVER, ST. JONES RIVER

Client: Delaware Department of Natural Resources and Environmental Control (DNREC)
Contact: Mr. Lyle Jones, 302-739-9939

Services Provided

Watershed assessments/characterization, pollution control strategies development, watershed assessment, stakeholder coordination, volunteer coordination

Project Description

Duffield Associates was selected to prepare watershed plans for the St. Jones (Kent County) and Broadkill (Sussex County) Rivers. The purpose of the plans was to characterize the watersheds, identify potential sources/ types/ location of impairments, and to make recommendations for potential restoration/improvement opportunities. The focus of these watershed plans was protection and restoration of water quality and associated natural resources. The overall objective was to assess the watershed, identify target areas for retrofit, restoration and conservation, develop watershed management plans to guide the implementation of pollution control strategies, and recommend demonstration projects.

The watershed assessment process established baseline conditions which involved analyzing existing monitoring data and past study results, compiling land use and other geospatial data, evaluating local programs, ordinances, and development patterns, and meeting with stakeholders to solicit input. Reconnaissance and field assessment of the watersheds, including both stream and upland areas, was performed. Duffield Associates utilized *Community Viz* software to assess the impacts of build out in the watersheds.

Restoration/enhancement/preservation opportunities was identified in the following major categories:

- Stream/Riparian Buffers/Floodplains;
- Wetlands;
- Agricultural Best Management Practices;
- Urban Stormwater Retrofits;
- Urban Sub-watershed Site Reconnaissance; and
- Conservation Easements or Acquisitions.

A goal of this project was to identify and prioritize potential restoration / preservation / improvement projects within the respective watersheds for implementation by DNREC and others. In addition, projects that may be eligible for 319b funds were identified for DNREC's use in submitting grant applications.

An important component of the watershed plan was coordination with stakeholders (those groups primarily associated with the Tributary Action Teams (TATs) and project partners. DNREC has a goal of including stakeholders, when possible, in developing strategy, identifying data sources, participating in data collection, and concurring on the implementation strategy.

P
Projects

Project Description

Owl's Nest Stream Stabilization & Enhancement Centerville, Delaware

Client: New Castle Conservation District
Contact: Larry Irelan, 302-834-3560



Many of New Castle County's streams were heavily eroded and destabilized because of multiple severe storm events. New Castle County identified a number of the impacted stream reaches to be restored and/or stabilized.

The focus of the Owl's Nest project was to stabilize a number of heavily eroded stream banks, improve the in-stream structural stability, and provide for a vegetated riparian area along the areas of interest.



One unique aspect of this project was that the approximately 400-foot reach of stream was entirely within a landscaped residential property. As such, a purely natural restoration design was not an ideal fit. The final design was a natural design which incorporated a pseudo-landscaped appearance utilizing specific boulder placement, and a greater density of selected flowering native shrubs and flowering plants.

CGC Geoservices was contracted to provide the implementation of the natural design. This work included sediment and erosion controls, excavation and backfilling, placement of boulders and planting of native vegetation.

Wolf Trap Park for the Performing Arts

In early April 2012 North Creek Nurseries and Wolf Trap Park for the Performing Arts converted a one acre turf grass site into a flourishing native meadow. The area is located in front of the Filene Center in Vienna, VA and functions as a stormwater drainage basin that captures and directs runoff from the surrounding impervious areas into a drainage system. The native meadow now infiltrates all runoff from the surrounding areas and infiltrates stormwater right at its source. Additionally, the short-grass meadow offers a multitude of ecological and aesthetic functions and it is the core of current ecological education programs and activities.

The plant palette was based on naturally occurring short grass prairies of the East Coast and all species were arranged with natural companion species. The area was planted with 21,000 Landscape Plugs™ during an April 2012 Earth Day event. All plugs were installed in 1.5 days by 80 to 95 volunteers. Design, Landscape Plug™ layout, and coordination of all volunteers on site were provided by North Creek Nurseries.



Rittenhouse Park in Newark, DE (Installer: Johnston Associates)

North Creek and Johnston Associates installed a large native bioswales in full shade for the City of Newark in fall 2010. The vegetated bioswales replaced compacted turf grass and invasive Japanese Stilt Grass. The image on the right shows the area right after installation. Only custom grown Landscape Plugs™ were used for the installation and Johnston Associates performed the installation of all materials. Two years later the area is covered in an attractive mix of native ferns, sedges and woodland forbs. We have received countless positive comments from the public and the bioswales has transformed the area. It provides stormwater infiltration, evaporation and a very high ecological and aesthetic function.



Vegetated wetlands, rain gardens, meadows, and bioswales at North Creek in Landenberg, PA

North Creek has been experimenting with native species in stormwater management structures for many years. Our Landenberg, PA property has over two acres of trial and test plantings including several rain gardens, bioswales, different types on native meadow and several vegetated wetlands and basins. All systems are replanted on a regular schedule to test a new set of native species for their performance in a functional landscape. The images below show a few example plantings and give a quick overview over what we are currently evaluating. All systems are planted with our deep LP50 Landscape Plugs™ and we evaluate how quickly the Landscape Plugs™ fill the area and lead to full vegetative cover.



Kennett Square Country Club, PA

North Creek Nurseries and LandStudies, Inc. assisted the Kennett Square Country Club with the construction and planting of a stormwater detention basin. The image on the top shows the basin after installation in May 2012. All native wetland species have filled in nicely and the middle image (August) shows perfect plant cover. Aesthetics were important in this location and a simple plant palette leads to general acceptance of the planting by club members.

North Creek Nurseries, Rutgers University, and the Brandywine Valley Association held a two day rain garden workshop in September 2011. The rain garden in front of the township building on Marshall Street in Kennett Square has turned out to be a real showcase project. Since its installation it has led to the construction of several other rain gardens in the immediate neighborhood. Public feedback is outstanding and the project has been highly successful.



TECHNICAL APPROACH

Duffield Associates, our affiliate construction company CGC Geoservices, LLC, and North Creek Nurseries (the Team) are uniquely qualified to design and construct innovative, sustainable water quality improvements to the Hunt at Louviers' three stormwater detention basins. Our approach uses micro-topographic re-grading, habitat restoration, and aggressive native plant plug installation to provide greater residence time and infiltration while improving water quality for any outflows. Using native plant communities will demonstrate bioremediation as the most effective and efficient ecosystem service method of water quality and quantity control for the limited project funding available.

Current Conditions

Inspection of the three detention basins at the Hunt at Louviers show that while stormwater enters the basins, it does not stay very long. Inverts are in close proximity to each other, often with exit pipes directly opposing inlet pipes. This leads to minimal residence time, which then leads to poor groundwater recharge and little opportunity to improve water quality while the water is in the basin. The flows that exit the basins reach Jenny's Run with more nutrients and energy than the stream has evolved to absorb. The resulting water quality impacts could negatively affect the White Clay Creek and its Wild and Scenic designation.

The detention basin bottoms are each lined with 2-3 inches of hardpan, composed mostly of mineral fines settled from stormwater runoff. In its current state after receiving many years' of stormwater, the layer is fairly consolidated and offers resistance to water infiltration. Beneath the hardpan, soils are generally sandy loam and are described as moderately well drained, often of the Brinklow channery loam (BkD – depth to water table approximately more than 80") or Glenville silt loam (GnB – depth to water table 20" – 30").

With the exception of small areas around the inlets, vegetation is fairly uniform throughout the basins, indicating no significant change in wet or moist/dry habitat. The basins and surrounding woodland and riparian areas are currently dominated by invasive and exotic species. These species include Japanese Stilt Grass, Canada Thistle, Greenbriar, Japanese Honeysuckle, Crabgrass, Multiflora Rose, Porcelain Berry, and numerous cool season European forage grasses. In order to minimize erosion and stabilize newly-constructed slopes, it is likely the original basin installation was planted in fast-growing lawn or ornamental landscape grasses. In the time since installation, we have learned that invasive plants pose a management challenge in detention basins and natural areas because:

- They may lack natural control, (e.g., grazing, foraging preferences, climate or soil influenced growth), and take over their surroundings, often preventing native plants and trees from growing;
- Their root systems are much shallower than native grasses and plants. They often do not penetrate the hardpan found in stormwater basins, and do not provide the water quality infiltration, water table recharge, and nutrient uptake ecosystem services that native plant communities provide;



Basin No. 1 (northernmost) as viewed from above the inlet pipe. On the wet day this basin was observed, only the area immediately in front of the inlet structure remained wet. Re-grading for native plant communities will allow nutrient uptake and infiltration for the entire basin bottom.



Basin No. 2 (middle) as viewed from the south. Note typical landscaping/lawn grass community throughout basin that typically have shallower root systems rarely penetrating the hardpan basin bottom.

- Complete conversion to invasive plants leads to a monoculture, which increases susceptibility to system failure due to disease.

Over many years these problematic species have established an extensive seed bank in the existing soil and very few native species have the potential to withstand the invasive's competitive pressure. The current site conditions limit the use of seed for the enhancement plantings. Seed germination and development would be strongly influenced by millions of invasive species germinating as soon as conditions are favorable. In other words, even if the invasive plants were manually removed and the area reseeded with native stock, the native seeds would not be able to sprout and mature before the invasive plants could once again take hold. If that happens, the value of any proposed bioremediation would be greatly reduced.

Project Approach

The Team proposes to retrofit the three detention basins at the Hunt at Louviers by designing and installing innovative, sustainable bioremediation measures that will provide water quality improvements in an innovative and cost efficient manner. The Team recognizes the need to work with the materials on site, complete the project with minimal disturbance, involve the public, and create aesthetically pleasing as well as functional stormwater basins.

The team will develop construction drawings illustrating the work required for the basin retrofits and will work in consultation with the City of Newark through at least one design meeting to finalize plans and confirm the construction schedule. The team will then secure the erosion and sediment permit for the work and arrange the preconstruction meeting. The contractor's insurance certification will be provided to the City as requested.

