LAND USE AND CONSERVATION PLAN FOR THE STONE HOUSE

by

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ABSTRACT

The Stone House is a property owned and maintained by the non-profit organization *stone circles* located in Mebane, NC. The organization's mission is to "sustain activists and strengthen the work of justice through spiritual practice and principles." They are committed to ensuring that their 70 acres of land benefit the local community, regional ecosystem, and the global environmental movement. The purpose of this master's project was to create a land use and conservation plan for *stone circles* that incorporates the organization's many visions for the site, as well as recommends sources of funding to reduce current management costs. To this end, the staff of *stone circles* helped us to identify their needs and limitations by posing questions that ultimately shaped how the plan addressed the following issues: (1) the management of onsite vegetation and wildlife habitat, (2) the expansion of organic food production, (3) the establishment of an educational trail system, (4) onsite stormwater management with particular attention toward erosion control, and (5) feasibility, costs, and funding of various management scenarios.

Several land use and funding options were explored for the *stone circles* property including: obtaining a conservation easement, using the back field as a wetland mitigation bank, using the field as a solar farm, leasing land for long-term residential use, leasing the field for agricultural use, and implementing the conservation and stormwater management plans that were developed. The conservation management plan involves permaculture improvements to the orchard, facilitating reforestation of the back field, installing a trail network, and the developing educational materials for onsite visitors. The recommended option for *stone circles* at this time is to implement the conservation and stormwater management plans. There are numerous funding streams available to assist in financing these plans, including governmental programs, grants, carbon offsets, and timber sales. A grant we have specifically applied for is the Rudolf Steiner Foundation Seed Grant. The estimated costs of the conservation management plan include:

Reforestation: $0 - $9,450
Trail: $13,500 - $99,000 (conservative estimate)
Signs: $72 - $1,350

In terms of stormwater management, the estimated costs for the plan include:

Purchase of four rain barrels: $216 - $480
Installing one rain garden: $4,000 - $6,000
Improving riparian buffers: $0 - $7,600
Paving the road with a permeable grassy paver: $65,000 (paving materials alone)
Implementing best management practices for the road: $10,000 (roadbed materials alone)

Total costs to implement the conservation management plan range from $72 to $109,800 and the cost of implementing the stormwater management plan range from $0 to over $79,000 depending on which portions *stone circles* decides to implement and at what scale.

TABLE OF CONTENTS

TABLE OF FIGURES

Introduction

The Stone House is a retreat center located in Orange County, NC that is run by the non-profit organization *stone circles*. Their mission is to "sustain activists and strengthen the work of justice through spiritual practice and principles." The 70 acre retreat center hosts individuals and groups seeking to deepen their capacity to effect social change, offering workshops and training to this end. The site consists of cabins, pasture, wooded areas, open space, ponds and cultivated gardens. Staff at *stone circles* would like to see their property managed in a way that will further their mission and fulfill their goal of a sustainable relationship between land and community.

For *stone circles*, this means enhancing both the contemplative nature and ecological sustainability of their surroundings, including: managing for wildlife habitat, organic gardens, nature trails and native plants, and improving water filtration and drainage on the site. These ideals were used to tailor our management recommendations to the *stone circles* organization and The Stone House property. To that end, the purpose of this master's project was to create a land use and conservation plan for *stone circles* that incorporates the organization's many visions for the site, as well as recommends sources of funding to reduce current management costs and implement the plan. The questions that *stone circles* specifically asked are:

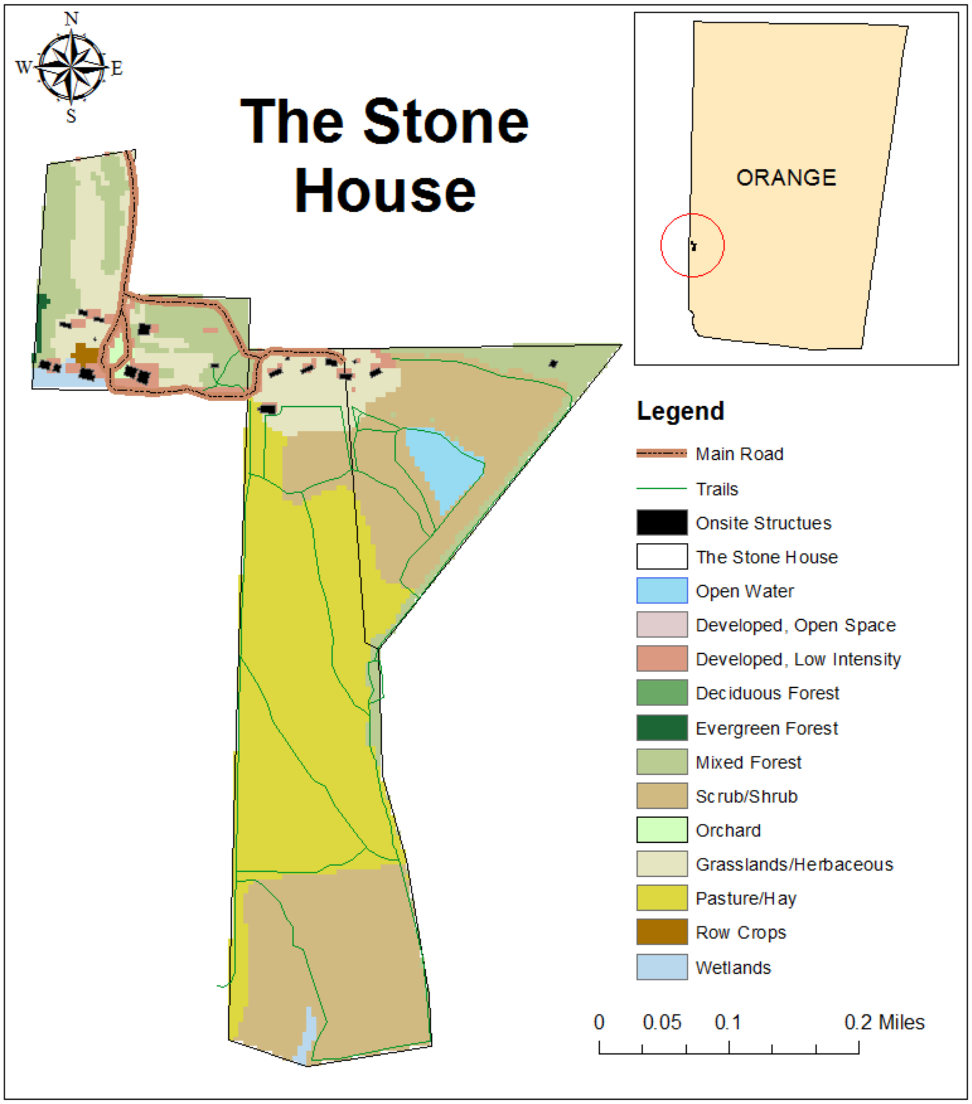
1) How can *stone circles* better create buffers between its property and those adjacent?
2) How can *stone circles* best capitalize on its on-site natural resources (particularly, through the management of educational nature trails and its gardens/orchards)?
3) How can runoff and drainage be managed most effectively to ameliorate flooding and soil erosion into adjacent creeks?
4) What funding streams may be available to the organization as it implements this land use plan?

To address these questions, this project is divided into three sections: a Conservation Management Plan, a Stormwater Management, and a series of Land Use Scenarios. The Conservation Management Plan (Section A) addresses Questions 1 and 2, provides a description of the natural conditions on site and recommends management strategies. The Stormwater Management Plan (Section B) addresses Question 3. Costs and feasibility of recommendations are included in both sections. The Scenarios section (Section C) includes assessments of several other land use options that *stone circles* asked us to consider.

Site Description

The Stone House is located in Mebane, North Carolina. It is in a largely rural part of western Orange County, very close to the border with Alamance County. Three parcels of land make up The Stone House and amount to a total of 70 acres. The land is zoned Agricultural Residential, the purpose of which is defined by the County to be "to assist in the preservation of land suitable for, as a result of location, existing farming operations, and the soils and topography for agricultural, silvicultural or horticultural uses, and to protect such uses from the adverse effects of incompatible land uses." (Orange County 2011a). Retreat centers are permitted in the Agricultural Residential district by special use permit. The property also falls within the Cane Creek Critical Area Overlay District.

The Stone House is made up of 12 primary land uses (e.g. pasture, shrubland, water, and row crops). The site has a dirt road and parking lot, as well as several cabins and two main houses. A garden, orchard, and chicken coop are also located onsite (Figure 1). The soil types at The Stone House are ideally suited for agriculture and pasture. Soils onsite include Georgeville silt loam and Henderson silt loam, ranging from 2-10% slopes (Natural Resources Conservation Service 2011).



Open Water: 1.4 acres
Developed, Open Space: >0.1 acres
Developed, Low Intensity: 1.8 acres
Deciduous Forest: >0.1 acres
Evergreen Forest: 0.2 acres
Mixed Forest: 9.3 acres

Scrub/Shrub: 23.7 acres
Orchard: 0.3 acres
Grasslands/Herbaceous: 7.5 acres
Pasture/Hay: 22.7 acres
Row Crops: 0.2 acres
Wetlands: 0.7 acres

Figure 1: Land Use at The Stone House

Section A: Conservation Management Plan

Methods

In order to better understand the existing vegetation on the stone circles property, and compile quantitative information useful for the development of vegetation management suggestions, educational materials, and a landscape master plan, a multi-stage survey of onsite flora was undertaken during the fall of 2010 and spring of 2011.

During the first stage of the survey, plant communities were observed onsite and described through field notation. Literature on Piedmont vegetation (especially Oosting, 1942) as well as plant identification field guides (Godfrey, 1997; Sibley, 2009; Petrides, 1998), were used to inform plant community delineation and species identification. It was noted that the 70 acres owned by stone circle consists principally of a single, early-successional ecosystem - former cropland/pasture. A variety of other plant communities occupy the remainder of the site, including open turf lawns, meadows with open grown canopy trees, thickets composed of Chinese Privet (*Ligustrum sinense*) and Japanese Honeysuckle (*Lonicera japonica*), single-dominant hardwood stands of relatively young age, middle-aged heterogeneous pine/hardwood stands, and older hardwood-dominated stands. These non-pasture communities are largely limited to the western portions of the property.

In order to delineate the borders of observed plant communities, and facilitate their field study, the borders of each were subsequently mapped using a GPS hand-held unit. The resulting property plan is depicted below.

Figure 2: Plant community borders.

Next, all free-standing trees, of DBH 3 inches or greater, were identified, mapped and measured in three plant communities targeted both for their comparative accessibility and their importance within the landscape – all three communities contain principally open-grown trees and occupy the grounds surrounding the Stone House, garden and western cabins. For each tree, species, diameter at breast height (DBH), geographical position, and surrounding herbaceous plants were recorded. A total of 485 individual trees, and 1620 understory specimens, were logged during this phase of the survey. Following collection, all field data was compiled in a geographic information system (GIS) for subsequent analysis. The map below illustrated the distribution of all individually surveyed trees.

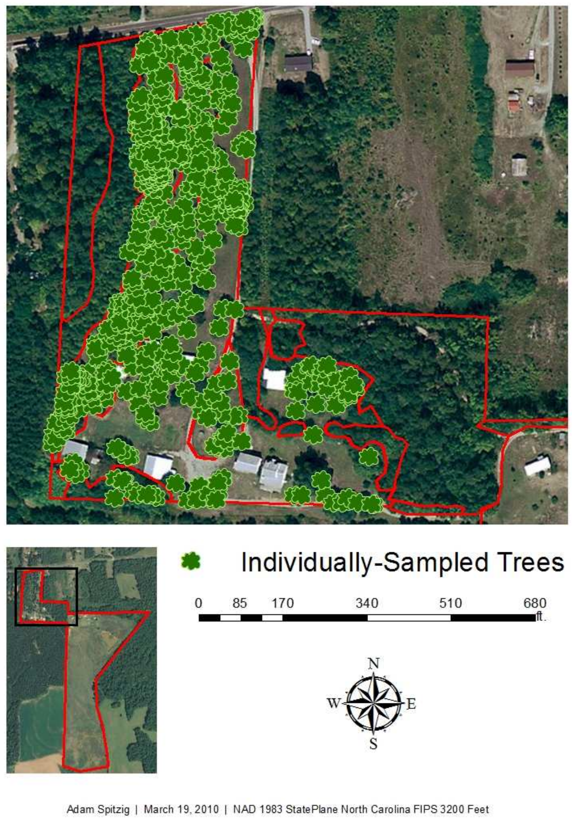


Figure 3: Individually-sampled trees.

Finally, a plot-sampling approach was used to estimate the composition of the remaining onsite plant communities – areas deemed too large to sample comprehensively. Two randomly-located plots, comprising 10% of total plant community area, were established in each, and all major canopy trees within them were identified and geo-located. A total of 147 individual trees were sampled during this phase. Field data was then imported into the established GIS. The maps below depict the distribution of all plot-sampled trees on the property. The composition of the plot-sampled trees, in each community, was presumed to represent the composition of the entire community.

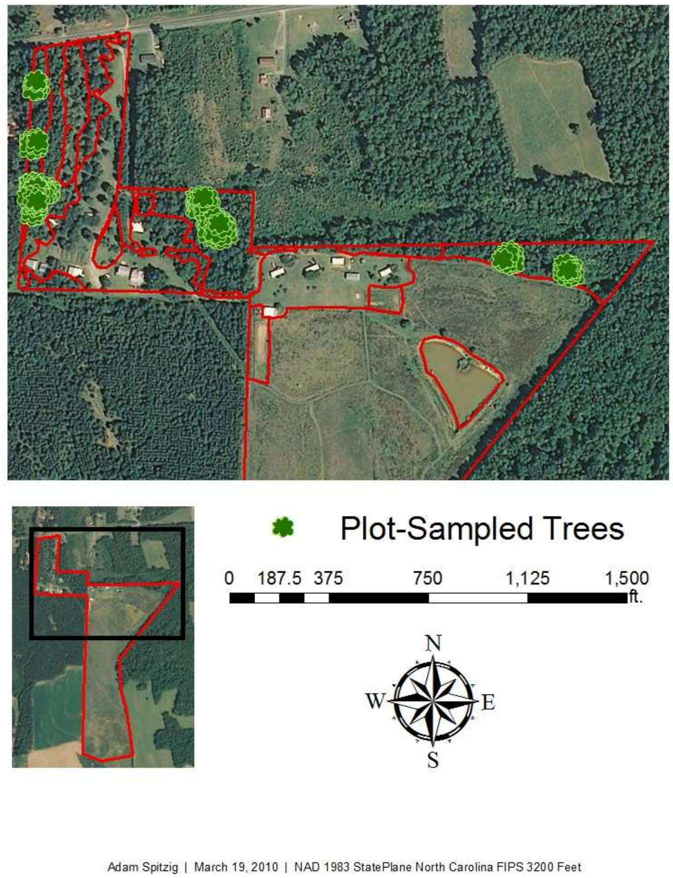


Figure 4: Plot-sampled trees.

Note that the target of both individual and plot-based vegetative sampling was the forest canopy – i.e. the most-established (generally, the oldest) trees within each stand. This focus rests on the well-supported assumption that overstory species substantially determine ecosystem functioning (Tiner, 1999), and provides a foundation for drawing broad conclusions regarding plant community make-up and site vegetation dynamics. It should be noted, however, that such sampling cannot be considered reflective of exact community composition.

Results

Survey results are summarized in the plant community descriptions and maps below. For additional information, including a spreadsheet containing the collected field data, see Appendix A below.

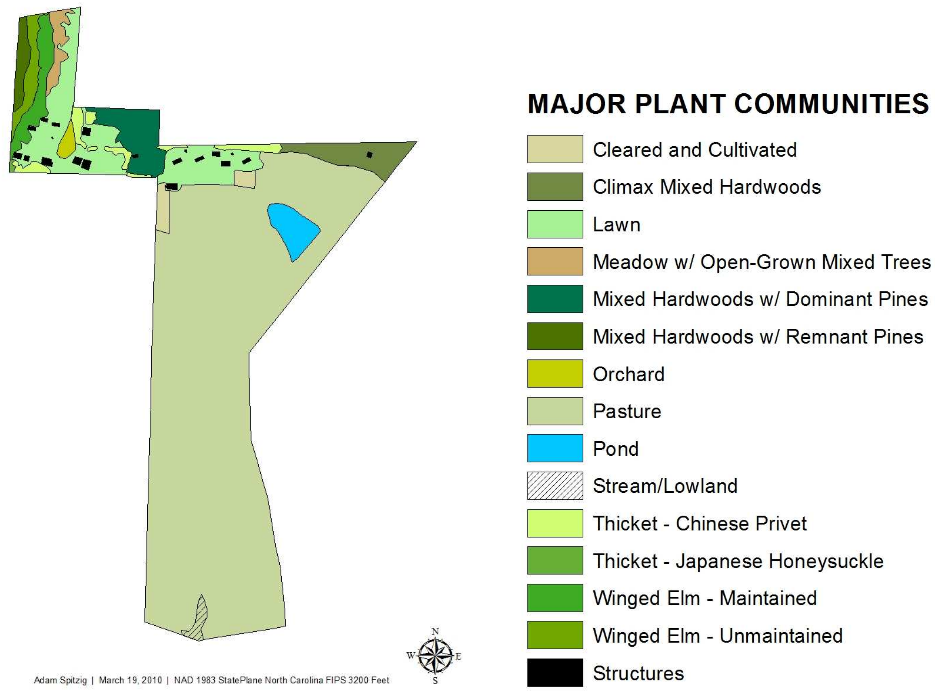


Figure 5: Map of major plant communities.

As seen above, a variety of plant communities populate the stone circles property. A well-established stand of mixed hardwoods and remnant pines, for instance, dominates the far north-western corner of the property ("Mixed Hardwoods w/ Remnant Pines"). The most abundant species of this tract include Sweetgum (*Liquidambar styraciflua*) (41%), Virginia Pine (*Pinus virginiana*) (35%), Southern Red Oak (*Quercus falcata*) (18%), and Shortleaf Pine (*Pinus echinata*) (6%). Note that trees not officially surveyed but observed during field work included Dogwood (*Cornus florida*), Honey Locust (*Gleditsia triacanthos*), and other oak species. The pie chart below summarizes stand composition.

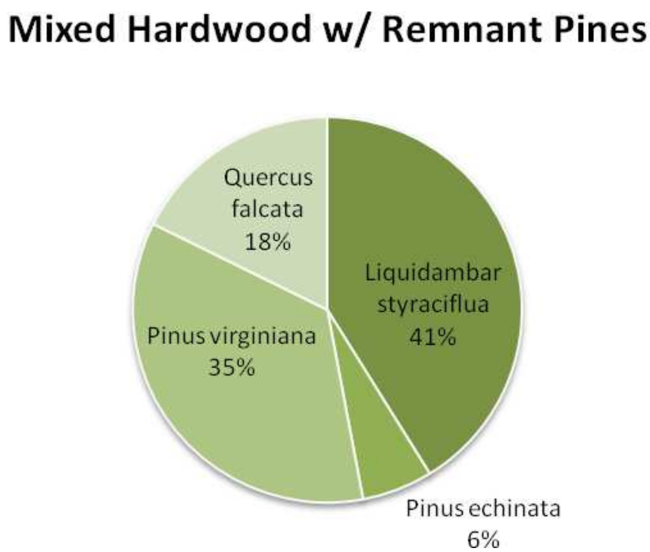


Figure 6: Composition of Mixed Hardwood w/ Remnant Pines

Note that the comparatively high average age, and hardwood-remnant pine composition, of this stand suggests that this area has remained uncultivated and uncleared for a longer period of time. (Oosting, 1942) The forest is likely middle-age successional, or roughly 40-70 years old. The stands' relatively recent escape from the plow and saw be may due to the relative steepness of its topography, especially in its most north-westerly reaches, as well as its location along the property line.

Directly to the east lies a stand of primarily winged elms, which can be subdivided into unmaintained and maintained areas. These sub-stand groups were considered separate plant communities for purposes of the survey ("Winged Elm-Dominated, Unmaintained" and "Winged-Elm Dominated, Maintained", respectively). The former contains densely distributed trees, growing in leaflitter groundcover matrix and, as indicated by its name, is overwhelmingly composed of Winged Elm (*Ulmus alata*) (77%). Other overstory trees recorded in this community include Loblolly Pine (*Pinus taeda*) (9%), Sweetgum (5%), Black Cherry (Prunus serotina) (4%), Eastern Redcedar (*Juniperus virginiana*) (3%) and Southern Red Oak (2%).

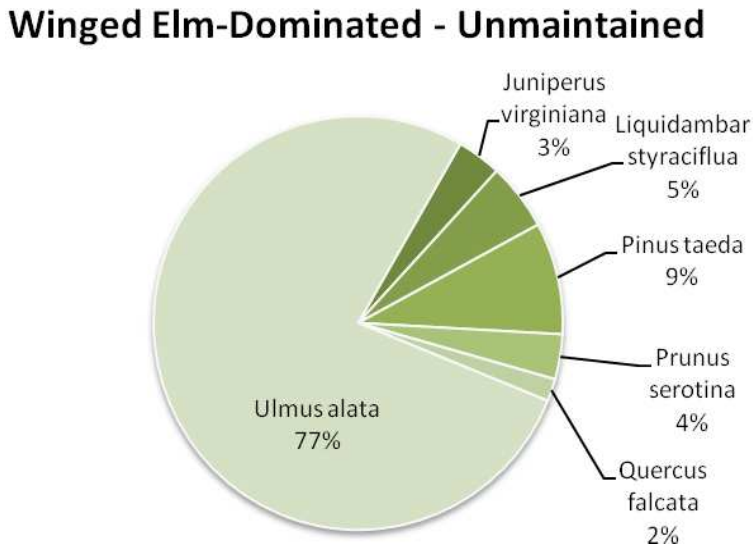


Figure 7: Composition of Winged Elm-Dominated - Unmaintained

The maintained area, on the other hand, is composed primarily of open-grown trees surrounded by grass or meadow. It is also dominated by Winged Elm (48%), but to a lesser extent than its unmaintained counterpart. Other prominent species in this stand include American Elm (*Ulmus Americana*) (29%) and Sweetgum (16%).

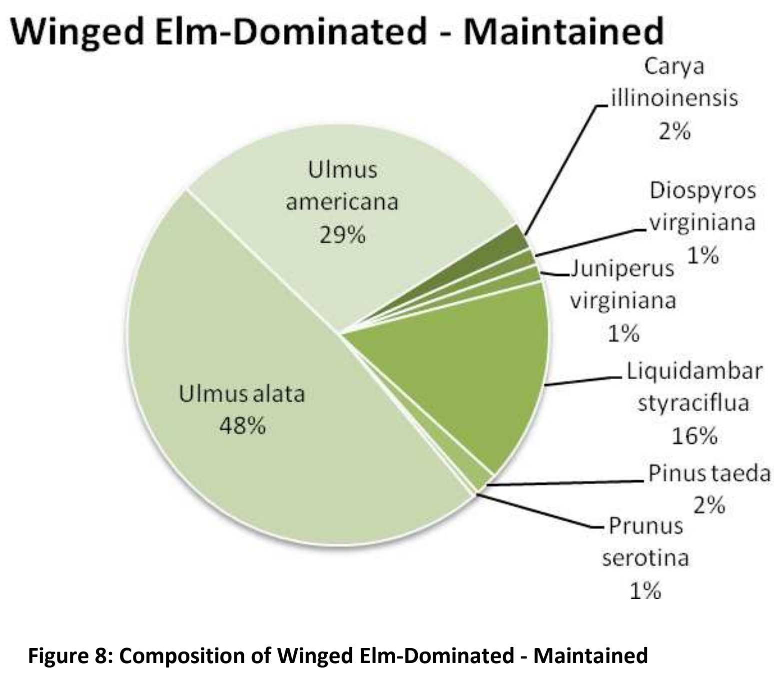


Figure 8: Composition of Winged Elm-Dominated - Maintained

In both maintained and unmaintained areas, the abundance and density of winged elm – a common, early-successional tree in the Piedmont – suggests a relatively youthful forest. The Winged Elms' average age was similar across both areas – approximately 20-30 years, based on stand composition and average DBH (8.3 inches). (Oosting, 1942) This similarity also suggests that both stands were established around the same time – perhaps after a sustained post-cultivation abandonment, lumber harvest, or yard-clearing – and diverge, today, in diversity and density, due only to recent differences in thinning and maintenance.

Several species were found repeatedly in the herbaceous layers of the maintained Elm, and surrounding, stands. These included grasses (*Festuca spp, Andropogon spp.)*(associated with 25% of sampled trees), Chinese Privet (*Ligustrum sinense*) (associated with 13% of sampled trees), Olives (*Elaeagus spp.*) (associated with 12% of sampled trees), and many others. Herbaceous layer observations are collectively summarized in the pie chart below.

