FINAL REPORT

"Old Schoolhouse Riparian Buffer & Rain Garden Demo Project"
Grant Number 06WQI-023, awarded March 05, 2007 to
Rappahannock Friends and Lovers of Our Watershed (RappFLOW)
By The Virginia Department of Forestry and
The Virginia Department of Conservation and Recreation

Executive Summary

Under a grant from the Virginia Department of Forestry (DOF) and with matching funds and volunteer labor from Rappahannock Friends and Lovers Of Our Watershed (RappFLOW), a large rain garden has been installed to control stormwater runoff from the parking lot of the Old Schoolhouse located on Route 211 in Sperryville, Virginia. This parking lot, at 27,000 square feet, is the largest paved parking area in Rappahannock County. RappFLOW is grateful for the generous support, advice and encouragement from DOF, especially that of our Project Manager, Ms. Barbara White. Mr. Cliff Miller, the owner of the property, graciously agreed to allow RappFLOW to pursue this project and has assisted us in uncounted ways. In addition, many volunteers donated their time and expertise in order to make this rain garden a success, notably Mr. Marc Malik who directed the work on this challenging project.

The Schoolhouse building is one of the most visible and highly-used properties in Rappahannock County and has become a prime location for many environmental and charitable events. Recent activities hosted at the Schoolhouse have included "The Biodiversity Workshop", sponsored by The Rappahannock League for Environmental Protection, and "Clean Streams Day", presented by the Rappahannock County Government in conjunction with RappFLOW, the Virginia Department of Health and the Culpeper Soil and Water Conservation District. The building, originally constructed in 1907, currently houses "The Link Community Center", providing a home to a number of local non-profit groups, under the management of the Rappahannock Non-Profit Center.

The Schoolhouse rain garden was originally conceived for the purpose of protecting the nearby Thornton River by controlling stormwater runoff from the building's large commercial parking lot and from two adjacent highways. The rain garden was intended to perform the dual roles of helping to filter pollutants before they reach the river, and helping to restore the hydrologic balance of the area by giving stormwater time to infiltrate into the ground. Both of these functions assist in preserving the river's water quality while replenishing the groundwater supply, which is the source of water for residents and businesses in the County.

Figure 1: The Schoolhouse Parking Lot. **Photo by Raymond Boc**

How the Rain Garden Works - Controlling the Parking Lot Runoff

Most of the runoff from the Schoolhouse parking lot tended to flow toward the east side of the building (to the left in the above photo) and down an existing utility service road toward the river. The new rain garden was specifically designed to capture that flow. Before the rain garden was constructed, stormwater runoff from the parking lot flowed directly into the river, overwhelming the existing riparian buffer (vegetated strip of riverbank), and thereby greatly reducing its effectiveness. The service road now has a constructed swale (a shallow depression) across it that diverts the water flow into the rain garden. The garden itself is sized to contain at least the first ½ inch of stormwater runoff from the parking lot and the front of the building. Studies have found that the bulk of pollutants are contained in that first ½ inch of water. In cases of extreme rainfall, such as that which can occur during major thunderstorms, excess water is slowed and allowed to pass over a raised vegetated berm (which acts like a buffer) down into a wide area of the Thornton River riparian buffer itself.

Stormwater, slowed and captured by the rain garden, has the opportunity to be absorbed into the ground. As this occurs, the garden's soil and plantings help to remove pollutants from the water. Inside and around the garden, native trees, shrubs and wildflowers are planted. As these native plants establish themselves, they will mature into an attractive and beneficial environment

specifically suited to indigenous birds, butterflies and other wildlife. The functioning garden thus serves as an effective control for stormwater runoff and at the same time provides a visible demonstration of the many other benefits a rain garden can convey.

Figure 2: The Rain Garden at the Schoolhouse

Rain Gardens and Other Runoff Controls Are For Everyone

A "Rain Garden" is just what it sounds like: a specially-designed garden area created to capture and filter rainwater (especially stormwater) that runs off from impervious surfaces such as parking lots, roads, driveways and rooftops. A rain garden can be any size. The Schoolhouse rain garden is quite large because its size was calculated to accommodate runoff from a very large paved (impervious) area. Homeowners and businesses can construct their own rain gardens, sized to their individual requirements. In addition to raingardens, there are a number of other rainwater control measures: rain barrels for capturing runoff from roofs, diversion of flow into large grassy areas, and the simple technique of mowing high (3.5 to 4 inches). Taller grass slows the speed of runoff, enhancing the opportunity for water to infiltrate into the soil.