To illustrate our design approach, Duffield Associates has prepared and included at the end of this section conceptual drawings for each of the three detention basins) that illustrate our proposed re-grading and planting plan by zone.

The construction proposed will include the following critical steps:

- Eradicate invasive plants currently inhabiting basin bottoms by tilling and spraying basin bottoms;
- Re-grade bottoms to create 3 native plant zones
 - **Zone 1:** frequently wetted: inundated after storm events, wet to moist between storm events
 - **Zone 2:** occasionally wetted: inundated after storm events, moist to dry between storm events
 - **Zone 3:** often dry: only inundated after extreme storm events, dry most of the time
- Replant basin bottoms with prescribed native plants in these three zoned communities.

This approach maximizes impact and minimizes disturbance within the basin and surrounding community. Opportunities for volunteer involvement will be presented during the plug planting phase. The Community will appreciate the aesthetic values of the native plant community, and will also benefit from an easily-seen, increased songbird presence that will use the native plants for forage and nesting.

The Team recognizes that work will be conducted in a residential subdivision, and will restrict work hours to 8:00am through 5:00pm Monday through Friday. It is understood that volunteer hours will be arranged to facilitate volunteer participation, and may include weekends. On project demobilization, the Team will remove erosion and sediment controls, ensure any construction trash or debris is removed, and restore any easement access disturbances that occurred due to mobilization and construction.



Typical basin bottom soil auger boring showing hardpan covering sandy moderately well-drained soils.

Further detail regarding the proposed basin improvements is provided below:

Preparing the basin bottoms

We will prepare the detention basin project area by first tilling the bottoms, then spraying the tilled area with herbicide to eradicate non-native and weedy pest plant species that have colonized the basin bottoms. Once the undesired plants die back, we will grade the project area.

Tilling will break up the consolidated hardpan common to this era of underperforming stormwater basins, thus mixing the soils and increasing infiltration to the water table. Tilling will also break up the dense surface root masses generally associated with non-native and pest species, allowing for a higher planting success rate with the native landscape plugs.

Re-grading the basins

Once tilled and sprayed, we will re-grade the basin bottoms to foster mesic and mesic/xeric plant habitats. Basin bottoms will be zoned according to moisture retention.

Erosion and sediment controls will be installed prior to tilling and removed after planting. The team plans to retain and reuse all soils on site.

We will create deeper areas (Zones 1 and 2), including micropools (Zone 1) to promote infiltration. Frequently wet areas in Zone 1 will be amended with leaf mulch if available and/or some of the basin's own hardpan material, allowing for longer filtration times. Once established, the Zone 1 plant root density will also assist in holding water over. The team will use the graded sediment or spoils material to create berms (Zones 2 and 3) that will direct the flow around the basins and increase the stormwater residence time.



Basin No. 2 (middle) viewed from the south. Proposed retrofits would install a berm roughly north-south through the basin using soil excavated to make the wet plant habitat (Zone 1). The berm would be planted in Zone 2-3 plants and will increase residence and infiltration time substantially.

This work will minimize disturbance on the site and within the community, as only relatively grading equipment will be utilized. Once the re-grading is completed, we will describe the zonations at the site.

We will use the Delaware Sediment and Stormwater Program's Post Construction Stormwater Management BMP Standards and Specifications as guidance for the grading plans. However, we have found that in retrofit situations (as opposed to new construction), not all criteria for all types of stormwater management facilities can be attained. We will discuss compromises at our mid-point meeting. On completion of the project, we will be able to calculate pollutant load reductions for use in the Community Water Quality Improvement Grant Final Report.



Basin 2 viewed from the north. The Zone 2 berm would run down the middle; the entire basin planted in native grasses and flowers, attracting butterflies and songbirds.

Plantings and Maintenance

We will plant the bottoms with appropriate native species in plugs by zones. The team proposes installing Landscape Plugs™ instead of seeding. The plugs are established individual plants with viable root systems 3" – 5" deep. They create shade quickly enough to keep some of the light sensitive invasive species from germinating. Landscape Plugs™ are a proven successful economic alternative to larger size containers. Within the first growing season the plugs will reach their full

height and establish a healthy cover, capable of both improving water quality and inhibiting invasive rebounds.

It is surmised that if the Hunt at Louviers basin bottoms were only re-graded and not planted in native plugs, some native wet plants would occupy the inundated areas of Zone 1. The remaining areas would most likely incur 5-6 years' worth of invasive growth and die-back corresponding with the inundations. This would result in inefficiencies in water quality treatment and infiltration; it is likely native species would not then become established in Zones 2 and 3, and the basins would not reach their potential without additional retrofitting.

The Team anticipates manually planting all Zone 1 and 2 plugs. Manual planting of Zone 3 plugs can be accomplished by the Team or used in coordination with a volunteer/community opportunity. Once planting is complete, we will provide a Zone/plant map and maintenance guidelines. It is expected that basin side/slope maintenance outside of the planted area will remain unchanged, but inside the planted area focused/targeted manual invasive removal will be warranted seasonally. We anticipate returning to the basins twice in the first year and then once the next year to monitor progress. We will create a monitoring report summarizing observations and any maintenance recommendations.

Planting Concept for the Existing Detention Basins:

The plant palette selected for the re-vegetation of the Hunt at Louviers basins includes some of the most competitive native species suitable for the site conditions. All native species have been selected to tolerate temporary inundation as well as very dry conditions between storm events in the middle of their active growing season. Species naturally occurring in local riparian zones, wet meadows, vernal pools, and intermittent seepage areas are adapted to the oscillating conditions of constructed stormwater management basins. The micro-topography proposed for this stormwater basin retrofit will create a diverse set of soil moisture zones, thus creating optimal conditions for two major plant communities.



Impaired stream that is the receiving stream for Basin No. 3 (southernmost). This stream drains directly to Jenny's Run.



Basin 3 (southernmost) viewed from the north showing limited wet area plants. This zone 1 community would be effectively tripled on retrofit.



Native plants typical of a Zone 1 community.

Zone 1 areas are the lowest elevations in the detention basins. Zone 1 areas will stay moist to wet between storms. The proposed vegetation consists of species that would naturally occur in similar wet meadow herbaceous plant communities in this eco-region. The basic ground cover function will be provided by a dense layer of semi-evergreen species including *Juncus effuses* (Common rush), *Carex emoryi* (Emory's sedge), and *Euypatorium coelestinum* (Blue mistflower). These native plants are extremely competitive and will help suppress invasive vegetation. They have the ability to reseed and quickly spread via underground rhizomes. This adaptation allows them to establish healthy and strong populations within the basins and they provide exceptional water cleaning functionality.

All native plants considered for this retrofit hold outstanding ecological value and will benefit native pollinator insect (i.e., butterflies) and bird species. This ground cover layer will be inter-planted with taller species mimicking the structure of a naturally-occurring actual plant community. The taller species tolerate the root and leaf pressure of the ground cover layer and form an additional layer above other vegetation. Species include *Asclepias incarnate* (swamp milkweed),

Eupatorium fistulosum (trumpetweed), *Verbena hastata* (Swamp verbena), and *Vernonia noveboracensis* (New York ironweed). These highly attractive natives have exceptionally deep and fibrous root systems; significantly increasing the infiltration function of the stormwater basins. Over time, the dense root systems will improve the existing soil and sequester carbon.



Native plants typical of a Zone 2 community.

Zone 2 is somewhat of a transitional area, higher in elevation and lower in soil moisture than Zone 1. A different plant community is required here for a successful planting. The plant palette is inspired by mesic herbaceous plant communities and characteristic ground cover species include *Pycnanthemum muticum* (Clustered mountainmint), *Andropogon virginicus* (Broomsedge bluestem), and *Elymus virginicus* (Virginia wildrye). These highly competitive native species will provide a strong layer of vegetation that protects the soil from erosion year round. *Pycnanthemum* forms evergreen basal leaves that protect and hold the soil in place at all times. This thick and lush layer of grasses and forbs will reduce water velocity and capture large amounts of sediment and nutrients.

These ground cover species will be inter-planted with larger native species including *Rudbeckia laciniata*, (Cutleaf coneflower), *Andropogon gerardii* (Big bluestem), and *Eupatorium perfoliatum* (Common boneset). The taller species are essential elements in the design and they will provide very high ecological and aesthetic functions. A mix of cool and warm season species provides seasonal diversity and mimics the complexity of natural plant communities. All of the Zone 3 grasses selected are known for their deeply-penetrating roots that maximize infiltration.



Native plants typical of a Zone 3 community.

Zone 3 areas would act like a buffer around the other two zones that rings the edges of the basins. Zone 3 plants would increase the infiltration and water quality functionality of the basins. Species selection is based on xeric to mesic herbaceous plant communities of the eco-region, and includes *Tripsacum dactyloides*, (Eastern gamagrass), *Deschampsia cespitosa* (Tufted hairgrass), *Elumus virginicus* (Virginia wildrye), and *Juncus tenuis* (poverty rush), *Chasmanthium latifolium* (Indian woodoats), and *Schizachrium scoparium* (little bluegrass). These plants can thrive in transitional zones and many are adapted to disturbance conditions, in other words, they will recover if accidentally mowed during the basin edge maintenance.

All mechanical and planting work will be performed in accordance with the most current prevailing wages as established by the State of Delaware Department of Labor, currently established at \$37.20 for Laborers and \$55.81 for power equipment operators (Source: <http://dia.delawareworks.com/labor-law/documents/Heavy%20Construction%20Prevailing%20Wage%20Rates.pdf>). Payroll information will be reported on a weekly basis to the City of Newark and the Delaware Department of Labor for the duration of the project.

On completion of the project, the Team will arrange a post-construction meeting and site review with the City of Newark. On approval of the project, the Team will engage a professional surveyor to develop as-built plans. The as-built plans will be submitted to the City of Newark in the form of three paper copies and one electronic PDF file.