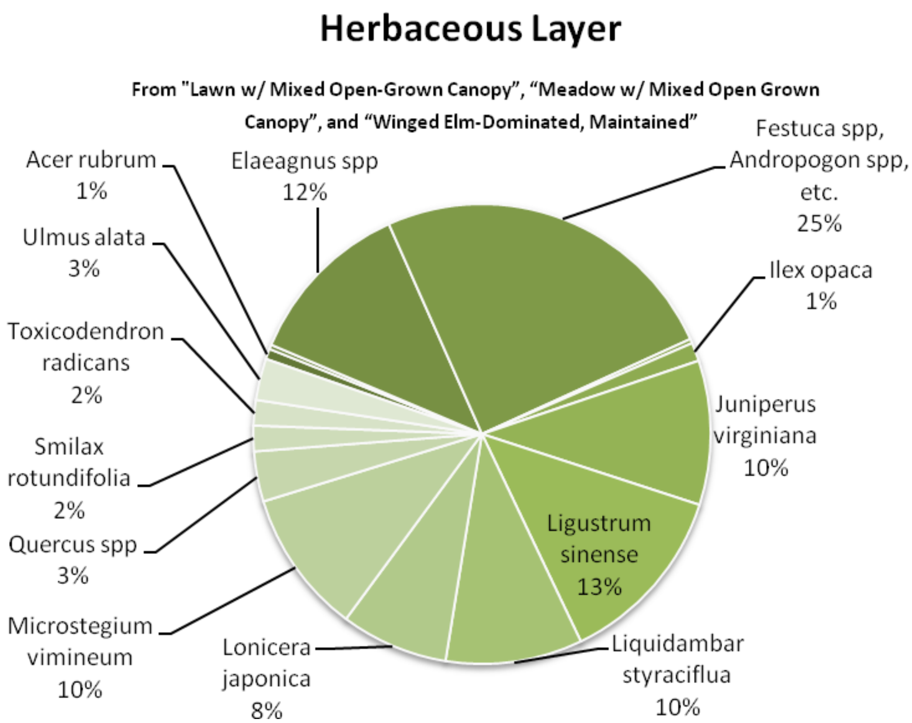


Figure 9: Composition of Herbaceous Layer

Surrounding the entryway and main house is the lawn, consisting principally of large, low-density deciduous and evergreen trees, and turf. Within this area, containing the most conspicuous and aged trees on the western portion of the property, were found Winged Elm (23%), Loblolly Pine (19%), Sweetgums (11%), Virginia Pine (10%), American Elm (7%), Mimosa Silktrees (*Albizia julibrissin*) (3%), Common Persimmon (*Diospyros virginiana*) (2%), and many others. Fruit trees, including what may be wild plum (Prunus spp.) (5%), and orchard trees (Apples, Pears, Plums, Figs, etc.), were also recorded on this portion of the property. The stretch of lawn around the main house, to the east, was noted to be home to several significant, yet minimally-represented, feature trees, including a Willow Oak (*Quercus phellos*) and a large Pecan (37.2 in. in diameter, and estimated to have been planted in the late 1800s).

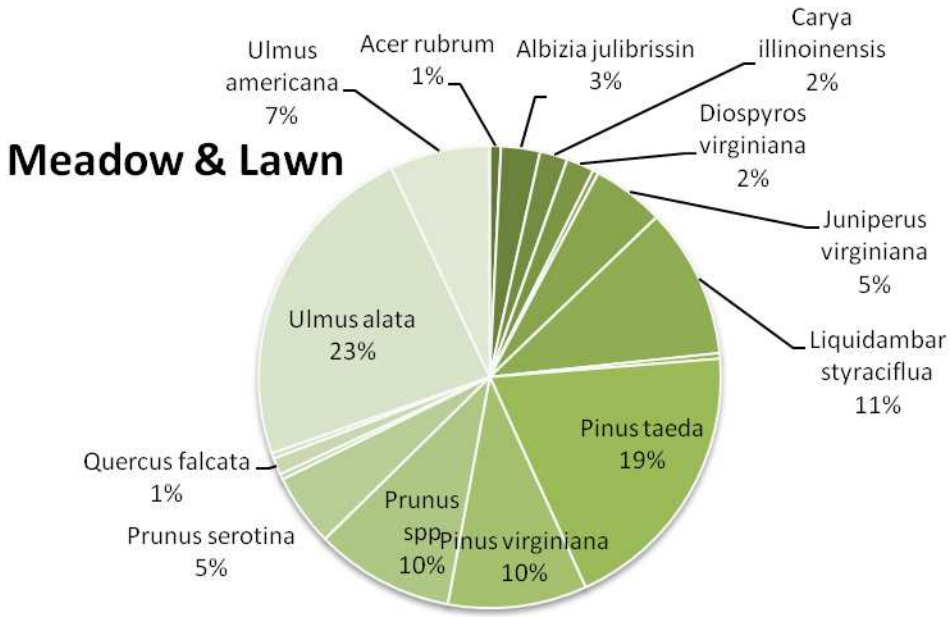


Figure 10: Composition of Meadow & Lawn

The greater average DBH of the lawn trees (especially American Elms, Persimmons, Loblolly Pine and Virginia Pines, and Hickories/Pecans), their open-grown appearance (large, spreading canopies, with comparatively higher proportions of lateral branches) and minimal surrounding herbaceous layer, suggest that this area is well-established as a semi-open, ornamental yard – i.e. that successional progression has been intentionally and consistently suppressed here for some time. The colonization of this area by Chinese Privet further suggests the existence of persistent edges, created by the maintenance of a distinct yard space.

The next discernible plant community, east of the pavilion area and northeast of the main house, is a well-established forest stand consisting of mixed pines and hardwoods ("Mixed Hardwood w/ Dominant Pines"). The stand was found to be dominated, in its upper elevation reaches, by smaller Winged Elm and other low-DBH hardwoods, and in its lower/eastern stretch, by mature Loblolly, Virginia and Shortleaf Pines. The stand's mature pine overstory and the consistent in-mixture of hardwoods, especially in the western portion, suggests that it is of middle successional age.

Note that the general vegetative gradient observed in this community, with older pines maintaining an increasingly higher share of canopy composition as one moves eastward and downward, suggests the possibility of dividing the stand into two plant communities – with the Winged Elm-dominated section existing as a continuation of the maintained and unmaintained Winged Elm stand to the west, and the pines existing as a community unto themselves. The distinct spatial location and contiguity of the stand, and the ultimate use of plant community data for a vegetative snapshot, educational materials, etc., however, counsels in favor, for the present analysis, of considering the stand as unitary.

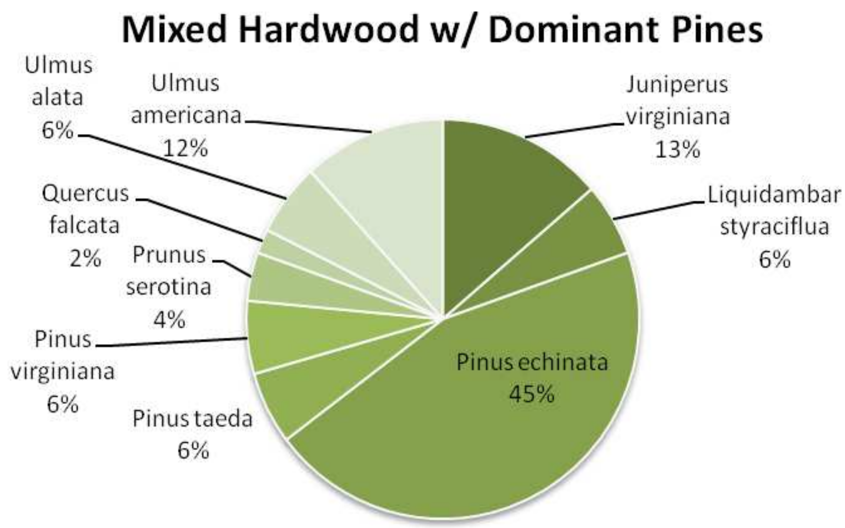


Figure 11: Composition of Mixed Hardwood w/ Dominant Pines

In the far north-eastern corner of the property, surrounding the hermitage cabin and straddling the nearby stream, lies the oldest, most well-established forest stand on the property ("Climax Mixed Hardwood"). Survey results indicate that the stand exhibits general gradient similar to the "Mixed Hardwood w/ Dominant Pine" stand, described above, with the western-most reaches dominated by Sweet Gum, Tulip Poplars and assorted oaks (winter leaf litter observations indicate a probable mixture of Northern Red Oak, Southern Red Oak, Black Oak and Scarlet Oak), and the lower, semi-bottomland portion dominated almost entirely by oaks, especially White Oaks (*Quercus alba*) (note that there exists distinct cluster of White Oaks surrounding the hermitage trail, a concentration monospecific, mature hardwoods unique on the property). The stand – which, in both sub-sections, exhibits mature stand-characteristic low density and high average DBH – is estimated to be at least 80 years old (Oosting, 1942). As a climax forest, the stand's composition, especially that of the lower oak-dominated portion, is not expected to vary drastically in the near future, and can be viewed as representative of the potential, long-term result of reforestation efforts on other portions of the property.

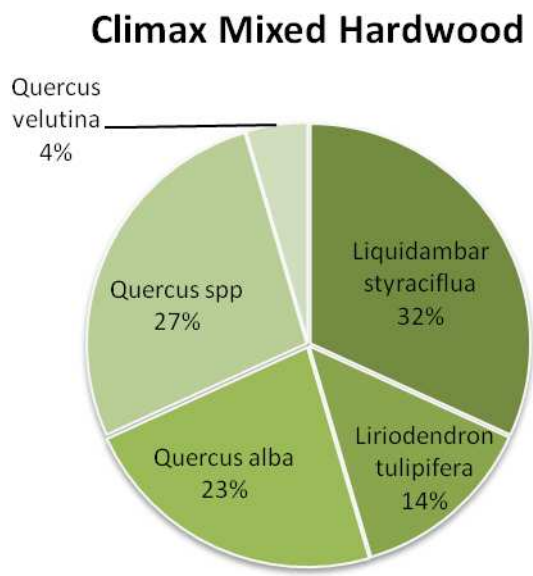


Figure 12: Composition of Climax Mixed Hardwood

While the tree-dominated portions of the property represent the focus of the survey, two other plant communities were also documented.

The largest, non-forest plant community on site is post-abandonment agricultural field, herein referred to as pasture. While a detailed survey of the grass and hardy shrub species of the pasture was not undertaken, observational and literature-based data support the conclusion the area is currently dominated by a mixture of scrub grasses (especially *Andropogon spp*. – e.g. Broomsedge), asters, goldenrods, hardy shrubs (such as Pokeweed, *Phytolacca americana*), and others – a composition highly characteristic of Piedmont cropland several years post-abandonment (Oosting, 1942).

The second type of major, non-forest community observed on-site, occupying most of the spatial margins and plant community edges, is vine/briar thicket. Chinese Privet, Japanese Honeysuckle and briars patches (Blackberry, etc.), were, at several locations throughout the property, observed in large, dense concentrations. The most prominent type of thicket is formed by Chinese Privet , a non-native, invasive shrub. Privet thickets are especially prominent along forest edges throughout the main house tract and near the chicken run. Chinese Privet-dominated communities were observed to contain well-established trees, tall enough to escape Privet's intense shading. While not surveyed as thoroughly as other property vegetation, the various Chinese Privet thickets on site were determined to have the following composition of these established trees.

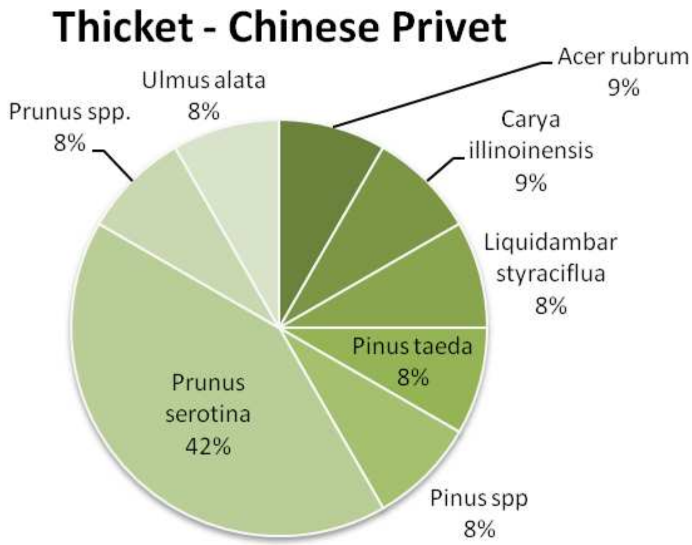


Figure 13: Composition of Thicket - Chinese Privet

Thickets formed by climbing vines and briars were also recorded – most notably, Japanese Honeysuckle (*Lonicera japonica*) and Blackberry (*Rubus spp*.) Briars were evident at various points along the pasture borders, particularly along fence-lines and at the northern pasture edge. Japanese Honeysuckle also occurred along pasture margins, and was noted, additionally, on two western sites – in the middle of the "Mixed Hardwood w/ Remnant Pine" stand, along the western boundary of the stone house tract, and in the extreme southwestern corner the western parcel.

While the geographic extent of thickets was spatially minor, their ecological significance for onsite vegetation may be substantial. The species forming two of the three types of thickets documented – Chinese Privet and Japanese Honeysuckle – are not native to the Piedmont, and are often considered problematic invasives. They retain the potential to locally displace native species and significantly reduce herbaceous layer site biodiversity.

Vegetation Management Recommendations

The following measures are recommended to support the continued stewardship of natural spaces and vegetation on the stone circles property. They are rooted in the findings of the vegetation survey, described above.

Develop a forest management plan. A substantial portion of the property is currently forested, and if succession is not intentionally repressed in un-forested areas (non-suppression is recommended), much of the remaining land will undergo reforestation in the coming years. The achievement of stone circles land and wildlife stewardship goals would thus benefit substantially from the expert-aided creation of a woodland management plan.

Such a plan could be facilitative of both the ecological/educational, and financial, goals of the organization. Through planning and consultation with professional foresters, stone circles could craft a guiding document balancing wildlife habitat generation and preservation, ecosystem service provision, invasives control, carbon credit certification, educational opportunities, timber harvest, and other activities. It is hoped the vegetation survey results, described above, provide a information base for such a plan.

Note that, prior to consultation and the formal creation of a management plan, preliminary steps may be undertaken. These include the identification of forest management priorities, and the implementation of certain low-cost forest improvement measures. It is advised, for example, that stone circles independently establish a basic framework of vegetation management goals, in which potential management practices – including wildlife protection/promotion, water management, recreation, aesthetic value, soil conservation, timber production and spiritual value – are triaged according to organizational objectives. Once specific objective, useful for long-term property planning, would entail the establishment of forest coverage goal – i.e. the minimum area desired for permanent forestation. The information contained in the final section of this report will aid in the creation of a management plan, as may freely available resources such as North Carolina State University's small-scale vegetation management guide, specific to Piedmont area ecology (see references, below).

It is further advised that several management practices are implemented in conjunction with the creation of a formal forest management plan. These include selective thinning and planting based on vegetation preferences (for example, the portion of the property termed "Winged Elm-Dominated, Unmaintained", on the western parcel, currently exhibit a fairly highly stem density and low tree diversity, and would likely benefit from selective thinning), and basic invasive species control (continued regular mowing to maintain, and push back, Chinese Privet thicket edges, and the general encouragement of native overstory and shrub plants to help shade-out invasives). Again, these basic forest health-promoting practices, tailored to the specific ecological and economic needs of stone circles, can be gleaned from many user-friendly resources (such as the previously cited NC State guide), and implemented with minimal costs.

<u>Allow the pasture to undergo natural succession</u>. It is recommended that succession be allowed to progress naturally within the pasture area. This approach – which simply entails the elimination of regular mowing of the pasture (except trails, see below), and, the gradual implementation of a forest management plan – is a long-term ecological investment supportive of shorter-term organizational goals.

In the short- to mid-term, during the next several decades, pasture will give way to young pines and scattered hardwoods, and the field-cum-forest will become increasingly denser. The natural succession process will, in this way, enhance the property's utility as retreat center by offering an aesthetic complement to existing onsite natural spaces (gardens, orchards, lawns, pond, trails, etc.), and the emerging forest, and the influx of wildlife it brings, will offer a living lesson in the ecology of Piedmont, old field succession. The establishment and maintenance of an educational trail system as a spatial and informational frame for this emerging forest (as discussed below) will aid in capitalizing on the forest's educational potential, and in maximizing visitors' enjoyment of the site.

In the long-term, the implementation of forest management practices, as defined by a forest management plan (such as selective timber sales or the sale/lease of forested land) will help secure additional revenue streams for organization operation. The costs and benefits of these options are discussed in subsequent sections of this report.

EDUCATIONAL MATERIALS AND NATURE TRAIL

Maps, charts and tables describing the results of the vegetation survey

A variety of graphical syntheses of the vegetation survey results, and cartographical information obtained during analysis, were created during data analysis. These materials are included in Appendix A, below. It is recommended that these products be utilized – in combination with the plant community descriptions included above – to (1) aid in the creation of educational materials for site visitors (beyond the trail network/guide, described below) (2) inform the development of a forest/vegetation management plan, as suggested above, (3) complement and illustrate marketing/promotional materials, and (4) provide information supportive of grant proposals.

Proposed natural trail network and guide.

The results of the vegetation survey were, additionally, used to create a proposed trail network and an accompanying educational guide. The trail network, depicted immediately below, was configured to: (1) pass through each of the major plant communities on site, affording the opportunity to maximize the exposure of visitors to Piedmont succession, the central theme of the trail guide, (2) connect the major functional areas of the property – including the garden, orchard, main house, and eastern lot cabins (as well as a proposed central gathering area – see landscaping master plan, below), providing the opportunity for stone circles to showcase and describe, in a walking tour-based orientation, its onsite operations and organizational mission, and (3) overlie, to the extent possible, existing trails (especially in the pasture), minimizing the need for expensive installment costs (see cost breakdown below). Note that the trail is divided into 1.46- and 0.68-mile loops, facilitating either an introductory site tour or, alternatively, a longer eco-educational hike.

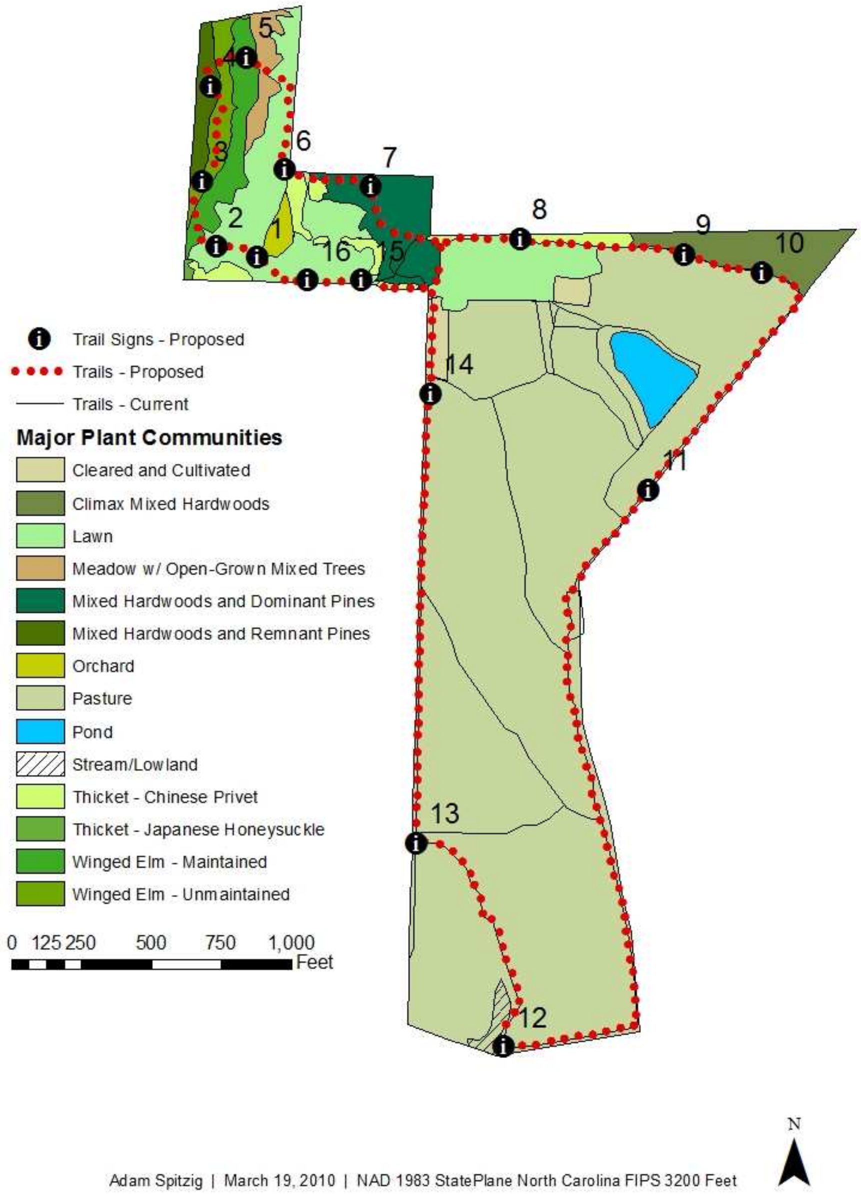


Figure 14: Map of proposed trail network.

At each of the stations indicated on the map above, it is recommended that a marker be installed, on which a number is displayed (construction options and costs are analyzed below). Additionally, it is recommended that a pamphlet be created containing a series of informative paragraphs, each numbered and corresponding to a specific trail post. The text forming the basis of such a pamphlet, may be modeled on those included in Appendix A, below. It is further recommended that a small, waterproof box can be installed at the trail head, and reusable copies of the pamphlet located within it. Copies may be made available to visitors in the main house, as well, and/or in informational orientation packets created as part of special events.

Permacultural Re-Design of Garden, Orchard and Surrounding Landscape

In order inform the permacultural expansion of the garden and orchard, and the landscaping of main house grounds, a two-phase research and design process was conducted as a supplement to the vegetation survey. During phase one, with the aid of NC State professor Will Hooker and the students in his spring 2011 residential design course, spatial measurements were taken across the central portion of the property. The site's topography was measured using land surveying equipment, and crossed-referenced with an area elevation map. The dimensions of all major buildings in the main house parcel were recorded. Non-building data – such as the road/parking lot dimensions, the locations of significant trees, and garden/orchard arrangement – were also recorded. Finally, photographs were taken across the site in order to calibrate site measurements. Field-collected data was then compiled and, in combination with satellite images of the property, used to create a detailed basemap.

During phase two, traditional landscaping and permacultural methods were used to analyze property dynamics, address specific landscaping goals expressed by stone circles, and ultimately create a landscaping master plan. Appendix A, below, contains digital versions one such master plan. It is recommended that all plans resulting from this design process (i.e. produced by students in Will Hooker's Residential Design studio) are analyzed, and used a foundation for future site development and landscaping.

Funding for the Conservation Management Plan

Together, the vegetation management recommendations, educational trail network, and materials and permacultural landscaping proposals discussed above constitute a general conservation management plan designed to aid in *stone circles'* continued stewardship of its natural spaces and site resources.

While implementation of this plan requires financial investment, funding is available to reduce some costs. In this section, cost estimates for reforestation, trails, and education are discussed and funding sources are recommended.

Reforestation

Reforestation at the *stone circles* property can occur in one of two ways. As recommended in the conservation plan, *stone circles* can allow natural succession. Alternatively, reforestation can occur more rapidly if seeds or trees are planted rather than allowing the process to occur naturally. Reforestation is consistent with *stone circles'* mission and vision for a sustainable relationship between land and community. Allowing the field to become forested will provide a number of ecological services (water uptake, carbon sequestration, etc), offer habitat for wildlife, and provide visitors with a large forested area to explore.

Financial Costs & Benefits

The costs of reforestation range, depending on the amount of site preparation required, from $0 to $200 per acre (Hamilton 2008). If natural succession is chosen, costs will be close to zero as the process will occur naturally over several years. If a faster turnaround is desired, some preparation of the field will be necessary to allow for replanting or reseeding. Costs of replanting or reseeding are approximately $70 per acre. This would amount to a total cost of $0 to $9450 to reforest the 35 acres that constitute the back field.

Funding Opportunities

State and Federal Programs

There are several governmental programs that assist landowners in reforestation efforts. The relevant programs for North Carolina are discussed below.

<u>Forest Development Program</u>

The Forest Development Program, administered by the North Carolina Division of Forest Resources (NCDFR), provides financial assistance for reforestation and afforestation (Division of Forest Resources 2011). It partially reimburses landowners for costs associated with establishing a forest, including site preparation, seedling purchases, tree planting, release of desirable seedlings from competing vegetation, and any other work needed to establish a new forest. Private landowners are eligible for cost sharing for a minimum of 1 acre to a maximum of 100 acres of forest. In order to qualify for funding (which is typically 40% of the cost), landowners must prepare a forest management plan that is approved by the NCDFR. Guidelines for creating a forest management plan are included in Appendix A.

<u>Forest Stewardship Program</u>

NCDFR also provides technical assistance for the creation of forest management plans through USDA's Forest Stewardship Program. To enter the program, which subsidizes the writing of Forest Stewardship management plans by approved plan writers, landowners must agree to manage their property according to an approved Forest Stewardship Management Plan (USDA 2010a).

<u>Conservation Reserve Program</u>

The Conservation Reserve Program (CRP) is run by the Farm Service Agency of the USDA. It is a voluntary program for agricultural landowners designed to protect the natural resources and reduce water runoff and sedimentation (USDA 2011a). CRP contracts last for 10 to 15 years, during which time the program pays annual rental rates to participating landowners and 50% of the costs of establishing approved conservation practices. Land is eligible if it has been used as cropland for 4 of the 6 previous years, or is marginal pasture land suitable for use as a riparian buffer.