Context of the Project

Rappahannock County is at the headwaters of the Rappahannock River. Seven hundred and fifty-five (755) stream miles in 1,010 stream segments (National Hydrography Dataset 2005), many on steep slopes, crisscross our rural landscape. The Rappahannock River Basin Tributary Strategy goals introduced a new idea for leaders in Rappahannock County: the goal of establishing 908 acres of forested riparian buffers on residential (non-agricultural) lands in Rappahannock County by 2010.

Rappflow (Rappahannock Friends and Lovers of Our Watershed) is a grassroots volunteer watershed protection group whose mission is to "help preserve, protect, conserve and restore water resources and watersheds in Rappahannock County." RappFLOW has taken seriously the idea of teaching residential landowners how to protect their streams with vegetative riparian buffers and Low Impact Development (LID) techniques. We have set a goal of creating a program of public education and outreach activities to meet these objectives. RappFLOW is focusing on the Thornton River watershed in this initiative because a segment of the Thornton has recently been listed as 303d "impaired" by the Virginia Department of Environmental Quality and because the village of Sperryville provides a challenging yet potentially rewarding opportunity to improve non-agricultural vegetative buffers.

The project team selected a highly visible site in Sperryville on the Thornton River to serve as our pilot demonstration project for riparian buffer and stream restoration. This site, at the corner of US Routes 211 and 522, will serve not only the expected role of protecting the river from stormwater runoff from a large parking lot area and two highways; it will serve also as a training ground for volunteers and local residents, and as a demonstration site for techniques of riparian buffer restoration and management.

The focus of our Grant Project has been to design, construct, and demonstrate a working rain garden. This rain garden is, to our knowledge, the only one that currently exists in Rappahannock County. We intend that the garden address an important water quality issue: the control of stormwater runoff from a large impervious surface, and we plan to use it for public outreach, encouraging the use of rain gardens as well as other Low Impact Development practices. The rain garden at the Old Schoolhouse is a very important component in RappFLOW's strategy to preserve and improve the water quality in our County. The rain garden controls the runoff from the largest paved parking lot in the County. It can therefore serve as a powerful illustration of how rain gardens can help homeowners and businesses alike to control stormwater runoff. The site is adjacent to RappFLOW's own headquarters, where we also train volunteers to assess macroinvertebrates in the stream.

The rain garden, as designed and built, successfully "captures" the surface runoff from the parking lot of the "Old Schoolhouse" and is sized to contain at least the first ½ inch of stormwater runoff. Research and consultations with other experts in the field led RappFLOW use this ½ inch design criterion because the greatest percentage of pollution from a parking area is known to be contained primarily in this first ½ inch of runoff. The sizing, placement, design and construction of the rain garden have proven to be correctly done, after significant additional work was performed to correct an unexpected drainage problem which occurred during

implementation of the plan. Figure 1 illustrates the parking area for which the rain garden provides runoff control.

The selection of the Schoolhouse site has proven to be even more fortuitous than originally anticipated due to the fact that the building has recently become the home of "The Link – A Community Resource Center". The Link houses an increasing number of non-profit organizations and is well on its way to becoming the locus for many types of community activities and events. As a result, the rain garden will continue to attract the interest of both citizens of Rappahannock County and of tourists passing through the area.

A dozen experts and volunteers participated in the initial evaluation of the Schoolhouse site and contributed to the plans. These persons included: Greg Wichelns, Manager of the Culpeper Soil & Water Conservation District (CSWCD); Mike Santucci, Area Forester, VA Department Of Forestry; Cliff Miller, owner of the property; Janet S. Davis, professional gardener and a founder of RappFLOW; Louise Bondelid, member of the Rappahannock County Garden Club; Mark Malik, retired naturalist at the Shenandoah National Park; Beverly Hunter, President of RappFLOW; Jack Price, Master Gardener; Tim Bondelid, Project Director for RappFLOW's National Fish & Wildlife Foundation grant, civil engineer and hydrologist; Donna Marquisee, professional landscaper; and Raymond Boc, Sperryville business leader and photographer.