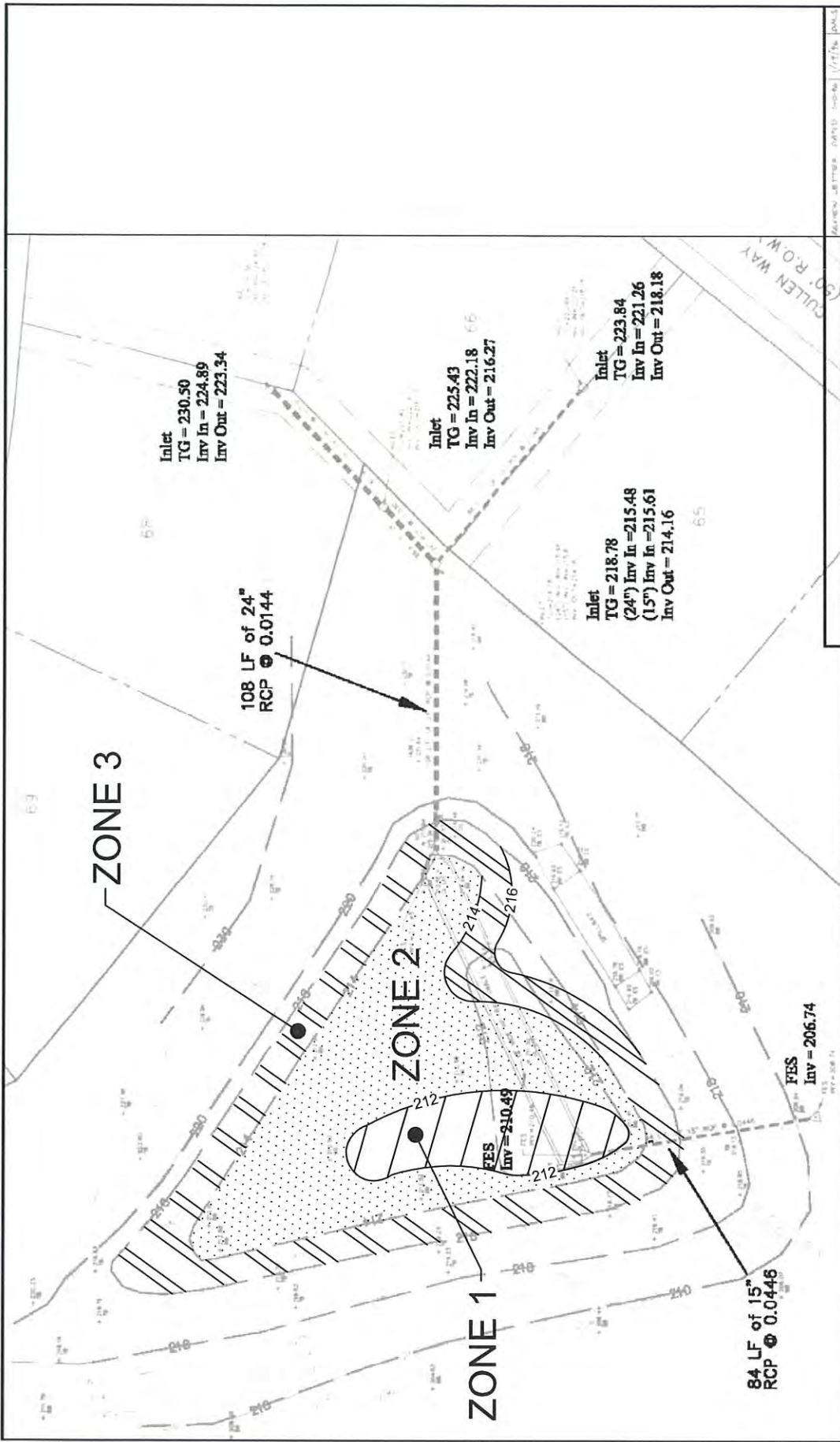
Maintenance and Review

During planting, Duffield Associates and North Creek will develop maintenance guidelines and provide initial maintenance training for the City Parks and Recreation staff with the goal of handing off maintenance duties. Duffield Associates and North Creek will request City of Newark Parks and Recreation staff to accompany them on the three post-construction monitoring visits to assess the basins' condition. Duffield Associates and North Creek will request Parks and Recreation staff input to the monitoring reports. Once the three contracted post-construction monitoring visits are completed, it will be expected that City of Newark Parks and Recreation staff will be able to continue unassisted with the prescribed monitoring and maintenance to the point of making and following their own adjustments and recommendations to the basins' maintenance schedule.

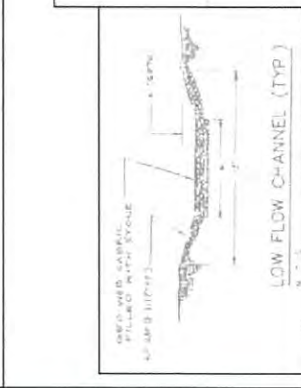
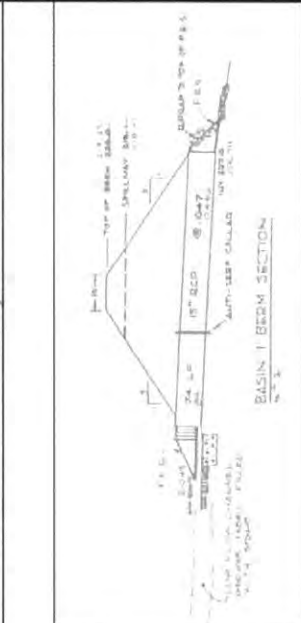
Technical Approach Determination

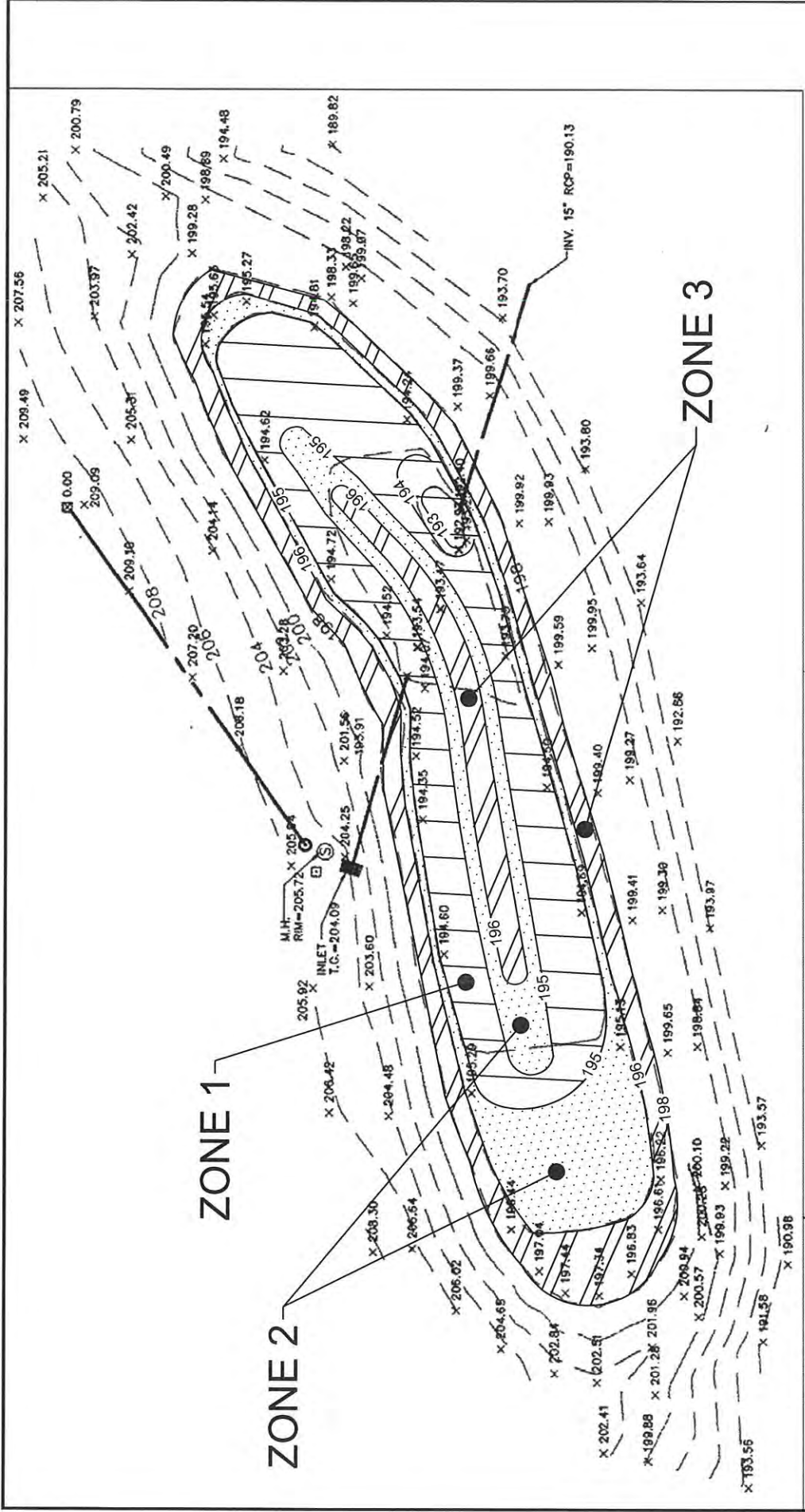
Duffield Associates developed the proposed technical approach based on past project success on design and design/build projects, and observation of real time underperforming stormwater basin conditions across the region. Recently Duffield Associates reviewed stormwater conveyance systems for select subwatersheds in New Castle County with the goal of developing a remote sensing protocol to diagnose areas in need of water quality improvements. As part of the process, field staff were able to physically inspect a variety of stormwater detention basins in the county. Distillation of these observations allowed Duffield engineers to determine the most cost-effective, practical and most likely successful retrofit mechanism for the Hunt at Louviers detention basins.