Tax Credits and Deductions

There are tax credits and reductions available to landowners involved in reforestation. Landowners can deduct up to $10,000 of qualifying reforestation expenses in the year they occur, and can repay the remaining costs over an 84 month period (Bardon 2005). Cost-sharing payments can be partially or totally excluded from taxable income. Management expenses may also be deductable.

Carbon offsets

A carbon offset is a reduction in the equivalent of one metric ton of carbon dioxide (CO_2) emissions that is made to compensate for emissions made elsewhere (CCX 2011). Companies, governments, or other entities purchase carbon offsets in order to comply with greenhouse gas emission limits or voluntarily reduce their contributions to climate change. Carbon offsets can be achieved through a number of emissions-reducing projects. The most common are renewable energy, energy efficiency, agriculture, and forestry projects. Since the United States has not passed legislation requiring greenhouse gas emission reductions, participation a carbon market or purchasing offsets is voluntary.

Landowners with small parcels who wish to participate in carbon offsetting generally do so through offset aggregators, who act as brokers of offsets. Aggregators are able to pull together many small projects and sell them as a bundle to private offset companies or, prior to 2011, on the Chicago Carbon Exchange (CCX). Carbon offsets can be verified by one of many certification standards.

In the United States, the current market for carbon offsets exists primarily in the form of private suppliers. There are a number of companies that sell offsets to private citizens, companies, or other entities that wish to compensate for their emissions. For example, CarbonFund.org (2011) offers offsets at $10 per ton. Many other companies provide the same services, and the emission reducing projects they choose to invest in vary. Most choose not to pursue small-scale projects.

Prior to 2011, the Chicago Carbon Exchange (CCX) was North America's only voluntary, legally binding greenhouse gas reduction and trading system. It stopped trading carbon credits at the end of 2010. While active, it provided an opportunity for small-scale farmers and foresters (reducing less than 10,000 metric tons of CO_2 equivalent per year) to sell their carbon offsets. Landowners did this through offset aggregators, who served as administrative representatives on behalf of project owners. Payments to landowners for their emission reductions fluctuated based on market demand (CarbonFund.org 2011; CCX 2011; Forestrycarbon.com 2011).

In 2011 and 2012, CCX will be operating the CCX Offsets Registry Program. It registers verified emission reductions based on the comprehensive set of established protocols established while the CCX was in operation. Aggregators can continue to have projects certified and registered by CCX during these years (Persky 2010). Many have chosen not to continue with the program or accept new landowners, however, because carbon prices have fallen to such a level that it is economically infeasible to participate (AgraGate Climate Credits Corporation 2011; North Dakota Farmers Union Carbon Credit Program 2011). It is possible in the future, however, that there may be a greenhouse gas regulation that makes legally binding trading programs viable once again.

Financial Benefits of Carbon Offsets

At The Stone House, the financial benefits of carbon offsetting can be achieved through reforestation. There are approximately 35 acres available for a reforestation project. Assuming Loblolly Pine is planted at a density of greater than 250 trees per acre, the project would offset 57.05 metric tons of CO_2 per year for the first five years. This number is calculated annually, and as the trees become older, they sequester more CO_2. For example, eleven years after planting, the 35 acres would offset 248.85 tons of CO_2. These offsets are sold annually and vary according to market demand. When trading was occurring on the CCX, prices reached a height of over $7 per ton of CO_2 in 2008, but by 2010 trading had all but stopped and prices were as low as $0.05 or $0 per ton. Assuming a mid-range value of $3.50 per ton, The Stone House's 35 acres of reforestation could be worth $199.68 in each of the first five years of the life of the forest. On a fifteen year horizon at an average price of $3.50 per ton, the reforestation would provide a total of $5,476 in income to *stone circles* if traded on a market like the CCX (Taylor *et al.* 2007; Current *et al.* 2007). Since CCX is no longer involved in trading, a private company must be found to purchase the offsets. In this case, prices may actually be more stable.

A reforestation effort at The Stone House would bring minimal monetary benefits at the present time. The current market for offsets suggests that compensation would amount to less than $600 per year in the first five years of growth, even if prices were as high as $10 per ton of CO_2. There are also some costs involved with a reforestation effort. Costs to the landowner associated with selling carbon offsets from reforestation may include: startup costs (inventory, certification of sustainability, and project preparation cost) and participation costs (verifications, aggregator fees). If *stone circles* were to contract through an aggregator, some of the costs may be included in the aggregator's fee (Taylor *et al.* 2007). At the current time, however, it may also be difficult to find an aggregator willing to work with new clients.

Selling timber

stone circles can achieve financial benefits from its reforestation efforts if it sells some of the timber that is produced. The price of timber depends on the species of the tree, its size, quality, location, and the competitive timber market. The type of timber harvesting done and the amount of timber sold in one sale also influence its value. Generally, larger sales can obtain higher prices per unit of wood because it is costly to cut only a few select trees. The location and condition of the site where the trees are growing influences the timber's value. The distance to the nearest road and mill, the slope, and soil conditions all affect operational costs of the harvesters. When operational costs are high, harvesters will offer lower prices.

Timber prices for pine trees are reported in terms of sawtimber and pulpwood. Trees sold for pulpwood do not have the size or quality to make other wood products, and are valued substantially less than sawtimber quality trees. Trees are measured by DBH and merchantable height (Bardon 2011; University of Arkansas 2006). The height of sawtimber is usually measured in terms of the number of 'logs' to some 'merchantable top.' 'Logs' are generally 16 feet long, and a 'merchantable top' is the small end diameter (about 8 inches) where the top of the tree will be cut off. To qualify as a sawtimber pine, trees generally have a DBH of at least 10 inches and a height of at least 16 feet before the tree has multiple branches. Pulpwood trees are smaller and have multiple branches. In 2010, the average market price for a sawtimber in western NC (includes Orange County) was $247 per thousand board feet and the average price of pulpwood was $23.90 per cord (128 cubic feet of compactly stacked wood) (NSCU 2011).

Financial Benefits of Selling Timber

It is difficult to estimate the value of timber when it has yet to be planted. Annual returns from 0% to 40% are possible from forest management (Bardon and Hamilton 2005). At *stone circles*, the value of the field as timber would depend on the density at which trees are planted, when the trees are harvested, as well as the factors mentioned above. If *stone circles* chooses to pursue reforestation for timber production, it should consult with a professional forester to create a plan and determine an ideal density and harvest age. To illustrate the potential value of the field as timber, consider the following example: A Loblolly Pine with a DBH of 18 inches and merchantable height of 32 feet would contain 0.164 thousand board feet. Assuming the average 2010 price of $247 per thousand board feet for saw timber, this tree would be worth $40.51.

TRAILS & EDUCATION

Expansion of the existing trail network throughout the stone circles property will allow guests to further explore the land and deepen their connection with nature. Fostering a sustainable relationship between land and community is one of stone circles' primary goals. Pairing a trail network with signs and other educational materials will simultaneously provide environmental education and spiritual opportunities.

Financial Costs & Benefits: Trail Construction

The primary costs involved in expanding the trail network at the stone circles property include: trail construction, trail maintenance, and sign purchase and installation. The cost of trail construction can vary substantially depending on the materials used. At the stone circles property, a natural surface trail, wood chip trail, or granular (crushed limestone paving) trail would be most appropriate. An asphalt or concrete tail would be prohibitively expensive and would take away from the natural feel of the property that stone circles aims for. The estimated cost of a 5 foot wide natural surface trail is $6,985 per mile (IDOT 2000). This estimate may be high, because there is not much grading required at the stone circles property. Construction services, documents, and administration could add an additional cost of $1,746 per mile, although much of this cost could be avoided if stone circles performs the work itself. The cost of a 5 foot wide wood chip trail is approximately $20,903 per mile. Again, this number is a high estimate as the grading work would not be substantial. Additional costs (e.g. construction services) could amount to as much as $5,226 per mile. The approximate cost of a 5 foot wide granular trail is $41,049 per mile, with additional costs potentially amounting to$10,262 per mile. The proposed trail network is 1.93 miles long. This would amount to a total cost of $13,481 for a natural surface trail with additional costs up to $3,370, $40,343 for a wood chip trail with additional costs up to $10,086, and $79,225 for a granular trail with additional costs up to $19,806.

Financial Costs & Benefits: Signs

The proposed trail network would require 17 trail markers. Each marker would contain a number that refers hikers to an interpretive trail guide with specific information relevant to that location. There are several companies that offer trail posts, markers, and signs and there are many different designs available. Prices range from $72 - $1,350. The companies from which stone circles could purchase signs are included in Appendix A along with the different designs that are offered. Alternatively, stone circles can create its own signs. Fence posts can be purchased for $11 from Home Depot and used as trail markers (see Figure 15) (Home Depot 2011). These posts can be painted with numbers and arrows or decorated by stone circles guests. This would minimize cost and simultaneously foster a connection to the stone circles property for those individuals participating in the painting activities. Purchasing 17 fence posts to be used as trail markers would cost approximately $187.

Figure 15: A fence post, like one of these from Home Depot, can be used as a trail marker

Funding Opportunities

Several organizations offer grants in support of environmental education and trail initiatives. Some of the grants that *stone circles* may qualify for are:

Cedar Tree Foundation awards grants in amounts up to $300,000 in the areas of environmental education, environmental health, and sustainable agriculture. They favor grant proposals that have strong environmental justice and/or conservation elements.

The **North Carolina Adopt a Trail Program** grants up to $5,000 for new trail construction, trail side facilities, brochures, and media.

The **Rudolf Steiner Foundation Social Finance Seed Fund** grants up to $5,000 to new initiatives in the areas of food and agriculture, education and the arts, and environmental stewardship.

Wallace Genetic Foundation awards grants of up to $40,000 in the areas of sustainable agriculture, protection of farmland near cities, plant genetic research, biodiversity protection, and environmental education and media.

More detailed information about each of the above grants, as well as others that *stone circles* may qualify for, are included in Appendix A. A grant application for Rudolf Steiner Foundation's Seed Fund, which can also be used as a starting point for other grant applications, is also included in Appendix A.

Conservation Management Conclusions

The full implementation of the conservation management plan is the recommended course of action for *stone circles*. It includes developing a forest management plan, allowing the field to undergo natural succession, and implementing an educational trails system. It is consistent with *stone circles'* mission and goals for the property, provides ecological benefits, and can be funded largely through grants and governmental programs.

SECTION B: STORMWATER MANAGEMENT STRATEGIES

INTRODUCTION

One of the major issues facing the *stone circles* property is how to manage stormwater. In order to assist onsite staff in making the most cost-effective decisions with how to ameliorate erosion and flooding, we conducted an extensive literature search of best management practices (BMPs) for stormwater control, focusing on proven strategies in the North Carolina Piedmont region where possible.

To this end, we determined that a rooftop-to-stream approach would most benefit the property in terms of erosion control on the roads and in the garden. This approach is a combination of individual approaches that focus on water capture from roofs (rooftop), water retention, and erosion prevention (stream). While each of these approaches may ameliorate flooding or erosion, working in concert, they address both simultaneously. For this approach, there are four main BMP's we suggest:

1) Rain Barrels
2) Rain Gardens
3) Improving Riparian Buffers
4) Paving the Road with a Pervious Paver or Incorporating BMPs into the Unpaved Road

The Gardener's Supply Company provided information on various BMPs associated with small-scale garden projects, specifically rain barrels. The North Carolina Cooperative Extension (NCCE) based out of North Carolina State University provided a comprehensive review of rain gardens in North Carolina, and should *stone circles* wish to incorporate another rain garden into its property, the group's website has a how-to guide for both sun and shade rain gardens, how to size them, and where to place them (NCCE 2011). The North Carolina Department of Transportation (NCDOT) and the United States Geological Survey (USGS) provided the base geospatial data used in the analyses conducted in this section of the plan. The analyses themselves were developed according to methods proposed by Baker *et al.* (2006) in the journal *Landscape Ecology*. Further journals such as *Building and Environment* and the *Journal of the American Water Resources Association*, in addition to company websites such as Boddington provided information on pavers and BMPs for dirt roads.

In the following sections we will discuss each of these BMPs and where and how the *stone circles* property might implement them.

RAIN BARRELS

The main function of rain barrels is to capture and store runoff from the rooftops of buildings (Hager 2003). They have the benefit of not only preventing water from eroding soil around gutter drainpipes, but also reducing nutrients from the 'first flush' effect of storms. Simply put, the 'first flush' effect is a phenomenon whereby early runoff from a surface during a storm event contains the highest concentration of dissolved nutrients (e.g. nitrogen and phosphorous) and particulate matter (e.g. sediment) (Laws 2000). This fits most closely with *stone circles'* mission to act as stewards for their own property. It also has the wider benefit of providing a small, but important form of stewardship for the Cane Creek watershed in which the property is located.

Additionally, the purchased rain barrels could be used to further *stone circles*' goal of educating visitors to the *stone circles* property about conservation and land stewardship practices. In allowing groups of visitors to help decorate the rain barrels, staff could explain their importance as water conservation units and provide information to interested persons about how they might obtain a rain barrel for their own home, thus promoting conservation offsite as well as on. Helping to decorate the barrels onsite would also foster a connection to the *stone circles* property for those individuals participating.

Financial Costs & Benefits: Rain Barrels

We suggest purchasing four rain barrels as a pilot, two for the Stone House Meeting/Kitchen building and two for the equipment room near the vegetable patch. These buildings were specifically chosen due to their proximity to sites on the western portion of the property that would require extra attention for watering and erosion control (e.g. the vegetable patch itself, and the garden in front of the main building). If these rain barrels proved effective in reducing water consumption and ameliorating erosion, the concept might be expanded in the future to encompass more buildings.

The least expensive 60 gallon barrels available on the web cost from $54.00 - $119.95, plus shipping and handling. The more costly models tend to be made of more durable materials. We would suggest the more costly plastic alternatives to the less costly fabrics due to the longer lifetime expectancy, resistance to daily wear and tear, and decorative appeal.

Overall, this BMP would have a base cost ranging from $216 - $479.80. With proper maintenance, the barrels themselves may be expected to last for 10-15 years (2011 phone interview with Gardener's Supply Company associate; unreferenced).

RAIN GARDENS

A rain garden is a garden situated in a low lying area where water may be directed to prevent it accumulating in more problematic areas, such as a depression on a road (Hunt et al. 2006). The vegetation placed in rain gardens is specifically tailored to be able to survive in saturated soils and works to remove water from the surface both by plant absorption and increasing the permeability of soils through root tissue growth.

The *stone circles* property already possesses a functional rain garden around one of the housing units situated to the east of the chicken coops, but staff onsite have indicated another area where water accumulates that would serve well as a rain garden: the orchard loop inside the road by the main house. The advantages of this particular BMP include water filtration and runoff control. Hunt et al. (2006) found that 'bioretention cells', a technical name for rain gardens, were able to reduce total phosphorous, total nitrogen, and total metal loads in stormwater outflow by diminishing the volume of water reaching nearby streams immediately following a storm event. This is another case where a BMP diminishes the impact of the 'first flush' effect of storm events. The National Research Council (2008) has cited nutrient runoff from anthropogenic sources as one of the greatest contributors to stream quality degradation in the country. In addition to the good land stewardship practice of reducing nutrient loading into streams, this particular BMP has the added value of providing an aesthetically pleasing landscape piece to the property.

Financial Costs & Benefits: Rain Garden

Ideally, rain gardens will be situated between a pollution source (e.g. rooftop gutter outlet) and the pollution's ultimate destination (e.g. an ephemeral onsite stream) (NCCE 2011). The North Carolina Cooperative Extension (NCCE) also recommends that, in siting rain gardens, they should be located partially in the sun at least 10 ft away from a building foundation, at least 25 ft away from well heads and septic system drainfields, and where the water table is at least 2 ft below the surface soil. The orchard loop meets all of these criteria.

While the orchard itself already provides water filtration and runoff control for the road, this capability could be enhanced by transforming it, or portions of it, into a full rain garden. Again, this presents the *stone circles* property staff with an opportunity for educating visitors because the garden would be in a highly visible portion of the property. While the NCCE (2011) has designs and vegetation suggestions for such a garden, we would recommend the more tailored garden landscape designs for the orchard in Section A of this paper.

The concrete costs of this BMP are variable depending on how much manual work *stone circles* staff conducts itself, but the NCCE (2001) estimated that rain gardens in the Piedmont region cost between \$4-\$6/ft^2. The NCCE also provides a calculation for sizing a rain garden. This is:

$$\text{Area}_{\text{Garden}} = (\text{Area}_{\text{Building}} * \%\ \text{SA}_{\text{Roof Contributing}})/2 + \text{Area}_{\text{Driveway}}$$

Performing this calculation for the Stone House Residence Building (2000 square feet) with the assumption that 100% of the flow on the roof would be routed to feed into the rain garden, and discounting road runoff as it will be addressed with other parts of this plan, the rain garden in the orchard would need to be 1000 square feet to capture a 1 inch storm event commonly seen in North Carolina. This brings the total costs of the project to \$4,000-\$6,000. Again, however, volunteer labor, as well as the possibility of discounted garden supplies and plants could reduce these costs.

IMPROVING RIPARIAN BUFFERS

As with the other two BMPs, improving riparian buffers fits the land stewardship portion of *stone circles*' mission. Additionally, this BMP, were it implemented, would help to improve the contemplative surroundings of the *stone circles* property by diversifying its landscape, especially in the field where we recommend reforestation (see Section A). Diversifying may encourage visitors to the property to explore this relatively under-used area, one of the goals for the onsite staff (2009 onsite interview with C Horowitz; unreferenced).

A Brief Explanation of a Riparian Buffer Analysis

Riparian buffers can be thought of, in their most straightforward form, as the floodplain of a waterbody. They are the transition zone between terrestrial and aquatic environments, periodically inundated by water, that can serve as habitat for semi-aquatic and aquatic organisms (Lowrance et al. 1985). However, as the *stone circles* property lacks significant streams onsite (although it does have a lake whose immediate surroundings would be considered riparian buffer), we broadened our concept of what might be considered a riparian buffer to those areas adjacent to ephemeral streams on the property. While it is a loose interpretation of the term, it still falls within the scope of such definitions of riparian buffers as laid out by Ilhardt et al. (2000) for natural resource management. This definition proposes that riparian buffers should be considered as areas with a "functional" relationship to waterbodies. Ephemeral streams are connected to waterbodies functionally through direct input during storm events.

In order to determine if the current riparian buffers onsite were performing adequately, we conducted a riparian buffer analysis (RBA). This analysis relies predominantly on onsite elevation and land cover land use (LCLU) type. We first determined how water was flowing on the landscape of the *stone circles* property according to elevation. Water runs downhill, so those areas with the lowest elevation tend to be where we find ephemeral streams during storm events. Next, we used the LCLU to determine if water was flowing through certain parts of the property where it would be more likely to pick up nutrients and/or sediment (e.g. developed and agricultural areas). Finally, the data were used to create a relative threat map for the property and identify areas without a functional buffer. In essence, the figure below identifies areas where polluted stormwater is likely to flow that do not have vegetation (or enough vegetation) to effectively prevent erosion and nutrient runoff.

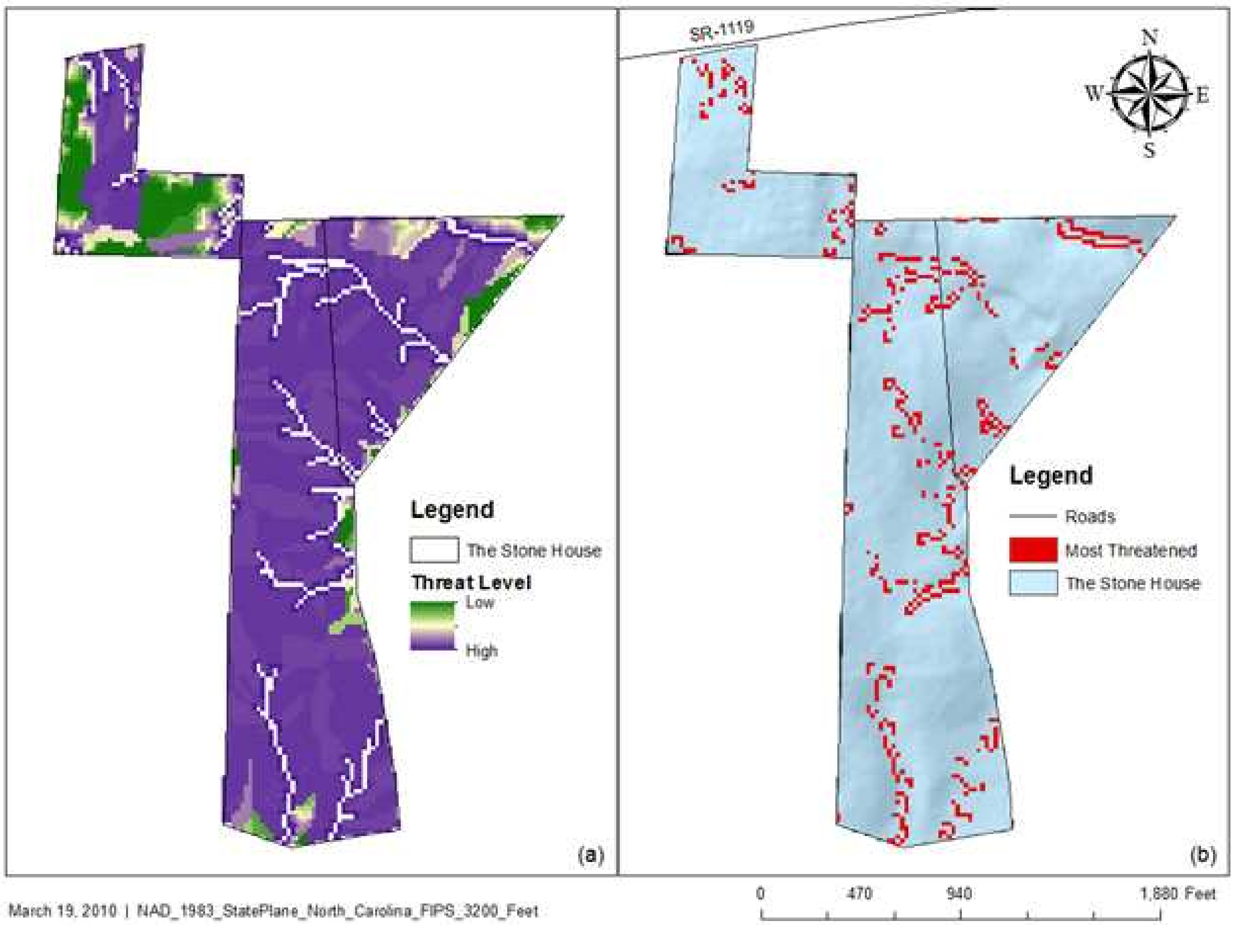


Figure 16: Results of riparian buffer analysis. The erosion threat map (left) shows the highest erosion potential areas in purple and the lowest in green. The functional buffer map (right) shows portions of the site with no functional buffer in red.

Our RBA showed that about 4.7 acres of the *stone circles* property do not have any functional buffer at all (Figure 16b). These are congregated around ephemeral streams. The RBA also determined that the mean buffer width on the property was 23.6 ft and that the standard deviation in this buffer was 19.4 ft. This means that while there are several large, good patches of buffer, they are unevenly distributed on the property (i.e. the green, low threat areas in Figure 16a).

For further discussion on the RBA itself, please see Appendix B. It contains a full description of how the RBA was conducted, the data and assumptions that went into it, possible sources of error, and suggestions for ways to improve the RBA for the *stone circles* property in the future.

Financial Costs & Benefits: Riparian Buffers

The results of our RBA indicate that the *stone circles* property needs to improve its buffers to take advantage of the nutrient and erosion-control benefits of a fully-functional riparian buffer. This would mean seeding and possibly fertilizing sites where grasses have thinned on the property to cover exposed soil that might be washed away during storm events. Given time and monetary constraints, we would suggest the staff at the *stone circles* property focus on enhancing buffers in the west parcel where the main house, cabins, and vegetable patch stand. This parcel also contains a majority of the main road where erosion is a problem. Riparian buffers specifically help control the loss of sediment by virtue of how plants work – their roots binding soil particles and slowing stormwater runoff by soaking it up or breaking up the soil to make it more permeable for runoff infiltration.

Ultimately, the *stone circles* property needs to increase the functional width of its buffers. The North Carolina Division of Forest Resources (2006) recommends a forested buffer width of at least 50 ft along each side of an intermittent stream to maintain good water quality and prevent destructive erosion. However, Gilliam et al. (1997) determined that a grass buffer of 14 ft in the North Carolina Piedmont region was enough to reduce sediment loss during storms by 68-71%. Another study by Lowrance et al. (1995) found that a 15 ft grass buffer reduced the sediment load of field runoff by 61%, the concentration of nitrogen by 4% and the concentration of phosphorus by 28.5%. The more effective buffers were larger, though, and combined forest and grass.

The cheapest method for improving riparian buffers is simply letting natural succession (the progression of a plant community toward a more complex ecosystem) to take place. It is a hands-off approach that will also require the most time.

