2005

Master planning communities with wildlife in mind

Helen A. Peebles
Louisiana State University and Agricultural and Mechanical College

MASTER PLANNING COMMUNITIES WITH WILDLIFE IN MIND

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
Requirements for the degree of
Master of Landscape Architecture

in

The Department of Landscape Architecture

by
Helen Antoinette Peebles
B.S., Louisiana State University, 2000
May 2005

Acknowledgments

Thanks to John Harper for steering me into this fascinating topic.

Thanks to Bruce Sharky for serving as my committee chair.

Thanks to Sadik Artunc and Charles Fryling for serving on my committee.

Table of Contents

Abstract

Master-planned communities can be designed for the protection of wildlife while providing an aesthetically pleasing, eco-friendly, and affordable community for people. This study was conceived from a background of academic studies in plant biology, forestry, and landscape architecture, and a desire to rescue wildlife habitat from the encroachment of urban sprawl. A variety of books and periodicals were consulted, along with a few web sites. The primary threats to wildlife habitat are habitat fragmentation, pollution, and exotic invasive species of plants, animals, insects, and diseases. Many aspects of planning are addressed, including wildlife corridors, site selection, connecting habitat patches, and stormwater management. With careful planning, new communities can incorporate the principles of sustainable design, building inside nature's envelope, green infrastructure, new urbanism, and Smart Growth to protect and preserve wildlife habitat.

Chapter 1: Introduction

This thesis was conceived out of a concern for the preservation of wildlife and the enrichment of the lives of people who are disenchanted with living in suburban-sprawl. The two concerns are as interconnected as the woven yarns in a piece of cloth. Suburban sprawl has reached proportions that have created distress in the lives of people who must depend on the automobile for every detail of their lives, dealing daily with traffic jams and air pollution. As for wildlife, suburban sprawl is a major cause of the destruction and fragmentation of their habitats, on which they depend for continued existence on Earth.

In the history of the world, mass extinctions have been rare, and most of them occurred millions of years ago. What happened millions of years ago may be incomprehensibly remote, and if it should threaten us again, there is probably nothing we can do to prevent it. But consider that the last ice age, only 11,000 years ago, wiped out approximately 70 species, and then consider what is happening on Earth today:

> "Midway into the twentieth century, botanists and biologists noticed that the rate of extinction was again escalating. We are now losing animal species a thousand times faster than we have been for the last 10,000 years. Not surprisingly, this seems to have coincided with our precipitous population explosion. *The more of us there are on the planet, the fewer there seem to be of every other life form.*" (Wasowski 28)

My interest in the connection between master-planned communities and protection of wildlife originated in my lifelong interest in wildlife and native plants and my increasing concern about the effects of urban sprawl on wildlife. Originally, I had planned to do my thesis on native plant use by landscape architects in the Southeast. After much research and a failed attempt at data collection from area landscape architects, I realized the topic was more related to horticulture than to landscape

architecture. After discussing my interests and career goals with John Harper, who was my thesis committee chair, John suggested that I study master planned communities and their effects on wildlife. John has since become too ill to continue as chair, but it is thanks to him that I was steered into this fascinating topic for my thesis.

Since I already had a basic knowledge of wildlife and their needs from personal experience, from recreational reading, and from my undergraduate studies in plant biology and forestry, I began my research by studying existing master-planned communities to see what trends and methods I could find that were promoting or inhibiting wildlife. My sources for master-planned community descriptions were books and periodicals. Although some of the communities have web sites, the sites did not feature information that was helpful in this part of my study. Books and periodicals again were the sources of information on new ideas for preserving and protecting wildlife, and I found much information on the Internet, particularly from the Smart Growth site and other sites recommended by Smart Growth.

My findings fall into three categories: wildlife requirements for survival, examples of existing planned communities, and ideas for planning for wildlife. In the next four chapters I have organized and presented the information I found. The planned communities featured in Chapter 5 were selected by the following criteria:

(1) Detailed descriptions of the communities were readily available in the sources I consulted.

(2) The communities provide some amount of preserved or restored natural habitat.

(3) From the perspective of each author, the developers appeared to have an enthusiasm for doing the best they could for wildlife under the circumstances of developing communities for people.

Chapter 6 covers my recommendations for applying this information to the planning of new communities.

Chapter 2:Wildlife Requirements for Survival And Human Activities That Deprive Wildlife of Their Basic Needs

Wildlife requirements fall into four basic categories: food, water, shelter from predators and the elements, and places to raise their young. These requirements are very specialized for each species of animal and insect. Wherever these specialized requirements are accessible to a species we call it a habitat. Wild species cannot survive outside their habitat. Habitats vary in size, depending on the specific needs of the animals.

More and more today human activities are rapidly destroying the habitats of our wildlife species. Not only are our natural woodlands disappearing, but wetlands, savannas, and even deserts are in decline. Prairies have suffered even greater destruction. Our once great American prairies have been reduced to little more than a few pockets and tiny strips along railroad lines. “People and [other fauna and flora] are all part and parcel of this marvelous and mysterious and interdependent whole we call life. The fate of one affects all the rest of us.”(Wasowski 26)

How are human activities destroying wildlife habitat? We pollute. We introduce invasive exotic species of plants and animals. Many of our technological inventions, such as night lighting and cellular phone signals, have a detrimental effect on wildlife, wreaking havoc with predator-prey relationships, sea turtle reproduction, and bird migration, among other problems. Worst of all, we physically destroy wildlife habitat or divide it into useless fragments through urban sprawl.

Pollution

Hardly anyone is not aware that water and air pollution have taken their toll on wildlife. We have polluted our air with – among other sources – automobile and industrial emissions. We have polluted our waterways with agricultural runoff, industrial waste, mining operations, garden chemicals, and roadway runoff. We have liberally sprayed pesticides on crops and gardens, killing not only the pests but also the predators that help control the pests, and "creating new breeds of 'superpests' that are resistant to these poisons."(Wasowski 28) Rachel Carson's *Silent Spring* graphically teaches the dangers of pesticides to our wildlife and ourselves. Landscape design can contribute to water pollution by allowing rain and irrigation water to run off unfiltered into our waterways.

Invasive Exotic Plants

One major effect of human activity is the introduction of invasive, exotic plants. In most cases the invasive exotics are harmful because they crowd out the native plant species that are essential to wildlife as sources of food and shelter. In some cases, such as Purple Loosestrife (*Lythrum salicaria*), the invasive exotic species destroy wetlands by creating an extensive root system that traps soil and gradually raises the land. In some cases, such as water hyacinth (*Eichhornia crassipes*), they cover the entire surface of a waterway with a tight mass of vegetation that shuts out light from the water and prevents native water plants from growing. In the case of invasive exotic vines, such as kudzu (*Pueraria lobata*) in the South and English ivy (*Hedera helix*) in the northwest, they crowd out groundcover species and swallow up trees, blocking the sunlight. Rick Darke, a landscape design consultant, wrote *The American Woodland Garden: Capturing the*

Spirit of the Deciduous Forest. Speaking on the subject of weeds, Darke wrote about exotic invasive species:

> "An important consideration in defining weeds is the effect the species in question may have not only in the garden, but also in the nearby native landscape, if it still exists. It has often been stated that the deciduous forest is capable of re-making itself after disturbance of all kinds. This may have been nearly the truth a century ago, but human influence on the global landscape has forever altered the woodland environment. Beyond trends such as the acidification of rainfall or artificially induced climatic shift such as global warming, the most profound influence on the temperate deciduous forest has been the deliberate and accidental introduction of invasive-displacing exotic species. Any plant, including a local native, may become a weedy nuisance given the right circumstances; however, exotics may have the additional capacity to grow out of balance and out of control in both the garden and the regional woodlands."(Darke 192-3)

Native plants provide far more food for wildlife than our introduced exotics. For example, the popular Bradford pear (*Pyrus calleryana 'Bradford'*) produces flowers that are not visited by butterflies and fruit that is not eaten by birds, while our native serviceberry (*Amelanchier arborea*) produces lovely flowers, fall color, and a fruit that is eaten by more than two-dozen native species of birds.(Cubie *"Choosing"* 70) The Kousa dogwood (*Cornus kousa*) provides food for primates in its native Japan, but the fruit is too large for most birds here, while our native dogwood (*Cornus florida*) produces fruit that is fed upon by nearly 75 species of birds. The fruit of the native dogwood is higher in fat content – another bonus for birds.(Cubie *" Choosing"* 70)

Most of us may not see insects as valuable wild creatures, but without the myriad talents and uses of insects, humans as well as wildlife would suffer tremendously. We humans rely worldwide on hundreds of thousands of species of wild pollinators, and over 10,000 species in the United States. One-third of the food we eat is dependent on pollination by these wild creatures. But today these wild pollinators are declining

drastically in numbers due to habitat destruction, including a reduction in the diversity of native plant materials over the last fifty years.(Abell 36) As a result of eons of evolution, each species of pollinator is very specialized in the types of flowers it pollinates. Each species of flower has reproductive structures that are matched to the behavior or body parts of certain insects. The flowers produce nectar for the insects to eat, and the activity of gathering nectar causes the flower to be fertilized and produce fruits and seeds. Some of the necessary requirements for a good match between pollinator and flower are the timing of bloom with timing of insect activity, which can mean time of year or time of day, as well as the color, shape, and fragrance of flower.

Another essential need of the pollinators is nesting habitat, which in many cases requires other specific species of plants on which the immature insects can feed. Doug Tallamy, a professor of entomology and applied ecology at the University of Delaware said, “In our studies, we discovered native insects rarely eat nonnative plants. They don't have the enzymes required to digest the leaves of exotics. Since many birds feed insects or insect larvae to their young, when insects decline, so do the birds.”(Cubie *“Backyard”* 23) And so do the butterflies. Tallamy also explains that butterflies may use the nectar of some exotics, “but they won't lay their eggs on them, because the caterpillars would starve.”(Cubie *“Backyard”* 22)

Habitat Fragmentation

Probably the greatest danger to wildlife has been habitat destruction and fragmentation (Fig. 2.1), which has occurred because of urban sprawl.

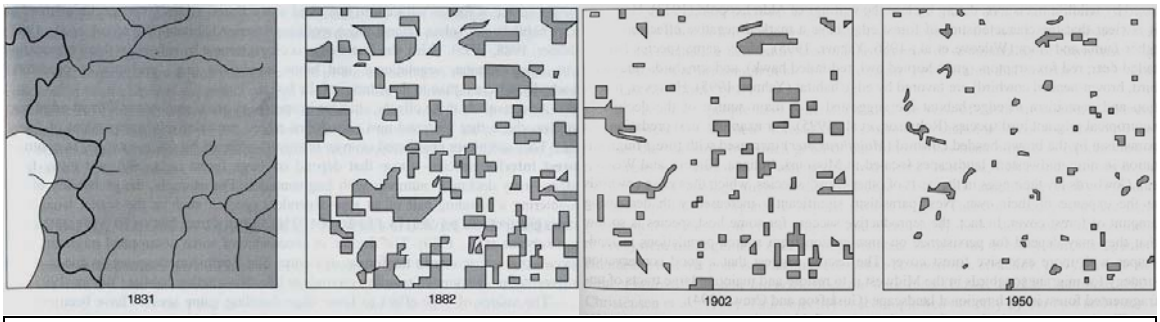


Fig. 2.1: Fragmentation of a forested area of Cadiz Township, Green Co., Wisconsin, during the period of European settlement. The township is six miles on a side. The shaded areas represent land remaining in, or reverting to, forest in 1831, 1882, 1902, and 1950. (From Barnes, *Forest Ecology*, 637)

> "According to the Audubon Society and other organizations that track wildlife populations, the number one cause of their declining numbers has been loss of habitat. And that ties in directly to our own growing population. As we build more and more housing developments, shopping centers, business parks, as well as the vast network of roads and highways to connect them all, we are destroying wildlife nesting and feeding sites and disrupting migratory routes."(Wasowski 28)

From California to Florida, urbanization "is wiping out unique birds and replacing them with über birds that can live anywhere."(Robert Blair, conservation biologist at University of Minnesota) Developed landscapes and even golf courses have many birds, but it is the declining numbers of forest and grassland birds that worry conservationists.(Nickens 85) University of Florida ecologist Larry Harris wrote, "Decades of land development around our conservation areas and the isolation of remnant populations [of wildlife] by gigantic systems of roadways, power lines, pipelines, and strip development are increasing the [ecological] problems with which we must deal."(Little 113) All of these things contribute to fragmentation of habitat. Harris described the four major consequences of habitat fragmentation:

(1) "The first is the loss of species that require 'deep woods' for breeding – a category that includes many kinds of birds.

(2) A second consequence is the local extinction of larger species such as bear and the large cats, most of which travel long distances for feeding and breeding. Under ordinary circumstances, Harris says, a single Florida panther needs at least a 50,000-acre range.

(3) Third, fragmentation leads to a 'human subsidy' for certain adaptive species such as English sparrows, raccoons, and deer, which can overpopulate and degrade habitat areas, making them less hospitable to species that are less adaptive.

(4) The fourth consequence is inbreeding, which weakens the genetic integrity of a species in isolation, sometimes leading to local extinction."(Little 113)

Much of our urban sprawl today consists of new residential developments carved out of woodlands and old farmlands. Residents of these communities commute to the nearest city for work and often for schools as well. The resulting roadway infrastructure contributes to the fragmentation of wildlife habitat, and the commuting vehicles contribute to air and water pollution. The housing displaces wildlife whether the land was in a relatively natural state or recently recovering from agricultural use.

In much of the west, development is now occurring in distant rural areas, transforming ranch land into subdivisions. Carl Bock, a biologist at the University of Colorado, is examining the idea that keeping ranch lands from development is vital to conservation. He wants to find out whether it is better for native birds, insects, mammals, and plants to live with widespread livestock grazing or to adapt to carefully planned clustered housing with large grassland preserves.(Nickens 86) This is new research, so

the results are not yet available. However, it is encouraging to know that careful scientific evaluation is given to issues such as this one and to look forward to the availability of useful guidelines in the near future.

Failed Efforts to Protect Wildlife

Over the past hundred years we have set aside parks, nature reserves, and wildlife sanctuaries to protect our wildlife species. In spite of our good intentions, many of these efforts have failed to support wildlife species other than our usual urban backyard species. Wherever we have tried to create or preserve natural habitat within the urban environment or along the edges of urban environments, there are many native species that benefit, but we have also found that some of the species we intended to protect are unable benefit from our efforts. Often these are species that require large expanses of habitat for survival. At the University of Washington, wildlife ecologist John Marzluff has conducted studies that show benefits to birds such as chickadees, nuthatches, and woodpeckers; but his studies also show others, such as pileated woodpeckers, brown creepers, and red-breasted sapsuckers, that cannot live in close proximity to human development.(Nickens 86)

In Boulder, Colorado, an extensive system of prairie and hayfields was incorporated as a preserve encircling the center city. It was found that birds would only nest deep in the middle because of predation from animals along the edges. Predators were attacking nests as far as 300 feet from the urban and residential borders. In addition, the robins, European starlings, common grackles, house sparrows, and house finches were out-competing the grassland birds in these edge spaces. Biologist Carl Bock has dubbed these five of the most numerous suburban species of birds the “Suburban Gang of

Five". Says Bock, "Almost all of our native birds are showing an aversion to the edges between the grasslands and the neighborhoods."(Nickens 85)

> "There is a new (at least to most of us) and quite specific scientific concept that has emerged which pertains directly to the crucial role that natural-corridor greenway planning can play in the protection of wildlife. This is the growing emphasis biologists and ecologists are placing on the problem of 'island populations' of wildlife and plants in isolated reserves and the need for natural corridors to provide for species interchange so that the island populations will not die out."(Little 112)

In North Carolina, wildlife ecologists are studying greenways. Greenways are "long, linear strips of woodlands, mostly sited along streams"(Nickens 82) which have been developed for the purpose of protecting wildlife in more than 500 North American cities. The North Carolina neighboring cities of Raleigh and Cary have more than 50 miles of greenways and are planning a large expansion. Wildlife ecologist Christopher Moorman is studying the greenways to determine characteristics, such as width and intensity of development on adjacent lands, that have an effect on wildlife success, because developers want working definitions. Moorman works with a landscape ecologist, an urban planner, and a parks and recreation expert. They want to determine how migrating and breeding birds respond to habitat fragmentation in an urban environment. Some of their findings to date:

(1) "Wide, maintained paths and landscaped areas within the greenway are 'bad news for birds'."(Nickens 84) They break up the greenway into two smaller greenways.

(2) Greenways less than 150 feet wide are useless for some deep-woods-nesting migrant bird species, so 150 feet could be considered a minimum width.

(3) Developers can create more bird-friendly spaces along the borders between neighborhoods and natural areas by doing away with the abrupt straight lines of grassy lawns and hedges of non-native species. Birds need

a better transition zone for escape cover from predators such as hawks and cats. (Fig. 2.2, 2.3)

(4) In many cases the greenways themselves have had all of the shrubs and small trees removed, leaving only large trees and turf. Natural cover should be replicated as closely as possible, with shrubs and trees of varying heights to increase nesting and foraging habitats. (Fig. 2.4)

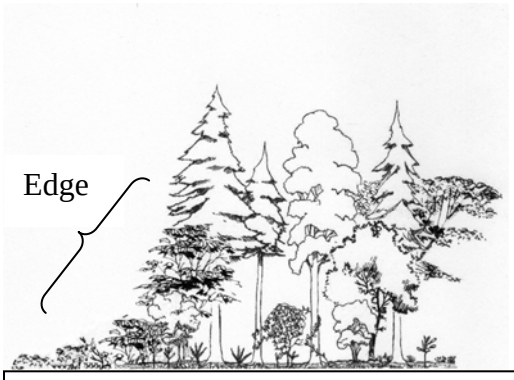


Fig. 2.2: Vertical structure of forest edge

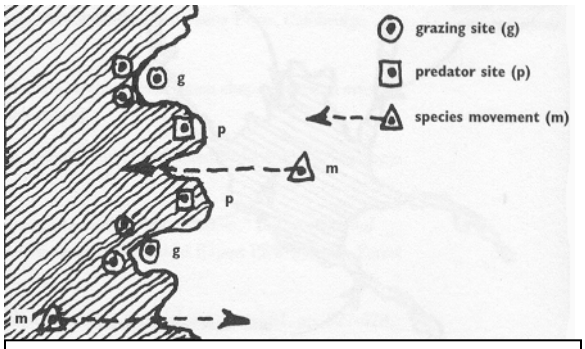


Fig. 2.3: Curvilinear structure of an edge creates greater habitat diversity and higher species diversity. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 31)

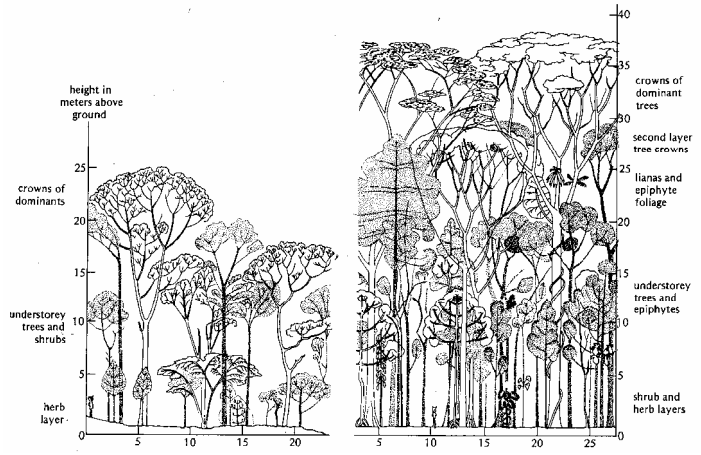


Fig. 2.4: Vertical structure of a forest. On the left is an Eastern broadleaf forest. On the right is a tropical rain forest. (From Ray, *Botany*, 687)

Some Greenway Successes

There are some greenways that have been quite successful in providing wildlife habitat. In Oregon, if you take a short canoe trip on the Willamette River, among the wildlife you are likely to observe are ospreys, blue herons, beaver, deer, salmon, and numerous species of songbirds. “The key feature, beyond overall corridor planning, is the setback line. It has been established at a minimum of 150 feet from either bank, and according to James Knight, an LCDC official, might extend as much as a quarter-mile or more ‘where there are sloughs and backwaters.’”(Little 109) The setback line has not had much effect in urban areas because of pre-existing land uses, but urban areas are only a small fraction of the Willamette’s corridor. The setback in the rural areas has made it possible to maintain natural processes in the corridor.