Further, Duffield Associates was recently asked to review stormwater detention structures against their designs throughout the Philadelphia area. Duffield Associates' staff reviewed standard detention structures as well as bioswales and bioremediation detention basins. In this process Duffield Associates was able to observe various stages of appropriate bioretention maintenance. With North Creek Nursery's extensive plant knowledge and our affiliate company's construction know-how, Duffield Associates can confidently design green, low-maintenance, cost-effective detention basin retrofits. The team is further able to develop comprehensive and cost-efficient maintenance solutions.



DESIGNER	BYRON W. RIMMER PROFESSIONAL LAND SURVEYOR LIC. NO. 90,850
CLIENT	HUNT AT LOUVIERS NEW CASTLE COUNTY, DELAWARE
DATE	11/21/20
PROJECT	BASIN # 1 FINAL AS-BUILT
SCALE	AS SHOWN
DRAWN BY	DUCKIE BK
CHECKED BY	
DATE	
SHEET NO.	
TOTAL SHEETS	





PLAN VIEW: AS-BUILT DETENTION BASIN #2:
SCALE: 1"=50'

NOTE:
1. AS-BUILT SURVEY PREPARED BY EASTERN STATES ENGINEERING MAY, 2000.

ELEVATION	SURFACE AREA (SF)	SUM OF VOLUME (CF)
192.40	0.0	0
193.00	277	83.1
194.00	3,405	1,924.1
195.00	13,306	10,279.6
196.00	18,688	26,276.6
198.00	24,956	69,920.6
199.37	27,245	105,678.3

COMMENT: SANITARY SEWER MAIN CROSSES UNDERNEATH BASIN BOTTOM FROM EXISTING MANHOLE.

AS-BUILT DETENTION BASIN #2:

BYRON W. RIMMER, P.L.S.
PROFESSIONAL LAND SURVEYOR
DELAWARE LICENSE NO. 600

HUNT AT LOUVERS
CITY OF NEWARK
NEW CASTLE COUNTY

E S E
EASTERN STATES ENGINEERING, INC.
2008 ST. ANDREWS DRIVE SUITE 2
BERWYN, PA 19312
610/647-1162

DESIGNED: J.T.
SCALE: 1"=50'

DRAWN: J.W.F.
DATE: 6/28/00

CHECKED: J.W.F.
DWC. NO. BASIN2ABREV

DETENTION BASIN NO. 3
STORAGE VOLUMES (AS-BUILT)

ELEVATION	SURFACE AREA (SF)	SUM OF VOLUME (CF)
191.10	0.0	0
192.00	3,437	1,546.7
193.00	9,812	8,171.2
194.00	11,399	18,776.7
196.00	14,817	44,992.7
197.77	18,540	74,513.6

NOTE:

- AS-BUILT SURVEY PREPARED BY EASTERN STATES ENGINEERING MAY, 2000.

AS-BUILT DETENTION BASIN #3:

HUNT AT LOUVERS
CITY OF NEWARK
NEW CASTLE COUNTY

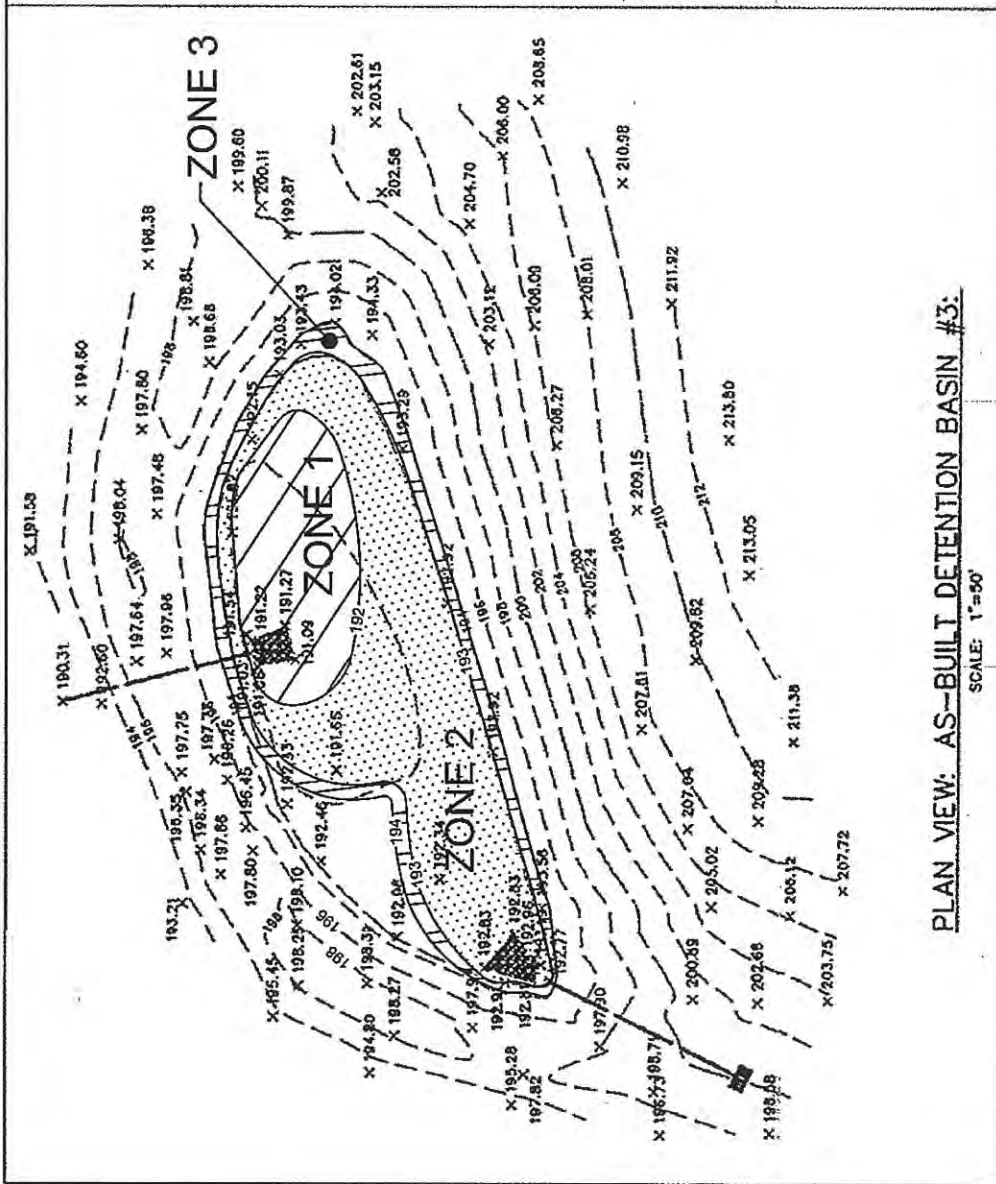
E S E
EASTERN STATES ENGINEERING, INC.

2008 STATEMENTS DATE SHEET 2
CHECKED: J.J.F. 6/10/07-1182

DESIGNED: J.T. DRAWN: VY CHECKED: J.J.F.
SCALE: 1"=50' DATE: 7/20/00 DWT. NO. RASH13ABRY

BYRON W. RIMMER, P.L.S.
PROFESSIONAL LAND SURVEYOR
DELAWARE LICENSE NO. 600

Byron W. Rimmer



PLAN VIEW: AS-BUILT DETENTION BASIN #3:

SCALE: 1"=50'

QUALIFICATIONS

Our staff currently includes 27 Professional Engineers of which 24 are registered in the State of Delaware and 9 Professional Geologists of which 8 are registered in the State of Delaware. Duffield Associates' accomplishments with respect to engineering, natural resources, and sustainable technologies are vast. We offer substantial experience in fields including:

- Stormwater Management Analysis and Design
- Stormwater quality improvements with bioretention features
- Watershed Studies and Management Plans
- Surface Water Modeling and Flood Studies/Analyses
- NPDES permitting and compliance
- Water Resource Protection Area Evaluations
- Hydrogeologic Evaluations
- Drainage Studies and Hydraulic Design
- Natural Resource Inventories/Habitat Assessments
- Dam Impacts and Removal Assessments
- Stream Characterization/Restoration/Stabilization
- Wetlands Assessment/Classification/Restoration
- Lake/Pond/Waters Assessments/Restoration
- Floodplain and Beach/Dune Restoration
- Forest/Meadow Restoration
- Protected Species Surveys/Management Plans
- Mitigation Banking
- Permitting (Federal, State, Local)
- Geographic Information Systems (GIS)

We have received numerous awards for engineering achievements throughout our history. Some of these award-winning projects include:

- 2011 White Clay Creek Stream Bank Restoration & Enhancement, Conceptor Award, ACEC-DE
Shore Lumber/White Clay Creek Floodplain/ Floodway Evaluation and Mitigation, ASCE DE
- 2010 Sunday Breakfast Mission Brownfield Redevelopment. Conceptor Award, ACEC-DE
- 2010 Restoration of the Historic Eleutherian Mills Dam, Historic Preservation Award for Industrial
Technology Restoration, New Castle County, DE
- 2009 TD Bank Water Resource Protection.
 - National Award from Stormwater Solutions Magazine.
 - Honor Award, ACEC-DE
- 2008 City of Lewes Canalfront Park rehabilitation. Conceptor Award, ACEC-DE
- 2007 Glendale II Flood Mitigation. Honor Award, ACEC-DE
- 2006 Glenville Community demolition and restoration. Conceptor Award, ACEC-DE
Tweeds Tavern relocation. Honor Award, ACEC-DE
- 2005 Design of Delaware City's flood wall. Grand Conceptor Award, ACEC-DE
- 2004 Restoration of the Sanford School Pond and Dam. Conceptor Award, ACEC-DE
- 2003 Rehabilitation of U.S. Army Corps Jetty at the Port of Wilmington. Conceptor Award, ACEC-DE
Replacement of Hearn's Pond Dam. Honor Award, ACEC-DE
- 2002 Rehabilitation of Delaware City's waterfront. Conceptor Award, ACEC-DE
Design of a Reflecting Pond at Brandywine Town Center. Honor Award, ACEC-DE

Duffield Associates' headquarters office in Wilmington, Delaware, with approximately 75 employees, will serve as the project office. This office is just minutes from the Hunt at Louviers as well as Newark City Hall. Short travel time will benefit this project by reducing cost and improving response time. This gives us the flexibility to meet your needs on this project in the least costly manner.