The other main option is seeding or planting and fertilization to enhance plant growth. A combination of forest and grass buffers may be most effective in the high-threat portions of the central parcel. At the moment, this area is a large, raised field (the fact that it rises above much of the surrounding landscape contributes to its high threat for erosion and nutrient runoff) consisting of various grasses and small shrubs. Seeding is cheaper than planting, though it is, again, slower. Unless *stone circles* wishes to begin a timber operation, though, planting individual tree saplings in key portions of the property where the RBA indicates the need for a riparian buffer may be an option. Loblolly pines are common in the Piedmont region of North Carolina and grow at a rate of about 2-3 ft/yr (2011 phone interview with TyTy Nursery associate; unreferenced). A 1-2 ft tall loblolly from a standard pine tree nursery costs $6.45, with costs rapidly increasing to $159.95 for an 8-10 ft tall tree (TyTy Nursery 2011). If *stone circles* were to plant the total area identified by the RBA with 1-2 ft tall loblollies at a density of 250 seedlings per acre (a relatively low density for afforestation in a timber operation), the costs would amount to $7,578.75. This is a very conservative estimate, however, as Hamilton (2008) places the average cost for seeding/planting at $70 - $270 per acre. Under Hamilton's figures, the costs for improving the total non-buffered area would amount to $329 - $1,269.

Paving the Road with a Pervious Paver or Incorporating BMPs into the Unpaved Road

One of the questions *stone circles* specifically asked us to address in our research was how to prevent erosion of their property into nearby streams. One of the major sources of erosion on the property is the unpaved road that runs from the entrance to the site south to the main house, and then east toward onsite housing units located just north of the field (2009 onsite interview with T

Walker; unreferenced). Paving the road or employing BMPs that that prevent erosion on unpaved roads would mitigate a substantial portion of the onsite erosion concern.

Financial Costs & Benefits: The Road

Two main alternatives exist for dealing with erosion on the main road: (a) paving the road, and (b) incorporating BMPs into the existing unpaved road. Paving is more costly in upfront costs for materials and labor, but it ultimately provides the longer-term solution to the problem. Leaving the road unpaved will result in more frequent intervals for standard upkeep. The least costly option, simply grading the road without incorporating BMPs, would require the most frequent intervals for standard upkeep, perhaps as often as twice a year as in another rural North Carolina community (2011 phone interview with J Coleman; unreferenced).

If *stone circles* decides to pave the road, in order to keep with their land stewardship ideals, we would recommend a pervious paver. Unlike traditional concrete and asphalt, pervious pavers allow water to trickle through their surface to underlying soil (Scholz and Grabowiecki 2007). This slows and reduces the volume of stormwater runoff from these roads. In terms of costs, pervious pavers are more expensive than traditional pavers. However, repair costs associated with permeable pavers may be substantially lower when compared to traditional pavers (Lake County Forest Preserves 2003). Additionally, a permeable paver has the benefit of maintaining the natural setting of the *stone circles* property over a traditional paver. With 28,662 square feet of road and parking lot to pave, *stone circles* would be looking at a substantial upfront investment. For a standard permeable grassy paver, the cost runs at $24.36 per 10.75 square feet (Boddingtons 2011). This means, just for the paving materials, *stone circles* would need to invest $64,949.43. Excavation of the road, and possible costs associated with filling the paver with gravel or top soil and seed will increase the costs, possibly into the $100,000.00 range.

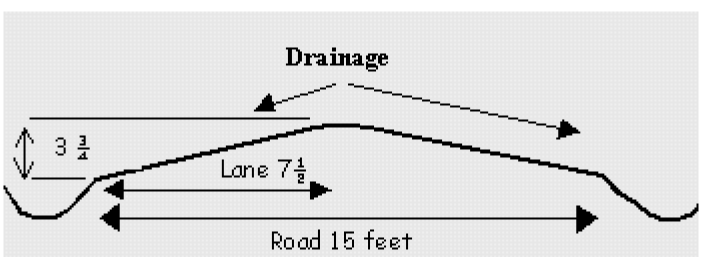


Figure 17: Cross-section of a properly shaped road; there should be $\frac{1}{2}$ inch of crown for each foot of road land width (Kennebec County SWCD 2000).

If *stone circles* decides to incorporate BMPs into the current unpaved road, we would recommend the BMPs proposed by Turton *et al*. (2009). These researchers conducted their study on two rural dirt roads in Oklahoma, but we believe that the situations and solutions proposed would apply to the *stone circles* property. Specifically, one of the study sites consisted of a road segment that suffered from poor drainage due to an inadequate crown (the center portion of the road that gradually slopes down at the edges), and unstable ditches. In order to address these issues, the researchers graded the road, established a proper crown (Figure 17), re-dug the ditches so that they were in a more stable trapezoidal configuration (Figure 18), and covered the road with crushed limestone at a thickness of 51 mm over the road surface to act as a uniform roadbed material (Turton *et al*. 2009). BMPs on the unpaved roads reduced sediment runoff by a statistically significant amount (20-80% reduction in sediment yields after one year). While this alternative will require more continuous costs for standard maintenance, the upfront costs are lower than for paving the road. Again, costs for this BMP are variable. A large-scale grading project will cost a substantial amount of money, and simply covering over the road with gravel would cost around $9,927.20 in total for the base materials (Soil Building Systems 2011). However, with access to grading equipment, volunteer labor, and low-cost materials, the upfront investment for this option may decrease.

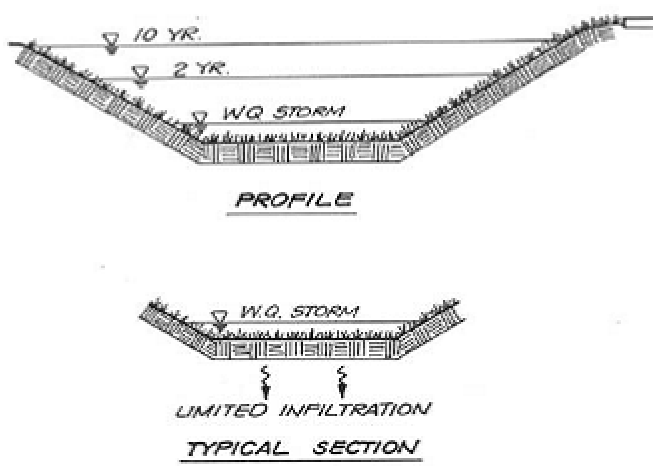


Figure 18: Cross-section of a typical configuration for a trapezoidal ditch (Claytor and Schuler 1996).

Whether *stone circles* decides to pave with a permeable or an impermeable surface or grade the road, another set of costs to bear in mind are permits. Orange County (2011b) requires an Erosion Control Plan be submitted if clearing or grading will exceed 10,000 square feet (around one quarter of an acre) when in a protected watershed. The *stone circles* property falls within the Cane Creek protected watershed and the road will require work on roughly 28,662 square feet. This plan must be drawn up and approved before any construction activities can take place. Generally, contractors performing grading and paving services will obtain these permits for their clients, but should the staff of the *stone circles* property try to undertake a grading endeavor themselves, they will likely need to obtain one of these permits. In total, the fees associated with the Erosion Control Plan Review Fee ($158) and the Land-disturbing Permit Fee ($310) amount to $468.

FUNDING FOR THE STORMWATER MANAGEMENT PLAN

The rain barrels, rain garden, riparian buffers, and improvements to the road that are discussed above constitute a stormwater management plan for the *stone circles* property. The plan has been designed to minimize stormwater runoff and erosion and will aid in *stone circles'* continued stewardship of its natural spaces and site resources.

While implementation of this plan requires financial investment as specified above, funding is available to reduce some costs. In this section, funding sources for the stormwater management plan are recommended.

<u>Community Conservation Assistance Program</u>

The Community Conservation Assistance Program (CCAP) is a voluntary, incentive-based program housed in the North Carolina Department of Environment and Natural Resources that is designed to improve water quality through the installation of BMPs on urban, suburban and rural lands, not directly involved in agricultural production (NCDENR 2011). Educational, technical, and financial assistance is provided to landowners by local soil and water conservation districts. For *stone* *circles,* the appropriate district is the Orange County Soil and Water Conservation District. To be included in the program, landowners apply to the appropriate conservation districts. Applications are ranked based on local water quality priorities. If landowners are eligible, a conservation plan for the instillation of the BMP is prepared and up to 75% of the pre-established cost of the chosen BMP may be reimbursed. The approved BMPs include: permeable pavement, grassed swales, riparian buffers, critical area planting, bioretention areas, cisterns, and others.

There are several organizations that offer grants in support of water quality and stormwater management initiatives. Some of the organizations that offer grants *stone circles* may qualify for are:

The **Clean Water Management Trust Fund** grants up to $3 million for stormwater quality projects that improve and protect water quality.

The **Park Foundation** supports projects that raise public awareness of freshwater issues and concentrates on the eastern United States.

More detailed information about each of the above grants, as well as others that *stone circles* may qualify for, are included in Appendix A.

STORMWATER MANAGEMENT CONCLUSIONS

In conclusion, we propose the following for the stormwater management plan:

1) Purchase four plastic rain barrels as a dry-run for their efficiency as both water storage and community-building devices.
2) Install a 1000 square foot rain garden in the orchard area and direct gutter flow from the Stone House Residence Building into this area.
3) Seed or plant portions of the main west parcel where the RBA indicates a need for improved riparian buffers and allow the central parcel field to undergo natural succession.
4) Implement BMPs on the dirt road and pave it with a permeable grassy paver in a piece-meal approach. This will substantially reduce upfront costs. Starting with the parking lot, which is the largest exposed surface area, and paving out from there would offer the best option for reducing erosion directly around the main buildings. Paving materials for the parking lot alone amount to around $10,000.

The ultimate costs of the stormwater management plan range from $0 to over $79,000 depending on which portions are implemented and at what scale. While costs are significant, *stone circles* can partially fund implementation of the stormwater management plan through available grants and cost-shares.

Section C: Alternative Land Use Scenarios

stone circles expressed interest in pursuing a number of potential land uses on their property. In this section, the feasibility, costs, and benefits, of each of these different land uses, or 'scenarios,' are evaluated. Scenario 1 is pursuing a conservation easement, Scenario 2 is using the back field as a wetland mitigation bank, and Scenario 3 is using the back field as a solar farm. Each of these scenarios was determined to be infeasible. Scenario 4 is leasing land for long term residential use and Scenario 5 leasing land for agriculture. Each of these scenarios is described in further detail below.

Scenario 1: Conservation Easement

A conservation easement is an agreement between a private landholder and an easement holder whereby the landowner gives up certain rights associated with his or her property (e.g. development rights) (Hiwassee River Watershed Coalition 2011). The landowner retains ownership, but depending on the nature of the easement, they may receive certain favorable tax status due to the easement. For instance, a landowner may apply for state conservation tax credits, receiving up to 25% of the value of the donated interest in the land to reduce their income taxes. This option may be employed for up to five years. Likewise, the landowner can claim the donated land on federal tax returns for up to six years.

Feasibility for stone circles

As the *stone circles* property already enjoys a favorable situation with its taxes, a conservation easement may not be the most appropriate course to pursue at the present. While an easement would be in keeping with the *stone circles* commitment to land stewardship and conservation, it may unduly restrict certain activities at a time when the organization and the *stone circles* property are facing an uncertain monetary future. Additionally, onsite staff have indicated a reluctance to purchase an easement on the *stone circles* property at present by organizations that typically purchase them (2011 onsite interview with C. Horowitz; unreferenced). Therefore, at this time we would recommend against pursuing an easement.

Scenario 2: Wetland Mitigation Banking

A wetland mitigation bank is a wetland area that has been restored, established, enhanced, or preserved to provide compensation for wetland conversion that results from development activities (USEPA 2009; USEPA 2008). Wetland mitigation banking is one option for compensatory mitigation required by the Clean Water Act for adverse impacts to wetlands (USEPA 2009; USEPA 2008). The Clean Water Act prohibits the discharge of dredged or fill material into the waters of the United States unless a permit is issued and such a discharge is approved by the Army Corps of Engineers or an approved state under Section 404 of the Act . For those discharges that are approved, all adverse impacts to aquatic resources must be avoided and minimized, or at last resort, compensated for. Where wetlands are adversely impacted, compensatory mitigation (restoration, establishment, enhancement, or preservation) is required to replace the loss of wetland functioning in the watershed. The value of a mitigation bank is determined by an ecological assessment and is defined in terms of "compensatory mitigation credits," which can be purchased by permit-holders. They are an attractive option for permit-holders, because they can simply purchase credits and are not liable or responsible for the design, construction, monitoring, ecological success, and long-term protection of the site (USEPA 2009; USEPA 2008).

Mitigation banks must be created under a formal agreement with a regulatory agency, and are generally created by government agencies, corporations, or nonprofit organizations. The Ecosystem Enhancement Program (EEP) is North Carolina's wetland mitigation program (Ecosystem Enhancement Program 2011; Ecosystem Enhancement Program 2008). It accepts compensatory funds and provides the projects for watershed improvement and protection (including wetlands). The program is also involved in watershed planning and project implementation. Landowner participation in the Ecosystem Enhancement Program can occur in one of three ways: donation or sale of a permanent conservation easement, donation of property in fee simple, or sale property in fee simple. When landowners are interested in using their lands as wetland mitigation banks, they are asked to submit a site proposal form to EEP. Potential sites for wetland restoration projects are judged based on the following criteria:

1) Proposed site is preferably located within an EEP Local Watershed Planning Area or Targeted Local Watershed
2) Must have a permanent conservation easement on the proposed site at a minimum
3) Must have permanent access to the proposed site for construction and long term monitoring and stewardship
4) Hydric soils present (might be relic)
5) Original wetland hydrology altered by ditching, tile drains or other means caused by human influences or naturally occurring events
6) Lack of appropriate wetland vegetation, Characteristics which may be observed:
    - Ditches / canals present
    - Tile drainage
    - Adjacent stream is incised
    - Dams or other water control structures
    - NRCS designated Prior-Converted (PC) land
    - Adjacent land use has affected hydrology
    - Vegetation removed or encroaching upland vegetation; evidence of wetland vegetation

7) Preference is given to sites greater than 5 acres, with a minimal number of landowners, and with minimal constraints (roads, etc) and utilities.

Using a portion of the land at The Stone House as a mitigation bank is consistent with *stone circles*' mission and vision for a sustainable relationship between land and community. A wetland on the property would provide valuable ecological services and wildlife habitat, as well as environmental education potential.

Financial Costs & Benefits

The financial benefits to landowners of using land for wetland mitigation are federal, state, and county tax deductions and reductions (Ecosystem Enhancement Program 2011; Ecosystem Enhancement Program 2008). Benefits are similar to those of conventional conservation easements.

Feasibility for stone circles

Based on the above information, wetland mitigation banking is not a feasible option for *stone circles*. The Stone House does not have the hydric soils necessary for the establishment of a wetland. Soils onsite include Georgeville silt loam and Henderson silt loam, ranging from 2-10% slopes (Natural Resources Conservation Service 2011). These soils are suited to agriculture and pasture, but do not have the characteristics of hydric soils that are formed under long periods of saturation, flooding, or ponding that are necessary for a wetland.

Scenario 3: Solar Farm

Solar energy is renewable, clean, and abundant. Production of this kind of energy, while not in direct line with stone circles' focuses on environmental stewardship, food security, and community building, is consistent with stone circles' overarching goal of sustainability. Solar farms are constructed on small parcels like the stone circles' by solar farm developers.

Financial Costs & Benefits

The costs involved in setting up and operating a solar farm are numerous and vary considerably from one location to the next. The terrain, proximity of high transmission capacity lines, installation, and other factors all play into the cost. There are a number of programs that help to make solar farms affordable.

Feasibility for stone circles

Developing a solar farm at The Stone House is not currently a financially viable option. North Carolina and the federal government offer tax incentives for solar projects, but they are unavailable to non-profit organizations (2011 e-mail from P. Brucke to M. McHugh; unreferenced). Although *stone circles* could sell the power generated by the solar farm back into the grid, there is currently no market for Renewable Energy Certificates (REC) from ground mounted systems in North Carolina. A REC is proof that 1 megawatt-hour (MWh) of electricity was generated from a renewable source (USEPA 2009b). It represents the attributes and benefits of the renewable quality of the electricity production and can be sold separately from the electricity itself. The lack of tax incentives and REC market suggests that it would take over 50 years for *stone circles* to recoup the initial investment required to install a solar farm

Scenario 4: Leasing Land for Residential Use

Buildings at the stone circles property are currently used for retreat-goers. To secure additional funds in the short-term, it is possible to rent one or multiple of these buildings as a long-term residence. This option may be consistent with stone circles' mission and goal of community building if space is rented to an activist or community member who is somehow involved in stone circles' work.

Financial Costs & Benefits

Rental rates in the Mebane area range from approximately $250-$350 per room in a house or cabin with access to a bathroom and kitchen (2011 e-mail from G. Phillips to M. McHugh; unreferenced). Much of the value of a bedroom in one of stone circles' cabins would depend on the tenant's access to the land, garden, and kitchen, heating, cooling, and who pays the utilities. Assuming stone circles allowed its renter access to the community kitchen, the organization could expect to make approximately $3,000-$4,200 per year by renting one of the cabin bedrooms. Several bedrooms could be rented at this rate.

Scenario 5: Leasing Land for Agriculture

Food security occupies a substantial portion of the educational programming at stone circles. As described above, the organization actively tends its orchard and garden, raises chickens, and uses these food sources to prepare meals for guests. The property is also surrounded by agricultural land uses and was formerly used as a farm. Converting the field back into agricultural use is therefore consistent with stone circles' mission and values. Expanding farm operations to the entire 35 acres of the back field would be a serious undertaking for the small stone circles staff. One option that would allow expanded food production to take place on that land without substantial effort and expense by stone circles is to lease the back field to another farmer for cropland or pasture.

Scenario 5a: Leasing Land for Cropland

Financial Costs & Benefits

One option for making use of the 35 acre field is to lease it for cropland. In Orange County, rental rates for non-irrigated cropland ranged from $25-49.99 per acre per year in 2009 (National Agricultural Statistics Service 2011). This would amount to a maximum of $1,750 in income per year for *stone circles*. Detailed methods for determining cropland rental rates can be found in Appendix C.

Scenario 5b: Leasing Land for Pasture

Financial Costs & Benefits

Pasture land in Orange County is leased for slightly less than cropland. Average rents of pasture in Orange County ranged from $20-29.99 per acre in 2010 (National Agricultural Statistics Service 2011). The price of pasture land is dependent on a number of things. Livestock facilities, the quality of the pasture, availability of water, and fencing all influence the price that can be charged (Fisher and Mangione 2006). The lack of fencing, water availability, and livestock facilities in the field at The Stone House suggest that without any additional investment, the land could be leased on the lower end of this scale. At $20 per acre, stone circles could expect to take in $700 per year. There are, however, several methods that can be used to establish a fair pasture rental rate. Pasture can be rented on a per acre per month basis, as a percentage of cropland value, as a percentage of land value, or on an AUM (animal unit per month) basis. An AUM is the amount of forage or feed required to feed 1,000 pounds of animal weight for 30 days (Fisher and Mangione 2006; Iowa State University Extenstion 2011; National Agricultural Statistics Service 2011). Detailed methods for determining pasture rental rates can be found in Appendix C.

Alternative Scenario Conclusions

There are several land use alternatives to the conservation and stormwater management plans have been explored. A conservation easement, wetland mitigation bank, and solar farm were determined to be infeasible for stone circles at this time. Leasing land for long term residential use can be pursued separately from or in addition to the conservation and stormwater management plans. It has the unique potential to bring immediate revenues to stone circles. Leasing land for agricultural use is a feasible land use strategy, but its income-generating potential is low.

Final Conclusions and Recommendations

Several land use and funding options were explored for the stone circles property including: obtaining a conservation easement, using the back field as a wetland mitigation bank, using the field as a solar farm, leasing land for long-term residential use, leasing the field for agricultural use, and implementing the conservation and stormwater management plans. The conservation management plan involved recommending permaculture improvements to the orchard, facilitating reforestation of the back field, installing a trail network, and developing educational materials for stone circles. The recommended option for stone circles at this time is to implement the conservation and stormwater management plans. There are numerous funding streams available to assist in financing these plans, including the Rudolf Steiner Foundation Seed Grant. The ultimate costs of implementing the proposed conservation and stormwater plans range from negligible to exorbitant, but these are plans that might be employed over the course of 1 – 50 years and have social, ecological, and financial benefits for stone circles.

These plans, if implanted in part or in full, will help the stone circles organization to fulfill its goal of a sustainable relationship between land and community. They will also address how stone circles (1) can create buffers between its property and those adjacent, (2) capitalize on its on-site natural resources, (3) manage stormwater to ameliorate onsite flooding and soil erosion, and (4) fund the recommended plans.

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APPENDIX A

Note that the materials included below represent only a sampling of those given directly to stone circles. The complete compilation, considered too bulky for inclusion below, has been provided to the organization as a complement to this report.

MAPS, CHARTS AND TABLES DESCRIBING THE RESULTS OF THE VEGETATION SURVEY

TREES					
	Species	**Common Name**	**Count**	**Avg. DBH (in)**	**% of Total**
	Ulmus alata	Winged Elm	220	8.4	33.9%
	Ulmus americana	American Elm	90	7.4	13.9%
	Liquidambar styraciflua	Sweet Gum	84	8.6	12.9%
	Pinus taeda	Loblolly Pine	63	13.5	9.7%
	Pinus virginiana	Virginia Pine	34	8.8	5.2%
	Prunus spp	Plums*	29	4.0	4.5%
	Pinus echinata	Shortleaf Pine	25	10.6	3.9%
	Juniperus virginiana	Eastern Redcedar	24	8.4	3.7%
	Prunus serotina	Black Cherry	23	9.5	3.5%
	Carya illinoinensis	Pecan	11	11.4	1.7%
	Diospyros virginiana	Persimmon	9	8.4	1.4%
	Quercus falcata	Southern Red Oak	8	10.5	1.2%
	Albizia julibrissin	Silktree Mimosa	7	7.7	1.1%
	Quercus spp	Oaks - Other	6	14.2	0.9%
	Quercus alba	White Oak	5	14.6	0.8%
	Acer rubrum	Red Maple	3	5.5	0.5%
	Liriodendron tulipifera	Tulip Tree	3	14.3	0.5%
	Prunus spp	Cherries - Other	2	8.6	0.3%
	Juglans nigra	Black Walnut	1	19.1	0.2%
	Quercus phellos	Willow Oak	1	20.7	0.2%
	Quercus velutina	Black Oak	1	17.5	0.2%
		Total	649		
OTHER**					
	Species	**Common Name**	**Count**		**% of Total**
	Festuca spp, Andropogon spp, etc.	Grasses (various)	404		24.9%
	Ligustrum sinense	Chinese Privet	209		12.9%
	Elaeagnus spp	Olives	194		12.0%
	Juniperus virginiana	Eastern Redcedar	164		10.1%
	Microstegium vimineum	Japanese Stiltgrass	164		10.1%
	Liquidambar styraciflua	Sweet Gum	157		9.7%
	Lonicera japonica	Japanese Honeysuckle	123		7.6%
	Quercus spp	Oaks	57		3.5%
	Ulmus alata	Winged Elm	47		2.9%
	Smilax rotundifolia	Roundleaf Greenbriar	29		1.8%
	Toxicodendron radicans	Poison Ivy	29		1.8%
	Ilex opaca	American Holly	21		1.3%
	Acer rubrum	Red Maple	12		0.7%
	Campsis radicans	Trumpet Creeper	5		0.3%
	Hedera helix	English Ivy	5		0.3%
		Total	1620		
	** Shrubs, vines, and saplings observed within 3-5 feet of base of sampled trees				
	Note: Orchard trees (apple, pear, blueberry, fig, plum) not included.				

Table 1: Vegetation survey results.

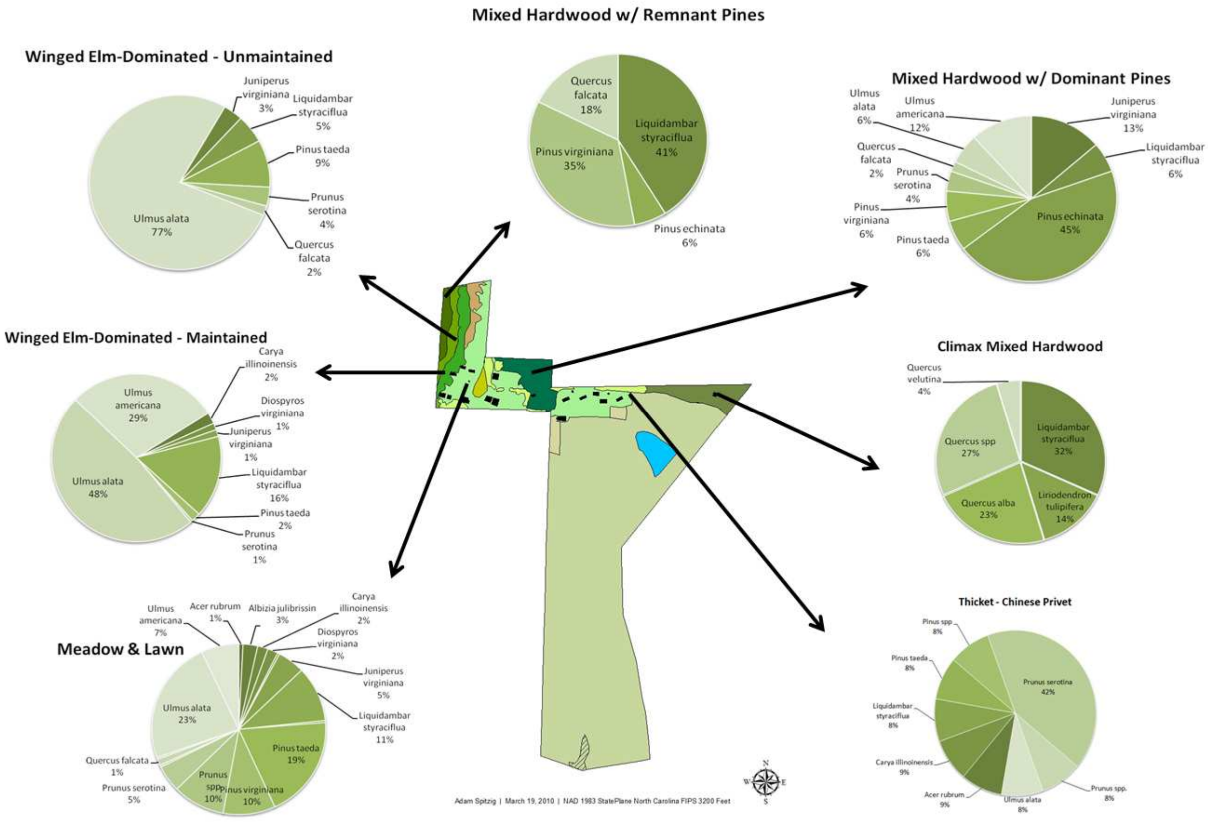


Figure 19: Map depicting vegetation survey results.

