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Ecologically sensitive wetland sites: an investigation of land use attitudes and development trends with educational objectives

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ECOLOGICALLY SENSITIVE WETLAND SITES: AN INVESTIGATION OF LAND USE ATTITUDES AND DEVELOPMENT TRENDS WITH EDUCATIONAL OBJECTIVES

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Acid bogs, one of the rare plant communities, are on the brink of extinction in the southeastern United States. This study uncovers what issues are at stake in land use, land development, and regulations of two specific areas in south Louisiana that contain this type of wetland.

This is an educational project oriented toward development of methods and information related to planning and design for the use of wetland sites while still protecting them. A hypothesis is presented that a combination of education with land use guidelines, helpful resources and regulatory incentives may help slow the eradication of bogs in the southern United States and increase the awareness of the importance of these small isolated wetlands.

Although small in size, acid bogs function in important ways to help society and surrounding natural ecosystems. Land use practices and attitudes towards building on sensitive inland wetland sites were investigated to discover what role developers and homeowners play in their destruction. Case studies of several Louisiana home sites found homeowner awareness of the wetland, but not of its value and consequently little effort being put into acid bog preservation. Property rights issues, plus the complete lack of market value recognition for the benefits of small inland wetland sites, were found to be at the root of the conservation problem. Likewise, a survey of developers in south Louisiana uncovered a disinterest in plant community preservation. Results point towards attitudes that seem to be governed by short-term monetary gain from wetland land use. Outdated development practices (draining and filling) in sensitive sites contribute heavily

to acid bog destruction. More importantly, wetlands are being destroyed due to a slow and confusing regulatory process as the regulations for them are being followed.

Guidelines and helpful resources are presented in order to lower development costs and facilitate acid bog conservation on individual sites. Moreover, findings indicate that an area wide effort is needed due to the unique connections that acid bogs have with underground water systems. Not only can improved design opportunities and higher property values be enjoyed through acid bog conservation, but cleaner and more available water for communities can also be achieved by developing properties in such a way as to protect the unique acid bog habitat.

CHAPTER 1: INTRODUCTION

Background

A rare plant community is on the brink of extinction. This paper focus is on certain types of small, isolated wetlands known as **acid bogs**. The simplified visual description for acid bogs will be - small, isolated upland wetlands of mostly an acre, usually covered with wetland grasses and related plants, but with few or no trees. These bogs occur at the point where the underground water flow is very near the soil surface, but there is usually not much standing water – just damp soils.

Acid bogs, along with all other wetlands, are most valuable to us because they greatly influence the flow and quality of water. Besides water purification and aquifer recharge, bogs may also participate in flood buffering, erosion control, and recreation and tourism at the individual site and on a regional scale. Bogs may even help globally by adding to the health of the ozone layer, and by helping fix atmospheric nitrogen into a usable form for plants and animals, and ultimately – us! In this way bogs make valuable contributions to society.

The ecological value of these places lies in their high productivity due to the richness of their soils which have built up over hundreds of years and in their unique hydrologies. Other important ecological values of acid bogs include exclusive habitat for some species and partial habitat for an abundance of many plants and animals because of site richness. Acid bogs serve as gene pools for their tightly packed plant and animal species mix, nutrient and energy circulators, and as a water reservoir during dry times.

Some species cannot survive without a unique water and fire-driven habitat. To illustrate the survival point, acid bogs themselves have been classified as globally

imperiled or very rare, as well as imperiled or rare in the state of Louisiana. Also, the fact that acid bogs are specialized habitats for many rare and endangered plants and some rare animal species lends urgency to this study. About sixty-two (62) rare species are known from an area roughly equivalent to the Florida parishes in southeastern Louisiana! Bog Spicebush (Lindera subcoriaceae) can now only be found in one location in Louisiana. Parrot Pitcher Plant (Sarracenia psittacina) is becoming hard to find in flatwoods and Longleaf Pine (Pinus palustris) savannahs. Several beautiful species of orchids can be found in acid bogs. Some are extremely rare, such as the White-fringed and Yellow Fringeless Orchids (Platanthera blephariglottis, and P. integra), the Southern Red Lily (Lilium catesbaei), and Spreading Pogonia (Cliestes divaricata). Bachman's Sparrows (Aimophila aestivalis), listed as very rare, are on the decline. They may spend some of their breeding season in and near bogs in the thick grassy protection they offer. A Pitcher Plant Moth (Exyra rolandiana) survives on the acid bog "pitchers" and two salamanders that are associated with bogs are known from very few sites within the state (Smith, 1986). See Appendix J, Rare and Endangered Species of Acid Bogs, for further listings.

Many acid bogs are situated on private property that is farmed, or that is surrounded by agricultural or timber companies. A particular water regime, either ground or rainwater or both, is the most important element in sustaining depresssional wetlands such as these. The largest concern at stake is for destruction of the all-important water basin, of which the bog is only a small part. Any obstruction of the water flow, either by ruining the clay hardpan underground thru ditching or compaction from heavy equipment, or diverting the flow in some way, such as by filling, would have disastrous results

or this fragile ecosystem. As a consequence, one bog left undisturbed might not survive within a highly developed suburb community or commercial strip.

The regular occurrence of fire is another important element of sustaining this plant community. Bog plants are adapted to fire: vigorous resprouting after fire incidence, and, fire requirement for flowering or seed germination in some wetland plant species i.e. Toothache Grass (Ctenium aromaticum), and Longleaf Pine (Pinus palustris), are other adaptive mechanisms. High temperatures during burning split the seed coats of these fire-adapted plants to hasten sprouting. Fire is also important for eradicating shrub and tree canopy over-story growth. Otherwise, in a space of just three years overgrowth would begin to crowd out the grass and the grass-related plant community. Although water flow regimes drive vegetation changes of herb-dominated depressional wetlands such as acid bogs, disturbances (such as fire) enhance how species live together, allow entry of other species, and thus maintain plant (and animal) community richness. Kirkman concludes that maximum species richness is probably balanced by disturbances and the natural succession from a less to a more populated local plant community. Given the national practice of fire suppression, not only by the U.S. Parks Services, but also by the populace in general, the future of small isolated wetlands hangs in the balance (Kirkman, 1995, 1998; Sutter and Kral, 1994).

Acid bogs in south Louisiana are in imminent danger of eradication due to: 1) **careless development in sensitive sites**, 2) **autonomous homeowner and developer attitude** and 3) **apparent lack of knowledge of the natural connections in their respective geographical surroundings**. How can these trends be turned around?

Careless development practices have resulted in the destruction of valuable wetland habitat both on private and commercial lands**.** Acid bogs, especially, with their high productivity and exquisite rare plants – are one of the plant communities on the endangered lists. They have been declining along with other small isolated inland wetlands due to their small size and due to the regulatory process. Homeowners' resolve to "do what I damn well please on my own property" has been stiffened with government regulation. Developers and builders are equally frustrated with the confusing layered tiers of federal, state and local regulations to conserve small inland wetlands. No one wants to be restricted; neither do they want unsightly land use in their own vicinity or development practices that may encroach on their own health and welfare. This development trend is especially evident in governmental restriction of private property land use in the interest of endangered species and wetland conservation. Currently, all property owners planning to develop a site containing a wetland must file for wetland delineation and site-plan approval through the U. S. Army Corps of Engineers.

Landscape architects, and developers in general, can provide a much-needed service to property owners who need assistance in the regulatory process, as well as in site design and installation. By utilizing conservation and best management practices in the development process, they can play a role in acid bog preservation as part of the stewardship role upheld by their profession and built into the services they offer the public. In a state rich in wetlands, developers can increase their public role by at least becoming knowledgeable about current wetland regulations and the regulatory wetland process.

Scope and Objectives

For this study, the following questions will be answered. What is the current knowledge level of homeowners and developers regarding bog identification? How does the developer or homeowner know if he has an ecologically sensitive site? If so, where would people look to find out? If bogs are to be protected, what is the best method of doing so? What are the current regulations regarding bog preservation?

Geographical areas known to have acid bogs in south Louisiana will be studied to better understand the factors that have brought acid bogs to the brink of extinction. Man-made changes have occurred in the study area, as elsewhere, much more rapidly than changes by Nature (Smith, 1986). Therefore, the focus of this paper is on recent man-made occurrences of land disturbance and land development within the study area and upon the attitudes that perhaps drive the use of the land.

This thesis will demonstrate:

1. Land use attitudes and land use practices of homeowners and land developers of certain small inland wetland sites – specifically bogs – are partly to blame for destruction of those wetland sites.
2. The effect governmental regulations have on the preservation of small inland wetland sites: the destruction of inland wetland sites occurring while current governmental regulations are being followed.
3. An educational focus aimed at homeowners and land developers of those small inland wetland sites may aid in the recovery of acid bogs in the study area, or at least help to slow down their destruction.

The above objectives will be accomplished by a five-step procedure roughly corresponding to the chapters outlined within the Table of Contents.

First step, there will be a literature review to uncover work already done to answer the above questions, and to guide the next steps (chapter 2).

Second step, there will be an investigation of disturbances occurring on three selected Louisiana home sites suspected to have a certain type of small, isolated wetlands known as bogs to understand what happens to a bog when the land is disturbed (chapter3).

Third step, attention will be turned to investigation of the attitudes of some local developers, builders, consultants, landscape architects, real estate agents and engineers in how they deal with these small, isolated wetlands in their projects within the vicinity of two metropolitan areas in south Louisiana (chapter 4).

Fourth step, there will be an assessment of the findings of the two preceding investigations to identify further actions and study (chapter 5).

Fifth step: finally, educational outreach and development guidelines will be proposed as a partial solution to the problem of disappearing, small, isolated inland wetlands. An informational pamphlet about sensitive wetland sites will be mailed to interested participants in the study. This pamphlet will contain information about the importance of such sites, how to identify them, and list “how to” resources for land usage on small wetland sites (chapter 6).

Landscape architects and those involved in the development process can play a role in bog preservation as part of the services they offer the public. Interested home-

owners and developers can turn to available sources outlined in this paper. Other noted sources can serve as models in restoring or preserving these special wetlands.

This study not only takes an in-depth look at the unique aspects of a fire-driven and water-driven plant ecosystem that is in danger of extinction at the southernmost edge of its range, but also points to the possible artificial causes of acid bog destruction in Louisiana. This study proposes an educational focus, land use guidelines and other helpful resources for conservation of a little-known plant community that has been overlooked by wetland preservation efforts in general.

CHAPTER 2: LITERATURE SEARCH

What Are Bogs and How They Function:

Louisiana contains one of the most wetland-rich regions of the world (Mistch, and Gosselink, 1986). The closeness of the Gulf Coast, as well as numerous streams and rivers, to the study area affords a large supply of wetland research material for this project. The distinct scarcity of material on small, isolated inland wetland bogs in the southern United States therefore seemed odd. Most literature on the subject of bogs is concentrated in the northern United States. The remaining body of work focuses on fens and bogs of Great Britain and Europe, and other places of the world. When Mistch and Gosselink (1986) review peatlands of North America there is no mention of bogs in the southern United States. Could it be that the chosen study subject area was so insignificant that is has been overlooked in the larger wetland picture? Or is it merely a matter of regional use of the term? The total worldwide acreage of bogs/fens is estimated to be 1,234 million acres (Finlayson and Moser, 1991). The acreage of bogs/fens for the southern part of the nation, in all probability, is not included in the above figure due to the scarcity of applicable information. Explanations for literature scarcity uncovered in this paper point to the fact that the individual sites are isolated, and Smith (1996) states that these southern bogs usually cover less than one acre, but almost always less than ten. Sutter and Kral (1994) found that isolation, as well as the small acreage of bogs/fens, of individual sites makes them more difficult to locate and document.

Another problem in understanding the subject matter was defining this type of wetland. Several sources were required to form a composite definition that fit this type of

wetland in the region where the study was conducted. There is a discussion of the problem of defining this type of wetland in Mistch and Gosselink (1986) due to the long use and misuse over the years of common terms to describe the different types of wetlands. A summary of wetland terms will be given next. Only a simple visual description was given for **acid bogs** in the Introduction chapter - small, isolated upland wetlands of mostly an acre, usually with few or no trees, and usually with not much standing water – just damp soils. A more in-depth explanation of acid bogs was uncovered from various sources and will be provided below. Also, the author's personal field experience on the thesis subject helped to contribute to an appropriate definition.

Wetlands have great diversity and have accumulated a range of definitions. **Wetland** is the broad umbrella term for many different types of plant communities. Wetlands spread across fully one half to two thirds of the U. S. (Mistch and Gosselink, 1986). They occur between permanently wet and generally dry environments, sharing characteristics of both environments, yet not classified exclusively as either (Finlayson and Moser, 1991). A **swamp** is a wetland with standing water *and* trees whereas a **marsh** is a wetland with standing water and *no* trees. Swamps extend through the southeastern U. S. over much of the Coastal Plain from New Jersey to central Texas (Mistch and Gosselink, 1986). Both of these plant communities are spread widely across Louisiana and may be adjacent to large or small bodies of fresh or salt water. Freshwater marshes in Louisiana account for over a half million hectares. Saltwater marshes along the Louisiana coastline constitute a large share of the total marsh acreage in the United States and are one of the most productive ecosystems in the world (Mistch and Gosselink, 1986). Both marshes and swamps contain high plant and animal species diversity (Finlayson and

Moser, 1991). **Peatland** is a general term for any wetland that accumulates partially decayed plant matter (Mistch and Gosselink, 1986).

A **fen** has come to be synonymous in North America with a swamp. It is a type of wetland fed by ground water or overland flow that produces a type of plant community higher in nutrient content than bogs, but because of saturated soil conditions still accumulates peat, or partly decayed plant matter (Finlayson and Moser, 1991). They occur as small "blankets across the landscape" and usually support marsh-like vegetation (Mistch and Gosselink, 1986). They can be found in both upland and bottom land positions throughout the state. Confusion begins when bogs are known as fens in the scientific classification (LaClaire, 1995).

Table 1 Inland Nonforested Wetland Characteristics and Terms

European Terms	Swamp	Marsh	Fen	Bog
North American Terms	**Marsh or Fen**			**Bog**
Characteristics				
Vegetation	Reeds	Grasses & Sedges		Mosses
Hydrology	Ground Water Fed		Rain	Water Fed
Soil	Mineral			Peat
pH	Roughly Neutral			Acid
Nutrient state	Rich	In-between		Poor

Source: Adapted from Table 3-1. Comparison of Terms (Mistch and Gosselink, 1993)

Bogs are small isolated wetlands with high species diversity for their size and with sensitive hydrology – that is, they are easily disturbed by factors that alter their water source (Kirkman, 1998). They are the smallest and least common plant community of those discussed. They are a type of wetland characterized by acid-loving vegetation. Bogs form when a high water table, fed by rain mostly, results in waterlogged soil. This,

in turn, lowers the levels of oxygen in the soil that allows accumulation of organic matter or peat (Finlayson and Moser, 1991). Bates and Jackson (1990) define bogs in their glossary as *alkaline* whereas bogs are designated as “waterlogged, spongy ground, consisting of primarily mosses, containing *acidic*, decaying vegetation that may develop into peat.” The term **acid bog** will be used here to denote bogs as defined by Kirkman, Finlayson and Moser, Bates and Jackson, and will include Smith’s definitions (see Appendix A, Terms). This plant community is noted for its adaptations to the water-logged and nutrient-poor soil conditions by the presence of Sphagnum mosses (Sphagnum spp.) and carnivorous plants. The most abundant plants in acid bogs are sedges or wetland grasses. Smith (1988, 1996) describes two kinds of acid bogs in Louisiana and their characteristics, as do the MacRoberts (1993b). See Table below.

Table 2 Acid Bog Types

Type of Acid Bog	Hillside (seep) Western Bog	Herbaceous (flatwoods) Eastern Bog
Occurrence	Along slopes of ravines and hills in southwest and central Louisiana	In the flatwoods region of longleaf-slash pine forest of southeast Louisiana
Soils	Sandy/pH=4.5/little peat buildup, CPA2	Acidic saturated soil, CPA3
Subsoil	Heavy clay and rock layers	On peat substrate (and clay layer)
Characteristic plants	Most abundant plants are grasses and sedges (Andropogon, Aristida, Panicum, Rhynchospora., Fuirena spp.), and other herbaceous plants scattered thoughout. Pipeworts (Eriocaulon and Yellow-eyed Grass (Xyris spp.) are conspicuous. (frequently found are Pitcher plants (Sarracenia spp.).	Conspicuous plants: Grasspink Orchids (Calapogon spp.), Pitcher plants (Sarracenia spp.), Bladderworts (Utricularia spp.), Sundews (Drosera spp.), Butterworts (Pinguicula spp.), Rose Pogonias (Pogonia ophiassoides), Club Mosses (Lycopodium carolinianum), Golden Crest (Lophiola americana), and grasses and sedges throughout.
Other comments	Is fire-controlled	Is fire-controlled

Source: taken from Smith’s (1986, 1996) bog descriptions.

Bogs may be contained within other plant communities. Such is the case with **pine savannahs** - a type of wetland found in seasonally flooded, mostly flat areas in southwest and southeastern Louisiana parishes. It is also characterized by acid-loving vegetation. It is a fire-driven plant community of sporadic shrubs, a few trees (dominated by Longleaf Pine) and longer drying out periods. Standing water is periodic (Smith, 1996). They may also be locally called "wet meadows."

Bogs can be formed in several ways by water flowing through an area. At the first stage, pooling up, brought on by some natural change such as beaver dams or the root

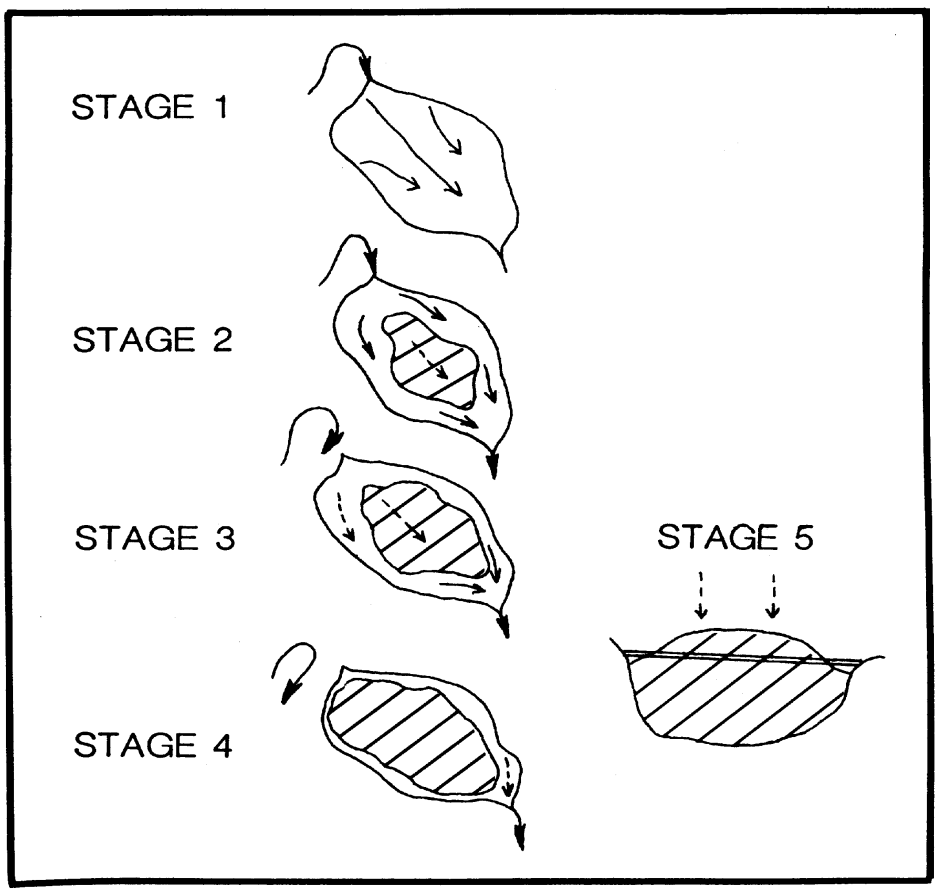


Fig. 1. Flow-thru succession of bog genesis (From Moore and Bellamy, 1974).

build up until the bottom rises above overland water flow (Pace, 1990). Overland water flow occurs only with peak floods in the last two stages, and is diverted by this build-up. In this way the soil acidity builds without the constant overland flushing mechanism, and the bog becomes mostly dependent on underground water flow to survive.

Organic matter builds up because of the slow breakdown of decaying plant matter in the waterlogged soil due to low oxygen conditions and low pH (acid) conditions in bogs. This process has low starting productivity when measured against a temperate forest, but yields a remarkable cache of organic material for its size with time. This "biomass" is measurable in grams per square meter produced each year (Marsh, 1997). The net result is that ecosystem inputs, though low, generally exceed the outputs and there is a buildup of peat or partially decayed plant matter (Mistch and Gosselink, 1986).

The quantity of available nutrients stored in the peat then becomes available upon each "pulse" or influx of fresh rainwater. The similar nutrient "pulse" cycle, as described by LaClair (1995) for small depressional wetlands, fits acid bogs also. She states there is a large vegetative growth response when late winter rains flush the bog and also noted low oxygen conditions exist. As seasons pass the soil becomes less saturated in mid-summer and plant productivity lessens. At the same time that soil drying occurs, plant tops begin to dry up and die, and oxygen returns to assist soil microbes in speeding up the decay process. The old plant parts are broken down to more simple humus that provides ready nutrients again to the plant community. The nutrients are then dissolved and made available upon the next rain event or influx of water to continue the cycle again.

A sound understanding of the dynamics of acid bogs came from many sources. Fire and water (hydrology) play a major role in the stability of acid bogs. **Water flow**,

either through the soil or in the form of rain as the "lifeblood" of acid bogs is discussed in multiple sources. Two *Wetlands* texts - by Finlayson and Moser (1991) and by Mistch and Gosselink (1986)– tell how rain washes nutrients out of the soil and then the slow breakdown of dead plants and other organic matter produces acids to form the characteristic natural bog (peatland) conditions. Mistch and Gosselink (1986) thoroughly cover water and soil chemistry in bogs. Soil water is one of the most important factors contributing to bog existence. Low oxygen, low nutrient content, and low soil-water pH (a measure of hydrogen and chemical exchange capabilities in the soil water) are brought about by the build up of partly decayed plant matter in the soggy soil. LaClaire (1995; 1992) and Mitsch and Gosselink (1986) recounted the role of water above in a life-giving wet and dry "pulse" effect. Journal articles reinforce the important water flow contribution to acid bogs. Vitt (1994) restates low nutrients and soil-water acidity are important factors for the classification of bogs. Weakley and Schafale (1994), in their study of isolated upland wetlands of the Blue Ridge in North Carolina, noted that plant community structure depended on water flow and topography (how the ground was shaped to hold the water). Similar findings, according to Tyndall (1990) and Cooper and Andrus (1994), state that water availability - the rate and length the flow is available - affects the amazing variety of bog plants that may be found in acid bogs. Schmidt's (1996) research papers on a southeastern Louisiana pine savannah/acid bog gave an overview of all aspects of hydrology on acid bogs in flatter terrain. She found that the pull of evaporation of moisture from plant leaves throughout the pine savannah/acid bog suctioned water vertically upwards through the soil to the plant community. Also significant was the utilization of more incoming water by the plant community than what

went out, demonstrating the “transformer-sink” behavior of acid bogs with respect to nutrients within the soil water. That is, that acid bogs accumulate and use what they get from the soil water to produce more plant growth. Most importantly, it can be inferred that the positive amount of water stored within the organic sandy soils there act as a natural local reservoir for times of drought and as an important aquifer recharge area for the water table.

Kirkman (1995, 1998) and Smith (1996) assure us that **fire** is one of the other essential ingredients in maintaining the health of the bog plant community. Smith (1996) and the MacRoberts (1993a) found that because of fire and water, only certain plants will grow in acid bogs. For instance, the saturated soil and clay hardpan discourage tree growth. Some plants have developed a fire resistance, such as Longleaf Pine (Pinus palustris). Cooper and Andrus (1994) have found that Spaghnum mosses (Spaghnum spp.) are favored in undisturbed, acidic sites that are waterlogged. Indeed, Mitsch and Gosselink (1986) and Vitt (1994) state that Sphagnum mosses are the best indicator plant for bog sites over the world. Kirkman (1995) recounts how natural fires sparked by spring and summer lightning strikes sweep through pine forests where bogs occur. Consequently, brush is kept cleared from underneath the fire-resistant pines and acid bogs are not overgrown by encroaching shrubs or young hardwoods. Fires also add natural potash or phosphorus, a major plant nutrient, from the burned plant matter back to the soil. Schmidt (1996) found that burning decreases soil moisture because quick seed germination and new growth quickly uses up available moisture in the ground and covers up bare ground exposed by the fire. Chapter 1 lists the ways Kirkman (1998, 1995) found that plant species have evolved to adapt to fire: vigorous resprouting after burning and

fire requirement for flowering or germination, perennials that reseed within one year, to name a few. Perennials – plants that take more than one year to go from seed to making more seeds – are favored over annuals in a fire-stricken location. Their tops may be gone after a burn, but they readily resprout from roots and crown parts.

Poor acid soil and waterlogged conditions promote unusual biological adaptations in plant species for conserving nutrients. Unique carnivorous plants preying upon hapless small insects with sticky digestive enzymes and slippery, tubular-shaped leaves – such as can be found in Sundews (Drosera sp.) and Pitcher Plants (Sarracenia sp.) – are just a few ways that plants survive rigorous bog conditions. Crawfish, a crustacean that inhabits many southern wetlands, simply dig a hole down to the receding water table during dry times leaving only telltale mud chimneys above the ground. Other less spectacular ways of survival include plant dormancy during drier parts of the year, and their rapid regeneration during the onset of another rainy period. Wet soil adaptations include oxygen leakage from some plant roots to provide a better micro-environment in the soil for local root growth, and reduced oxygen consumption in some plants or, conversely, large intercellular spaces for greater oxygen supply in others (Mistch and Gosselink, 1986).

The threat to these unusual plants' existence is due to their adaptations to life in the acid bogs. Although acid bogs are a rugged plant community used to extremes – droughts, inundation and a lean nutrient supply - they are intimately connected with the surrounding water basin and require fire to sustain them. The Community Ecology Group (1998) ranked communities of plants for The Nature Conservancy in North Carolina in order of species that globally are the most in danger of extinction. Acid bogs are

classified as critically imperiled globally. Latimore Smith (1996), of the Louisiana State Wildlife and Fisheries' Natural Heritage Program, similarly ranked plant communities in statewide species conservation order. Eastern and western hillside seeps, and herbaceous or flatwoods bogs are among the plant communities he covers within the state as most endangered, along with others including flatwoods ponds, wet and saline coastal prairies, bayhead swamps, and Slash pine–Pond Cypress/ hardwood forests. Louisiana's acid bogs have been classified statewide as imperiled or very rare.

A negligible amount of literature was found specifically on the benefits of acid bogs until a little used educational CD (compact disc) was uncovered (Beyt, 1999). The uniqueness of acid bogs was presented in an easy-to-understand fashion with interactive displays on carnivorous plants, rare animals, snakes, bugs, preserved bodies and other unusual features to reinforce the habitat as an outdoor learning laboratory. The value of acid bogs was gleaned from the larger "umbrella" topic of wetland values covered by several authors. General social and ecological wetland values of were found to apply to these small, isolated upland wetlands and be adaptable to the specific way in which acid bogs function within the larger water basin to which they are connected.

Wetlands generally benefit society in their high productivity, flood buffering capacity, erosion control, recreation and tourism opportunity, and by greatly influencing the flow and quality of water (Finlayson and Moser, 1991; Department of the Interior, US Fish and Wildlife Service, 1990). Mitsch and Gosselink (1986) note several global benefits to which acid bogs may contribute: evidence that methane, a by-product of the plant decay process, may help act as a self-adjusting regulator for the ozone layer, and also contribute an ecological share of nitrogen, a prime plant nutrient, that comes from

the fixation of atmospheric nitrogen gas by a small group of wetland plants and animals that convert it to organic form. Wetlands function globally in bird migration routes (Finlayson and Moser, 1991).

All wetlands, including acid bogs, provide a high level of public resource benefits on privately owned lands. The ecological values of acid bogs, shared with other wetlands, include exclusive habitat for some species, partial habitat for many, gene pools, nutrient and energy circulators, and water reservoir capacity (Mitsch and Gosselink, 1986). The functioning of wetlands, and acid bogs, provides essential support for plant and animal life in sediment and pollution control, and in food chain support (Mitsch and Gosselink, 1986; Marsh, 1997). Other wetland ecological values include habitat for an abundance of many species, fish–shellfish–and timber production, gene pools for their high diversity species mix, shoreline stabilization and saltwater intrusion control, and as water reservoirs during dry times (Finlayson and Moser, 1991; Jones, 1990).

Bogs can also contribute to social values at various levels (Jones, 1990). Marsh (1997) and Jones (1990) stated that owners can profit from their wetland, at the small scale, in a number or sustainable or non-consumptive ways: waste assimilation capabilities plus educational, aesthetic and visual-cultural values, not to mention recreational opportunities such as photography, bird-watching or hunting. Jones (1990) thinks the greatest value to society may be at the state or regional level. Participation in the downhill loop of the area hydrological cycle cannot be overstressed for acid bogs. The water basin may involve many individuals' properties and water could flow down through a large area before it came to the lowest elevation in the basin, such as with the Atchafalaya water basin. All the properties in this basin would benefit from the flow.

Also, these wetlands act as part of the unseen link between surface and ground water in the natural aquifer discharge and recharge systems (Odum, 1978). Bogs may also contribute to reducing flood peaks because of the higher capacity of their peat, or partially decayed organic matter, to absorb more water. Benefits of acid bogs, like other wetlands, include erosion control, water purification, aquifer recharge, commercial production (i.e.timber), wildlife habitat, recreation and tourism and aesthetic values (Department of the Interior, US Fish and Wildlife Service, 1990). Southeastern Louisiana bogs may also be used as a stop-over for wintering migratory birds. Therefore, the decline in wetland acreage constitutes significant losses of public and ecological benefits (Coreil, 1993; Gosselink, 1984; Mitsch and Gosselink, 1986).

Jones work (1990) was especially helpful. She presented the social values of coastal wetlands at the individual property scale, as well as at regional and global scales. The greater benefit to society comes from regional wetland benefits: participation in the water cycle and storm buffering capacity. She described values of that might come from wetlands on individual properties as: education and recreation, aesthetics and pollution control, as well as harvest value. The ecological values she presented, echoing those above – habitat, gene pool reservoir, energy and nutrient circulation and water level moderation – were helpful with acid bog functions and disappearance of endangered species from acid bogs. She presented a composite of guidelines for coastal wetlands that were adapted for forming the Land-Use Guidelines for acid bogs in the Regulation vs. Education chapter. She presented mostly ecological, but some design guidelines (see Table 3 below). A summary of her guidelines includes:

To protect the ecosystem, and choose appropriate designs and construction techniques to achieve first goal, or at least minimize disturbance to the ecosystem during land development. Monitor subsequent land use for above goals.

Table 3 Jones' Guidelines

Ecological Guidelines	Design Guidelines
Maximize the opportunity for net productivity	Maintain or restore overland flow through wetlands
Protect the subsidized energy flows and design them to work for human benefit	Choose the design that is most appropriate for the entire range of possible future rates of rise in relative water levels
Optimize limiting factors for the existing and planned communities	Raise all structures located in wetlands on pilings
Avoid creating trigger factors	Provide open space for natural processes and habitat in addition to human use
Optimize the carrying capacity of desired species, humans, and development	Create new wetlands, as compensation for those unavoidably destroyed
Do not interrupt biogeochemical cycling mechanisms or change their rates significantly	Avoid construction of canals
Evaluate the hydrologic regime with respect to the distribution of plants	Carefully evaluate use of weirs
Meet the requirements of wildlife of the site	Develop a mitigation design to reduce predicted unavoidable impacts
Do not reduce the areal extent of unique or highly diverse ecosystems, or those that support endangered or threatened species	
Design a data gathering program to study selected ecosystem processes before the synthesis phase of design	
Sustain the resiliency and stability of the ecosystems on the site	
Exercise strict controls on construction and other disturbing activity during occupation so that impact on wetlands is minimized	

Source: from Ecological and Design Guidelines, pp 31-86 (Jones, 1990).

A coastal wetland social benefits table by Kusler (1983) summarizes basic wetlands' contributions to society and the issues of concern that might reduce those benefits. (See Appendix K, Social Values of Coastal Wetlands). He covered seven social values of wetlands that pertained to acid bogs: pollution control, sediment control, flood

storage, recreation, aquifer recharge, and wildlife habitat. For instance, dredge and fill reduce the value of wetlands to provide wildlife habitat, reduces flood storage and aquifer recharge capacity and decreases the wetlands' ability to act in flood conveyance. This information was helpful in determining the seriousness of disturbances to acid bogs. Both he and Jones listed the various disciplines needed to analyze the issues of concern for the individual wetland benefits. For instance, in determining the aquifer recharge value of a site, a team consisting of an engineer, hydrologist, soil scientist or geologist, and a regional planner's services might be used. This was helpful in compiling a list of developers to question during the research. The above background information, along with the other studies of ecological functions of acid bog plant communities, contributed to the formulation of the investigative research procedures.

Wetland Development Trends

Background: Wetland development trends were researched to understand how the benefits of acid bogs have been impacted. At the same time that destruction of small, isolated inland wetlands such as acid bogs is eminent, there has been a growing environmental awareness in the population of this country of the fragility of ecosystems. Faulkner (2000) reported that avoidable manmade disturbances may take many generations to repair and environmental education has been linked to our own survival. Figure 2 below shows graphically that intentional rerouting of water supplies and damage from development (urbanization) take hundreds of years to mend. Groundwater misuse (exploitation) by humans is equal to a meteor strike from space in level of disturbance to natural systems, and takes longer for Nature to correct than the natural damage from tsunamis or volcanic eruptions.

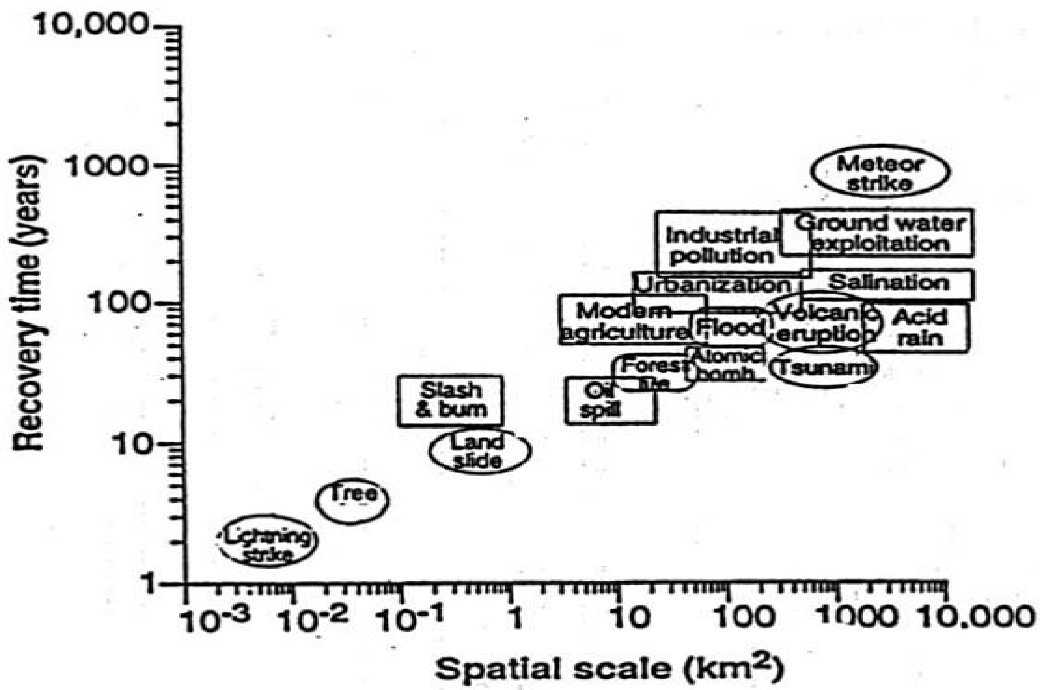


Table 1. The time scales for biological and physical processes involved in the development of ecosystems on a newly produced bare area.