Duffield Associates has extensive experience on public works projects for local municipalities, state and federal agencies. We have a solid record of assisting our clients in preparing responsive and effective studies, design, management programs, and permits, and we enjoy a strong working relationship with

county, state, and federal regulatory agencies. Within the last five years, Duffield Associates has worked for over 30 public agencies, municipalities, and Departments in Delaware and in the mid-Atlantic region.

A representative list of our current and recent public sector clients includes:

Local Government Agencies in Delaware

- City of New Castle
- City of Lewes Board of Public Works
- City of Wilmington
- City of Delaware City
- City of Dover
- Town of South Bethany
- Town of Bethany Beach
- Town of Elsmere
- Town of Middletown
- New Castle County
- Kent County
- Sussex County
- New Castle Conservation District
- Kent Conservation District
- Sussex Conservation District

State and other Delaware Agencies

- Department of Natural Resources and Environmental Control
- University of Delaware Water Resource Agency
- Division of Facilities Management
- Department of Transportation
- Delaware Emergency Management Agency
- Delaware National Guard
- Delaware Solid Waste Authority
- Department of Corrections
- State of Delaware Port Corporation
- Delaware River & Bay Authority

Federal Agencies

- U.S. Army Corps of Engineers – Philadelphia District
- U.S. Army Corps of Engineers – Baltimore District
- U.S. Army Corps of Engineers – New York District
- U.S. Fish and Wildlife Service – Annapolis, MD
- U.S. Mint
- U.S. Postal Service
- Dover Air Force Base



Duffield's headquarters, just 10 minutes from Newark, includes innovative bioretention design for stormwater management.

Duffield Associates has been a leader in innovative and sustainable site design, stormwater management, and conservation since our inception more than 30 years ago and is likewise committed to incorporating sustainable design principles into our projects. This commitment is reflected in the 17 LEED (Leadership in Energy and Environmental Design) Accredited Professionals on our staff, as well as in our headquarters. As a company, Duffield Associates has systematically and aggressively implemented energy saving, water conservation, and sustainable practices throughout our offices and facilities. From constructing a new green building to a pioneering recycling program to geothermal climate control to adaptive reuse, our culture fosters "living green" not only with and for our clients but in our facilities. As part of our continuing commitment to renewable resources, Duffield Associates relocated to our Wilmington property and landmark farm buildings in 1980. Our Barn, portions of which predate 1800, was first renovated into office space in 1984, expanded and further renovated in 1995 and again in 1998. In all of the renovations, our goal has been to beneficially use the property while preserving the agricultural past of the Mill Creek Hundred. Amenities at our campus include:

- the staff.
- Energy audit and energy saving measures.
- Nutrient management program.
- Bioretention basin.
- Heat island redesign (strategic tree placement).
- Certification as a National Wildlife Federation "Backyard Wildlife Habitat."

- The preservation and beneficial reuse of a historic barn and farmhouse.
- Geothermal heating/cooling installed in 1984.
- A meadow garden to attract wildlife and to cut down on lawnmower emissions.
- A butterfly and vegetable garden maintained by

Duffield Associates' affiliate company, CGC Geoservices, provides construction services and stormwater management facility maintenance services. Through the affiliation of our two companies, we are able to provide cost-effective design/ build solutions for our clients, and can take Duffield Associates' design expertise all the way through construction. CGC Geoservices has the equipment necessary for working on sites where minimal site disturbance and impact on neighbors is desired. Our staff has experience with stormwater management retrofit and maintenance, and with providing the site preparation necessary for successful plant establishment. CGC Geoservices is based in Hockessin, Delaware, in close proximity to the project site.

North Creek's appreciation for regulatory and certified landscapes emphasizes their commitment to employ ecological standards amenable to the Landscape American Society of Landscape Architects' Sustainable Sites Initiative (SITES) standards and in compliance with The Center for Plant Conservation's Codes of Conduct. They continually strive to reduce resource consumption while minimizing waste generation in our operations. North Creek's commitment to the environment and community is demonstrated throughout their two farms in Landenberg and Oxford, Pennsylvania, where many sustainable practices have been implemented, for example:

- The capture and recycling of all irrigation runoff water onsite

- New plant introduction guidelines that prohibit the introduction of invasive species or species that have potential to become invasive, while encouraging native species and their cultivars
- Sustainable growing practices in an uncontaminated growing environment, with no plants wild collected, use of sustainable soil amendments, and reduction of greenhouse gas emissions, reduction of energy consumption through a multi-point program,
- Preference for local or regional vendors for materials and other operational inputs
- On-going plant trialing efforts to ensure tough, regionally appropriate plant selections with minimal inputs
- Optimum Landscape Plug™ sizes that reduce waste: lower freight costs, lower maintenance requirements, and ensure full establishment
- Integrated pest management practices that reduce or eliminate chemical application via use of biological, biorational control. North Creek uses beneficial insects such as predatory mites, green lacewing larvae (aphid lions), and nematodes to control thrips, aphids, fungus gnats, and shore flies.

North Creek's sustainable site design practice includes expertise in smart-growth site analysis that promotes open space and protects, restores, and enhances natural environments. Utilizing multi-disciplinary staff of engineers, ecologists, geologists, and landscape architects, they frequently design sustainable stormwater best management practices such as bioretention areas, infiltration systems, porous pavements, water quality ponds, green roofs, rain gardens, capture and reuse systems, and pollutant source controls. North Creek's water efficient landscaping designs feature native species plant selection for minimal water usage.

SCHEDULE

Ability to Complete Projects on Time and within Budget

As a regional leader in innovative sustainable engineering design, Duffield Associates is familiar with building and adhering to construction schedules that consider seasonally appropriate field work and optimal planting times. We propose the following schedule for the design / build services for water quality improvements at the three stormwater detention basins in the Hunt at Louviers:

As a regional leader in innovative sustainable engineering design, Duffield Associates is familiar with building and adhering to construction schedules that consider seasonally appropriate field work and optimal planting times. We propose the following schedule for the design / build services for water quality improvements at the three stormwater detention basins in the Hunt at Louviers. This schedule assumes a fall 2012 award and spring 2013 construction planting.

Fall 2012	Project award Team meeting and direction on preliminary engineering design
Winter 2013 Month 1	Preliminary engineering design submitted Planting list finalized Mid-point meeting
Winter, 2013, Month 2	Final design completed Permit application process initiated Hunt at Louviers community education initiated
Winter 2013, Month 3	Preconstruction meeting Plants ordered and prepared
Spring 2013 Month 1	Initial tilling (week 1) Spraying tilled areas (week 2) Construction mobilization and installation of E&S controls (week 3) Re-grading basins (week 4)
Spring 2013 Month 2	Planting Zones 1 and 2 (week 1) Planting Zone 3 (week 2) Demobilization and removal of E&S controls (week 3) Deliver final planting report and maintenance plan (week 4)
Summer 2013, Month 1	1 st monitoring event (week 2) Coordination with City for plant maintenance (week 3) Deliver 1 st Monitoring report (week 4)
Fall 2013	2 nd monitoring event (week 1) Further coordination with City for plant maintenance (week 2) Deliver 2 nd Monitoring report (week 3)
Summer 2014	3 rd monitoring event (week 1) Deliver 3 rd Monitoring report (week 2) Provide any additions or modifications to plan as necessary (week 3)

The Team will meet with the City of Newark to finalize the project schedule and adjust as necessary. Once finalized, the Team will make every effort to adhere to the agreed-upon schedule and expectations. It is understood that any factors outside of the Team's control, such as long durations of inclement weather or unforeseen storm events, may occur and project plans may have to be adjusted accordingly. Should such events occur, the Team will notify the City of Newark upon any delay or change in plans, and work with the City to arrive at a reasonable alternative course of action.

PROJECT MANAGEMENT

Project Team

Duffield Associates thrives on the diversity of our staff's experience. Our pragmatic approach to projects, willingness to listen to new ideas and challenges to improve ourselves helps us deliver successful projects. Most of our staff is cross-trained in engineering and natural resource applications and have direct experience with all defined aspects of this project resulting in our ability to provide well-rounded, cost-effective solutions. There is no substitute for experts to support certain aspects of our practice as related to this contract. Accordingly, we have sought to include the very best team we could assemble to enhance our capabilities and deliver to the City of Newark an exceptional project.

The following is a brief description of the key personnel on our team proposed for your project and their primary responsibilities. Resumes are included at the end of this section.

David C. Gosse, M.A., Ecological Restoration Specialist. Mr. Gosse was hired by Duffield Associates this past June and has over 20 years of experience in science-based project and program assessment, planning, and management. He has worked in the Washington, DC area, southern Ohio / northern Kentucky region and the state of Arkansas for not-for-profit organizations and management consulting firms. He specializes in restoration and ecosystem-based natural resource management projects using decision support systems to develop measurable, attainable goals from regulatory requirements and public/stakeholder input. He has been responsible for restoration and planning projects ranging in scope from 250 foot stream reaches to 146,000 square mile ecosystems. He has a Master's degree in Marine Affairs from the University of Virginia. Mr. Gosse has a successful record designing restoration projects with aquatic ecology needs and water quality goals in mind. His projects have returned migratory birds and native fishes and invertebrates to the project landscape. Mr. Gosse will manage the project and ensure all timelines are met in a cost-efficient manner. He will also oversee field preparation and planting, perform the monitoring, and provide the monitoring reports to the City of Newark.