RappFLOW will continue to publicize the rain garden. A highly visible sign at its inlet will feature the logo of the Virginia Department of Forestry. Signage will include an outdoor literature box to contain flyers, brochures and other selected information about rain gardens to be taken away by interested members of the public. RappFLOW is currently generating a brochure to fully explain the Schoolhouse rain garden, its functions, "lessons learned" and how we addressed them, and how to get more information for building rain gardens. The flyer and other rain garden materials will also be made available during RappFLOW's future education and outreach activities.

Building the Rain Garden

During work on this project, RappFLOW volunteers encountered a number of unforeseen challenges, not the least of which turned out to be "Mother Nature" herself. Development of the rain garden involved a number of basic steps. The publication "Rain Gardens, a landscape tool to improve water quality – Technical Guide" published by the Virginia Department of Forestry was used as a primary information source. The first activity was to observe runoff patterns during weather events to help best determine the actual path of runoff, how much area needed to be controlled and where the rain garden should be placed for maximum effect. These first steps happened to coincide with the severe drought conditions experienced during the summer of 2007. After some weeks of impatient waiting, we had the opportunity to experience a rainfall event and to observe and understand how and where the water actually flowed over the site. Once the runoff pattern was understood and the runoff area was computed, the rain garden site was selected.

Adequate infiltration capacity at the chosen site is critical so that water can be readily absorbed into the soil. Otherwise, runoff will sit in the garden and become a "pond", drowning the vegetation and providing a breeding ground for mosquitoes. Drainage characteristics are normally evaluated by performing percolation tests, which consist of digging holes, filling them with water, and observing how quickly they drain. If the holes empty within one or two days, the drainage is deemed suitable. At the Schoolhouse site, three test holes were dug, filled with water and observed. All three of the test holes emptied well within the design parameters. In our case, it is possible that the drought may have affected the results of our percolation tests. Because the ground was so exceptionally dry, some of the water may have been absorbed into the sides of the test holes.

An adequate rain garden design should accommodate at least the first ½ inch of runoff. Additionally, measures (such as swales) may be required to ensure that the runoff actually flows into the garden. The garden area must be dug out and a level berm built up to contain the garden's volume capacity. The berm is planted to stabilize the soil and to slow down any overflow. Runoff overflow should spread and wash evenly across the top of the berm.

A planting plan, ideally using native trees, shrubs and flowers suited to rain garden conditions, must also be developed. The ideal soil mix for a Rain Garden is a sandy loam that drains well and supports the cultivation needs of the chosen plantings.

The Schoolhouse rain garden was begun in the Fall of 2007, including initial soil excavation and building up of the berm. RappFLOW volunteers then planted the berm with native grasses and small trees. An unanticipated "nightmare" scenario developed during this first phase of construction. The good news was that the placement and basic design of the rain garden performed precisely as planned. The runoff from the parking lot, driveways and the front of the building all funneled beautifully down the shallow swale and into the rain garden but, because the planned garden was much too large for manual, 'by-hand' construction, a piece of heavy equipment had been necessary for the digging and shaping and this had created a serious problem. The sheer weight of the "Bobcat" compressed the soil in the rain garden. Although we had observed some clay in the soil during our percolation tests, it had not seemed to affect

absorption. As it turned out, the entire rain garden contained an essentially continuous layer of clay (probably fill) that varied widely in thickness from place to place. Though we had thoroughly tilled the garden area and mulched it after the shaping was complete, the compacted clay layer turned our rain garden into a 'rain pond'!

In order to investigate, test and implement any corrective actions, we needed an empty rain garden. "Mother Nature" chose that moment to end the record drought of 2007. A string of otherwise much-welcomed thunderstorms filled the rain garden faster than volunteers could man an electric pump to drain it. After two lengthy pumping sessions, we elected to install a temporary drain pipe through the berm, to remain in place until the ponding problem was solved.