In Georgia, Charles Aguar, a landscape architecture professor at the University of Georgia in Athens, was instrumental in the development of the 35-mile long and two-mile wide Oconee River Greenway. From its inception in 1973, the Oconee River Greenway was established “as a non-recreational project to protect the natural corridors of the north and middle forks of the Oconee and its tributaries north of Athens, Georgia.”(Little 111) There is recreation along its banks within the city, but there are no trails along the protected upper reaches of the river. On this greenway, local regulation protects the one hundred-year floodplain of the two branches, but this is the usual situation in most parts of the country. “What is different about Aguar’s plan is that it calls for a preservation district overlay, providing a means for government jurisdictions along the Oconee’s branches to have their planning and zoning decisions comport with the environmental qualities of the corridor as a whole. The width of each corridor is two

miles – a mile on each side of the riverway. ‘It’s not completely a preservation plan,’ Aguar told me, ‘but proposes land uses that are consistent with maintaining the ecological integrity of the river corridors.’”(Little 112)

Chapter 3: Current Trends and Innovations in Planning for Wildlife

Today there is renewed hope for the future of our wildlife. There are many new methods of creating wildlife habitat within planned communities and urban settings as well as new technology and methods for lessening water and air pollution. Larger elements being incorporated into community design today include preserving portions of land as wildlife habitat, creating or restoring wildlife habitat within human communities, clustering housing within a community in order to reserve more land as open space, and a method of building "within nature's envelope" that leaves a minimal impact from human development and land use. Smaller but equally important elements include "green" roofs, rain gardens, and eliminating the lawn. There is continued interest in creating backyard habitat, in using native plants in the landscape, in permaculture and in Xeriscaping. Carl Bock, a biologist at the University of Colorado said, "Across the country, researchers who are studying sprawl's impact on birds are concluding that if you can't beat it, plan it. So they are designing landscapes to help, not hurt, native species."(Nickens 81) Ecologists and urban planners are working together to determine the best strategies for urban expansion without infringing on the needs of wildlife, such as avoiding expansion into areas that would reduce the effectiveness of wildlife corridors and sanctuaries, re-developing of poorly used existing urban spaces, and creating master-planned communities that are intended to reduce or eliminate commuting for residents.

Green Infrastructure

University of Florida ecologist Larry Harris is one of many ecologists who understand that we can and should alleviate the problem of habitat fragmentation and isolation. We can do this by creating "a series of greenbelts, habitat linkages, wildlife

corridors, and riparian buffer strips connecting key parks, refuges, and habitat islands."(Harris, in Little 113) The National Wildlife Federation uses the term "green infrastructure" to describe the network of natural ecosystems, protected waterways, other open space, and green elements of built environments that can make up the framework for healthy and sustainable wildlife communities. "With a green infrastructure in place, communities can protect native species and ecological processes, maintain clean air and water, reduce habitat fragmentation, pollution, and other threats to biodiversity, and improve the health and quality of life for people."(National Wildlife Federation web site)

Riparian Corridors: A Component of the Green Infrastructure

Ecologists understand that the most critical location for wildlife corridors is where land meets water. These riparian habitats sustain numerous resident species of fish, amphibians, reptiles, birds, and mammals, and are used as stopovers by migratory species as well. As previously mentioned, they serve humans and wildlife in their capacity to cleanse water. Vegetation within a riparian zone serves to moderate water temperature when it overhangs the water, and it serves as cover for wildlife that live or stopover there. Aquatic vegetation – that is, plants that grow in the water – serves to oxygenate the water as well. "Width and length of a vegetated stream corridor interact or combine to determine stream processes. However, a continuous stream corridor, without major gaps, is essential to maintain aquatic conditions such as cool water temperature and high oxygen content. Without these, viable populations of certain fish species, such as trout, will not be maintained." (Dramstad 40)

Riparian corridors can vary in size. They can be quite large to protect species such as pileated woodpeckers that require deep woodlands for survival or species such as bear

that must range far within their habitat for survival. An example of a large wildlife corridor can be found in Florida where the Pinhook Swamp was acquired to link the Okefenokee Swamp National Wildlife Refuge with the Osceola National Forest. (Fig. 3.1) The acquisition included 60,000 acres of land around the swamp and created a five-mile-wide wildlife corridor. The three areas together make up more than 600,000 acres of unbroken habitat for many rare and endangered species, including those like panthers and bears that require a very large home range.

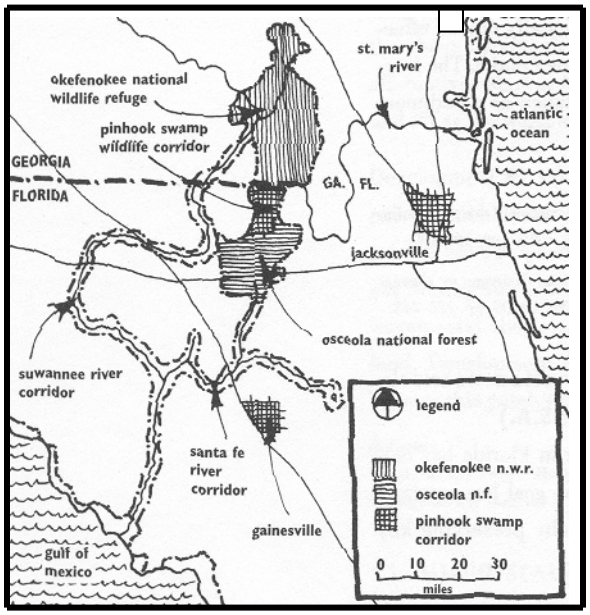


Fig. 3.1: River network and Pinhook Swamp linkage. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 68)

Dramstad describes a proposed Suwannee River Corridor, which is intended to link the Okefenokee refuge, the Osceola National Forest, and the Pinhook Swamp to the Gulf of Mexico. A river corridor such as this can be successful with a smaller preserved area on each side of the river, like the Willamette River corridor in Oregon and the Oconee River in Georgia. (See Chapter 2.) It would require the minimum 150 feet on each side wherever possible, with greater amounts at junctions with other waterways, and

could incorporate a preservation district overlay of regulations to protect the one-hundred-year flood plain from development that would threaten the ecology of the corridor. In existing urban areas, recreational greenways could be incorporated wherever possible, but otherwise there may be little or no change to pre-existing urban land uses.

Besides riparian zones there are other land types that are useful as wildlife corridors. Powerline rights-of-way and hedgerows serve as corridors to connect fragments of habitat for many species. However, these primarily serve edge species and may be useless to interior species. Deliberately designed corridors are more effective.

In designing urban greenways, researchers recommend placing walking and biking trails "along the edges of open spaces, instead of encouraging humans to penetrate deep into open lands."(Nickens 86) In urban settings and elsewhere, we must educate people about the benefits of the green infrastructure and inform them of the dos and don'ts of protecting its components. Some frequently seen problems that occur in greenways adjacent to private properties include dumping of yard trimmings in the greenways, removing dead trees from the greenways, trimming out the understory or mowing the adjacent greenway, pets preying on wildlife, and children shooting wildlife with BB guns.

Remnant and Created Patches: A Component of the Green Infrastructure

Today we live in a patchwork matrix of urban, suburban, and rural lands, with varying sizes of wildlife habitat scattered throughout. Although large areas of preserved ecosystems are vital to the survival of most interior species and for protecting aquifers for human use, smaller patches can often serve the needs of wildlife in other ways. "Small patches that interrupt extensive stretches of matrix act as stepping stones for species

movement. They also contain some uncommon species where large patches are absent or, in unusual cases, are unsuitable for a species. Therefore small patches provide different and supplemental ecological benefits than large patches."(Dramstad 22)

Most of the planned communities that set aside lands for wildlife are preserving small patches of habitat. Some are creating small patches when they introduce constructed wetlands for stormwater treatment. "Where the landscape fabric is damaged, it must be repaired and/or restored. As most of the ecosystems are increasingly disturbed, every development project should have a restoration component. When site disturbance is uncontrolled, ecological deterioration accelerates, and natural systems diminish in diversity and complexity. Effective restoration requires recognition of the interdependence of all site factors and must include repair of all site systems – soil, water, vegetation, and wildlife."(Andropogon Associates, in Earle 7) When evaluating a site to be developed, if it includes patches of natural land, it is important to examine the patches for their:

1) *contribution to the overall system*, i.e., how well the location of a patch relates or links to other patches within the landscape or region; and
2) *unusual or distinctive characteristics*, e.g., whether a patch has any rare, threatened, or endemic species present.(Dramstad 24)

Dramstad published recommendations for utilizing patches in *Landscape Ecology Principles in Landscape Architecture and Land Use Planning.* For preserved patches of wildlife habitat Dramstad suggests that we can enhance wildlife benefits if we pay particular interest to the boundary edges of the patch. Edges occur in nature wherever land meets water or where different ecosystems converge, as between forests and

grasslands. The edge shares some of the characteristics of the adjacent areas but has a unique character of its own. The edge is an important transition zone between the natural and built habitats. While it provides cover, nesting habitat, and food for many species of native wildlife, too much edge can be detrimental to our native species. "Scientists know of the troubling consequences that befall native birds when logging pocks forest or agriculture use chops woodlands, prairie, or desert into ever smaller pieces. They call them 'edge effects' – increased competition with non-native species, greater exposure to predators, and restricted travel corridors."(Nickens 82)

Wildlife inhabiting the edge may be quite different from the species within the interior of the patch. "Vertical and horizontal structure, width, and species composition and abundance, in the edge of a patch, differ from interior conditions... Whether a boundary is curvilinear or straight influences the flow of nutrients, water, energy, or species along or across it."(Dramstad 27) The patch may need to be expanded to extend along waterways or its edge may need to be re-formed into a curvilinear form where it has been previously forced into a straight line. (Chapter 2, Fig. 2.3) This curvilinear edge will provide quick access to escape cover from predators. In addition, it is advisable to preserve or create extensions of habitat vegetation that project outward from the edge like arms that serve to attract species toward the patch or to enable safe movement toward the next patch. (Fig. 3.2)

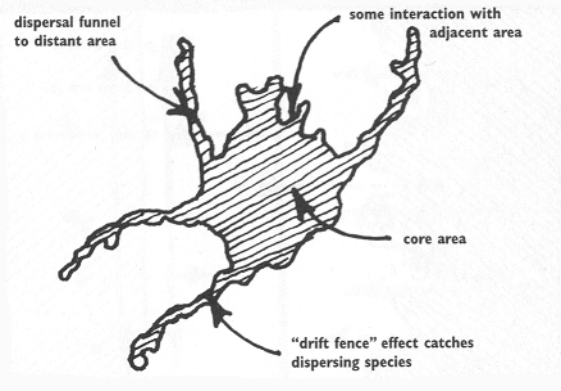


Fig. 3.2: Ecologically Optimum Patch Shape. (From Dramstad et al. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 32)

The edge should always be evaluated for invasive exotic plant species, which will be present in most cases. These species must be removed to prevent further damage, and native plant species suitable for the edge should be restored.

When preserving or creating a patch habitat it is important to consider its orientation to any nearby larger patches. If the smaller patch is to have a long axis, it is preferable to orient the axis parallel to the facing side of the larger patch. (Fig. 3.3) If this is done, individuals dispersing from the larger patch will be more likely to move into the smaller patch. (Dramstad 32)

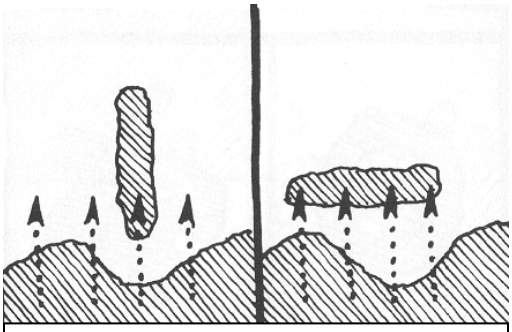


Fig. 3.3: Optimum linear orientation of patches is depicted on the right. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 32)

To provide a connection for larger habitat patches, rather than using one small patch it is preferable to use a cluster of small patches. (Fig. 3.4) This will provide wildlife with alternate routes of passage between habitats (Dramstad 38), because "a finely-fragmented habitat is normally perceived as continuous habitat by a wide-ranging species, whereas a coarsely fragmented habitat is discontinuous to all species, except the most wide-ranging large animals." (Dramstad 45) (Fig. 3.5)

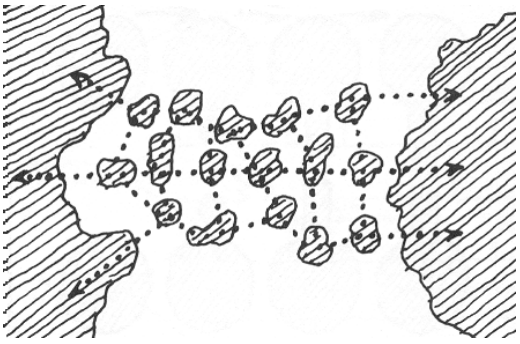


Fig. 3.4: Clustered stepping stone patches between large patches. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 38)

Connecting Habitat Patches When Interrupted by Roads

Frequently we find wildlife habitat broken by a roadway. Constructing overpasses and underpasses can lessen this disturbance to wildlife, particularly if "drift fencing" (Fig. 3.7) is placed to guide the animals away from the road and into the safe crossing zone. Wildlife tunnels that go beneath the roadway have also been successful when properly designed. "As habitats are increasingly bisected and fragmented by roads and development, artificial links such as underpasses, tunnels, and overpasses between fragments must be carefully considered. Knowledge of the habitat requirements and social organization of the key species is critical."(Dramstad 61) Dramstad gives the example of an underground tunnel beneath a roadway in Australia that enables the endangered mountain pygmy-possum to continue its normal seasonal dispersal in safety. The tunnel was specially constructed to imitate the animal's native habitat. (Fig. 3.6)

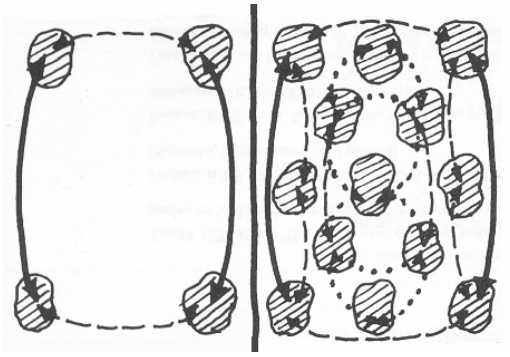


Fig. 3.5: Scale of fragmentation: coarse fragmentation is depicted on the left; and fine fragmentation, on the right. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 45)

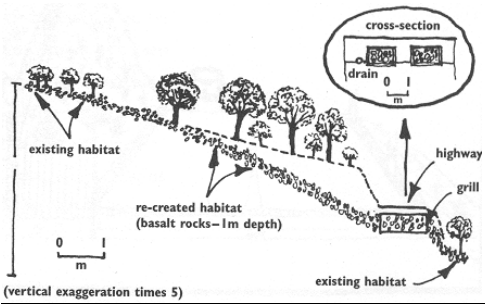


Fig. 3.6: Specialized tunnel for Australian mountain pygmy possum. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 61)

As an example of just how specialized such structures must be, tunnels for amphibian crossings in Europe and the U.S.A. are also described. (Fig. 3.7) Many of them failed because of "excessive mortality, predation, inadequate light or ventilation, filling with water, lack of light at end of tunnel, and poorly designed drift fences."(Dramstad 62) Some failed because they only allowed one-way crossings; it is "most important that tunnels provide two-way access between habitat on both sides of the roadway."(Dramstad 62) When placing a roadway bridge over a riparian corridor, Dramstad recommends locating the bridge supports in positions that leave dry land underneath the bridge on both sides of the waterway so that land species' movement beneath the bridge is uninterrupted. Leave the native vegetation intact to prevent a gap in the corridor. (Fig. 3.8)

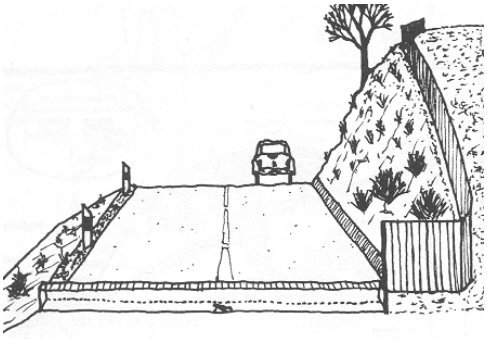


Fig. 3.7: Amphibian tunnel under roadway with drift fencing. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 62)

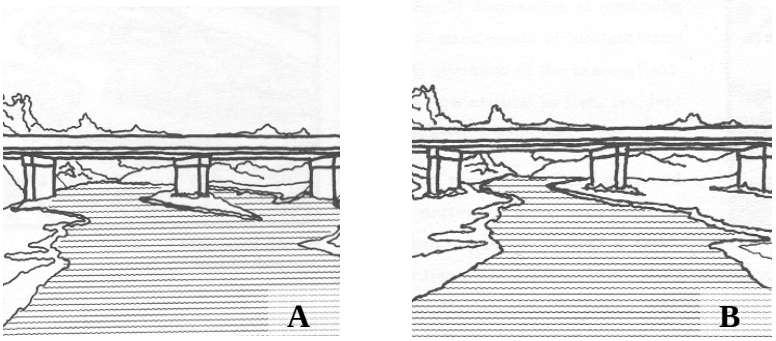


Fig. 3.8: A illustrates the wrong way to design a wildlife overpass: there is no dry land crossing underneath the span. **B** illustrates the correct way to design a wildlife overpass, where there is dry land on either side of the waterway. (From Dramstad, *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*, 55)

Dramstad provides an illustration of a study of deer habitat and the best placement of a housing development. The area is a mixture of forest and agricultural land, with a winding riparian corridor between the two primary patches of forest habitat. Extensions to the riparian corridor provide additional cover for the deer to move from patch to patch. Two roadways cross the middle of the site, on either side of the river corridor, and cut through forest and farmland. In Figure 3.9, site #3 would be the worst location for development because it not only reduces the primary deer habitat but also isolates one large patch from the other by introducing a break in the corridor. Site #2 would be undesirable because it is located on prime agricultural land. Site #1 is preferred because it is located on a previously isolated and small habitat patch that is not a part of the corridor, does not reduce primary patches A or B, does not interfere with the connection from A or B to the corridor, and is not located on prime agricultural land.

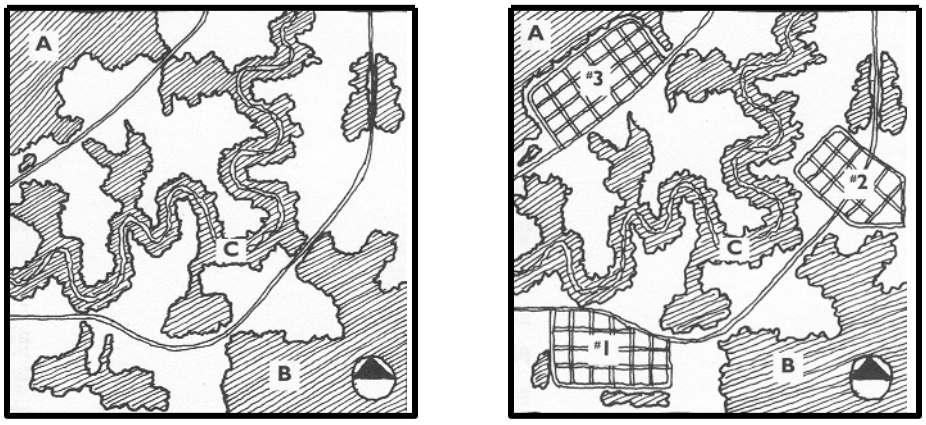


Fig. 3.9: Housing Developments and Deer. A and B are large habitat patches. C is a riparian wildlife corridor. Two roads run through the area, one on each side of the riparian corridor. 1, 2, and 3 are sites studied for possible housing development. Site 2 is located on prime agricultural land. Site #1 is preferred because it is located on a previously isolated and small habitat patch that is not a part of the corridor, does not reduce patches A or B, does not interfere with the connection from A or B to the corridor, and is not located on prime agricultural land. (From Dramstad et al. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning.* 65)

Clustering Houses to Create Habitat Patches in the Green Infrastructure

Clustering of houses within a development is a method that makes use of the least environmentally sensitive sites while preserving forested land, steep slopes, wetlands, valuable landscape features, wildlife habitat, and green space for community use. It also serves to reduce the net stormwater runoff into waterways. In clustering, individual house lots are smaller in size than those in standard suburban development. Infrastructure is reduced because fewer roads are needed for access to the houses. Houses are generally placed on streets that end in cul-de-sacs, which are then connected by walking and bicycle trails.