William J. Mather, P.E., Civil Design Manager. Mr. Mather has 20 years of experience in the management, design and construction of civil works and land development projects. He has managed projects for industrial, institutional and residential projects as well as municipal water and sewer facilities and has a diverse background in land development, utilities and infrastructure, scheduling, cost control, and regulatory permitting of all types of projects. He has designed, and/or managed the construction infrastructure projects such as stormwater conveyance and management facilities, water and sewer lines, wastewater treatment plant expansions, and roadways and is knowledgeable in public procurement and construction procedures. Mr. Mather has performed master stormwater planning for east campus and north campus housing complexes at the University of Delaware and was recently selected by DNREC to assist in the evaluation of pending changes to the State's Sediment and Stormwater Regulations. He is a former President of the Delaware Section of the American Society of Civil Engineers. Mr. Mather will oversee development of the stormwater basin design drawings and will provide the requisite professional engineer's seal upon completion.

John G. Fellows, RLA, LEED AP. Mr. Fellows brings more than 20 years of experience in landscape architecture and planning, and civil design and engineering of land development and subdivision projects to the team. In addition to traditional landscape planning and design, John's experience includes vehicular and pedestrian circulation design; grading, drainage, erosion control and sanitary sewer design; site lighting designs, ordinances and code review; assistance with grant applications and obtaining required project approval and permits. He was the principal designer and manager of our recently completed rain garden projects in Milton. His expertise will complement Duffield Associates' engineering team, particularly on projects with sensitive environmental and aesthetic considerations. Mr. Fellows will help coordinate design activities of Duffield and North Creek.

Colin Kraucunas, P.E., LEED AP. Mr. Kraucunas brings more than 11 years of project management and design experience in sustainable stormwater development and retrofitting, underperforming stormwater structure identification and assessment, and civil engineering to the team. His prior projects

have included land development; civil site design; hydrologic and hydraulic analysis; stormwater quality and quantity management; and erosion and sediment control design. Other responsibilities include preparing federal, state and county permit applications; and preparing construction cost estimates and schedules. Mr. Kraucunas has experience in TR-20, TR-55, HEC-RAS, HydroCAD, PondPack, Hydraflow, CulvertMaster, FlowMaster, and FESWMS (Finite Element Surface Water Modeling System) on various projects to model hydrology and hydraulics of surface water and storm drain systems. Mr. Kraucunas also has experience with Geographic Information Systems (GIS) and Computer Aided Design (CADD). Mr. Kraucunas will develop the stormwater basin design drawings.

Stacy B. Ziegler, P.E., LEED AP/ BD+C. Ms. Ziegler has over ten years of experience in the geotechnical engineering and construction engineering fields, and has worked closely with Duffield Associates on the implementation of several stormwater management basin maintenance and streambank stabilization/ retrofit projects. Ms. Ziegler will provide input on constructability issues as the stormwater basin retrofit drawings are being developed by Duffield Associate, and will coordinate the regrading portion of the project.

Claudia West, Bioremediation Restoration Specialist. Ms. West grew up in a family-owned landscape nursery business in Germany which specializes in garden design and perennial, woody and cut flower production. Claudia holds a Master's of Landscape Architecture & Landscape Planning from the Technical University of Munich, Germany. Ms. served as a design consultant for Wolfgang Oehme/Carol Oppenheimer: Landscape Architecture, and was employed at Bluemount Nurseries and Sylva Native Nursery. Her extensive background in horticulture, ecology, and environmental restoration delivers a wealth of experience and knowledge, in sales and as a consultant in her current role to North Creek Nurseries. Ms. West will provide input as the stormwater basin design drawings are being developed, design the planting guide, and oversee field installation of the plantings. She along with Mr. Gosse will perform the monitoring.

Quality Assurance / Quality Control

Our quality assurance / quality control program includes the following:

- A managed program of regular in-house and external seminars attended by all of our technical and professional staff;
- A well-established internal quality assurance review system for all work products;
- Peer reviews, every 5 years, of technical and business practices under the ASFE Peer Review Program;
- Active participation in local and national professional societies and business practice groups. As an example, staff members have served as national officers and board members in ASFE and ACEC, as well as local leadership positions in ASCE, NSPE and SWE;
- Cross-department utilization of technical and professional personnel to promote diversity and utility.

David C. Gosse

Senior Project Scientist

Education M.A., Marine Affairs, The University of Virginia, 1998
B.A., English Literature, Drew University, 1989

Memberships/Associations Society for Conservation Biology
Society for Ecological Restoration
Society of Wetland Scientists

Background/Skills

Mr. Gosse has over 15 years' experience developing and managing natural resource and habitat restoration projects and programs with a wide range of for Federal and state programs, consulting firms, and national and local not-for-profits. He has successfully led and participated in ecosystem-based natural resource management, restoration, conservation technical support, and redevelopment projects throughout the eastern and central US. Projects range from multi-site habitat management, ecosystem, and watershed planning and implementation, site assessment and reporting; river reach restoration and streambank stabilization; and education and public-private partnership development and consensus building. Restoration management and planning successes range from 146,000-square mile ecosystems to 200-foot stream reaches.

He is experienced in using decision-based support systems to create measurable, attainable goals from regulatory requirements, public/stakeholder input, and client requests and excels at translating technical requirements, client needs, and/or regulations to quantifiable results. He has developed or contributed to policy and guidelines for USEPA Superfund National Office, Superfund Redevelopment (Brownfields) initiative, and the Commonwealth of Virginia's Department of Environmental Quality. Mr. Gosse has successfully integrated terrestrial, often avian, and aquatic species and habitat needs to develop comprehensive yet achievable projects and has worked on stream restoration and streambank stabilization with Rosgen, Newbury, and Sotir approaches. Mr. Gosse is also an experienced technical writer and editor, contributing to works from public policy analyses to higher education textbooks.

Mr. Gosse has presented to the Society for Conservation Biology, Southwest Chapter, on Red River Conservation strategies (2002), and has had his Upper West Coastal Plain Multi-Site Management Plan used by The Nature Conservancy's South Central Division as standards model (2004) and by the Department of Defense's Legacy Program as a Technical Case Study for publication. He has performed site assessment and presented findings to the Arkansas Academy of Sciences regarding status and distribution of rare and endangered mussel species (2003).

Selected Project Experience

Conservation Scientist, Twin Creek Watershed Management, Preble County, OH

While developing a Watershed Management plan for the Nature Conservancy in concert with the state-funded Watershed Action Plan in response to an impaired waterways (TMDL) finding, Mr. Gosse worked with state and local government officials, landowners, farmers, and concerned citizens, to identify and address critical conservation planning issues. The TMDL addressed nitrogen, phosphorus, and sedimentation/turbidity, and Mr. Gosse coordinated efforts of local cattle owners to well-water their stock and isolate the streams from watering activities.

Aquatic Ecologist and Environmental Planner, Mississippi River Alluvial Plain Habitat Management Plan Update

While with The Nature Conservancy's Arkansas Field Office, Mr. Gosse was part of an interdisciplinary team that revised and updated the Mississippi River Alluvial Plain Habitat Management Plan to better work with public and private partners. Working with a variety of Federal, State, and local stakeholders, Mr. Gosse helped integrate terrestrial and aquatic conservation targets into a workable plan with achievable roles for all parties. Results included revised USACE dredging techniques towards Endangered Species Act Compliance and integration of non-game birding activities into the Mississippi Delta ecotourism venue.

Environmental Planner, DoD Multi-Site Management Plan / Upper West Gulf Coastal Plain Ecoregional Plan

With The Nature Conservancy's Arkansas Field Office, Mr. Gosse led an interdisciplinary team of scientists, policy experts, and the public towards an achievable natural resource management plan for priority TNC Conservation areas as well as key DoD facilities in a 4-state region. The plan included a tiered system of conservation management and coordination between DoD facilities and similar privately-held resources that allowed for less intensively used areas to be managed with a different conservation goal than more intensively used areas but in coordination with conservation targets throughout the region.

Project Manager, Beckett Ridge Restoration Site, West Chester, OH

Mr. Gosse was able to leverage Municipal Sewerage funds with community and local nonprofit amounts to enhance armoring of a hanging pipe run over an impacted stream into a stream reach restoration project that restored natural physical parameters. The project stabilized the stream, enhanced native wildlife and protected the pipe run by completely burying it in a reconstructed riffle.

Project Manager, Ouachita and Upper West Gulf Coastal Plain Ecosystems

Mr. Gosse provided site assessment, reporting, and field personnel training for both Ouachita and Upper West Gulf Coastal Plain ecoregions. Mr. Gosse led site assessments for aquatic and terrestrial sites including pine sandhills and savannah, saline flats, riverine sandbars, and canebrake forests. Site assessment findings provided additional data necessary to link threatened species, such as the Interior Least Tern, Bachmann's Sparrow, and Swainson's Warbler, with appropriate and achievable habitat management goals and requirements for and coinciding habitats already managed under the ESA.

William J. Mather, P.E.

Senior Project Manager

Professional Registration:	Professional Engineer – Delaware, Maryland, Pennsylvania, Virginia and Florida
Education	Bachelor of Civil Engineering, University of Delaware
Memberships/Associations	Past President – Delaware Section ASCE American Public Works Association

Background/Skills

Mr. Mather has 20 years experience in the management, design and construction of civil works and land development projects. He has managed design projects for industrial, institutional and residential projects as well as municipal water and sewer facilities. Mr. Mather has a diverse background in project management, land development design, utility and infrastructure design, scheduling, cost control, consultant and contractor coordination, and regulatory permitting of all types of projects. He is knowledgeable in public procurement and construction procedures for public works projects. He has designed, and/or managed the construction of various types of projects including infrastructure projects such as water and sewer lines, wastewater treatment plant expansions, roadways. He has extensive experience in leadership roles as a civil department manager, office leader and a former President of the Delaware section of the ASCE. He is experienced with AutoCAD, Microsoft office suite, Microsoft project and several stormwater modeling programs including Pondpak, HydroCAD, and ICPR.