Biological processes		Physical processes	
Time scale (years)	**Process**	**Time scale (years)**	**Process**
1–50	Immigration of appropriate plant species	1–1000	Accumulation of fine material by rock weathering or physical deposition
1–50	Establishment of appropriate plant species		
1–10	Accumulation of fine materials captured by plants	1–1000	Decomposition of soil minerals by weathering
1–100	Accumulation of nutrients by plants from soil minerals	1–100	Improvements of soil available water capacity
1–100	Accumulation of N by biological fixation and from atmospheric inputs	1–1000	Release of mineral nutrients from soil minerals
1–20	Immigration of soil flora and fauna supported by accumulating organic matter		
1–20	Changes in soil-structure and organic-matter turnover due to plant, soil microorganism, and animal activities		
1–20	Improvements in soil water-holding capacity due to changes in soil structure	10–10000	Leaching of mobile materials from surface to lower layers
10–1000	Reduction in toxicities due to accumulation of organic matter	100–10000	Formation of distinctive horizons in the soil profile

Fig. 2. Land disturbance/recovery time (From OCS 7001 class notes, Faulkner, 2000 taken from Table 1, The time scales…Dobson et al, 1997).

Marsh (1997) recounts that nowhere in the world has there been such a dramatic change in vegetation as in the settlement of the U.S. during the early clearing of the North American interior. With few exceptions, American farmers in the 19th and early 20th centuries were very hard on the land. Most known soil conservation and crop management practices were ignored. A large share of the deforested land was also converted to farmland and a veritable agricultural "parkland" emerged over large expanses of the Midwest, East and South. Even unusable wetlands, such as swamps, have been dramatically reduced or altered. What remains is often quite different from the original plant cover because the remaining wetlands may be too small to support viable populations. Wetlands have also been subject to disturbances such as compaction, sedimentation, and flooding that have eliminated certain ground plants and tree species and encouraged introduced species (Marsh, 1997).

Long-term developmental trends that started with colonization and clearing of the land for agricultural purposes (Marsh, 1997), coupled with logging practices into the early part of this century, set the arena for further development of urban areas. City dwellers took flight to smaller towns and suburbs began to sprawl away from their metropolitan centers (Sennett, 1990). This social movement was due to the growing dependence on vehicles within a steadily growing economic base, and also to an under-lying reliance on practicing our freedoms to go where we wanted, and do as we please in the pursuit of our daily lives (Southworth, 1993).

Federal agencies have echoed similar findings in their reports on wetland development trends. Indeed, over most of the past two centuries Americans have repeatedly enacted laws and devised programs that were aimed at encouraging the

development of wetland areas (Department of the Interior, US Fish and Wildlife Service, 1990). As a result, the U.S. has experienced wetland losses exceeding fifty-four percent (54 %) since the time of European colonization. Only recently have people begun to realize the value of wetlands to society. Wetlands are among the most biologically productive natural ecosystems in the world. Because wetlands, acid bogs included, are so productive and because they greatly influence the flow and quality of water, they are valuable to us (Wetland Training Institute, Inc., 1995).

Wetland perceptions and development trend attitudes:

People, throughout much of our history, regarded wetlands as foreboding, dangerous places, which had little economic value (Department of the Interior, US Fish and Wildlife Service, 1990). Public concern for pollution and runaway land development upon the nations' finite resources helped turn the tide of wetland exploitation (Dahl and Allord, 1994). Recent studies of attitudes towards wetlands helped to formulate appropriate questions for the survey phase of this study to probe the conservation ethic within the study area. Coreil (1993) found that people thought of wetlands as inferior land. He found problems between federal regulation of wetland development and the land rights issue. Another study by Adams, Dove and Leedy (1984) concentrated on more specific distasteful aspects of wetlands, such as insects and unsightly appearance. Conversely, this same study also found that people believed wetlands to be beneficial. The link between how people feel about small wetlands, or acid bogs, on their own properties and how they behave toward them in land development may be established with a survey of current land-use trends. Sommer and Sommer (1997) caution that

actions do not necessarily follow attitudes. Other factors involved with small wetland development will be covered below.

A literature search for acid bog development trends began with wetland status. MacRoberts and MacRoberts (1998c) found that the acid bog plant community conforms to regulatory wetland definitions and criteria, and should, in fact, be recognized as wetlands. The 1987 Wetland Delineation manual (Wetland Training Institute, Inc., 1995) notes that current wetland criteria are that 1) the dominant vegetation is the type that grows in wet soils, 2) that the soil have waterlogged characteristics of reduced, gray color and humus in the top few inches among other things, and 3) also that the time span the soil is saturated be more than half of the days of the growing season to a certain depth (=< 6.6 feet).

A description of the level of damage to this small, isolated upland ecosystem by recent land development trends is presented in a few recent scientific works and unpublished agency research papers. Smith (1986, 1996) describes the issues of endangered species to be shortages of information on them and their requirements, they occur at the edge of their natural ranges or in very tiny areas and have very specific needs, and last, but not least, they are feeling the pressures of careless development and land-use practices. Indeed, few people understanding the healthy functioning of ecosystems or realizing the extent to which humans remain dependent upon them. Smith (1996) noted the reasons for the rapid disappearance of acid bogs due to mismanagement or land-use practices are:

> Lack of frequent, properly-timed fires.
>
> Alteration of ground-water regimes that maintain bog seepage. Rates can be affected by the stocking density of trees upslope from the bog.

Mechanical damage from any machinery, including off-road vehicles.

Physical damage incurred from timber harvest and planting practices (e.g. soil compaction, rutting, bedding)

Conversion to Loblolly (Pinus taeda) or Slash pine (P. elliottii) plantations

Chemical pollution (e.g. herbicides, fertilizers) from adjacent managed lands.

Livestock damage from cattle, hogs and horses. Hog rooting has been a severe problem at times in bogs on Kisatchie National Forest.

Excessive foot traffic by visitors.

Residential and commercial development.

Weakley and Schafale (1994) recognized that acid bogs are threatened by surrounding agriculture and logging practices. They agree with Smith (1986, 1996) that management is clouded by poor understanding of the natural systems and connect saving the remaining sites with more research and education of the public. The critical nature of site-specific and regional threats on acid bogs was also discussed by Sutter and Kral (1994). They state that bogs require at least three to six months of a steady water source and a fire frequency of every one to five years. Pressure from agriculture and forestry, and from different types of development with the attending changes in local and/or regional hydrology were issues Sutter and Kral (1994) found to be threatening these isolated small wetland communities. They claim that mismanagement in the way of fire suppression has been particularly damaging.

In addition, how irreversible the changes to acid bogs might be was pointed out in the time-scale graphic in Figure 2 , which Faulkner (2000) borrowed from Dobson (1997). Mitsch and Gosselink (1986), Vitt (1994), and Pace (1990) all corroborate Faulkner, and expand on the lengthiness (hundreds if not thousands of years) for the

formation of acid bogs. This fact may be used as a precautionary note in land development.

All focused on the rapid disappearance of small, isolated inland wetlands, such as acid bogs. The combination of high number of endangered species noted by Latimore Smith (1986, 1996), Craig et al (1987), and Gilmore and Smith (1988), coupled with the fact there was limited local knowledge of this endangered ecological community in the scientific population, and almost none within the development field, provided the impetus for the research and for the educational focus of this project. Fuel was added to the fire, so to speak, when Smith (1986) and Gagliano (1973) reported that rampant development in the "North Shore" area above Lake Ponchartrain was the reason for the demise of acid bogs in that area. The MacRoberts (1998a) reported similar results for northwest Louisiana. Many authors (Gilmore and Smith, 1988; Fink and Searns, 1993; Coreil, 1998; Department of the Interior, US Fish and Wildlife Service 1990; Finlayson and Moser 1991; Marsh, 1997; Kirkman, 1998). supported the general historical trend that wetlands are fast disappearing due to urban sprawl and other careless development trends.

Regulations

A preponderance of regulatory information, including helpful agency personnel and websites, was available from the U. S. Army Corps of Engineers (1999). Current regulations state that any one proposing development on a property containing a wetland must apply for wetland delineation through the U. S. Army Corps of Engineers. Governmental agency pamphlets and research papers covered. The Department of the Interior, U. S. Fish and Wildlife Service (1990) and Dahl and Allord, (1994) recount the loss of over half of the nation's inland wetlands due to expanding agriculture and

construction projects. By the 1950s the extent of our wetlands had been greatly modified by ambitious engineering and drainage projects and the federal government encouraged land drainage and wetland destruction. Public concern in the 1970s for run-away pollution, urban sprawl, highway and railroad bed construction, and canal projects for transportation of commerce, as well as oil and gas development, began to turn the tide of legislation and policies that fostered wetland destruction. Marsh (1997) agrees with Dahl and Allord, (1994) that since the 1970s increased public awareness of, and education about, wetlands have improved peoples' understanding of the roles that all wetlands play in the environment.

A discussion of laws enacted to reverse wetland losses due to past development trends was covered by several authors. Coreil (1993,1998) describes Section 404 of the 1972 Federal Water Pollution Control Act or Clean Water Act (as it is more commonly known), which regulates wetland conversion. Wetland avoidance, minimization of effects to the wetland, or wetland compensation, known as "mitigation," are the guiding parameters for property owners to obtain permits that allow development on the wetland sites. A "no net loss" policy is in effect to maintain the nation's remaining wetlands acreage. Louisiana passed the Coastal Zone Management Act to reduce impacts to coastal zone waters and wetlands by land use regulation (see Figure 2 for the state coastal zone). A wetland permit from the Louisiana Dept. of Natural Resources (DNR), the regulatory agency administering the Coastal Zone Management Act, takes precedence over other wetland permits and also adheres to the "no net loss" policy. Agriculture, forestry and aquaculture concerns are exempt from permitting. Dahl and Allord, (1994) mention the federal "Swampbuster " Act that likewise discourages wetland destruction on agricultural

properties. Marsh (1997) relates the components of the 1972 Endangered Species Act, which provides protection for all threatened or endangered species on all land and marine environments within the country making it illegal to get, sell, kill or transport those protected species.

Finlayson and Moser (1991) reviewed other wetland conservation efforts in North America: government acquisition of wetlands and management as wildlife refuges, or designating them as high-priority wetlands to be set aside. Private organizations, such as Ducks Unlimited, The Nature Conservancy, and the National Audubon Society, are also buying wetlands in an effort to manage and preserve them. Dahl and Allord, (1994) report federal efforts to restore wetlands have increased and there appears to be a declining rate of loss although the findings do not include degraded or modified wetlands, and certainly not small, isolated wetlands such as acid bogs.

The Wetland Training Institute, Inc. (1995) discusses factors of soil and water in wetlands, along with wetland vegetation, as noted above in their instructions on how to delineate a wetland. The motivating factor for questioning developers on their knowledge level of plant species for acid bogs was formed when vegetation types and complexity were found to be the prime habitat valuation criteria set by the U. S. Army Corps of Engineers (Wetland Training Institute, Inc. 1995) in the wetland delineation process.

Other Studies and Helpful Resources

Previously conducted attitudinal studies were researched in order to better develop the case studies and telephone surveys. Coreil (1995) contributed an understanding of why attitudes were negative toward the regulatory process. He found that property owners held wetlands in low regard for land use purposes. It would then

make sense for these people to want to change the land to something more useable in their estimation, which the regulations are in force to prevent. Land rights weighed in heavily in this argument for land use. Adams, Dove, and Leedy (1984) conducted an early study on public attitudes toward urban wetlands for storm water control and wildlife enhancement. An appreciation for wetlands was uncovered although there was some concern among those questioned about living close to wetlands. Some thought there unsightly and there might be hazards from pests. Allen (1997) surveyed Alabama tree homeowners, mayors and board members, focusing on tree protection and preservation on construction sites. Both the Adams and Allen found a predisposition in their respondents for lower impact land development and ecological conservation.

A developers' point of view was presented in an essay titled "Confessions of a Developer" (Kaufman, 1999). The author recounts his career in the development industry and practicality issues of what people look for in buying raw or newly developed land. According to Kaufman (1999) people want a recognizable order and security – a road, edges, possibly electricity/water/ sewage. And most properties must be changed to give them this sense of place. He also discusses causes of negative public opinion towards developers and the duality of serving nature and the public's requirement for development. The public thinks poorly of developers because the changes they work on the land eliminate things they care about, and because some developers cut corners to keep expenses down.

The process required to assess the small wetlands for bog characteristics was adapted from previous studies by Laclair (1995) in a north-central Florida depressional pond study, from and Chance, et al (2000) in restoring a small, isolated wetland in

southwest Mississippi. The way soil cores and vegetative sample were taken and analyzed was described, along with observation techniques. In addition, Kirkman (1998) and Tyndall, et al (1990) described site selection and careful analysis of results in detail. Statistical analysis expertise was provided from Louisiana State University personnel, Statistics and Forestry Departments.

Site observation and analysis, and research on other similar wetland projects were also referenced to synthesize feasible wetland mitigation/restoration guidelines. Brzuszek (1999) wrote about restoration work at Crosby Arboretum where an old, wet strawberry field was turned into a lake with waterside attractions and a nearby acid bog was "restored." Important issues were the high water table that fed the bog, and much initial research to identify what exactly was on the site and what ecosystems and plantings it could support after development. Site management played a sizeable part in its success. The site also made use of gray water. Kirkman (1998) described reasons why studies of an isolated, seasonally-ponded, small wetland in southwest Georgia was considered high value: because of high plant species richness as well as the suitability of the site for an endangered frog. He and Fink (1993) recommended a transitional buffer zone to continue the connection to the nearby upland habitat and gave a nod for prescribed fire burns. LaClaire (1995) emphasized understanding the plant distribution of a temporary citronelle pond to develop the most appropriate management plan with an end of restoring two endangered animal species. She also explained about the sensitive nature of the small water basin and the element of fire for keeping the integrity of the plant community.

Plant keys and descriptions were used to assure the presence of acid bogs on the three case study sites. The author was assisted in plant identification by matching the plant descriptions and the conditions where they could be found in texts by Radford (1968), and Grelen and Hughes (1984) with plant samples collected from the study sites. The USDA website (1999), and the U. S. Fish and Wildlife Service, National Wetlands Inventory Center websites (2000) (see end of chapter 5) were used in verifying the wetland status of the case study plant samples. Louisiana State Herbarium and Louisiana State University botany personnel were consulted for unknown specimens. Various sources of information contributed to an indicator plant list for acid bogs to assure the presence of acid bogs on the three case study sites. Journal articles by Zoltai, and Vitt (1995) and the MacRoberts (1993b and 1998b) tabulated characteristic bog plants and noted the best indicator plants were wetland grasses and Sphagnum moss.

The agencies and/or websites contacted during the course of this investigation will comprise a helpful resource listing at the end of the Regulation vs. Education chapter. This information will be included in a final summary to be sent to interested participants in the study. A few examples will be noted here. The Louisiana Natural Heritage Program, LA Dept. of Wildlife and Fisheries, offered specific rare plant listings from anywhere in the state (Brunet, 1999), and have the personnel to compile an onsite analysis that helps site development and environmental management. The Nature Conservancy (MacGinnis, 2001) oversees the protection/ acquisition of sensitive sites within the state. The National Resources Conservation Service (NRSC) site (2001) gives resource data and maps on all aspects of our national resources in and under the ground and makes links available for other resources information such as the National Plants

Database, Water and Climate Data, and National Cartography and Geospatial Information databases. National Resources Conservation Service website provided an agricultural library resource for educational information on wetlands and links to the U. S. Fish and Wildlife Service to find out about endangered species within the country. The U. S. Army Corps of Engineers website (2000) and the EPA (2001) website yielded educational material on wetlands and their ecological importance and value to society.

An in-depth look at what is happening to acid bogs on homeowner sites was undertaken in this study. The next chapter begins the research aspect of this study by analyzing three Louisiana sites suspected of having acid bogs.

CHAPTER 3: CASE STUDIES

Case Studies Introduction

One of the objectives of this study is to investigate land use attitudes and land use practices of homeowners and land developers of acid bogs by investigation of disturbances occurring on selected Louisiana home sites suspected to have a certain type of small, isolated wetlands known as acid bogs to understand what happens to a bog when the land is disturbed. Investigation of the attitudes of a sample group of local developers, builders, consultants, landscape architects, real estate agents and engineers and how they deal with these small, isolated wetlands in their projects will be discussed in the next chapter.

This thesis is an effort in quasi-applied behavioral research that will show that:

1) rampant development in sensitive sites

2) to independent, self-directed and defensive homeowner attitude an

3) possibly lack of homeowner and developer knowledge of the natural connections in their respective geographical surroundings, the existence of southern bog sites is in imminent peril.

Case Studies Methodology

Case studies are descriptive studies and chosen for the fact that they emphasize the individuality and uniqueness of the setting and show changes over time. This method will focus on processes of change with attention to the role that individuals play in promoting or hindering wetland conservation. It is meant to provide illustrative examples within the larger thesis investigation of wetland development trends using multiple

methods. In other words, the case studies results may help explain findings obtained from the telephone survey. Reliability is obtained thru cross-verification of people's accounts and through use of multiple methods – observation, analysis of physical traces and public records to supplement interview data. Finally, local differences must be taken into account, since this is a local study of bogs at the southern-most limits of their habitat range.

The chosen method is guided by time and availability of resources and by the questions to be answered (Sommer and Sommer, 1997). In depth case studies are limited to three sites due to geographic dispersion of the sites, time limitations and budget constraints, therefore extrapolation to the general population is not possible. This type of data still sheds new and important light on this topic.

The choice of sites came from the author's personal knowledge of them for a fifteen to twenty year time span. Two of the three sites chosen for investigation were from the area in the state where most bogs occur – in west-central Louisiana. Prior knowledge of these sites was acquired by previous field trips to bog sites and wetland plant data collecting excursions. They were also picked to demonstrate a range of land use effects. These particular isolated wetlands are composed of less than an acre of land and most of them contained on private property. Numerous acid bogs may also be found on Fort Polk U. S. Army base, located at the southwestern corner of the Kisatchie district of the Kisatchie National Forest. The shaded sections in Figures 3 and 4 show exemplary areas/acid bogs.

Landowners whose property was suspected of having bogs were selected for case study participation. These particular sites were also chosen for their suspected

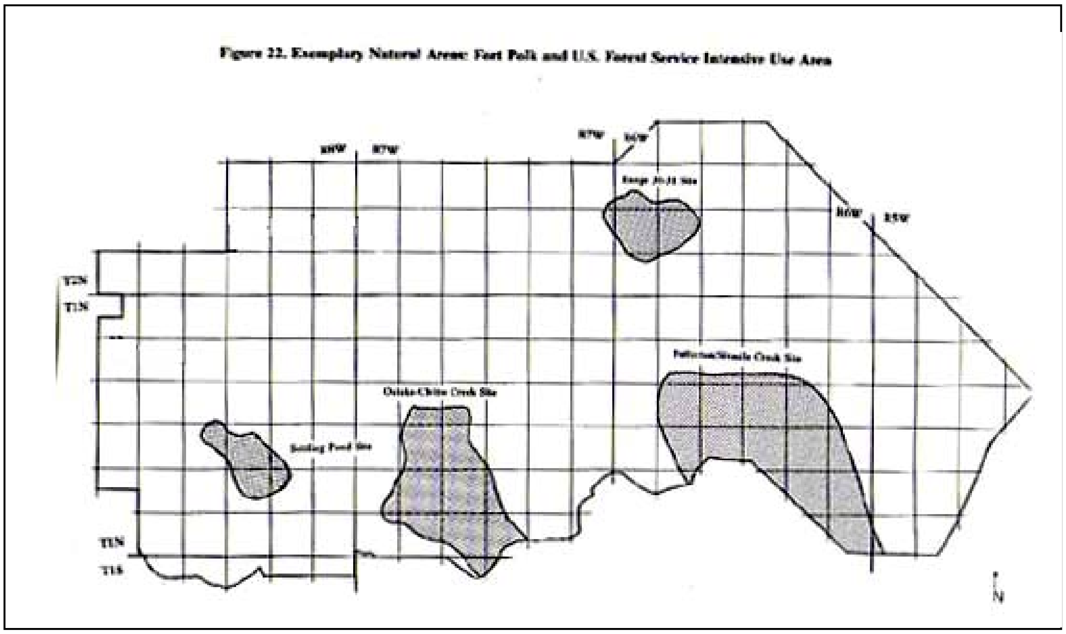


Fig. 3. Fort Polk and training area, Exemplary sites (Adapted from figure 22, Exemplary Natural Areas…Hart and Lester, 1993)

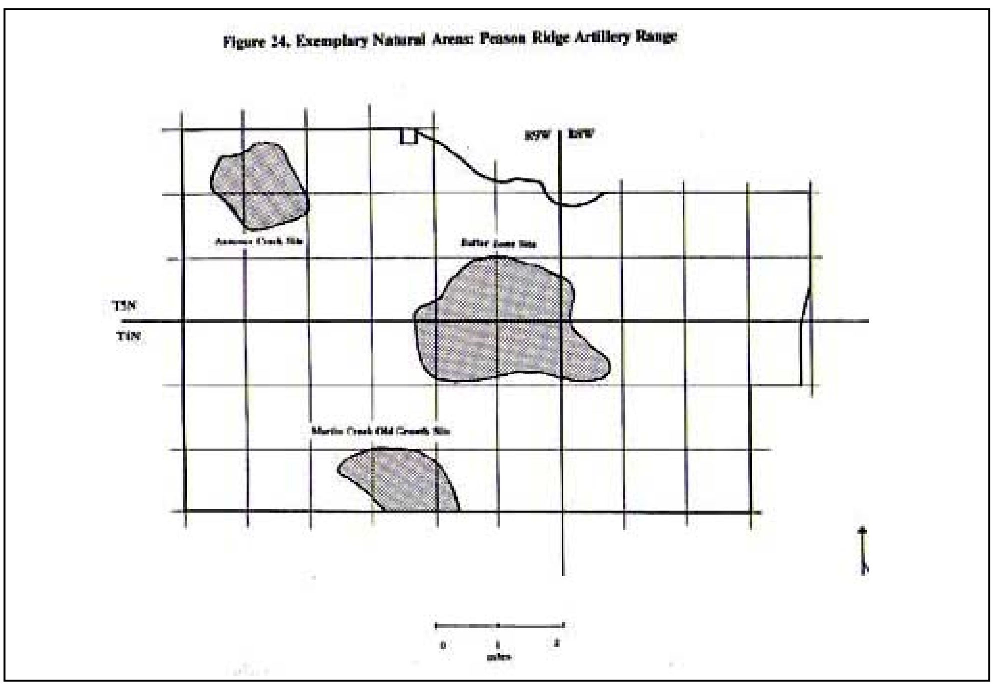


Fig. 4. Peason Ridge, Exemplary sites, Exemplary sites (Adapted from figure 24, Exemplary Natural Areas…Hart, and Lester, 1993)

progression of land disturbance. Their wide range of topography also demonstrates the diverse terrain acid bogs may inhabit. It is important to note unifying factors of all bogs are that 1) they occur downhill from a source of water flow (no matter how slow) which provides them with damp soil (Smith, 1986) and 2) they share plant species (indicator species) in common.

The three main wetland indicator factors - **hydrik soils, hydrophytic vegetation, wetland hydrology** (see terms, Appendix A) used by the Army Corps of Engineers in wetland designations - were taken into account to assess each site for presence of acid bogs. **Hydrik soils** are waterlogged soils formed under conditions of saturation, flooding or ponding long enough during the growing season to develop oxygen-less conditions in the upper part of the soil (USDA, National Resources Conservation Service, 1999; Wetland Training Institute, Inc., 1995). **Hydrophytic vegetation** is wetland vegetation. The most noticeable vegetation consists of plant species that are typically adapted to areas having water and soil conditions that are flooded or saturated by surface or ground water sufficiently to support wetland species. These species, due to physical characteristics, inner chemical processes and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce and/or persist in oxygen-less soil conditions (Wetland Training Institute, Inc., 1995). **Wetland hydrology** pertains to areas that are wet or damp part of the time, or the whole year; an area that is flooded either permanently or periodically at mean water depths =< 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation (Wetland Training Institute, Inc., 1995).

Vegetation status is one of the most important criteria of wetland health and rank high in the level of value attributed to a wetland in the delineation process done by the U. S. Army Corps of Engineers (Wetland Training Institute, Inc. 1995). Taxonomy keys, state herbarium personnel, and descriptive works of native plants for the South were consulted to identify wetland plants (Radford, et al. 1968; Grelen and Hughes 1984; MacRoberts and MacRoberts, 1993b, 1998b; Hart and Lester 1993; Wasowski and Wasowski, 1994). The USDA website (USDA, National Resources Conservation Service, 1999) was used to verify acid bog indicator plants and their wetland status ranking (see Appendix B). Recent works by the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program on wetland plant communities (Smith, 1986, 1988, 1996; Brunet, 1999; Hart and Lester 1993) were used to check species rareness/ endangered status. After the *Munsen Color Guide* (*Munsen Color Guide,* 1994) was used to classify soil core samples, agronomy and wetland experts from Louisiana State University assessed these same samples to confirm the correctness of the wetland status identification. In addition, Louisiana parish (county) soil survey maps published by the Natural Resource Conservation Service (NRCS) for the USDA were also consulted.

Site inventory:

Investigation procedures consist of:

1. bog verification data collection - vegetation identification for wetland indicator status, soil analysis to check for hydrik or wetland soils, and visual hydrology check to look for damp ground conditions.
2. land use data collection – parish courthouse title searches to uncover property land use over time and on-site images if possible to add to visual observations

3. client interviews – property land use disturbance over time) and attitudes toward land use and wetland preservation.

The same procedure was used on all three sites. The investigation at Mink, Louisiana is given below by way of example of the research process. Additionally, feedback will be provided to case study participants in an information mail out.

The site investigation for bog habitat was conducted – vegetation was collected and identified, soil core samples taken and analyzed, and images of the vegetation and the site were photographed with permission. The half-acre area with a suspected bog was assessed for wetland indicator species by collecting vegetation throughout the wetland area. Specimens were then identified and categorized according to their wetland status (see Plant Samples, Appendix C). Digital images were taken upon consent of the owners to provide not only vegetation details, but also give an idea of the lay of the land and of the bog in relation to its surroundings. The hydrology check was done by obtaining information on water well depth from the homeowners and by taking core samples and visually analyzing them for hydric soil color (see Soil Core Samples, Appendix B) (Smith, 1996). In addition, parish (county) soil survey maps were consulted to establish hydrik soil type presence in the study area.

A title search of the property was conducted at the parish courthouse to identify the chain of land ownership. It was hoped information on prior ownership might indicate previous land use. For instance, an owner with concerns in a lumber company might very well have the land clear-cut to harvest the timber. This in turn would be beneficial for the wetland by keeping overgrowth from crowding out sun loving bog plants. The landowner

was interviewed for land use history and types of disturbances that might have occurred to the land over time. Attitudes were discerned by cooperativeness given, willingness to provide unsolicited or solicited information, helpfulness in locating other adjacent wetland areas, and/or inquisitiveness towards conservation land use techniques.

The map indicates the approximate location of the three study sites in Louisiana. Two sites are situated in west-central Louisiana; the third site is in southeast Louisiana. The west-central sites are hillside seeps; the southeast site is a much flatter site than the two northern ones and is contained within a Longleaf Pine Savannah.

Site Introduction:

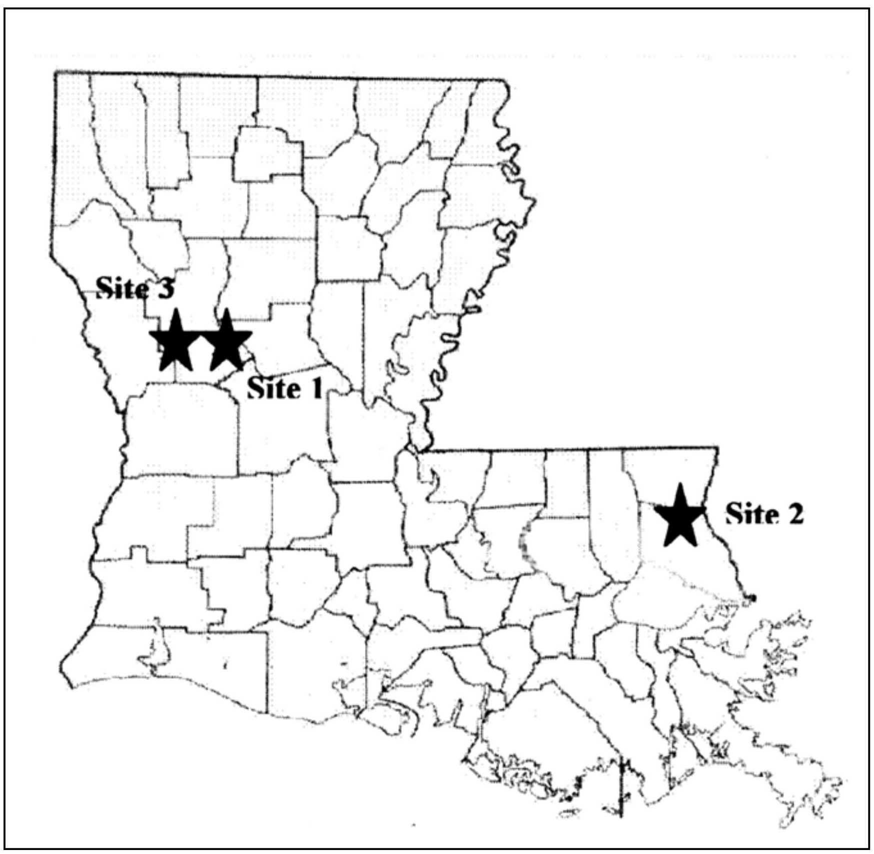


Fig. 5. Case study areas (from Location of St. Tammany map, Trahan, et al., 1990)

Areas of attention for this paper, as mentioned above, will include investigation of land use attitudes and land disturbances occurring on three selected home sites thought to have a certain type of small, isolated wetland defined as acid bogs. Site 1, at Mink, Louisiana is a privately owned site in west-central, LA amid rolling country side; Site 2, at Lake Ramsey, Louisiana is a second privately owned site in southeast, Louisiana -the site is well known in the environmental community (Schmidt, 1996; Smith, 1996,) and its wetland status and preservation are well documented. The Louisiana Dept. of Wildlife and Fisheries manages a large section (Martin, 2000). Site 3, Kisatchie, Louisiana is a third privately owned site in west-central, Louisiana. It is the steepest of the three properties investigated for wetland plant communities. The western and southern property lines are adjacent to the Kisatchie National Forest.

Case Studies Findings

This phase of the study was conducted in the summer and fall of 2000, during the third year of a statewide drought. Soils were still damp and bogs were verified on all three sites. The sites under investigation displayed a "continuum" of disturbance from the Kisatchie property with the least land disturbance to Mink having the worst disturbed site. Ironically, the site with the most radical land use had the richest bog, and visa versa.

1. Mink Findings

The site was found to have not only a small Upland Bog community, but an attending baygall as well. Baygalls, or bayhead swamps, are typically dense, often flooded forested wetlands whose midstory canopy consists of evergreen shrubs and little herbaceous cover in the often-flooded depressions where Sphagnum moss can form thick mats. Baygalls generally occur on lowest positions in the landscape (Smith, 1996).

The edge of the wetland was striking in this open field site. It could be identified by a totally different type grass with only a small amount of mixing of wetland and non-wetland species at the lip. Yellow Pitcher Plants (Sarracenia flava) and other colorful carnivorous plants were prevalent in this bog. The indicator plant, Spaghnum moss

Fig. 6. Mink site (Image by Byron Sevario)

(Spaghnum sp.), a hallmark of most bogs (Vitt and Belland, 1995),and other wetland plants were evident throughout. Collected plant species were identified and listed with their wetland status. (See Plant Samples, Appendix C)

Hydrik, or waterlogged soils, were also found both in core samples and by observation. (See Soil Core Samples, Appendix B) The appearance of crawfish chimneys and damp soil, including standing water, continued from the lowest bog elevations next to the baygall to within three quarters of the way up to the bog edge, which was six to eight feet

higher in elevation. In addition, parish soil survey maps showed presence of possible hydrik soil types in the study area (Butler, et al. 1990). Soil type for this identified was in the Beauregard-Malbis-Guyton complex (See Appendix D, Soil Surveys).

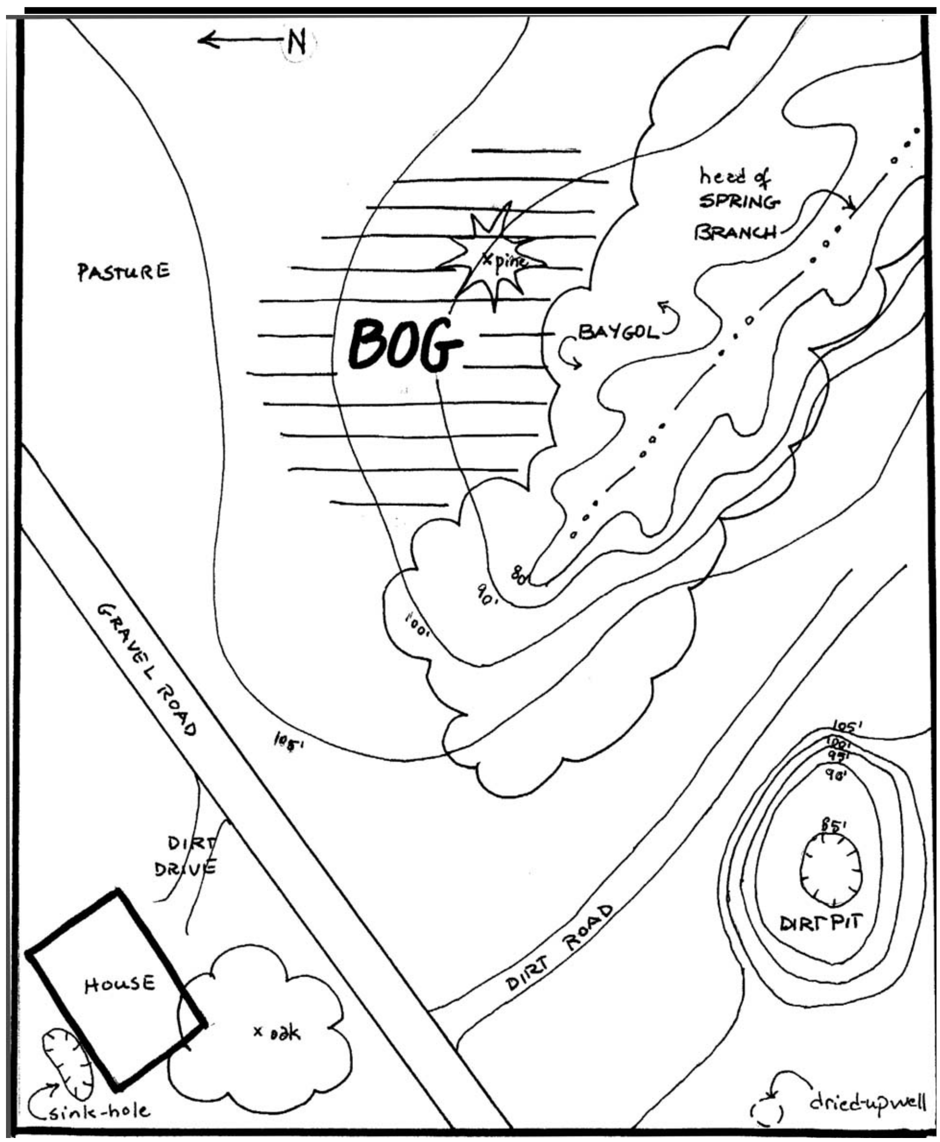


Fig. 7. Mink site plan (not drawn to scale)

The hydrology check in the fall of 2000 followed three years of drought conditions. A check on water well depth was done by obtaining information from the homeowners. A large sinkhole had developed behind the house, which was positioned

some distance uphill and across a parish road from the bog. Owners recounted their dug water well depth to be eighteen to nineteen feet (and guessed the same for the nearby sink hole). Well water depth was nine to ten feet. With this information, it can be surmised that a substantial underground water flow was occurring even in the drought. Depth to hardpan can also be placed by water well information at the ten-foot limit in the uphill location near the residence.

The title search and the homeowner interview indicated that extensive logging had occurred around the turn of the century. Agricultural uses such as cattle grazing and crop farming were the most likely activities on what was an old home site used for three generations.