Many community designs today cluster houses to increase the overall amount of open space. Cul-de-sac arrangements work well with this and allow for extensions of wildlife habitat patches into or between the adjacent backyards. Placing the houses closer to the road leaves a wider strip of open space behind the houses while reducing the amount of paved area by shortening driveways. (Fig. 3.10) Optimum planning includes a

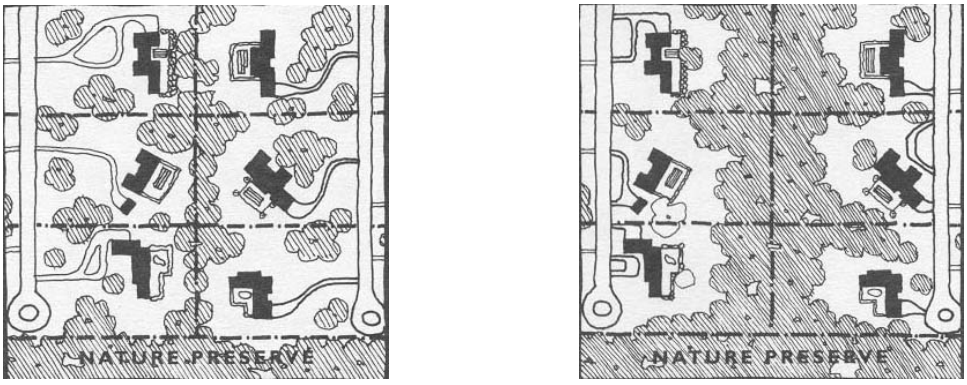


Fig. 3.10: On the left, houses are placed away from the road, resulting in more fragmentation of habitat and more infrastructure. On the right, houses are placed close to the road, reducing infrastructure and allowing for a more continuous extension of habitat between houses. (From Dramstad et al. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning.* 54)

provision for a continuous vegetated corridor of native plants between or included in the backyards. Not only does the presence of native plants provide the appropriate food and shelter for wildlife, but it also minimizes the threat of exotic plant species invading and displacing natives in the wildlife habitat. When a cul-de-sac is adjacent to a nature preserve, some designers avoid placing a house at the end position on the cul-de-sac.

Building Within Nature's Envelope as a Component of the Green Infrastructure

A growing number of designers and planners today are following nature's guidelines when deciding the best location for buildings and infrastructure in planned communities. The object is to disrupt as little as possible the natural topography of the land, its biodiversity, and its beauty. Darrel G. Morrison, FASLA, of the University of Georgia, wrote, "when we choose to develop sites that possess natural diversity and beauty, we need to practice on-site stewardship by minimizing the amount of disruption of that diversity and beauty."(Wasowski *x*)

Traditional development destroys most of the native vegetation and wildlife of an ecosystem, replacing "biotically rich and aesthetically rewarding landscapes" with "highly simplified or even dysfunctional landscapes that resemble too closely our generic, homogeneous suburbs."(Morrison in Wasowski *x*)

> Ironically, by the time the moving vans pull up to many ... newly completed homes, the beauty and character of the land – the very things that attracted the buyers in the first place – have been harmed or destroyed. Bulldozers have scraped the land clean of all vegetation, in many cases leveling the lots so that all traces of the original topographical features – arroyos, slopes, rock outcroppings, etc. – have been eradicated... What [the homeowners] haven't considered is that, aside from the tragic environmental loss, there is a real dollars-and-cents value to all that natural vegetation. Moreover, they have already paid for it. The established landscape was a major factor in the original evaluation of the property. If they had seen it denuded of vegetation, the price would

> assuredly have been much lower. But then they would not have even considered buying it.(Wasowski 3-5)

Then there is the expense of re-landscaping the property, and usually this is done with plants that have nothing to do with the natural habitat of the area. After that there is the ongoing nuisance expenditure of time and money on weed eradication, because the land has been scraped clean of its native topsoil, and this scraped-clean soil provides the favorite habitat for weed seeds. “Topsoil itself is a garden in microcosm. It contains soil bacteria and soil fungi that help a plant’s roots absorb water and nutrients. It contains the “seed bank,” in which seeds can be stored for decades until they are needed again... *When the topsoil is removed by bulldozer or erosion, future generations of native plants disappear along with its history, and the land is vulnerable to weeds.*”(Wasowski 33-4) To add insult to injury, the removed topsoil is often sold to soil businesses that sell it back to garden centers and landscapers. The topsoil that is brought in to the scraped-clean lot can contain seeds that are inappropriate for the site, as well as seeds of weed species.

The method of following nature’s guidelines for development addresses the problem from two scales. The first is the scale of the whole community. Ian McHarg addressed this problem with his layering technique for determining the most ecologically sensitive areas on a site so the buildings and infrastructure can be located only in areas that are least susceptible to harm. The second is the scale of the individual structure and its site. This is the scale at which the individual building is designed to fit the land, and the native plant materials are carefully preserved and protected during construction.

Andy Wasowski became interested in promoting the practice of building with minimal disturbance to the ecosystem. He found successful examples of the practice he calls “building inside nature’s envelope” nationwide, in individual houses and in planned

communities and “on all sorts of terrain, from woodlands to deserts to savannas to coastal scrub... Still, it became clear that these examples constituted a very small percentage of all the construction going on across the country – including in natural areas. And the vast majority of people in the building profession... knew nothing of this technique...” (Wasowski xvii) So Wasowski researched the subject and authored his book *Building Inside Nature’s Envelope*, in which he gives the fine details of how this is most effectively accomplished and also explains how this practice is more cost-effective than traditional methods. “Utilizing nature’s envelope adds approximately 5 percent to the total building costs. But... that is normally more than offset by eliminating the considerable expense of re-landscaping from scratch.”(Wasowski 76)

The basic idea for building inside nature’s envelope on the scale of the individual structure has three parts.

(1) Clear only a band of five to fifteen feet around the perimeter of the footprint; (Fig. 3.11)

(2) Design the structure to fit to the land rather than grading the land to fit the structure; and

(3) Preserve the native vegetation on the site, including the plants removed from the building footprint.

This may sound like a radical and inconvenient adjustment for the contractor, but in fact it has proven to be very workable. “I’ve talked to a number of builders who, after having successfully completed their first envelope project, are enthusiastic converts – for bottom line as well as environmental reasons.” (Wasowski xviii)

> Not only does the environment benefit from the careful planning and construction methods that protect functioning natural communities, but

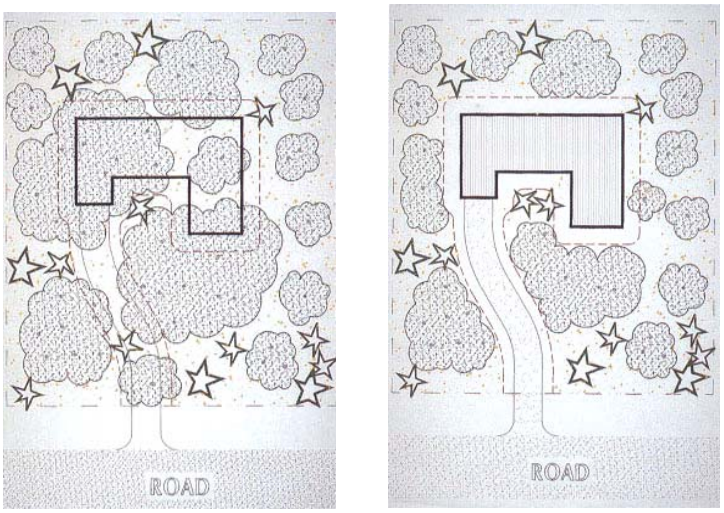


Fig. 3.11: Before and after illustrations of building inside nature's envelope: vegetation is cleared only for the footprint and a 5-15 foot strip around footprint. (Wasowski, *Building Inside Nature's Envelope*, 64)

> humans who occupy the resultant landscape benefit... from the shading and cooling effects provided by mature trees, from the natural erosion control provided by an intact ground layer of woodland or grassland herbaceous plant species, and the very real economic savings that are derived from not having to revegetate large areas or "landscape" in a traditional sense...landscape that is truly "of the place" within a few feet of the building, or finding joy in the knowledge that we humans can live in harmony with our natural surroundings and with other forms of life.(Morrison in Wasowski x-xi)

What kind of landscape is appropriate for building within nature's envelope? The established, mature, preserved natural landscape is where it is essential to use nature's envelope if you wish to build. Specific habitats include coniferous forests, deciduous forests, woodlands, chaparral, savannas, and deserts. Unfortunately, there is so little remaining prairie that the only way to have a prairie surrounding your building would be to restore it. There are other mid-western habitats that are so degraded with exotic plant species that, like the prairie, they would have to be restored. Land that has reverted from

agricultural use back to a state of natural vegetation, and other restored lands, are also good candidates for building within nature's envelope.

The preserved natural landscape is easy to maintain. It is perfectly adapted to the climate, including the natural cycles of rainy and dry seasons. Although weeds are increasingly a problem because of wind and water-borne seeds of invasive exotic species, the established preserved landscape supports fewer weeds as long as you are careful not to disturb the ground layer. "It requires minimal upkeep, it costs you virtually nothing, and it provides badly needed habitat for numerous species of wildlife that are declining in numbers because they are losing their feeding and nesting sites."(Wasowski 18)

Wasowski has determined the necessary steps for success in building within nature's envelope. Each of these steps should of course be adapted to each specific situation:

* The plant survey should be performed by a professional and should include inventory as well as health, special aesthetic features, wildlife uses, and sensitivity to construction disturbances; and it should identify noxious weeds. The plant survey will help in siting the building. For a qualified person to do the survey, contact the local native plant society, the botany department of a university, the Nature Conservancy, or a local arboretum. An arborist will know the trees but probably not the understory and ground cover.
* Select an architect or builder, and landscape architect, who are willing and enthusiastic about working within nature's envelope. It is not necessary for them to be experienced in the technique, but it is imperative that they understand and are

willing to meet your expectations. The architect will choose the contractor and ensure that he understands the technique.

* Get a topographical survey – your landscape architect may arrange this or recommend qualified surveyors.
* Mark off the footprint of the house and driveway where it will make the least negative impact on the land and save as much of the best vegetation and most interesting topography as possible. Do this with your architect, who will have good suggestions for making your building work with the topography.
* Determine the long-term effects of natural precipitation and flow of surface water on the vegetation and how the placement of the house, driveway, patio, etc. may alter this. This is of particular importance in arid zones. There are structural features, such as flow-through ports in patio walls, that can address various problems. Where tree roots are cut, supplemental watering will be required for a few years.
* Other factors: remember to look at the orientation of the house to the sun and views. Locate the infrastructure for the septic system, well, and other utilities as carefully as possible to minimize disturbance or removal of native vegetation.
* Divide Up the Property:
    (1) The private zone: The footprint of the house, driveway, parking, patio, pool, garage, etc.
    (2) The transition zone: 5 to 15 feet between the private and natural zones. For nature’s envelope to be effective, the smaller the better. Scaffolding is only 5 feet wide, so 5 feet should be ample room for workmen.

(3) The natural zone: It is imperative that this is fenced off and that workmen understand that absolutely nothing is to touch that area. Along the top of the fence run a tape printed with “do not enter, protected vegetation area”. This is available from Industrial Sign and Graphics, Charlotte North Carolina, telephone 800-824-7446.

* Mark the keepers using colored outdoor tape. You will need different colors for each category of plants. Mark plants that are to be preserved where they are; plants to eliminate; plants to move to a new location; plants to dig up and preserve off-site for later use. Make sure the architect, builder, and workmen are familiar with your color code.
* Save the topsoil from the private and transition zones and use it in the transition zone after construction is complete. This applies in all cases, even in deserts, no matter how thin a layer it may be.
* Re-plant the preserved plants that were saved from the private and transition zones.(Wasowski 55-76)

Wasowski also advises that your contract makes the builder responsible for protecting the plants from injury. He suggests that you put price tags on the plants to show subcontractors their value, which may be far above any replacement cost in cases where the plants are irreplaceable due to size or availability. These values should serve as liquidated damages amounts if the plants are injured.(Wasowski 67)

Wasowski gives further advice on preserving the vegetation. For the private and transition zones, he stresses the importance of hiring experienced and competent people to transplant or dig up and preserve plants for later transplanting. He

recommends hiring a nursery to preserve smaller groundcovers or collect seeds and grow new plants in flats. For trees that remain in the transition zone, fence them off around the drip line. For tree limbs that overhang the construction area it is not always necessary to cut them off. Some can be pulled out of the way with ropes for the time that they are in the way of the workers. When construction equipment must cross the drip line of a tree, a platform can be constructed to protect the roots.

For the arid regions of the country, Wasowski has recommendations for reducing the risk of forest fire:

* "Build in relatively mature woodlands with large, well-spaced trees and a high canopy.

* Clear away deadwood and other combustibles surrounding the house, both ground debris and dead branches on trees and shrubs. Needles from conifers ought to be left alone... A thick bed of needles will actually retard a fire, whereas a thin layer will burn much too quickly to pose any real threat.

* On the side of the house where winds are most likely to sweep a fire in your direction, create a fireguard – a patio or high masonry wall. And have ample water outlets installed.

* If you plant trees in the transition zone, choose those that are less likely to burn.

* Homeowners may elect to push the envelope line out farther."(Wasowski 74-75)

Russell A. Beatty, ASLA, has additional recommendations for reducing the risk of fire in arid zones. He recommends a transition zone of at least 30 to 100 feet or more around a structure; this zone width depends on the steepness of slope and density of the vegetation around the structure. Within this zone:

* Mow dry grasses to four inches after rains have ceased, usually in June.

* Remove dead and dry brush such as coyote brush (*Baccharis* pilularis) and chamise (*Adenostoma fasciculatum*); keep other brush under two feet tall.

* Remove excessive accumulation of dry leaf litter and duff.

* Thin out trees so canopies do not touch.

* Thin existing shrubs or plant new shrubs in widely detached islands.

* Remove highly flammable trees such as pines, other conifers, and blue gum eucalyptus.

* Raise the crown of trees to a minimum of 15 feet above grade to reduce the fire ladder effect; clearance over roofs should be 10 feet. Use species that do not have loose bark.

* Do not use invasive exotic plants that are highly flammable (broom, pampas grass, cotoneaster, and eucalyptus).

* "Plant fire-resistant trees, shrubs, and ground covers in the transition zone and in the landscape surrounding [the] house."(Beatty 65)

* Maintain the health of the plants to keep them fire-resistant. Young, vigorously growing plants contain more moisture and are more fire-resistant. Irrigation by a drip system, usually ½ inch of water per week in summer, is recommended for most plants.

* Low-growing, compact plants are more fire-resistant than taller, more open-structured plants.

* Beatty recommends a website of the Forest Products Laboratory at the University of California, Berkeley, for a list of plants and other recommendations for a fire-safe landscape: www.ucfpl.ucop.edu

* Replace wood fences with wire mesh fencing.

Note that Beatty's and Wasowski's recommendations for pines are contradictory. Beatty also has recommendations for site design to protect against fire:

* Enclose the understructure of cantilevered decks, houses, carports, and garages to eliminate draft, and use a firewall material.

* Set buildings 50 to 100 feet from the prow of the top of a hill, and construct a non-flammable wall at the top of a grass- or brush-covered slope.

* Do not site houses in or at the head of canyons or ravines. A ravine draws a fire upward. "Even radiant heat from a fire on the opposite slope across a

canyon can penetrate windows of a house and ignite the building from inside. In such a setting, the installation of retractable exterior metal shutters could be effective in protecting windows."(Beatty 65)

* Incorporate firebreaks: wide, paved paths; or fire-resistant vegetation, properly maintained.

Permaculture in the Green Infrastructure

In *A Permaculture Primer*, Dan Earle defines permaculture as:

> a practical concept applicable... from the city to the wilderness [that] enables people to establish productive environments providing for food, energy, shelter, material and non-material needs, as well as the social and economic infrastructure that support them. Permaculture means thinking carefully about our environment, our use of resources and how we supply our needs. It aims to create systems that will sustain not only for the present, but for future generations. From a philosophy of cooperation with nature and each other, of caring for the earth and people, permaculture presents an approach to designing environments [that] have the diversity, stability and resilience of natural ecosystems. This approach also addresses the need to regenerate damaged land and preserve existing ecosystems.(Earle on the "Contents" page, no page number)

Some components of permaculture that should be utilized by community planners are: using nature as a model; re-using already disturbed areas that have been abandoned; making a habit of restoration of ecosystems; efficient energy planning as regards sun and wind; considering geography, geology, and ecology to determine appropriate sites for development; preserving and restoring water quality; using plants that provide habitat and food for native wildlife; considering the individual and social needs of people; providing efficient, well-connected, and varied forms of transportation; providing ecological waste management for the ultimate goal of a no-waste system; and making communities as self-sufficient as possible. Many of these goals are consistent with the goals of the new trend

that is personified in the group called Smart Growth. (See Chapter 4 for more about Smart Growth)

American Gardener featured an article by Rick Darke, author of *The American Woodland Garden: Capturing the Spirit of the Deciduous Forest*. Darke says, "Today, though the notion of wilderness lingers as an ideal, in fact our hand is evident everywhere and 'all the world's a garden'. If that garden is to be eminently fit for human habitation while respecting the resources and requirements of other living communities, its making will depend partly on an understanding of ecological principles and partly on creative skills and techniques that are in the gardener's domain."(Darke *American Gardener* 48)

Using Native Plants in the Green Infrastructure

Native plants are essential to wildlife habitat. More and more landscape architects are incorporating natives in their planting designs. Some entire planned communities are limiting exotic plants to private courtyards, fenced backyards, or containers on private property, while they are banning the invasive exotic species altogether. Some are building within nature's envelope to preserve the native ecosystem, including the native plants, right up to within fifteen feet of the house. Some are requiring greenbelts of native vegetation between backyards and including large portions of the backyards. Where human development is adjacent to wildlife preserves, it is most important to prevent the spread of exotic plants into the wildlife habitat. "In landscapes undergoing suburbanization and consequent invasion of exotic species, a biodiversity or nature reserve may be protected against damage by invaders using a (buffer) zone with strict controls on exotic species." (Dramstad 44)

Stormwater Management in the Green Infrastructure

We all know that water pollution is a major problem for wildlife. A major pollutant is stormwater runoff. According to the Natural Resources Defense Council, one year of roadway runoff from a city of five million can contain as much oil as one large tanker spill, and “EPA studies indicate that as much as half of all pollutants in stormwater come from home landscapes,” wrote Maryalice Koehne.(Koehne 38) “As we build, we replace our natural landscape -- forests, wetlands, grasslands with streets, parking lots, rooftops, and other impervious surfaces. The effect of this conversion is that stormwater, runoff which prior to development is filtered and captured by natural landscape, is trapped above impervious surfaces and accumulates and runs off into streams, lakes, and estuaries, picking up pollutants along the way.”(smartgrowth.org) A city block produces nine times more runoff than a forest of the same area. Mature forests process rainwater at a very high rate, in part because of their spongy litter layer that absorbs and slows water runoff. “According to the EPA,” Koehne writes, “national forests alone are responsible for capturing and filtering the drinking water used by more than 60 million Americans.”(Koehne 38)

“In a permaculture design we try to capture, conserve and reuse water many times as it moves through our design. On an urban or suburban site this might be as simple as collecting water that runs off a roof for use in watering plants and trying to design the site so it has zero runoff.”(Earle18) Some planned communities are doing just this, and in doing so create new wildlife habitat within urban developments when they incorporate naturalistic filtering systems for rainwater runoff. These systems serve to retain the water that runs off of roofs and pavement and purify it as it percolates down to the water table.