A note concerning survey limitations:

While every measure was taken to ensure data quality, the accuracy of tree sampling methods was limited by several factors. First, because manpower and time were limited, only small portions (10%) of plot-sampled regions were evaluated. The process of extrapolation required to estimate stand composition, based on only 10% coverage, entails an unavoidable degree of uncertainty – sampled plots are not presumed completely representative of stand complexity. Second, as an unavoidable result of the project timeline, a large portion of the tree identification, especially in older forest stands, was undertaken during the winter, resulting in a degree of taxonomical uncertainty and perhaps identification error. The general targeting of dominant, overstory species was employed to minimize such uncertainty. Finally, data was collected only from areas within, or in some instances immediate adjacent to, the stone circles property. Because many plant communities extend beyond property lines, and exogenous ecological forces may exert significant influence on on-site vegetation, the survey must be understood as limited in its capacity to fully describe the ecological dynamics of onsite vegetation.

Note also: all data representation – particularly graphics and tables displaying plant community composition – depict pure abundance (i.e. the quantity, and proportion, of individual species members in a given community or plot). Depending forest management objectives, additional metrics – e.g. “(relative) dominance”, which provides an indication of both abundance and size for particular species within a given area – may be useful. The raw data provided may be used to calculate this and other metrics.

Proposed Trail Network and Guide

Figure 20: Visualization of trail and sign

Figure 21: Visualization of trail passing next to a cabin

MODEL TRAIL GUIDE TEXT	
Station	**Sign Text**
1	"Welcome to the stone circles community garden!..." (Left blank so Tahz can input desired information on garden) (typical crops; frequency of harvest; related workshops/events, etc.)
2	"Our food production extends beyond the garden itself, into our forests..." "...before you are our poduction Pecan trees.." " also notice the native Persimmons that dot the property" (Left blank so Tahz can input desired info)
Inter-stop (include as Introduction to Site Ecology, in pamphlet)	The soil and vegetation of the Piedmont region of North Carolina has been heavily influenced by the hand of man. An excerpt from an early eco-botanical survey of the region by Henry J. Oosting ("An Ecological Analysis of the Plant Communities of Piedmont, North Carolina", 1942) provides a useful introduction to the land settlement tendencies that shaped modern forests in this region and, by extension, to the stone circles property itself. "In the early days of settlement, large tracts of forest were cleared for cultivation. Land was cheap and little thought was given to agricultural practices that would maintain soil productivity. The heavy winter rains soon washed away the best of the topsoil from unterraced fields and, after several years of cultivation without fertilizing, they became relatively unproductive. It became common practice to abandon such fields and clear new land. This procedure has continued to the present day, although lands now being cleared have usually been cultivated before, in some instances probably more than once. Piedmont farm land is therefore an irregular patchwork of fields and forested areas of all sizes, the latter usually having grown up on previously cultivated land." This patchwork of forests and farms continues to the present day. Encouragingly, though, a high proportion of former cropland has returned to its pre-agricultural, forested
3	Now that you've become familiar with the general patterns of succession, why not examine an exception! The area before you here, for example - dominated by Winged Elm - represents a forest in which pines are likely to be absent as a major successional stage. Instead, this stand is expected to maintain its current hardwood dominance throughout its un-disturbed lifetime - as these Winged Elms will, in 70-90 years, be replaced by a mixture of Oaks and Hickories. While the exact cause of this hardwood-to-hardwood succesional exception is unknown, scientists suggests that certain disturbance types, including selective clear-cutting and episodic hydric soil conditions, can disproportionaly favored the reestablishment of hardwoods over pines. This stand, then, may have been clear-cut or flooded during its history, and continutes to exhibit the results of these past disturbances to this day.
4	The forest canopy of this portion of the property is co-dominated by both hardwood species (including various Oaks species, Sweet Gum, and Honey Locust) and pines (including Loblolly and Virginia). This composition suggests that it is of middle successional age - roughly 50-70 years old. Within several decades, if left undisturbed, the remnant pines of this forest - the towering Loblollies and Virginias before you - will succomb to old age, fail to reproduce (due to inhospitable forest-floor light conditions), and give way to near-complete hardwood dominance. A fine example of pine-to-hardwood succession in action!
5	This stand provides a good exmple of the morphological differences exhibited by forest-grown trees and open-grown trees. The former are subject to intense spatial and biological competition from their neighbors, and, as a result, tend to take on a narrow, vertical shape. They are represented here by the small, densley-spaced Winged Elms immediately surrounding you. Open-grown trees, on the other hand, enjoy comparatively high levesl of light, space and nutrients during their lifetime, and consequently exhibit a wide, spreading canopy. They are represented here by the larger, broadly-spaced Winged Elms and other trees a little down the path. Note that, in this region of the country (which enjoys ample annual rainfall, and thus the potential for dense reforestation nearly everwhere), open grown trees occur almost exclusively in human-modified landscapes.
6	"Before you lies the centers of stone circles' fruit production..." "Harvested fruits are used for...."
7	This patch of forest may be represative of both previously-discussed successional pathways (i.e. the common pine-to-hardwood pathway, and the rarer hardwood-to-hardwood pathway). The upper portion of the forest - located immediately in front of you - contains comparatively few pines and many younger hardwood trees. If left undisturbed, its composition is likely to gradually shift from Elms, Cherries, Junipers, etc. (hardwoods) to largely Oaks and Hickories (also hardwoods). The lower portion of the forest, on the other hand, a 100 feet or so down the trail, is currently dominated by a mixture of Loblolly , Virginia and Shortleaf pines. In several decades, these will be replaced entirely by hardwoods, and the typical pine-to-hardwood successional trajectory will have been completed. The adjacent stands before you, then - currently distint in vegetative composition - will likely become indistinguishable with time.
8	"Welcome to the second major residential portion of the stone circles property...." "...this area is used for..."
9	The patch of forest immediately before you is one of the oldest on site. Consisting of a mixture of towering hardwood species - Tulip Poplar, Sweet Gum, mixed Oaks, etc. - this stand, in combination with the stand at the next stop, represents the closest approximation to a Piedmont climax forest found on the stone circles property. Undisturbed for 80-100 years, the site was probably considered unworkable as farmland by previous landowners due to the pathside creek/wetland ahead, and was thus spared from the clearing and cultivation experienced by its contemporaries.
10	Here, the climax forest just described continues. Notice the White Oaks - with their characteristic blocky, white-ish bark - surrounding the creek below. Their density here, unmatched anywhere else on the property, is indicative of the comparative maturity of this stand. Notice too, the sharp difference between the forest before you, and the pasture immediately behind you. The pasture represents the state of vegetative regeneration almost immediately following disturbance. These adjacent ecosystems can be viewed as the alpha and omega of succession.
11	The pasture before you - abandoned, as cropland, only a few years ago - is currently dominated by a variety of pioneer scrub grass species, the most prominent of which is broomsedge. Blackberries, sumacs, pokeweed, an other shrubs may also be observed scattered throughout the field. In the throws of early succession, this area will soon be populated by pine seedlings transported from surrounding Loblolly, Virginia and Shortleaf-dominated forests. So covered, it will begin the decades long process of reforestation, and move gradually toward the climax composition viewed at the previous stop.
12	Post-abandonment succession may take different paths depending on the micro-environment experienced on a given site. Wet areas, as mentioned, may have a particularly significant effect on vegetation regeneration. Just before you lies on of the moister areas onsite - a bottomland and confluence area for several emphemeral streams. Notice how the vegetation is already - only a few years after abandonment - developing somewhat different composition and community structure than its upland counterpart. What species, not found in othe pasture areas, can you spot here?
13	Before you lies the fields of a working farm. If abandoned, this field will naturally progress toward an ecosystem similar to the pasture behind you, and in time, towards a forest system similar to those observed at earlier trail stops.
14	The working pine plantation immediately ahead - though cultivated and thus unnaturally dense - is nontheless somewhat representative of the dense pine clustering that typically occur 20-50 years after abandonment in a Piedomnt field. This stage - characterized by pine canopy domination - is the only major successioanl period not represented on the stone circles property. Notice how dark the interior of the forest is, and how drastically, through this light deprivation, the pines have altered the understory environment (as compared to both the pasture behind you, and the climax forest seen several stops back). The forest floor, nearly-completely shaded, thus becomes inhospitable to pine seedling establishment, and ripe for gradual colonization by shade-tolerant hardwoods.
15	"The large Pecan Tree in front of you is reference point and gathering area on the stone circles property..."
16	"Welcome back!..." "...we hope you enjoyed your tour of the property and have learned a bit about our organziation and the ecology of our lands..." " Please visit our main house/kitchen/..." "Inside you'll find..."

Table 2: Model text for trail guide.

Note that the theme "Piedmont, old-field succession" underlies the contents of the proposed trail guide text. This theme is intended to capitalize on the plant community variety observed on site, and maximize the ecological information provided to trail users. Note that spaces, however, have been left within the guide to provide visitors with practical organizational information, including details about garden/orchard operation, onsite residences, retreat information, etc.

GRAPHICS DEPICTING GARDEN/ORCHARD/LANDSCAPE RE-DESIGN PROCESS

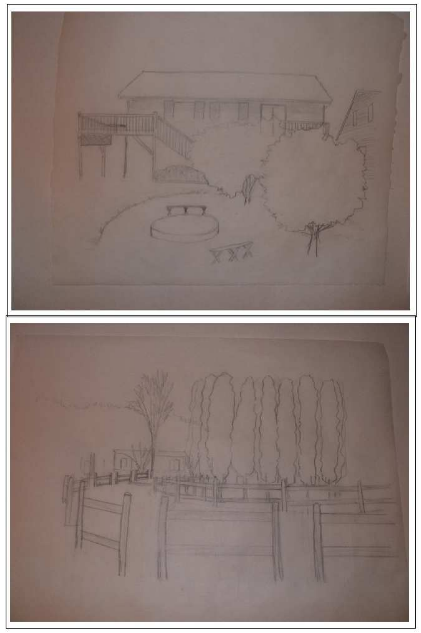


Figure 22: Design process – sample 1.

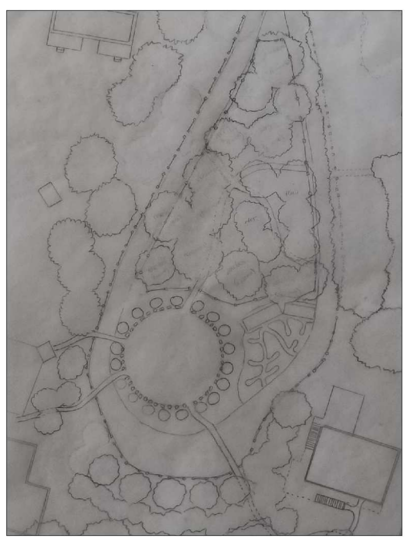


Figure 23: Design process - sample 2.

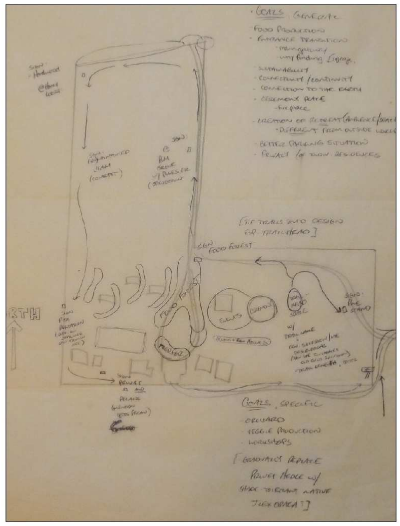


Figure 24: Design process - sample 3.

ANNOTATED LANDSCAPING PLAN

Figure 25: Master landscaping plan 1.

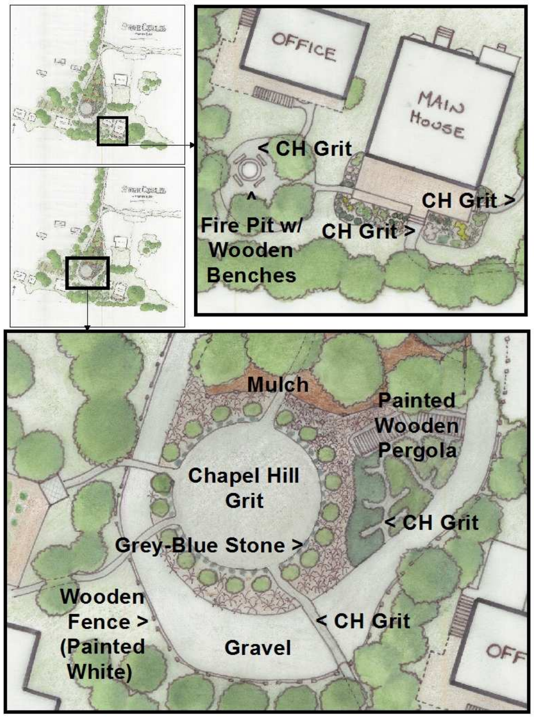


Figure 26: Master landscaping plan 2.

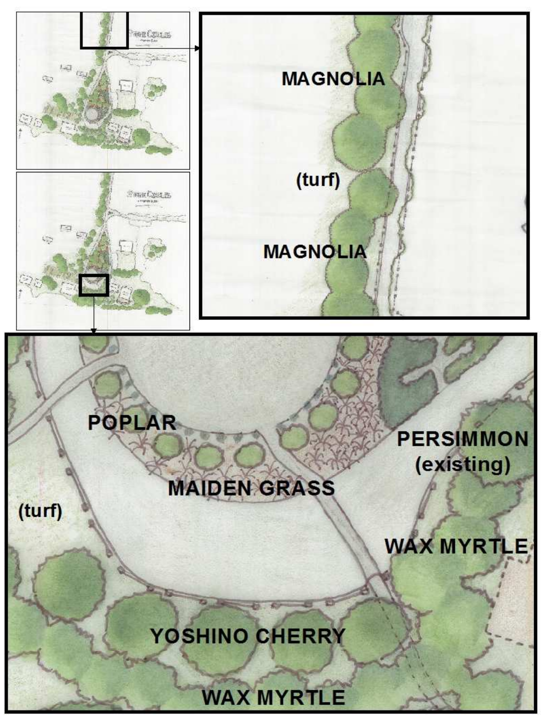


Figure 27: Master landscaping plan 3.

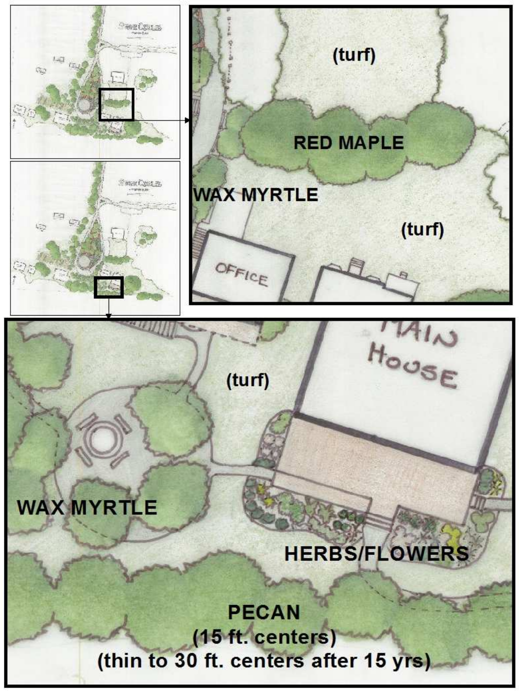


Figure 28: Master landscaping plan 4.

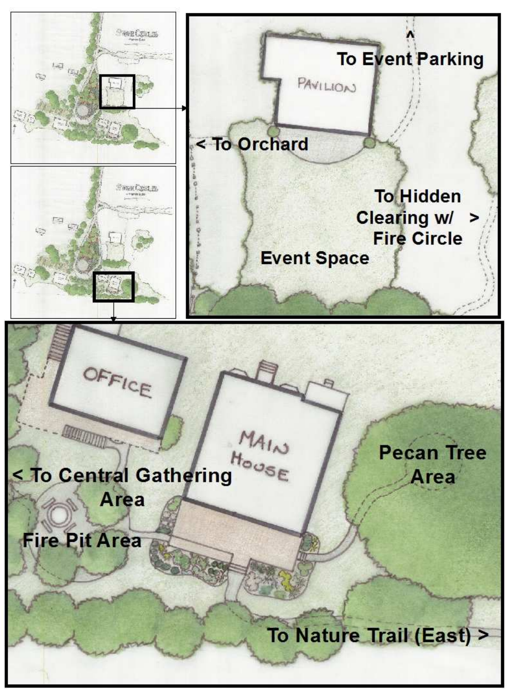


Figure 29: Master landscaping plan 5.

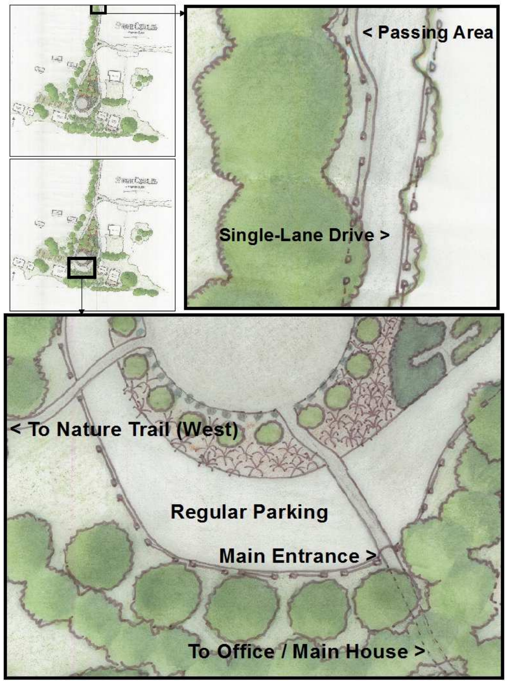


Figure 30: Master landscaping plan 6.

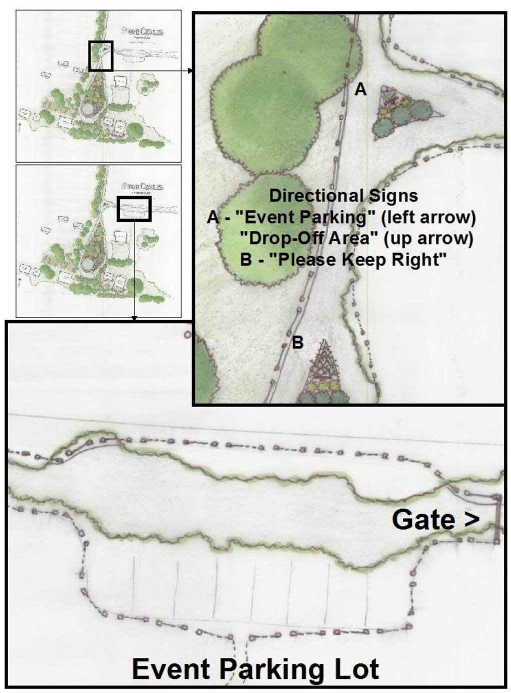


Figure 31: Master landscaping plan 7.

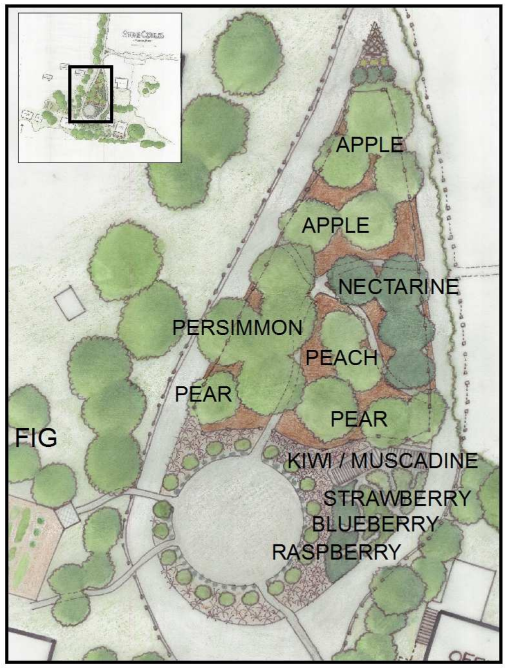


Figure 32: Master landscaping plan 8.

Note: Plant selection guides, and other horticultural resources, are included in the supplemental materials provided directly to stone circles. It is recommended that these resources be used to complement the landscaping plan and to inform the selection of particular fruit tree, briar, and vine cultivars, where indicated in master landscaping plan.

Components of a Management Plan For Cost-Share Assistance From the Forest Development Program

"To insure a high level of customer service and reduce delays in servicing cost-shared projects [FDP, FIP, CRP, and others], the following items should be included in all management / practice plans. Plans that do not contain this information may delay funding approval until the necessary information can be obtained.

Plans prepared by Division of Forest Resources (DFR) – Plans prepared by Division personnel must follow established policy and procedure, and may require the inclusion of additional information beyond what is outlined below.