At first, the current landowners were reluctant to give information because of an expressed belief that government regulation may possibly follow. However, proprietary pride and neighborliness overcame their suspicions, and recent land use and site disturbance were discussed. Interviews revealed the site in question had been used as stated above for grazing, and as a hay meadow. An acre-size garden area was evident uphill from the acid bog. Also found uphill from the suspected bog/ baygall community, a large dirt pit, fifteen to twenty feet deep, had been dug in 1998. In the words of the resident, the pit went down past the "white clay." Two weeks after the interview with the homeowner the baygall was bulldozed and the meadow with the bog community mowed down with a bushog.

2. Lake Ramsey Findings

The historical disturbances on this site included sporadic logging and burning up to the early 1920s. A campground was established for recreation on nearby manmade

Lake Ramsey. Recent suburb development began fifteen years ago in the area, and the Nature Conservancy moved to buy up large tracts of the surrounding site for ecological preservation (Martin, 2000).

Talks with the owner had the same resulting defensive attitudes as the owner of the Mink site concerning agency interference on his private property. The landowner stated he bush hogged the property because of fear of having his property declared a wetland and being restricted in using it as he desired.

Fig. 8. Lake Ramsey site (Image by Paul Chance)

The client described other recent land disturbances such as plowed firebreaks and a man-made ditch running through the property. He expressed an interest in bulldozing

away the undergrowth along this area with the purpose of landscaping the ditch to increase its “attractiveness.”

This site was naturally about a foot higher than the surrounding bog / Longleaf Pine flatwoods community. Fill dirt had been brought in to raise the grade of the land to

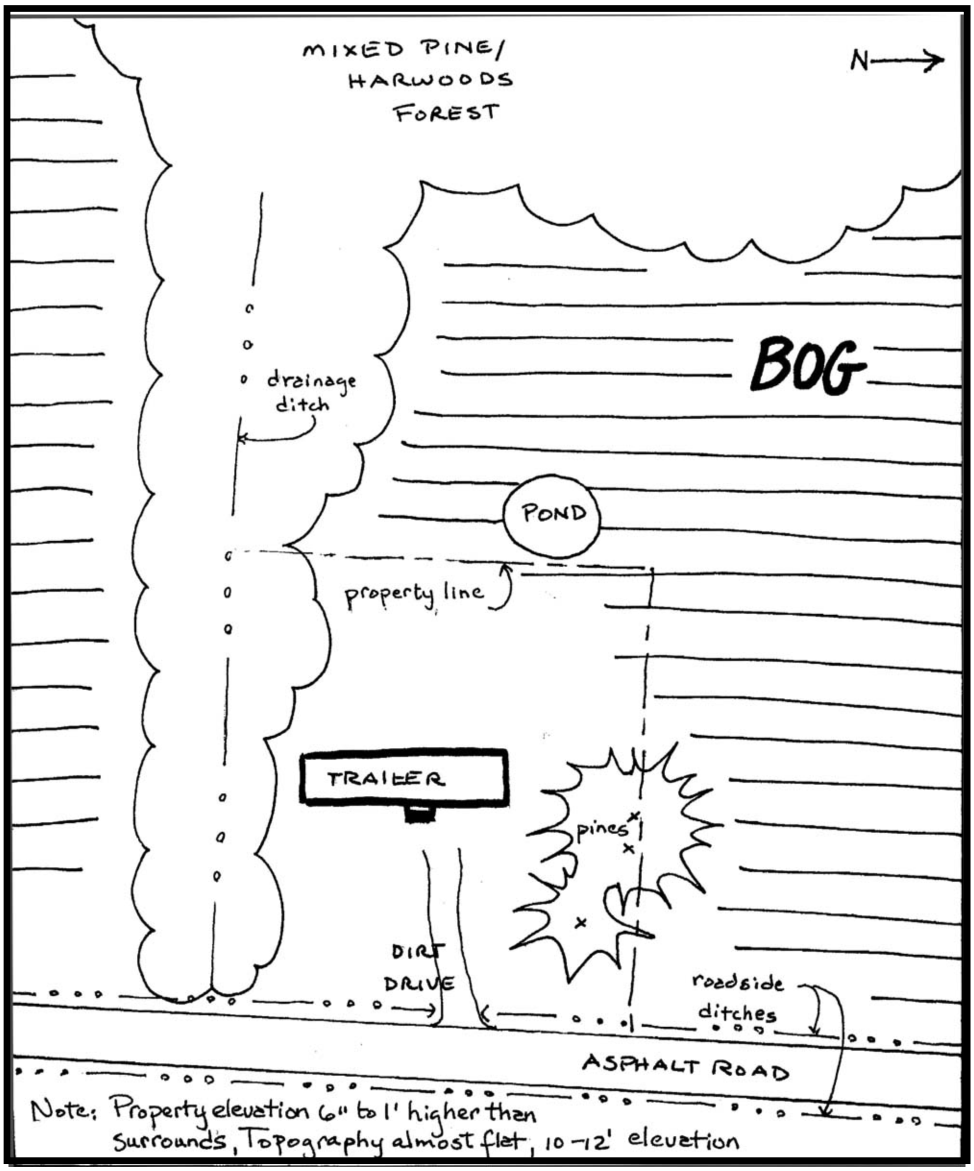


Fig. 9. Lake Ramsey site plan (not drawn to scale)

improve the site for his mobile home. A well had been installed some time earlier and no other visible disturbance to the site had recently occurred by the fall 2000 interview.

Permission was reluctantly given to collect soil and plant samples, although no images were allowed. Soil corings and plant specimens were taken and analyzed as with the Mink Site. (See Appendix B for soil results and see Appendix C for collected plant species / wetland status) The Myatt soil series is the wetland soil identified at this site, which sits adjacent to Guyton soils that predominate throughout the surrounding savannah/bog (See Appendix D, Soil Surveys).

The entire area is a rapidly growing residential subdivision. Garbage was found dumped in front of the Louisiana State Wildlife and Fisheries Wildlife Management signage nearby marking the set-aside conservation area.

3. Kisatchie Findings

This is the steepest of the three properties investigated for wetland plant communities, (see Appendix C for collected plant species / wetland status) and had a hillside seep with hydric soils (see Appendix B for soil results), but the fewest of wetland plant species because of invasion of trees and woody shrubs throughout the uneven, sloping terrain. Ossier or Briley soil series were determined to be the prevalent soil types (Butler*,* et al. 1990). See Appendix D, Soil Surveys.

Historical land uses for this rural site have included heavy timber cutting at the turn of the century, and dynamiting of pine stumps to obtain turpentine. Information about land disturbances was obtained from neighbors, and former owners, as there was no home on the site at the time of interview. Dim logging roads on the uphill side of the property, and family memories of a home place around fifty years ago are reminders of what may have occurred on this site. A hand-dug well (originally fifteen feet deep) was found just off the west property line and a former owner told of an old house long since

Fig. 10. Kisatchie site (Image by Paul Chance)

gone that was situated in a clearing on the top of the hill at the southwest property corner. Other past land uses included a kitchen garden and barn near the old house. The passing of time saw only hunting activities and wild hogs rooting in the undergrowth. No evidence was found of forestry management practices such as control burns to clear undergrowth that might have spread from the newly established Kisatchie National Forest onto the case study site. The western and southern property lines are adjacent to the Kisatchie National Forest, which was established in the 1930s. A clear cut about eight years ago was one of the last major disturbances in recent times leaving deep visible ruts and large tipped-over pine roots.

Visual investigation for hydrology / damp soil conditions turned up wetland soil conditions. The main flow seep from the hill occurred off the southwest property corner and was reported in the interview as continually flowing until 1999 and 2000, the last two

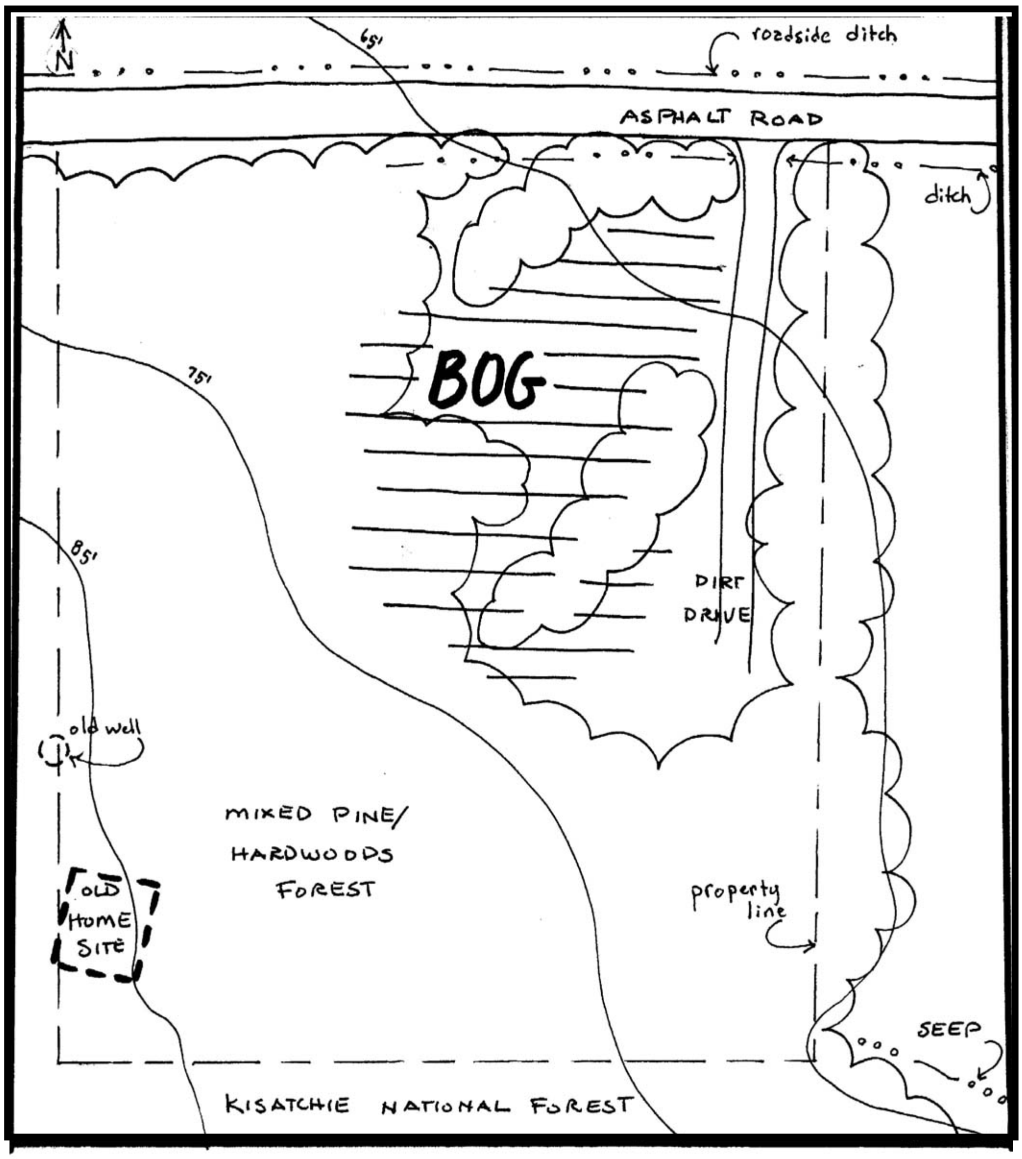


Fig. 11. Lake Ramsey site plan (not drawn to scale)

years of a recent three-year drought. Within the last five years the hillside seep area was bush hogged two or three times because of lush-growing grasses, another factor pointing toward perennial vegetation and damp wetland soils even in times of drought. The same

investigative procedures were followed here. Because of the danger of erosion, this site was perhaps the most sensitive to any development. An incline of about fifty to sixty feet (50-60') occurs from the front to back property line.

Previous owners knew of the seep on the face of the hill, but "didn't pay much attention." New owners are amenable to control burns of the site and selective clearing of shrubs and young trees to open the site up for possible bog restoration. Careful building placement and the lowest impact land development procedures are being considered.

Case Studies Analysis

The independent, self-directed stance displayed by the homeowners in this phase of the research point to the freedoms enjoyed in the United States today. The data suggests that property owners prefer to make informed decisions regarding the outcome on their land. The defensive attitudinal findings of the owners of the case study properties reflect the fact that nobody likes to be restricted on their own property. This attitude is more evident in the southern U. S. due to the historical manner in which the land was used (Walsh, 2000). This study corroborates another attitudinal wetland survey done in south Louisiana that found one of the two most frequently cited responses towards wetland owners' listed issues/needs categories being the private property rights issue (Coreil 1995).

A possible negative attitudinal stance might be suggested from the garbage found dumped in front of the Louisiana State Wildlife and Fisheries Wildlife Management signage marking the set-aside conservation area. This observation was made in the vicinity of the Lake Ramsey site. There were many other likely dumping sites along the way. This finding conflicts with other studies noting a preference by private property

owners for nature or wildlife preserves to locate next to their properties (Coreil 1995). Such preference might be explained by the human need for green space (Jones, 1990).

Limitations of the study methods are that 1) observation may have low reliability which equates to repeatability (a component of internal validity), 2) the telephone survey questionnaire may gloss over deeper, significant issues because due to time constraints (Hollay, 2001) or the respondent saying what they think the interviewer wants to hear, and 3) conflicts may arise between information from different sources. Generally, different methods provided flexibility but there also is a risk of reactivity where the first procedure may affect the results of the rest (Sommer and Sommer, 1997). In both the case study interviews and the telephone survey questions about sensitive topics were asked towards the end of the interview to avoid “red flag” terms.

Eradication and degradation of acid bogs can be seen from the case studies. The Kisatchie hillside bog site displayed damage from heavy machinery as a result of timber cutting operations. The damage resulted in possibly speeding the water flow out of the bog area and lessening the high count of flowering plant species of the bog by drying up the soil. Mining the ground below the hardpan level, over which the underground water flows, as was done at the Mink site, has the same disastrous results for this fragile ecosystem. As a consequence, a nearby well had dried up and crops had withered as a dramatic indication of the disturbed hydrology. It would be important to know the depth to the hardpan not only for construction purposes, but also for purposes of preservation of the endangered ecological plant community, not to mention maintenance of rural water supplies for those who depend on wells. As stated earlier, no one mentioned protection of

the area water system, although there was mild concern detected from the Mink landowner interview about resources on his own property.

It is impossible to surmise why the Mink owner eradicated the baygall and mowed down the bog. Perhaps he feared repercussions from governmental agencies as a result of having this site studied, or simply wished to put more acreage towards agricultural use. There have been little repercussions from land use disturbances to the acid bog sites to draw interest or attention in their favor as ecologically sensitive. The interest to their detriment comes from people assuming that since endangered animal species can be protected on private property, then endangered plant species protection will follow along the same lines. Not so. There is nothing that can be done if a private property owner wishes to destroy the last single remaining individual of an ecologically endangered plant community (Martin, 2000)!! The Endangered Species Act does not apply to plant species living “in place” so to speak, but only to getting them and the further actions that might be taken with the endangered species after acquisition.

Interest in plant ecology will always be necessarily limited to events that strike close to the property owner’s health and well being. The major land disturbance at the Mink site – a large pit dug at the top of the hill above the baygall and bog – had the consequence of a nearby well drying up and crops withering as a dramatic indication of the disturbed hydrology (see image, next page).

The fill added by the Lake Ramsey site owner did not change the already high water table surrounding his home. He simply eradicated bog plants from his property by covering up the existing plant community and allowing more upland species to take their place in the resulting higher soil. This was still a blow for the endangered plant

community, and is multiplied many times more in the same area by the encroaching subdivision. No one witnessed the bog community on the Kisatchie site become invisible while the natural progression from open to forested land occurred. Only a fire could have caused the rebirth of the hillside bog, but fires have necessarily been suppressed near home sites. It is feared that until a dramatic lessening of water purity and water supply is experienced for many large and small water basins, or some other drastic threat to private property owner's health and well being occurs, there will be no general acceptance of conservation measures for endangered wetland plant communities. Consequently, acid bogs – with their unique water flow requirements - will continue their demise.

Fig. 12. Endangered sites (Image by Paul Chance)

Until that time small seeds of inquisitiveness for low-impact land use information and conservation appreciation can still be found in two of the three case study interview results: the Kisatchie owners are amenable to preserving their hillside bog and possibly maintaining it with proper control burning; the Lake Ramsey owner prefers to build thoughtfully trying for less impact to the sensitive area he already occupies. All three case study site owners requested the summary information of this research.

The major findings of this chapter were that landowners had mixed views about their acid bogs. Land use generally did not take into account best management practices or conservation issues. As a consequence, acid bogs were being destroyed. Land use will be covered from the developer's point of view in the next chapter. Attitudinal findings toward the wetland development process and the regulations that guide it will also be given.

CHAPTER 4: TELEPHONE SURVEY

Telephone Survey Methodology

Introduction: This part of the study investigates development trends on sensitive wetland sites and developers' attitudes towards wetlands in southern Louisiana, which is the southernmost edge where acid bogs are found in the United States. The two geographic areas of wetland development are selected: the greater Baton Rouge area, and a larger area above Lake Ponchartrain known collectively as the "North Shore" area (see map below). There are several reasons why these two areas were selected for comparison.

Fig. 13. Telephone Survey study areas (From fig. 1.1, LA Coastal Zone. Jones, 1990 & from Location of St. Tammany map. Trahan, et al, 1990)

The Greater Baton Rouge area is experiencing some infill growth and growth at the edges. The statement that, "all the good land is used up, so all that's left are wetlands" is a generally accepted notion of this area. It is an interesting contrast with the North Shore area, which is experiencing rapid growth in all its wetland areas as people continue to

move northward from the crowded New Orleans crescent. The" North Shore" study area is bounded on the west by the town of Albany, on the northwest by Amite, on the northeast by Franklinton and Bogalusa, on the east by the Mississippi-Louisiana state line, with the northern shore of Lake Ponchartrain as the southernmost edge. Both areas are in the Gulf Coastal Plain, and both contain a general lay of the land that graduates from low, flat land to gently rolling country. Both areas have a wealth of rivers, creeks, and bayous, although, the North Shore has a higher occurrence of lakes and small bodies of water.

The general rise in elevation of the Baton Rouge parish area is gradual to 50-70

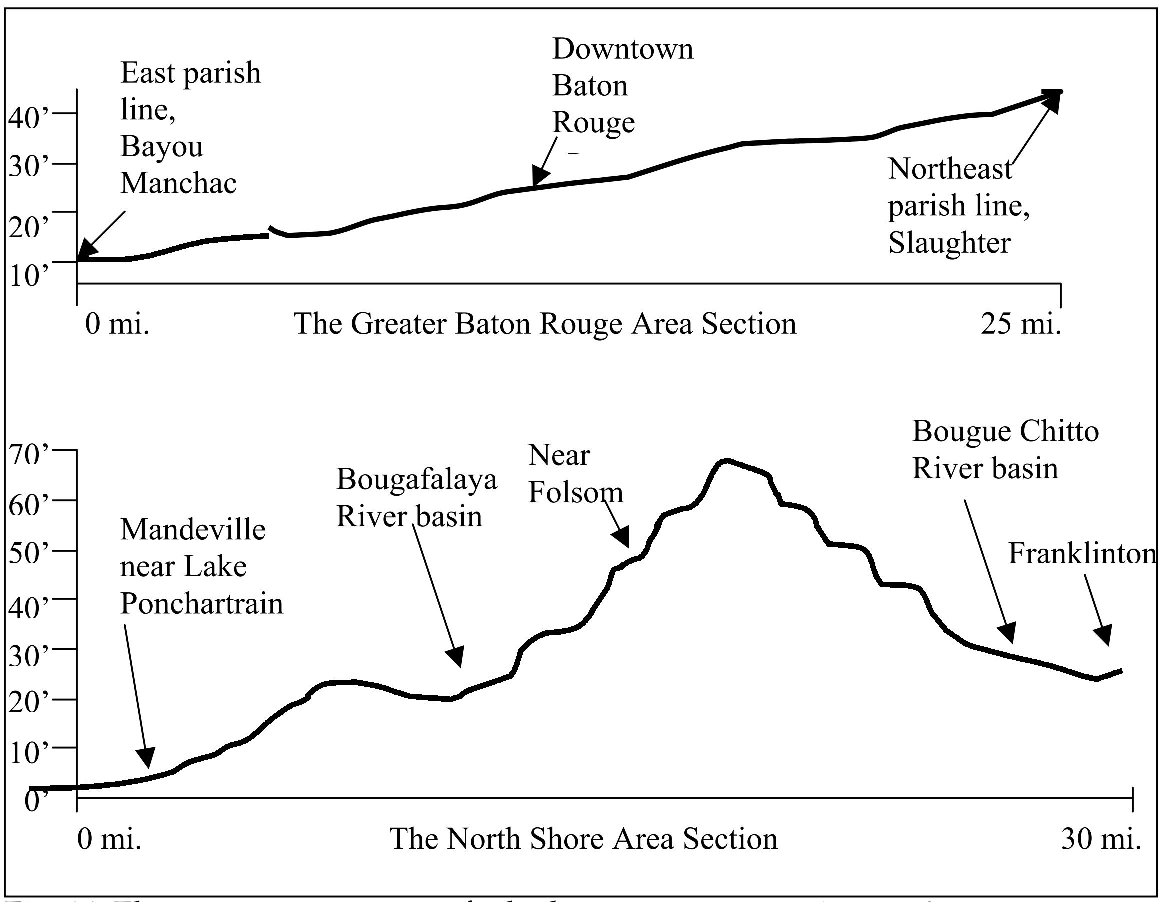


Fig. 14. Elevation comparisons of telephone survey areas (Drawn from Baton Rouge, New Roads, Amite & Ponchatoula quadrangle maps. USGS, 1984, 1983a, 1983b & 1983c)

feet (USGS, 2001) above sea level; the North Shore has more varied topography. The higher land in the North Shore upper area, going to 95-110 feet mostly, falls lower than the Baton Rouge study area in its southern reaches, standing at just a few feet above sea level near Lake Ponchartrain (elevation of Mandeville is 3-10 feet), (USGS, 2001).

Telephone Questionnaire Process: Questionnaires are more successful in identifying attitudes and opinions than other behavioral research techniques because it is the most helpful research method to explore the importance or value of an issue to the person being questioned. To learn what people think, they must be asked. Behavior towards those issues may also be examined. Additionally, the questionnaire is economic; it does not require the apparatus of an experiment or the time investments of long observation (Sommer and Sommer, 1997). The mail-out questionnaire and the telephone survey questionnaire were two methods considered to investigate development practices in wetlands, and bogs in particular, in south Louisiana for these reasons: ease of elaboration, higher and more reliable response rates, higher confidentiality levels and, most importantly, because they allow better quality of return information and more thorough investigation of the context of complex issues.

The self-administered questionnaire is very efficient, but requires clear instructions and careful wording. With the telephone survey, clarification is easy. When a respondent has a question or it becomes clear to the telephone interviewer there is a misunderstanding, the issue can be dealt with immediately. That being said, efforts must be made to avoid prompting a certain response by waiting for the respondent to reply in his own words (Hollay, 2001). For this reason the telephone survey is chosen over other methods to enhance the response rate and to ensure clarity regarding the type of wetland

site under investigation. Telephone interviews are more thorough and better for dealing with complex issues (Sommer and Sommer, 1997). In these ways higher and more reliable response rates can be achieved. Better results can be achieved by the degree of detachment that can be maintained over the phone while at the same time allowing sensitive issues to be broached. Although in face-to-face interviews expressions and body language can be helpful, tone of voice and response time can also be noted with this method. This would be impossible with an impersonal mail-out questionnaire. The survey is considered the most effective way to gather opinions while still maintaining confidentiality. Anonymity is assured to each respondent, and University Internal Review Board protocol is followed throughout (See Appendix G, IRB Approval Form).

Again, the multi-method approach chosen for this investigation serves to bolster research reliability thru cross-verification of results. Two research instruments were used to accomplish these objectives: 1) case studies and 2) the telephone survey. Open and close-ended questions will be used in this part of the study. Statistical analysis of the data will be performed using a number of standard analytical techniques.

The telephone survey method questioned land developers who had wetland designations applied to their land development projects within the two chosen study areas. A target list of individuals and companies was obtained from the U. S. Army Corps of Engineers, Louisiana New Orleans District, which is the governmental agency that performs wetland designations in the area. These project owners, who recently had wetland designations done by the Army Corps, were contacted to investigate land use practices and attitudes. Their referrals were also called. All land developers were placed into descriptive categories: builders, consultants, developers, engineers, landscape

architects, realtors, others (government agencies, child care). Area phone book yellow pages were looked up when there was an insufficient number of a type of respondent in a development category. An attempt was made to get at least five individuals per category to fulfill the target number of respondents approved by the Internal Review Board at Louisiana State University for this portion of the study.

A recorder was used initially to facilitate data gathering. To increase cooperation a cover letter was mailed out prior to the survey asking each individual if they would like to participate and the best time for them to receive the survey call (See Appendix G, Cover Letter). A pretest or pilot test was conducted to reduce telephone survey ambiguity. It included questions to verify if wetland sites were used in land development projects in south Louisiana; it also attempted to ascertain any interest in receiving information on acid bogs (See Appendix E, Pretest).

Next, a series of written questions on the wetland development topic was formulated with a combination of closed-ended and open-ended questions. This technique has been useful for determining the importance of an issue in people's minds. This method helps the researcher discern the major contributing factors of a complex issue and may help cut down on the time-consuming tendency of people to ramble – even on the phone (Sommer and Sommer, 1997). Attitudinal scales were used to measure developers' opinions and attitudes towards land use and regulation.

The entire questionnaire is included in Appendix H, Telephone Survey/Answers, along with tabulated results. The first three questions were formulated to qualify respondents as suitable candidates for the survey. If the respondent *had* encountered "small, isolated inland wetland sites with few or no trees, no standing water, but with

wetland grasses" and wanted to participate, they were included in the survey. The fact that they *would* or *did* continue with their project once the wetland feature was identified was also a requirement for getting put on the survey list.

The single most important question on the telephone survey, "**How were these sites used in the development**?" was important for gaining knowledge of current wetland practices. Two questions were formulated to be scaled attitudinal questions, similar to Likert scales (Hollay, 2001). These questions were concerned with the importance of relevant factors in the land developer's decision to proceed with development. They were the most important questions to determine current land use attitudes. They also provide insight to developers' attitudes on governmental regulations and regulatory agencies. Quantitative results are obtained from scaled questions, whereas, much of the data generated from the rest of this research is descriptive or qualitative data.

Three questions were used to determine developer knowledge of wetlands or wetland information sources. They asked about the general and specific criteria used to identify the site as a wetland or bog. Because helpful information may also be obtained in other ways, the respondents were also question on the literature they might receive or the volunteer/professional organizations that they belong to or whose activities they might participate in. Additionally, this last question may determine if conservation attitudes are connected to information availability. Inquiries were also made for demographic information on company size and wetland development benefits to the company.

Negative answers to the first three qualifying questions may also hold useful information (Sommer and Sommer, 1997). Those who indicated that they had not worked with wetland sites and would not develop on wetlands of this study type were asked

questions fashioned to glean all possible data on what the deterring factors might have been. Valuable information might be brought out, such as: a developer might hold back on a project because of economic reasons if he knows that it will cost more to develop a property containing a wetland. Conversely, it could be found that there is a trend not to develop for conservation reasons. To improve participation, information feedback to participants is promised upon completion of the project.

Both qualitative and quantitative raw data answers will be grouped and statistically analyzed. The data will be analyzed for statistical significance. The quantitative data is used to support the qualitative findings of the telephone survey, as well as the results of the case studies.

Telephone Survey Findings

Noted below is the data breakdown for the survey population from U. S. Army Corps of Engineers' wetland delineation/permitting process, which consisted of a two to three year listing (and also their referrals). Legislation requires that these landowners, who wanted to do development work on their properties containing wetlands, have a wetland delineation done before obtaining a permit to work on them. Forty-eight of the total eighty-four people questioned about their wetland projects qualified by having properties containing wetlands, were in the study area and agreed to become telephone survey participants. The first three questions of the survey identified forty-eight indivi-duals, or fifty-seven percent (57 %), of the survey sample as usable survey candidates. This was the population sample being tested. An impressive eighty-five (85 %)percent return was produced with this investigative method and the entire wetland designation population was surveyed for this study area. After the survey, four lists were generated:

Table 4 Respondent Breakdown

Survey Population	Number of responses	Percent of Total
Total usable respondents	48	57%
Non-usable respondents	23	27%
Total respondents	71	85%
No response	13	15%
List total	84	100%

Even though total responses were exceptional, time, economic resources and help limitations precluded further telephoning efforts. Phone conversations rarely took less than a half hour each. Initially, a recorder was used, but quickly found to inhibit responses, especially in the rating questions. Use of the recorder was discontinued and responses were hand written. The “no response” list included those who could not be reached after five callbacks or those with incorrect addresses. Telephone survey responses may be found in Appendix H, Telephone Survey/Answers. Respondents with development projects outside of the study area were put in the “non-usable” category. The usable respondent list was broken down into the type of respondent represented:

Table 5 Type Companies in Telephone Survey

Type Company:	Numbers of Respondents:	Percentage of Survey Population:
Builders	6	12.5%
Consultants	9	18.8%
Developers	5	10.4%
Engineers	7	14.6%
Homeowners	1	2.1%
Landscape Architects	7	14.6%
Realtors	9	19%
Others	4	8%
Totals	48	100%

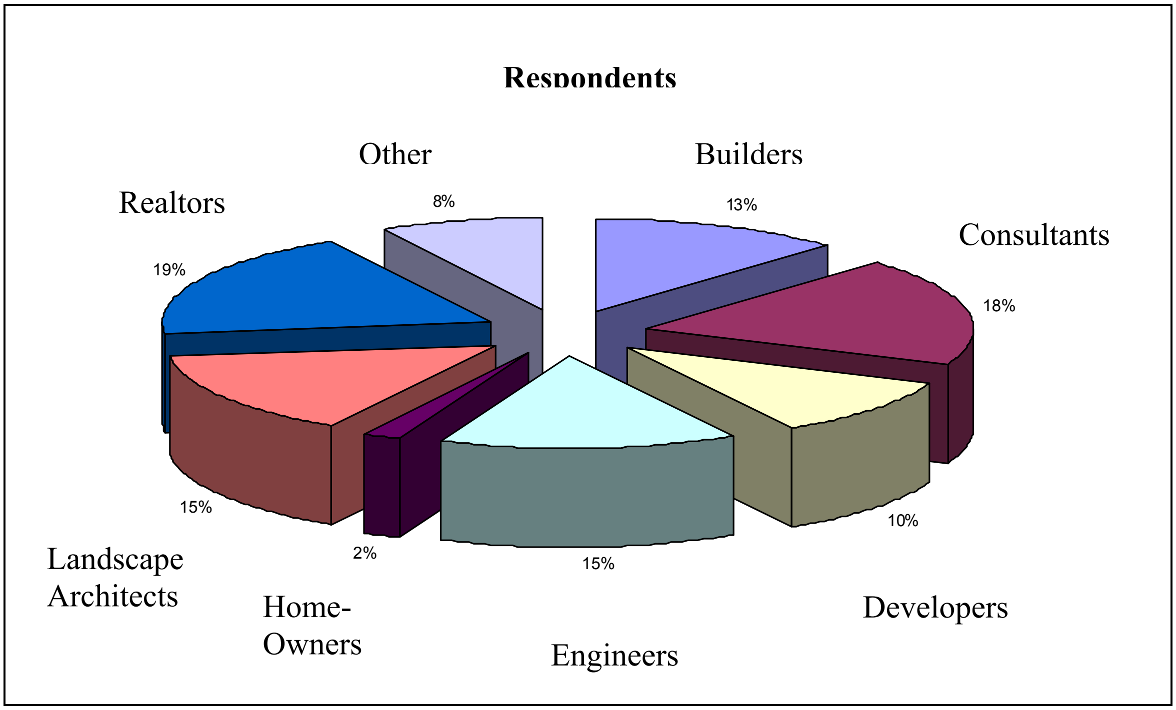


Fig. 15. Respondents' breakdown for telephone survey

The difference between developers and builders is that the first coordinates and oversees the development process where the builder does the actual installation. The data break-down to gender types from total usable respondents in figure 16 below was as follows: of the forty-eight number of respondents, seventy-five percent (75 % or n=36) were male, and twenty-five percent (25 % or n=12) were female.

The software used for statistical data analysis was SPSS/PC version 10 Statistical Analysis. Based on a total of forty-eight applicable respondents, frequency of responses to each question was recorded and percentages calculated to associate answer clusters with important development factors. In addition to recording the frequency of each response per question, a mean rating was calculated and used to rank the answers. Differences between the means for applicable respondents' answers were tested for significance using t-tests with P-0.05 being significant and P-0.005 being very

significant. Chi-square analysis further identified where the significant differences in opinions existed (Allen, 1997). See Appendix I, Statistical Analysis for results.

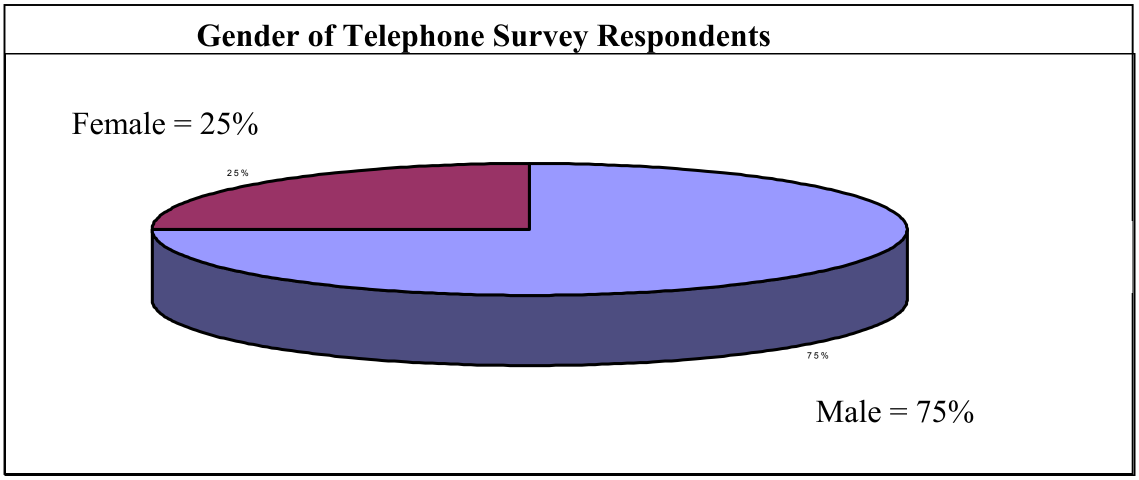


Fig. 16. Gender summary for telephone survey

The fact remains that Louisiana continues to lose wetlands while land developers are following (or avoiding) governmental regulations to protect them. This single-most important observation is supported by the findings and comments yielded from the telling question **- "How were these sites used in the development**?"