Selected Project Experience

Project Manager – Master Planning and Construction Documents for Freestanding Emergency Dept. – Christiana Care Health Services – Middletown, DE

Mr. Mather is currently serving as project manager for the civil master planning of a 1,000,000 sf medical campus on a 108 acre site in Middletown, Delaware. The first phase of development will include a Freestanding Emergency Department (FED) and associated parking. Future phases will include a 450 bed hospital and approximately 500,000 square feet of Medical Office. Responsibilities include site master planning of interior roads and parking, utilities and infrastructure including water, sanitary sewer, and stormwater management. Responsible for the preparation and approval of design documents for the FED including the modification of the existing Park and Ride entrance from a Dept. of Transportation roadway, grading and drainage, utilities, site layout and erosion control.

Project Manager – East Campus Housing Complex Planning and Design, University of Delaware, Newark DE

Mr. Mather is currently serving as project manager for the civil master planning and design of a new dormitory complex on the East Campus of the University of Delaware. Mr. Mather worked with the Architect on the site planning of the full five building master plan as well as preparing design and construction documents for the first two dormitory complexes. Responsible for the planning of ADA and service vehicle parking, fire lanes, service areas, electric yard location and master stormwater planning. Mr. Mather is also responsible for the detailed design of the first phase including, layout, grading and drainage, utilities, erosion control and walkway/paving/ fire lane design.

Project Manager - North Campus Dormitories University of Delaware, Newark DE

Mr. Mather served as project manager for the civil design of new dormitories on the north (Laird) campus of the University of Delaware. The project included the relocation of the north campus recreation area including tennis and basketball courts, preparation of an overall north campus stormwater management plan incorporating the final campus plan. Mr. Mather was responsible for the site design of 4 new dormitories as well as a new pedestrian bridge to Ray Street. Responsibilities included design of erosion and sediment control, grading and drainage design of the site, utility coordination and design including steam and chilled water design, and project specifications. Mr. Mather was responsible for agency coordination and permitting, coordination with the architect and outside consultants and Client contact. Mr. Mather was also responsible for the project's proposal preparation, setting the cost and schedule and monitoring compliance of schedule and budget.

Project Engineer - New Castle County Talley Day Park, Wilmington DE

Mr. Mather was the project engineer for the civil design of the park. Working with the landscape architect Mr. Mather was responsible for the plan preparation including erosion and sediment control, grading and drainage design, stormwater management, utility design, and traffic signage and striping plans. Along with the Landscape Architect coordinated with the Client and reviewing agencies.

Project Engineer – Sussex County Airport Master Stormwater Management Plan Implementation, Georgetown, DE

This project provided detailed design of multiple regional stormwater basins identified in a master stormwater plan for the Sussex County Airport. Mr. Mather's duties included interpretation and modifications to the original master plan, detailed stormwater calculations to verify the adequacy of the master stormwater plan. Mr. Mather developed alternative stormwater concepts, investigated seasonal high water elevations at the airport and prepared an analysis of the conveyance capacity of existing tax ditched on the airport. Alternative designs are being considered to achieve the Airport's goals despite severe site constraints unidentified in the previously prepared master storm water plan.

John G. Fellows, R.L.A., LEED AP Senior Consultant

Professional Registration: Registered Landscape Architect – Delaware, Pennsylvania, Maryland, New Jersey

Education: B.S., Landscape Architecture, Penn State University 1985

Memberships/Associations
American Society of Landscape Architects
American Planning Association
Maryland Park and Recreation Association
Pennsylvania Planning Association
U.S. Green Building Council

Background/Skills

Mr. Fellows has 25 years of experience in landscape architecture and planning, and civil design and engineering of land development and subdivision projects. Project tasks include: vehicular and pedestrian circulation design; grading, drainage, erosion control and sanitary sewer design; and site lighting designs. Projects required careful review and adherence to ordinances and codes; creative funding and assisting with grant applications; obtaining required project approval and permits; and client maintenance, invoicing and collection.

Selected Project Experience

Landscape Architect – Christiana Care Health Systems Freestanding Emergency Department, Middletown, DE

Duffield Associates was retained to prepare landscape and hardscape designs to enhance the main entrance of their new Freestanding Emergency Department building. One of the main features of this design was a pedestrian “contemplation” plaza adjacent to the main entrance. This plaza space features planters, fountains, seating areas, landscaping and soft lighting all designed to provide a peaceful and tranquil contemplation space. The landscaping at the main entrance as well as the paver design of the main vehicular drop off area is intended to be inviting and accent the building entryway.

Landscape Architect – Fisker Automotive Master Planning Site Development, Newport, DE

Duffield Associates is working with Fisker Automotive’s planning team to develop a master plan for redevelopment of a vacant automotive manufacturing plant in Wilmington, Delaware. The master plan will address exterior space improvements, such as vehicular and pedestrian circulation, parking facilities, landscaping and green space amenities, and stormwater quality improvements, and will incorporate sustainable site design principals. Mr. Fellows is the site designer and landscape architect lead on this project.

Project Manager – Middletown Site Development, Middletown, DE

Mr. Fellows worked with the site developer and senior engineers within Duffield Associates in developing concepts for the development of an outparcel on a relatively large retail site. In addition to tight site constraints the site was also within a designated Water Resources Protection Area which limited the amount of allowable impervious coverage without a variance.

Landscape Architect – Woodlands Perryville, Perryville, MD

Mr. Fellows worked closely with the lead developer and Duffield Associates’ engineers in refining the site layout and developing the landscape plan for this sustainable, mixed-use community.

Landscape Architect – PHI Cecil Substation Expansion, Elkton, MD

Mr. Fellows is currently assistant project manager for preparation of land development plans for the expansion of the Cecil Substation. This includes preparation of land development plans for Town of Elkton/Cecil Conservation District approval including a Major Land Development Plan, assistance on Grading and Stormwater Management Plan, Erosion and Sediment Control Plan, Lighting Plan, and preparation Landscape Plan.

Landscape Architect – State Street Redesign, Kennett Square PA

This project included redesign of State Street in association with the Genesis Elder Care headquarters building. Streetscape enhancements including pedestrian cross walks, street trees, street furniture, curb extensions, and a pedestrian plaza connected to the public parking garage. Mr. Fellows was responsible for the project from the conceptual streetscape design.

Landscape Architect – H.O. Brittingham Elementary School Rain Garden, Milton, DE

Mr. Fellows was the lead designer of a rain garden proposed at the school intended to not only improve water quality in the Broadkill River but be an outdoor science classroom as well. Native plants were utilized for this project funded by a DNREC Clean Water Advisory Council grant.

Landscape Architect – Land Preservation, Park and Recreation Plan, Cecil County, MD

Mr. Fellows assisted Cecil County in the planning and preparation of the 2011 Land Preservation, Park and Recreation Plan (LPPRP). The LPPRP is the county’s land preservation and recreation comprehensive plan. This document is prepared every six years to assess land preservation and recreation areas in Cecil County and its eight incorporated towns. The LPPRP serves as a planning guide for land acquisition and recreation improvements and supports the state’s planning vision and qualifies local governments for State Program Open Space (POS) funds. Mr. Fellows provided evaluations of existing county park and recreation areas/facilities; recommendations for future park improvements and planning for future county park and open space needs.

Colin M. Kraucunas, P.E., LEED AP

Project Engineer

Civil and Water Resources Engineering

Registrations:	Professional Engineer, Delaware 2007 LEED Accredited Professional, GBCI 2009
Education	B.S., Civil Engineering, Virginia Tech, 2001
Associations	Toastmasters - Local club Vice President

Background/Skills

Mr. Kraucunas is a Project Manager whose responsibilities include land development; civil site design; hydrologic and hydraulic analysis; stormwater quality and quantity management; and erosion and sediment control design. Other responsibilities include preparing federal, state and county permit applications; and preparing construction cost estimates and schedules.

Mr. Kraucunas has experience in TR-20, TR-55, HEC-RAS, HydroCAD, PondPack, Hydraflow, CulvertMaster, FlowMaster, and FESWMS (Finite Element Surface Water Modeling System) on various projects to model hydrology and hydraulics of surface water and storm drain systems. Mr. Kraucunas also has education and years of experience with Geographic Information Systems (GIS) and Computer Aided Design (CADD).

Selected Project Experience

Project Manager – TD Bank Stormwater Monitoring, Hockessin, DE

During design of the project, Mr. Kraucunas served as a project engineer, collaborated with the design team on site layout, grading; landscape plans and design of green technology best management practices (GTBMPs) including filter strips and rain garden, which required a water balance due to the site location in a sensitive drinking water supply Water Resource Protection Area (WRPA). After construction, Mr. Kraucunas served as project manager for the county-required monitoring of the performance of the GTBMPs.

Project Engineer – University of Delaware, East Campus Development; New Castle County, DE

Mr. Kraucunas attended meetings with university officials and city regulators to determine development requirements; reviewed previous plans and reports to determine impacts to wetlands, floodplain and existing utilities; and performed stormwater analysis utilizing survey and Geographic Information System (GIS) data to estimate drainage areas and ground cover. Mr. Kraucunas also worked with the project team to develop campus layout, proposed grading, and potential impacts to regulated resources.

Project Engineer - DNREC Blue Ball Dairy Barn Adaptive Re-Use

Duffield Associates provided civil engineering services and innovative regional stormwater management for this LEED certified facility. Mr. Kraucunas served as the project engineer for this effort, which included conservation design techniques such as bioswales, underground infiltration and detention to manage the anticipated regional stormwater, as well as more conventional stormwater management approaches.