Plans Prepared by Others – Plans prepared by consulting foresters, landowners, land managers and others should contain the items listed below when and where they apply. Plans that do not include one or more of the applicable items below may not be funded until the necessary information is obtained. This can be rectified by efforts of DFR, the plan preparer, or through a joint effort by all parties." (Division of Forest Resources 2001)

Table 3: Components of a Management Plan (Division of Forest Resources 2001)

Component / Item	Justification / Comments
Landowner / Company Name, Address and Phone Number	For project documentation requirements and to be able to contact the owner if questions or problems arise.
Agent's Name, Address, Phone Number (if applicable)	" " " " "
Date plan prepared	For project documentation purposes
Owner's objective / purpose for requesting cost-share assistance	For project documentation and to insure the owner's objectives match the purpose of the program
Estimated acres involved in the project	Needed to complete the cost-share application; to determine the extent of assistance needed
Description of present situation	Need enough information to justify the practice(s) and treatment(s) to be cost-shared
Recommendations for the project should include: ----- *<u>for Reforestation Projects</u>* ----- □ Site Prep Method(s) & Specifications – • What, how, when, where, who will do the work, and the approximate cost. □ Tree Planting Specifications – • Tree species, including seed /seedling source, and seedling treatments (Pales weevil, deer browse repellant, etc.), if necessary; • Planting spacing and / or the number of seedlings per acre; • Planting method; by machine or by hand (when appropriate, include type of tool); • Planting time frame (month & year); • Who will do the work and approximate cost ----- *<u>for TSI and Release Work</u>* ----- □ TSI Treatments & Release Specifications – • What, how, when, where, who will do the work, and approximate cost.	Need enough information to be able to assign and approve the proper practice(s) / treatment(s) and the most appropriate cost-share rate

*** *for all pesticide treatments* *** Specify the purpose of the treatment, chemical(s) and adjuvant(s) to be used; include amounts / rates of application, and other information as needed, such as target species to control, crop species to protect, buffer specifications, and other requirements	Needed to determine necessary cost-share rate and insure that the recommended treatment(s) is within labeled specifications
Applicable cost-share program requirements, restrictions and eligibility information, including: • Necessary protection measures for the duration of the cost-share contract • Required maintenance treatments for the duration of the cost-share contract	• Need to insure that the participant is fully aware of program requirements to maintain their eligibility and avoid "recapture" actions. • Need to insure participants know what is expected of them to maintain the practice.
Specify appropriate environmental protection measures to be taken during the implementation of the work to protect soil, water, wildlife and air quality (when and where applicable)	Need to insure that all appropriate environmental rules and regulations [wetlands, T&E species, smoke management, buffer rules, FPGs and BMPs, etc.] are followed, and that environmental quality is maintained, protected or enhanced.
Other relevant / beneficial information about the project, as needed.	As needed to inform the program participant or support / justify recommended treatments above.
Name of person preparing the plan	Needed, in the event questions arise about the implementation of the project
Project Map(s) should include: • Tract location and shape • Project area(s) denoted / identified • Who prepared the map & date prepared • North arrow, scale, legend and other information , as applicable	Needed to locate the project area and conduct compliance checks and environmental reviews as necessary to satisfy program policies and documentation requirements

GRANTS RELEVANT TO *STONE CIRCLES*' WORK

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Cedar Tree Foundation	Environmental Education / Environmental Health / Sustainable Agriculture Grants	Education / Health / Agriculture	Grants in excess of $300,000 have been awarded	No deadlines. LOI accepted yearlong	Yes	Cedar Tree Foundation gives particular consideration to proposals demonstrating strong elements of environmental justice and/or conservation within the program areas of Environmental Education, Environmental Health, and Sustainable Agriculture	Center for Rural Affairs, Pesticide Action Network North America (PANNA), Victory Programs, Healthy Schools Campaign, Sister Song, Common Good City Farm, Kansas City Center for Urban Agriculture	http://www.cedartreefound.org/apply.html	617.695.6767 info@cedartreefound.org
Clean Water Management Trust Fund (CWMFT)	Restoration and Stormwater Projects Grant	Water Quality	up to $3 million	February 1, 2011	501(c)(3) non-profit organizations whose primary purpose is the conservation, preservation, and restoration of North Carolina's environmental and natural resources	CWMTF will fund restoration projects, including: Stream Restoration, Enhancement, or Stabilization, Wetland Restoration, Creation, or Enhancement, Other projects that would promote the quality of receiving surface waters.		http://www.cwmtf.net/a/index.html#restostorm.htm	Will Summer (919) 851-6654 will.summer@ncdenr.gov
Clean Water Management Trust Fund (CWMFT)	Planning Grant	Water Quality		February 1, 2011	501(c)(3) non-profit organizations whose primary purpose is the conservation, preservation, and restoration of North Carolina's environmental and natural resources	CWMTF planning grants are intended to lead to proposals that could be funded by CWMTF in the following categories: Riparian Buffer Acquisition, Greenway (or Regional Trail) Corridor Acquisition, Stream or Wetland Restoration, Stormwater Quality, Wastewater Infrastructure		http://www.cwmtf.net/a/index.html#planning.htm	Will Summer (919) 851-6654 will.summer@ncdenr.gov
Clean Water Management Trust Fund (CWMFT)	Donated Easement Minigrants	Water Quality	up to $25,000	February 1, 2011	501(c)(3) non-profit organizations whose primary purpose is the conservation, preservation, and restoration of North Carolina's environmental and natural resources	Donation mini-grants are intended to provide up to $25,000 to pay transaction costs associated with the donation of a permanent conservation easement or a fee simple real property interest, for the purpose of protecting surface water quality. If the donation is in fee simple, a permanent conservation easement must be recorded on the real property.		http://www.cwmtf.net/a/index.html#donated_mg.htm	Will Summer (919) 851-6654 will.summer@ncdenr.gov
Conservation Fund	Kodak American Greenways Program	Trails	up to $2500	June 15, 2011	land trusts, local governments, and other organizations	Funded projects typically advance one or more of the following Program goals: Catalyzing new greenway projects, Assisting grassroots greenway organizations, Leveraging additional money for conservation and greenway development, Promoting use and enjoyment of greenways. For 2011, the Program anticipates awarding up to fifty percent of the grants to those greenways projects that demonstrate the convergence of economic prosperity and the environment.	Trees Atlanta, Passaic River Coalition, Esperanza Community Housing Organization	http://www.conservationfund.org/kodak_awards	Emily Hankin ehankin@conservationfund.org

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Department of Transportation's Federal Highway Administration provides funds to the State	Recreational Trails program	Trails	up to $75,000	Congress is currently considering reauthorization - funding uncertain. Last year's deadline was January 29, 2010	Yes	New Trail Construction, Trail Renovation, Trail Side Facilities, Land Acquisition (Willing Sellers Only)	Carolina Mountain Club, McDowell County, Jordan Lake Trails Conservation Association, Town of Pittsboro, Alamance County Recreation and Parks	http://www.ncparks.gov/About/trails_grants.php AND http://www.ncparks.gov/About/grants/docs/primer.pdf	Vincent T. Newman-Brooks (919) 715-1846 Vincent.NewmanBrooks@ncdenr.gov
EPA	Environmental Education Grants	Education	Regional grants: up to $50,000; Headquarters grants: up to $200,000	Last year's deadline was December 15, 2009	Yes	The grant is intended to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program provides financial support for innovative projects that design, demonstrate, or disseminate environmental education practices, methods, or techniques. Educational priorities: capacity building, educational advancement, community projects, human health & the environment, environmental education teaching skills, career development, statutory authority, linkage to EPA's strategic plan	Elon University, MountainKeepers, Alamance County Health Dept, Wake County Government,Hillandale Elementary School PTA, NC DENR	http://www.epa.gov/enviroed/grants.html	
Golden Leaf Foundation	Open Grants	Economic	up to $200,000	Year-round	Yes	Golden Leaf Foundation funds projects that show the most potential for strengthening North Carolina's long-term economy, especially in tobacco-dependent, economically distressed, and/or rural communities. In the Open Grants Program, Golden LEAF's grantsmaking is focused in the areas of Agriculture, Job Creation and Retention and Workforce Preparedness.		http://www.goldenleaf.org/opengrants.html	252-442-7474 info@goldenleaf.org
Golden Leaf Foundation	Economic Catalyst Grants	Economic		Year-round	Yes	Project requests in this category must be for job creation. The projects must be AT RISK without Golden LEAF participation. Projects are determined to be "At Risk" based on a number of factors including: evidence of urgency for assistance necessary to facilitate job creation, demonstrable need, the county's ability to pay, competitive sites in other states being considered, and others. The most competitive applicants will provide information showing that without Golden LEAF participation a funding gap exists that would significantly impair the applicant's ability to attract jobs tied to the project. Grants are available for projects that include the creation of full-time equivalent positions (FTE) in NC. Full-time equivalent is defined as employment that provides 1,600 hours or more per year of work. In addition, companies must provide at least 50% of the cost of employee-only health insurance.		http://www.goldenleaf.org/economiccatalyst.html	252-442-7474 info@goldenleaf.org

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Health & Wellness Trust Fund	Various opportunities	Health		RFPs have not been released yet. Last year's deadline was January 15, 2010		Funding opportunities vary from year to year. Purposes of the Fund: To address the health needs of vulnerable and underserved populations in North Carolina; To fund programs and initiatives that include research, education, prevention and treatment of health problems in North Carolina, and to increase the capacity of communities to respond to the public's health needs; To develop a comprehensive, community-based plan with goals and objectives to improve the health and wellness of the people of North Carolina. A priority is to prevent, reduce and remedy the health effects of tobacco use, particularly in youth. Applications should include measurable health and wellness objectives and a proposed timetable for achieving these objectives. In developing the plan, the Commission shall consider all facets of health, including prevention, education, treatment, research and related areas.		http://www.healthwellnc.com/default.aspx	(919) 981-5000 healthwell.nc@healthwellnc.com
Ittleson Foundation	Environmental Program Grants	Environmental	up to $90,000?	Initial letters of inquiry must be received before September 1st.	Yes	The Ittleson Foundation supports innovative pilot, model and demonstration projects that will help move individuals, communities, and organizations from environmental awareness to environmental activism by changing attitudes and behaviors. They particularly seek to encourage and nurture environmental action through: supporting the present generation of environmental activists, whether professionals or volunteers through education, training and other activities; educating and engaging the next generation of environmentalists with a special interest in supporting the training of those who are teaching that generation; strengthening the infrastructure of the environmental movement with a particular focus on efforts at the grassroots and statewide levels; activating new constituencies, particularly those focused on environmental equity issues	Antioch University, Audubon Vermont, Center for Whole Communities, Shelburne Farms, In Our Backyards, Cornell University, Trust for Public Land, River Network	http://www.ittlesonfoundation.org/how-to-apply/	Anthony C. Wood (212) 794-2008
Jessie Smith Noyes Foundation	Promote a sustainable agricultural and food system grants	Agriculture	Approximately $20,000	No new grants in 2011	Yes	The Jessie Smith Noyes Foundation is dedicated to supporting rural and urban organizations that: Work with farmers and consumers on issues involving sustainable agriculture and community food security; Advocate for governmental policies and funding allocations that advance sustainable agriculture and community food security; and Counter the actions of public and private sector institutions and corporations that further the concentration of food production and the industrialization of agriculture.	Hunger Action Network of New York State, National Sustainable Agriculture Coalition, Missouri Rural Crisis Center, National Family Farm Coalition, Southern Sustainable Agriculture Working Group	http://www.noyes.org/taxonomy/term/3?page=1	Kolu Zigbi (212) 684-6577 kolu@igc.org

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Kate B Reynolds Charitable Trust	Health Care Division Grants	Health	Grants in excess of $500,000 have been awarded	March 15th OR September 15	Yes	The Trust responds to health and wellness needs and invests in solutions that improve the quality of health for financially needy residents across the state of North Carolina. Their four areas of emphasis are: Diabetes, Mental Health and Substance Abuse, Access to Primary Care, and Community Change	East Carolina University School of Medicine, Moore Free Care Clinic, Inc., The North Carolina Agricultural Foundation, Inc., Black Women's Health Network, Community Foundation of Western North Carolina, North Carolina Council of Churches	http://www.kbr.org/health-care-division-fund.cfm	336.397.5500
Mary Reynolds Babcock Foundation	Mary Reynolds Babcock Foundation Grants	Poverty	up to $50,000 for grassroots orgs, up to $200,000 for orgs with proven track records	No deadlines. The Foundation's board reviews proposals in February, June and October of each year	Yes	The mission of Mary Reynolds Babcock Foundation is to help people and places to move out of poverty and achieve greater social and economic justice. They support organizations and networks that work across race, ethnic, economic and political differences to make possible a brighter future for all. Organizations may use grant funds in a variety of ways, including but not limited to: General operating support; Project support; "Glue" support for bringing together networks of grassroots and partner organizations; Organizational development support; and Efforts to bring 18- to 30-year-olds into leadership roles in the organization.	Adelante Education Coalition, Beloved Community Center of Greensboro, Inc., Blueprint NC, Center for Community Action, Center for Participatory Change, Conservation Fund - North Carolina office, Conservation Trust for North Carolina, First Baptist Church, Latino Community Credit Union, Little Theatre of Winston-Salem, Inc.	http://www.mrbf.org/applyForGrant.aspx	336-748-9222 info@mrbf.org
NC Department of Justice	Environmental Enhancement Grant Program	Education	up to $500,000	Last year's deadline: 10/1/2010	501(c)(3) non-profit organizations whose primary purpose is the conservation, preservation and restoration of North Carolina's environmental and natural resources	Funds immediate restoration or improvement projects to restore and protect impaired, degraded or endangered surface waters, groundwater and other natural resources. In addition, the EEG Program promotes long-term environmental enhancement programs to conserve and protect targeted natural areas.	Ducks Unlimited, Nature Conservancy, Tar River Land Conservancy, NC Foundation for Soil & Water Conservation	http://www.ncdoj.gov/Top-Issues/Improving-the-Environment/Environmental-Grants.aspx	(919) 716-6600 rallen@ncdoj.gov
Park Foundation	Environmental Grants	Water Quality		2010 Deadlines: January 4; April 2; July 2; October 1.	Yes	The Park Foundation is committed to raising public awareness of freshwater issues— particularly availability, quality, and accessibility. The Park Foundation will consider small lead gifts for innovative, new or enhanced programs, challenge gifts to encourage the participation of other donors, "last dollars" to achieve a specific goal, and one-time, short-term gifts to sustain a program until its long-term funding is stabilized.	Food and Water Watch, Natural Resources Defense Council, Southern Environmental Law Center, North Carolina Environmental Defense, Inc.	http://www.parkfoundation.org/applying.php	(607) 272-9124 info@parkfoundation.org

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Patagonia	Environmental Grants	Environmental	up to $8000	April 30, 2011 or August 31, 2011	small, grassroots 501(c)(3) non-profit organizations	Patagonia is most interested in making grants to organizations that identify and work on the root causes of problems and that approach issues with a commitment to long-term change. Their funding focuses on small, grassroots activist organizations with provocative direct-action agendas, working on multi-pronged campaigns to preserve and protect our environment and organizations that build a strong base of citizen support. Categories: Alternative Energy, Biodiversity, Forests, Resource Extraction, Social Activism, Sustainable Agriculture, Toxics/Nuclear, Water/Marine	California Food and Justice Coalition, Friends of the Mountains-to-Sea Trail, Midwest Environmental Advocates, Planned Parenthood Federation of America, Florida Conservation Alliance Institute	http://www.patagonia.com/us/patagonia.go?assetid=2942	(800) 638-6464
Rudolf Steiner Foundation	Seed Fund Grants	Agriculture / Environment / Education	up to $5000	March 15th	Yes	Rudolf Steiner Foundation has three focus areas – Food & Agriculture, Education & the Arts, and Ecological Stewardship. RSF is dedicated to exploring new economic models that support sustainable food and agriculture, while raising public awareness of the value of organic and Biodynamic farming, helps fund education and arts projects that are holistic and therapeutic, and provides funding to organizations and projects devoted to sustaining, regenerating, and preserving the earth's ecosystems, especially integrated, systems-based, and culturally-relevant approaches.	Center for Social and Environmental Responsibility, Soil Born Farms, Sonoma County GoLocal Cooperative, Lakota Waldorf School, People's Grocery – Growing Justice Training Institute, Mercy Corps Northwest – Organic Farmer Training Site	http://rsfsocialfinance.org/services/giving/seedfund/apply-for-a-seed-fund-grant/	Caitlin Peerson 415.561.6163 caitlin.peerson@rsfsocialfinance.org
State of NC	Adopt a Trail Program	Trails	up to $5000	Last year's deadline was January 29, 2010	Yes	Grants awareded to projects that are: On lands owned in fee simple or easements that are held in perpetuity by a governmental agency provided that the public is allowed use of the trail or facilities, On lands owned in fee simple or easements that are held in perpetuity by a non-profit organization provided that the public is allowed use of the trail or facilities, or On lands that are leased by a governmental agency or non-profit organization for a minimum of 10 years. Can be used for Trail Brochures, Website Information & Promotional, Media, New Trail Construction, Trail Renovation, Trail Side Facilities, Land Acquisition (Willing Sellers Only)		http://www.ncparks.gov/About/trails_grants.php	Vincent T. Newman-Brooks (919) 715-1846 Vincent.NewmanBrooks@ncdenr.gov

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
Surdna Foundation	Sustainable Environments Grants	Agriculture / Environment		No deadlines. LOI accepted yearlong. Grants awarded 3 times per year	Yes	The Surdna Foundation seeks to create just and sustainable communities where consumption and conservation are balanced and innovative solutions to environmental problems improve people's lives. They work from a sustainable development perspective to demonstrate that a healthy environment is the backbone of a healthy economy and a democratic society. They fund three key related priority areas -- Climate Change, Green Economy, and Transportation and Smart Growth. The Surdna Foundation is focused on demonstrating that climate change measures will not harm the economy and that jobs and businesses can be created which will revitalize communities and our manufacturing sector and create pathways out of poverty for low-income communities.	American Farmland Trust, Center for Working Families, Center for Climate Strategies, Earth Day Network, Ecotrust, Ella Baker Center for Human Rights, Friends of the Earth, U.S.	http://www.surdna.org/grants/how-to-apply.html	(212) 557-0010 questions@surdna.org
Sustainable Agriculture Research and Education (SARE) Southeast	Sustainable Community Innovations Grant	Agriculture	up to $10,000	Lat year's deadline was October 1st	Yes	SARE invests in projects/programs that promote a stronger alignment between sustainable agriculture and community development strategies in the South. Applicants MUST demonstrate that their project team has a good mix of backgrounds and experiences relevant to sustainable agriculture and community development. Priority areas for 2010 were: Strategic Planning Efforts, Integrating Agriculture into the Local Economic Development Plan, Food Assistance/Security Activities, Linking Farmers and Local/Regional Consumers, Strengthening/Creation of Niche Food and Agriculture-Related Businesses, Regional Agriculture-Related Economic Clusters, Civic Dialogue/Deliberative Initiatives, Local Leadership Development Efforts. Recipients must incorporate an educational outreach component to their project.		http://www.southernsare.uga.edu/callpage.htm	Sandra Young (770) 229-3212 syoung@griffin.uga.edu
Town Creek Foundation	Environmental Program Grants	Environment		2 cycles: LOI due November 12, 2011, proposals due December 17, 2010 OR LOI due March 18, 2011, proposals due April 22, 2011	Yes	Town Creek Foundation's environment program supports organizations that are working to establish healthy, sustainable relationships between humans and the ecological systems . They are especially interested in working with organizations that actively engage the American population in efforts to preserve biological diversity and to challenge and reverse the unsustainable ways that natural resources are currently managed and consumed.	American Rivers, Center for Environment & Society / Washington College, Dorchester Citizens for Planned Growth, The Conservation Fund, Wild South, Assateague Coastal Trust, Dogwood Alliance	http://www.towncreekfdn.org/applicationprocess.html	410-763-8171 info@towncreekfdn.org

Issuing Organization	Grant	Category	Amount	Due Date	Eligibile?	Goal/ Permitted Uses of Funds	Previous Recipients	Website	Contact
USDA	Community Food Projects Competitive Grants	Agriculture	up to $300,000	Funds authorized until 2007 - no grants have been issued since 2007	Yes	The program is designed to: Meet the needs of low-income people by increasing their access to fresher, more nutritious food supplies, Increase the self-reliance of communities in providing for their own food needs, Promote comprehensive responses to local food, farm, and nutrition issues.	The Corporation for Economic Opportunity, Oklahoma Sustainability Network, Hunger Action Network of New York State, Calypso Farm and Ecology Center, Farm to Table	http://www.csrees.usda.gov/nea/food/in_focus/hunger_if_competitive.html	
USDA	Farmers Market Promotion Program	Agriculture	up to $100,000	Last year's deadline was April 15, 2010	Yes	This program is designed to help improve and expand domestic farmers' markets, roadside stands, community-supported agriculture programs, agri-tourism activities, and other direct producer-to-consumer market opportunities.	Appalachian Sustainable Agriculture Project, Warren County Government, Coastal Harvesters, Inc., The North Carolina Coalition of Farm and Rural Families, Sandhills Family Heritage Association	http://www.ams.usda.gov/AMSv1.0/FMPP	
W.K. Kellogg Foundation	Healthy Kids Grants	Agriculture		No deadlines.	Yes	WK Kellogg Foundation seeks to help children get a healthy start by funding organizations that improve birth outcomes and first food experiences, create access to healthy foods, and educate families and communities on the factors that determine well-being. They especially focus on children who are disadvantaged by multiple societal factors, a disproportionate percentage of whom are children of color.	Centers for New Horizons, Inc., National Coalition on Black Civic Participation, Inc., Community Food Security Coalition, Inc., National Alliance for Hispanic Health, West Harlem Environmental Action, Outdoor Discovery Center of Wildlife Unlimited	http://www.wkkf.org/grants/for-grantseekers.aspx	(269)968-1611
Wallace Genetic Foundation	Wallace Genetic Grants	Agriculture / Education	up to $40,000	No deadlines. Grants received after November 1 may not be reviewed until after the first of the year	Yes	Wallace Genetic Foundation's areas of interest include: Sustainable agriculture, Protection of farmland near cities, Plant genetic research, Biodiversity protection, Environmental education and media	Audubon Naturalist Society, Environmental Working Group, FreshFarm Markets, Georgia Organics, Healthy Schools Network, Land Trust Alliance, Practical Farmers of Iowa	http://www.wallacegenetic.org/grant_info.php	(202) 966-2932 wgfdn@aol.com
Wells Fargo		Education / Environment		No deadlines.	Yes	Wells Fargo's first priority is to support programs and organizations whose chief purpose is to benefit low- and moderate-income individuals and families. Their primary interest areas are: Community development, Education, Arts and culture, Civic engagement, Environment, and Human services.		https://www.wellsfargo.com/about/charitable/nc_guidelines	Juan Austin 336-732-6138 juan.austin@wellsfargo.com
Z Smith Reynolds Foundation	Small Grants	Environmental	up to $35,000 per year for up to 2 years	August 1, 2011	Yes	The Foundation seeks to conserve, protect, improve and restore North Carolina's natural areas; to ensure clean air and water for all North Carolinians; and to minimize the burden of the state's environmental hazards, particularly on marginalized communities. They focus on social, economic, and environmental justice.		http://www.zsr.org/environment.htm	(336) 725-7541 info@zsr.org

Request for $5000 from RSF Seed Fund for *Success!on* - March 2011

Name of Organization:	*stone circles*
Address:	6602 Nicks Road, Mebane, 27302
Telephone:	919-304-5000 Fax: 919-304-1300
Organization Website :	www.stonecircles.org
Contact:	Claudia Horwitz, Executive Director
Email:	claudia@stonecircles.org
Amount of Request:	$5,000

We are pleased to submit this request for $5,000 from the RSF Seed Grant program to support the *Success!on* program at *stone circles*. *Success!on* is a new educational program that will utilize our land at The Stone House as a teaching tool, providing a model of sustainable practices and demonstrating the connection between land, food, and community.

Project Summary

The goal of *Success!on* is to increase public awareness and knowledge through experiential and participatory learning in an environment that embodies the integration of land, food, and community. *Success!on* has three components: (1) transformation of our existing orchard; (2) construction and extension of trails and signs throughout our 70 acres, and (3) development of educational programming for all those who visit The Stone House about our local ecology and food system. The infrastructure design portions of *Success!on* have been completed through partnerships with the Nicholas School of the Environment at Duke University and the Department of Landscape Architecture at NC State University. RSF Seed Grant will be used to implement the project infrastructure of orchard improvements, trails, and educational materials.

About *stone circles*

stone circles was founded in 1995. Our mission is to sustain activists and strengthen the work for justice through strategic action, spiritual life, and a sustainable relationship between land and communities. In 2007, we acquired 70 acres of land in Mebane, NC where we created The Stone House – the present home for *stone circles*, which includes a retreat, training, practice and gathering center. We are committed to ensuring our land benefits the local community, regional ecosystem, and national movement-building.

Project Plan

We are requesting seed money for *Success!on* in order to improve the ecological functioning of the land and its educational potential. This proposal has three components:

(1) Orchard: *Create and sustain a diversified and healthy system of fruit production*

Our orchard currently functions as a place for meditation and food production, but has not reached its full potential. The RSF Seed Grant will allow us to transform the orchard using a permaculture design. We will introduce a diversified range of native fruit trees to enhance our capacity for organic food production, remove diseased trees, and introduce native vegetation that will serve to uptake stormwater runoff from our roads. An enhanced capacity for fruit production will also allow us to deepen our economic collaboration with neighbors, who share in the work and harvest.

(2) Trails & Signs: *Encourage visitors and community to explore their natural environment*

In the orchard and throughout our land, we plan to construct a network of trails and educational signs. The trails will provide emotional and aesthetic relief, while also providing educational opportunities about the food system and local ecology. The focus of both the trail network and accompanying signs will be sustainable food production and Piedmont, old-field succession. Our land was formerly a farm, and we continue to use portions of it for food production. The trails and signs will show guests how food is produced and what happens when an agricultural field is abandoned and nature takes over, guiding them though the various parts of the property and explaining how they illustrate different stages in the succession process.

(3) Education: *Provide ongoing educational experiences grounded in local ecology and food production*

The ongoing, financially independent, educational component of *Success!on* will begin in tandem with the work on the orchard and trails. It will involve regular briefings and workshops for *stone circles*' program participants and guests on food production, field succession, and our local ecology. We will use our garden and orchard to demonstrate how food is grown and use the trails to lead tours of the property, explaining what field succession is and what it physically looks like at different stages. The program will utilize the knowledge of our cooks and land staff to draw out the connection between our natural environment and food production. The trails and signs will also provide permanent infrastructure for engagement of the over 1,000 people who come through our facility each year. We will encourage guests to venture onto the trails to learn about the environment from our signs and their own curiosity.

<u>Project Timeline</u>

Success!on will have two phases: construction and incorporation.

Construction: Beginning in the summer and fall of 2011 we will transform our orchard, construct the trails network, and install educational signs throughout our land. We will emphasize interdependence, community involvement and education throughout the process, by utilizing volunteers that come for our regular community work days to complete construction. We will dedicate at least four work days towards this project, using the labor of our usual 15+ participants. This collaboration will build into the community a shared sense of responsibility towards caring for both the land and each other.

Incorporation: Once the construction phase of *Success!on* is complete, we can permanently incorporate the changes into programming at *stone circles,* begin the ongoing educational component, and more effectively show our visitors what it means to be ecological stewards and grow food sustainably. A larger variety of native species in our orchard will enhance our organic food production capabilities as well as our educational opportunities with guests. A network of signed trails will facilitate easy access to the Stone House's resources by community members and visitors alike, while providing opportunities for self-guided, exploratory learning. The Stone House land, food, and kitchen will become living laboratories for education around sustainability, permaculture, and food. Our goal is that everyone who comes here will learn something new and be touched in some way by their natural surroundings. We will measure our success by the number of visitors who report having gained in knowledge about food and the environment from having spent time at The Stone House, and the number of people who use our trails.

Partnerships

We have completed the design work for *Success!on* through a partnership with Duke and NC State Universities. Graduate students at Duke's Nicholas School of the Environment have worked with us for over 6 months to write a conservation management plan. Along with a species inventory, and stormwater management and forestry recommendations, the students have designed the network of trails, signs, and educational materials that we plan to use. Graduate students in Landscape Architecture at NC State spent two weeks studying our orchard to create a new permaculture design.

Furthering Mission of RSF

Our plans to implement *Success!on* align closely with two of RSF's interest areas: Ecological Stewardship and Food & Agriculture. The project will diversify and expand our organic food system and preserve onsite ecosystems, providing an educational model pertaining to our work in sustainable and accessible food production. Incorporating the revitalized orchard and trails will allow participants to leave The Stone House with an integrated knowledge of food systems and ecology, and a deepened relationship with the earth. *Success!on* will also directly improve the ecological functioning of the land by reducing erosion and soil compaction and replacing diseased trees with a more diverse selection of native, fruit-bearing species. The project overall will help us to achieve our goal of a sustainable relationship between land and communities, while educating the community about food systems and our local ecology.