The single most-often used land development practice was "filling" the wetland, reported by twenty-seven respondents, which is more than half (56%) of the developers questioned. A full eighty-one percent (39 or 81%) of developers practice fill and draining. One respondent pointed out clearing increased site usage, while five reported

Table 6 Development Practices

Development Practices	**Responses**		**Development Practices**	**Responses**
Filled	27		Left undisturbed	10
Ponded (catch- basin drainage	4		Other	1
Drained (ditched)	12		Enhanced	3
Protected	4		Manicured	0
Fenced	0		Cleared of debris	5
Posted	1		Planted	4
			Other	1

"clearing out debris as a land enhancement. It is important to note that many respondents (14) used a combination several categories of land development practices for treating one property. This includes the respondents (9) who qualified the type of development action

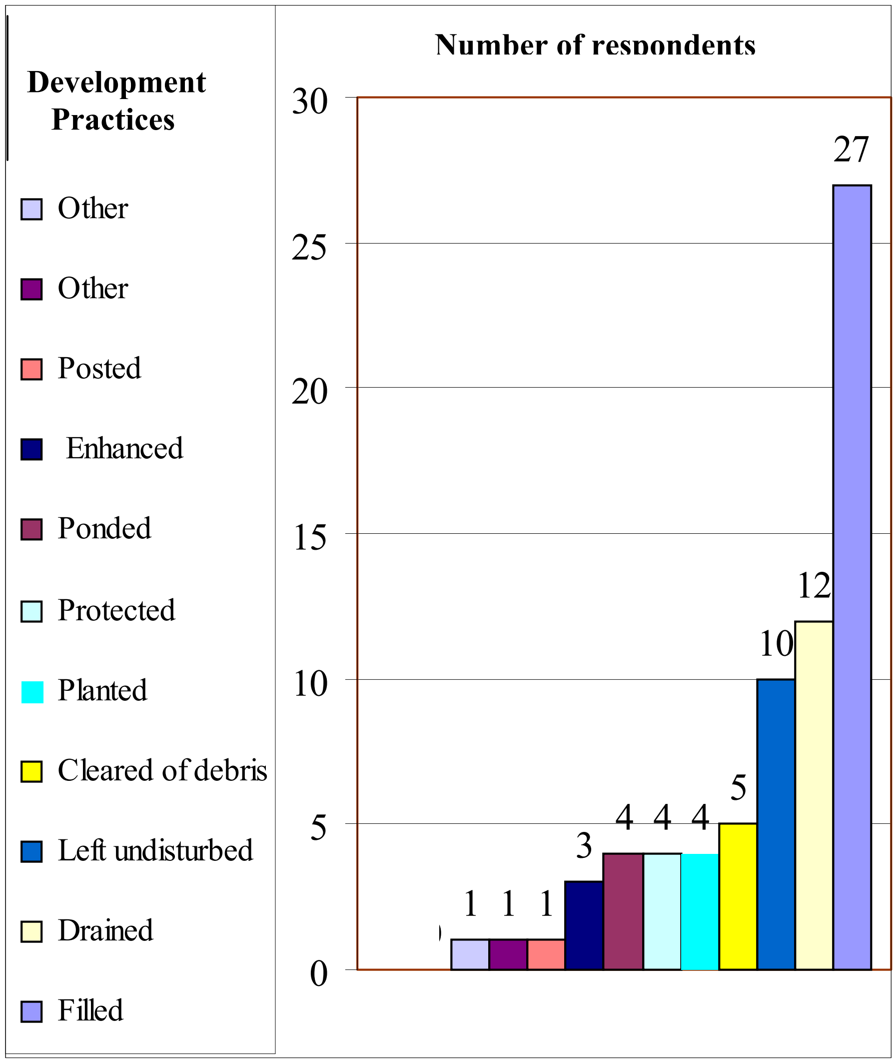


Fig. 17. Development practices

to be taken by first describing the factors taken into consideration.

Some respondents elaborated on their "depends" comments with further development decision factors. Four respondents noted that site development depended on location and property size. They indicated that if the property were larger (one person gave the 100 acre figure), that wetland development would be feasible. Consultant fees,

environmental assessments, alternative plans to avoid the wetland, and the cost of buying other wetlands that had been set aside in preservation efforts by land banks were some of the economic considerations involved with dealing with the wetland site. These respondents stated that a small site would not return enough money to bear the extra wetland development costs, and that other non-wetland properties would be searched out. Two respondents voiced concern with the development site's location and how the wetland on their property was connected or not to the larger habitat or wetland basin. Several respondents indicated proceeding with land development only after Corps approval and according to the general wetland permit conditions recommended by the Army Corps of Engineers – avoidance, minimization, and mitigation (Wetland Training Institute, Inc, 1995). See Appendix A, for a description of Army Corps permit condition terminology.

A surprising few (3 or 6%) flatly stated avoidance of wetlands. Three respondents pointed out the decision to develop their property was tied directly to regulatory development costs for the wetland. One first-time developer added ruefully, that he was "too far into it [the development/regulatory process] to pull out now." Comments to avoid development of the wetland were tabulated in the "undisturbed" answer for the question asking how exactly the sites were used in the development. A summation of comments is listed below:

Respondents who chose the "undisturbed" category frequently qualified their answers with an explanation almost the same as the respondents who qualified their "depends" answers. The economic variable was the important consideration for them, and locating another property without a wetland would be less expensive than proceeding

Table 7 Comments on Development Practices:

Development Practice Comments	**Response Numbers**	**Percent of Respondents**
Not applicable	1	2%
Negative answers	2	4%
Depends (on location & size=4, offsite conditions=1, cost/ regulations =3, size, uniqueness=1, dev after designation=1)	9	19%
Avoid to protect =1; avoid if too costly = 2	3	6%
Avoidance (with no explanation)	3	6%
Corps of Engineers' approval	2	4%
Increased site usage/clearing	1	2%
Burning	1	2%
Corps of Engineers' permit conditions: avoid, minimize, mitigate	2	4%
Combination of development procedures	5	10%
Develop after approval	1	2%

according to the Army Corps' recommendations and mitigating. Similarly, in another response category, a couple of "undisturbed" responses cited wetland avoidance as the best way to protect area wetlands with a footnote that the properties would have to be "big enough" for on-site mitigation. Conversely, the "protected" answer category was used by two of the four responding developers because cost-return of wetland development made the project non-feasible.

It is worth mentioning that several (4, or 8%) respondents used the catch basin method of land development for draining. The developer located the basin in the wetland, which required building a levee to prevent the natural flow of water draining off the project. No respondents mentioned protection of area hydrology. Two respondents pointed out control burning as the "other" site development procedure.

Attitudes towards wetlands can be discerned by two important attitudinal rating questions, and may demonstrate the reasons why there is continuing wetland loss in south Louisiana, while land developers are following (or avoiding) governmental regulations.

Below is a breakdown of the rated responses to scaled Question 6: "**On a scale of 1 to 5, where 1 is least important and 5 is most important in your decision making, please rate the following factors in your decision to develop the small wetland feature**:"

Table 8 Development Factor Importance Ratings

Ratings of Factors Important To Developers	1 least impor-tant	2	3	4	5 most impor-tant	Not applic-able
To increase the real estate's value	5	2	4	5	18	8
Need to reclaim land for other use	5	1	6	6	22	4
Intrinsic value of the wetland	15	5	8	5	8	3
Customer requested preservation	18	6	4	6	4	7
Added value from wetland feature	18	4	3	5	5	4
Understanding of regulations	3	4	8	13	12	4
Ability to pass on regulatory cost	1	2	5	5	7	24
Availability of good information on conservation methods / practices	5	5	5	13	12	2
Cooperation from regulatory agendy	10	4	8	11	3	6
Potential problems / regulatory agency				1	1	46
Prompt response from regulatory agency	10	6	11	7	5	4
Want no contact / regulatory agency		1				47
Preservation of plant species on site	8	6	8	4	4	5
Too expensive to work on wet sites	1		1			46

The two highest ranking factors found among developers in their decision to proceed with their projects were: 1) reclaiming land for other use and 2) increasing real estate value. This is the reason for wetland loss in the surveyed area. There were eighteen (38%) and twenty-two (46%) responses scored respectively toward these two top items. Conversely, there was very low importance placed on intrinsic value of the wetland and plant preservation with each scoring eighteen (38%) responses.

Some of the statistical analysis results (see Appendix I) depend on the perspective of what was intended for the developed property. The most statistically significant factor

for developing wetlands is real estate reclamation value with almost a “4” rating in development decision importance (n=40, mean=3.97, standard deviation =1.40). Real estate value was found to have the highest significant positive correlation (r=.389, 2-tailed significance: .023, n=34) with reclaiming the land considerations (Hollay, 2001). There was also a positive and significant linear correlation between intrinsic property value (r=.466, 2-tailed significance: .013, n=30) and plant preservation. Statistical analysis pointed out a highly *negatively* significant correlation between plant preservation (r=-.519, 2-tailed significance: .004, n=29) and reclaiming the land considerations. There was a very low mean (statistical significance percentage) for plant preservation (n=30, mean=2.67, standard deviation =1.37) and intrinsic value (n=41, mean=2.66, standard deviation =1.56), both rating almost at the bottom of the scale in importance for developing. These important results statistically support that land **development practices and plant with preservation, along other conservation practices, are mutually exclusive** in the “North Shore” study area. Additionally, and perhaps more importantly, the positive statistical correlation results between reclaiming the land considerations (r=.346, 2-tailed significance: .045, n=34) and cooperation of the regulatory agencies statistically points out the fact that **Louisiana is losing wetlands while land developers are following governmental regulations to protect them.** Use of the land does not include keeping what makes Louisiana the place that it is – a place for wetlands, and, in the case of acid bogs – a unique, but unknown, fast-disappearing small wetland.

The ecological importance of small wetlands, such as providing habitat and gene-pool corridors, and acting as water-level moderators, warranted only three quick comments out of the forty-eight questioned. One respondent spoke of habitat

considerations, a second mentioned turning to threatened species lists before deciding a course of action in development, and another developer looked at water basin connections that might or might not be existent between the property wetland and its surroundings. Appreciation of the important social values: watershed considerations, such as flood conveyance, sediment and pollution control and aquifer recharge, and provision of green space, and aesthetics value that wetlands provide was very limited. Other respondents said that wetlands, when found on small tracts of land, are too expensive to develop, they detract from land appraisal value, and are viewed as “a nuisance.” One developer retorted that green plants are “things that get in the way!”

Why is it that wetland preservation is valued low? It’s not that developers (and homeowners) don’t care; considerations are driven by economic factors. Developers want to use wetlands for something other than preservation. Generally then, the descriptive analysis data tells why developers are destroying wetlands, and may indicate the effectiveness of regulations by the importance of development factors represented by the rating values (or “gripe” ratings) for certain survey questions. Note the results of answers from “understanding of the regulations,” “ability to pass on regulatory costs,” “cooperation and prompt response from regulatory agencies.” But, indications are that by the analysis of statistical data wetland economics outweigh intrinsic wetland value by about one and one-half times (Mean=3.97, reclamation value compared to mean=2.66, intrinsic wetland value). See reported means in Appendix I, Statistical Analysis Results.

Two factors in the decision to develop were: **Cooperation from regulatory agencies** and **prompt response from regulatory agencies** Both prompted one third of the respondents to report somewhat favorably, but another third to report most

unfavorably for regulatory agencies in general. The remaining third of people questioned about their attitude toward regulatory agencies took a tolerant stance about the hardships agencies must work through and rated them in the middle of the road, so to speak. A high understanding of the regulations was reported by many respondents in the survey with twelve (25%) giving themselves a "4" rating, and thirteen (13, or 27%) giving a very high rating of "5" to themselves.

Another scaled question went on to rate developers' attitudes about the specific regulatory agencies in this way: **"On a scale of 1 to 5 where 1 is least important and 5 is most important please rate the following agencies' or groups' importance in your efforts to develop the feature"** These are the responses in Table 9 below.

Table 9 Regulatory Agency Importance Ratings

Regulatory Agency Importance Ratings	1 least impor-tant	2	3	4	5 most impor-tant	Not appli-cable
a. Environmental Protection Agency	3	5	8	3	1	21
b. U. S. Army Corp of Engineers	11	3	6	9	3	5
c. La. Dept of Environmental Quality	4	5	9	5	4	16
c1 Dept. of Natural Resources	3	1	6	6	4	21
c2 LA Dept. of Wildlife & Fisheries	1	6	5	8	2	18
c3 Federal Energy Commission	1		1			39
d. Parish Reg. Agency	3	2	9	4	6	15
e. City Reg. Agency	1	5	1	6	4	22
f. Trade Association/group		3	3	2	2	27
g. Local Non-profit group	1	3	4	3		25
h. National/régional environmental group	3	2	6	4	1	13
i. Other					1	

Although they ranked somewhat favorably in nine (19%) responses, the U. S. Army Corp of Engineers drew a higher number of negative responses (11, or 23%) than any other single regulatory agency. Additional comments by respondents indicated an

explanation for the poor ratings received by the U. S. Army Corp of Engineers. Many surveyed developers pointed out that the regulatory process was long and drawn out, sometimes taking two years! Other negative comments are summarized below:

Negative Comments:

1) About the Army Corps: very subjective, costly, unreasonable, get the "run-around," have done a terrible job of taking care of the land, understaffed, lazy and overrated, drag their feet, inconsistent.
2) About the regulatory process: very expensive, slow, political (poor landowners left "holding the bag"), extreme politics, much red tape, a nightmare, "pass the buck," inconvenient and costly, give problems to people "piece-meal," mitigation extremely expensive, too much government bureaucracy, wetlands viewed as a nuisance, wetlands devalue the land and take land out of commerce, ludicrous, driving people off because fractured and expensive, no incentive, wetlands make small projects cost prohibitive, mitigation gets rid of free market, every-day revisions=steep learning curve
3) About engineers: waste of money because they overcharge as a liability protection,
4) About developers: not educated for looking into unique site features, need more standardized approach, bring about the "plastic" look, don't disclose about wetlands
5) About consultants: very expensive
6) About builders: many don't go through the Corps
7) About realtors: didn't understand the regulations, don't disclose about wetlands
8) About conservation organizations: need to get more involved in development, need to work a "campaign" on fill practices, land bank types are getting rich, mean well but not informed, cause delays, not effective, need to approach issue/balance,
9) About the EPA: no idea what's going on
10) About DEQ: understaffed and overworked
11) About state Wildlife and Fisheries: large bureaucracy and mismanaged,
12) About the planning process: unqualified political appointees (favoritism), conflicting regulations, variable from parish to parish, need regional planning, hard to keep greenspace, needed for natural corridor protection and to fight politics and waste (terrible planning), needed for better drainage

Another regulatory agency was cited for importance in land development, the National Resource Conservation Service (NRCS), which received a high rating. Some developers observed that parish and city agencies vary in importance depending on what area is involved. On more than two occasions developers said that property owners were avoiding wetland delineation.

People put themselves in the “non applicable” category in the two rating questions because they relied on a hired consultant to deal with the issues. Realtors depended on their client to follow up on decisions to develop the wet site (which they had to reveal about the property as required by law). In the same way, the developer responding to the questionnaire may not have to recoup the consultant’s fee and they also answered “non applicable.” Many who used consultants answered that when it came to understanding the regulations and to dealing with the regulatory agencies, the question did not apply to them because that decision was solely left up to their consultant.

Some respondents indicated “0”, or even negative numbers, of importance in some of the ratings. There were thirty-four “0s”, seven (21%) and five (15%) respectively that went to “requested preservation” and “added value from the wetland feature” scaled factors for the first attitudinal question. Three responses were recorded below 0; two were for the response and cooperation from regulatory agencies. One respondent thought so poorly of the agency they rated them at “-98”. The zeros and negative numbers were changed to “1”s, the lowest end of the scale. For purposes of running the Statistical Analysis program, all “non applicable” (and other textual responses) were eliminated.

The most important finding of the telephone survey was Louisiana continues to lose wetlands while land developers are following (or avoiding) governmental regulations to protect them. Wetland valuation was driven by economic considerations, which the Army Corps has caused, in part. The second-most important finding is that developers don’t recognize bogs. This was evidenced by two results of the Telephone Survey: the necessity during the survey to continually repeat the definition of a bog as “small sites –

(usually) less than 1 acre – and without standing water but with saturated soils; with very few or no trees, but with pitcher plants, sedges or other wetland grasses" to insure correct responses. Additionally, answers to the question **"What plant species were identified on the site," showed** lack of knowledge of indicator species of acid bogs. For instance, several answers point to other types of ecological communities, some not even wetland types. Common Bald Cypress (<u>Taxodium</u> <u>distichum</u>) are found in swamps, Dwarf Palmetto (<u>Sabal</u> <u>minor</u>) and Water Oaks (<u>Quercus</u> <u>nigra</u>) are found in damp woods; and American Sweet Gum (<u>Liquidambar</u> <u>styraciflua</u>) is an upland tree inhabiting drier sites. Respondents *did* know some wetland plants and described wetlands in general. But even after reiteration of the bog description; less than a handful knew what acid bogs are – even fewer could describe development practices on bogs.

Other answers to the question "What plant species were identified on the site," showed lack of knowledge of indicator species of acid bogs. Many evaded answering which species, and gave general statements about "hydrik plants", "lowland grasses" or looking for "different" plants. Eleven (23%) had no response at all, and fifteen (31%) respondents answered that they left plant identification up to someone else or looked them up in a plant key or manual. Even among the consultants there was confusion in the percentages of wetland vegetation required to designate a site as a wetland (Wetlands Training Institute, Inc, 1995).

Answers to another question, **"What criteria were used to identify the site as a wetland or bog?"** indicated that most people in the telephone survey *did* have a general grasp of wetlands, even though they didn't specifically know about acid bogs. Many

answered correctly with the three factors – wetland soils and vegetation and wetland hydrology – that designate a site as a general wetland. Other comments are listed below.

Table 10 Wetland Criteria Comments:

Criteria = Number of Responses	**Criteria = Number of Responses**
No response=3	Wetland vegetation (or veg type)=18
Not applicable=2,	Hydrophytic vegetation=6
“Surface examination”=3	Threatened species list = 1
Terrain & depressions (elevation)=6	Wetland hydrology=10
Habitat = 1	Prior knowledge=4
Time of year (when wet)=1	Site history=1
Offsite conditions=1	Flood & silt lines & drift=1
Soil conditions=11	Maps=8 & GPS positioning=1
Hydrik soils=8	Use consultant=4 & engineer=3
Walk site=7 & On site survey=3	Wetland determination/Corps=3

Demographic information on company size and wetland development benefits to the company were provided by the last two questions on the survey. There were conflicting answers received for the question asking, “**What percentage of income do wetlands represent for your company**?” Curiously, some respondents (4, or 8%) indicated “0” percent returns from wetland development projects when they had already proceeded with land development projects having known wetlands within them.

There was a predominance of respondents – ten (10, or 21%) (shown in black on the bar graph below) - that indicated returns of one percent (1%) (shown in aqua on the bar graph below), with seven (15%) respondents earning up to five percent (5 %). There were fewer respondents in all other percentages of income earned. For example, Figure 18 shows only one or two respondents to each of the higher percentages earnings from wetland development above ten percent (10 %) up to 100 percent (100%). The responses to the question, “What percentage of income do wetlands represent for your company?” are tabulated below:

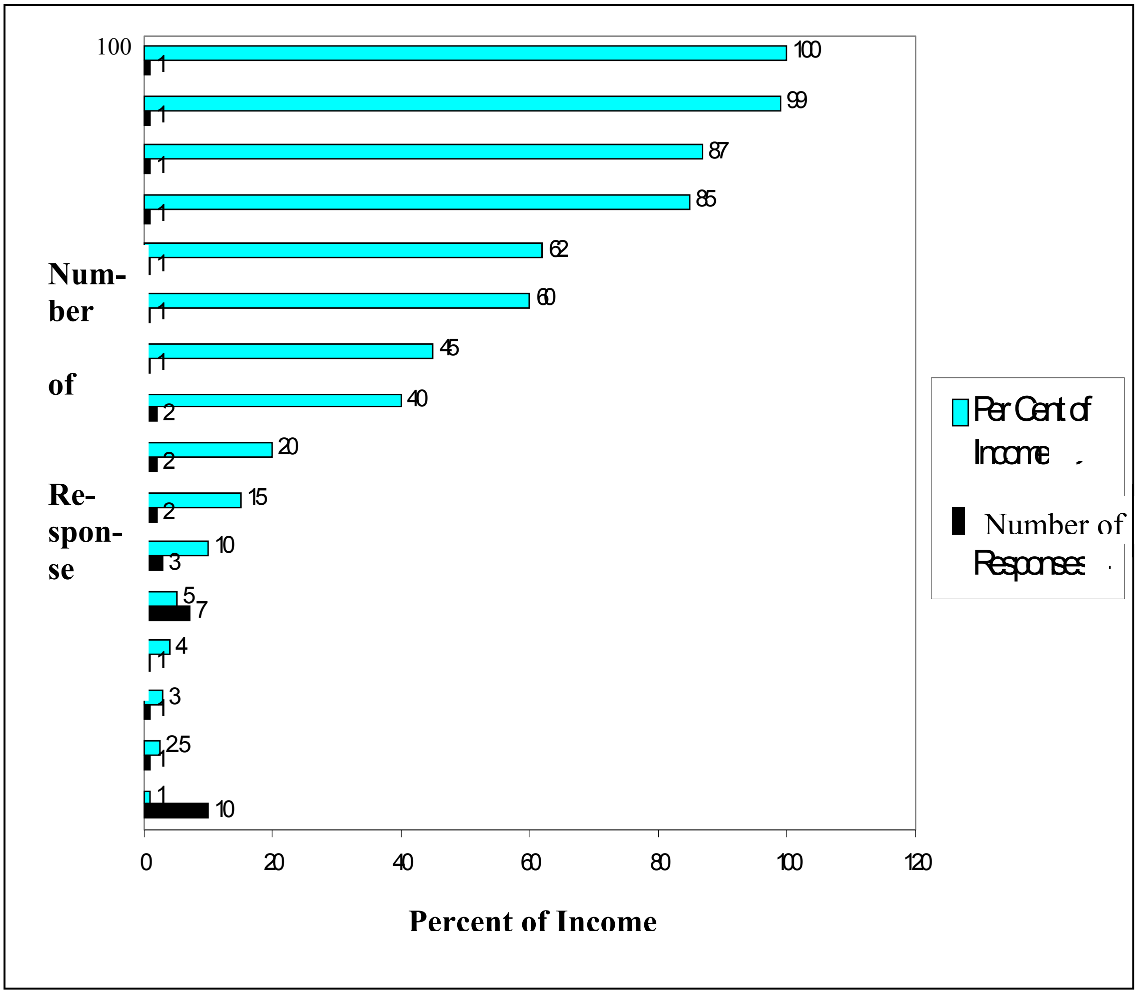


Fig. 18. Percent of income from wetland development

Table 11 Percent of Income from Wetland Development

Wetland Income Percent	Number of Responses		Wetland Income Percent	Number of Responses
0%	4		20%	2
1%	10		40%	2
2.5%	1		45%	1
3%	1		60%	1
4%	1		62%	1
5%	7		85%	1
10%	3		87%	1
15%	2		99%	1
			100%	1

Answers accepted from respondents for the last question on the survey, **“How many people are in your company**?” included the number of people in the local branch

office or division as the number of people in the company. A few companies were large (largest was 370), but most – thirty-two out of forty-eight respondents (67%) - had a company size of one to eleven people. The table indicates the range of people per company from the study group.

Table 12 Employees per Company

Company Size Number of Employees	Number of Responses
1-3	11
4 -7	8
8 –10	11
11 –18	5
30 – 75	6
120 +	3

Activities participation was found to be high in response to the question, **"Volunteer/Professional Organizations to which you belong: (participate in activities, or receive literature)."** There was much developer participation reported in organizational and local activities These activities received more participation: Home Builders Association, area Chambers of Commerce, Louisiana Real Estate Commission, ASLA (American Society of Landscape Architects) with fifteen (31%) survey respondents involved. Some of the more popular literature that developers received were from professional organizations, such as LES, Louisiana Engineering Society or ASLA, with mention of some conservation-minded journals serving the consultant group of respondents. Many respondents said they received much literature, but did not give examples. A few comments downplayed the usefulness of paper communications and confirmed greater website use and computer map usage for ease of information access. One respondent stated that organization involvement doesn't affect information transfer.

Telephone Survey Analysis

Even though the returns were exemplary, a noted limitation of this study was the small population number represented which limits extrapolation of the results. Survey results apply to the two study areas, and extrapolation of the results was limited to those same areas. Time constraints and limited economic resources precluded further efforts, and may have resulted in shortening the number of return calls and limiting the number of the survey calls per area. The telephone survey when compared to the mail-out questionnaire may have glossed over deeper, significant issues due to time constraints or the respondent saying what they thought the interviewer wanted to hear. In addition, time constraints may evoke "bare bones" answers by respondents anxious to return to their work.

Although rating scales for attitude detection were easy to construct and answer, they may have drawbacks: conflicts may have arisen between information from different sources and they may yield a different result at another time. In other words, the same respondent may answer the same question differently the next time contacted. Compared to the mail-out questionnaire, scaled questions could be confusing when used over the phone. Care was taken to assure that the respondent understood the rating order and the factor being judged. Generally, different methods provided flexibility and higher reliability, but there also was a risk of reactivity where the first procedure may have affected the results of the rest. In both the case study interviews and the telephone survey, questions about sensitive topics were asked towards the end of the interview to avoid "red flag" terms. The telephone survey method was chosen for this phase of the study because of the thoroughness in which land development issues could be covered, along with

higher response rates and confidentiality levels that all seem to surpass the risk of the above limitations.

Indications from findings of this research are that **the current level of developer and homeowner knowledge of wetland values is not sufficient** to allow actions on their parts. If they had the inclination, homeowners and developers would not be able to adequately conserve their wetlands. Setting aside small isolated inland wetlands such as bogs for low impact land development or for wetland preservation requires knowledge of biological system fundamentals. Lack of knowledge of the social and ecological wetland values was demonstrated by limited survey responses. Only three (6%) quick comments out of the forty-eight questioned mentioned the benefits of wetlands. They demonstrated general knowledge of wetlands as being part of wildlife corridors and as possible unique habitats for endangered species. Consultants demonstrated more wetland value considerations than other groups surveyed, although one engineer spoke of wetlands for sediment control. Developers might be unaware of the publics' need for the benefits to society and the ecological values that wetlands can provide, such as flood buffering, aquifer recharge and water purification. A few developers even displayed an antagonistic attitude toward "green plants." It goes without saying that decisions for development actions without full knowledge and appreciation of the variables involved will lead to short-term solutions and quick environmental degradation.

Likewise, knowledge of bog identification was lacking in most survey responses. Vague responses, such as looking for "different" plants and site "uniqueness," showed definite unawareness of the characteristic plants of acid bogs. Evasion of answering the question about bog indicator species perhaps indicates the same lack of knowledge. Quite

a few wetland plant species were named, but this only points to general wetland knowledge.

One respondent pointed out clearing increased site usage, while five (10%) reported “clearing out debris” as a land enhancement. Some respondents could have interpreted “clearing out debris” as the general property clearing in preparation for the land development process. Do these responses reflect on the general development practice in subdivisions of wiping the slate clean of plant growth only to start over again with new, non-native landscaping?

Without knowledge of the dynamics of how wetlands function, the wise development of wetlands is impossible. The single-most used land development practice was “filling” the wetland, reported from twenty-seven (56%) respondents. Sixteen (33%) answers accounted for the second-most used practice reported by developers, which was draining, including ponding-type drainage. These types of development practices represent a full eighty-nine percent (89%) of the way wetlands are handled in the two study areas of the telephone survey. These **two commonly observed development practices in south Louisiana, cleared to use - filled to develop**, haven’t changed much from eighteenth and nineteenth century practices when there were no conservation considerations! Any obstruction of the water flow, either by ruining the underground clay hardpan through ditching or compaction from heavy equipment, or diverting the flow in some way, such as by ditching or filling, would have disastrous results for the fragile acid bog ecosystem. As a consequence, one bog left undisturbed might not survive within a highly developed suburb community or commercial strip. Examples of this type of treatment to ecosystems may be found on the Lake Ramsey site and in the nearby vicinity

of Lake Ramsey. Ecosystem damage is what is resulting from development practice decisions to fill or ditch all over both telephone survey areas.

The **independent, self-directed stance** displayed by the homeowners and developers in both phases of the research point to the freedoms enjoyed in the United States today. The data suggests that property owners prefer to make informed decisions regarding the outcome on their land. The defensive attitudinal findings of the owners of the case study properties reflect the fact that nobody likes to be restricted on their own property. The same mind-set was apparent in the telephone survey findings.

It is telling how some respondents elaborated on their “depends” factors. Comments to Question 5 answers on current wetland development practices give important descriptive insight into what drives development practices within the study area. The economic variable was the important consideration for them. As mentioned before, **economics outweigh intrinsic wetland value by about one and one-half** (1 ½) **times** in the wetland development process. Locating another property without a wetland would be less expensive than proceeding according to the Army Corps’ recommendations and mitigating. Another consideration voiced by two respondents stated that development decisions” depends on location” not only for return on dollars spent, but possibly for ease of the regulatory process in that area. One Army Corps district or parish or local community may be preferred over another for less strict regulation enforcement or non-existence zoning regulations.

Several respondents indicated proceeding with land development only after Corps approval, although, the few who flatly stated “avoidance” of wetlands, and the reports of developers not following the delineation process could point to the Army Corps’ wetland

designation process as unsavory. Poor cooperation of regulatory agencies could explain avoidance of wetlands. The complaints about the regulatory agencies, especially the U. S. Army Corps of Engineers, points out there are **problems with the regulatory process and/or agencies involved.** Many respondents cited the lengthy wetland delineation process, costs of building around the wetland to avoid it and very high mitigation costs – purchasing other set-aside wetland properties - to be prohibitive to property development. The comments to avoid development of the wetland tabulated in the "undisturbed" answer for Question 5, "How were these sites used in the development?" were directly tied to wetland ratings by the Corps. Statistical analysis backs up the attitudinal scale findings with "real estate value" and "reclaiming the land" variables getting the highest mean percentage ratings for the top factors that are the most important in the decision to proceed with land development. Economic non-feasibility of development may put wetlands in the "protected" category as a possible way to avoid high regulatory costs. If market demand grows higher with the scarcity of developable sites, the market would be in a position to bear land development costs. Then those economically undevelopable sites would be in jeopardy. Therefore, it is questionable to leave non-developable land as a way of having a site protected!

The unfavorable attitudinal responses toward the U. S. Army Corp of Engineers may have been due to the fact that all respondents dealt with this agency. But, the long, expensive delineation process drew out heated comments. Many surveyed developers pointed out that the regulatory process sometimes taking two or more years. It follows that developers would certainly want to avoid or minimize the expense of consultants and wetland mitigation whenever possible. Analysis of statistical data shows wetland

economics outweigh intrinsic wetland value by about one and one-half (1 ½) times. With development considerations being driven by economic factors and land developers begrudgingly following (or avoiding) governmental regulations, attitudes towards wetlands demonstrate the reasons why there is continuing wetland loss in Louisiana. Thus, **wetland destruction is occurring while developers are following the regulations**!

Interpretation of the results may be difficult. Were developer answers "bare bones" to some questions? For instance, no elaboration was given for some "avoid" wetlands answers for the question regarding development practices. Further explanation for the decision to develop depending on the property location was also brief. In the case of rating factor, "understanding of the regulations," how truthful were the high ratings of the respondents' answers about themselves? Was there an attempt to look better in the eyes of the interviewer or perhaps they truly thought they understood the many tiers of regulations. The responses could also have meant that respondents may have access to adequate professional assistance to deal with the regulations. Answers to Questions 9 and 10 - about demographic information on company size and wetland development benefits to the company - equaling zero are also puzzling. Is this again answer without much thought, or does this answer indicate the very minor role wetland development plays within their company? The latter attitude seems to be the case because more companies indicated a low percentage (less than one percent, 1%) return for their businesses from wetland development.

Additionally, determining if conservation attitudes are connected to information availability may be difficult. It was apparent by the plentiful answers to the question ,

“Volunteer/Professional Organizations to which you belong: (participate in activities, or receive literature),” there was much local and regional involvement. Professionals in the development arena of necessity must remain in close contact with national, regional and community activities to keep a firm business footing. The statement that organization involvement doesn’t affect the transfer of information cannot be accounted for, but there appears to be a **greater need for appropriate and easily accessible information to develop the area wetlands wisely**.

Confusion may also be generated from the respondents who answered negatively to the first two survey questions, “In your development work, have you ever encountered small inland / depressional wetland sites or bog like sites of less than one acre?” and to “If you were to encounter such features on a site would you continue the development of the site?” The lone respondent answering “no” to the first question was still qualified to participate in the survey because he did answer affirmatively to the third qualifying survey question, “did you continue development of the site once the small wetland was identified?” and in fact *did* go on to develop. Of the four (8%) respondents that replied “no” to second question if they *would* develop on such sites as described, two (4%) responded further that they *did* continue the development of the site once the wetland was identified. One of the other” no” respondents explained his “depends” answer to the question of continuing development that he was in the middle of the wetland delineation process. The judgment would be made to continue with site development after Army Corps recommendations were assessed according the economic feasibility of the project. Likewise, the last negative response to whether they would continue development after

wetlands were discovered described how the amount of extra development cost incurred by the regulatory process/recommendations would guide his further development efforts.

These research findings in the applied behavioral studies of two areas in south Louisiana showed that due to 1) careless development in sensitive sites and due to 2) independent, self-directed and defensive homeowner attitude and 3) apparent lack of homeowner and developer knowledge of the natural connections in their respective geographical surroundings, the destruction of southern acid bog sites is continuing. Property rights issues and problems with how wetlands are valued in the market were at the heart of these findings. Other, unlooked-for reasons were uncovered that contributed to development practices. Due to problems with the regulatory process and/or agencies involved wetland destruction is occurring while developers are following the regulations! These actions are placing acid bogs in imminent peril for their existence.

Development trends and environmental regulations will be discussed in the next chapter. Improvements in the development process and other efforts to help slow the damage to Louisiana's acid bogs will also be presented next.

CHAPTER 5: REGULATION VS. EDUCATION

Environmental Regulation

This thesis points out current (2001) detrimental attitudes, and land development practices toward acid bogs, and wetlands, in general, that are still prevalent in the study areas. The ecological and social values of acid bogs have been stressed. Next, implementing the knowledgeable use of these values, both ecological and social, by utilizing them in the environment must be passed on in a practical sense to land developers who are generally first on the scene of new opportunities. After all, endangered plants don't have the legislated clout of endangered animals. The goals for the last part of this study are to further wetland value understanding within the development community and through them pass that appreciation on to the general public. Ways to make use of these unique wetlands while impacting them as little as possible, and providing helpful resources to those interested in doing so, will be suggested below. This may help to alleviate the greatest threats to wetlands, and particularly to water flow-sensitive acid bogs, which originates a considerable distance away due to excessive demand for finite water sources (Finlayson and Moser, 1991).

Research of homeowners in the study areas has found that most are aware of the wetlands' preservation trend and not insensitive to it. Resolving this trend with land rights issues within a democratic society appears to be the "sticking point." The traditional conservation ethic, focused on endangered populations and species emphasizing rareness, uniqueness and model examples of ecosystems, has failed to compete successfully with economic "progress" regarding the private landowner

(Finlayson and Moser, 1991). Site "uniqueness," as one telephone survey respondent put it, *does* figure into how the acid bog wetland functions with its surroundings in flood abatement, erosion control, lending important refuge for insectivorous plants and other wildlife habitat, water purification, and providing all-important aquifer recharge areas (Coreil, 1993). Private property owners with wetlands may not be appreciative of the important social values of wetlands simply because the market does not compensate them for these values and, more importantly, these values have not been set.

Developers, in general, can help preserve the "uniqueness" of each, individual site. Wetlands are what make Louisiana the place that it is. In landscaping terminology: wetlands give a definite "sense of place" to site development. How to balance society's need to use the land and the need to protect wetlands, especially endangered ones, requires the attention of planners and scientists working at the level of individual land use sites (Marsh, 1997). Without the cooperation of a joint effort, the ecosystem becomes fractured, water recharge and flood/erosion control areas are lost, and recreation and tourism suffer. Although great labor may go into the development on each site, an entire area may be devalued as a consequence of lower water purity and availability, flooding, and disappearance of wildlife habitat.

How to bring education to the awareness of developers and homeowners? The first step, which involves general improved public awareness toward the plight of endangered wetlands, has already been taken (Marsh, 1997). In the same sense that homeowners may not be aware of social and ecological values of wetlands, it could be that developers are unaware of the publics' need for the social and ecological values that they can provide by wiser wetland use.

First, an understanding of the economic plight of developers will serve to clear up why their attitudes stand as they do regarding wetlands. The dilemma is that as individuals, and collectively as a society, people have chosen both nature and society. In the mind of America that loves convenience, cars, technology, comfort, green parks and wilderness, developers occupy a secure but lonely corner. There are several reasons for this. First, development is often an assault on the senses – the noise, the dirt and change in surroundings. Second, the total disregard / lack of sensitivity to the existing landscape: development destroys things deeply cared about – streams, trees, hills, animals. But most importantly, development brings out greed. Almost everyone has a price (Kaufman, 1999). There is also the liability of wetland construction that is different from building on uplands. Earle (1975) and Mumphrey (1976) have provided early documentation of the many problems and their extra costs during the development process of wetlands, which are later passed on to the homeowner. Resolving the problem of competing demands from incompatible land use activities in a way that is acceptable to a free society is neither easy nor cheap (Finlayson and Moser, 1991). Coastal areas have long been attractive places to visit, but in the past fifty years development for residential and commercial purposes has increased substantially (Marsh, 1998). Early conclusions that urban development is one of Louisiana's most critical environmental problems (Gagliano, 1973) continues as the large New Orleans metropolitan area continues to push north and claim the low environs around Lake Ponchartrain as its own (Smith, 1986; Schmidt, 1996).