Koehne, in *American Gardener*, describes the technique of using "rain gardens" to capture and clean storm runoff from built structures. Rain gardens may take the form of bioretention ponds, infiltration basins, stormwater marshes, and wet gardens. In residential areas rain gardens, or wet gardens, are located near the downspouts of roofs or in low areas near driveways. Composed of a shallow basin cut into the ground and planted with appropriate vegetation, the wet garden captures and filters pollutants from the rainwater runoff, while allowing much of the water to slowly percolate down through the soil to replenish watersheds and aquifers. "As an added bonus, these plantings attract and provide habitat for birds, butterflies, and other beneficial wildlife," says Koehne, "There is no single formula for creating rain gardens... If you have a steeply sloping lot or get a high volume of water flow during major storms, you may want to consult a landscape architect."

Koehne gives the basics of constructing a simple rain garden and gives advice about plant selection for varying degrees of moisture and sunlight. Landscape architect Jon Calabria also described different methods of constructing rain gardens in his presentation at the 2004 Cullowhee Conference on Native Plants in the Landscape . The simplest rain garden is a shallow bowl excavated up to eighteen inches deep, with a packed clay or gravel bottom. Plants are added according to their tolerance for wet soil and for drying out between wet periods. A clay bottom holds water longer. A gravel bottom allows the water to percolate through more quickly. Overflow pipes may be required for larger rain gardens such as those that drain parking lots.

A recent project at Prairie Crossing, a master planned community in Illinois, was the addition of rain gardens to collect the runoff from roofs. "Michael Sands, Prairie

Crossing's environmental manager, recently enlisted residents to share the cost of constructing rain gardens, which involve redirecting roof downspouts to a slight depression excavated between houses. The depressions range from 200 to 500 square feet in area, depending on the site. Most are surfaced with native clay to retain water, but others are lined with pea gravel to allow water to infiltrate the soil. After construction, the rain gardens are planted with a variety of moisture-loving native species." (Kane 156)

Koehne describes several suburban runoff projects that work to retain rainwater in the soil. She wrote, "In Seattle [Washington], they're part of a 'Salmon Friendly Gardening' program, while in Maryland they are being promoted as a way to 'Save the Bay'." In Seattle, the Street Edge Alternative for subdivisions is a program that has city agencies planting trees, shrubs, perennials, groundcovers, and wetland plants in drainage ditches along the streets. They work with the homeowners for plant selection, the city does the planting, and then it is the homeowners' responsibility to maintain the plantings. In St. Paul, Minnesota, a neighborhood association and the city worked together to funnel stormwater runoff into a 900-square-foot rain garden to protect a restored wetland along the Mississippi River from runoff. "In Milwaukee, a new law will require 45,000 homeowners and businesses to disconnect downspouts from sanitary sewers."(Koehne 41) Alternatives will be rain gardens, green roofs, rain barrels, roof restrictors, and increasing the tree canopy. This will eliminate the dumping of sewage into creeks, the Milwaukee River, and Lake Michigan during sudden heavy rainstorms. Many municipalities, botanical gardens, and businesses are turning to rain gardens to absorb parking lot runoff. Even the catch basins in parking lots can be modified into an infiltration trench to assist in water filtration before the water moves on to the rain

garden. Jon Calabria described his technique for constructing an infiltration trench that filters water while it beautifies the parking lot. (Fig. 3.12)

His method first involves grading the lot so the water flows toward a strip between facing parked cars. This strip is excavated as a trench; geotextile is placed along the clay bottom; perforated drainage pipe is placed in the bottom and leads to the rain garden pond; filter fabric is placed over the perforated pipe; eight to ten inches of gravel

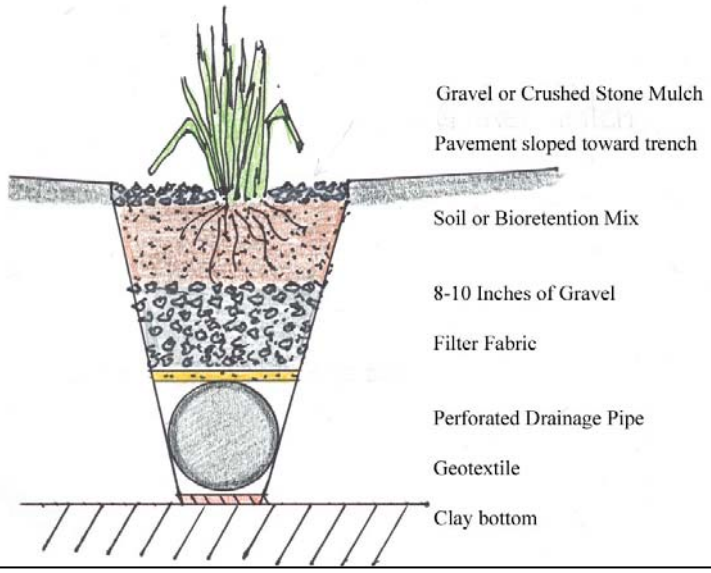


Fig. 3.12: Structural layers of infiltration trench for parking lot runoff.

is placed over the filter fabric; native soil or a bioretention mix is then filled in to near the top of the trench; plants are planted in the soil; gravel or crushed stone is used as mulch. After flowing past the roots, through the soil and gravel and finally into the pipe, the rainwater goes on to the rain garden-infiltration basin to be returned to the water table in a purified condition. Calabria showed a particularly attractive planting design that

incorporated a fence with native wisteria trained on it and smaller perennials covering the ground.

Stormwater management in a planned community also involves careful placement of buildings and infrastructure. Sometimes low berms are built across slopes to slow the movement of water and prevent erosion. “On larger sites we may go to greater extremes to store and control water flow and erosion. Water may be stored in the soil, infiltrated by earthworks, held in ponds... or retained in biological systems... The concept of water use is to collect it and connect it across a site using combinations of dams, terraces and swales to control flow.”(Earle 18) Clustering of houses within a development also has a beneficial effect on overall reduction of pollution by stormwater runoff. “Runoff can be reduced through clustering of development, thereby leaving larger open spaces and buffers. Although compact development generates higher runoff and pollutant loads within a development, total runoff and pollutant loads are offset by reductions in surrounding undeveloped areas.” (smarthgrowth.org)

Green Roofs for Water Purity and Green Infrastructure

Green roofs are being added to buildings in many cities in the United States and Europe for the purpose of purifying the air and reducing the heat island effect created by cities. A green roof is a roof that grows plants. It is not the same as a roof garden, and it is not necessarily designed for walking and other human use. It is not necessarily flat. Its benefits include reducing of pollution in stormwater runoff by eliminating the impurities that are added to runoff by a conventional roof; reducing air pollution and carbon dioxide by plant respiration; providing habitat for some native plants and some wildlife species such as birds and pollinators; reducing heating and cooling costs for the building, and,

consequently, reducing air pollution through lowered use of energy for heating and cooling.

Green roofs do require a knowledgeable specialist for installation. (Fig. 3.13)

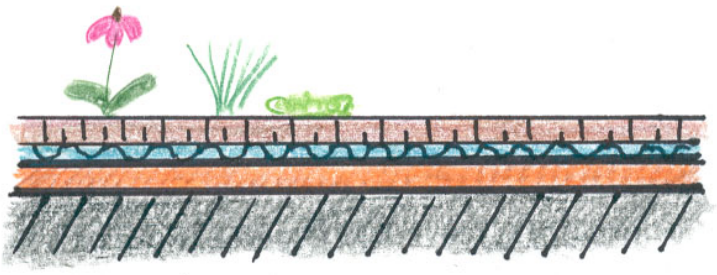


Fig. 3.13: Basic layers for a green roof. The soil retention grid is required only on a sloped roof.

Suitable plants are those that thrive in the sun, thrive under the normal climate conditions of the location, and are not deep-rooted. They do not require watering, fertilizer, or mowing. They range from mosses and cacti to prairie flowers and grasses. I would not recommend a green roof in a location where many leaves would accumulate in the autumn. Because of this the most effective use for green roofs is probably on city buildings.

> The Green Roofs of Berlin: In Berlin, people have planted gardens on many large rooftops... Not the ones planted in soil over a foot deep. They require intense watering of ordinary bushes, flowers, or even vegetables. But roof gardens that have shallower soil and take little maintenance would make ideal targets for reconciliation. None of these gardens is watered, fertilized, or mowed. They come in three soil depths. Roof gardens with less than two inches of soil have mosses. Those with two to four inches grow fleshy-leaved colorful *Sedum* species. And those with four to six inches support grassy mini-meadows.(Rosenzweig 24)

Reconciliation Ecology in the Green Infrastructure

Ecologist Michael Rosenzweig is enthusiastic about a concept he calls "reconciliation ecology", which he defines as "the science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work, or play." He emphasizes that reconciliation ecology is not a replacement for wildlife reserves and habitat restoration, but an additional benefit we can provide for wildlife in need of conservation. "We must diversify the habitats of our surroundings instead of creating, as we now do, the very limited number of habitat architectures that we have come to like. Every front lawn need not look like a golf course. Every city park need not look like a savannah. Every schoolyard need not look like a desert."(Rosenzweig 7)

Green roofs are one example of reconciliation ecology. Golden Gate Park, in San Francisco, California, is another example.

> Golden Gate was invented by humans. It began as a system of sand dunes. Humans created its meadows, and keep them mowed. Humans dug and lined its ponds, filled them with water, and then introduced about eleven species of waterfowl, mostly exotics. Humans planted its trees and shrubs, many of them also exotics. Golden Gate Park is as much a fantasy as Versailles! But the spirit of Golden Gate Park is not the spirit of Versailles. Versailles flaunts its unreality proudly; Golden Gate Park conceals it deceptively. We have good company in being deceived by Golden Gate Park. Many [native] species of birds also see it as a set of natural habitats.(Rosenzweig 22)

When we design our urban parks, wildlife will benefit if we follow the lead of Golden Gate Park. Of course, today we would not add invasive exotic species. "No one will cry interference if we help the song sparrows by allowing a few more shrubs in the understory around the ponds. And no one should mind if more vegetation overhangs the ponds to help the kingfishers and the black phoebes... Versailles is extraordinary and

should remain so. But let us make our Golden Gate Parks a commonplace."(Rosenzweig 24)

Rosenzweig's most innovative example of reconciliation ecology is a restaurant built underwater and designed for coral to live on its exterior surface. People enter by elevator and while they dine they look out on an astounding scene of tropical fish and corals in their native habitat.

I found an interesting example of reconciliation ecology in Louisiana. Louisiana State University's Red River Watershed Management Institute, in Shreveport, is hopeful about a new mosquito control tool: attracting bats by constructing artificial caves from used giant tires. Southwestern Electric Power Co. has had a problem recycling the tires of its earth-moving equipment and hopes this will be the solution to the problem. The tire is called "Big Bertha" and has a tread of 42 inches, a diameter of 100 inches, and an interior opening of 45 inches. The entrance to the cave is constructed of a 30-inch diameter steel culvert, fitted with a custom-made "bat gate," and will be the only visible portion of the cave. They are expecting it to take up to a few years for bats to discover and move into the caves. There are no natural caves in northern Louisiana where bats normally inhabit hollow trees. The Institute will be monitoring and controlling the internal temperature of the cave to be certain it is appropriate for the bats.

More everyday examples of reconciliation ecology are the creation of backyard habitat for wildlife and replacing lawns with more diverse species that provide habitat while reducing the need for watering and eliminating the need for mowing.

Lawns: A “Non-Component” of the Green Infrastructure

Andy Wasowski describes our attachment to lawns as a “love affair.” Indeed it seems that most of us are totally entranced with the look of the lawn or the lawn-centered landscape. Wasowski recognizes that for all of history, from Europe to the Far East, we have valued the lawn-centered landscape. He also feels that the desire for residential lawns began to accelerate with the advent of landscape designs such as those by William Kent and Lancelot “Capability” Brown. Then came landscape architect Frank J. Scott, who, in 1870, published *The Art of Beautifying Suburban Home Grounds*. It was the dawn of suburbia, and this instant best seller was designed especially for the throngs of new suburbanites who were dealing with yards of their own for the first time. In it, Scott told homeowners, “A smooth, closely shaven surface of grass is by far the most essential element of beauty on the grounds of a suburban home.”(Wasowski 19)

It seems our fascination with lawns, or at least with open expanses of grass, does indeed go back to earliest time. Rosenzweig writes of a study of human habitat preferences conducted by ecologist Gordon Orians and psychologist Judith Heerwagen:

> They showed a lot of people a lot of pictures and asked them to rank their attractiveness. What they discovered... First in our hearts comes a grassy savannah habitat. A few trees growing in a rather open vista satisfies us at some deeply subconscious level... we prefer our trees with several trunks, or at least with only a short trunk topped by a wide branching structure (perhaps to give us shelter from sun or rain). Orians guesses that multi-trunked trees may also be easiest to climb should we be surprised by the odd lion prowling the grassland for a tasty 100-pound morsel... They also discovered that we exhibit slightly different habitat preferences depending upon our sex. Men prefer the more open vistas of the savannah. Women like a more sheltered, lightly wooded corner. Orians and Heerwagen had actually predicted these differences based on the likelihood that primitive people were hunter-gatherers, with men emphasizing the hunting and women the gathering. Of course, we like water, too. So we want our savannah on the edge of a lake or a river. And we want it full of grazing animals like deer or sheep... And we love flowers.”(Rosenzweig 17)

Carole Rubin, author of *How to Get Your Lawn Off Grass*, found that the same differences exist today between men and women. She conducted a survey of two hundred Canadian men and women to determine how they valued their lawns and how they would feel about replacing their lawns with native trees, shrubs, flowers, grasses, and ground covers. She found that the lawn gave 78% of men a sense of pride, peace, and beauty, and 87% of men were horrified at the idea of doing away with their lawns. For women, the responses contained less emphatic language than the men, but 58% indicated that the lawn was too much work or never looked good, while the other women were proud of their lawns. When asked about replacing the lawn with native vegetation, 82% of the women thought it would be wonderful and a good challenge.

In spite of our natural instincts to create a lawn, we must not lose sight of the benefits of vegetative alternatives to the lawn. "What is the significance of human habitat preference? Just this: Very few species like what we like. In fact, very few can even survive in the habitats we like."(Rosenzweig 17) For that reason many people today are using native plants in their yards to create a little piece of wildlife habitat. People are also attracted by the lower maintenance requirements of native plants. "Plants that are native, or indigenous, to the locale in which they are being used... have adapted over the millennia to the soil conditions, the temperatures, and the rainfall of the region. They are genetically encoded with all the information they need to exist in those conditions. In addition, they have, over time, developed a harmonious and synergistic relationship to their habitat – both plants and animals."(Wasowski 14) Carol Rubin and others are promoting the transformation of lawns to native species of trees, shrubs, flowers, grasses, and ground covers because of the food and shelter benefits to wildlife and also because of

increasing water scarcity, the pollution of water by lawn treatments, and the pollution of air by lawn equipment. An added benefit is the lower cost of maintenance, both in money and in time.

What about the neighbors? "People can be quite pushy about their preferences. Consider the covenants and restrictions attached to many people's homes. Keep your grass mowed. Keep weeds out."(Rosenzweig 18) Rubin recommends that you talk to your neighbors and local officials before you begin so you can let them know what you are doing and why. You can educate them about the ecological benefits. Rosenzweig cites an example of a botanist who won over his complaining neighbors by educating them about the natural history of the wildflowers in his yard. He was so effective that some of the neighbors began incorporating wildflowers into their yards. Do a small portion of your lawn at a time, gradually over time, so the neighbors can adjust to the change. Dress it up to give structure to the edges – a decorative fence, a hedge, or brick edging. Put up a sign that says "Butterfly Garden," "Bird Sanctuary," or "American Prairie Garden." Incorporate paths, benches, birdbaths, bird feeders, and sundial. Make small clearings covered with low groundcovers. Felder Rushing, who also spoke at the Cullowhee Conference, recommends yard art mixed in with your vegetation, made as zany as you like. Do not preach to your neighbors to try to convert them to native landscaping, whether they admire your yard or detest it. They are entitled to their own opinions and style of gardening.

Backyard Habitat: A Component of the Green Infrastructure

Of all the descriptions of the value of a backyard wildlife habitat, I have found none more beautiful than the words of Sally Roth, author of *Natural Landscaping: Gardening With Nature to Create a Backyard Paradise*:

> My garden evolved from a traditional semiformal showpiece to a place of wilder, natural beauty. Because I used Mother Nature's plantings as a guide, my garden quickly became an inviting habitat for birds, butterflies, toads, incredible insects, and a host of other fascinating creatures... By being able to observe at close range, without making a special trip, I learned wonderful things – how birds weave grasses, how rabbits pull fur from their chests to line their nests, how hummingbirds collect spider silk, how bugs fight to the death, how plants create their own territories... The list is endless, because the natural world is full of constant surprises... When I see the multitude of life that this little garden nurtures and protects, I can't help wondering 'what if.' What if there were a million drops in the bucket? What if every subdivision made the switch to natural landscaping? What if every city street held a secret garden full of these wild things? It took just one year for indigo buntings to discover this place. It took three years for meadowlarks to return to the hill just behind this house, where once they nested by the dozens.(Roth 9)

The concept of a backyard wildlife habitat is very similar to that of eliminating the lawn. However, a backyard or front yard habitat can include a portion of lawn. Well known across the country as a promoter of the backyard wildlife habitat, The National Wildlife Federation appreciates anyone who sets aside even a very small portion of his garden for wildlife habitat.

> Wisely, the [National Wildlife Federation's] backyard wildlife habitat strategy does not ask us to abandon our properties to wild things. In fact, if you scan its landscape designs, you will see that each one pays attention to the needs and desires of people. It harmonizes our image of a perfect habitat with those of many other species. Sometimes it accomplishes this by setting aside small patches of lawn overshadowed by shade trees and harboring a comfortable bench or two in the midst of the lawn. Or sometimes it calls for a pleasant pathway to thread through a patch of woodland. Again, we detect in the backyard strategy both the absence of dogmatism and the desire for reconciliation. Backyard habitats may be

> patches of nature, but they are also homes for their owners.(Rosenzweig 21)

The components of a backyard habitat are simply food, water, cover from predators, shelter from the elements, and places to rear young.

Native plants provide fruits and seeds appropriate for birds and small mammals. Food is also available in the form of insects when we avoid using pesticides. Pesticides kill many harmless and beneficial insects as well as the pests. It is better to get rid of an infested plant than to use pesticides. The leaves of some plants are the food for insects such as butterfly larvae, or caterpillars. Pesticides kill butterflies and their larvae. Systemic pesticides in newly purchased plants have wreaked havoc on monarch caterpillars in my own yard. Some non-invasive exotic plants can also be a part of the wildlife habitat garden, particularly those that are provide nectar for butterflies and hummingbirds, and may be especially useful in areas where we have difficulty getting natives to grow in soil that was altered during construction of the houses.

Water for wildlife can be provided in the form of ponds and birdbaths. Naturalistic ponds constructed in the ground provide drinking water and living habitat for more species than above ground ponds. A naturalistic pond should be deep enough at its deepest area to prevent freezing to the bottom in winter. It should have gently sloped edges for wildlife access. It should be planted around the edges with aquatic and wetland plants, and it should have some shrubbery or trees close enough to create a shady area for temperature moderation in the heat of the summer. For a larger pond a bridge or deck can provide shade over a portion of the pond. Birds, butterflies, and some other creatures can use an above ground pond. It must have structures such as rock piles along the inside edges for amphibian and reptile escape and structures for birds to stand on while they

drink. A smooth, rounded edge will not do. For butterflies and other pollinators it should have a rock or gravel area that is barely wet with water.

Shelter from the elements and cover from predators in a backyard habitat take the form of shrubbery, small trees, rock piles, brush piles, bird, butterfly, and bat houses, and, where the space is available, hollow trees or logs. Native, clump-forming grasses provide passageway and shelter for ground-feeding birds and small mammals whose numbers have suffered since the introduction of turf grasses.