SIGNS

There are several companies that offer trail posts, markers, and signs. Sample signs and their costs are included below.

Voss Signs

Voss signs offers metal trail markers in a several of colors (Voss Signs 2011). They sell a variety of reflective decals that can be affixed to the markers. Examples of these markers and decals can be seen below in Figures 33 and 34 Trail markers cost $18.95- $19.95 per sign and decals cost $0.85 each. For the 17 signs needed for the proposed trail, this would amount to a total cost of $336.60 - $353.60 plus shipping. Voss Signs also sells tree identification signs that can be purchased for $3.85 each (See Figure 35).

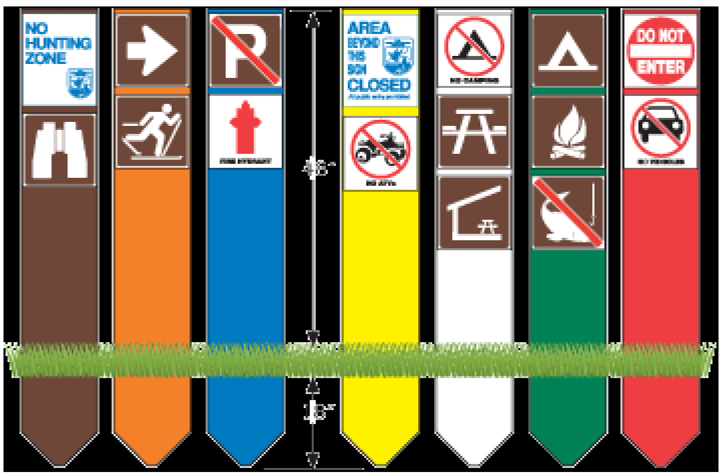


Figure 33: Trail markers sold by Voss Signs

Figure 34: Reflective decals sold by Voss Signs

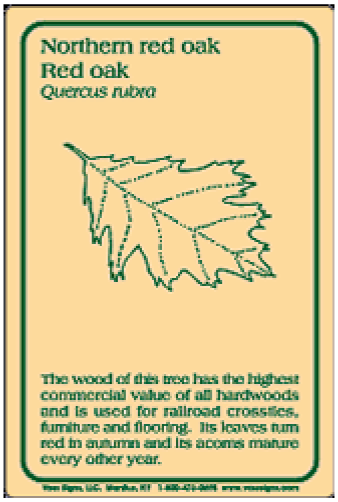


Figure 35: Tree identification signs sold by Voss Signs

EcoSigns

EcoSigns sells trail markers made from recycled plastic (EcoSigns 2011). They are made to look like lumber and come in four natural colors. The costs of the markers range from $49 for the 3x4x36" size markers, to $69 for the 4x4x48" size markers. Engraving costs an additional $15 and reflective graphics or arrows cost an additional $15. s*tone circles* would likely require one engraving that designates the trail (perhaps the stone circles logo) and one reflective number. This would amount to a total cost of $79 - $99 per trail marker, or $1350 - $1680 to equip the entire trail with trail markers.

Figure 36: Trail marker sold by EcoSigns (EcoSigns 2011)

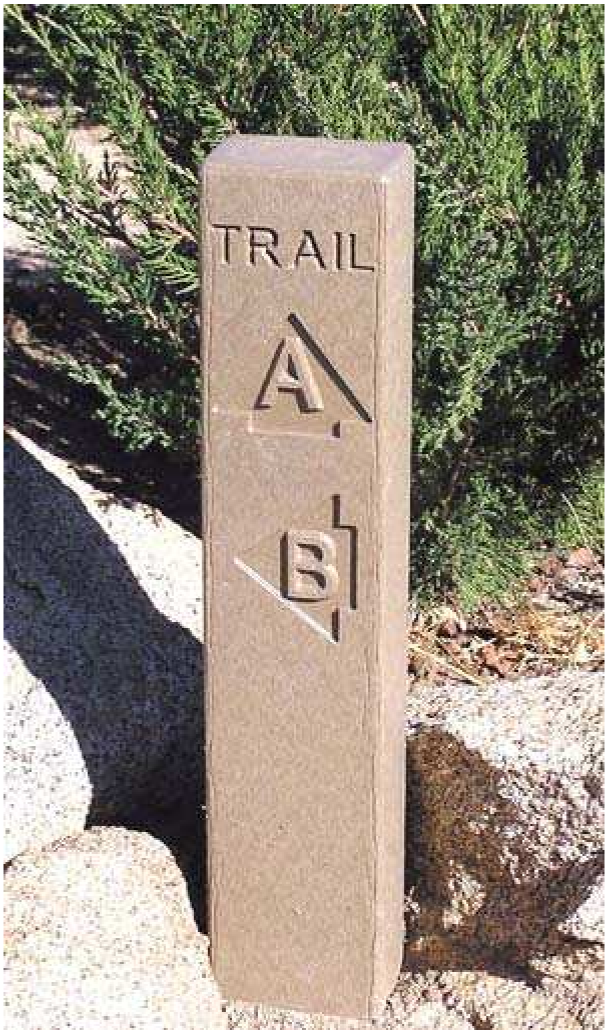


Figure 37: Trail marker sold by EcoSigns (EcoSigns 2011)

Mega Print Inc.

Mega Print Inc. can produce signs from all common graphic design programs (Mega Print Inc. 2011). Signs from Mega Print are the most customizable and are printed on outdoor vinyl affixed to 1/8 in plastic. These signs cost $15 per square foot. Assuming *stone circles* purchased 17 signs in a one square foot dimension, total costs would amount to $255 plus shipping. Purchasing these signs would eliminate the need for a trail guide, since text can be included directly on the sign.

Figure 38: Sign sold by Mega Print Inc. (Mega Print Inc. 2011)

Nurton OSM

Nutron OSM sells small, simple metal signs that can be affixed to trees (Nurton OSM 2011). Standard signs, such as a hiker or an arrow can be purchased for $1.85 each, or customizable signs can be purchased for $4.25 each. In order to include numbers on the signs, customizable signs would need to be purchased. This would amount to a total cost of $72 for the 17 necessary signs.

Figure 39: Standard signs sold by Nurton OSM (Nurton OSM 2011)

Figure 40: Custom signs sold by Nurton OSM (Nurton OSM 2011)

Appendix B

Introduction

One particular concern for the staff at the Stone House involves stormwater management. They asked us: "How can runoff and drainage be managed most effectively to ameliorate flooding and soil erosion into adjacent creeks?" (2009 onsite interview with C Horowitz; unreferenced).

In order to assist the staff in developing a plan to improve onsite stormwater management and answer this question, we performed a riparian buffer analysis (RBA). In his article in Landscape and Urban Planning, Xiang (1996) discussed riparian buffers, strips of vegetation bordering waterways and sensitive landscapes, as a best management practice (BMP) for erosion and nutrient-rich runoff control. Further, Xiang proposed the use of GIS-based analysis to assess the efficacy of current riparian buffers and identify sites where larger buffers might be needed. Research by Coops *et al*. (1996) into the effect of vegetation on slope stabilization corroborates Xiang's assertion with regard to riparian buffers as effective BMPs, showing that vegetation cover has a demonstrable impact on the erosivity of soils along shorelines and riverbanks. The authors did note, however, that the efficacy of the vegetation on slope stabilization depended on both the type of soil and the vegetation used.

We designed our own RBA, and associated GIS tools, to assess the effectiveness of the current riparian buffers at the Stone House and identify those areas where attention to restoring buffers may prevent excessive soil loss to nearby ephemeral streams. Additionally, we used these data to help focus our research into further stormwater management and erosion control practices.

Materials and Methods

Study Site

The Stone House stands in a rural area of southwestern Orange county, which is in the Piedmont region of North Carolina. Three land parcels totaling 70 acres comprise the total area of property (See Figure 1 in Figures and Models). These parcels consist of cabins, pasture, wooded areas, open space, a pond, and cultivated gardens. Agricultural fields, mixed and deciduous forest, and pine plantations border the majority of the parcels with a paved road boarding the northern most portion of the west parcel. Within the property, one main road runs from the northern entrance in the west parcel south, then east into the upper part of the central parcel before dissipating in the east parcel and becoming a trail. Other trails meander through all three parcels; both the trails and the road are unpaved. It is from the road and cultivated gardens in the west parcel that the greatest erosion occurs according to onsite staff (2009 onsite interview with T Walker; unreferenced).

Datasets and Sources

One of the principle reasons we chose to conduct an RBA for the Stone House is that it requires very little user input data, and end users may alter what few inputs there are to accommodate changing land-uses and/or site extent. Table 1 lists the study datasets and their sources.

Table 4: Datasets used in RBA

Dataset	Description	Data Source
Elevation	20ft resolution digital elevation model for Orange County and Alamance County, NC	LiDAR (NCDOT 2007a, NCDOT 2007b)
Parcel Boundaries	The boundaries of the Stone House's three lots	Tax Parcel Database (Orange County 2010)
County Boundaries	The boundaries of all counties within North Carolina	NC One Map (2010)
Land Cover Land Use (LCLU)	Raster dataset of major land cover types within the Stone House watershed from 2010.	Landsat 7 SLC-off (USGS 2010)

Riparian Buffer Analysis

We began by preparing the data for analysis (e.g. filling the DEM), generating the watershed for the Stone House, creating layers for use in display purposes (e.g. streams generated by flow accumulation), and further analyses (e.g. a binary layer containing stream and non-stream pixels, and a layer that only contained only stream pixels). We did not burn the original stream channels into our digital elevation model (DEM). After considering the scale of this analysis, and the lay of the documented stream channels in relation to our study site, we determined that this was unnecessary. We captured the documented stream channels of relevance in our own generated streams network along with smaller, ephemeral, streams on the site (Figure 1). On a related note, when creating out no data and binary streams layer, we set a tolerance of 50. That is, pixels only appeared in the final streams layer if they had greater than or equal to 50 other pixels 'flowing' into them according to the local topography (See Model 1 in Section 2 for further detail). We chose this tolerance in order to capture the fine-scale movement of water onsite given the relatively small study area in which our analysis took place.

Next, we took the datasets we obtained from the preparatory model and began our RBA. We used the "flow-path" method of RBA described by Baker *et al*. (2006) for this research. We thought this method suited the staff's needs best as they are interested in pinpointing problem areas onsite and dealing with them first and foremost. The "flow-path" method specifically addresses the directionality of water movement to identify those areas most in need of additional buffering based on elevation. It also has the advantage of considering nonpoint source pollution cells (e.g. cropland) individually and as a whole within the study area. As the Stone House's immediate watershed resides in rural portions of Orange and Alamance Counties, and the history of the site involves the production of tobacco on the largest land parcel among the holdings of *stone circles* (2009 onsite interview with T Walker; unreferenced), this seemed most appropriate of the various RBA methods described by Baker *et al*. (2006).

For the RBA, we first isolated nonpoint source cells from our LCLU dataset. Then, with the flow direction derived from our preparatory model, we used these cells as a weight in a flow accumulation to create a mask of cells that identified cells in which nonpoint sources pollution accumulated. We used this mask in isolating forest and wetland cells along the flow path and, ultimately, identifying contiguous forest and wetland cells along that same path. We accomplished the latter through a comparison of flow lengths between non-stream flow cells (i.e. the directional flow of 'water' according to elevation with the generated streams set to No Data) and forest and wetland flow cells. That is, if the flow lengths were equal, the forest and wetland cells were contiguous (See Model 2 in Figures and Models for further detail).

Next, we wanted to determine the relative threat-level from erosion and nonpoint source pollution onsite and identify areas in need of immediate buffering (i.e. cells that have no contiguous riparian buffer between streams and nonpoint source pollution cells). To this end, we calculated the distance to the stream from non-stream cells using the forest and wetland flow path as a weight. This produced a continuous dataset that showed distance to streams from non-stream cells with contiguous forest and wetland cells acting as a buffer. Higher values (i.e. greater relative distances) indicated a better buffer. From this, we extracted cells that had no buffer along the flow path as those areas most vulnerable to erosion and nutrient loading via runoff. In addition to the above results, we also used zonal statistics after isolating contributing nonpoint source cells to determine the mean buffer width within the study site (See Model 3 in Figures and Models for further detail).

RESULTS

The Stone House faces a relatively high threat throughout the entire property for erosion and nonpoint source pollution runoff (See Figure 2 in Figures and Models). The low threat areas are concentrated in several patches where forests exist on the property, although a few patches of lower threat also appear around the edges of the property. This is likely due forests bordering these sections. The majority of the property is classified as Scrub/Shrub and Hay/Pasture, these two LCLU comprising 46.4 out of 70 acres (See Figure 4 in Figures and Models). The property has a mean buffer width of 23.6 ft, but the standard deviation of this mean is almost equal to the itself (19.4 ft), indicating that buffers are not evenly distributed (See Figure 2 in Figures and Models).

In terms of prioritizing the creation of riparian buffers, only about 4.7 acres (6.7%) of the total 70 acres require immediate attention. These 4.7 acres fall directly along the flow path between nonpoint source pollution cells and streams, and have no buffer whatsoever. The relevant acreage is widely distributed throughout the property, congregating around the banks of ephemeral and documented streams with the highest proportion congregating in the central parcel (See Figure 2b in Figures and Models).

DISCUSSION AND CONCLUSIONS

The literature on riparian buffers and their potential positive impacts as BMPs is vast (e.g. Xiang 1996; Coops *et al*. 1996; Baker *et al.* 2006; Baker *et al.* 2007). The afore-mentioned literature has concluded that riparian buffers represent one of the most important BMPs for erosion and runoff control because these buffers connect the terrestrial habitat with the aquatic. However, while substantial portions of the literature related to GIS-based RBA focus on watershed-scale analyses, were unable to find fine-scale analyses on the order of individual ownership parcels. This is, in part, due to the difficulty of obtaining data with a high enough resolution, but also due to the nature of these analyses. They rely on water accumulation patterns that occur at the watershed level. Still, the question of what individual owners might be able to accomplish by improving the onsite riparian buffers remains. We have attempted to answer it in this analysis.

Based on our results, the Stone House's streams are not well-buffered. In prioritizing areas for improving the buffer, we are aware of the fact that *stone circles* faces an uncertain financial future and have little money to spend on such projects at present. Therefore, we would suggest efforts initially focus on the west parcel. It is in this parcel that the majority of the activity at the site takes place. The most active agricultural activity on the site takes place here (i.e. the garden) and most of the buildings stand in this lot. The road here receives the most traffic and has the greatest length and width. Next, the Stone House Staff might prioritize the upper portions of the central and eastern parcels as the rest of the road runs through and the rest of the buildings on the property stand in these areas. Last in terms of prioritization, the center and lower portions of the central parcel might be considered once *stone circles* can afford to address the rest of the Stone House. This portion of the parcel, originally used in the production of tobacco, has lain fallow since before the group acquired the property in 2007 (2009 onsite interview with T Walker; unreferenced) and improving vegetated buffers here would be time-consuming, labor-intensive, and expensive due to the size extent of the area in question.

In terms of sources of error, we have attempted in this analysis to remove as much as possible related to the resolution, extent, and time-scale of our datasets. For the LCLU of the watershed we conducted an unsupervised classification using the Landsat 7 SLC-off from 15 May 2010 (USGS 2010). We combined this with a hand-digitized LCLU for the site itself that we derived from satellite imagery taken from Google Earth (The Stone House 2011). While the data from Google Earth and Landsat 7 were not exact matches on date, we did not find evidence of any significant LCLU changes on the Stone House property between May and October 2010. We wanted the most accurate LCLU possible for the property and determined that a hand-digitization process for the property itself would provide the best results. This classification process ultimately produced an updated LCLU for the Stone House watershed and property that we used in the RBA. Still, some error in LCLU throughout the watershed is possible and since we did conduct the RBA at the watershed level – clipping out the data for the property at the end – this may have contributed to errors in the ultimate results.

One other consideration for future RBA's on the Stone House property might be the inclusion of some weighted characteristic for soils. While not strictly a source of error, the type of soil (e.g. clay versus sandy-loam soils) may influence the runoff potential of nonpoint source pollution cells, porous soils acting, in and of themselves as nutrient sinks (Coops *et al.* 1996). The soils onsite consist of Georgeville silt loam, 2 to 6 percent slopes (~53%), Herndon silt loam, 2 to 6 percent slopes (~29%), Herndon silt loam, 6 to 10 percent slopes (~15%), Georgeville silt loam, 6 to 10 percent slopes (~4%) (USDA 2011). Both of these soil series are well drained, produce medium runoff, and have a moderate permeability (USDA 2010). Unfortunately, the available soils data are at such a coarse resolution as to be impractical to be incorporate into an analysis for a property as small as the Stone House. We would suggest a site specific soil survey of the property in order to include these data into future RBA's.

Briefly, the our RBA indicates the need for improved buffering on the Stone House property in order to ameliorate erosion into onsite ephemeral streams. We believe the most efficient manner in which to address the issue would be to focus first on buffering areas in the west parcel, then the upper central and east parcels, before addressing the more-diffuse, but ultimately more-costly middle and lower portions on the central parcel.

FIGURES AND MODELS

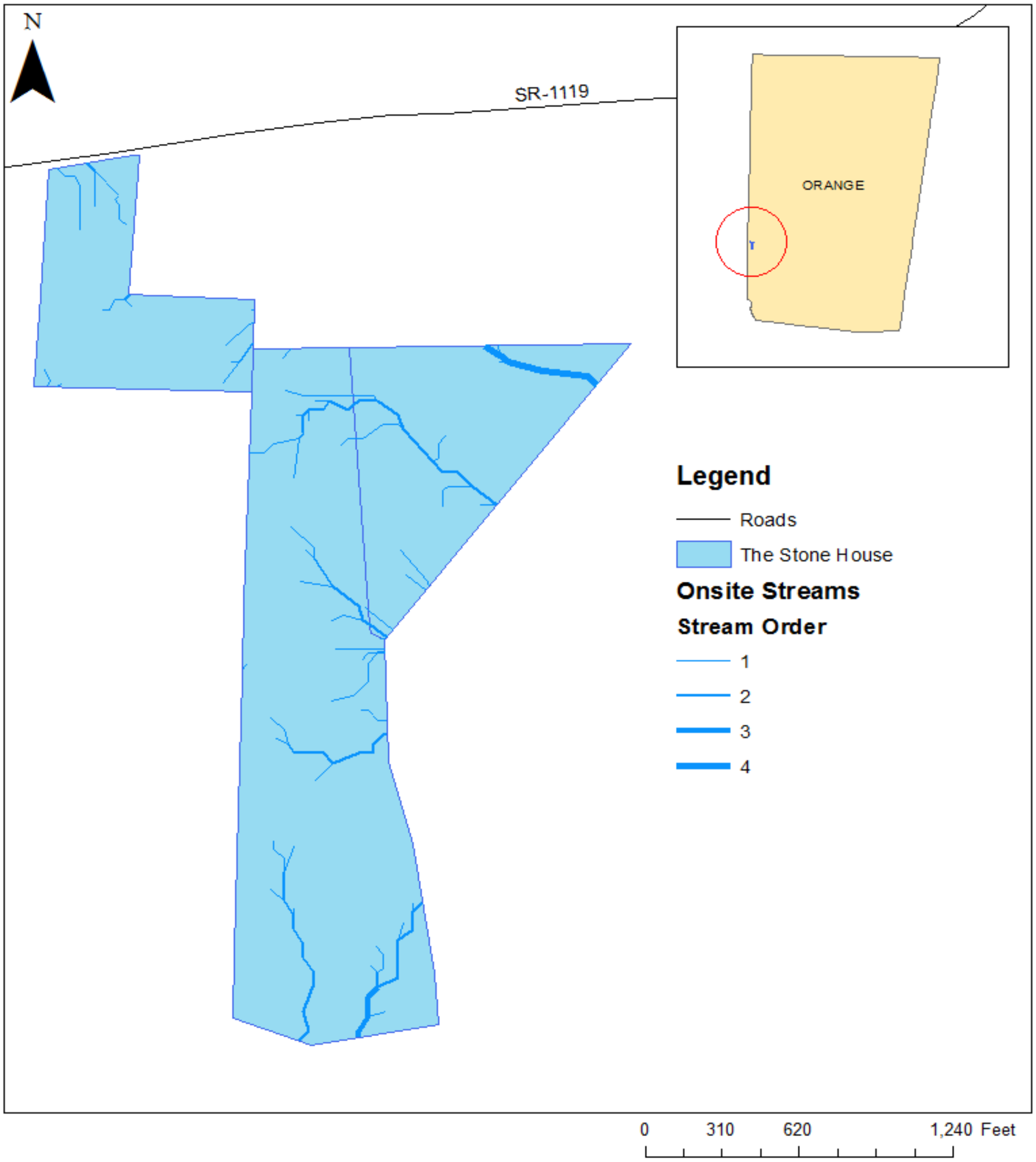
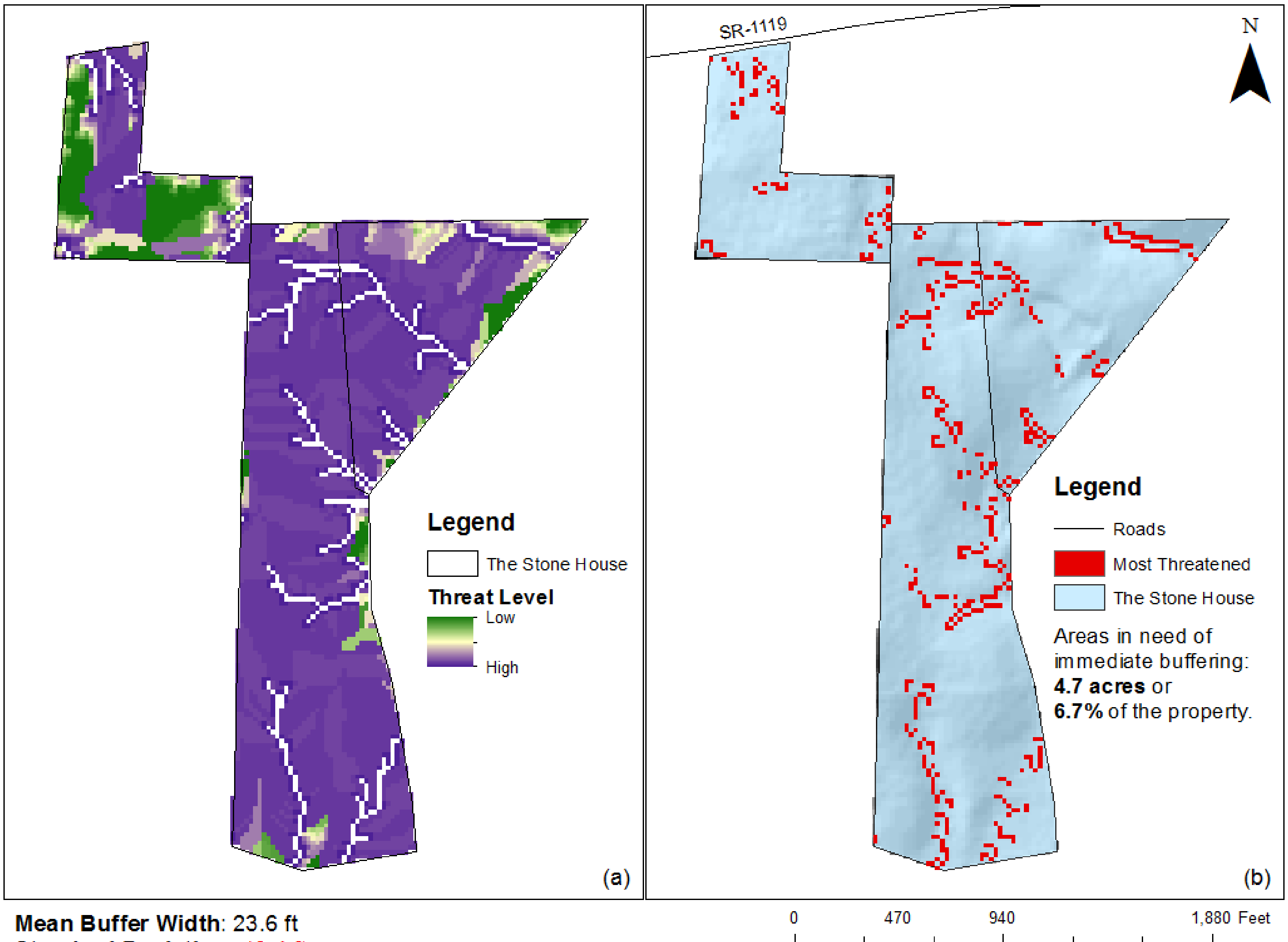


Figure 41: Onsite ephemeral streams at the Stone House.



Mean Buffer Width: 23.6 ft
Standard Deviation: *19.4 ft*

Figure 42: (a) Threat levels erosion and nutrient runoff threats faced by The Stone House, and (b) 20ft cells with no buffering capacity which lie directly within nonpoint source pollution flow paths.