Bottom-line economics outweigh intrinsic wetland values and that is why the three highest-ranking factors found in the developers' decision to development were

reclaiming land for other use, recouping regulatory costs, and increasing real estate value. Those considerations demand quick regulatory agency response and cooperation - supported by the *highly* positively significant correlation (r=.596,2-tailed statistical significance: .000, n=36) ratings by telephone survey respondents between quick regulatory agency response and cooperation. It has already been said that economic considerations colored the attitudes of the survey respondents who gave low ratings to regulatory agencies. If all things remain the same, what happens to undevelopable land in the "protected" category when demand rises as developable acreage becomes scarce? The market will bear the costs and endangered wetlands will disappear.

How effective are regulations?

Many questions come to mind regarding the subject of governmental regulation of small wetland sites. Regulations seem concerned with limiting incursions into wetlands. Can attitudes towards acid bogs, and wetlands in general, be changed with this type of regulation? Currently the regulations are motivated by disincentives, or punitive measures; there is nothing currently in place to create a positive attitude to save wetlands.

Laws are in place to guard against misuse of high value wetlands to the detriment of the general public health, safety and welfare. The ways that this is done is through regulating dredge and fill operations both on coastal and inland wetlands.

This study has observed that governmental regulation is not enhancing acid bog conservation because governmental regulations don't address small, isolated upland wetland sites or the many values of these eco-communities. How much intrinsic value is written into the regulations? Or is this a portion of southern forest that has been overlooked with no significance in relation to coastal wetlands. The central question is

how to protect these small wetlands and can they be protected? The regulations must do a better conservation job if we are to keep these endangered wetlands and the social and ecological functions they provide. Perhaps a brief survey of the regulations and other incentives set in place for wetland conservation will shed some light on these questions.

The management and conservation of wetlands in North America takes several forms. The United States government has acquired many wetlands in order to set up large-scale systems of wildlife refuges. Private non-governmental organizations are also active in wetland protection in North America, such as National Audubon Society and Nature Conservancy. Wetland sites in North America and Canada have been designated high priority wetlands for protection, and some of international importance placed in the list of treaty-protected ownership (Ramsar Treaty). In the U. S., state and federal governments have enacted laws that regulate wetland alteration on all lands, public and private (Finlayson and Moser, 1991). Protection has been implemented through a variety of policies, laws and regulations, ranging from land use policies, to zoning restrictions, to enforcement of dredge and fill laws. In the United States, wetland protection has historically been initiated federally, with some assistance from individual states. (Mitsch and Gosselink, 1986).

Every coastal state has some level of regulation on inland and, more importantly, on marine wetlands. The Coastal Zone Management Act (1972) is the federal law in force to increase public interest in U. S. coastal areas. The Louisiana Department of Natural Resources manages Louisiana's zone management program. These regulations usually require any person who wishes to alter a wetland to obtain a permit. The coastal zone use permit takes precedence over a federal wetlands permit (Coreil, 1993). If a permit is

issued, it contains conditions that the applicant must follow to ensure that the proposed project does not impair the public health, welfare and safety functions of wetlands. United States law does not permit governments to control the use that a private individual makes of his or her land unless that use puts the public interest at risk. Thus, the regulatory process is likely to give higher consideration to the importance of wetlands in relation to flood control and water quality than to wildlife and fish habitats.

The U. S. Fish and Wildlife Service, the Environmental Protection Agency (EPA), and the U. S. Army Corps of Engineers are the agencies at the heart of the regulatory review process. The United States federal government, through the U. S. Army Corps of Engineers and the EPA, regulates dredge and fill activities in wetlands of all states under Section 404 of the 1972 Federal Water Pollution Control Act, known widely as the Clean Water Act. The Corps issues wetland permits and the EPA sets the standards for the program (Finlayson and Moser, 1991). Permitting involves the balancing of environmental and economic interests (Gardner, 1991; Holden, 1992). Dredging and filling is prohibited if there is another solution with less adverse impact to the ecosystem. What is considered a worthy alternative is subject to considerable negotiation with the federal agencies involved (Coreil, 1995).

Up to the 1960s, most political, financial and institutional incentives to drain or destroy wetlands were in place and functioning very well - total wetland losses exceeded fifty-four percent (54%) as noted above (Dahl and Allord, 1994). Until the middle of the 20th century, wetland management meant wetland drainage. Since the early 1970s there has been increasing awareness that wetlands are valuable areas that provide important environmental functions (Dahl and Allord, 1994).

The main weaknesses of Section 404 of the Clean Water Act are that it does not regulate activities, like agriculture, that are the most destructive to wetlands (Finlayson and Moser, 1991). Farmers use fertilizers to increase yields and herbicides and pesticides to reduce competition against their crops. Runoff of these materials can seriously impair area hydrology. An example of unregulated runoff, the Tangipahoa River running through the study area has been off limits to fishing and swimming for many years due to agricultural pollutants. It has also taken the EPA and the Corps many years to agree on techniques and standards (Finlayson and Moser, 1991). Survey respondents give the U.S. Corp of Engineers poor ratings, adding that the regulatory process is long and drawn out. The difficulty of the process appears to accelerate wetland loss possibly resulting in noncompliance or outright avoidance. Here again, another possible solution might be incentives to reverse negative attitudes and to speed up the process. Although survey respondents indicated they had access to adequate professional assistance to deal with regulatory agencies, this may afford landscape architects versed in wetland regulations and the delineation process an opportunity to help out.

Wetlands continue to be the focus of legal efforts to protect them. Recognizing that about seventy-five percent (75%) of the nation's wetlands are privately owned, the agricultural and conservation communities have recently combined their efforts for new initiatives to restore, improve and protect wetland and wildlife habitat on privately owned lands (Coreil, 1993). Dahl and Allord (1994) state in a U.S.Geological Survey (USGS) Wetland Resources report that, along with increased awareness and increased wetland education, federal policies, such as the "Swampbuster," have tried to eliminate incentives and other mechanisms that have made wetland destruction technically and economically

feasible on privately owned lands (Mitsch and Gosselink, 1986). In provisions of the 1985 and 1990 Farm Bills, a farmer is not eligible for price support payments, farm storage facility loans, crop insurance, disaster payments or other loans for any year in which wetlands are converted to crop production (Heimlich, 1991). The findings of this study questions whether economic incentives have been eliminated, and that it is still feasible to destroy small, endangered, isolated upland wetlands for market gains. Dahl and Allord (1994) go on to state that although the rate of wetland losses is declining, land development continues to destroy wetlands and losses continue to outdistance gains. Currently, a major strategy of new USDA (United States Department of Agriculture) and conservation organization initiatives includes providing technical assistance to private landowners (Coreil, 1993).

No part of the landscape provides so many benefits at so little cost to the public as America's wetlands. Such benefits outlined above include resources that nurture wildlife, purify polluted waters, check the destructive power of floods and storms, not to mention recreation and many learning experiences. The growing environmental awareness trend, reflected by two decades of federal and state laws and other programs, are aimed at preserving and protecting our remaining wetlands (Department of the Interior, US Fish and Wildlife Service, 1990). The most valuable products of wetlands are public amenities that have little commercial value for the private landowner (Jones, 1990). Although it is outside the scope of this paper to investigate public regulatory theory or market economics, this issue is central in wetland regulatory controversy. The controversy seems to revolve around the problem of setting the costs for the larger social benefits of wetlands and these useful functions defy evaluation on a small scale. Public wetland

benefits are generally non-market related and are generally perceived by landowners as negatively associated with private landowner objectives, as seen with this study. Private wetland landowners have specific wetland management objectives that are aimed at providing revenues to repay long and short-term investments. Conversely, society has wetland objectives that are not related to direct market investments and when private landowners try to meet their goals, society often perceives a reduction in public wetland functions and values (McBride, 1992). Many other authors propose regulatory and economic solutions to environmental quality problems. See Cynthia Jones' thesis, 1990, for summation of wetland evaluation approaches, pages 24-26.

Mentioned by survey respondents, and perhaps outside the reach of regulation, is the issue of possible price gouging by mitigation land banks, the "easy money" some wetland consultants and engineers may benefit from in the wetland evaluation process, and ever-present, but shifting, political winds within the government and its agencies resulting in who gets what done.

Coastal marshes are faring better than other types of wetlands because of protective laws enacted by the federal government and a number or states during the 1960s and 1970s. The fact that wetlands provide values in perpetuity, where commercial values are finite, is surpassed only by the fact that wetland development is often irreversible (Jones, 1990)! Refer again to figure 2, Land disturbance/recovery graphic, for the magnitude of disturbance impacts in recovery years and in area affected for urban development. As the space needed for cropland continues to grow and urban areas continue to expand, America's wetlands - especially small, isolated ones - will continue to disappear (Department of the Interior, US Fish and Wildlife Service 1990).

The Solution: Land-Use Guidelines and Educational Outreach

Think of the reversal of all the ecological and social benefits listed above as the outcome of the loss of acid bogs (as with the loss of wetlands in general). Nelson and Weller have ranked these detrimental kinds of impacts in orders of magnitude. The orders reflect the cost and technical difficulty of attempting to reverse the environmental damage as a result of duration, extent and/or permanence of the large environmental effects. For instance, large wetland loss is hugely expensive to reverse, as in the Florida Everglades system, or in the Mississippi River diversion project. The variables included below in the Magnitude Table 13 determine how serious the impact is to society. Wetlands provide value at many scales to nearby ecosystems and to society as a whole (Jones, 1990). These values are greatly reduced by traditional development, which contributes directly to wetlands loss by conversion to something else – a first order of magnitude detrimental impact, and indirectly by second through fifth order detrimental changes (Nelson and Weller, 1984).

Land development guidelines:

The author believes that professional landscape architects, and developers in general, should help alleviate wetland loss when working with development projects that include small, isolated upland wetlands such as acid bogs. Development guidelines will be proposed as a partial solution to the problem of disappearing, small, isolated inland wetlands. These guidelines direct efforts towards designing sustainable wetland projects. Also, adherence to these guidelines will better insure compliance with wetland permit requirements.

Table 13 Orders of Magnitude

ORDERS OF MAGNITUDE OF DETRIMENTAL IMPACT ON WETLANDS

ORDER OF MAGNI TUDE	TYPE	TYPICAL ACTIVITY	POSSIBLE MITIGATION
1ST	Conversion of wetlands to something else	Drain and fill, canal excavation, bulkheading	Offsite creation of wetlands; this is difficult and expensive
2ND	Permanent irreversible adverse changes to wetland	Road on fill, or change in water level, temperature or circulation	Build elevated roads, or use many small culverts, use sediment traps, construction to allow animals passage
3RD	Gradual confined change to soils	Chemical contamination, erosion	Restrict clearing of plants, protect exposed soil from erosion, use settling basins
4TH	Chronic low level degradation of water quality	Agricultural runoff, point source pollutants, over enrichment of nutrients	Overland flow, use wetlands as tertiary treatment & vary points of discharge, culture plants such as water hyacinth in controlled areas
5TH	Temporary localized damage to soils, vegetation, & water quality	Turbidity, chemical or oil spill, noise, construction activity	Use existing access, timing to minimize impact on wildlife, restore vegetation

VARIABLES MODIFYING THE ORDER OF IMPACT

1. OPERATIONS VARIABLES

Distribution, scale, & type of activity
Frequency, duration, & season of activity
Location of activity within ecosystem; allignment of flow direction, avoid canal connecting saline and fresh, or deep to shallow waters

2. PHYSICAL & CHEMICAL VARIABLES

Hydrologic regime
Particulate composition of soils & sediments; bottom type
Chemical composition of water & sediments; activities have different impacts in different chemical settings

3. BIOLOGICAL & ECOLOGICAL VARIABLES

Habitat diversity and carrying capacity

Source: Table 2.2 Orders of Magntude, after Nelson and Weller (1984).

Consultants and design teams may solve given project requirements and site conditions with many solutions. Any wetland project based on ecology will require management or monitoring to respond to outside changes and seasonal differences to maintain designed benefits (Jones, 1990). Here strategies will be presented that are useful to achieve the intended effect of the guideline. Important ecological guidelines will be offered before the design recommendations. Adaptation of Jones' ecological and design guidelines will be presented for conservation and restoration of small, endangered, isolated upland wetlands such as acid bogs (Jones, 1990).

Guideline 1

Maximize the opportunity for net productivity.

Maximize the surface extent of vegetation, overland flow and protect soil structure. Make sure all possible sunlight reaches plants so as not to inhibit the conversion of light energy to stored plant energy to begin the progression of energy flow through the food chain.

Strategy 1) Keep over story growth of emerging shrubs and trees from shading the bog by prescribed burning every two to three years, or by late summer mowing at the same interval. It has been found that the larger the surface area a bog occupies, the more floristically varied it will be (Smith, 1996).

Remember the extensive low-oxygen zone beneath the wetland soil surfaces that needs to be protected because decomposition takes place much slower than at the surface. Not allowing fertilizer runoff or erosion to take place in or near an acid bog will protect anaerobic (low-oxygen) microbes and their functions.

Strategy 2) This strategy may be accomplished by use of settling terraces along the development edges of the bog for a buffering effect. (See unique ecosystem, figure 20) If there is existing access for discharging pollutants, such as nearby ditches or storm sewer lines, use them. Otherwise, loss of slowly built-up organic soil, or nutrient glut from excess fertilizer would damage the ecosystem. Nelson and Weller (1984) might label these third and fouth order of magnitude detrimental impacts. Avoid creating new sources of pollution, reduction in soil or water quality, and most especially, changes in the drainage or circulation pattern (Marsh, 1997). In Nelson and Weller's terms, Table 13 (1984), these would be second to fifth orders of magnitude of detrimental impact.
Strategy 3) Cover exposed soil surfaces with mulch such as bark or pine straw or geotextile cloth over seeded with grass to minimize erosion and runoff. Use of a pine straw bale embankment to hold back erosion may be included with construction, but is temporary. Re-vegetate exposed areas as soon as possible. Before the site construction phase of site development, it may be very helpful to minimize compaction and prevent root damage of trees and shrubs adjacent – not within – the acid bog by spreading a thick layer of mulch (6-12 inches) under their canopy as well (Culpepper, 2001).
Strategy 4) Protecting the soil includes avoiding using heavy machinery except in dry seasons and use of boardwalks for foot traffic. (Illustration in strategy 3 of Guideline2) Compaction from traffic or damage to the clay hardpan that may be within inches of the soil surface must be avoided in acid bogs.

Avoid fill within the bog site as it will change the fragile soil chemistry and avert water input. It is important to note that without fresh water input, the self-perpetuating

system ceases to function. According to Nelson and Weller's Table 13 (1984), these are first and second order magnitude detrimental impacts.

Guideline 2

Evaluate the hydrologic regime (and likely future rate of change) with respect to the distribution of plants; maintain or restore overland flow through wetlands

Natural overland flow of water and steady rainfall should be sustained or re-instituted. These flows perform the actual work of recycling nutrients (Mitsch and Gosselink, 1986). This allows organisms to use solar energy more efficiently and makes this type ecosystem very productive despite its poor soil and nutrient status. A note of caution should be added for the fragile hydrology of acid bogs to especially watch over water flow, the lifeblood of hillside bogs. This may be difficult because land ownership boundaries rarely coincide with natural drainage basins (Day and Templet, 1989). To ensure the water regime is able to sustain the existing plant bog community, install plant species that are tolerant to present conditions and those conditions predicted based on the proposed development. Acid bogs function within hydrologic "pulses" caused by rain events that initiate release of stored nutrients from partially decomposed plant material. Rapid plant growth occurs after the initial influx of water, flowering and heavy seed production occurs as bogs soils dry, and drying vegetation along with the slow decomposition of plant debris await the next "pulse." This regime favors sturdy perennials with fire and drought tolerance, as well as tolerance for growing in acid soils (LaClaire, 1995; Kirkman, 1995, 1998; Mitsch and Gosselink, 1986).

Strategy 1) The natural hydroperiod or seasonal flow pattern should be maintained or re-instituted so that the structure and function of the wetland system is reasonably stable.

This and maintaining maximum possible sunshine (Guideline 1) are two of the most important guidelines for maintenance of a healthy bog. Check to see if construction has dammed up water flow, lessened it, or speeded it up through the site. To do this, insure that the original soil grade or slope is maintained as much as possible on site.

Strategy 2) If water flow has been lessened with construction, it is possible to use a tertiary treatment system with overland flow of treated waters, such as gray water from household use (excludes septic effluent) to increase wetland productivity. Manage flow to mimic natural hydroperiod "pulse," as described above. Overland flow replaced with fresh or tertiary treatment water, if soils and temperature are not adversely affected, should maintain the ecosystem stability of the acid bog.

Strategy 3) Minimize blockage of overland flow on site (Nelson and Weller, 1984; Clark, 1977):

- *Raise structures that block flow*
- *Align unavoidable structures that block flow parallel to flow*
- Add many large culverts to maintain flow as much as possible

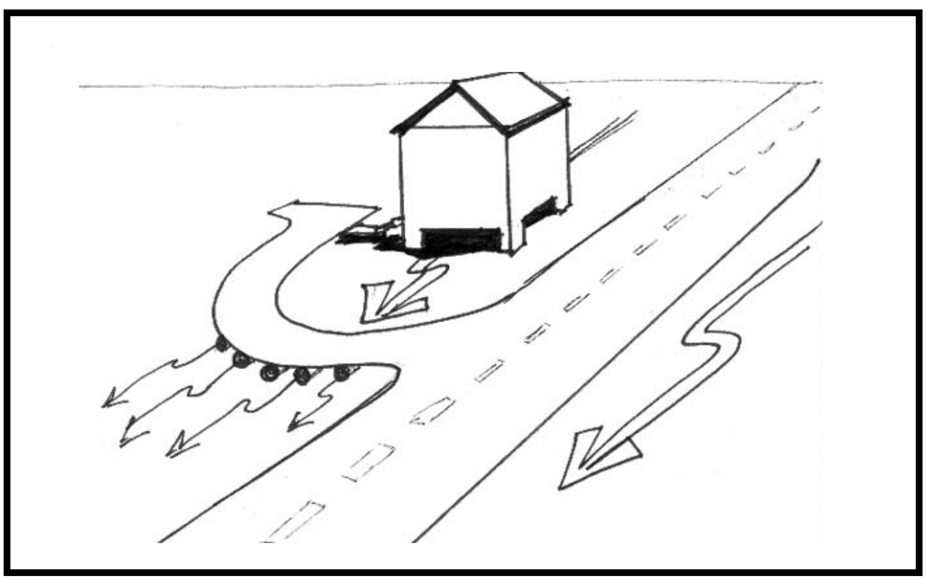


Fig. 19. Practical strategies to minimize blockage of overland flow

Guideline 3

Do not reduce the extent of unique or highly diverse ecosystems, or those that support endangered or threatened species.

It is especially imperative to make the important ecosystem the basis of a protected area, having minimum human activity within the core and surround it by a buffer zone with conservation goals. These areas should be managed for system level support rather than for a single species (Mitsch and Gosselink, 1986), which means the buffer zone should have the same goals as Guideline 1 – maximum sunlight, and soil and water flow protection. Ecosystems containing many species, related to the amount and quality of habitat available, can maintain pools of unexploited species that may prove especially valuable in the future. Figure 20 illustrates a general concept of a preserved protected area.

Strategy 1) Starting with the core area – the acid bog – create a buffer zone of a neighboring habitat of at least fifty (50) to 300 feet depending on slope, vegetation, soil, land use, and other factors to remove most sediment, nutrients and other urban runoff (Scheuler, 1987). The greater the slope, the sparser the vegetation, or the sandier the soil is will be the criteria for buffer width.

Strategy 2) Neighboring habitats in the second step may be open and linked to the core area by flows of nutrients and species (animal) movement. Visitor use may include recreation and education or traditional hunting.

Strategy 3) In the third step special use zones allow urban and industrial development, agricultural and other intensive uses. If these linked habitats are within the watershed of the core zone, they should be controlled with regard to sediments, pesticides, herbicides

fertilizers, and fresh water flooding (Salm and Clark, 1984). Adequate size buffer zones or settling terraces are two possible strategies covered above.

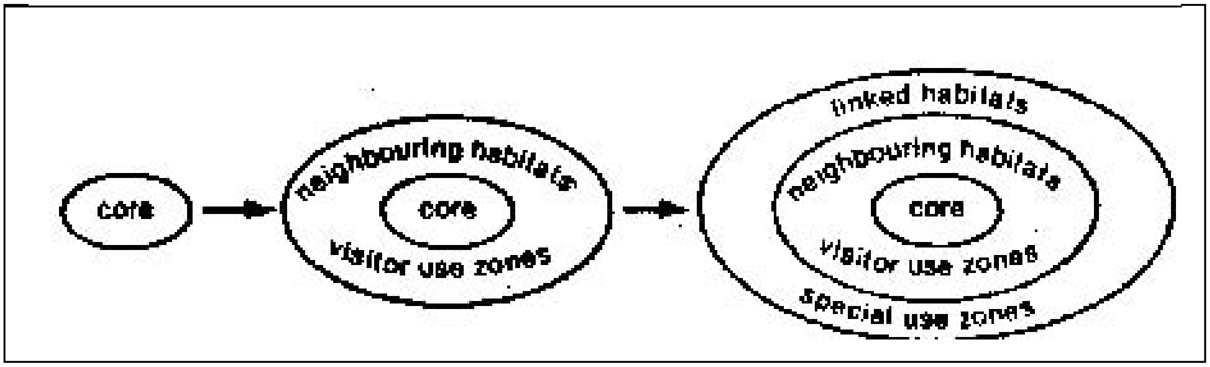


Fig. 20. Unique ecosystem protection (From figure 3.11, Principle Steps in the Design of a Coastal Protected Area. Salm and Clark, 1984)

Guideline 4

Design a data-gathering program to study the sensitive ecosystem processes before the synthesis phase of design; **then, meet the requirements of the wildlife (potential as well as existing) of the site**.

Biologic distributions and abundances are not quickly determined because of seasonal and annual variability. Wetlands scientists should evaluate the functional relationships between ecosystem components. Measurements to reveal system responses to stress should be selected (Holling and Gold berg, 1978). Food chain dependencies of the indicator species nutrient cycles and energy pathways should be studied, along with major physical, chemical and biologic processes that maintain optimal habitats for these species, and key species in their food chain. Indicator species should be easily observable, and show quick response to pollution or other environmental degradation that might be produced by the project (Clark, 1977).

Apply the following ecological concepts to meet the requirements of the wildlife of the site: habitat diversity, edge effects, interspersion, and island biogeography. In upland areas, A. habitat diversity - in figure 21 of Ecological strategies below, increases the likelihood of meeting the requirements of a greater number of species. Basic wildlife habitat requirements include food, water, cover and space.

Strategy 1) In the case of protecting acid bog integrity, bring in appropriate bog plants that would offer more wildlife food such as seed or berry producing grasses or grass-allied bog plants.

Strategy 2) Bringing new food plant species within a site may also apply at the edges of a developed area, and provide a transition into the adjacent ecosystem in B. edge effects below, figure 21. The mixed benefits between ecosystems increase plant and animal richness. A mosaic effect increases edge effects greatly and is more naturalistic.

Strategy 3) Interspersion is the spatial relationships of different types of habitat and the requirements of wildlife for good habitat as shown in C, figure 21 (Cash, 1988).

Strategy 4) The number of species that occurs in an island of habitat is a function of its size and isolation from other islands. See Island Biogeography, figure 22. If the development site is large enough to contain several types of habitats (islands) the illustrations below, along with ecological concepts just described may be useful in how to configure different habitats on the site.

Guideline 5

Choose the design that is most appropriate for the entire range of possible future rates of drop/rise in relative water level.

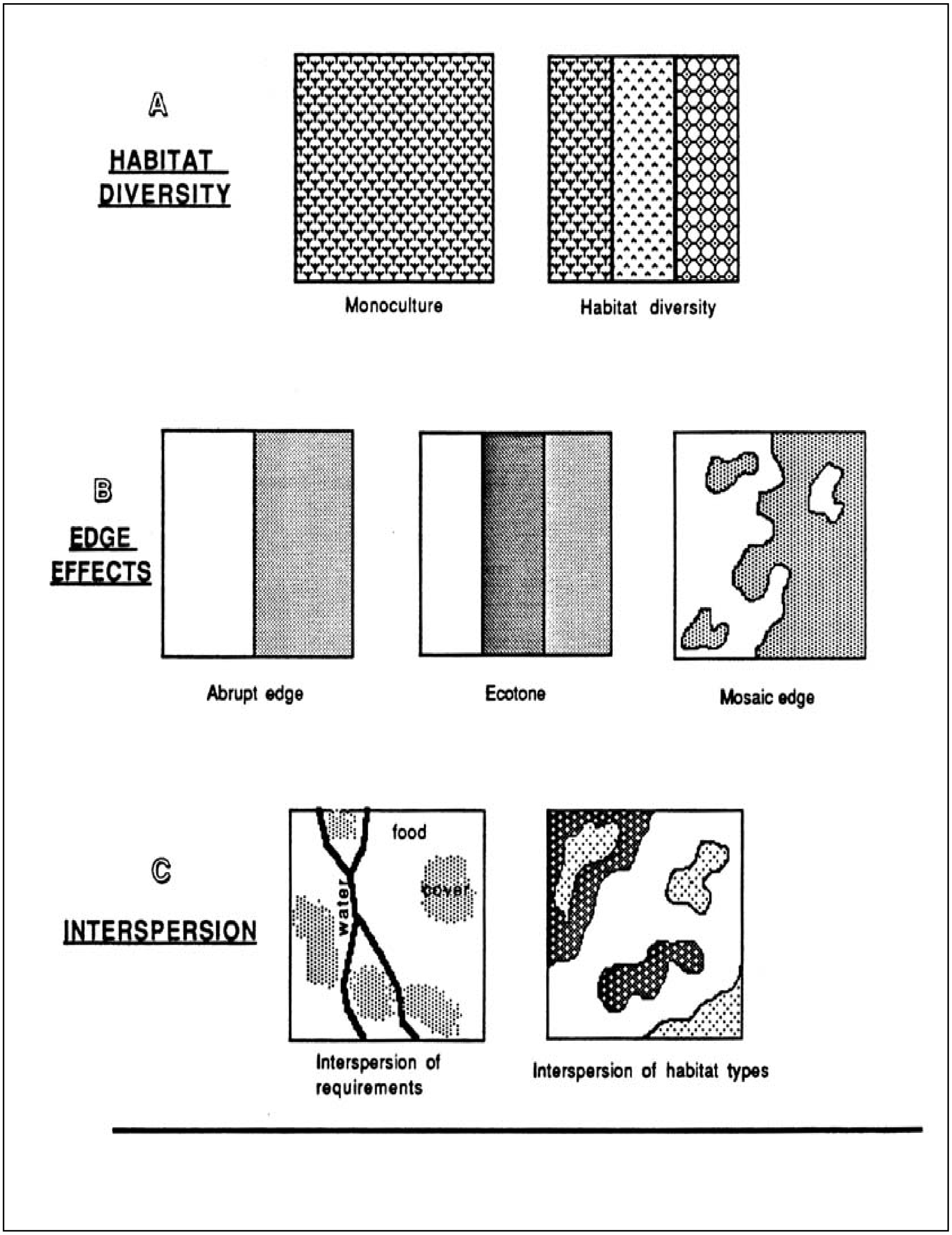


Fig. 21. Ecological strategies (From figure 3.8, Ecological Concepts of Habitat Diversity… Cash, 1988)

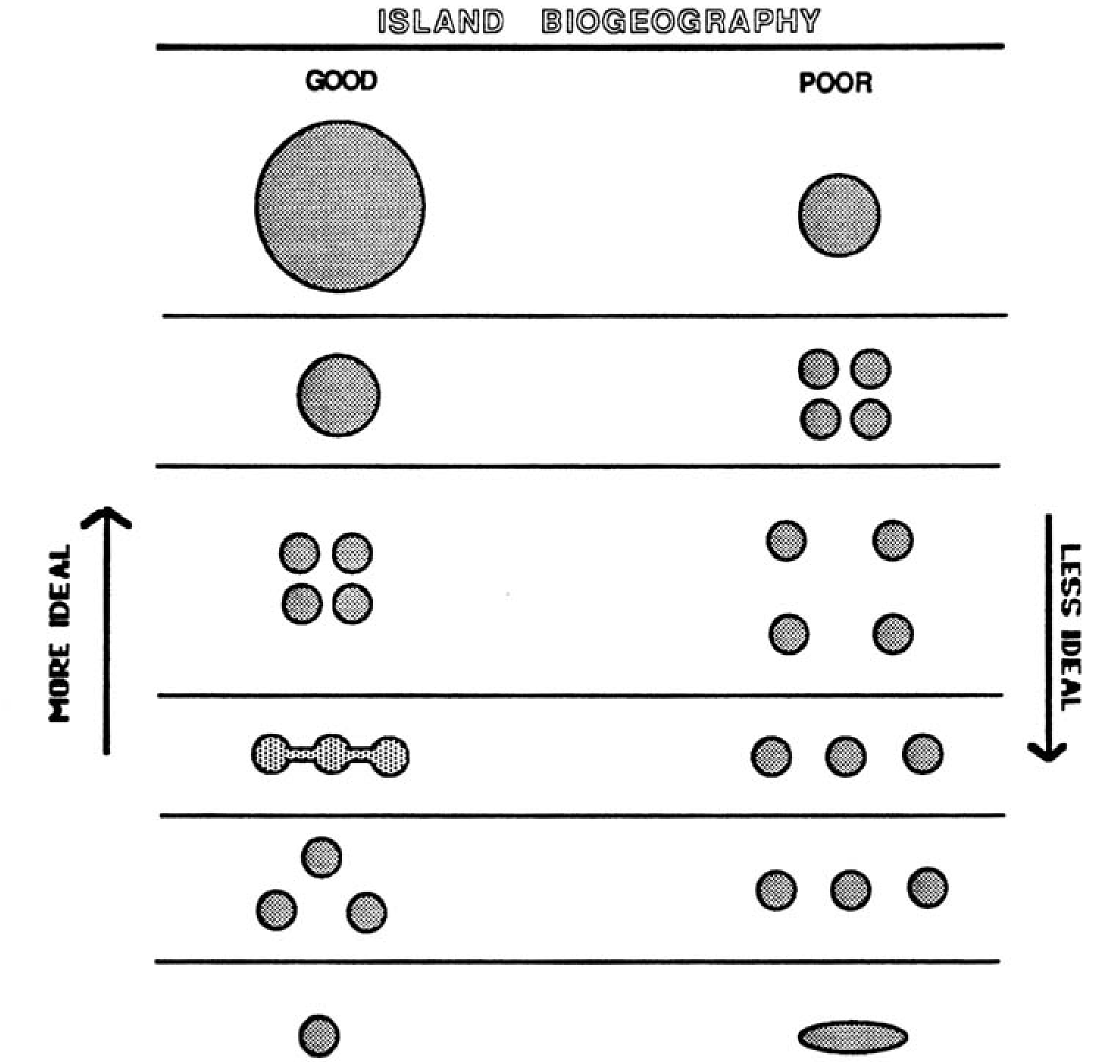


Figure 3.9; Nature reserve planning derived from general principles of island biogeography. These drawings represent the geometric shape of natural biological islands in a sea of different or hostile environment. These six pairs of drawings emphasize the ideal (left column) compared to the less preferable (left column). Also, as one moves down the column less preferable situations are shown (adapted from Diamond, 1976 by Eagles, p.17; 1984).

Fig. 22. Biogeography (From Diamond, 1976 by Eagles, 1984)

Strategy 1) Related to Guideline 2, this strategy also strongly suggests raising all structures located in wetlands or refrain from building in areas of threat. Traditional

structures have a first order detrimental impact on wetlands unless they are raised to allow for flow underneath the structure. If structures are raised:

- Flooding and localized subsidence problems are minimized.
- Structures will be easier to permit and involve less upkeep.
- Long and short-term property values will remain higher.
- Flood abatement capacity and water quality benefits downstream will be kept.
- Flow will also provide nutrients downstream to other ecosystems (Jones, 1990).

Strategy2) Choose the appropriate alternatives for structures and transit paths: (Also see typical development activity and possible development process improvements (mitigation) listed in Orders of Magnitude, Table13 (Nelson and Weller, 1984).

- *Structures* - Raise on pilings.

- *Utilities* – Gas and electricity lines to buildings need flexible joints and/or structural support (Earle, 1975; Mumphrey, 1976) and may be raised. Sewerage lines are acceptable if wetlands are used as tertiary treatment facility. Conventional sewerage systems may conflict because of high water tables and lack of flow gradient.

- *Storm and drain systems* – Runoff rates may be beneficial if it is directed through the wetland, depending on loading rates and assimilative capacity of the bog. Avoid ditches and plow lines in the wetland vicinity, as they will interfere with the natural underground circulation of water through the bog. The clay hardpan, upon which the underground water flows, may be breached in the ditching process resulting in permanent flow interruption.

- *Parking, Walkways and Roads* – First order detrimental impacts will occur if surfaces are not raised. If surfaces are on an embankment, they have first order of magnitude impact. If they are aligned with flow direction, the order of magnitude may be reduced. Compaction, runoff, surface permeability and pollution are some of the issues associated with roads, walkways and parking lots (Jones, 1990).

Clark offers three scenarios for land use – preservation, conservation and traditional development. See Table 14 Land Use Constraints below (Clark, 1977).

Table 14 Land-Use Constraints

LAND-USE CONSTRAINTS

PRESERVATION	CONSERVATION	DEVELOPMENT
No construction, development, or land alteration	Limited development - homes on fill islands (upland clusters) or stilts. Maximum density 1 du/5 acres.	Intense development
No roads	Roads parallel to water flow or raised (trestle)	Adequately culverted roads
No canals or dredging - maintain historic (natural) overland water flow	No canals or dredging - wetlands used to receive, clense and disperse water	No canals longer than 800 yards - drainage into man-made retention ponds, eventually into wetlands
Low intensity recreation (hunting, fishing, individual camping)	Moderate intensity recreation, with realization that areas may be periodically flooded	Intense recreation
No waste disposal	No solid waste disposal, dumps, or landfills. Sewage by approved system	No dumps. Approval of DPC for sewage and solid waste disposal
No water consumption	Water consumption not to exceed 150 gpd/acre	Water consumption not to exceed 1800 gpd/acre
No removal of vegetation	Maximum 5% vegetation removed, except for exotics. Only native vegetation used for landscaping	Maximum 40% vegetation removed, except exotics. No melalogua or Brazilian pepper used

Source: From Table 3.1, Land-use Constraints…Clark (1977)

Guideline 6

Exercise strict controls on construction and other disturbing activity during occupation so that impact on wetlands is minimized; and mitigate to reduce predicted unavoidable negative impacts.

Remove a minimum of vegetation, to prevent sediment runoff traditionally resulting from construction (Clark, 1977). These are fifth order Nelson and Weller (1984) detrimental impacts.

Strategy 1) These listed construction techniques are ecologically sensitive:

- Use "end-on-end" construction technique, that is, schedule sequential construction to minimize impact on the site

- Time activities to avoid nesting, nursery and spawning time of sensitive species (Terrel and Shanks, 1979; Nelson and Weller, 1984).

- Schedule construction during time of low rainfall or runoff (Clark, 1977; Nelson, and Weller, 1984).

- Use of sediment traps, strips of buffer vegetation, and direct runoff away from exposed soils (Clark, 1977; Nelson and Weller, 1984).

Include these mitigation possibilities: re-vegetation, bog restoration or creation of new wetlands to offset those destroyed, leveling old spoil banks and plow lines, and plugging drainage structures. Time activities for least interference with nesting or spawning activities.

Strategy 2) Find alternatives to canals, drainage ditches or fire breaks in the wetland vicinity, such as re-vegetation programs or overland flow. This strategy is related to Guideline 5 in its appropriateness for land development near acid bogs. To minimize the impact of drainage structures and burn plow lines and canals (Craig and Day, 1977):

- Plug both ends and at internal intervals.
- If drains and plow lines are shallow, disc over them during a dry-down period (MacGinnis, 2001).
- Restrict new drainage structures to natural corridors, levees, or defined development corridors
- Use mowed corridors as fire breaks.
- Alignment of canals should take advantage of existing natural or artificial channels.
- Limit canals between vegetative types.