Places to rear young include cover from predators but may be more specialized because of specific dietary needs of the young. Butterflies, for example, don't "rear" their young, but they do lay their eggs on the plant species that will nourish their young. Trees and shrubs, nest boxes, hollow trees, rock piles, and holes excavated in the ground or in trees, are some of the places where birds, mammals, and reptiles can rear young. Amphibians, of course, need water with safe access and egress, such as a gently sloped and vegetated edge to a pond or a rock pile on the inside edge of an aboveground pond.

When thinking of native plants, many people overlook the value of native grasses to wildlife. In "The Grass is Greener When You Grow Natives," Cubie writes that native grasses are beautiful plants that require minimal care and provide food and nesting materials or cover for wildlife. Some homeowners are using native grasses for lawns, others in their perennial beds, pocket prairies, meadows, or alone for ornamental effect. "Butterfly caterpillars often overwinter at the base of bluestem clumps. Turkeys, doves and many other species of birds devour the seeds... Today, switch grass and bluestem... are wonderful plants for wildlife. Switch grass is especially valuable as winter cover for birds and small mammals because it stays upright even during heavy snow or sleet...

Bunch grasses are often better for wildlife [than turf grass]... native bunch grasses leave spaces where ground-nesting birds can put their nests and other wildlife can take a dust bath."(Cubie "*Grass*" 10-12) Bunch grasses allow meadow voles and other small mammals to travel easily through a field. Buffalo grass is the recommended native for lawns in the drier parts of the Midwest and western states; it is durable and tolerant of extreme heat and drought. "It also withstands the onslaught of insect pests because it harbors many beneficials, such as big-eyed bugs and lady beetles, which naturally control harmful insects."(Cubie "*Grass*" 12)

Sally Roth changed her showplace flower garden to a wildlife garden when she realized her best leisure time was spent walking through nearby woodlands and field to observe the wild creatures there.

> Then came the summer when the common milkweed I'd planted... threatened to swamp the irises and hardy geraniums. Ready to do battle, I waded in among the thicket of milkweed stems, only to find that the leaves were hung with magic green lanterns, the small, ethereal chrysalises of the monarch butterfly. A few flashy striped caterpillars were still munching on the big oval leaves. Of course I couldn't pull out the milkweed. Instead I moved the sissy plants to another area, and I let the milkweed overtake that patch of the garden. I moved in some equally feisty goldenrod, ironweed, asters, and beebalm – all of them from our wild field – and before long I had a new favorite part of the garden.(Roth 8)

In *National Wildlife*, Cynthia Berger described the experiences of some homeowners who transformed portions of their yards into wildlife habitat. In Selma, Indiana, Jim and Judy Lambert restored a portion of their six acres to tallgrass prairie using big bluestem, little bluestem, Indian grass, gamma grass, and compass plants. Evergreens and fruiting trees near the house provide shelter and food for songbirds and small mammals. They restored a patch of wetland that had previously been plowed under, and added "a large pond that attracts sora rails, double-crested cormorants, wading birds

and nesting Canada geese."(Berger 32) Another participant in the Backyard Habitat program was quoted as crediting his backyard wildlife garden for the rapid resale of each of his three previous homes. Even a tiny yard has space for a wildlife garden, as illustrated by a resident of Arlington, Virginia, who restored the postage-stamp sized yard of his rental house with more than twenty native species, including columbine, white wood aster, bleeding heart and wild geranium, all collected from plant rescue sites and friends' gardens. He said, "In last summer's drought, my natives did better than my neighbors' ornamentals."(Berger 34) Even his landlords are very pleased with his garden.

Unfortunately, backyard wildlife habitats may sometimes be misunderstood and result in complaining neighbors. The same strategies can be applied to backyard habitats as for front "ex-lawns." It is important to take these precautions from the beginning rather than wait for neighbor complaints.

Chapter 4: Putting an End to Urban Sprawl

Fig. 4.1: Frank and Ernest comic strip used with permission of Bob Thaves.

The primary reason for wildlife habitat destruction and fragmentation is urban sprawl, as discussed in Chapter 2. Controlling sprawl is a top priority for concerned people with a variety of backgrounds and occupations from urban planners and developers to environmentalists.

A leader in the movement to control urban sprawl is a group called Smart Growth. The Smart Growth Network is a partnership between the United States Environmental Protection Agency and several non-profit and government organizations. These organizations include local and state governments, environmental groups, developers, real estate interests, historic preservation organizations, and professional organizations. The network was formed in 1996 “in response to increasing community concerns about the need for new ways to grow that boost the economy, protect the environment, and enhance community vitality.”(smartgrowth.org)

> In communities across the nation, there is a growing concern that current development patterns -- dominated by what some call "sprawl" -- are no longer in the long-term interest of our cities, existing suburbs, small towns, rural communities, or wilderness areas. Though supportive of growth, communities are questioning the economic costs of abandoning infrastructure in the city, only to rebuild it further out. Spurring the smart growth movement are demographic shifts, a strong environmental ethic,

> increased fiscal concerns, and more nuanced views of growth. The result is both a new demand and a new opportunity for smart growth.(smartgrowth.org)

Concerned about the issues of economics, environment, health, housing, transportation, and quality of life, Smart Growth promotes the concept of compact, mixed-use development planning and the following ten principles:

* Create a range of housing opportunities and choices
* Create walkable neighborhoods
* Encourage community and stakeholder collaboration
* Foster distinctive, attractive communities with a strong sense of place
* Make development decisions predictable, fair, and cost effective
* Include mixed land uses
* Provide a variety of transportation choices
* Strengthen and direct development towards existing communities
* Take advantage of compact building design and efficient infrastructure design
* Preserve open space, farmland, natural beauty and critical environmental areas

The idea of permaculture goes along with the goals of Smart Growth. People cannot go on gobbling up farmland and forest for residential use. They cannot go on building on flood plains and in sensitive wildlife habitats. In North America since World War II, suburban sprawl has become the standard pattern of growth. Yet this pattern could not continue even if there were no negative economic or quality of life ramifications from suburban sprawl. Consider that the traditional, mixed-use neighborhood “continues to be the dominant pattern of habitation outside the United States, as it has been throughout recorded history.”(Duany 4) Then consider what would happen if the rest of the world emulated the sprawl pattern of the United States:

> If the present world population of 5.8 billion people were to live at current North American standards of 4.5 ha/person the productive land requirement would be 26 billion hectares. But, there are only 8.8 billion hectares of ecologically productive cropland, pasture or forest on earth.

> That is, we need two additional planets at least as productive as Earth to accommodate all its people at a level that less than twenty-five percent of us enjoy today. If population was to stabilize at 10-11 billion in the next century, five additional Earths are needed.(Earle 48)

In *Suburban Nation, The Rise of Sprawl and the Decline of the American Dream*, Duany et al wrote, "Unlike the traditional neighborhood, sprawl is not healthy growth; it is essentially self-destructive. Even at relatively low population densities, sprawl tends not to pay for itself financially and consumes land at an alarming rate, while producing insurmountable traffic problems and exacerbating social inequity and isolation."(Duany 4) Duany et al distinguish the structure of the traditional urban neighborhood from that of urban sprawl with the five basic components of urban sprawl: housing subdivisions, shopping malls, office parks, civic institutions, and roadways. The problem is that "while one component may be adjacent to another, the dominant characteristic of sprawl is that each component is strictly segregated from the others."(Duany 5) Walking to schools, to work, or to the grocery for a few items is not a part of the plan and can be unpleasant or even hazardous. The result of this segregation of components is the need for a massive infrastructure of roadways, parking lots, and miles upon miles of underground pipelines and conduits. On the other hand, in the traditional urban neighborhood we see "a sustainable form of growth" in "mixed-use, pedestrian-friendly communities of varied population, either standing free as villages or grouped into towns and cities."(Duany 4)

There are multiple perspectives on the problem of urban sprawl – its social effects, its economic effects, and its effects on the quality of human life, on air and water quality, and on wildlife habitat. Environmental groups and many urban planning activists are in agreement that our sprawling, automobile-oriented cities are largely responsible not

only for air and water pollution and global warming but also for wildlife habitat destruction and fragmentation.

> "As development moves further and further to the metropolitan fringe it competes with open space habitat and prime farmland. Loss of open space impacts the environment in multiple ways. First, we lose many of the natural landscape features we value -- forests, wetlands, etc. Second we lose the functions that these features provide -- runoff control, wildlife migration, etc. And in the instance of farmland loss we hasten the use of lesser quality soils for production; thereby heightening conversion of forest and wetlands for crop production; and increasing dependency on irrigation, fertilizers and chemicals."(smartgrowth.org)

The most frequently recommended solution to curbing urban sprawl is to reuse already disturbed areas. "Despite the declining availability of relatively unspoiled land and the wasteful way sites are conventionally developed, existing built areas are being abandoned and new development located on remaining rural and natural areas. This cycle must be reversed. Previously disturbed areas must be reinhabited and restored, especially urban landscapes."(Andropogon Associates in Earle 7)

New towns are frequently built today for the purpose of eliminating commuting. Their designers hope to achieve this purpose by including offices, businesses, schools, and recreation facilities within the town to provide for residents' daily needs. Duany et al are successful at designing such towns, but they emphasize "new towns are not always the answer. The appropriateness of a greenfield development depends on the particular characteristics of the surrounding region."(Duany 184) If the region is not growing sufficiently in population and wealth, a new town will only drain the inner city of residents and businesses and result in wasteful construction of new infrastructure. However, automobile-based urban sprawl is still rampant. "Conscientious designers are faced with a difficult choice: to allow sprawl to continue without intervention, or to

reshape new growth into the most benevolent form possible."(Duany 185) Until the trend for unjustified greenfield development is reversed, "designers should endeavor to ensure that what gets built on the urban fringe is as environmentally sound, economically efficient, and socially just as possible."(Duany 185)

By curbing urban sprawl we will preserve open space not only for the preservation of critical environmental areas and wildlife habitat, but also for recreation, for keeping prime farm and ranch lands available, for preventing flood damage, for erosion control, and for providing a natural filter system to prevent trash and pollutants from entering ground and surface water supplies.

Public Opinion on Open Space

One purpose of curbing urban sprawl is to preserve open space. "Open space" is a term used today to denote a variety of land uses that include natural areas, parks and recreation areas, waterways, and wildlife habitat.

> Urbanization proceeds by increasing the density within and extending the periphery, always at the expense of open space. As a result – unlike other facilities open space is most abundant where people are scarcest. This growth, we have seen, is totally unresponsive to natural processes and their values. Optimally, one would wish for two systems within the metropolitan region – one the pattern of natural processes preserved in open space, the other the pattern of urban development. If these were interfused, one could satisfy the provision of open space for the population. The present method of growth continuously preempts the edge, causing the open space to recede from the population center.(McHarg 57)

For many Americans open space is a highly valued but too scarce commodity. "There is growing political will to save the 'open spaces' that Americans treasure. Voters in 2000 overwhelmingly approved ballot measures to fund open space protection efforts. The reasons for such support are varied and attributable to the benefits associated with open

space protection. Protection of open space provides many fiscal benefits, including increasing local property value (thereby increasing property tax bases), providing tourism dollars, and decreasing local tax increases (due to the savings of reducing the construction of new infrastructure)." (smartgrowth.org)

In the state of Illinois, a recent General Assembly task force on urban growth observed that "poorly coordinated growth and development often threaten natural areas and open space."(smartgrowth.org) Illinois has a program called the Open Lands Trust which was developed to acquire and protect wetlands, woodlands, prairies, and urban greenways. The program was limited to a duration of four years, after which time it would be reconsidered for renewal or replacement.

In May of 2003 the state of Illinois conducted a study to determine what value people put on open space and whether voters would approve continuing the Open Lands Trust program and creating a permanent funding source for protecting open spaces. The report, entitled Public Attitudes Towards Open Space: The Unmet Demand for Open Space in Illinois, can be found at the website of the Illinois Department of Natural Resources. The study was conducted by the University of Illinois (Department of Leisure Studies), Illinois Natural History Survey, and the Illinois Department of Natural Resources (study funded by the Illinois DNR and Illinois Association of Park Districts). The study included analysis of statewide surveys by the DNR and by the Illinois Association of Park Districts as well as an evaluation of local ballot initiatives.

"In developing the [DNR] survey there was the concern that 'open space' may not mean the same to all people... it was clear that the survey needed to provide specific guidance regarding the meaning of open space. Open space was explicitly defined in this

survey as ‘natural areas, parks and recreation areas, wildlife habitat, and lakes & streams; agricultural lands are not included as open space in this questionnaire.’” (Illinois DNR web site) The results of the study showed that people put as high a value on open space as on other major urban issues: 70% feel that protecting natural areas is important, and 90% feel that protecting water quality is important, while crime prevention gets 85% and road improvements 71%. “Furthermore, when asked to choose the most important issue their communities face, respondents selected managing growth and new development most frequently. Urban growth typically encompasses protecting open space and water quality, as well as other issues such as traffic congestion and urban infrastructure.”(Illinois DNR web site)

The Illinois study also looked at people’s reasons for valuing open space. “The most significant reasons given by those respondents who expressed an opinion are the following: 56% of people find open space to be important to their quality of life (only 14% said it was not important). Losing open space to development is a significant concern – 82% believe we need to acquire open space before it is lost to development. 92% believe we need to preserve open space to protect wildlife habitat... 88% say that open space enhances property values.”(Illinois DNR web site) When questioned about what types of open space people want, the response was for “undeveloped open space such as natural areas, stream corridors, forest, wetlands, wildlife habitat and state parks and developed open space such as community or neighborhood parks and walking trails.”(Illinois DNR web site)

The Illinois study concluded that “the public generally views open space as an important aspect to their community and are supportive of acquiring more open space. A

strong majority of respondents see open space as a key component of their quality of life. Respondents also understand the need for open space to provide wildlife habitat and that we need to protect what remains before it is lost to urban development."(Illinois DNR web site)

Chapter 5: Examples of Master Planned Communities and Other Developments That Protect Wildlife

Today, many master planned communities are setting aside dedicated wildlife preservation areas. In some cases, these areas preserve isolated wildlife habitats and native species that can survive when their habitat is in close proximity to humans. In other cases the preserves are connected to other natural greenways so that they provide an extension to the wildlife corridor. Some planners are actually restoring acreage to its former natural state to create wildlife habitat.

In addition there are many master planned communities that are building within nature's envelope. As described in Chapter 3, "building inside nature's envelope" is the term coined by Andy Wasowski for the process of selecting the building-footprint and infrastructure locations and preservation of the native vegetation on a site. Some master planned communities have very successfully utilized the concept of building within nature's envelope.

The master-planned communities described herein were planned with careful attention to wildlife preservation, by preserving, protecting, or restoring wildlife habitat, or by building within nature's envelope. These communities have used additional conservation techniques, such as stormwater management, clustering of houses, and making communities walkable, which were discussed in Chapter 3.

Master-Planned Communities and Residential Developments that Preserve Lands for Wildlife Habitat

Bonita Bay (Fig. 5.1), in Bonita Springs, Florida, is remarkable in several ways. First, in its success in protecting wildlife – there is a bald eagle nest on the site that has successfully reared twenty chicks in the past thirty years. Remarkable as well is the fact that this successful community was planned very early in the movement to protect wildlife in master planned communities. Finally, and amazingly, the community was the brainstorm of a man with no professional training or experience in planning, developing, or design. Yet he envisioned a "self-contained ecological sanctuary... where people and nature could live harmoniously." (Gause 41) The man was David Shakarian, chairman of Bonita Bay Properties, and he began buying the land in 1979. Today Bonita Bay covers 2,400 acres of land. When Shakarian died in 1984, his son-in-law David Lucas took over his position as chairman and began to build Shakarian's dream community.

Figure 5.1: Bonita Bay Master Plan **(**Gause, *Great Planned* Communities, 43)
Planner: Wilson Miller, Naples, Florida

The site was completely unspoiled and featured "a range of delicate ecosystems, from fresh- and salt-water marshes to mangrove stands, hardwood hammocks, a pristine river, and a creek." (Gause 41) To a large extent Bonita Bay is a community that was built within nature's envelope. During the site assessment the developers identified forty different habitat types and twenty-two drainage basins. The primary focus of the design was to protect

these features of the natural ecosystem. Therefore, the resulting plan is not based on a geometric or other formal pattern, but instead on the natural lay of the land. One of the techniques credited with protecting the wildlife habitat was the selective clearing of the land and the saving or moving of many of the trees.

More than 200 lakes on the property were carefully sited to preserve the natural flow of water. “To protect the delicate Estero Bay ecosystem, natural wetlands were preserved and a storm water system created to allow plants to filter out silt, nutrients, and pollutants. After 20 years of water quality monitoring, there have been no significant long-term effects due to land development or golf course maintenance at the community.” (Gause 47)

Visitors to Bonita Bay are impressed with the harmony between man and nature. Houses are clustered and sited back from the roads in an extensive buffer system of vegetation that includes many native plants that were preserved from the site during construction as well as added native plants.

With 3,300 housing units divided into 51 distinct neighborhoods, amenities for people include a marina, a fitness center, fitness trail, canoe launch, butterfly garden, lecture pavilion, shopping and dining center, art gallery, hotel, adult living facility, medical center, four waterfront parks, playgrounds, picnic areas, tennis courts, basketball courts, boat ramps, day slips, 10 miles of bicycle and walking trails, and three golf courses. The Audubon Society has awarded the golf courses with the Audubon Sanctuary certificate for preserving and enhancing the natural ecosystem in their design and maintenance. Some design features that qualify the golf courses for the Audubon Sanctuary certification are their very small percentage of turf and the use of indigenous

vegetation. For the purpose of protecting wildlife, the approach has proved remarkably successful. “A wildlife survey was performed prior to construction of the Bonita Bay East courses and again seven years later. The number of listed species observed increased by 50 percent postdevelopment.”(Gause 47)

In addition to the basic design, management practices are beneficial to wildlife as well. “An integrated program of environmental management has been established that includes a natural pest-management program, recycling natural materials, leaving snag trees undisturbed to provide habitat, restricting pesticide application anywhere on the property, making hand-pulling of weeds standard procedure, and planting native grasses to reduce maintenance and to provide for wildlife.” (Gause 47)

Water conservation features include a dual system of potable water for homes and treated reuse water for irrigation, as well as the xeriscape landscaping. “The community’s governing documents mandate use of Xeriscaping, the planting of hardy, drought-tolerant native plants.”(Gause 49) “The South Florida Water Manager District named Bonita Bay the region’s first Xeriscape demonstration site in recognition of its innovative water-conservation practices.”(Gause 47) Storm water runoff follows the natural contours of the land and is filtered through indigenous vegetation.

Located near Orlando, Florida, **Celebration** (Fig. 5-2) is a master-planned community that preserved 5,000 acres of natural habitat including wetlands, woodlands, and water that wind through the site. Celebration was built as a result of Walt Disney’s original plan for EPCOT. In the 1960s, the Walt Disney Company bought the 27,000 acres of undeveloped land that today also contain the EPCOT theme park.

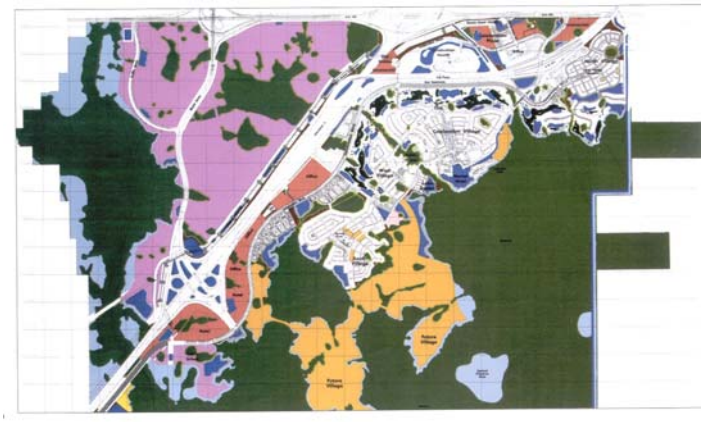


Fig. 5-2: Celebration Master Plan (Gause, *Great Planned Communities*, 52)
Planner: Robert A.M. Stern Architects, New York
Planner: Cooper, Robertson & Partners, New York

Disney had envisioned EPCOT as a futuristic community, and in fact, the letters stand for Experimental Prototype Community of Tomorrow. "Plans were drawn up for the new town, but when Walt Disney died in 1966, the idea for EPCOT evolved instead into the futurist theme park." (Gause 50) It was not until the 1980's that Disney CEO Michael Eisner created the Disney Development Company to deal with the 10,000 remaining acres of undeveloped land. The plan was developed to conform to the ecological features of the site with development limited to "peninsulas and islands in a sea of natural vegetation, connected by landscaped boulevards, parkways, and trails"(Gause 53) on 4,900 acres of the site. Amenities include 5,000 to 6,000 housing units, a town center, golf course, office park, health center, retail development, and a trail system.