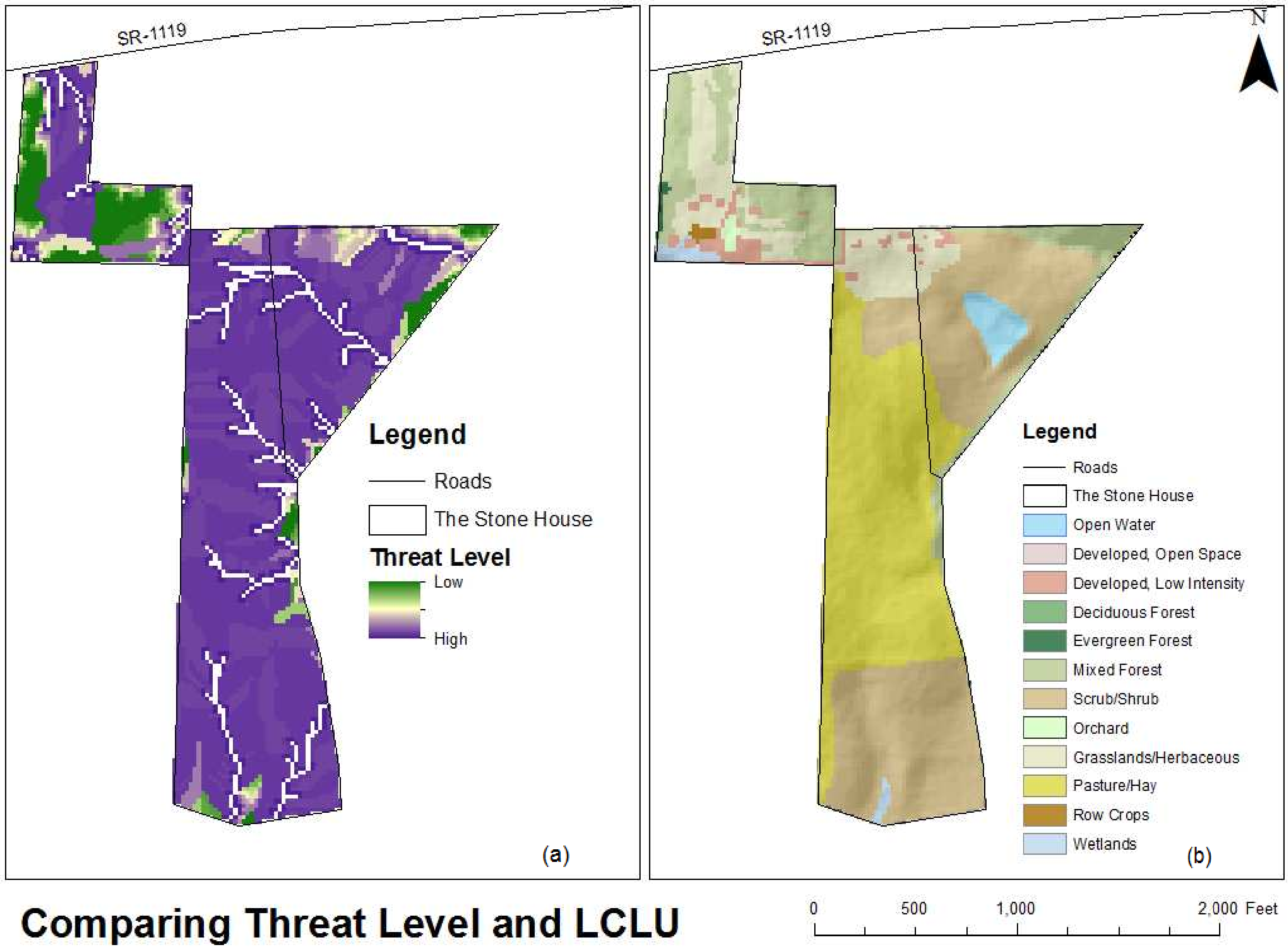
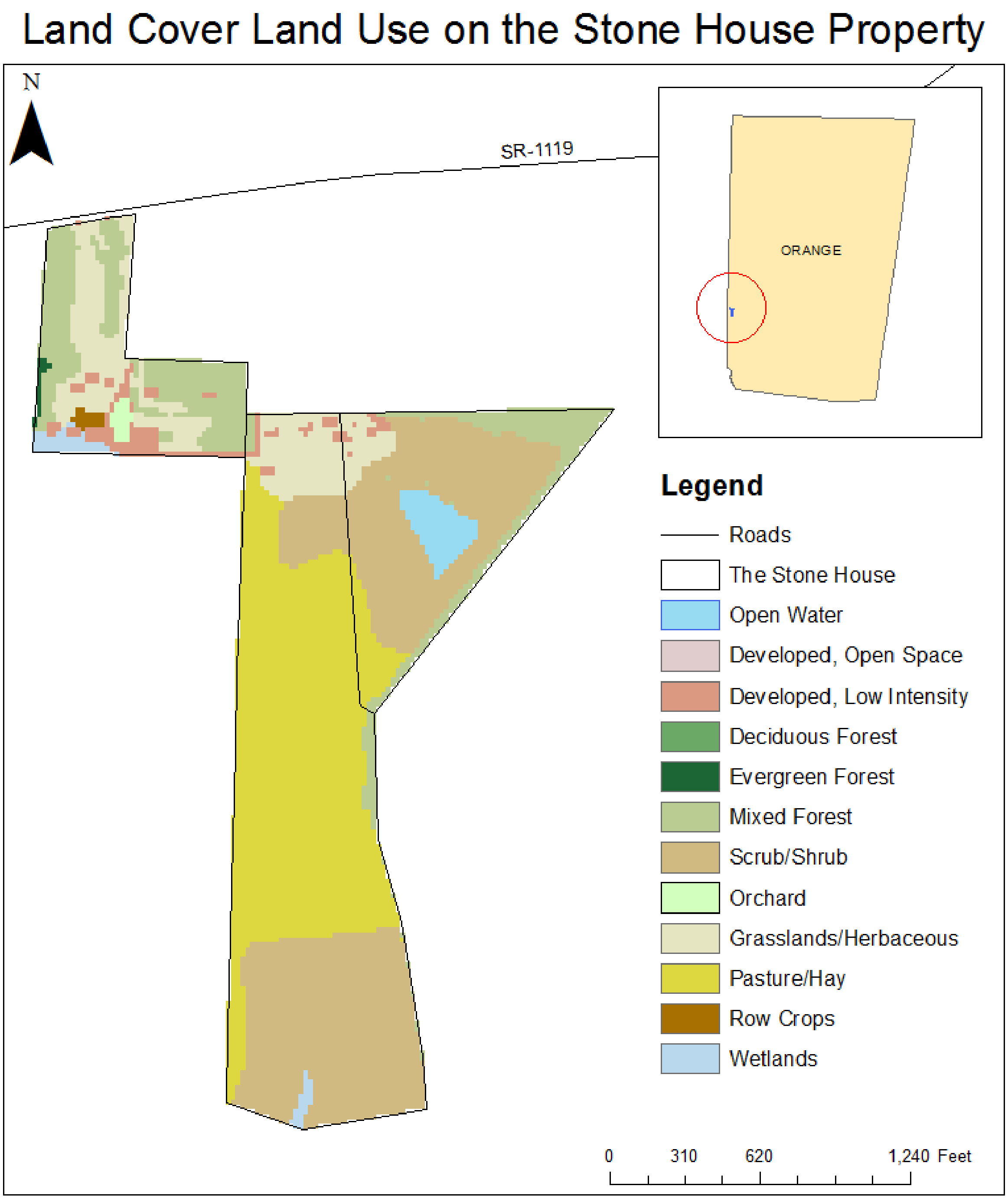


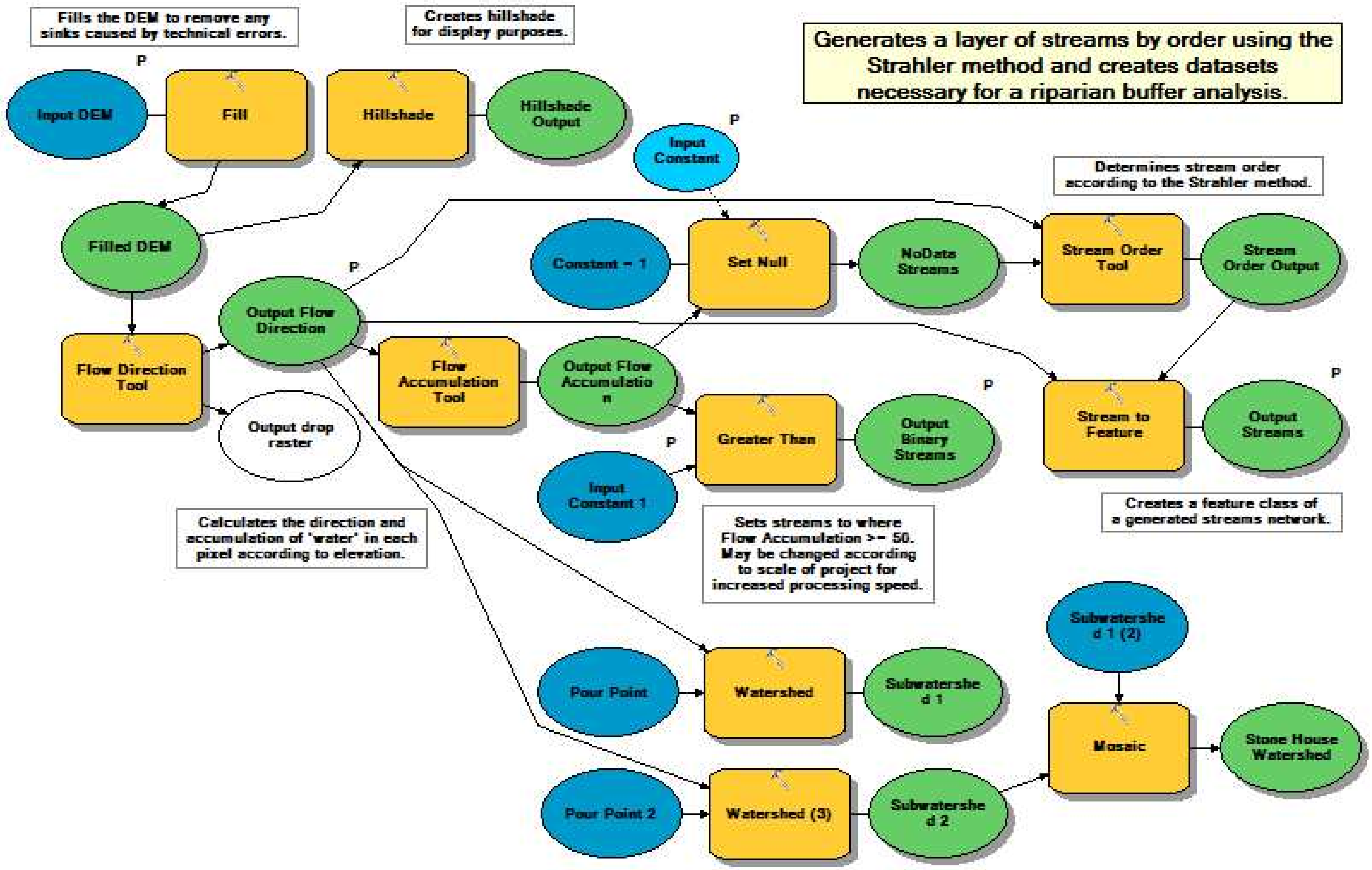
Figure 43: Comparison of (a) erosion and nutrient runoff threat and (b) land use land cover classes.



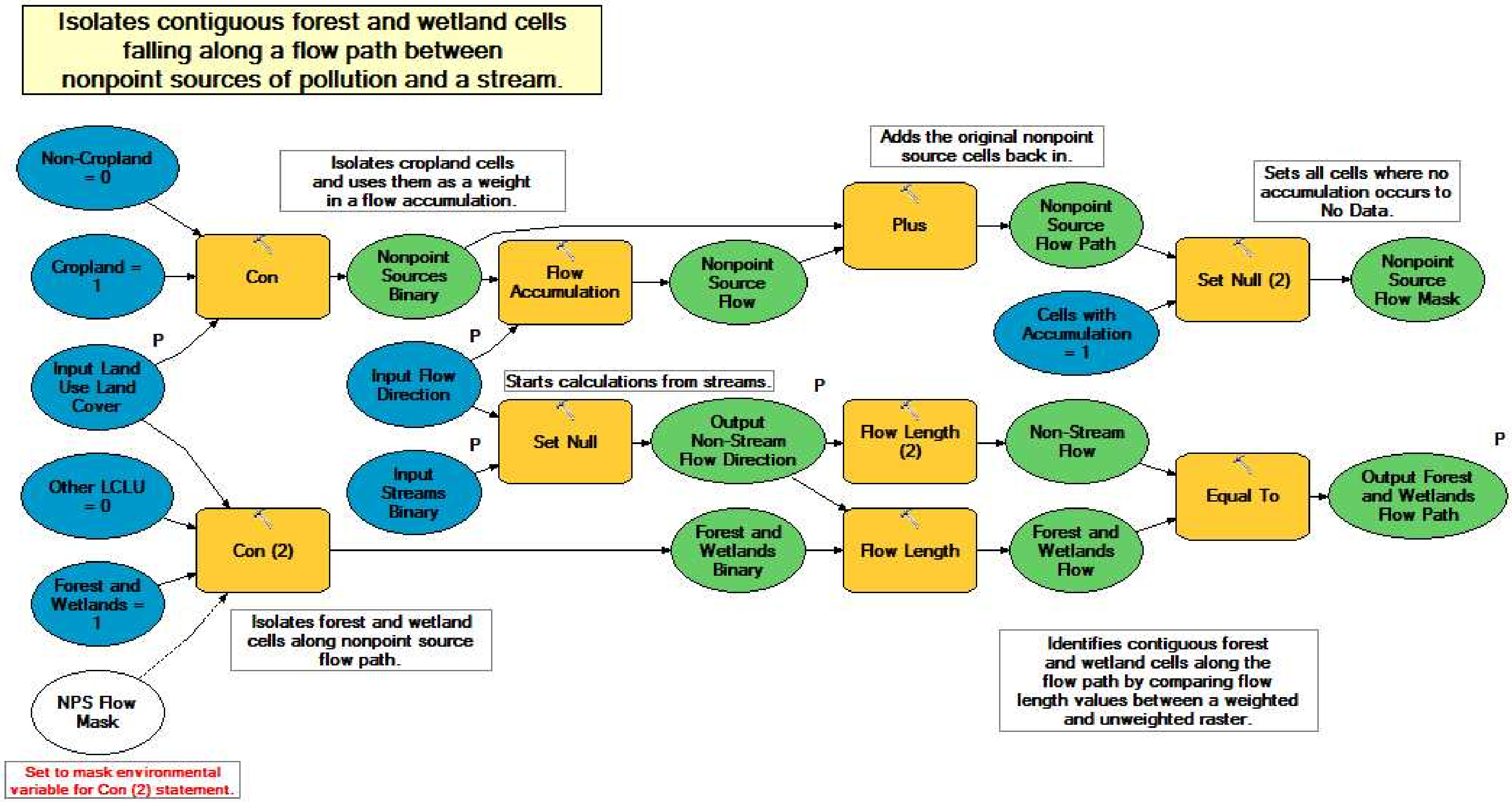
Open Water: 1.4 acres
Developed, Open Space: 0.0 acres
Developed, Low Intensity: 1.8 acres
Deciduous Forest: 0.0 acres
Evergreen Forest: 0.2 acres
Mixed Forest: 9.3 acres

Scrub/Shrub: 23.7 acres
Orchard: 0.3 acres
Grasslands/Herbaceous: 7.5 acres
Pasture/Hay: 22.7 acres
Row Crops: 0.2 acres
Wetlands: 0.7 acres

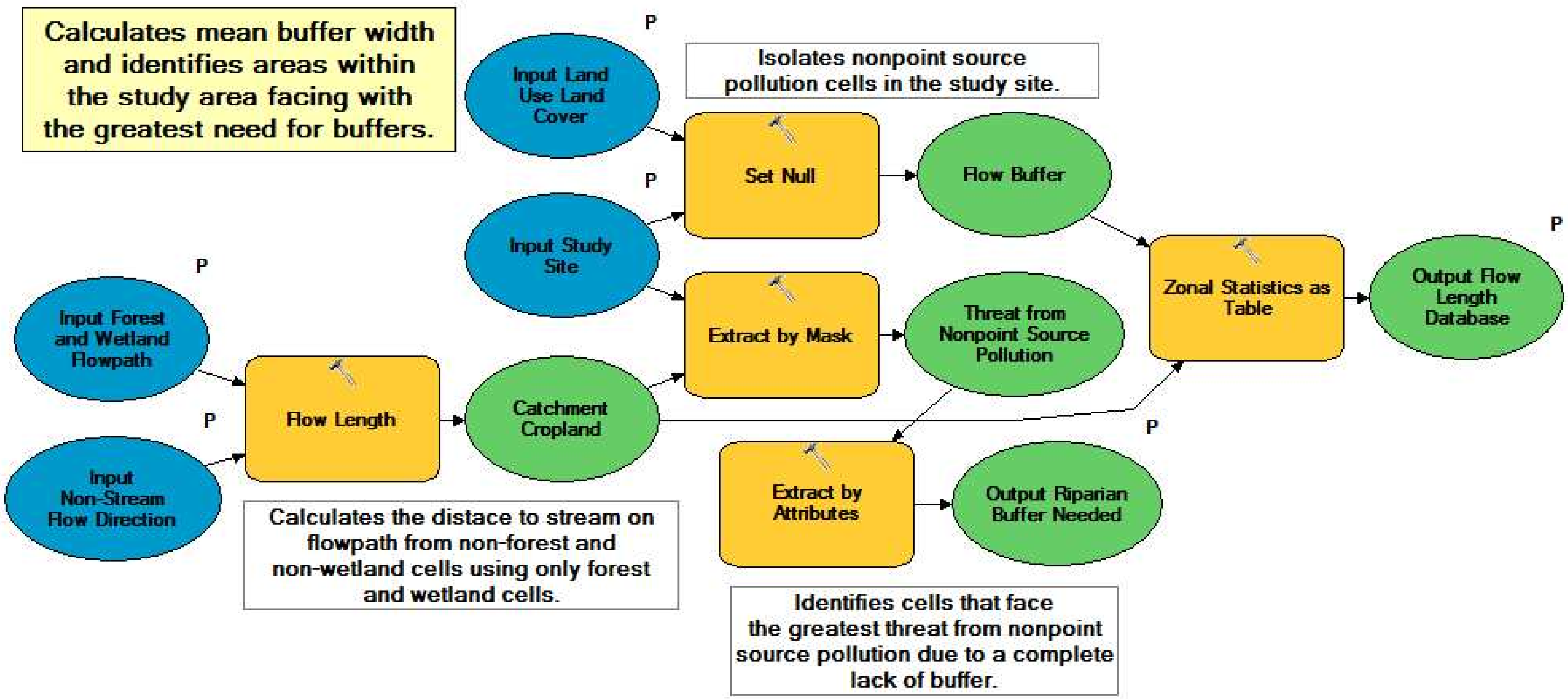
Figure 44: LCLU for the Stone House property.



Model 1: Data Preparation 1



Model 2: Riparian Buffer Analysis



Model 3: RBA Results

Appendix C

Establishing a Fair Cropland Rental Rate

There are several different methods of determining a cash rental rate for cropland. Estimating a rental rate can be based on:

• What others are charging/paying
• Average yields
• Share of gross crop value
• Return on investment (Percentage of Land Value)
• Crop share equivalent
• Tenant's residual

What Others are Charging/Paying

Charging what others are charging is the most common way of establishing a rental rate. Average rental rates for counties are readily available from the USDA (CITE) and can be obtained simply by talking with neighbors. This method, while popular, assumes that what others are charging is fair and equitable. However, there can be major differences in the quality of the land. When using this method, it is important to compare rental rates to land of similar quality. Landowners should also compare many rental rates instead of just one and be wary of rumors.

Average Yields

Rental rates can be based on a farm's average yields (Iowa State University Extension 2011). Average rental rates per bushel of corn, for example are available. Using this rate and the average farm yield a landowner can compute a rental rate per acre. For example, if the average yield of a farm were 160 bushels of corn per acre and the average rental rate for a bushel of corn was $1.10, a rental rate of $176 per acre would be charged.

Share of Gross Crop Value

Rental rates can be calculated using a percentage of the gross value of the crops being produced. If, for example the rental rates have averaged 40% of the gross value of crops being produced, a landowner could simply multiply this percentage by the expected gross value of the crops produced to obtain a rental rate. The expected value of the crops produced is estimated using expected yields and estimated prices for the coming year.

Return on Investment (Percentage of Land Value)

A rental rate can be obtained by multiplying the estimated current market value for the cropland by an expected rate of return. For example, if the land's value is $3500 per acre and cash rents have averaged 4% of this value, the rental rate would be $140 per acre.

Crop Share Equivalent

A cash rental rate can be estimated based on the return that would have been received from a 50-50 crop share lease. In a crop-share lease, the landowner's return is affected by changes in yield, selling price, and input amounts and prices. To calculate a cash rental rate based on a 50-50 crop share, a landowner must obtain estimates of yields, selling prices, and input costs for the coming year. This can be difficult to do. The table below is an example of how a rental rate might be computed using this method.

Table 5: Computing a rental rate based on 50-50 crop share (Iowa State University Extension 2011)

Income	Corn	Soybeans
Yield (1/2)	80 bu.	24 bu.
Price	$4.00	$9.00
USDA payments, per acre (1/2)	$12	$12
Total income to owner	$332	$228
Expenses		
Seed (1/2)	$47	$27
Fertilizer (1/2)	85	48
Pesticides (1/2)	19	11
Crop insurance (1/2)	10	6
Drying and storage (1/2)	18	0
Miscellaneous (1/2)	4	4
Interest (1/2)	7	4
Total expenses paid by owner	$190	$100
Net return to owner	**$142**	**$128**

Tenant's Residual

Another method of establishing a rental rate is to use the tenant's residual. This is how much income the tenant has available for rent payments after subtracting his expenses incurred in producing the crop. The table below is an example of how a rental rate might be computed using this method.

Table 6: Computing a rental rate based on tenant's residual (Iowa State University Extension 2011)

Income	**Corn**	**Soybeans**
Yield	160 bu.	48 bu.
Price	$4.00	$9.00
USDA payments, per acre	$24	$24
Total income	$664	$456
Operating costs		
Seed	$94	$54
Fertilizer	170	96
Pesticides	38	22
Crop insurance	20	12
Drying and storage	36	0
Miscellaneous	9	9
Fuel and repairs	30	23
Interest	14	8
Total	$411	$224
Machinery ownership	$47	33
Labor	29	27
Management (estimate at 5% of other costs)	24	14
Total costs	**$511**	**$298**
Residual to tenant	**$153**	**$158**

ESTABLISHING A FAIR PASTURE RENTAL RATE

The value of pasture land is dependent on supply and demand, alternative land use (e.g. cropland), livestock facilities and their condition, the availability of water, and the division of responsibilities between landowner and livestock owner (Fisher and Mangione 2006). Generally, the landowner is responsible for real estate taxes, cost of fence repairs, insurance, and interest on his/her investment. Other land-related activities, such as weed and brush control, and fertilizing and reseeding pastures, are typically negotiable. Renters are usually responsible for the production activities, such as checking livestock, providing fly control, and checking the water supply. There are two primary methods of determining pasture rental rates: on an animal-unit-per- month (AUM) basis or on a per-acre basis. An Animal Unit Month is the amount of forage or feed required to feed 1,000 pounds of animal weight for 30 days. The table below gives Animal Units for common livestock.

Table 7: Common animal units (Fisher and Mangione 2006)

Type of Livestock	A.U.
Cattle	
Cow with an unweaned calf at side, or heifer two years old or older	1.25
Bull, two years old or older	1.3
Young cattle, one to two years	0.8
Weaned calves to yearlings	0.6
Horses	
Horse, mature	1.3
Horse, yearling	1.0
Weanling colt or filly	0.75
Sheep	
5 Mature ewes, with or without unweaned lambs at side	1.0
5 Rams, two years old or older	1.3
5 Yearlings	0.8
5 Weaned lambs to yearlings	0.6
Meat Goats	
5 Mature does, with or without unweaned kids at side	0.75
5 Mature bucks, two years old or older	1.0
5 Yearlings	0.5
5 Weaned kids to yearlings	0.25

Animal-Unit-Per-Month Methods

A common formula for determining the rental rate per animal head per month takes into account animal units, a pasture quality factor, and hay prices. The formula is:

(Number of animal units) x (Hay price per ton) x (Pasture quality factor) = Pasture charge per head per month

Pasture quality factors are found in the table below.

Table 8: Pasture quality factors (Fisher and Mangione 2006)

Pasture Quality Factors	
Factor	Description
0.12	Unimproved, poor condition
0.15	Fair to good permanent pasture
0.18	Very good permanent pasture
0.20	Excellent measow (grass and legumes)
0.22	Lush legume pasture

There are also two rules-of-thumb that are commonly used to determine AUM rental rates. These formulas are:

(Number of animal units) x (Hay price per ton)/ 8.5 = Pasture charge per head per month

(Number of animal units) x (Corn value per bushel) x 2.2 = Pasture charge per head per month

Per-Acre Methods

There are several methods of determining a per-acre rental rate for pasture land. Similar to cropland, rent rates can be established by what others are charging or as a percentage of the land value (typically 3.5 to 6%). The quality of pasture, supply, and demand are factors that landowners should consider when determining the rental rate. Rental rates can also be calculated as a percentage of the land's cropland value.

Pasture rental rates can also be computed using the productivity and suitability of soil for grazing or the pounds of weight gain in the livestock.