Strategy 3) Create new wetlands as compensation for those unavoidably destroyed. After insuring that the subsoil contains a relatively impervious layer, and that it is the

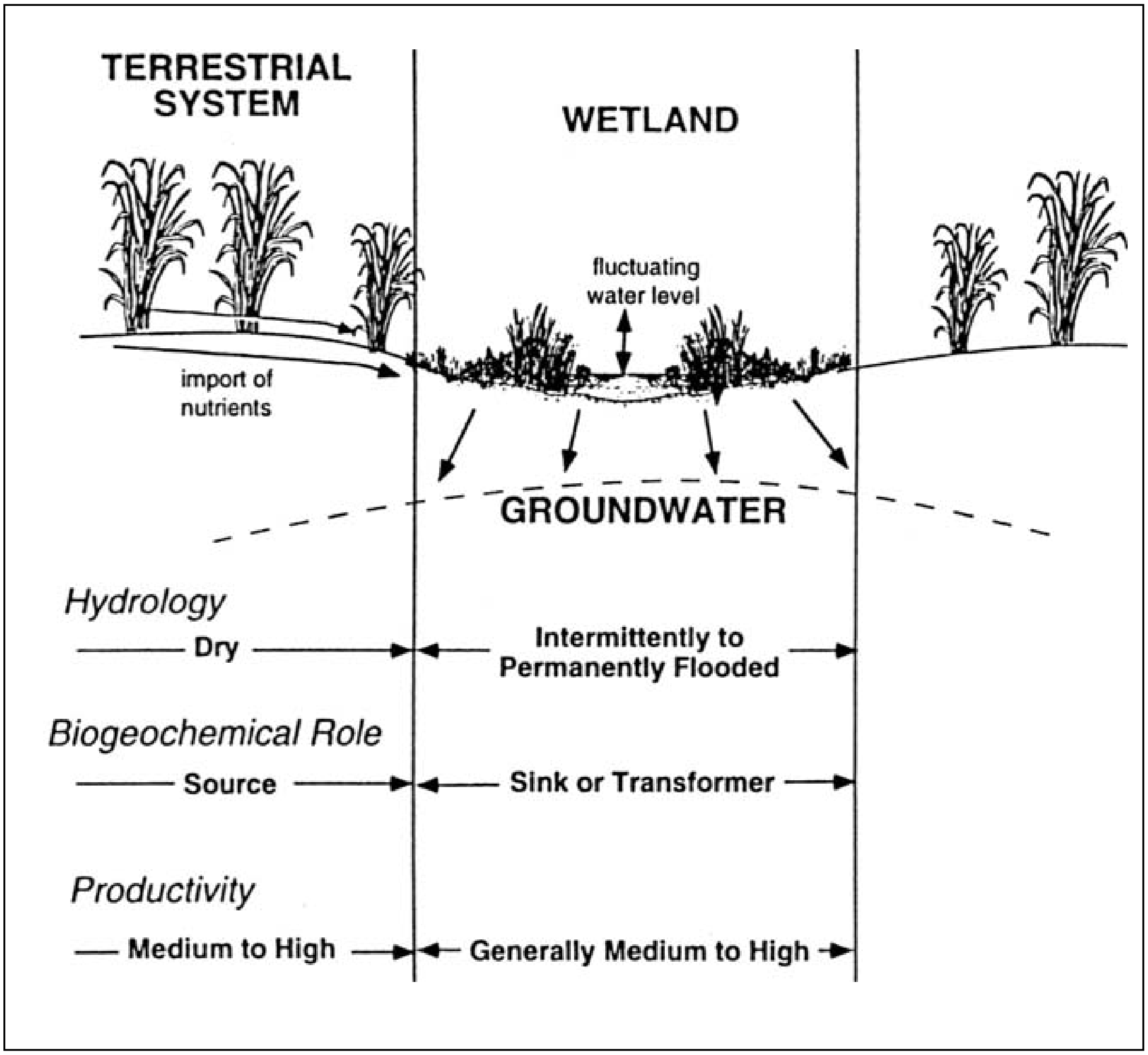


Fig. 23. Depressional wetland hydrology (From figure 2.1B Isolated from water body connections. OCS 7001 class notes on wetlands, Mitsch, and Gosselink, 1986)

correct acidity, water flow must be provided through the intended area to mimic the "pulse" effect described in Guideline 2. The graphic of wetland hydrology, above in figure 23, may provide some understanding of system dynamics of acid bogs.

In acid bogs, groundwater is usually very close to the soil surface providing constant dampness. With the pulse of rain and ground water flow and the combination of

sandy soil consistency, there is good exchange of nutrients that results in lush, rapid plant growth. In this way the small wetland acts as a medium to high “sink” or transformer of chemicals (shown in figure 23) to slowly build up to a diverse, highly productive and unique ecosystem.

Remember, an area of poor soil (low nutrient level) and low pH with proper overland or underground water flow will provide the slow decomposition and adaptive nutrient cycling pathways required by insect-eating plants and other spectacular flowering bog plants. Addition of suitable wetland grasses and forbs (grass-allied plants) will finish the restoration. See Appendix C, Plant Samples, for a selection of some species appropriate to acid bogs. Wetland management in the form of monitoring the hydrology and correctly timing control burns or mowing after seed set will help insure the health of the acid bog. Removal of exotic plant species is desirable.

Educational outreach:

Saving some of the remaining small, endangered upland wetland sites may be achieved by educating a few interested individuals in the landscape development arena, and by also having close-at-hand information for the interested homeowner. An understanding of the value of wetlands in the utilizing them in the environment must be passed on in a practical sense to land developers who are generally first on the scene of new opportunities. Most landowners need technical assistance. Is it true as reported in the findings of this survey that developers have sufficient technical information from their consultants or the Corps to put their wetland value understanding to use in on-going or future projects? Having a proactive informational campaign continued by community concerns, both private and public, timed to present helpful data to the interested

homeowner or developer when they most need it, appears to be most appropriate course of action for preserving our sensitive sites.

Informational brochures can be compiled to send out to nonprofit / special interest groups, or governmental agencies that are most strategically positioned to influence the interested developer or homeowner who would like to preserve or enhance their sensitive sites. Organizations, such as chambers of commerce, planning commissions, police juries, building associations, county/parish agents, local branches of the Native Plant Society and other garden clubs, and plant nursery or feed and seed clerks, are likely candidates for educational information on acid bogs (Williston, Balmer and Tomczak, 2001; Chance, 2001). Special interest groups and school science programs may also want to make use of information from this study or from the following list of helpful sources for educational purposes. Helpful resources to those interested in finding out about acid bogs and ways to make use of these unique wetlands while impacting them as little as possible have been reviewed and included below. These are some of the people and agencies that stand ready to help:

Agencies:

The Nature Conservancy (for information & wetland conservation technical assistance):
PO Box 4125, 340 St. Joseph St., Baton Rouge, LA 70821; contact person – Richard Martin; phone – 225-338-1040
"North Shore" branch office, PO Box 1497, Covington, LA 70434; contact person – Nelwyn McGinnis; phone – 504-320-9284

The Nature Conservancy websites: (for wetland, agency information and contact numbers): http:// tncnt.tnc.org and http:// la.nature.org

Natural Heritage Program, (for .org.org.org.org.org.org.org.orgon technical assistance):
LA Dept. of Wildlife and Fisheries,
PO Box 98000, Baton Rouge, LA 70898-9000; contact persons – Gary Lester, Jill Kelly, phone – 225-765-2821

LA Cooperative Extension Service, Natural Resources Project (for information & public educational outreach):
327 Forestry, Wildlife & Fisheries Building, LSU, Baton Rouge, LA; contact person - Hallie Dozier, urban ecology specialist; phone – 225-578-7219
or CK @ each parish (county) seat for parish (county) agent – find complete listing in Private Lands Technical Assistance Handbook for Louisiana below
specialists @, 163 Miller Hall, LSU campus, Baton Rouge, LA 70803; contact person – Dr. Allen Owings, horticulture specialist; phone – 225-578-2222

USGS National Wetlands Research Center, (for wetland information, restoration & public educational outreach)
700 Cajundome Blvd., Lafayette, LA 70506: contact persons - Sue Horton, Sue Grace, Ron Boustany; phone – 337-266-8500

Forest Stewardship Program, , (assistance/wetland conservation)
LA Office of Forestry, PO Box 1628, Baton Rouge, LA 70821-1628; contact person – Pat Beard; phone – 225-925-4500

US Fish and Wildlife Service, National Wetlands Inventory Center (for wetland questions)
1875 Century Blvd., Room 240, Atlanta, GA 30345; contact person – Charlie Storrs; phone – 404-679-7081
Local sources: (for ecological assistance on private lands)
East Baton Rouge Parish agent, 825 Kaliste Saloom Rd., Bldg. II, Suite 102, Lafayette, LA 70508; contact person – Andy Dolan ; phone – 318-262-6630
"North Shore" area agent, 1010 Gause Blvd., Slidell LA 70458; contact person – Howard Poitevint; phone – 504-646-7555

National Resources Conservation Service, (for technical resources and references):
USDA website: http://www.nrsc.usda.gov
or CK @ each parish (county) seat for parish (county) agent (for conservation planning) – find complete listing in Private Lands Technical Assistance Handbook for Louisiana below

US Army Corps of Engineers website: (for wetland info and wetland delineation)
http://mvn.usace.army.mil/ops/regulatory

US Army Corps of Engineers, (for wetland info & regulatory assistance):
New Orleans District, PO Box 60267, New Orleans, LA 70160-0267; contact persons – Gail Lawrence; phone – 504-862-1627, John Bruza; phone – 504-862-1288

LA State Herbarium, (for assistance in wetland/bog plant identification),
202 Life Sciences Annex Blg, LSU Dept. of Biologicalificificificificificificificific contact person – Dianne Ferguson, phone – 225-578-8564

LSU Biological Sciences Dept. website, (for state plant distribution information):
Biological Sciences Dept homepage: http://www.biol.lsu.edu or
http://www.biol.lsu.edu/courses/biology4020
201 Life Sciences Annex Blg, LSU Biological Sciences Dept, Baton Rouge, LA 70803; contact person – Dr. Urbatsh, dept. head, phone – 578-8555

Wetland Institute, (for information & wetland soil technical assistance):
LSU Agronomy Dept., 104 Sturgis Hall, Baton Rouge, LA 70803-2110; contact person – Dr. Pringall; phone – 225-578-1337

Crosby Arboretacttacttacttacttacttacttacttactisiting a bog):
PO Box 1639, Picayune, MS 39466; contact person - Bob Brzuszek; phone – 601-799-2311 ext. 22

Louisiana Native Plant Society, (for bog contact persons statewide)
PO Box 126, Colliston, LA 71229, Beth Erwin – secretary, phone – 318-874-7777 or
Folsom Native Plant Society, (for "North Shore" bog contact persons)
P. O. Box 1055, Folsom, LA 70437; contact person - Marion Hargeones, phone – 985-796-3325

Lake Ponchartrain Basin Development Foundation, (for agency assistance and incentive programs for wetland protection &/or restoration):
3838 N. Causeway Blvd., Metairie, LA; contact person –Carlton Dufreshoe; phone –504-836-2215

Environmental Research Center (for area bog information)
Bldg. 2505, 23rd St., Fort Polk US Army Base, Leesville, LA; contact person – Stephanie Stevens; phone – 337-531-6088

Other help sources*:*

Kneedeep in LA Wetlands (Educational CD about bogs)
author – Linda Beyt,; other contact person – Susan Horton, National Wetlands Research Center, (address above) phone - 337-266-8500

Private Lands Technical Assistance Handbook for Louisiana (Private Landowner Grants, Agency Assistance and Incentive Program Listings for wetland protection &/or restoration):
LSU Agricultural Center with LA Cooperative Extension Service; author – Paul Coreil; Bulletin #2536, 1993

USDA website (for wetland information, plant species listings & illustrations):
http://plants.usda.gov

US Fish and Wildlife Service, National Wetlands Inventory Center website: (for wetland plants, status and development trends): http://wetlands.fws.gov/NWI_Reg

Wetlands Functions & Values in Louisiana (general wetland appreciation)
LSU Agricultural Center with LA Cooperative Extension Service; authors – Andy Dolan, et al., Bulletin #2519, 1998

EPA website: (general wetland information and conservation)
http://www.epa.gov/OWOW/wetlands/vital/toc.html

The Savage Garden (for creating or restoring an urban acid bog)
author – Peter D'Amato; Ten Speed Press, Berkeley, CA

LA House, (view best & low eco-impact management practices, & lo-energy housing, sustainable (?) living environment):
corner of Nicholson Dr. & Burbank St.(near LSU), Baton Rouge, LA;
LSU Department of Agriculture/LA Cooperative Extension Service
" website: http://www.la.nature.org

CHAPTER 6: CONCLUSIONS

This study focused on acid bog wetlands and findings support the original hypothesis. Autonomous homeowner and developer attitude and the apparent lack of knowledge of the natural connections in their respective geographical surroundings are contributing to the decline of this rare plant community in Louisiana. Outdated development practices in sensitive sites, and a slow and confusing regulatory process is also putting acid bogs in imminent danger of eradication.

Homeowners

Interviews conducted for this study found that most landowners are aware of the wetland conservation trend and are not insensitive to it. The research showed that homeowners in the three case studies have seriously disturbed the acid bogs on their properties without awareness of the values to themselves or the ecosystem. They have disrupted the connection between the acid bog and the ground water within the area water basin. By doing so they have greatly lessened the benefits of this unique small wetland. While conclusions are confined to the study sites, there is a likelihood that other people are behaving in a similar fashion.

Landowners are aware of the presence of acid bogs on their properties, but the knowledge level appears to stop there. From the homeowner's point-of-view, the acid bog is seen as an inconvenience to future plans they might have towards the use of their land instead of a necessity in contributing to the quality of their local environment. In two out of three case studies, the presence of a bog site has brought out an antagonistic attitude to the point of obliterating the very thing that was critically endangered to begin

with for the sake of property rights. Landowners appear to be mostly uninformed that the presence of acid bogs suggests protection of the clay hardpan that brings them a ready supply of well water. Is it necessary to take the practice of our freedoms to do what we please to the brink of endangering our safety and welfare? Is a more long-term view in land use only to be had when ecosystem damage is very expensive or irreversible?

Developers

Why is it that wetland conservation is valued so low? The crux of the problem stems from property rights issues and also from the market not compensating landowners for the benefits enjoyed from those wetlands. It's not that developers don't care; but considerations are driven by economic factors. Developers use profit as their guide, as with every business. Results of interviews with homeowners, and developers alike, suggests that landowners prefer to make informed decisions about their property use. They are not interested in preservation, according to statistical analysis of their responses, because bottom-line economics outweigh intrinsic wetland values by one and one-half (1 ½) times.

Indications are that wetland destruction is occurring while developers are following regulations. Regulatory costs drive up the price of wetland development and conservation because the process is lengthy and expensive. Multiple regulatory layers and confusing procedures contribute greatly to both negative landowner attitude as well as higher development costs (consultants must be hired in many cases).

Regulation is not enhancing bog preservation because the regulations don't address upland sites and the value of eco-communities. How much intrinsic value is written into regulations? As it stands, the Endangered Species Act applies to protection of

animals, but not plants. Regulating bodies don't concern themselves with upland bog sites; they are more geared for health, safety and welfare of the general public. The regulations may better protect small local inland wetlands through creating incentives that heighten awareness of wetland values. Protection of acid bogs, by way of their connection to area hydrology, contribute directly to those higher social concerns by contributing to recharging and purifying local water sources, acting as flood buffers, and in many other ways. At no cost they serve the public as recreation and educational areas, and open green space in developed areas.

Current regulations mandate that any wetland property up for development must first apply to the U. S. Army Corps of Engineers for a permit, or to the Louisiana Department of Natural Resources first, if the wetland falls within the coastal zone. Small properties of less than five acres are eligible for free Army Corps wetland delineation, yet they are the ones falling thru the cracks. Regulating agencies and wetland mitigation land banks are more interested in setting aside larger acreage for wetland preservation. Larger tracts are thought to be more valuable habitat because they usually have higher plant and animal diversity. There is more work to do for protection of small, isolated inland wetlands.

Do developers lack knowledge of wetland intrinsic value? This study *does* find the lack of knowledge of acid bogs and their values within the development community, as a whole. Although great labor may go into the analysis and development of each site, an entire area may be devalued as a consequence of lower water purity and/or less water available, higher incidence of flooding, and disappearance of wildlife habitat as a result of destruction of acid bog wetlands. Findings indicate an area wide effort is needed in this

type of preservation effort. As mentioned earlier, one bog left undisturbed might not survive in a highly developed community due to its connection with the underground water basin.

With the exception of consultants, providing the public service of ecological conservation while satisfying basic demands for new emerging home and business sites is not the trend that is being pursued. Toward this end, landscape architects could move to the forefront of a new cutting edge public service. Landscape architects should foster the interdisciplinary cooperation essential to developing a defensible scientific base for their designs. Knowledgeable landscape architects could smooth the regulatory process for property owners. Homeowners and businessmen alike share contact with developers when changes in land use occur, even with “raw” land. There is the opportunity for changes in land use trends at this juncture. Will landscape architects and other developers step up to the conservation challenge or continue in the same development trends in practice since the 1700s?

There are two rationales behind the conservation/protection trend – in the form of laws and regulations - to respect inland wetlands in land use planning. Here they will be applied to acid bogs. 1) These wetlands are an integral part of the hydrologic system necessary for maintenance of water supplies and water quality; and 2) acid bogs are important habitats necessary to the survival of many species, some critically endangered. Other practical reasons call for acid bogs to be protected against the pressure of land development. First, the places in the landscape where these wetlands form are characterized by drainage conditions that are somewhat limiting to most land uses. The conditions do not simply disappear by scraping the wetland away; they extend over a

larger area than the bog itself. There is considerable trouble with delineation of the underground margins of this wetland and this problem may offer consultants and wetland engineers a real challenge. As stated earlier, attempts to build in these sites may increase overall development costs because of the need for special allowances for site drainage, flood protection, and facility maintenance. Second, most wetlands are usually underlain by organic soils that are unstable for most forms of development. This also calls for extra engineering schemes, or excavation and refill with a more stable material. Either way costs increase significantly. Third, acid bogs may be used as a showcase landscape amenity, and can improve land values and design opportunities for the insightful developer. Marsh (1998) states that the market value of land would increase if wetlands were included in local and regional planning. Clearly, property values could be enhanced if acid bogs were integrated into land use planning schemes.

Guidelines have been suggested that improve land values and provide a wider range of design opportunities in this study. The proposed guidelines should be used as a bridge between the analysis and implementation of standard design approaches in the area of ecologically sensitive sites such as acid bogs. Use of these guidelines is one of the most effective ways to slow the destruction of acid bogs. During the analysis phase, the first four ecologically sensitive guidelines, plus their strategies, should be developed as a transition to the synthesis phase of the design process. An environmental site manager may have input to the design strategies. Strategies for individual development sites should form the basis of a mitigation plan and concept development. The last two guidelines are oriented towards site design, and a management plan may also be developed simultaneously for compatibility with land use. Use of the guidelines should

allow landscape architects and other developers to produce site plans that will not increase loss of acid bogs, or other locally sensitive wetland sites, in Louisiana in areas next to development projects.

Application of the Jones' guidelines (1990) and the guidelines in this thesis may prove useful in other environmentally sensitive areas and ecosystems that are at risk of being developed without regard for the complete benefits they provide to the natural systems nearby and to the public. Development of geological guidelines may be important in instances of areas with critical water shortage.

"How and where to find out if you have an ecologically sensitive site?" was asked in the beginning chapter. Comparisons may be made with any wetland site against the detailed information on acid bogs provided in this study, and from other helpful sources listed in the previous chapter. Descriptions of what acid bogs sites are like, where they may be found in the landscape and local examples of these ecologically endangered sites are all included in this study. Common acid bog indicator plants are given along with a more complete vegetation list in Appendix C. Another list of especially rare and endangered plants from acid bogs can be found in Appendix J. Helpful website sources, as well as physical locations, were tabulated at the end of chapter 5 where these unique plants can be viewed along with their individual descriptions. A wide range of general wetland help is available from governmental agencies, such as county agents and state herbariums, to local arboreta and other non-governmental organizations.

Implications and Further Study

Other areas for further research were uncovered. There are no regulatory incentives to get people to utilize wetlands wisely. What would make developers set aside

wetlands? Although state and regional planning issues are outside the scope of this study, protection issues could be searched and local ordinances supported. Other study might be the use of small endangered and isolated upland wetlands in regional matrix and corridor planning.

Currently understanding of ecosystems in small inland wetland sites is minimal. While much wetland work has been done in coastal lowlands and estuaries and there is much research available in many disciplines, relatively little work has been done on upland wetlands (which includes acid bogs) from the different disciplines. Because disturbances are intermittent, continual, long-term research into eco-niche communities should be conducted to get the full value of these ecological systems. Conservation/preservation techniques may not be most appropriate and will not be until information is available from the different scientific disciplines. Other questions include: what was the historical status of acid bog sites, what is the timeline and progression of plants species in hillside bog establishment? All answers are pertinent information to bog restoration. Resources and guidelines were gleaned from other studies of lowland wetlands; little or no conservation/preservation material is available to specifically for isolated, upland wetlands. Information for acid bog restoration is virtually non-existent.

If bogs are to be protected, what is the best method of doing so and can they be protected? How to change attitudes? These and many other intriguing and important questions were raised during the course of this investigation. It could be that saving wetlands is not important in this area of development and problems are other than originally thought. Was something missed in consumer behavior attitudes? Cross tabulation of telephone survey results could be done on rating questions for grouping

similarities between types of developers to see which developer groups to target for further attitudinal research. Ways to bolster the market value of small wetlands could be probed. Property rights were a noted cause of friction in the regulatory process and in land use trends. Yet, when developer and homeowner attitudes toward small inland wetlands were investigated, in almost every instance a desire for more information on the subject was encountered. Do requests for more information mean that what has been received from organizational activities and professional literature is insufficient?

It is the premise of this study that information availability is the most assured method in protecting our finite resources. A "grass-roots," or public awareness/effort towards acid bog conservation seems to be the best avenue to prevent this important natural resource from disappearing, In this way two main issues - the non-market feasibility issue and the fact that these wetlands have been considered to be too small to be effective in contributing to the publics' water quality and recharge - may be turned around. By educating a few interested individuals in the landscape development arena, and by also having close-at-hand information for the interested homeowner, saving some of the remaining sensitive sites may be achieved. This goal may be accomplished in several steps:

1) Summaries of this research will be sent to all interested participants in the study.
2) Compile informational brochures to send out to nonprofit / special interest groups, or governmental agencies that are most strategically positioned to influence the interested developer or homeowner who would like to preserve or enhance their sensitive sites.
3) More scientific research can be done and published in professional and scientific journals on hand at local libraries.
4) An informative Internet website on acid bogs may be initiated to show how to identify such sites, and where to turn for further help in doing so.
5) Investigation of the possibility of signage for local bogs with the help of non-governmental agencies.

6) Foster federal interest in maintaining ecosystems with public-minded citizens and on public administered properties – such as federal, state and local preserves and park situations – by public speaking at governmental and professional conferences and other activities.
7) College seminar classes, quick summer courses, and school outings can be held to educate young people and the public in general.
8) Personal research of the author will continue study of disturbances to acid bog sites on government lands, such as national forests and military bases.

The first step above is within the scope of this study; the remaining steps represent further conservation work to be done for acid bogs. Many observers believe there will be increased responsibility for individual states and less with the federal government for the protection of wetlands in the U. S. in the future (Mitsch and Gosselink, 1986). Management may not be able to preserve sites in commercial ventures, but "grass-roots" efforts can sway the tide of conventional land use trends. Next, land developers who are generally first on the scene of new opportunities must practice implementing the knowledgeable use of these values, both ecological and social, by utilizing them in the environment.

General study limitations were the small population sample size due to time and resource constraints. More comprehensive study is needed to extrapolate the results to the entire population. The attitudinal study had drawbacks in that the results may not be repeatable. Local differences, such as the strong geo-political land rights trend in Louisiana, and the extremity of the range for Louisiana acid bogs, was at the edge of the scope of this paper. Lengthier and more in-depth studies can be undertaken to answer the other questions posed in this chapter.

In conclusion, no part of our landscape provides so many benefits at so little cost to the public as America's wetlands. Benefits include: flood buffering, erosion control, water purification, aquifer recharge, commercial production (i.e. timber), wildlife habitat,

recreation and tourism and aesthetic values (Department of the Interior, U. S. Fish and Wildlife Service, 1990). Greenways, in the form of acid bogs, can provide us with the ability to explore the outdoor environment and learn more about the unique landscapes in our communities (Fink and Searns, 1993). It would be a sad commentary on this generation if saving the remaining acid bogs in Louisiana at the southern-most part of their range is not feasible, and the last sites where they may be found will be on public lands within the federal trust and at the mercy of fluctuating political winds.

Every state embodies a wide expanse of ecosystems that endow it with a rich natural heritage. Maintaining our common natural heritage requires that the facts be identified. This research found not what was originally hoped for – that conservation in land use trends was being fostered – but what was found strengthened the original purpose – to highlight the problems of this fast-diminishing natural resource and to offer solutions. This research has found there is much more to be done to protect diminishing small ecosystems.

REFERENCES

Adams, L. W., L. E. Dove, and D. L. Leedy 1984. "Public Attitudes Toward Urban Wetlands for Stormwater Control and Wildlife Enhancement." *Wildlife Society Bulletin* 12: 299-303.

Allen, Brenda 1997. "Alabama Tree Ordinances, Protection and Preservation on Construction Sites." Dissertation. Auburn University. Auburn, AL.

Bates, Robert, and Julia Jackson, ed. 1990. *Glossary of Geology*. American Geological Institute, 4220 King St., Alexandria, VA 22302.

Beyt, Linda 1999. *Kneedeep in Louisiana Wetlands*. CD (computer disc) Educational Technology Review Center, Lafayette, LA: IBM/MacIntosh.

Brunet, David 1999. "Rare Plant Species of LA." LA Department of Wildlife and Fisheries, Natural Heritage Program, Baton Rouge, LA. Photocopy.

Brzuszek, Bob et al. 1999. "Vegetation of the Crosby Arboretum Natural Areas." Research paper, Crosby Arboretum, P.O. Box 1639, Picayune, MS: 3,5-8. Mimeograph.

Butler, Larry et al. 1990. *Soil Surveys of Natchitoches Parish, Louisiana.* USDA, NRCS (formerly Soil Conservation Service) in cooperation with Forestry Service, LA Agricultural Experimental Station, and LA Soil and Water Conservation Commission, Alexandria, LA. U. S. Printing Office.

Cash, C. C. 1988. "Wildlife Habitat as an Integral Component of Landscape Architecture and PUD Design." Master's thesis, Louisiana State University, Baton Rouge, LA.

Chance, Linda et al. 2000. "Gopher Frog (Rana capito) Pond Restoration Project: Pony Branch 1." OCS 7001 Unpublished research paper, Louisiana State University, Dept. of Oceanographic Studies, Baton Rouge, LA.

*---------. 2001. "Building in Sensitive Sites." LA 7354 Research paper. Louisiana State University, Dept. of Landscape Architecture, Baton Rouge, LA.

Clark, J. R. 1977. *Coastal Ecosystem Management*. John Wiley & Sons, Inc. NY, NY.

Community Ecology Group, 1998. "International Classification of Ecological Communities: Terrestrial Vegetation of the Southeastern United States, Louisiana Review Subset." Report extracted from Biological Conservation Data system and Excerpt from Working Draft of August, 1998, The Nature Conservancy, Southern Conservation Science Dept., Chapel Hill, NC. Photocopy.

Cooper, David, and Richard E. Andrus 1994. "Patterns of Vegetation and Water Chemistry in Peatlands of the West-central Wind River Range, Wyoming, USA." *Canadian Journal of Botany* 72 (11): 1586-1597.

Coreil, Paul et al. 1993. *Private Lands Technical Assistance Handbook for Louisiana*. Louisiana Cooperative Extension Service and Louisiana State University Agricultural Center publication 2536. Baton Rouge, LA.

Coreil, Paul 1995. "Landowners' Perceptions Related to Wetland Regulatory Policy in Coastal Louisiana." Doctoral Dissertation, Louisiana State University, Baton Rouge, LA.

*---------. 1998. "Wetlands Functions and Values in Louisiana." LSU Agricultural Center and Louisiana Cooperative Extension Service with the U. S. Environmental Protection Agency (EPA), Publication no. 2519. Baton Rouge, LA.

Craig, N. J., and J. W. Day, 1977. "Cumulative Impact Studies in the Louisiana Coastal Zone: Eutrophication and Land Loss." Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

Craig,,Nancy Jo et al. 1987. "The Natural Communities of Coastal Louisiana." Louisiana Natural Heritage Program, LA Dept. of Wildlife and Fisheries Baton Rouge, LA. Photocopy.

Culpepper, Jimmy 2001. "Tree preservation/development." Louisiana Native Plant Society annual winter meeting, Alexandria, LA.

Dahl, and Allord 1994. "Technical Aspects of Wetlands: History of Wetlands of the Counterminous United States." U. S. Geological Survey (USGS), National Water Summary on Wetland Resources, USGS Water Supply Paper 2425. From USGS website: http://usgs.gov/nwsum/WSP2425/history.html.

Day, J. W. Jr., and P. H. Templet, 1989. "Consequences of Sea Level Rise: Implications from the Mississippi Delta." *Coastal Management* 17: 241-257.

Department of the Interior, U. S. Fish and Wildlife Service 1990. *Wetlands of the United States: Current Status and Recent Trends*. Publication 259-713. Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. (stock number 024-010-00656-1).

Dobson, Andrew 1997. *Justice and the Environment: Conceptions of Environmental Sustainability and Theories of Distributive Justice*. Oxford University Press, Oxford, NY, NY. Mimeograph of illustration.

Environmental Protection Agency (EPA) 2001. Website http://www.epa.gov/OWOW/wetlands/vital/toc.html (general wetland information and conservation) last update 4/24/2001.

Earle, D. W. 1975. "Land Subsidence Problems and Maintenance Costs to Homeowners in East New Orleans, Louisiana." Doctoral dissertation, Louisiana State University, Baton Rouge, LA.

Faulkner, Stephen 2000. OCS 7001 Lecture notes on time scales-disturbances. Restoration Ecology, Louisiana State University, Baton Rouge, LA.

Fink, Charles A., and Robert M. Searns 1993. *Greenways*. Island Press, Washington DC.

Finlayson, Max, and Michael Moser 1991. *Wetlands*. International Waterfowl and Wetlands Bureau, (Facts on File, Inc., 460 Park Avenue South, NY NY 10016) Toucan Books Limited, London.

Gagliano, S. M., and D. W. Roberts 1973. "Marsh Management in the Mississippi Deltaic Plain." abstracts of the *Marsh Management in Coastal Louisiana: Effects and Issues* (June 7-9), Baton Rouge, LA.

Gilmore, Nelwyn, and Latimore Smith, 1988."Plants of Special Concern." *Plants and Animals of Special Concern in the Louisiana Coastal Zone.* Gary Lester, ed. Louisiana Natural Heritage Program, special publication no.2, Louisiana Dept. of Wildlife and Fisheries, Baton Rouge, LA. Photocopy.

Gosselink , J. G. 1984. *The Ecology of Delta Marshes of Coastal Louisiana: A Community Profile*. U. S. Fish and Wildlife Service, Office of Biological Services, 84-09.

Grelen, Harold, and Ralph H. Hughes 1984. "Common Herbaceous Plants of the Southern Forest Range." Research Paper SO-210, New Orleans, LA: U. S. Department of Agriculture, Forest Service, Southern Forest Experimental Station. New Orleans, LA.

Hart, Barbara L., and Gary D. Lester 1993. "Natural Community and Sensitive Species Assessment on Fort Polk Military Reservation, Louisiana." LA Dept. of Wildlife and Fisheries with The Nature Conservancy, Arlington VA, Final Report submitted to the Dept. of the Army Corps of Engineers, Memphis, TN. Photocopy.

Heimlich, R. E. 1991. "Wetlands and Agriculture: Recent Federal Policy and Emerging Issues." Presented to the Southern Extension Public Affairs Committee, Clearwater, FL.

Holden, R. E. 1992. "The Section 404 Permit Program." Paper presented at Louisiana Wetlands Conference, New Orleans, LA, March 5-6.

Hollay, Marianne 7/19/2001. Discussion of telephone survey analysis results with author.

Holling, C. S., and M. A. Gold berg, 1978. "Ecology and Planning." *Journal of the American Institute of Planners* 37 (no. 4).

Hudnall, Wayne 2001. Discussion on case site soil core samples with author. Agronomy Dept., Louisiana State University, Baton Rouge, LA.

Jones, Cynthia 1990. "Guidelines for Design of Site Scale Landscape Architecture Projects in LA Coastal Zones." Master's thesis, Louisiana State University, Baton Rouge, LA.

Kaufman, Wallace 1999. "Confessions of a Developer." In *Literature and the Environment*, edited by Lorrain Anderson. Addison-Wesley Education Pub. Photocopy.

Kirkman, L. K. 1995. "Impacts of Fire and Hydrological Regimes on Vegetation In Depressional Wetlands of the Southeastern USA." *Proceedings of the 19th Tall Timbers Fire Ecology Conference*, No. 19, Tall Timbers Research Station, Tallahassee, FL: 10-20. Mimeograph.

Kirkman, L. K. et al. 1998. "Ecotone Characterization Between Upland Longleaf Pine/Wiregrass Stands and Seasonally-Ponded Isolated Wetlands. " *Wetlands* 18 (no. 3, Sept.): 346-364. Mimeograph.

Kusler, J. A. 1983. *Our National Wetland Heritage: A Protection Guidebook.* Environmental Law Institute, Washington, D. C.

LaClaire, Linda V. 1992. "The Ecology of Temporary Ponds in North-central Florida. " Masters thesis, University of Forida, Gainsville, FL. Mimeograph.

*---------. 1995. *Vegetation of Selected Upland Temporary Ponds in North and North-Central Florida*. FL Museum of Natural History Bulletin 38, PT-I (3): 69-96. Mimeograph.

David Lavine et al., 1974. *Evaluation of Inland Wetland and Water Course Functions*, Connecticut Inland Wetlands Project.

MacGinnis, Nelwyn 2001. Telephone conversation on wetland development trends and longleaf pine savannah/acid bog conservation with the author.

MacRoberts, Michael H., and Barbara R. MacRoberts 1993b. "Floristic of a Bog in Vernon Parish, Louisiana, with Comments on Noteworthy Bog Plants in Western Louisiana." *Phytologia* 75 (3): 247-258.

*---------. 1998a. "Quality Change of Habitat in Northwestern Louisiana." *Phytologia* 84 (4): 297-303.

*---------. 1998b. "Community Classification of West Gulf Coastal Plain Bog Communities: A Floristic Assessment." *Phytologia* 85 (1): 32-39.

*---------. 1998c. "Wetland Status of Hillside Bogs, Wetland Pine Savannahs, and Muck Bogs in the West Gulf Coastal Plain," *Phytologia* 85 (1): 22-31.

Marsh, William M. 1997. *Landscape Planning and Environmental Applications*. John Wiley and Sons, Inc., NY.

Martin, Richard 2000. Discussion on bogs with author. The Nature Conservancy, Baton Rouge, LA.

McBride, D. J. 1992. "Wetlands Regulation: A Landowner's Perspective." Paper presented at Louisiana Wetlands Conference, March 5-6, New Orleans, LA.

Mitsch, William J., and James G. Gosselink 1986. *Wetland*s. Van Nostrand Co., Inc., NY, NY.

Moore, P. D., and D. J. Bellamy, 1974. *Peatlands.* Springer-Verlag, NY, NY.

Mumphrey, A. J., J. S. Brooks, and J. C. Miller 1976. *Urban Development in the Louisiana Coastal Zone: Problems and Guidelines*. Urban Studies Institute, University of New Orleans, New Orleans, LA.

Munsen Color Guide 1994. *Munsen Color Guide*, Macbeth Division of Kollmorgan Instruments Corp., 405 Little Britain Rd., New Windsor, NY, 12553.

National Resources Conservation Service (NRCS) 2001. USDA website: http://www.nrsc.usda.gov (for technical resources and references) last update 10/17/2001.

Nelson, R. W., and E. C.Weller, 1984. "A Better Rationale for Wetland Management." *Environmental Management* 8 (no 4): 295-308.

Odum, E. P. 1978. "The Value of Wetlands: A Hierachical Approach." From Greeson, P. E., J. R. Clark, and L. E. Clark, eds. 'Wetland Functions and Values: The State of Our Understanding." *Proceedings of the National Symposium on Wetlands*, held in Disneyworld Village, Lake Buena Vista, FL: 16-25.

Pace, Linda 1990. "A Palynological Study of 2 Upland Bogs in the Gulf Coastal Plain." Master's thesis, Louisiana State University, Baton Rouge, LA.