Project Manager – Christiana Mall Redevelopment, New Castle County, DE

On this redevelopment project, Mr. Kraucunas collaborated with the design team on site layout, grading; landscape plans and design of green technology best management practices including bioretention areas and bioswales. Mr. Kraucunas also assisted with calculation of redevelopment credits and coordination with county and state agencies for the various approvals.

Project Engineer – Tally Ho Shopping Center, Bank Construction, New Castle County, DE

On this redevelopment project, Mr. Kraucunas coordinated with the property owner, the bank's consultants, and New Castle County Department of Land Use to demolish and backfill a retail building and construct a LEED certified branch bank. To obtain LEED credits, the site featured no potable water irrigation by disconnecting rooftop runoff through filter strips and rain gardens, and reduced impervious coverage. Mr. Kraucunas prepared the construction plans which included demolition, erosion & sediment control, stormwater quantity & quality, layout, grading, fire lanes, and utilities design.

Project Engineer – Christiana Hospital Medical Office Building, New Castle County, DE

Mr. Kraucunas collaborated with the design team on site layout, grading and utilities layout; and was responsible for design and modeling of stormwater quantity and quality management, including modification of an existing pond outlet structure and green technology filter strips and bioswales. Mr. Kraucunas also designed an infiltration system elsewhere on the site to achieve stormwater volume management credit.

Project Engineer – Hockessin Athletic Club, Hockessin, DE

On this redevelopment project, Mr. Kraucunas worked on civil site design including grading, roadway design, parking lot layout, fire marshal requirements, utilities layout, drainage design, and stormwater quantity & quality measures. Mr. Kraucunas also prepared various applications to the county including redevelopment plans, rezoning application, and stormwater reports; attended local and state public hearings; coordinated efforts with environmental Brownfields cleanup plans, wetlands mitigation and geotechnical recommendations; and prepared construction cost estimates.



Stacy B. Ziegler, P.E., LEED-AP/ BD+C
President - CGC Geoservices, LLC

Professional Registration

Professional Engineer – Delaware, Pennsylvania, New Jersey, Maryland

Education

M.C.E., Geotechnical Engineering, University of Delaware, 1996
B.C.E., Geotechnical Engineering, University of Delaware, 1994

Certifications

40 Hour OSHA Certification
OSHA 10 hour Construction Safety Training
IGSHPA Accredited Geothermal Installer

Associations

Member of National Society of Professional Engineers (DE Chapter President – 2006 to 2008)

Member of IGSHPA (International Ground Source Heat Pump Assoc.)

Background

Ms. Ziegler began her career as a Geotechnical /Construction Engineer in 1995. Her experience includes geotechnical fieldwork and analysis, infiltration testing and evaluation, bearing capacity and settlement, pile capacity, slope stability, design of mechanically stabilized earth structures, and pavement evaluations. She also provides oversight and management of large and small construction review projects, and has served as Field Construction Engineer for utility construction, large earthwork, concrete, and pavement construction projects. Her experience also includes field review of specialized instrumentation; concrete, utilities/piping earthwork, video inspections and pavement.

Selected Project Experience

Owl's Nest Streambank Stabilization and Enhancement, Centreville, Delaware

The focus of this project was to stabilize a number of heavily eroded stream banks, improve the in-stream structural stability, and provide for a vegetated riparian area along the areas of interest. The approximately 400-foot reach of stream was located entirely within a landscaped residential property. As such, a purely natural restoration design was not an ideal fit. The final design was a natural design which incorporated a pseudo-landscaped appearance utilizing specific boulder placement, and a greater density of selected flowering native shrubs and flowering plants. CGC Geoservices was contracted to provide the implementation of the natural design. This work included sediment and erosion controls, excavation and backfilling, placement of boulders and planting of native vegetation.

Restoration of the Eleutherian Mills Dam and Adjacent Millrace, Wilmington, Delaware

The Eleutherian Mills Dam on the Brandywine River is at the location of the original DuPont Powder Works. The dam, built in 1803, was in a deteriorated condition and the timber faced spillway was completely missing in some areas. Hagley contracted CGC Geoservices to perform the restoration of the dam and adjacent millrace. Adjustments were made to the design as necessary based on the actual conditions uncovered during construction as well as to deal with the challenges of construction in the middle of the Brandywine River during an unseasonably wet summer and fall construction period. The project included dewatering of sections of the dam to allow evaluation and repair, placement of large boulders, riprap and concrete in the middle of the river, reconstruction of masonry walls, maintenance of sediment and erosion controls throughout the project, and vegetative restoration of the stream banks in a natural river setting. The dam restoration was successfully completed within budget and with minimum disruption to the surrounding historic and natural setting.



Claudia West **Ecological Sales Representative**

Ms. West holds a Master's of Landscape Architecture & Landscape Planning from the Technical University of Munich, Germany. Previously, Ms. West served as a design consultant for Wolfgang Oehme/Carol Oppenheimer: Landscape Architecture, and was employed at Bluemount Nurseries, Sylva Native Nursery and Envirens, Inc. Her extensive background in horticulture, ecology, and environmental restoration delivers a wealth of experience and knowledge, in sales and as an environmental educator in her current role to North Creek Nurseries.

Experience

Project Consultant and Designer – Numerous local projects

Ms. West serves as ecological sales representative at North Creek Nurseries. In her work, she assists customers with proper plant species selection for a broad range of projects; including meadows, rain gardens, bioswales, stormwater basins, and constructed wetlands. Ms. West works closely with landscape architects, designers, engineers, environmental organizations etc and coordinates nursery operations with project time schedules and requirements. Her work includes a substantial amount of environmental education in the form of workshops, lectures, lunch & learns, field trips, and the management of trial and test plantings at North Creek Nurseries.

Lecture references:

- Irvine Nature Center in Owings Mills, MD (2012)
- Perennial Plant Association in Boston, MA (2012)
- Millersville Native Plant Conference in Millersville, PA (2012)
- PA/DE Chapter of ASLA Annual Meeting in Lancaster, PA (2012)
- MAEOE Conference in Ocean City, MD (2012)
- New England Grows in Boston, MA (2012)
- CCLC Turning a New Leaf Conference in Lancaster, PA (2011)

Rain Garden Workshop references:

- Brandywine Valley Association, Rutgers University, North Creek Nurseries (2012)
- Mt. Cuba Center, North Creek Nurseries (April 2013)
- Longwood Gardens, North Creek Nurseries (September 2013)

Project Designer - Wolf Trap National Park for the Performing Arts, Vienna, VA

Ms. West worked closely with the National Park Service to design and establish a one acre short-grass meadow at the Filene Center in Vienna, VA. The diverse native meadow replaced all turf grass in the stormwater management basin in front of the park's main entrance. Ms. West designed the plant palette based on native plant communities. A detailed project time schedule and installation plan was developed prior to the installation. North Creek Nurseries, Inc. custom grew all 21,000 Landscape Plugs™ and Ms. West coordinated over 80 volunteers during the plug layout and installation on Earth Day 2012. Ms. West is working closely with the Wolf Trap team to monitor and maintain the meadow to ensure proper plant development.

Project Designer - Lehigh Cement Quarry Expansion, New Windsor, MD

Ms. West performed wetland and stream delineations, invasive and endangered species assessments, as well as mitigation planning for the Lehigh Cement Quarry Expansion in New Windsor, MD. Ms. West worked with Envirens, Inc. on the development of stream and wetland mitigation plans including planting concepts that were designed to create stable natural plant communities with high ecological value.

Education M.A., Landscape Architecture and Regional Planning, Technical University of Munich, Germany, 2008

STATE OF DELAWARE



DELAWARE ASSOCIATION OF PROFESSIONAL ENGINEERS
92 Read's Way, Suite 208, New Castle, DE 19720

PHONE: 302-323-4588 FAX: 302-323-4590
E-mail: office@dape.org

CERTIFICATE OF AUTHORIZATION

ISSUED BY THE AUTHORITY OF
THE COUNCIL OF THE DELAWARE ASSOCIATION OF PROFESSIONAL ENGINEERS
TO

DUFFIELD ASSOCIATES, INC.
5400 LIMESTONE ROAD
WILMINGTON, DE 19808

THIS CERTIFICATE AUTHORIZES THE AFORESAID CORPORATION OR PARTNERSHIP TO
PRACTICE OR OFFER TO PRACTICE PROFESSIONAL ENGINEERING IN THE STATE OF
DELAWARE AS PROVIDED IN THE DELAWARE LAW, TITLE 24, CHAPTER 28, SECTION 2821.

FOR THE PERIOD: 7/1/2012 to 06/30/2013

CERTIFICATE NUMBER: 156

ANNUAL RENEWAL FEE: \$150.00

DATE OF ISSUE: June 6, 2012

APPROVED

BY: Charles L. McAllister
Charles L. McAllister, P.E., President



DATE **September 19, 2012**

FIVE THOUSAND DOLLARS AND ZERO CENTS

AMOUNT

*******5,000.00**

PAY TO THE ORDER OF

**The City of Newark
RE:9662 Proposal**

DRAWER: WILMINGTON SAVINGS FUND SOCIETY, FSB

ISSUED BY: MONEYGRAM PAYMENT SYSTEMS, INC.
P.O. BOX 9476, MINNEAPOLIS, MN 55480

DRAWEE: THE BANK OF NEW YORK MELLON
EVERETT, MA

MP

MP
MP

A. S. Mellon

AUTHORIZED SIGNATURE

⑆ B 255349 ⑆ ⑈ 0 1 1007092⑆ ⑈ 0 160012182181⑆



5400 Limestone Road
Wilmington, DE 19808-1232

**CERTIFIED CHECK FOR RFP 12-03
DESIGN BUILD SERVICES FOR WATER QUALITY
IMPROVEMENT PROJECTS AT THREE
STORMWATER DETENTION BASINS IN THE
HUNT AT LOUVIERS**