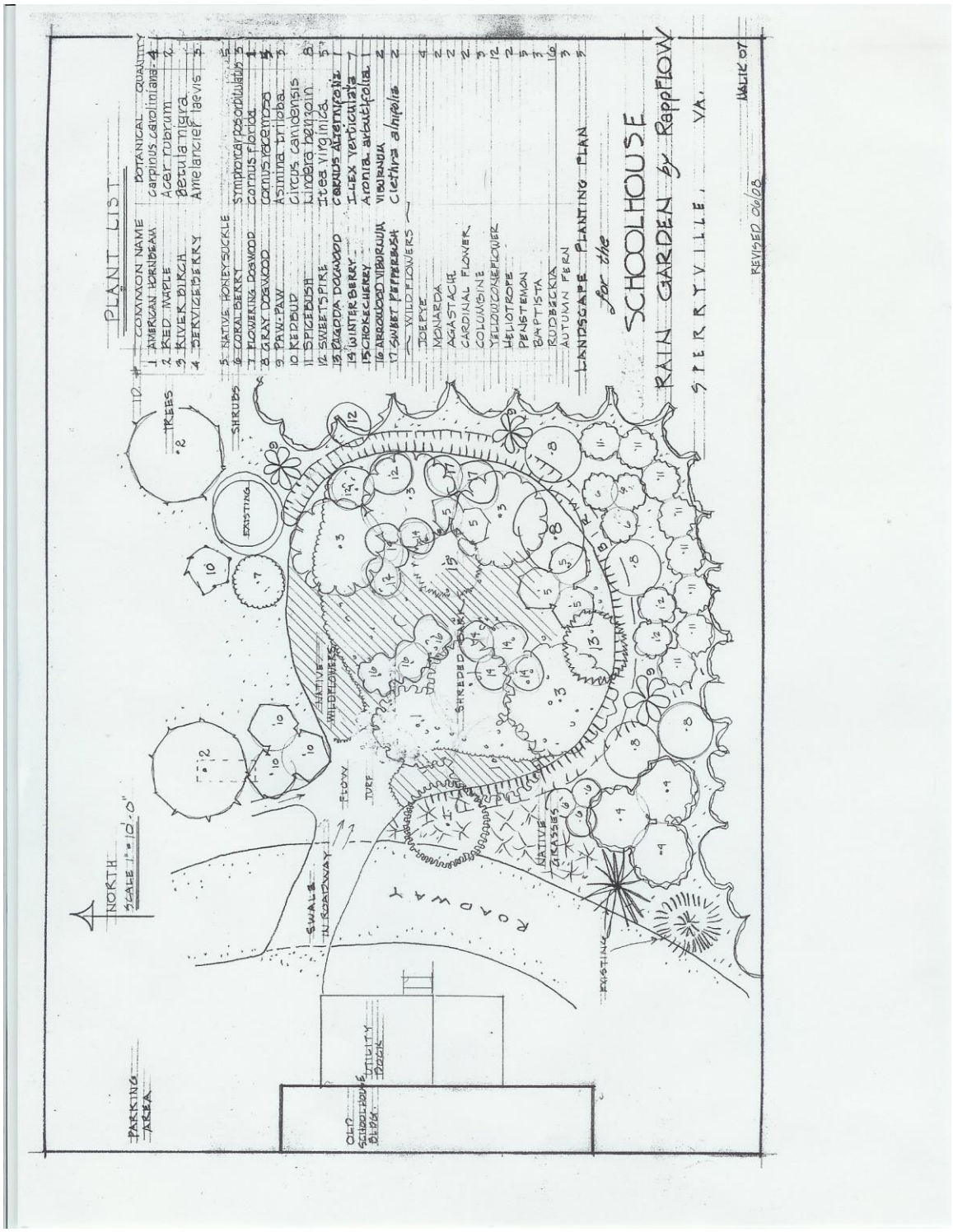
A number of methods were tried during our attempts to improve the garden's drainage rate. We first experimented with a series of holes designed to pierce the clay layer but this approach did not provide sufficient drainage improvement. Additionally, we worried that this approach would increase the maintenance needed to keep the Rain Garden functioning properly over time.

RappFLOW consulted with various experts on how best to solve the problem. It was finally determined that the only course of action likely to yield a well-functioning rain garden was to remove the clay in its entirety and replace it with a layer of sand at the bottom and a twelve- to eighteen-inch layer of special "biofilter" soil mix. After excavation and disposal of the clay, 20 cubic yards of sand and 50 cubic yards of biofilter mix were moved into the garden area and spread by volunteers. "Mother Nature" assisted in this endeavor by sending us a record-setting heat wave.