Radford, Albert E. et al. 1968. *Manual of the Vascular Flora of the Carolinas*. University of NC Press, Chapel Hill, NC.

Salm, R. V. and J. R. Clark, 1984. *Marine and Coastal Protected Areas: A Guide for Planners and Managers.* International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.

Savage, N. 1986. " The Mitigation Predicament." *Environmental Management* 10 (no.5): 319-320.

Schmidt, Carrie P. 1996. "The Hydrology of a Longleaf Pine (Pinus palustris) Savannah Wetland in Southeast Louisiana." Master's thesis, Louisiana State University, Baton Rouge, LA. Photocopy.

Scheuler, T. R. 1987. "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices." Washington Metropolitan Water Resources Board, Washington, DC.

Sennett, Richard 1990. "The Neutral City", *Readings in Planning Theory*. Scott Campbell and Susa Fairstein, ed., Blackwell Publishing Co., Cambridge, MA.

Smith, Latimore 1986. "Louisiana Natural Heritage Program: Final Report." Louisiana Natural Heritage Program, LA Dept. of Wildlife and Fisheries, Baton Rouge, LA. Photocopy.

*---------. 1988. "Natural Communities of Louisiana." Louisiana Natural Heritage Program, LA Dept. of Wildlife and Fisheries Baton Rouge, LA. Photocopy.

*---------. 1996. "The Rare and Sensitive Natural Wetland Plant Communities of Interior Louisiana." including working paper, "Savannah/Bog Plant Species Check List." Louisiana Natural Heritage Program, LA Department of Wildlife and Fisheries, Baton Rouge, LA. Photocopy.

Sommer, Robert, and Barbara Sommer 1997. *A Practical Guide to Behavioral Research*. Oxford University Press, NY.

Southworth, Michael, and Peter M. Owens 1993. "The Evolving Metropolis," *Journal of the American Planning Assn*. 59 (no. 3, summer).

Sutter, Robert D., and Robert Kral, 1994. "The Ecology, Status, and Conservation of Two Non-Alluvial Wetland Communities in the South Atlantic and Eastern Gulf Coastal Plain, USA." *Biological Conservation* 68: 235-243. Elsevier Science Limited, Great Britian.

Terrel, C. R., and L. R. Shanks, 1979. "Coastal Impact Mitigation and OCS-Induced Oil and Gas Development: a Perspective of the Clean Water Act's Section 404 Guidelines." *The Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats*, U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station General Technical Report RM-65: 247-277.

Trahan, Larry et al. 1990. *Soil Surveys of St. Tammany Parish, Louisiana*. USDA, NRCS (formerly Soil Conservation Service) in cooperation with Forestry Service, LA Agricultural Experimental Station, and LA Soil and Water Conservation Commission, Alexandria, LA. U. S. Printing Office.

Tyndall, R.Wayne et all. 1990."Vegetation of 6 Carolina Bays in Maryland." *Castanea* 55 (1, March): 1-21. Mimeograph.

U. S. Army Corps of Engineers 1992. "General wetlands information." Paper presented at Environmental Issues Update Conference, LSU Agricultural Center, Baton Rouge, LA.

*---------. 1999. Website http://www.mvn.usace.army.mil/regulatory/ (for wetland info and wetland delineation) last update 6/10/1999.

USDA, National Resources Conservation Service 1999. The PLANTS database http://plants.usda.gov/plants National Plant Data Center, Baton Rouge, LA, 707874-4490, USA, Nov.1999. last update 12/6/2001.

U. S. Fish and Wildlife Service National Wetlands Inventory Center 2000. Website: http://wetlands.fws.gov/NWI_Reg (for wetland plants, status and development trends) last update 12/6/2000.

U. S. Geographical Survey (USGS) 1999 *Geographic Name Information System* [database]. Website: http://gonames.usgs.gov, last update 7/31/01.Washington, DC.

U. S. Geographical Survey (USGS) 1983a. *New Roads, LA* [quadrangle map]. 1:100,000 scale. Series nm 30x60 min. (30 topographic). Washington, DC.

*---------. 1983b. *Amite, LA* [quadrangle map]. 1:100,000 scale. Series nm 30x60 min. (30 topographic). Washington, DC.

*---------. 1983c. *Ponchatoula*, *LA* [quadrangle map]. 1:100,000 scale. Series nm 30x60 min. (30 topographic). Washington, DC.

*---------. 1984. *Baton Rouge, LA* [quadrangle map]. 1:100,000 scale. Series nm 30x60 min. (30 topographic). Washington, DC.

Vitt, Dale H. 1994. "An Overview of Factors that Influence the Development of Canadian Peatlands." *Memoirs of the Entomological Society of Canada* 10 (169): 7-20.

Vitt, Dale H., and Rene J. Belland 1995. "The Bryophytes of Peatlands in Continental Western Canada." *Fragmenta Floristica et Geobotanica* 40 (1): 339-348.

Walsh, E. V. 2000. Conversation with the author. Environmental Sciences Dept., Louisiana State University, Baton Rouge, LA.

Waslowski, Sally, and Andy Wasowski 1994. *Landscaping with Native Plants of the South*. Taylor Publishing Co. Dallas, TX.

Weakley, A. S., and M. P. Schafale 1994. "Non-Alluvial Wetlands of the Southern Blue Ridge: Diversity in a Threatened Ecosystem." *Water, Air and Soil Pollution* 77: 359-383. Kluwer Academic Publishers, Netherlands. Mimeograph.

Wetland Training Institute, Inc. 1995. *Field Guide for Wetland Delineation: 1987 Corps of Engineers Manual*. Poolesville, MD WTI 95-3.

Williston, Hamlin, William E. Balmer, and Don Tomczak 2001. " Managing the Family Forest in the South. " Revised general report SA-GR 22. USDA Forest Service, Southern Region, 1720 Peachtree Road, N.W., Atlanta, GA 30367.

Zoltai, S. C., and D. H. Vitt 1995. "Canadian Wetlands: Environmental Gradients and Classification," Vegetatio 118 (1-2): 131-137.

APPENDIX A
TERMS

Acid bogs – includes 2 terms below, and can be described visually as small isolated inland, upland wetlands –usually of an acre or less. These areas have damp soils and not much standing water, and very few or no trees, but with pitcher plants, sedges or other wetland grasses.

> Hillside bog – "Graminoid bogs along slopes of ravines and hills in southwest and central LA formed when water soaks through the porous surface soils near the hilltops, but cannot penetrate heavy clay and rock layers beneath the surface. Most abundant plants are sedges (Rhynchospora spp., Fuirena spp.), and other herbaceous plants scattered thoughout. Pipeworts (Eriocaulon and Yellow-eyed Grass (Xyris spp.) are conspicuous, pH=4.5/little peat buildup. CPA2" (Smith, 1986).
> Herbaceous bog (flatwoods bog) – "wetland on peat substrate with acidic saturated soil, which is common in the flatwoods region of longlieaf-slash pine forest. The sub-climax herbaceous layer is fire-controlled. Characteristic plants include: Grasspink Orchids (Calapogon spp.), Pitcher plants (Sarracenia spp.), Bladderworts (Utricularia spp.), Sundews (Drosera spp.), Butterworts (Pinguicula spp.), Rose Pogonias (Pogonia ophiassoides), Club Mosses (Lycopodium carolinianum), Golden Crest (Lophiola americana), and sedges (Fiurena spp.). CPA3" (Smith, 1986).

Bogs are small isolated wetlands with high species diversity and sensitive hydrology (Kirkman, 1998).

They are a type of wetland characterized by acid-loving vegetation. Bogs form when a high water table, fed by rain mostly, results in waterlogged soil. This, in turn, lowers the levels of oxygen in the soil that allows accumulation of organic matter or peat (Finlayson and Moser, 1991).

A peat-accumulating wetland that has no significant inflows or outflows and supports acidophilic (acid-loving) mosses, particularly Sphagnum; bogs are noted for their nutrient deficiency and waterlogged conditions and for the biological adaptations to these conditions, such as carnivorous plants and nutrient conservation (Mistch and Gosselink, 1986).

Baygall – typically dense, often flooded forested wetlands whose midstory canopy consists of evergreen shrubs, and little herbaceous cover in the often-flooded

depressions where Sphagnum moss can form thick mats. They generally occur on lowest positions in the landscape (Smith, 1996).

Bog –

A type of wetland characterized by acid-loving vegetation, and formed when a high water table, fed by rain mostly, results in waterlogged soil, which lowers the levels of oxygen, and then accumulates organic matter or peat (Finlayson, and Moser 1991).

Bogs are designated as "waterlogged, spongy ground, consisting of primarily mosses, containing acidic, decaying vegetation that may develop into peat" (Bates and Jackson, ed., 1990).

A peat-accumulating wetland that has no significant inflows or outflows and supports acidophilic (acid-loving) mosses, particularly Sphagnum; bogs are noted for their nutrient deficiency and waterlogged conditions and for the biological adaptations to these conditions, such as carnivorous plants and nutrient conservation (Mistch and Gosselink, 1986).

Small isolated wetlands with high species diversity and sensitive hydrology (Kirkman, 1998).

Carrying capacity – a measure of the numbers or weight of individuals of a given species that an ecosystem is capable of supporting (Clark, J. R. 1977).

Concentrations – distinct color concentrations in the soil due to chemical reduction of elements (Bates and Jackson, ed., 1990).

Conservation – use by humans while still maintaining essential ecological functions; how much use before permanent harm results is the issue of contention (Jones, 1990).

Depletions – lighter colored areas in the soil due to iron, manganese or clay being stripped out of the soil (Bates and Jackson, ed., 1990).

Ecosystem – the biological energy system made up of food chains along which energy is passed from one group of organisms to another (Marsh, 1997).

Endangered species – those in imminent danger of extinction in all or a significant portion of their ranges (Marsh, 1997).

Fen – synonymous in North America with a swamp. "It is a type of wetland fed by ground water or overland flow that produces a type of plant community higher in nutrient content than bogs, but because of saturated soil conditions still accumulates peat" (Finlayson and Moser, 1991).

They occur as "blankets across the landscape" and usually support marsh-like vegetation (Mistch and Gosselink, 1993).

Forbes – non-woody, herbaceous dicots (non grass-like) plant species associated with or allied with grass communities.

Hydric soils – waterlogged soils formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA, National Resources Conservation Service, 1999; Wetland Training Institute, Inc. 1995).

Hydrophytic vegetation - in "wetland vegetation the prevalent vegetation consists of macrophytes (higher order plants) that are typically adapted to areas having hydrologic (water) and soil conditions that are inundated or saturated by surface or ground water sufficiently to support hydrologic (wetland) species. These species, due to morphological (plant form and structure), physiological (processes of living) an/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce and/or persist in anaerobic (oxygen-less) soil conditions" (Wetland Training Institute, Inc. 1995).

Indicator plants – vegetation associated with certain habitat conditions (Wetland Training Institute, Inc., 1995)

Mitigation – federal def summed by Savage Council on Environmental Quality Regulations in implementing The National Environmental Policy Act, 1974:

1. Avoiding the adverse impact altogether by not taking certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.

4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
5. Compensating for the impact by replacing or providing substitute resources or environments (Savage, 1986).

Preservation – isolating an area from human disturbances while keeping its most important ecological functions intact (Jones, 1990).

Reclaiming (the land) – controversial meanings; correction from "improper" or old land uses to those that make the area more "useful". In some cases that might mean bringing the "useless" wetland into production by levying, draining or filling for further development or agricultural use; returning to pre-impact state (Jones, 1990).

Restoration - returning to pre-impact state (Jones, 1990).

Sustainable development – combines conservation and development in such a way that they are complimentary and contribute to improvement of the quality of human life and the essential preservation or ecologic integrity. (Jones, 1990).

Wetlands – Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soils (US Army Corps of Engineers, 1992).

Wetland designation/delineation – in accordance with the Clean Water Act enacted by the US Congress to help combat degradation of the nation's waters, Section 404, thru the Chief of Engineers issues permits for putting dredge or fill materials into US waters, including wetlands; a process followed by the Army Corps of Engineers or consultant to determine if a site has 3 environmental criteria to qualify as a wetland: hydrophytic vegetation, hydrik soils, & wetland hydrology (Wetland Training Institute, Inc., 1995).

Wetland hydrology – a wet or damp area part of the time, or the whole year an area that is inundated either permanently or periodically at mean water depths =< 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation hydrology (Wetland Training Institute, Inc., 1995).

Wetland Indicator Status and Average % Vegetation Categories

Table 2. Wetland Indicator Status and Ecological Index Values (EI) (Reed 1988; Wentworth et al.

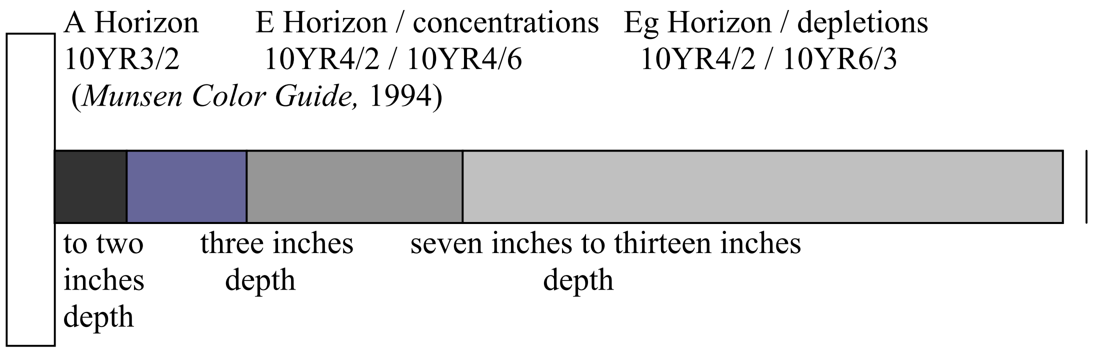
Category	Symbol	Definition
Obligate Wetland	OBL	Plants that occur almost always in wetlands under natural conditions (estimated probability > 99%).
Facultative Wetland	FACW	Plants that usually occur in wetlands (estimated probability > 67% to 99%) but also occur in non-wetlands (estimated probability 1% to 33%).
Facultative	FAC	Plants with a similar likelihood of occurring in both wetlands and nonwetlands(estimated probability 33% to 67%).
Facultative Upland	FACU	Plants that sometimes occur in wetlands(estimated probability 1% to 33%), occur more often in non-wetlands (estimated probability > 67% to 99%).
Obligate Upland	UPL	Plants that occur rarely in wetlands (estimated probability < 1%) but occur almost always in non-wetlands under natural conditions(estimated probability > 99%).

(USDA, National Resources Conservation Service, 1999)

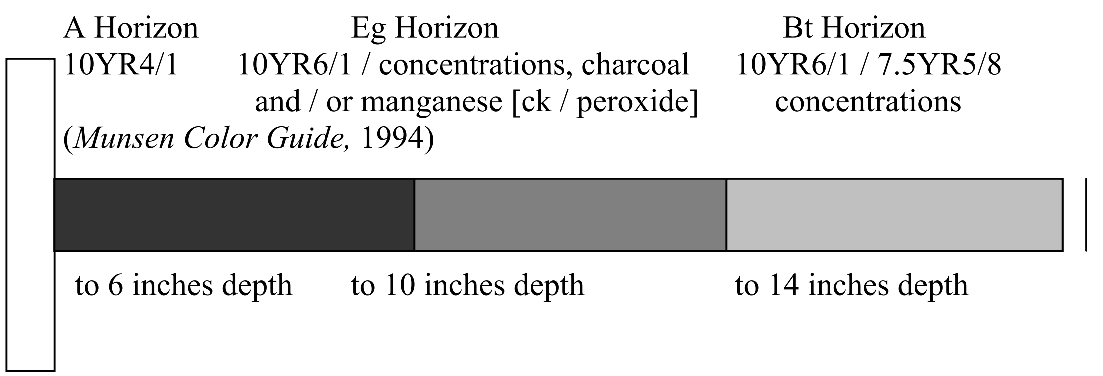
APPENDIX B
CASE STUDY SOIL CORE SAMPLES

All samples determined to have stripped soil from the different soil layers (matrices) due to saturated conditions (Hudnall, 2001), which indicates wetland soil conditions. *Soil determinations with help of LSU personnel. Soil layers are shown in coring tools for each site.

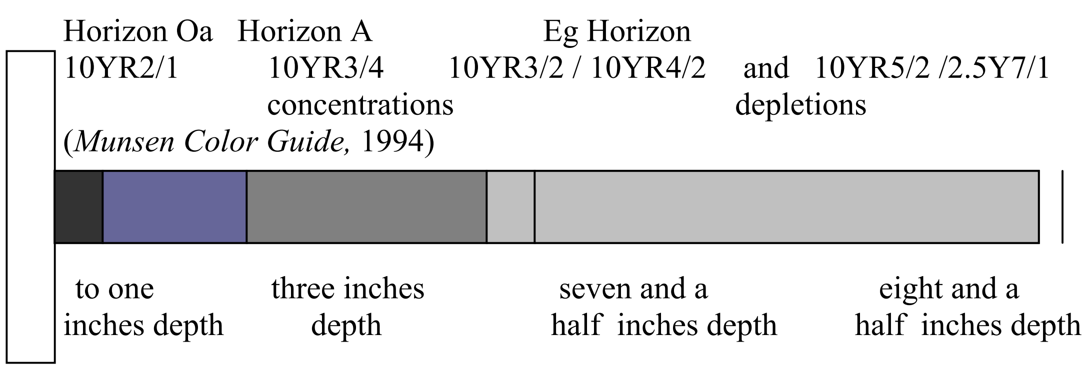
1. ***Mink Site*** - Guyton soil series,* Beauregard-Malbis-Guyton soil complex (Butler, et al. 1990)



2. ***Lake Ramsey Site*** – Myatt soil series* (Trahan, et al. 1990)



3. ***Kisatchie Site*** – Ossier * or Briley soil series (Butler, et al. 1990)



APPENDIX C
CASE STUDY PLANT SAMPLES

Plant investigations confirmed the wetland status of the three sites with more than half named sampled species falling into the wetland category (Wetland Training Institute, Inc., 1995). An explanation of categories follows. Possible rare specimens are noted.

Indicator categories:

- OBL – Obligate Wetland - occurs almost always (estimated probability 99 %) under natural conditions in wetlands.
- FACW – Facultative Wetland – Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
- FAC - Facultative – Equally likely to occur in wetlands or non-wetlands (estimate probability 34%-66%).
- FACU – Facultative Upland – Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found in wetlands (estimated probability 1%-33%).
- UPL - Obligate Upland - Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the region specified. if a species does not occur in wetlands in any region, it is not on the National List.
  (USDA, National Resources Conservation Service, 1999)

State Element Ranks:

- S1 = Critically imperiled in Louisiana because of extreme rarity (5 or fewer known populations or because of some factor(s) making it especially vulnerable to extirpation.
- S2 = Imperiled globally because of rarity (6 to 20 known extant populations) or of some factor(s) making it very vulnerable to extirpation.
- S3 = Rare and local throughout the state or found locally (even abundant at some locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations).

Global Element Ranks:

- G1 = Critically imperiled because of extreme rarity (5 or fewer known populations or because of some factor(s) making it especially vulnerable to extinction.
- G2 = Imperiled because of rarity (6 to 20 known extant populations) or of some factor(s) making it very vulnerable to extinction.
- G3 = Either very rare and local throughout its range or found locally (even abundant at some locations) in a restricted region (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations).
- G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations).
  (Smith, 1996; Community Ecology Group, 1998)

Plant species listing from Case Study Sites ……………………...	Wetland Status

***Site 1, Mink, Louisiana*:**

Aletris aurea, Colic Root	FACW+
Alnus serrulata, Hazel Alder or Raspberry Bush	FACW+
Aristada purpurescenes (*A. affinis*), Arrowfeather Three-Awn Grass	FACW-
Carex echinata (*C. cephalantha*), Star Sedge	OBL
Dichanthelium (*Panicum*) *strigosum*, Roughhair Rosette Grass	FAC
Dichanthelium (*Panicum*) *dichotomum* var. *ensifolium*, Cypress Panic Grass	
Eriocaulon decangulare, Tenangle Pipewort	OBL
Eryngium integrifolium, Simpleleaf Snakeroot, Blueflower Eryngo	FACW
Fuirena brevisita, Umbrella Sedge	OBL
Helianthus angustifolius, Swamp Sunflower	FAC+
Hydrolea ovata, Ovate False Fiddleleaf	OBL
Hypericum crux-andreae, St. Peter's Wort	FACW+
Juncus validus or *J. scirpoides*, Needlepod Rush	FACW+
Juncus tenuis, Wiregrass,Three-Awn Grass	FAC
Lobelia siphilitica, Great BlueLobelia	OBL
Ludwigia linearis, Seedbox, Narrowleaf Primrose Willow	OBL
Lycopodiella (*Lycopodium*) *alopecuroides*, Slender Clubmoss	OBL
Magnolia virginiana, Sweetbay Magnolia	FACW+
Marshallia graminifolia, Grassleaf Barbara's Buttons	OBL
Nyssa sylvatica, Blackgum	FAC
Panicum virgatum, Switch Grass	FAC+

Pluchea rosea, Rosy Camphorweed, Marsh Fleabane	FAC
Ptilimnium capillaceum, Herb William	OBL
Rhexia aristosa (?), Meadow Beauty	OBL
Rhynchospora sp., Beakrush	FACW, OBL
Sarracenia alata, Yellow Pitcher Plant	OBL
Solidago rugosa, Sweet Goldenrod, Wrinkleleaf Goldenrod	FAC
Sphagnum sp., Sphagnum Moss	OBL
Viburnum nudum, Possumhaw Viburnum	FACW+
Xyris sp.(?), Yellow Eyed Grass (S1,S2)	OBL

***Site 2, Lake Ramsey, Louisiana*:**

Agalinus linifolia, False Foxglove (S1)	FACW
Aletris aurea, Colic Root	FACW+
Andropogon gyrans, Elliot's Bluestem	OBL
Andropogon liebmanii, Bluestem Grass	FACU
Andropogon ternarius, Splitbeard Bluestem	FACU
Andropogon virginicus, Broomsedge Bluestem	FAC-
Balduina uniflora, Oneflower Honeycombhead	FACW
Bigelowia nuttallii, Rayless Goldenrod	FACW
Buchnera americana (*B. floridana*), American Blueheart	FAC
Carphephorus odoratissimus (*Trilisa odoratissima*), Vanillaleaf	FACW
Centella asiatica, Urban Spadeleaf	FACW
Chrysopsis mariana (*Heterotheca*), Upland Gold Aster	UPL
Coreopsis tinctoria, Annual Coreopsis, Golden Tickseed	FAC

Dichanthelium (*Panicum*) *dichitomum*, Cypress Panic Grass	FAC
Dichanthelium (*Panicum*) *dichitomum* var. *ensifolium*, Cypress Panic Grass	
Erianthus giganteus, Sugarcane Plume Grass	FACW
Eriocaulon decangulare, Tenangle Pipewort	OBL
Eryngium integrifolium, Simpleleaf Snakeroot, Blueflower Eryngo	FACW
Eupatorium leucolepis, White Thoroughwort, Justiceweed	FACW+
Eupatorium rotundifolium, Roundleaf Thoroughwort	FAC
Eupatorium serotinum, Lateflowering Thoroughwort	FAC
Helianthus angustifilius, Swamp Sunflower	FAC+
Helianthus heterophyllus, Roughleaf Sunflower	OBL
Helianthus radula, Rayless Black Eyed Susan	FACW-
Hypericum crux-andreae, St. Peterswort	FACW+
Hypericum sp., St. Johnswort	
Ilex glabra, Inkberry Holly	FACW
Juncus tenuis, Wiregrass, Poverty Rush	FAC
Lechia tenuifolia, Narrowleaf Pinweed	
Liatris elegans, Indian Gayfeather, Pinkscale Blazing Star	
Lobelia brevifolia, ShortleafLobelia	FAC+
Lycopodiella (*Lycopodium*) *carolinianum*, Slender Clubmoss	OBL
Magnolia virginiana, Sweetbay Magnolia	FACW+
Muhlenbergia capillaries (*M. expansa*), Muhly Grass	FACW-
Myrica cerifera, Wax Myrtle	FAC
Nyssa sylvatica, Black Gum	FAC

Oxypolis filiformis, Water Cowbane	FACW+
Panicum virgatum, Switch Grass	FAC+
Photinia floribunda (*Aronia arbutifolia*), Purple Chokeberry	FACW
Pinus palustris, Longleaf Pine	FACU+
Pityopsis graminifolia, Narrowleaf Silkgrass	UPL
Quercus marilandica, Blackjack Oak	
Rhexia alifanus (?), Savannah Meadow Beauty	FACW
Rhyncospora sp., Beakrush	OBL, FACW
Sarracenia alata, Yellow Pitcher Plant	OBL
Schizachyrium scoparium, Little Bluestem	FACU
Smilax laurifolia, Laurel-leaf Smilax	FACW+
Symphyotrichum (*Aster*) *adnatus*, Scaleleaf Aster	
Symphyotrichum (*Aster*) *dumosum*, Rice Button Aster	FAC
Triadenum tubulosum (*Hypericum*) (?), Pink St. Johnswort	OBL
Tridens ambiguus, Pinebarren Tridens	FACW+
Xyris sp. (?), Yellow Eyed Grass (S1,S2)	OBL

***Site 3, Kisatchie, Louisiana*:**

Acer rubrum var. *drummondii*, Swamp Red Maple	OBL
Carex glaucescens, Southern Waxy Sedge	OBL
Chionanthus virginicus, Fringe Tree	
Eriocaulon dicangulare, Tenangle Pipewort	OBL
Itea virginica, Virginia Willow	FACW+
Juncus effusus, Common Rush	FACW+

Juncus tenuis, Wiregrass, Poverty Rush	FAC
Magnolia grandiflora, Southern Magnolia	FAC+
Magnolia virginiana, Sweetbay Magnolia	FACW+
Myrica herophylla, Swamp Wax Myrtle	FACW
Nyssa sylvatica, Black Gum	FAC
Panicum sp., Panic Grass	
Panicum virgatum, Switch Grass	FAC+
Quercus laurifolia, Laurel Oak	FACW
Rhododendron canescens, Pink Wild Azalea	FACW-
Rhyncospora sp., Beakrush	OBL, FACW
Sphagnum sp., Sphagnum Moss	OBL
Toxicodendron vernix, Poison Sumac	OBL
Viburnum nudum, Possumhaw Viburnum	FACW+
Xyris sp.(?), Yellow Eyed Grass (S1,S2)	OBL

APPENDIX D
CASE STUDY SOIL SURVEYS

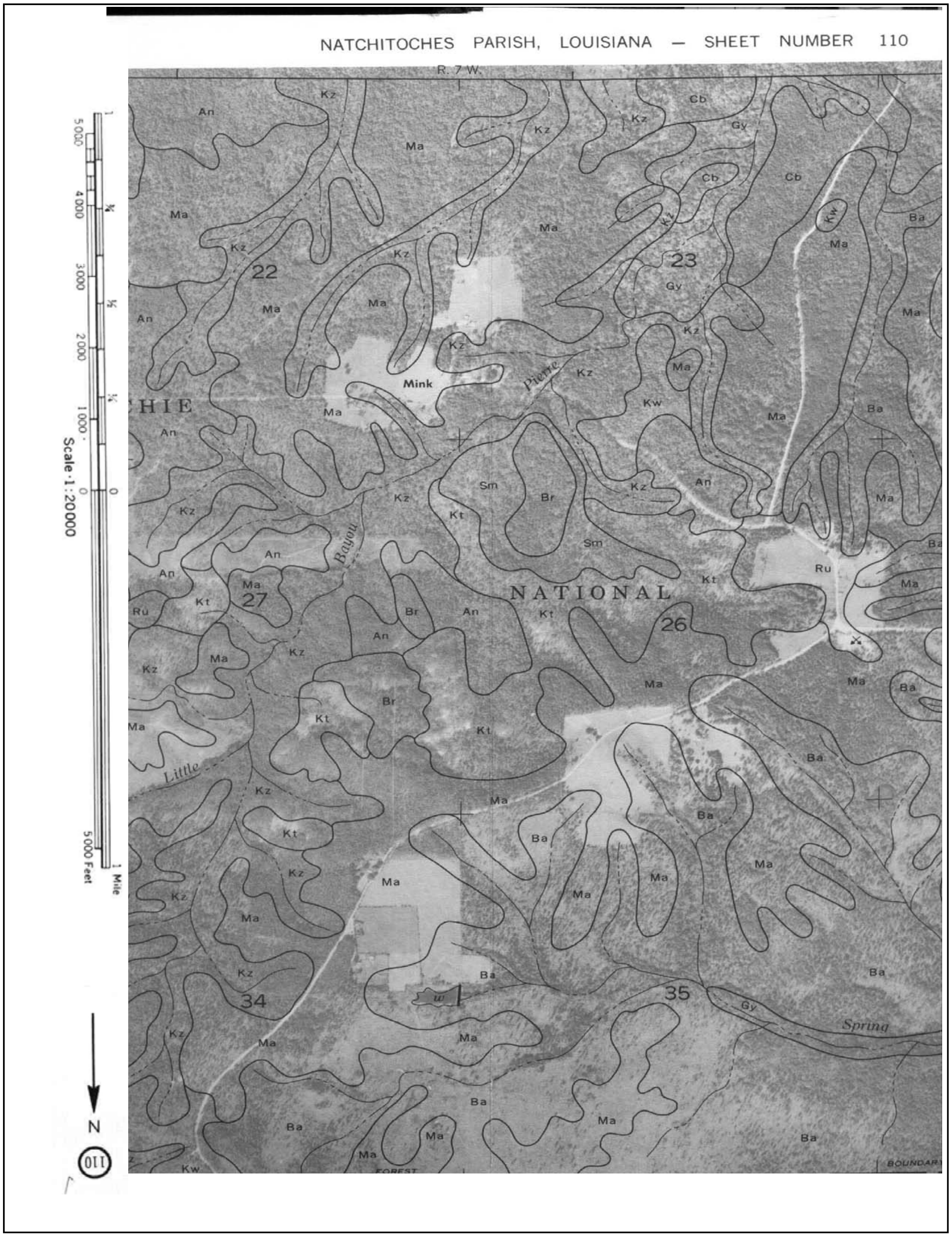


Fig. 8. Mink soil survey (From map sheet no. 110, Natchitoches Parish, LA. Butler, et al. 1990)

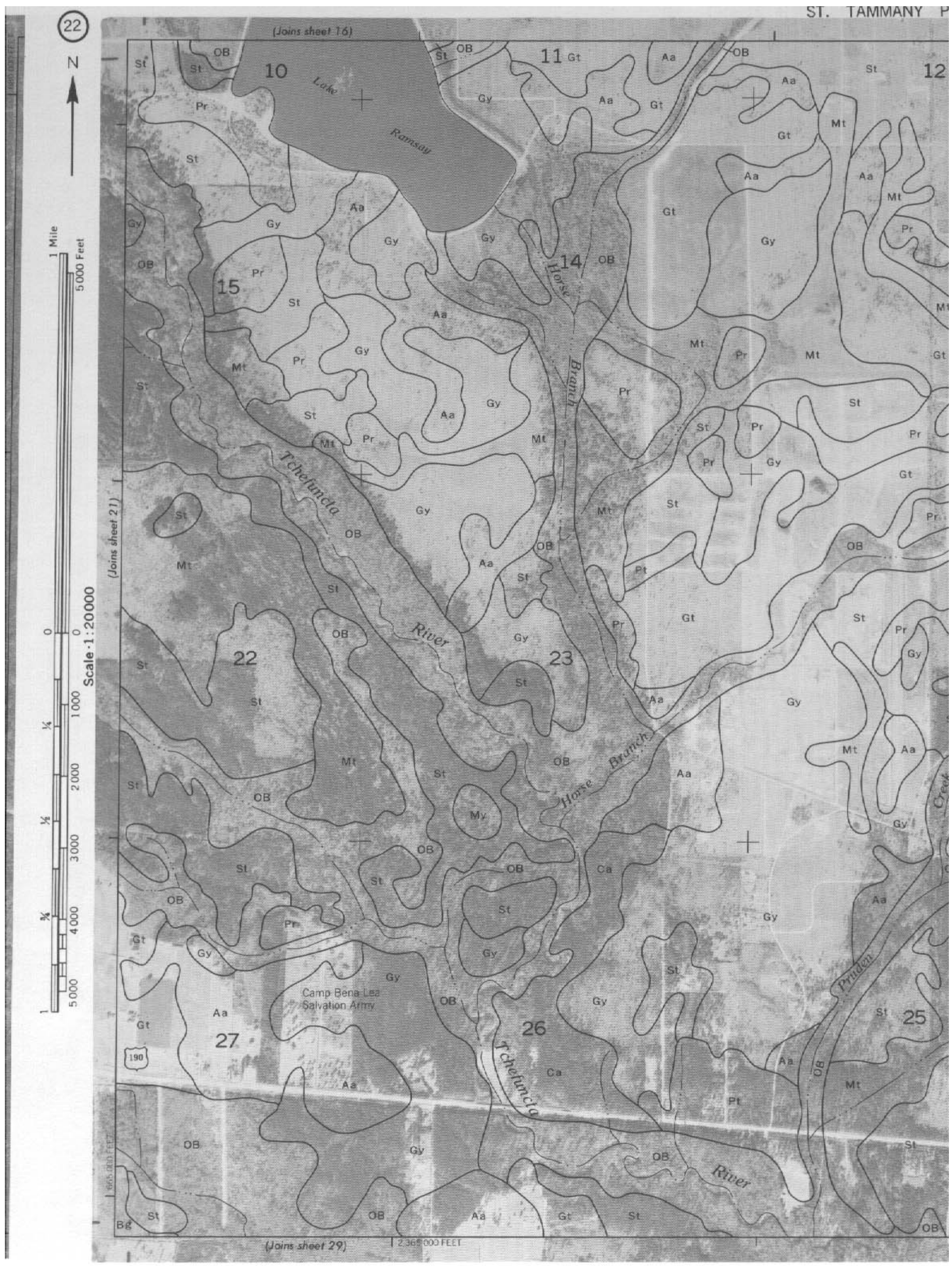


Fig. 9. Lake Ramsey soil survey (From map sheet no. 22, St. Tammany Parish, LA. Trahan, Larry et al. 1990)

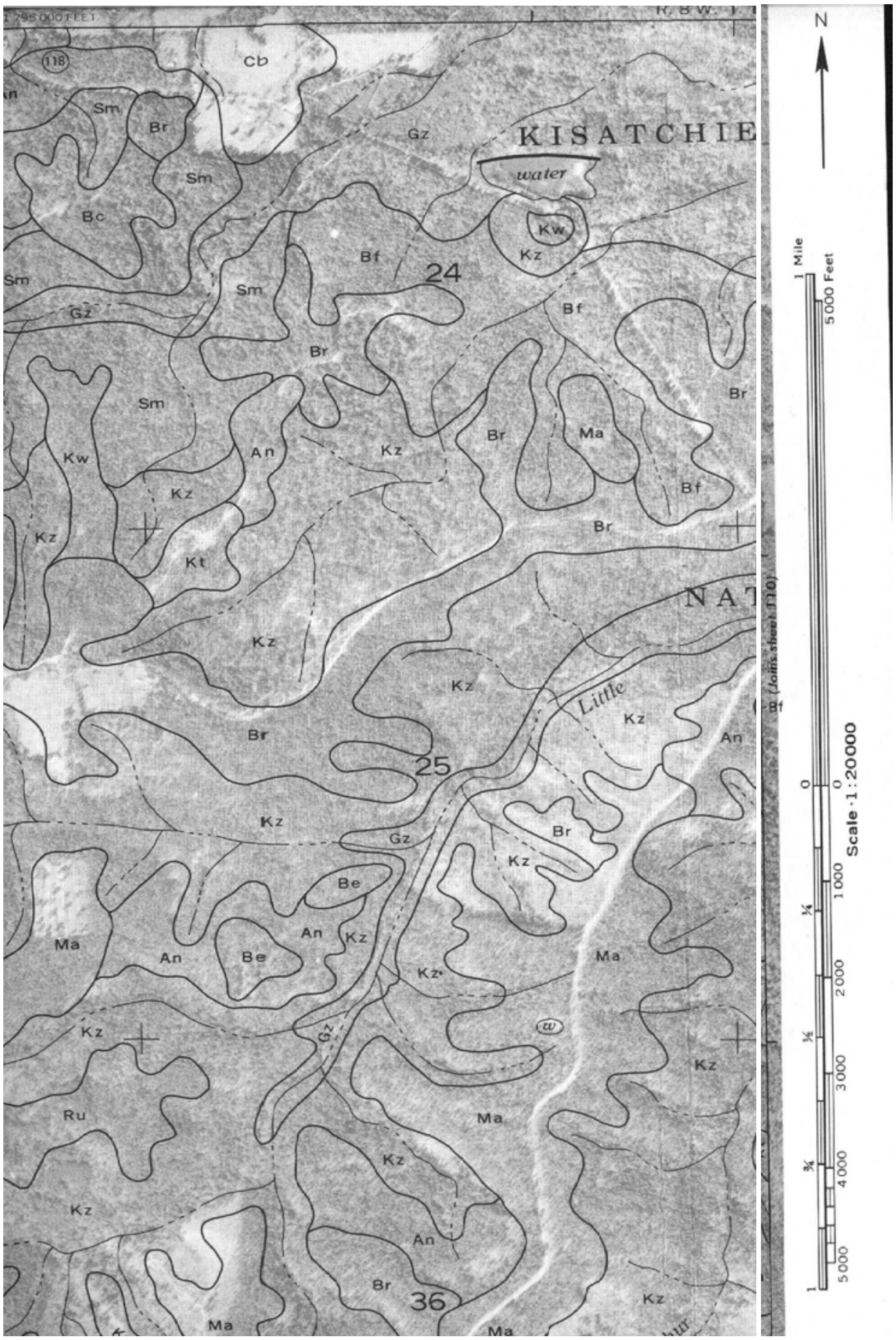


Fig. 10. Kisatchie soil survey (From map sheet no. 109, Natchitoches Parish, LA. Butler, et al. 1990)

APPENDIX E
TELEPHONE SURVEY PRETEST

Thesis, Questionnaire 1/11/2001

Telephone Questions

Introduce myself.
Brief questions for the developers/builders/consultants in the area:

1. Does your firm work on rural or undeveloped sites, such as grown up timber tracts, old farm sites, or other rural projects?