At the community of **Civano** (Fig. 5-3), 30 percent of the 1,145-acre site was preserved as natural desert habitat space, primarily the areas around natural drainage basins. Civano is remarkable as a community that was planned with a focus on energy conservation and on preservation and restoration of natural habitat throughout the development. Located in Tucson, Arizona, Civano was planned to blend new urbanism

with advanced environmental design features. The master plan is based on the Transept concept of new urbanism, that arranges housing types from most urban, at the town center, to most rural, at the fringes of development, adjacent to the preserved natural lands. Likewise, the town center is "more dense, multifunctional and public"(Gause 214) while this density gradually decreases to the urban edge of low-density residential space. To illustrate some of the finer points of this concept, "a street is more urban than a road, a curb more urban than a swale, and an allee of trees more urban than a tree cluster."(Gause 214) The neighborhood follows the concepts of new urbanism to create a sense of community through the incorporation of a pedestrian-friendly design with diverse building types and uses. A priority of the planners was to respect the climate and place in architectural form, materials, and orientation of structures.

Fig. 5-3: Civano Master Plan (Gause, *Great Planned Communities*, 216)
Planner: Duany Plater-Zyberk & Co., Miami, Florida
Planner/Architect: Moule & Polyzoides, Pasadena, California

Environmental issues were addressed in all elements and phases of the design, including the construction phase in which trip mileage was reduced by 40 percent and solid waste production by 30 percent, as compared with the average figures for construction in the local area. Energy and water conservation were among the environmental goals for the community, specifically, to design buildings that

"use 50 percent less energy than specified in the 1995 Model Energy Code"(Gause 214) and use "65 percent less potable water than Tucson's baseline 1999 residential average"(Gause 214). To this purpose, two water systems were installed, "one for potable water and the other utilizing reclaimed rainwater and household (gray) water for nonedible plant irrigation." (Wasowski 132)

> Summer heat gain is minimized through building massing and orientation. Additional passive solar techniques include small openings on west-facing facades, shading devices on south facades, and the use of light, non-absorbent exterior color finishes on solar-exposed building surfaces. Building setbacks, height restrictions, and the appropriate location of deciduous and evergreen trees are also outlined in the... residential design principles. (Gause 223)

Another goal, to create within the community one job for every two residences, was for the purpose of reducing traffic commuting to the city.

A priority of the planners was stewardship of the land, "respecting indigenous patterns of natural growth, drainage, and erosion; local history and culture; and the native fauna and flora."(Gause 214) The planners included conservation and restoration of the native riparian habitats in this desert habitat, much of which had suffered from previous overgrazing. Indigenous plants were salvaged and re-used in the landscape, and drought-tolerant natives were recommended for all landscaping.

> So far over 2,400 cacti and ground covers and 465 mature trees have been successfully transplanted, exceeding plant preservation guidelines set down by the city of Tucson. ... In addition, programs are in place for permaculture, rainwater harvesting, and reuse of reclaimed water. (Wasowski 132)

Dewees Island, South Carolina, has 350 acres preserved as a wildlife refuge, included in more than 65 percent of the island that is protected from development. This

coastal plain barrier island is an example of an entire community built within nature's envelope, down to the footprints of the buildings. The community was created by John L. Knott Jr. with the idea that "we simply need to rediscover our intuitive base about how to live in harmony with our environment, as opposed to dominating and destroying more than we need." (Wasowski 97) John Knott translated his idea into seven guiding principles:

* "Development and environment plans are natural allies.
* All development should occur in the context that all resources are limited.
* Communities can be resource providers, not just resource users.
* Land is a stewardship role for future generations.
* It is less expensive, in the short and long term, to build in harmony with the environment.
* Communities are planned for people, and technologies are to be supportive, not dominant.
* Environmental education is an essential first step in the rediscovery of our intuitive sense of integrating with the environment." (Wasowski 97)

"This approach... has resulted not only in ecological benefits but also in economic benefits – to property owners, to the developer, and to the community as a whole." (Wasowski 97)

Early in the planning process, the South Carolina Department of Natural Resources was called on to work with an environmental consultant to prepare a comprehensive wildlife management plan. The entire infrastructure, from the marina to the waste management system, was designed to have minimal impact on the existing ecosystem. Soils, topography, wetlands, and plants and animal life were analyzed to determine the most appropriate places for construction. Seminars on protecting the

natural environment were required for builders. Natural heating, cooling, and lighting were incorporated into the design of the buildings.

At Dewees Island, planners have protected more than 65 percent of the island from development, including 350 acres that have been preserved as a wildlife refuge. Plants native to the island are the only vegetation allowed. There are no formal lawns. Full-time employees of the development include a landscape ecologist and a coordinator for environmental programs. Probably the most unusual feature of this development is that all transportation on the island is by golf cart! Transportation to the island is by ferry.

At **Fairview Village** (Fig. 5-4) four and a half acres of upland forest and forested wetlands were preserved. Eleven acres of conservation easement make up a portion of the natural area on site. Fairview has a regional trail system that connects Fairview Village with adjacent city-owned wetland and upland park areas. Natural flood control was used. "Preserving and enhancing these resource lands has led to air and water quality benefits, reclamation of wildlife habitat, native feedstock for migrating birds, and has created recreational and educational opportunities." (Gause 68)

Fig. 5-4: Fairview Village Master Plan (Gause, *Great Planned Communities*, 71)
Planner: Holt & Haugh, Inc., Portland, Oregon
Planner: Lennertz & Coyle Architects & Town Planners, Portland, Oregon

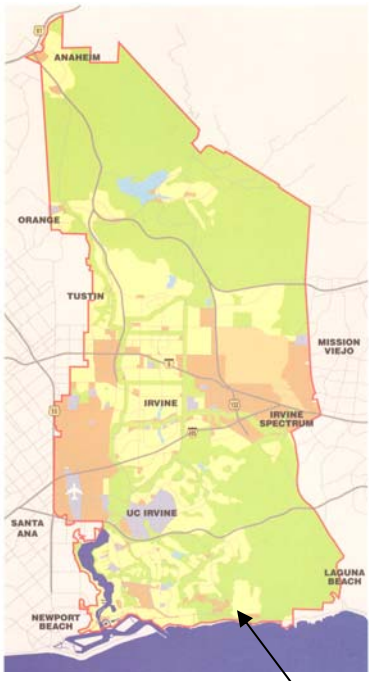
Located in Fairview, Oregon, Fairview Village is a smaller urban development that

encompasses 96 acres with 500 housing units and 219,000 square feet of office space. Private yards were kept compact to allow for neighborhood parks and thirty acres of "conservation land."

At **I'On** (Fig. 5-5), wetlands were preserved and additional wetland wildlife habitat was created. I'On, in Mount Pleasant, South Carolina, is located on 244 acres adjacent to the deep-water marshes of Hobcaw Creek. Two man-made lakes that existed on the property were left available for all to use. "The Rookery, a five-acre pond used by wading birds as a nesting site, was enhanced as a freshwater wetland preserve. Careful planning and monitoring has protected the area, enabling the nesting population to increase while allowing residents to view the birds without disturbance from blinds."(Gause 92) Other wetland areas and buffer areas around them have been preserved to protect the freshwater springs, which "are the headwaters of I'On's tidal creeks and home to a wide variety of Lowcountry plants and wildlife."(Gause 92) Along the Hobcaw and Shelmore creeks, a green corridor features more than two miles of walking trails. When complete, I'On will include over 700 houses and a small commercial area, numerous playgrounds, pocket parks, and an athletic field.

Fig. 5-5: I'On Master Plan (Gause, *Great Planned Communities*, 91)
Planner: Duany Plater-Zyberk & Co., Miami, Florida
Planner: Dover Kohl and Partners, South Miami, Florida
Planner: Seamon-Whiteside and Associates, Mount Pleasant, South Carolina

At the **Irvine Ranch** (Fig. 5-6), fifty thousand acres are made up of permanently protected wilderness, greenbelts, parks and recreational areas. Preserved lands include Limestone Canyon, Bommer Canyon, Upper Shady Canyon, Quail Hill, and 8,000 acres of Pacific coastal scrub. Also included are the San Joaquin Wildlife Sanctuary, which is one of California's largest coastal freshwater marshes and home to more than 200 bird species, and an impressive geological formation called "the Sinks".



Newport Coast is a village of *The Irvine Ranch*, in Irvine, California. The Irvine Ranch is a series of villages within the cities of Irvine, Newport Beach, Tustin, Orange, Laguna Beach, and Anaheim. In the 1960s William Pereira conceived the idea to develop much of the 93,100 acres of the former 120,000-acre ranch that spanned 22 miles, from the Pacific Coast to the Cleveland National Forest.

"With at least three decades of preparation, probably no part of the Irvine Ranch was more carefully planned than the Newport Coast."(Gause 101) The 10,000-acre Newport Coast is on the Pacific Coast Highway, overlooking the Pacific Ocean. Naturally beautiful rolling hills, canyons, and coastal ridges make up the landform of the area. The planners wanted to preserve most of the environmentally sensitive canyons and ridges. To ensure

Fig. 5-6: Irvine Ranch Map (Gause, *Great Planned Communities*, 101). Green areas are preserved natural lands. The Pacific Ocean is at the lower end, in dark blue.
Planner: The Irvine Company, Newport Beach, California

the protection of these areas, “the Irvine Company entered into an alliance with the Nature Conservancy, a national land conservation organization, to manage wildlands and restore natural habitats.”(Gause 102) The developers decided to utilize only one fourth of the space for development and leave the rest natural. Clustering of houses permits a decreased built area and large expanses of open space. Native vegetation is used in the transition zones between natural areas and private yards.

At **Portola Valley Ranch** 350 of its 450 acres are preserved native oak woodlands. This California residential development is located about halfway between San Francisco and San Jose in the town of Portola Valley. The town had existing regulations requiring the protection of the area’s ecosystem. When developer Joseph Whelan acquired the site he called on a team of landscape architects, land planners, architects, attorneys, economists, geologists, engineers, naturalists, and the California Native Plant Society to conduct a thorough environmental study. Geologists were particularly important since the site straddled a fault line. Building sites were located away from potential landslides that could result from an earthquake, and homes were sited on bedrock. The existing plant community was native oaks and grasslands, so the land management regulations were designed to protect the native vegetation and control invasive species. The 205 single-family homes were built on only 100 acres with the remaining 350 acres of oak woodlands preserved. Roads were located on the ridgelines to avoid disturbance of the topography, while houses were located in cul-de-sacs below the ridgelines. Footpaths connect the cul-de-sacs to a ten-mile network of trails for hiking, jogging, and riding. In 1984 the community received the ASLA award.

At **Sea Ranch** (Fig. 5-7), half of the total acreage of the site is reserved for hiking, watching wildlife, and other recreation. It was the idea of Lawrence Halprin to leave the coastal bluffs undeveloped so they could be accessed and enjoyed by all rather than by a few privileged homeowners.

Sea Ranch, California, was the vision of architect and land planner Alfred Boeke. Boeke wanted a community designed to respect the natural landscape. With over 2,300 homesites on 4,000 acres, designers have managed to maintain the impression of the natural ecosystem. (Wasowski 99) Written restrictions protect the natural environment, establish guidelines for development, and ensure that human activities will have minimal impact on the site.

The land has an interesting history of human impact. Initially logged and then used for grazing livestock, the land was gradually restored to primarily native vegetation when the state set aside much of its coastal lands as natural area. Since the natural succession in the area is from grassland to forest, the forest is now beginning to develop. However, the state prefers to set aside some portions as forest and other areas as grassland. To preserve the grasslands the state has introduced controlled burning. In Sea Ranch, residents are allowed to use non-native plants only in their courtyards or behind their fences to protect the public view of the natural landscape.

Fig. 5-7:Sea Ranch Landscape (Wasowski, *Building Inside Nature's Envelope*, 98)
Planner: Alfred Boeke
Planner: Lawrence Halprin

Developments that Restored Wildlife Habitats

Coffee Creek Center (Fig. 5-8), in Chesterton, Indiana, was conceived as "a direct response to the national debate over urban sprawl and its incompatibility with the health of natural systems."(Gause 224) Lake Erie Land Company and a team of planners are developing the property, which was purchased in 1995. The land at Coffee Creek was not pristine when the company bought it. Beginning in the 1930s the area had been subjected to row-crop agriculture, and at the time of the site analysis highly advance erosion of the stream beds had developed. "To reverse such environmental degradation, the Coffee Creek watershed is being restored to its presettlement condition. Further, deep-rooted native plants are being reestablished in prairies, savannahs, and open woodlands."(Gause 229) "Storm water systems were modeled after the natural ecology by minimizing impervious surfaces and using native plant systems to clean, filter, and absorb water."(Gause 230) Constructed wetlands are being established to absorb and retain rainwater and to treat wastewater on the site.

Fig. 5-8: Coffee Creek Center
Master Plan (Gause, *Great Planned Communities*, 226).
Planner: William McDonough & Partners, Charlottesville, Virginia
Planner: Looney Ricks Kiss, Princeton, New Jersey
Planner: Gibbs Planning Group, Birmingham, Michigan

Located on 675 acres 45 miles southeast of Chicago, Coffee Creek Center will provide, upon completion, 3,000 residential units, nearly 4 million square feet of

commercial and retail space, civic and public facilities, and 225 acres of open and recreational space. With environmental sustainability a primary focus, plans are for "a series of compact, mixed-use, pedestrian-oriented neighborhoods, where homes, workplaces, and retail centers sit lightly on the land."(Gause 224)

Restoration of native ecosystems and habitats are also in the plans, and 167 acres meandering through the center of the site make up the Coffee Creek Watershed Conservancy. Outside of the conservancy land, only 17 acres are restricted from building, but nearly one-third of the developed area is dedicated to green space, parks, and constructed wetlands. Besides Coffee Creek, the landscape of the development is made up of prairie, savannah, marsh, fen, and riparian forest.

At **Prairie Crossing**, Illinois, prairie farmland was restored back to prairie. Prairie Crossing (Fig. 5-9) was developed as a community with the character of a small village and with an interest in preserving the natural landscape. It is located at the edge of the Liberty Prairie Reserve in an area that is quickly becoming suburbanized. The 3,200-acre preserve is not strictly a natural habitat because it includes farms along with forests and riparian corridors. This patchwork combination of farm and natural ecosystems provides habitat to thirteen threatened and endangered species.

Landscape architect Bill Johnson, of Berkeley, California, worked with the property owners to develop the plan from the initial idea of simply a farm village to the broader idea of "creating a place that integrated an environmental ethic in its design and function." (Kane 129) Eventually other landscape architects became involved, including Peter Lindsay Schaudt, of Chicago.

Fig. 5-9: A restored prairie garden at Prairie Crossing. (Kane, in *Landscape Architecture*, 124)

Natural landforms at Prairie Crossing resulted from glaciation during the last ice age. Site analysis revealed that during the 100 years of agricultural use, the land had been drained of excess water by way of a system of drainage tiles, yet still surviving from pre-agricultural times were a small wetland and a few patches of native prairie. Habitat restoration was initiated early in the project when the drainage tiles were removed to allow the water to return to its natural flow.

> "Today a system of vegetated swales collects and conveys stormwater from roads and rooftops. The water is then directed over prairies where sediments, nutrients, and contaminants settle out or are removed biologically. About 65 percent of the water remains in the prairie and slowly flows into the adjoining wetlands. The water that reaches the wetlands through surface flow is significantly cleansed when it flows into the 22-acre man-made Lake Aldo Leopold and two adjoining ponds, which serve as stormwater basins. This so-called treatment train results in a 60 percent decrease in stormwater conveyed off site compared to the predevelopment agricultural landscape." (Kane 156)

In Prairie Crossing homeowners are encouraged to use prairie and wetland native plants instead of grass lawns. They are also encouraged to avoid use of chemical fertilizers and pesticides. They have access through their homeowners' association to lists of native species, invasive nonnative species and other information about native plants. After attending a workshop to learn about the prairie landscape and function, four of the early homeowners planned their gardens with the assistance of Schaudt, and landscape architects Carl Korfmacher and Frank Haas, and landscape designer Kerry Leigh. Some chose to combine native plantings with a lawn, others chose a meadow of prairie plants

with no lawn. Today about 150 homeowners have chosen prairie gardens. These prairie gardens do require occasional burning for maintenance. This is an event enjoyed by the homeowners and carefully supervised by trained volunteers.

> "Prairie Crossing is also involved in the protection and restoration of threatened or endangered native species. Lake Aldo Leopold serves as a refuge for four fish species (blackchin and blacknose shiners, the Iowa darter, and the banded killifish) that are on the Illinois Department of Natural Resources list of "at risk" native species. The department, which uses the lake as a research site, stocked the water with the largest population of these species in the Des Plaines watershed." (Kane 157)

Master-Planned Communities That Built Within Nature's Envelope

DC Ranch (Fig. 5.10), in Scottsdale, Arizona, is a more recent development on 8,281 acres of land formerly used as a cattle ranch. Scottsdale has an ordinance that requires significant indigenous plants to be inventoried and saved for reuse if removal is necessary during construction. DC Ranch strictly adheres to this policy and employs landscape specialists to replant by hand the "desert grasses, flowers, and cacti in the same orientation and habitat density as occurs naturally."(Gause 64) DC Ranch policy also defines acceptable landscaping plant lists, which include native, Sonoran, Southwestern, arid, and non-invasive exotic plants. Regulations define landscape zones where each type of plant may be used. Zones include natural, transition, private, and streetscape. Small areas of turf are permitted in front yards.

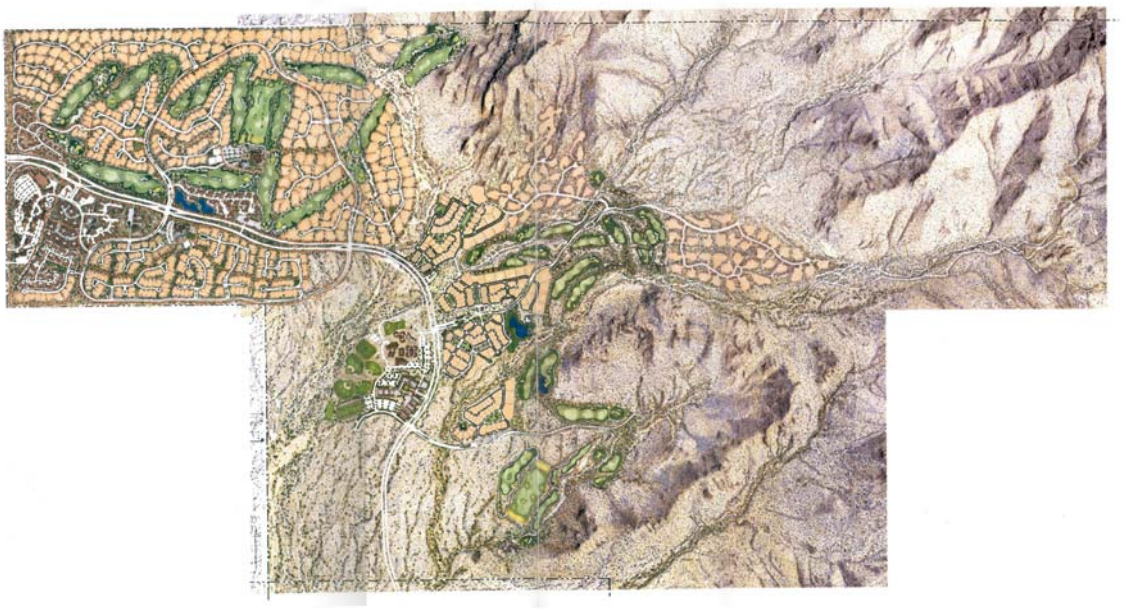


Fig. 5.10: DC Ranch Master Plan (Gause, *Great Planned Communities*, 62-3). Planner: Swaback Partners, PLLC, Scottsdale, Arizona

The site consists of four vegetation zones, from Sonoran Desert lowlands to high mountains. Construction is prohibited on the highest elevations of the site in order to preserve the dramatic views of the mountains for both the residents of DC Ranch and for others living in the area. Building is also prohibited in the low-lying washes, as mandated by the U.S. Army Corps of Engineers. The houses are arranged in neighborhoods of about 60 houses each. The nearby McDowell Mountain Preserve and Scottsdale's regional path system are connected to the community by a system of paths and open spaces that connect the groupings of houses.