Biofilter soil is a special mix developed for exactly this type of application: filtering rainwater and providing an excellent planting medium. The biofilter soil composition was first developed in Prince George's County, Maryland and has since been used elsewhere. For example, it has been officially approved for use in Spotsylvania County. Greg Wilchelns of the Culpeper Soil and Water Conservation District (CSWCD) recommended this soil and provided us with the information for a local source. At each step in the corrective process (removing the clay, putting in the sand, and adding the biofilter soil) progress was evaluated by observing the drainage during and after a thunderstorm. This corrective work was done during the Spring of 2008, fortunately a period of ample rainfall, so that the length of time between test observations was only a matter of one or two weeks. In this instance "Mother Nature" worked to our advantage.

In conjunction with the implementation of the drainage solution, the landscaping plan was revised to incorporate more plants within the confines of the rain garden itself along with the plants already surrounding the garden. A maintenance plan has been developed by professional landscaper, Donna Marquisee, and will be implemented in concert with the landowner.

Attachment I – Landscaping Plan



Attachment II – Biofilter specifications

LUCK STONE

TECHNICAL DATA SHEET

BIOFILTER

* HIGH IN ORGANIC MATTER
* NUTRIENT RICH
* SANDY TEXTURE
* MODERATE pH

TYPICAL SIEVE ANALYSIS

(% passing)

4.75 mm	99.2 %
2.36 mm	89.8 %
1.18 mm	75.5 %
0.60 mm	57.9 %
0.30 mm	37.5 %
0.15 mm	25.6 %
0.075 mm	15.0 %

TYPICAL ANALYSIS

Sand	83 %
Silt	11 %
Clay	6 %
USDA Classification	Loamy Sand
Moisture	15.2 %
Organic Matter (OM)	3.7 %
pH	6.2 %
Estimated Nitrogen Release (ENR)	99 lbs/A
Phosphorus (P)	63 ppm
Potassium (K)	157 ppm
Magnesium (Mg)	120 ppm
Calcium (Ca)	913 ppm
Sodium (Na)	77 ppm
Sulfer (SO4-S) (S)	59 ppm
Zinc (Zn)	8.3 ppm
Manganese (Mn)	183 ppm
Iron (Fe)	249 ppm
Copper (Cu)	1.4 ppm
Soluble Salts	0.4 ms/cm
Acidity (H)	0.8 meq/100g
Cation Exchange Capacity (CEC)	7.1 meq/100g

GENERAL INFORMATION

Composition	Native Soil Materials Mineral Filter Natural Sand Organic Compost
Bulk Density	1.4 tons/yd^3
Textural Classification	Loamy Sand
Organic Matter	3-4%
pH	6.0-7.0
Maximum Particle Size	4.75mm

APPLICATION

For use in biotention basins and other bioremediation projects where a sandy topsoil is required. Luck Biofilter has many of the same qualities as our Premium Topsoil, but with a sandier texture that allows it to drain more readily.
Use as a high-sand Rootzone for high end athletic field construction.

For more information on Luck Stone Corporation and our products, please visit www.luckstone.com.

These products are mixes of natural materials, so results can vary.

Attachment III: Care & Maintenance Recommendations for Riparian Buffer and Rain Garden

The grass in lawn areas on the property around the schoolhouse should be mowed at a height of 3-1/2 inches or higher.

The grass in the buffer zone behind the school can be left to grow to full height.

An intermediate zone between the lawn areas and the buffer zone could be mowed at 5 to 7 inches on a monthly basis to allow greater absorption of rain roof water.

Trails linking the plantings and an area around each plant should be maintained on a bi-monthly basis to reduce soil compaction. If a bi-monthly schedule is not feasible, quarterly maintenance is recommended. Mulching around the riparian plants will reduce weed competition, and will help retain moisture at the root zone.

The rain garden plants will need regular watering during their first year, and through dry spells until the plants become established.

Weeding around the plants in the rain garden in Spring and Fall is recommended.

The wild sunflowers growing on the perimeter of the rain garden will produce seed in the Fall. These seedlings should be weeded out from inside the garden area.