2. Have you ever encountered a small wetland (or bog with pitcher plants) or boggy site with no trees? If so, how does that impact your site development?
   - Are they filled or drained?
   - Are they utilized in your designs?

3. Would you be interested in learning methods of identifying sensitive sites and incorporating these sites as an element of your developments
   - to know how to increase your returns on these areas.
   - to make it easier to comply with regulatory agencies.

4. Can I include you in my mailing list that I am sending to another handful of developers/builders and others in the area with information developed from my research on methods of identifying sensitive sites and optimizing them as an element of your developments?

Thank you for your time. Your information will not only help me improve on my thesis experience, but get you better returns on what you do, too.

APPENDIX F
TELEPHONE SURVEY IRB APPROVAL

INSTITUTIONAL REVIEW BOARD

ACTION ON PROTOCOL APPROVAL REQUEST

TO: Anne Spafford
Landscape Architecture

Linda Chance
Landscape Architecture

FROM: Robert C. Mathews
Chair, Institutional Review Board for Research with Human Subjects

RE: IRB# 2225

TITLE: "Building on Sensitive Wetland Sites"

New Protocol/Modification : N

Review type: Full _____ Expedited X Review date: 03/05/2001

Risk Factor: Minimal X Uncertain _____ Greater Than Minimal _____

Approved X **Disapproved** _____

Approval Date: 03/05/2001 **Approval Expiration Date:** 03/05/2002

Re-review frequency: (annual unless otherwise stated) _____

Number of subjects approved: 50

By: Robert C. Mathews, Chairman [signature]

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING -- Continuing approval is **CONDITIONAL** on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.osp.lsu.edu/irb*

APPENDIX G
TELEPHONE SURVEY COVER LETTER

February 28, 2001

Participant's name
And address

Dear Participant,

I am a third year graduate student at the LSU School of Landscape Architecture. as part of my thesis project I am conducting a survey of land development practices.

I have developed a database of people involved in the land development business from a number of agencies located in Louisiana. I propose to contact as many of these companies and individuals as possible in order to gather information on inland wetland development techniques and processes.

I would be most grateful for your input. No individual or company's responses will be identified in the study findings. All proprietary information will be protected with full confidentiality. Beginning on Thursday, March 8, 2001 between 9 and 11:00 o'clock in the morning I will be telephoning all the names contained in this list. The total time required to complete the survey should not exceed 5 – 10 minutes. Without your help and the help of other professionals in your industry this project will not be feasible. If you will not be available the week of March 8, from 9 a.m.– 11 a.m. please allow me to make an appointment to talk to you as soon as possible.

I can be reached at any time by pager at #504-539-4112 or if you would like to leave a message on my answering machine you may call 225-752-0881. I look forward to talking with you and I thank you in advance for your participation.

Sincerely,

Linda Chance
Graduate Student
Landscape Architecture,
Louisiana State University

APPENDIX H
TELEPHONE SURVEY/ANSWERS

A. Survey Population

Survey population was chosen from the U. S. Army Corps of Engineers', New Orleans district wetland delineations most recent 2-3 year listing. Their referrals were also included, plus some added companies selected from the yellow pages of the phone books of 2 metropolitan test areas in the survey, but only when category numbers were low - below 4 or 5 for a given type developer population.

Population Breakdown:	x+z=23 non-usable respondents
Total applicable respondents=48	*- no address provided =4
x- not applicable to survey =14	**- couldn't be reached =9
z- not in survey area =9	(*+**= 13 no response)
Total respondents=71	Complete List total=84

Gender Summary: (from Total applicable respondents)
F=12 or 25%
M=36 or 75%

Table 5 *Type Companies in Telephone Survey*

Type Company:	**Numbers of Respondents:**	**Percentage of Survey Population:**
Builders	6	12.5%
Consultants	9	18.8%
Developers	5	10.4%
Engineers	7	14.6%
Homeowners	1	2.1%
Landscape Architects	7	14.6%
Realtors	9	19%
Others	4	8%
Totals	48	100%

B. Telephone Survey Introduction
Hello, my name is Linda Chance. I am a graduate student at the LSU School of Landscape Architecture. I am conducting a survey of land development practices as part of my thesis project.

May I please speak with someone in your company who takes care of the development permitting issues for your company?? Or is this a private residence?

(Reintroduce self once this person is online.) As part of my thesis I am conducting interviews with area architects, engineers, developers and builders to determine their attitudes and practices involving development in small inland/upland wetlands and similar sites. (Elaborate, if necessary: not coastal, not marshes, but small sites – less than 1 acre – and without standing water but with saturated soils; with very few or no trees, but with pitcher plants, sedges or other wetland grasses.) Specifically, are such sites incorporated as part of the development process?

No company or individual will be identified in the survey or the thesis documents. All your responses are strictly confidential. If you like I will provide you a summary document of the findings of this research for your participation in this study. Would you be willing to participate in this study by answering a few short questions?? If required, consent forms can be mailed or faxed to you before interviewing. It should only take 10 or 15 minutes to complete.

C. Telephone Survey: Questions & Responses:

1. In your development work, have you ever encountered small inland / depressional wetland sites or bog like sites of less than one acre?

Yes: 47
No: 1 (no answer did go on to develop)
Total: 48 = 100% respondents (see Data Breakdown above)

2. If you were to encounter such features on a site would you continue the development of the site?

Yes: 42
No: 4
Depends: 2
Total: 48 = 100% respondents (see Data Breakdown above)

2a. Did you continue the development of the site once the small wetland was identified??

Yes: 38
No: 0
Depends: 10
Total: 48 = 100% respondents (see Data Breakdown above)

3. **What criteria were used to identify the site as a wetland or bog??**

no response=3
na=2,
"Surface examination"=3
Terrain & depressions (elevation)=6
Habitat=1
Off site conditions=1
Soil conditions=11
Walk site=7 & on site survey=3
Wetland det./Corps=3
Use consultant=4 & engineer=3
Maps=8 & GPS positioning=1
x of yr (when wet)=1
Prior knowledge=4
Site history=1
Flood & silt lines & drift=2
Threatened species list=1
(Unique and indicator) Wetland vegetation (or veg type)=18
('87 Corp manual wetland designation factors) hydrik soils=8
('87 Corp manual wetland designation factors) hydrophytic vegetation=6
('87 Corp manual wetland designation factors) wetland hydrology=10

Criteria = Number of Responses	Criteria = Number of Responses
No response=3	Wetland vegetation (or veg type)=18
Not applicable=2,	Hydrophytic vegetation=6
"Surface examination"=3	Threatened species list = 1
Terrain & depressions (elevation)=6	Wetland hydrology=10
Habitat = 1	Prior knowledge=4
Time of year (when wet)=1	Site history=1
Offsite conditions=1	Flood & silt lines & drift=1
Soil conditions=11	Maps=8 & GPS positioning=1
Hydrik soils=8	Use consultant=4 & engineer=3
Walk site=7 & On site survey=3	Wetland determination/Corps=3

4. **What plant species, if any, were identified on the site?**

Developers indicated these plants were wetland types that they used to identify wetland sites: Ferns, Pitcher plants, Red Milkweed, Butterworts, Colicroot, Sweet Bay, Palmetto, Water Oaks, *Cyperus, Juncus,* Alligator Weed, Long Leaf Pine/ Loblolly, Red Maple, Sweet Gum, Wax Myrtle, Greenbrier, Grass Pink Orchid, Toothache Grass, Sunbonnets, Sugarberry, Cypress trees

Other Developers indicated these factors for bog/wetland indicator species id:

Other identifying factors = Number of Responses	Other identifying factors = Number of Responses
None = 2	Plant key (or form)=3
Ck/& Corps=1	"Different" & hydrik plants=4
('87 Corps manual) dominant hydrophytic vegetation=2	Wetland or lowland grasses=5
(20%)dominant hydrophytic vegetation=1	Ck/botanist=3
(50%)dominant hydrophytic vegetation=3	Consultants=5
(50-75%) dominant hydrophytic vegetation=1	Not applicable=6
Indicator plant list=3	

5. How were these sites used in the development? (note: many respondents used

Question 5 Answers	Responses		Question 5 Answers	Responses
a. Filled	= 27		c5. Other	= 1
a1.Ponded (catch-basin drainage	= 4		d. Enhanced	= 3
b. Drained (ditched)	= 12		d2. Manicured	= 0
c. Protected	= 4		d3. Cleared of debris	= 5
c2. Fenced	= 0		d4. Planted	= 4
c3. Posted	= 1		d5. Other	= 1
c4. Left undisturbed	= 10			

Question 5 Comments:

Note: many respondents used several answer categories; multiple responses are noted.

na=1
neg. answers = 2
depends=9
avoid=6
(Some commented) development proceeded only after Corps approval=2
(Others gave important general) dev. "depends" (comments) on property size & location (or site uniqueness")=4
development "depends" on offsite cond.=1
(A surprising few flatly stated) avoidance (to protect wetland?)=3
The important cost factor regulated avoidance, which was directly tied to the wetland rating by the Corps=3
(One respondent pointed out) clearing increased site usage=1
(Another knowledgeable respondent pointed out) burning (as other site development procedure)=1
Corps permit conds: avoid, min, mit=2

Question 5 Comments	Response Numbers
Not applicable	=1
Negative answers	= 2
Depends (on location & size=4, offsite conditions=1, cost/ regulations =3, size, uniqueness=1, dev after designation=1)	= 9
Avoid to protect =1; avoid if too costly = 2	= 3
Avoidance (with no explanation)	=3
Corps of Engineers' approval	=2
Increased site usage/clearing	= 1
Burning	= 1
Corps of Engineers' permit conditions: avoid, minimize, mitigate	= 2
Combination of development procedures	= 5
Develop after approval	= 1

6. **On a scale of 1 to 5, where 1 is least important and 5 is most important in your decision making, please rate the following factors in your decision to develop the small wetland feature:**

Question 6: Importance Ratings	1	2	3	4	5	Not applicable
a. To increase the real estate's value	5	2	4	5	18	8
b. Need to reclaim land for other use	5	1	6	6	22	4
c. Intrinsic value of the wetland	15	5	8	5	8	3
d. Customer requested preservation	18	6	4	6	4	7
e. Added value from wetland feature	18	4	3	5	5	4
f. Understanding of regulations	3	4	8	13	12	4
g. Ability to pass on regulatory cost	1	2	5	5	7	24
h. Availability of good information on conservation methods / practices	5	5	5	13	12	2
i. Cooperation from regulatory agency	10	4	8	11	3	6
i1. Potential pblms / regulatory agency				1	1	46
j. Prompt response from regulatory agency	10	6	11	7	5	4
j1. Want no contact / regulatory agency		1				47
k. Preservation of plant species on site	8	6	8	4	4	5
k1. Too expensive to work on wet sites	1		1			46

7. On a scale of 1 to 5 where 1 is least important and 5 is most important please rate the following agencies' or groups' importance in your efforts to develop the feature:

Question 7: Importance Ratings	1	2	3	4	5	Not appli-cable
a. Environmental Protection Agency	3	5	8	3	1	21
b. U. S. Army Corp of Engineers	11	3	6	9	3	5
c. La. Dept of Environmental Quality	4	5	9	5	4	16
c1 Dept. of Natural Resources	3	1	6	6	4	21
c2 LA Dept. of Wildlife & Fisheries	1	6	5	8	2	18
c3 Federal Energy Commission	1		1			39
d. Parish Reg. Agency	3	2	9	4	6	15
e. City Reg. Agency	1	5	1	6	4	22
f. Trade Association/group		3	3	2	2	27
g. Local Non-profit group	1	3	4	3		25
h. National/regional environmental group	3	2	6	4	1	13
i. Other					1	

8. Volunteer/Professional Organizations to which you belong: (participate in activities, or receive literature)

na=8
positive response but didn't list lit or activities = 6
none =1

Respondent Literature list: Conservation Force, Journal of Wetland Scientists, Wetland Newsletter, Lumber Industry Material changes, Realtor Landscaping, Gulf Coast Conservationist, lit from Corps application

Activities participation & Listing: Home Builders Assn.=6, area Chambers of Commerce=3, Water & Air Pollution Control, LA Water Environment Assn, Wildlife Society, Society of Am. Foresters, Assn. of Am. Foresters, Board of LA Forestry, chair Endangered Species Committee, Aldo Leopold Foundation, LA State Survey Society, Ntl. Wetlands Scientist Assn.=2, Nature Conservancy, Society for Ecological Restoration, LA Native Plant Society, National Homebuilders, Urban Land Institute, American Assn. of Christian Counselors, Structural Engineers Assn., Ntl. Society of Prof. Engineers, Am. Soc. of Civil Engineering, Water Environment Assn., and AWWA (?),404-10 Group, Ntl. Wetlands Coalition, Engineering assns.: ASCE, LES (LA Engineering Society), American Public Works Assn., LA Real Estate Commission=3, ASLA (American Society of Landscape Architects)=3, ALCA (Am. Landscape Contractors Assn), American Planning Assn., AICP & Landscape Architecture and Specified News, BR LA Assn, Metamorphosis Childrens' Garden, St. Andrew's Church, CLARB, LA Native Plant Society, LA Society of Horticultural Research, Magnolia, Holly & Azalea societies, 20-21 Assn. (St. Tammany parish), Baton Rouge Board of Realtors, Ntl. Headstart Assn.

9. What % of income do wetlands represent for your company?
note: eliminated >=< or ^ indicators, & used average # when a range of values were given

Wetland Income Percent	Number of Responses		Wetland Income Percent	Number of Responses
0%	= 4		20%	= 2
1%	= 10		40%	= 2
2.5%	= 1		45%	= 1
3%	= 1		60%	= 1
4%	= 1		62%	= 1
5%	= 7		85%	= 1
10%	= 3		87%	= 1
15%	= 2		99%	= 1
			100%	= 1

10. How many people are in your company?

Results = 1 to 370

Employee Number per Company	**Number of Responses**		**Employee Number per Company**	**Number of Responses**
1	3		12	1
2	4		14	1
3	4		18	1
4	1		30	3
5	4		38	1
6	1		42	1
7	2		75	1
8	2		120	1
9	6		350	1
10	3		370	1
11	2			

APPENDIX I
TELEPHONE SURVEY STATISTICAL ANALYSIS

Correlation variables are given with T-Test results below .152 significance; P-0.05 are significant (*), and P-0.005 are very significant (**). N = the number of responses. The means and standard deviation tables follow development factors from the two attitudinal scaled questions, 6 and 7, used in both tables. See next page for all corresponding abbreviations used in table below and in Descriptive Statistics table on last page.

Correlation Table

Development Decision Factor	6a	6b	6c	6f	6g	6i	6j	6k
6a-Real estate value Significance(2-tail) (REVALUE) N		.389* .023 34						-.307 .128 26
6b-Reclaim the land Significance2-tail) (RECLAIM) N	.389* .023 34					.346* .045 34		-.519** .004 29
6c-Wetland intrinsic value Significance(2-tail) (IVALUE) N					.361 .117 20	.307 .073 35		.446* .013 30
6f-Understand regs Significance(2-tail) (REGS) N					.392 .107 18			
6g-Recoup regulatory costs Significance(2-tail) (COST) N			.361 .117 20	.392 107 18		.534* .027 17	.343 .151 19	
6h-Have conservation info Significance(2-tail) (CINFO) N				.280 .085 39	.291 .213 20			
6i-Reg. agency cooperation Significance(2-tail) (COOP) N		.346* .045 34			.534* .027 17	.307 .073 35	.596** .000 36	
6j-Prompt reg. agency reply Significance(2-tail) (RESPONSE) N					.343 .151 19	.596** .000 36		
6k-site preservation Significance(2-tail) (PLPRESV) N	-.307 .128 26	-.519** .004 29	.446* .013 30					

Telephone Survey Attitudinal-Scale Questions:

6. On a scale of 1 to 5, where 1 is least important and 5 is most important in your decision making, please rate the following factors in your decision to develop the small wetland feature:

	1	2	3	4	5
a. To increase the real estate's value (REVALUE)	___	___	___	___	___
b. Need to reclaim land for other use (RECLAIM)	___	___	___	___	___
c. Intrinsic value of the wetland (IVALUE)	___	___	___	___	___
d. Customer requested preservation (PRESV)	___	___	___	___	___
e. Added value from wetland feature (AVALUE)	___	___	___	___	___
f. Understanding of regulations (REGS)	___	___	___	___	___
g. Ability to pass on Reg. Comp. Cost (COST)	___	___	___	___	___
h. Availability of good info on (CINFO) conservation methods/practices	___	___	___	___	___
i. Cooperation from Reg Agency (COOP)	___	___	___	___	___
i1.Potential pblms/Reg Agency (PBLM)	___	___	___	___	___
j. Prompt response from Reg. Agen. (RESPONSE)	___	___	___	___	___
J1.No contact/Reg. Agency (no contac)					
k. Preservation of plt. species on site	___	___	___	___	___
k1.Want no contact/Reg. Agency (WANT_NO)					
l. Other ______________________	___	___	___	___	___

7. On a scale of 1 to 5 where 1 is least important and 5 is most important please rate the following agencies' or groups' importance in your efforts to develop the feature:

a. Environmental Protection Agency (EPA)	___	___	___	___	___
b. U. S. Army Corp of Engineers (CORPS)	___	___	___	___	___
c. LA. Dept of Environmental Quality (DEQ)	___	___	___	___	___
c1 Dept. of Natural Resources (DNR)	___	___	___	___	___
c2 LA Dept. of Wildlife & Fisheries (DWF)	___	___	___	___	___
c3 Federal Energy Commission (FEC) (underground pipelines)	___	___	___	___	___
d. Parish Reg. Agency (PAR)	___	___	___	___	___
e. City Reg. Agency (CITY)	___	___	___	___	___
f. Trade Association/Group (TRADE)	___	___	___	___	___
g. Local non-profit group (NONP)	___	___	___	___	___
h. National/régional envir. Group (ENVIR)	___	___	___	___	___
i. Other (sp. ______________________)	___	___	___	___	___

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NUMCOS	47	1	370	28.19	73.74
PERC	38	0	100	20.86	29.82
OTHERS	1	5	5	5.00	.
PBLM	2	4	5	4.50	.71
TYPE	48	1	8	4.35	2.37
RECLAIM	40	1	5	3.97	1.40
COST	20	1	5	3.80	1.20
REVALUE	35	1	5	3.77	1.55
REGS	40	1	5	3.65	1.23
CINFO	42	1	5	3.62	1.38
CITY	17	1	5	3.41	1.33
PAR	25	1	5	3.40	1.32
DNR	20	1	5	3.35	1.31
TRADE	10	2	5	3.30	1.16
DWF	22	1	5	3.18	1.10
DEQ	24	1	5	3.13	1.30
ENVIR	16	1	5	2.88	1.20
NONP	11	1	4	2.82	.98
COOP	36	1	5	2.81	1.37
RESPONSE	39	1	5	2.77	1.37
EPA	20	1	5	2.70	1.08
CORPS	32	1	5	2.69	1.45
PLPRESV	30	1	5	2.67	1.37
IVALUE	41	1	5	2.66	1.56
FEC	2	1	3	2.00	1.41
WANT_NO	2	1	3	2.00	1.41
no contac	1	2	2	2.00	.

APPENDIX J
RARE and ENDANGERED SPECIES of ACID BOGS

Ranking is assigned to each element, both globally and statewide. Global ranking is done by The Nature Conservancy, Washington, DC; state ranks are assigned by each state's Natural Heritage Program. Wetland codes were omitted from this listing.

Rarity ranking of eastern hillside bogs = S1G1G2Q, western hillside bogs = S2S3G2G3; rarity ranking of eastern herbaceous bogs = S1G?, of western herbaceous bogs = S1S2G2Q (western saline variant = S1G1) (Smith, 1986, 1996)

STATE ELEMENT RANKS

S1 = Critically imperiled in Louisiana because of extreme rarity (5 or fewer known populations) or because of some factor(s) making it especially vulnerable to extirp

S2 = Imperiled in Louisiana because of rarity (6 to 20 known extant populations) or of some factor(s) making it very vulnerable to extirpation

S3 = Rare and local throughout the state or found locally (even abundant at some locations) in a restricted region of the state, or because of other factors making it v to extirpation (21 to 100 known extant populations).

S4 = Apparently secure in Louisiana, with many occurences (100-1000 known ext

S5 = Demonstrably secure in state (1000+ known extant populations).

SA = Accidental in state, including species (usually birds or butterflies) recorded o only at great intervals, hundreds or even thousands of miles outside their usual ran

SH = Of historical occurrence in Louisiana but no recent records verified within the formerly part of the established biota, possibly still persisting.

SR = Reported from Louisiana, but without conclusive evidence to accept or reject

SU = Possibly in peril in Louisiana but status uncertain; need more information

SX = Believed to be extirpated from Louisiana

(Brunet. 1999)

Watch List Categories:

W1 – includes species for which further information is needed to determine rarity and distribution in Louisiana. Also includes species previously included on the Louisiana rare plant list that warrant monitoring so that population declines may be assured.

W2 – includes apparently rare species with questionable taxonomic validity that may warrant addition to the Louisiana rare plant list if determined to be valid.

W3 – includes species which have been reported from Louisiana but there is inadequate information to verify.

W4 – includes apparently rare species known from Louisiana, whose occurrence may or may not have been the result of introduction species known only from ruderal places.

W5 – includes species that warrant monitoring because populations are in all likelihood declining due to habitat alteration, disease, fire suppression, poor reproduction, etc.

GLOBAL ELEMENT RANKS

G1 = Critically imperiled globally because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extinction

G2 = Imperiled globally because or rarity (5 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abunantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21-100 known extant populations)

G4 = Apparently secure globally, though it may be quite rare in parts of its range, escpecially at the periphery (100 - 1000 known extant populations).

G5 = Demonstrably secure globally, although it may be quite rare in parts of its range, escpecially at the periphery (1000+ known extant populations).

GH = Of historical occurrence throughtout its range, i.e., formerly part of the established biota, with the possibility that it may be rediscovered (e.g., Bachman's warbler).

GU = Possibly in peril range-wide but status uncertain; need more information

G? = Rank Uncertain. Or, a range (G3G5) delineates the limits of uncertainty

GQ = Uncertain taxonomic status

GX = Believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered

T = Subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but with a subpecies rank of G4

WETLAND CODES

FAC - Facultative (similar likelihood (33-67 %) of occurring in both weltands and nonwetlands)

FACW - Facultative Wetland (usually (>67-99%) in wetlands)

OBL - Obligate Wetland (almost always (>99%) in wetlands

Species with a "---" ranking are not listed as wetland species.

(Brunet, 1999)

note: ** in ranking categories may mean the species is extinct

Rare & Endangered Acid Bog Vegetation/Ranking
(Brunet, 1999; Smith, 1986, 1996; Craig et al, 1987; Hart & Lester, 1993)

Scientific Name	Common Name	Global Rank	State Rank
*= known only in Eastern acid bogs, + = known in eastern and western acid bogs, ** = known only in Western acid bogs, ***= western saline bog			
	Hillside Acid Bogs		
Grasses:			
Eulophia ecristata	a wild coco	G3G4	S2
Panicum strigosum	rough-hair switchgrass	G5	SU
Panicum tenerum+	southeastern panicgrass	G4	S1?
Psilocarya nitens	short-beaked bald-rush	G3	S1?
Rhynchospora baldwinii	Baldwin's beakrush	G4	SU
Rhynchospora capitellata	beakrush	G5	S1?
Rhynchospora compressa	flat-fruit beakrush	G4	S2
Rhynchospora divergens	beakrush	G4	S1
Rhynchospora macra**	beakrush	G3G4	S1
Rhynchospora stenophylla*	narrow-leaved beakrush	G2	S1?
Other Non-woody plants (herbs):			
Agalinis filicaulis+	purple false-foxglove	G3G4	S1
Bartonia texana	Texas screwstem	G2	-
Burmannia biflora	northern burmannia	G4G5	S2
Calapogon barbatus+	bearded grass pink	G5?	S1
Calapogon oklahomensis	Oklahoma grass pink	G?	S1?
Calapogon pallidus+	pale grass pink	G4G5	S2
Cleistes divaricata*	spreading pogonia	G4	S1
Helenium brevifolium	shortleaf sneezeweed	G4	S1
Lachnanthes caroliniana*	Carolina redroot	G4	S2S3
Lachnocaulon digynum**	pineland bog button or pipewort	G3	S2
Lilium catesbaei*	southern red lily	G4	S1
Lophiola aurea*	golden crest	G3G4	S2S3
Lycopodiella cernua**	staghorn clubmoss	G5	S2
Macranthera flammea*	firespike or flameflower	G3	S2
Pinguicula lutea*	yellow butterwort	G4G5	S2
Platanthera blephariglottis var. conspicua**	white-fringe orchis	G4G5T3T4	S1
Platanthera integra**	yellow fringeless orchid	G3G4	S2
Rudbeckia scabrifolia**	sabine coneflower	G2	S2
Sabatia macrophylla+	large-leaved rose-gentian	G4G5	S2S3
Sarracenia psittacina*	parrot pitcher plant	G4	S3

Scientific Name	Common Name	Global Rank	State Rank
Triantha (Tolphieldia) racemosa*	coastal false-asphodel	G5	S2S3
Xyris drummundii**	Drummond's yellow-eyed grass	G3	S1
Xyris scabrifolia**	yellow-eyed grass	G2G3	S1
Xyris stricta	yellow-eyed grass	**	**
Zigadenus densus+	black snakeroot	G5	S1
Zigadenus leimanthoides	death camas	G4Q	S1
Wild life:			
Pituophis melanoleucus ruthveni	Louisiana pine snake	G2	S2
Picoides borealis	Red-cockaded woodpecker	G3	S3?
Aimophila astivalis	Bachman's sparrow	G3	S3?
Perognathus hispidus	hispid pocket mouse	G5	S2
Reithrodontomys humilis	eastern pocket mouse	G5	S?

Herbaceous Bogs

Scientific Name	Common Name	Global Rank	State Rank
Grasses:			
Andropogon mohrii	bluestem grass	G4G5	SU
Carex incomperta	Atlantic sedge	G5TU	SU
Cyperus louisianensis	Louisiana umbrella sedge	GU	SU
Coelorachis tessellata	joint grass	GU	S3
Fuirena simplex	umbrella grass	G5	S1
Panicum tenerum+	southeastern panicgrass	G4	S1?
Rhynchospora chapmannii*	Chapman beakrush	G4	S2
Rhynchospora ciliaris*	ciliate beakrush	G4	S1?
Rhynchospora compressa+	flat-fruit beakrush	G4	S2
Rhynchospora debilis*	savannah beakrush	G4?	S1?
Rhynchospora divergens***	beakrush	G4	S1
Rhynchospora stenophylla**	narrow-leaved beakrush	G2	S1?
Rhynchospora tracyi**	Tracy's beakrush	G4	SH
Scleria verticillata**	low nutrush	G5	S1
Sporobolus vaginiflorus var. silveanus***	silveus dropseed	G3	S2S3
Other Non-woody plants (herbs):			
Asclepias michauxii	milkweed	GU	S1
Agalinis aphylla*	coastal plain false-foxglove	G3G4	S1
Agalinis filicaulis+	purple false-foxglove	G3G4	S1
Agalinis linifolia*	flax-leaf false-foxglove	G3G4	S1

Scientific Name	Common Name	Global Rank	State Rank
Bartonia verna	white screwstem	G5?	S2
Calapogon multiflorus*	many-flowered grass pink	G3	S1
Calapogon barbatus	bearded grass pink	G5	S1
Calapogon pallidus+	pale grass pink	G4G5	S2
Chaetopappa asteroids var. asteroides***	chaetopappa	G5	S2 ?
Circium lecontei	thistle	G4G5	SU
Cleistes bifara (divaricata)*	spreading pogonia	G4	S1
Drosera intermedia*	spoon-leaved sundew	G5	S1
Drosera tracyi	Tracy's sundew	G5T3T4	SH
Helenium brevifolium	shortleaf sneezeweed	G4	SU
Lachnanthes caroliniana*	Carolina redroot	G4	S2S3
Liatris puntata***	gayfeather	G ?	S1 ?
Lilium catesbaei*	southern red lily	G4	S1
Lophiola aurea*	golden crest	G3G4	S2S3
Ludwigia microcarpa**	seedbox	G3G4	S1
Lycopodiella cernua**	staghorn clubmoss	G5	S2
Mayaca aubletii	bog moss	GU	S3
Pinguicula lutea*	yellow butterwort	G4G5	S2
Platanthera blephariglottis var. conspicua*	white-fringe orchis	G4G5T3T4	S1
Platanthera integra*	yellow fringeless orchid	G3G4	S2S3
Polygala chapmannii*	Chapman's milkwort	G?	S1
Polygala hookeri*	Hooker's milkwort	G3	S1
Ruellia noctiflora*	night-flowering wild petunia	G2	S1
Sabatia dodecandra var. filiosa***	Marsh rose-gentian	W1	
Sabatia macrophylla*	large-leaved rose-gentian	G4G5	S2S3
Sarracenia psittacina*	parrot pitcher plant	G4	S3
Sarracenia purpurea*	pitcher plant	G5	SH
Schwalbea americana**	American chafseed	G2	S1
Triantha (Tolphieldia) racemosa*	coastal false-asphodel	G5	S2S3
Xyris serotina*	yellow-eyed grass	G3G4	SH
Xyris stricta*	yellow-eyed grass	**	**
Zigadenus densus*	black snakeroot	G5	S1
Zigadenus leimanthoides*	death camas	G4Q	S1
Woody plants:			
Myrica inodora	odorless bayberry	GU	S1
Quercus minima	dwarf live oak	GU	S1

Scientific Name	Common Name	Global Rank	State Rank
Wild life:			
Pseudacris ornate	ornate chorus frog	G5	SH
Rhadinaea flavilata	pinewoods snake	G4?	S2
Hemidactylium scutatum	four-toed salamander	G5	S1

APPENDIX K
SOCIAL VALUES of COASTAL WETLANDS

WETLAND FUNCTION	CONCERN	HOW WETLANDS PERFORM FUNCTION	FACTORS DETERMINING IMPORTANCE OF FUNCTION	DISCIPLINE NEEDED FOR ANALYSIS
Flood Conveyance	If flood flows are blocked by fills, dikes, or other structures, increased flood heights and velocities result, causing damage to adjacent, upstream and down-stream areas.	Some wetlands (particularly those immediately adjacent to rivers and streams) serve as floodway areas by conveying flood flows from upstream to downstream points.	Stream characteristics, wetland topography and size, vegetation, location of wetland in relationship to river or stream, existing encroachment on flood-plain (dikes, dams, levees, etc.).	Engineer Hydrologist Soil Scientist Wetland Biologist
Wave Barriers	Removal of vegetation increases erosion and reduces capacity to moderate wave intensity.	Wetland vegetation, with massive root and rhizome systems, bind and protect soil. Vegetation also acts as wave barriers.	Location of wetland adjacent to coastal waters, lakes, and rivers, wave intensity, type of vegetation, and soil type.	Soil Scientist Engineer Ecologist
Flood Storage	Fill or dredging of wetlands reduces their flood storage capacity.	Some wetlands store and slowly release flood waters.	Wetland area relative to watershed, wetland position within watershed, surrounding topography, soil infiltration capacity in watershed, wetland size and depth, stream size and characteristics, outlets (size, depth), vegetation type, substrate type.	Engineer Hydrologist Soil Scientist Wetland Biologist
Sediment Control	Destruction of wetland topographic contours or vegetation decreases wetland capacity to filter surface runoff and act as sediment traps. This increases water turbidity and siltation of downstream reservoirs, storm drains, and stream channels.	Wetland vegetation binds soil particles and retards the movement of sediment in slowly flowing water.	Depth and extent of wetland, wetland vegetation (including type, condition density, growth patterns), soil texture type and structure, normal and peak flows, wetland location relative to sediment of vegetated buffer.	Soil Scientist Engineer Ecologist Range Scientist
Pollution Control	Destruction of wetland contours or vegetation decreases natural pollution capability, resulting in lowered water quality for downstream lakes, streams, and other waters.	Wetlands act as settling ponds and remove nutrients and other pollutants by filtering and causing chemical breakdown of pollutants.	Type and size of wetland, wetland vegetation (including type, condition, density, growth patterns), source and type of pollutants, water course, size, water volume, streamflow rate, microorganisms, etc.	Sanitarian Soil Scientist Geologist Hydrologist Engineer Ecologist Botanist Biologist Chemist

12

			microorganisms, etc.	Chemist
Fish and Wildlife Habitat	Fills, dredging, damming, and other alterations destroy and damage flora and fauna and decrease productivity. Dam construction is an impediment to fish movement.	Wetlands provide water, food supply, and nesting and resting areas. Coastal wetlands contribute nutrients needed by fish and shellfish to nearby estuarine and marine waters.	Wetland type and size, dominant wetland vegetation (including diversity of life form), edge effect, location of wetland within watershed, surrounding habitat type, juxtaposition of wetlands, water chemistry, water quality, water depth, existing uses.	Ecologist Biologist Forrester Soil Scientist Botanist Wetland Biologist Wildlife Biologist Fisheries Biologist
Recreation (water-based)	Fill, dredging or other interference with wetlands will cause loss of area for boating, swimming, bird watching, hunting, and fishing.	Wetlands provide wildlife and water for recreational uses.	Wetland vegetation, wildlife, water quality, accessibility to users, size, relative scarcity, facilities provided, surrounding land forms, vegetation, land use, degree of disturbance, availability of similar wetlands, distribution, proximity of uses, vulnerability.	Planner Sociologist Ecologist Landscape Architect Recreational Planne
Water Supply (surface)	Fills or dredging cause accelerated runoff and increase pollution.	Some wetlands store flood waters, reducing the timing and amount of surface runoff. They also filter pollutants. Some serve as sources of domestic water supply.	Precipitation, watershed runoff characteristics, wetland type, size, outlet characteristics, location of wetland in relationship to other water bodies.	Hydrologist Geologist Engineer Soil Scientist Planner
Aquifer Recharge	Fills or drainage may destroy wetland aquifer recharge capability, thereby reducing base flows to streams and groundwater supplies for domestic, commercial, or other uses.	Some wetlands store water and release it slowly to groundwater deposits. However, many other wetlands are discharge areas for a portion or all of the year.	Location of wetland relative to water table, fluctuations in water table, geology including type and depth of substrate, permeability of substrate, size of wetland, depth. Acquifer storage capacity, groundwater flow, runoff retention measures.	Geologist Engineer Hydrologist Soil Scientist Planner

Source: modified from David Lavine et al., *Evaluation of Inland Wetland and Water Course Functions*, Connecticut Inland Wetlands Project (1974).

VITA

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