All architecture, roads, and even the golf course are required to blend with the land's natural features and contours. Bridges, walls, paths and other structures are often constructed with native stone from the site. Building regulations require that houses

conform to the natural slope of the site by incorporating interior level changes and stepped roof lines.

A remarkable feature of DC Ranch is its computer-controlled irrigation system that dispenses water to each plant according to its specific needs. "The computer-controlled system is outfitted with extensive information on plant species, water use data, and planting zones and densities, recognizing that turf, trees, cacti, Saguaros, wildflowers, and desert shrubs each require different quantities and frequencies of water. The irrigation system receives information daily from an on-site measuring station, which tracks wind, solar radiation, rainfall, humidity, and temperature."(Gause 64)

Five thousand dwellings and a 400-acre golf course are ultimately planned, along with a mixed-use town center, community center, two schools, a recreation center, and 700 acres of open space.

Desert Highlands is an 850-acre residential community in North Scottsdale, Arizona, and is located in one of the world's most fragile ecosystems, the lovely Sonoran Desert. "The topography consists of ravines, washes, dramatic rock outcroppings, and fields of boulders. It is also alive with a wide variety of wildlife: desert tortoises, colorful chuckwalla lizards, roadrunners, and hummingbirds galore, as well as a vast palette of indigenous flora, from armies of stately saquaros and luminescent backlit chollas and ocotillos, to the softer, gentler shapes of palo verde, creosote, fairyduster, bur sage, and brittlebush." (Wasowski 103) The designer Gage Davis, who is architect, landscape architect and urban planner, recognized the opportunity to prove the effectiveness of building within nature's envelope. The purchase agreement for the home sites specifies guidelines for home design and landscaping to ensure that the desert habitat is respected

and preserved in a harmonious blend with people and their structures. Property owners are required to meet with their architects, builders, and the community's design review committee to ensure that the guidelines are met. Exotic plants are permitted only in the private zones and must not spoil the visual aesthetics of the natural desert landscape.

Seaside, Florida, set out from its inception to preserve in its landscaping the look of the existing 80 acres of native scrub forest land and beach sand dunes. Founded by Robert S. Davis, its architects were Andres Duany and Elizabeth Plater-Zyberk. Native plants and an approved list of non-natives are permitted in front yards. Lawns were forbidden. In the communal areas, clusters of native species include sand live oak, Southern magnolia, woody goldenrod, bluestem grass, wild lupines, and beach rosemary. Homeowners are so enthusiastic about the use of native landscaping that, when city planners wanted to cover the median of Seaside Avenue with turf grass, they raised a hue and cry to protect the existing native scrub vegetation on the median. (Wasowski 106)

The Woodlands is located 27 miles north of downtown Houston, Texas. George Mitchell, president of Mitchell Energy Company founded The Woodlands in 1975, with the idea that it would be a self-sustaining community where people could live, work, and play in harmony with nature. It was built on 19,000 acres of dense oak and pine forest that had lost its natural forest structure from repeated logging in the nineteenth and early twentieth centuries. The unremarkable landform was flat to gently sloping, but its forest impressed the planning team as a very special feature when compared to the predominance of prairie grassland in the area. "The Woodlands holds the distinction of being the first plan for a new city produced through ecological planning, taking into

account the site's natural systems, its processes, and complex interrelationships."(Gause 200)

"The seven goals of land use organization were to minimally disrupt the surface and subsurface hydrological regimen; preserve woodlands; establish a natural drainage system; preserve vegetation; provide wildlife habitats and movement corridors; minimize the cost of development; and avoid hazards to life or health."(Gause 209) Houses and even the commercial areas are screened from the streets by native trees and understory. At completion, about one-fourth of the land will be preserved as open space, including golf courses, lakes, parks, and forest preserves.

It was landscape architect Ian McHarg who realized that "conventional development practices would alter the site's natural rates of groundwater recharge and surface water runoff" (Gause 200), resulting in changes in the water table and downstream flooding. "McHarg used his system of overlaying environmental constraints in order to identify lands most suitable for development. Building envelopes were based on maximizing groundwater recharge, protecting permeable soils, maintaining the water table, reducing runoff, retarding erosion and siltation, increasing the base flow of streams, and protecting natural vegetation and wildlife habitats. Thus the ecological planning study became the major determinant in preparing the land for the community."(Gause 200) Ecologically important areas such as stream corridors were restricted from building. Conservation zones were established. Major roads were placed on ridgelines to keep them away from drainage areas. A gradient of development density was established to place more development near the major roads and less near the ecologically sensitive zones. Soil studies located the areas of impermeable soils for the location of the most

intensive development. “Minor residential streets were designed as berms perpendicular to the slope of the site to impede flow over excessively permeable soils.”(Gause 203) This resulted in a natural pattern of development without any strong geometric or formal pattern as also seen in Bonita Bay.

In The Woodlands plan are seven 2,000-acre villages, each with housing, schools, recreation facilities, shopping, and community services. “In addition to over 15,000 occupied homes, the community includes some 600 companies employing over 13,000 people, as well as a hospital, a performing arts pavilion, and an executive conference center.” (Wasowski 106)

Although preserving and restoring the indigenous vegetation on the site was emphasized in the planning, regulations for landscaping and acceptable plant lists were not included in the covenants. Suggested guidelines for landscaping and informative plant lists are issued to residents, but homeowners have not regarded them as requirements. “Many homeowners have strayed from the initial concept” (Wasowski 107), cutting down trees and adding manicured hedges and lawns and exotic plants. “Maintaining the integrity of the forested environment continues to be a challenge, both during development and after residents move in. New homebuyers from outside the community often require some education to prevent them from removing the preserved forest understory in their yards to create more expansive lawns and other high-maintenance landscapes.”(Gause 210)

Chapter 6: Recommendations for Improving Master-Planned Communities For the Protection of Wildlife

The problem of urban sprawl has reached crisis proportions for the human environment and for wildlife habitat.

> Today almost all major studies point to a coalescence in the next few decades of significant land degradation, population growth, water shortage, fertile soil erosion, biodiversity loss, and spread of huge urban areas. Society is comfortable in thinking of small spaces and short times, or at best considering trends separately. When the trends are connected, it is hard to miss the crisis looming. The timetable says we and our children will be there. At center stage will be land-use pattern.(Dramstad 9)

> "One environmentalist stated that we have no more than a hundred years to 'turn things around. After that it will be too late.' Others think that is an optimistic viewpoint. The fact is, we no longer have the luxury of taking our natural surroundings for granted."(Wasowski 134)

Undoubtedly, the best we can do for wildlife is to send urban growth back into the cities and reclaim our countryside for wildlife habitat and wildlife-friendly forestry, farmlands, and recreation. Thanks to movements like Smart Growth, we are, to some extent, sending growth back to the cities. However, with human population growth continuing as it is, new towns and new residential subdivisions on the urban fringe are being built at an ever-increasing rate. This situation is unlikely to end in the near future. If we cannot stop development outside of cities, we can at least improve the function and reduce the environmental impact of new development. We can be more selective about where we build; when we build, we can do so in a more wildlife-friendly manner. We can practice sustainable development. The three main categories of planning for wildlife are: planning regionally to avoid development in critical habitats and corridors; planning within the site to preserve, create, and restore habitat and corridors within new developments; and creating a green infrastructure, regionally and within the site.

For landscape architects, this means that processes and patterns of ecology must become a basic element of landscape design. When we are consulted early enough in the planning phase, we can influence the builder to select from among possible sites, choosing the one that will best prevent further encroachment on wildlife habitat.

Regional Planning: Site Selection for Sustainable Development

For the purpose of protecting wildlife, site selection can be divided into three main categories: (1) re-using previously disturbed areas that have been abandoned, (2) selecting in-use sites where ecology and efficiency can be improved, and (3) selecting new sites based on their geology, geography, ecology, and wildlife habitat sensitivity.

We should look first to the cities for sites that have been previously disturbed and abandoned. Although existing planned communities of this nature are not specifically covered in this paper, such development serves wildlife by drawing people back to the cities and reducing development of rural lands. This concept is gaining popularity since it has proven successful in many new communities located in major cities all over the United States.

Second, in-use sites (such as older existing urban and suburban residential neighborhoods) can often be prime candidates for re-shaping into environmentally sustainable mini-communities within the urban framework. With the help of re-zoning and a strong design team, these single-use neighborhoods can be transformed through such concepts as mixed-use, ecological stormwater treatment, walkability, and riparian corridor restoration. Although this paper does not cover this type of development, I feel that it is a topic that deserves further study and may be a strong area of concentration for landscape architects and urban planners in the near future.

Finally, in selecting a previously undeveloped site for new development, we must first consider the geology, geography, and ecology of the site. Geological features, such as unstable soil conditions and geological fault lines, are generally a high priority to thoughtful designers, primarily because errors in this portion of site analysis can have disastrous effects. Ian McHarg's process of site analysis is very comprehensive in this regard. Other geological features to consider are those that have aesthetic value and should be incorporated into a design, rather than bulldozed to make a level plain for construction. In addition, there may be geological features that contain a microhabitat for wildlife and should be preserved as a valuable ecological asset.

> A complete study would involve identifying natural processes that performed work for man, those which offered protection or were hostile, those which were unique or especially precious and those values which were vulnerable. In the first category fall natural water purification, atmospheric pollution dispersal, climatic amelioration, water storage, flood, drought and erosion control, topsoil accumulation, forest and wildlife inventory increase. Areas that provided protection or were dangerous would include the estuarine marshes and the floodplains, among others. The important areas of geological, ecological and historic interest would represent the next category, while beach dunes, spawning and breeding grounds and water catchment areas would be included in the vulnerable areas.(McHarg 57)

Geographical features have been given less attention, since we continue to build in natural-disaster prone areas. For example, we build along the Atlantic and Gulf coasts in major hurricane zones where the result is billions of dollars spent in reconstruction and tons upon tons of waste material entering landfills after each major hurricane. We also continue to build and rebuild in the flood plains of rivers where homes and businesses are wiped out in years of high flood levels. Flood plains are often valuable as prime farm or forestry land and should be preserved for these uses and for wildlife habitat. Ian McHarg, in *Design With Nature*, addressed this issue in 1967:

> It also seemed reasonable to conclude that certain areas and natural processes were inhospitable to man – earthquake areas, hurricane paths, floodplains and the like – and that those should be prohibited or regulated to ensure public safety. This might seem a reasonable and prudent approach, but let us recognize that it is a rare one.(McHarg 55)

The Atlantic and Gulf coasts once provided important wildlife habitat. Their continued development, along with destruction caused by exotic invasive plant species, has wreaked havoc with animals such as shore birds and sea turtles that depend on these habitats for reproduction. Reconstruction along our coasts should be extremely limited, and these areas should be off-limits to new construction.

Another geographical aspect is the historical value of certain sites, which should always be studied for preservation or for giving the new development a "sense of place." Historical styles of architecture were usually based upon the climate of the region and give us an excellent basis for energy-conserving architectural design today. Too often today we see old farmland converted to new urban sprawl. We should not look for new development sites in prime farmland, even if abandoned. It is not in the best interest of future generations to replace prime farmland with roads and buildings, however well designed. This land must be preserved for the possibility of future re-use as farmland.

Most essential to wildlife is the ecological analysis of the site.

> In a world faced with dwindling resources, Mississippi landscape architect Robert Poore maintains that it is no longer enough for builders to understand the techniques of construction alone. 'We need to understand the environmental, biological, and ecological functioning of all the components of the ecosystem we're building in,' he says, 'including how food chains operate, the importance of species diversity, and seasonal effects on wildlife and flora.'(Wasowski 134)

From deserts to wetlands, from mountains to ocean beaches, from pristine natural areas to the most disturbed mining or industrial sites, every place has an ecological system of its own that is connected in some way to that of its neighbors. Every potential building site

must be evaluated for its function, actual or potential, in preserving wildlife and for characteristics that may be contributing to the decline of wildlife. To aid in this endeavor, we are fortunate to be able to call on wildlife specialists to evaluate the site for the presence of rare species of animals and plants. Sources for these specialists are the botany and wildlife departments of universities, the local native plant society, a local arboretum, the Audubon Society, and the Nature Conservancy. It may be of little use to call on a local arborist, because, as stated in Chapter 3, an arborist will know the trees but probably will not know enough about the understory and ground cover. With the aid of these specialists, we may also discover isolated patches of wildlife habitat. In addition, as we analyze the surrounding area of the site, we must determine whether the site is adjacent to wildlife corridors. Certainly, under no circumstances should we choose to develop an area that would break up a wildlife corridor.

Whether or not the landscape architect has been consulted in the selection of a site for development, he can still make a master plan that will protect existing wildlife, protect neighboring wildlife corridors and habitat patches, or create new wildlife habitat within the new community.

Site Planning for Protection of Wildlife Habitat in a New Community

Riparian zones and other wildlife corridors are by far the most important lands to protect. When a site is directly connected to a wildlife corridor, very careful attention to design is required. As discussed in Chapter 2, even a 300-foot-diameter preserved space is not an adequate size for prevention of predation by dogs and cats. Where it is not feasible to provide a 300-foot buffer zone, it is important to include in the development's covenants enforceable restrictions that keep pets out of the wildlife habitat. We must do our best to concentrate development away from existing riparian zones and other wildlife

corridors in order to preserve or restore as much natural land as possible adjacent to the corridor, with an absolute minimum of 150 feet on either side of a waterway. In addition, we must provide a 100-foot buffer zone along the edges of the developed area in which non-native invasive exotic plants are strictly forbidden and native, wildlife-food-producing plants are among the majority of species preserved and planted.

Currently, the most frequently preserved wildlife habitat within a planned community is the riparian corridor. We should look also at preserving natural lands that can, by their size and orientation to wind direction, serve as wildlife preserves as well as making our communities more energy-efficient and more comfortable for walking. Ian McHarg, in his book *Design With Nature*, suggests that urban expansion should be contained between radial fingers of preserved land. These fingers of green space, which McHarg calls "urban airsheds," should be located according to the primary wind directions so they function to bring in clean air from the countryside. The most important wind direction to consider is the source of inversions, which hold polluted air close to the ground.

> The central phase of air pollution is linked to temperature inversion, during which the air near the ground does not rise to be replaced by in-moving air. Under inversion, characterized by clear nights with little wind, the earth is cooled by long-wave radiation and the air near the ground is cooled by the ground... During... inversion... in cities, pollution becomes increasingly concentrated."(McHarg 64)

McHarg recommends forested land as the most effective toward this purpose.

> Areas that are in vegetative cover, notably forests, are distinctly cooler than cities in summer – a margin of 10' F is not uncommon... To relieve summer heat and humidity, it is essential that these air-sheds be substantially in vegetative cover, preferably forested. (McHarg 64-65)

Part of the result of this design element is to benefit the city and its inhabitants, since it would result in a natural cooling and cleaning of urban air as well as a reduction in

humidity, making the city more walkable and reducing air conditioning use. The other result is the function of the preserved natural land as wildlife habitat. It is only one of the many details we can utilize in planning for the protection of wildlife while improving our urban living as well.

During the site analysis we may find patches of land that appear to be wildlife habitat. Each patch must be evaluated for two main qualities: “1) contribution to the overall system, i.e., how well the location of the patch relates or links to other patches within the landscape or region; and 2) unusual or distinctive characteristics, e.g., whether a patch has any rare, threatened, or endemic species present.”(Dramstad 24) When our site analysis finds wildlife habitat in isolated islands and patches, we can plan development in such a way as to protect independent habitat islands and to provide connections between other patches in order to provide safe movement of wildlife from place to place, as discussed in Chapter 3. (Fig. 3.9) For example, when patches of forest are connected by open spaces, many animals travel from patch to patch through the open spaces at various times of the day or night or during different seasons. They do so at great risk from exposure to predators. When we develop such an area we can provide safe passage by restoring habitat as a connecting extension between patches, or by introducing a tree canopy between patches, or by introducing small “stepping-stone” patches of tree canopy (Fig. 3.4 and 3.5), and we can construct roadway underpasses and overpasses to preserve the mobility of wildlife between patches. (Fig. 3.8) We must ensure that the edges of patches are curvilinear to provide quick access to escape cover from predators. We must provide extensions of habitat vegetation that project outward from the edge like arms that serve to attract species toward the patch or to enable safe movement toward the

next patch. (Fig. 3.2) When designing a small, stepping-stone patch, it is important to remember that its length should be parallel to the length of the facing side of the nearby larger patch to make the smaller patch more accessible to wildlife from the larger patch. (Fig. 3.3) When constructing roadway overpasses and underpasses, we must not forget to install the drift fencing to direct wildlife to the passageway and away from the roadway. (Fig. 3.6 and 3.7)

It is also important to plan walking and biking trails only along the outer edges of the wildlife corridor to keep the human presence from disturbing the interior wildlife. Where the corridor is narrow it is necessary to place the trails outside of the existing naturally vegetated area. In such instances, planting locally native vegetation can enhance the beauty and wildlife experience of the trails. It is important to plant layers of canopy trees, understory trees, shrubs, and ground cover. (Fig. 2.4) This will serve to extend wildlife habitat by providing native food materials. Careful plant selection and design can produce quite an attractive array of native vegetation that will provide seasonal interest the year round.

After construction it is of utmost importance that we educate prospective residents and business owners in the importance of, and rules for, maintaining the wildlife habitat. The most common problems, as mentioned in Chapter 3, suggest a simple basic list of "No-No's": no dumping of yard trimmings in the habitat areas, no removal of dead trees from the habitat areas, no trimming out the understory or mowing the habitat area, no pets allowed in the habitat area, and no shooting of wildlife with BB guns. Children can be taught to appreciate the wonders of nature and to treat the wildlife sanctuary with respect. Prospective residents and business owners must be clearly informed of the value

of the wildlife spaces and the rules for protecting those spaces before they agree to purchase or lease a property.

When we go so far as to build our new planned community in an established natural ecosystem such as desert or forest, buildings and infrastructure should be carefully placed on the least sensitive portions of the site, certainly never on the lowest land that makes up the riparian zone. Buildings and infrastructure should be placed and constructed for the least interference with natural drainage patterns. Of tremendous importance to wildlife is to plan building footprints and infrastructure according to the techniques of building within nature's envelope, as discussed at length in Chapter 3. (Fig. 3.11)

> Ian McHarg, an internationally known and respected ecologist, and the author of *Design with Nature*, dedicated his life to changing the way we see humanity's role in relation to the natural world. Never shy about speaking his mind, McHarg has been quoted as saying that conventional development is 'the ransacking of the world's last great cornucopia.' ...McHarg believed that, once exposed to this kind of environment [that is, the environment of nature's envelope developments like The Woodlands, Texas], residents would have their expectations raised and would demand the same kind of ecological considerations at the next place they or their children live.(Wasowski 107)

Clustering houses on cul-de-sacs (Fig. 3.10) has the benefits of lowering infrastructure, reducing rainwater runoff, and allowing more green space where the riparian zone or other wildlife corridor meanders through the site; or it can serve to create habitat patches as stepping-stones between corridors. Building in a more geometric pattern, such as a grid, can be used effectively in areas with larger expanses of level land when housing and businesses areas are planned with the space-conserving techniques of Smart Growth and traditional neighborhood development. In such cases most of the natural lands are restricted to the periphery of the site, but wildlife can be given a boost

by incorporating into the built area stepping-stone patches and the various components of "green infrastructure", as discussed in Chapter 3.

Creating a Green Infrastructure

As an essential part of the "green infrastructure" green roofs should be installed on as many buildings as possible, especially in deserts and other treeless areas. As discussed in Chapter 3, green roofs benefit wildlife by purifying air and water and by providing habitat for birds and pollinators. Green roof vegetation should consist of native plants to promote the welfare of birds and butterflies. Specialists can install green roofs on flat or sloped roofs. A roof in a forest may be a good candidate for a green roof installation if it is designed in such a way that there is access for easy removal of leaf accumulation, but I would only recommend this for homeowners or building owners who are enthusiastic enough about having a green roof to keep up with the seasonal maintenance chore of leaf removal.

In selecting the plant palette for private and public zones within the development it is of course most beneficial to wildlife to use the locally native plant species that will provide wildlife food and shelter. However, there are certain aesthetic qualities that many people find valuable in exotic plants. A blend of native and exotic plant material can be very effective aesthetically, and there are many instances in which our native plants can serve as effective substitutes for exotics. On the other hand, there are also some exotic plants that provide food for wildlife. Above all, the plant palette should strictly prohibit invasive exotic species. At Mt. Laurel, outside of Birmingham, Alabama, landscape architect Rip Weaver has successfully limited public and private landscape plant materials to native plants, most of which were found on the site. One very efficient

technique used at Mt. Laurel is to immediately transplant the vegetation from a cleared construction zone to a newly completed house or public site. Homeowners in Mt. Laurel are allowed to plant non-invasive exotics in pots and in planters that are included in the front yard landscape of each house. Other communities allow more exotic plants on private property located outside of the wildlife buffer zones, as long as invasive exotics are excluded and plants are visually compatible with the overall aesthetics of the landscape.

The reduction or elimination of lawns will also serve to increase wildlife habitat. One very effective way to achieve lawn elimination is to build within nature's envelope. A well-designed planting of the most attractive of our native plants in the areas usually dedicated to lawns will benefit wildlife and provide seasonal interest. A mixture of natives and non-invasive exotics can be used here as well, when the property is outside of the wildlife buffer zone. Homeowners can be encouraged to create a backyard wildlife habitat. Today many homeowners are learning the benefits of gardening for wildlife and finding that a garden full of birds, butterflies, and other wild creatures is far more exciting and rewarding than a garden of showy flowers or evergreen exotics that are ignored by wildlife. Many new developments are providing workshops for homeowners to teach them the techniques for providing the basic components of food, accessible water, and shelter in a backyard habitat. I encourage developers to provide such a service to new property owners.

Lighting in the wildlife-friendly development should be very carefully planned so that it is efficient enough to be used at a minimum. Lighting should be directed

downward, never upward toward the sky. Lighting should be used only when necessary as a safety feature.

Features that prevent air and water pollution are additional components of the green infrastructure. Toward this purpose, the principles of New Urbanism embrace environmentally sound methods.

Use the Principles of New Urbanism to Reduce Environmental Impact

In some areas the “new urbanism” trend is called “traditional neighborhood development.” It has also been termed “sustainable development.” Landscape architects and other urban planners are looking at the successes of traditions that developed over most of the history of urban development to overcome the enormous environmental, economic, and social problems we have created in recent times with the growth of suburbia. We can combine traditional development with modern technology to produce the best of all possible communities for people and for protection of our wonderful wild creatures. In spite of the historical and possibly inherently instilled attitude of people as conquerors of nature, new urbanists wisely look at nature as a model for urban planning.

One principle of new urbanism is to create communities that encourage less dependence on the automobile. We can create walkable communities by mixing residential and business use, by providing for physical comfort with designs that moderate the extremes of weather, by slowing automobile traffic within the community, and by reducing distances between residences and businesses. When a community is self-sufficient, automobile commuting to cities is reduced. To this end we provide office and retail space within the community. We provide retail space for daily needs within a reasonable walking distance of residences. Generally, a five-minute walk is short enough for the typical North American to refrain from using the car.(Duany) Certainly in the

warm humidity of the Deep South five minutes would be the maximum for much of the year. We moderate the weather by planting deciduous trees along the streets for cooling shade and by arranging streets and buildings to prevent wind tunnels in winter in a cooler climate or to bring in breezes in summer in a warm climate. Narrower streets serve to slow traffic and reduce infrastructure.

In addition to making communities walkable, new urbanism recommends using a variety of transportation choices that are efficient and well connected. Streetcars, cable cars, and buses are useful within the larger development, and rapid transit connections to nearby cities should be provided as well.

Another principle of new urbanism is energy efficiency in building and planting design. Building design should be based on the local climate to reduce the impact of summer heat and winter cold. Architects look at historical architecture for inspiration in such design and combine the features with modern technology to reduce energy consumption. Xeriscaping reduces water consumption in the landscape.

New urbanism uses natural wastewater treatment. Rainwater must be captured from roofs and hardscape, and it must be conserved and re-used. Rain gardens, parking lot infiltration basins, and detention ponds should be installed to achieve the purpose of capturing and cleaning runoff. Using brown water for watering plants is a feature of communities developed under the principles of new urbanism.

Cost Friendliness of Planning for Wildlife

Planning for wildlife may sound prohibitively expensive when you consider the amount of space to be set aside for wildlife habitat. Certainly, it is less expensive from the larger perspective of land use over time, since it is designed for efficiency of use and preservation of natural resources.

> ‘Building in harmony with the environment,’ [John L. Knott, developer of Dewees Island, South Carolina] explains, ‘is less expensive than dominating or destroying natural resources. Since all resources are limited, this practice contends that man can be a resource provider, not just a resource user.’ (from Wasowski)

In addition, it is has proven to be financially lucrative for the developers. Consider the successful communities described in Chapters 5 and 6. These communities were planned with wildlife conservation in mind, they set aside land for wildlife habitat, and several of them were built within nature’s envelope. As shown in several of these communities, this style of development does not have to be limited to high-priced housing, but can be utilized for a wide range of housing costs. Chapter 3 describes the cost savings of landscaping by the principles of building within nature’s envelope. With careful planning for wildlife and for people with the principles of new urbanism, the huge reduction of infrastructure results in savings that can make these communities less expensive than other suburban development types. The following quotation from Andy Wasowski makes this quite clear:

> “An important part of controlling capital outlay, says [John L.] Knott [developer of Dewees Island, South Carolina], is preplanning that can reduce infrastructure costs from 40 to 60 percent. ‘Let’s say I doubled the cost of the planning phase,’ he says. ‘That’s a drop in the bucket compared to the cost of the infrastructure itself. We builders are trained to think incrementally. We see things in little boxes. We know from past experience that this phase should cost so much, that phase should cost this much. But we have to learn to think holistically, considering the overall development.’ Builders, he contends, are the most creative resource in a community... It’s a flexibility Knott believes most of his colleagues will understand and adapt to.” (Wasowski 132)

Obstacles to Planning for Wildlife

There are a few obstacles to planning for wildlife. These include building codes, city ordinances, and the misconceptions of people already in a community suffering from suburban sprawl. People often fail to see the benefits of adding a larger, master-planned

community or traditional neighborhood development, as opposed to incrementally adding many new residential-only neighborhoods. Getting approval can be difficult from this perspective, since there are a great many people who are unaware of the environmental and human quality-of-life benefits of the new style of development. Nor do people realize the true cost of conventional development.

> Normal urban growth tends to be incremental and unrelated to natural processes on the site. But the aggregate consequences of such development are not calculated nor are they allocated as costs to the individual developments. While benefits do accrue to certain developments that are deleterious to natural processes at large (for example, clear felling of forests or conversion of farmland into subdivisions), these benefits are *particular* (related, say, to that landowner who chooses to fell trees or sterilize soil), while the results and costs are general. Thus, costs and benefits are likely to be attributed to large numbers of different and unrelated persons, corporations, and levels of government. It is unlikely that long-term benefits accrue from disdain of natural process; it is quite certain and provable that substantial costs *do* result from this disdain. Finally, in general, any benefits that do occur – usually economic – tend to accrue to the private sector, while remedies and long-range costs are usually the responsibility of the public domain.(McHarg 65)

Andy Wasowski discovered many of the building code and ordinance obstacles when he researched his book on building within nature's envelope, and especially when he presented a lecture to a group of builders. After Wasowski's lecture, the question-and-answer session revealed that:

> "many developers... wanted to build more environmentally but were confronted by mountains of red tape and local building codes... tree ordinances dictate the location and size of the shade trees on a property, and often perfectly healthy specimens have to be cut down to conform to these mandates. Nearby wetlands have to be drained despite the negative repercussions to wildlife. Excessively wide roadways and easements are required, shaving off chunks of property that might otherwise be left intact with native vegetation... codes that make it illegal to collect rainwater, use 'gray' water, or have understory vegetation – all environmentally sound practices. Other ordinances required that the property be reshaped so as to provide 'proper drainage' away from the house, in many cases destroying

> the indigenous vegetation and the natural topographical features that help give the property its character." (Wasowski 128-9)

Hope For the Future

Yet there is hope for the future. The few new ecologically designed communities have proven success with developers, builders, and residents. As the president of the Civano development, Kevin Kelly, said,

> People are seeing what we are doing here – and what a few other builders and developers are doing around the country – and they're liking it because it makes sense and it's achievable at affordable prices. They like the way we tread lightly on the land and use our natural resources wisely. They like how we take advantage of the free solar capital available here. And they like the sense of true community that exists here. The more the public sees of this approach, the more they'll be expecting other developers to provide the same kind of living environment. Conventional approaches just aren't going to cut it in the new century. (Wasowski 134)

Not only are the new, environmentally progressive urban planning methods gaining popularity, but the subject of urban sprawl and environmental degradation is constantly in the news these days. I have seen this trend develop over the time it has taken me to research and write this paper. When I first began, my sources were books and environmentally oriented journals. Increasingly in the past year, *Landscape Architecture* magazine has featured articles regarding the subject of ecological urban design, including specific methods covered in this paper, such as green roofs and the capturing and filtering of stormwater runoff. *Landscape Architecture* also featured an article about a landscape architecture firm, Conservation Design Forum, in Elmhurst, Illinois, that has employed a biologist to ensure that their designs are ecologically sound. Newspapers and radio and television shows are addressing these issues as well. New examples of a rebirth of environmental conscience in our country are constantly coming to light, giving me a sense that we will be able to turn things around before it is too late. Landscape architects

can – and should – play a critical role in this awakening by incorporating environmentally sound practices into their designs.

Suggestions for Further Study

Continued attention must be paid to new ideas and issues that arise in planning for wildlife, including environmental quality issues, which are always directly or indirectly connected with the success of wildlife preservation. Further studies should be done regarding the problem of wildfire and building within nature's envelope. Studies should be done to examine just how far people are willing to walk in the new traditional neighborhood developments under various conditions such as climate, weather, season, and destination.

References

Abell, Jo Ann. "Garden Havens for Pollinators." *The American Gardener* 82, no. 5 (Sep.-Oct. 2003): 35-39.

Bailey, Robert G. *Ecoregion-Based Design for Sustainabiltiy.* New York: Springer-Verlag, 2002.

Barnes, Burton V., Donald R. Zak, Shirley R. Denton, and Stephen H. Spurr. *Forest Ecology, 4th Edition*. New York: John Wiley & Sons, 1998.

Beatty, Russell A. "On the Wildfire Frontier; Planting Design to Manage Fires in the Rural/Urban Interface." *Landscape Architecture* 94, no. 5 (May 2004): 54-67.

Begon, Michael, John L. Harper, Colin R. Townsend. *Ecology: Individuals, Populations and Communities*. Third edition. Oxford: Blackwell Science Ltd, 1996.

Berger, Cynthia. "When Gardeners Grow Wild." *National Wildlife* 41, no. 4 (June/July 2003): 28-34.

Carson, Rachel. *Silent Spring*. Fortieth Anniversary Edition. Boston: Houghton Mifflin Co., 2002.

Cathey, H. Marc. "Good Breeding Curbs Invasiveness." *The American Gardener* 82, no. 2 (March/April 2003): 13.

Clermont County Department of Community Planning and Development http://www.co.clermont.oh.us/planning/clustering.htm

Cubie, Doreen. "Choosing a Tree for Your Yard? Go Native." *National Wildlife* 41, no. 6 (Oct/Nov 2003): 70.

Cubie, Doreen. "The Grass is Greener When You Grow Natives." *National Wildlife* 41, no. 4 (June/July 2003): 10-12.

Cubie, Doreen. "Backyard Habitat: Taking a Local Approach to Growing Vines." *National Wildlife* 41, no. 5 (August/September 2003) 22-23.

Darke, Rick. *The American Woodland Garden: Capturing the Spirit of the Deciduous Forest*. Portland, OR: Timber Press, 2002. 192-3.

Darke, Rick. "Designing the Woodland Garden." *The American Gardener* 81, no. 6. (Nov-Dec. 2002): 44-48.

Dennis, John V. *The Wildlife Gardener.* New York: Alfred A. Knopf, 1985.

Dramstad, Wenche E., James D. Olson, and Richard T. T. Forman. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning.* Harvard University Graduate School of Design, Island Press, and the American Society of Landscape Architects. Washington, DC: Island Press, 1996.

Druse, Ken. "Ken Druse Speaks: What's So Bad About Invasives?" *Garden Design* (Nov/Dec. 2002):17.

Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. *Suburban Nation, The Rise of Sprawl and the Decline of the American Dream.* New York: North Point Press, 2000.

Earle, Dan. *A Permaculture Primer*. 1996.

Eisenman, Theodore. "Sedums Over Baltimore, How a green roof made a rehabilitated building more sustainable." *Landscape Architecture* 94, no. 8 (Aug. 2004) 52-61.

Fontenot, William R. *Native Gardening in the South, A Personal Guide for Understanding, Appreciating, and Using the Indigenous Plants of Dixie.* Carencro, LA: Prairie Basse, 1992.

Gause, Jo Allen, et al. *Great Planned Communities*. Washington, D.C.: ULI – the Urban Land Institute, 2002.

Illinois Department of Natural Resources. *Public Attitudes Toward Open Space: The Unmet Demand for Open Space in Illinois*. http://dnr.state.il.us/pubaffairs/2003/July/OpenSpacessSurvey.htm

Kane, Rene C. "Prairie Flower." *Landscape Architecture* 93, no. 10 (10/2003): 122-131, 156-159.

Kimmins, J.P. *Forest Ecology, A Foundation for Sustainable Management.* Second Edition. Upper Saddle River, NJ: Prentice Hall, 1996.

Koehne, Maryalice. "Rainy-Day Gardens." *The American Gardener* 82, no. 2 (March/April 2003): 37-41.

Little, Charles E. *Greenways for America.* Baltimore, MD: The Johns Hopkins University Press, 1990. 105-116.

Lyle, John T. *Regenerative Design for Sustainable Development.* New York: John Wiley & Sons, 1994.

Martin, Alexander C., Herbert S. Zim, Arnold L. Nelson. *American Wildlife & Plants, A Guide to Wildlife Food Habits.* New York: Dover Publications, Inc., 1951.

Martin, Frank Edgerton. “Shorelines on the Prairie.” *Landscape Architecture* 93, no. 9 (Sept. 2003): 82-89, 105-108.

Mays, Vernon. “Walk on the Wild Side.” *Landscape Architecture* 93, no 12 (Dec. 2003): 83-91.

McHarg, Ian L. *Design With Nature*. New York: John Wiley & Sons, Inc., 1992.

Miller, James H., Karl V. Miller. *Forest Plants of the Southeast and Their Wildlife Uses.* Asheville, NC: Southern Weed Society, 1999.

National Wildlife Federation. www.nwf.org

Nickens, Edward T. “Living on the Edges.” *Audubon* 105, no. 3 (Sept. 2003): 81-86.

Pope, Thomas, Neil Odenwald, Charles Fryling, Jr. *Attracting Birds to Southern Gardens.* Dallas, TX: Taylor Publishing Co., 1993.

Rosenzweig, Michael L. *Win-Win Ecology: How the Earth’s Species Can Survive in the Midst of Human Enterprise*. Oxford University Press. 2003. 7-36

Ross, Gary Noel. *Gardening for Butterflies in Louisiana: a Guide for Gardeners, Educators, and Enthusiasts.* Louisiana Dept. of Wildlife and Fisheries, Natural Heritage Program, Wildlife Division. 1994.

Roth, Sally. *Natural Landscaping, Gardening With Nature to Create a Backyard Paradise*. Emmaus, PA: Rodale Press, 1997.

Rubin, Carole. *How to Get Your Lawn Off Grass, A North American Guide to Turning Off the Water Tap and Going Native*. BC, Canada: Harbour Publishing, 2002.

Sedenko, Jerry. *The Butterfly Garden, Creating Beautiful Gardens to Attract Butterflies.* New York: Villard Books, 1991.

Seidenberg, Charlotte. *The Wildlife Garden, Planning Backyard Habitats.* Jackson: University Press of Mississippi, 1995.

Smart Growth web site: www.smartgrowth.org

Stein, Sara. *Noah’s Garden, Restoring the Ecology of Our Own Back Yards*. New York: Houghton Mifflin Co., 1993.

Stevenson, Violet. *The Wild Garden, Making Natural Gardens Using Wild and Native Plants.* New York, NY: Penguin Handbooks, 1985.

Thayer, Robert L., Jr. *Gray World, Green Heart; Technology, Nature, and the Sustainable Landscape.* New York: John Wiley & Sons, 1994.

Theriault, Carmen. "Plants that Heal the Earth." *The American Gardener* 81, no. 6 (Nov-Dec. 2002): 23-27.

U.S. Fish & Wildlife Service. *Paradise Lost? The Coastal Prairie of Louisiana and Texas.* U.S. Geological Survey. October, 1999.

Wasowski, Andy and Sally. *Building Inside Nature's Envelope.* New York, NY: Oxford University Press, 2000.

Appendix A: Definitions

Exotic plant, or exotic species: a plant or animal that was introduced into an area of North America intentionally or by accident since the time of European settlement

Habitat: all of the components that are required for survival of a species - food, water, shelter from the elements, materials and locations for nesting and rearing young; even mating rituals can require specific components within a habitat.

Interior species: wildlife species that require large areas of habitat for survival and live only in the interior of these large habitat spaces

Native (or native species): a plant or animal that is indigenous to a specific area; in the United States this is species that were indigenous prior to settlement by Europeans

Riparian: related to or living in the area between water and dry land, e.g. river banks and flood zones

Sustainable design: the process of prescribing compatible land uses, buildings, and infrastructure based on local and regional limits of ecology, geology, geography, and natural resources

Sustainability: the ability of built or natural environments to maintain processes, functions, and productivity over time

Watershed: the area drained by a river or stream and its tributaries

Wetland: a biological community in an area of wet ground with water that is static or flowing, fresh or brackish, and which may have seasonal absence of surface water, e.g. marshes, swamps, peatlands

Wildlife: refers to native wildlife unless otherwise stated

Xeriscape: a landscape of plants that, once established, require no water other than the normal amount of rainfall for the region

Appendix B: Consent Form

Web Mail Printable Message Page 1 of 1

From: Helen A Peebles hpeebI1@lsu.edu
To: hpeebleS@earthlink.net
Subject: Re: Frank & Ernest permission request
Date: Dec 10,2004 3:11 PM

From:BobThaves@aol.com on 10/04/2004 23:12 EDT

Sent by: BobThaves@aol.com

To: hpeebll@lsu.edu
cc:

Subject: Re: Frank & Ernest permission request

Helen,

Okay to use the cartoon as you described. No fee unless you require a clean copy of the strip, or if the thesis appears in a publication which people pay to receive or contains advertising. If you use the strip, please add "used with permission of Bob Thaves" near the cartoon.

Thanks,

Bob Thaves

12/14/2004 ~

Vita

Helen Peebles is a native of Louisiana. She attended The University of the South, at Sewanee, Tennessee, from 1971 to 1973, where she began her undergraduate degree with a concentration in forestry. During her career as a mother of three, she returned to school at Louisiana State University, where she earned her Bachelor of Science degree in plant biology, with a minor in forestry, in 2000. Also at Louisiana State University she earned her Master's degree in Landscape Architecture in 2005. In 2003 she received the Plant Materials and Planting Design Award from the School of Landscape Architecture. She is a member of the Louisiana Native Plant Society, the Cajun Prairie Habitat Preservation Society, the Audubon Society, the Nature Conservancy, the Sierra Club, and the American Society of Landscape Architects.