URBAN WETLAND RESTORATION:

AN EVALUATION OF

STILLWATER

CREEK

By

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CHAPTER 1

INTRODUCTION

Background

"Marsh," "swamp," and "bog" have been well-known terms for centuries, but only relatively recently have attempts been made to group these landscape units under the single heading "wetlands." This general term has grown out of a need to understand and describe the characteristics and values of all types of land, and wisely and effectively manage wetland ecosystems. Until recently, the nation's wetlands were considered virtual wastelands to be filled, dammed, dredged, and/or drained for what were perceived to be more "useful" economic purposes such as farming, water supply, construction or waterfront development. The intrinsic values of wetlands were not fully recognized until their losses began to reveal problems (O'Brien 1996). For example, sports enthusiasts gradually began to notice declines in wildlife and fish, commercial fur trappers found dwindling catches in their traps, and rural homeowners discovered contamination in their well water and, in some cases, had to drill much deeper to find adequate water. Flooding along rivers and shorelines also increased to historic levels (Doust and Doust 1995; Patrick 1994).

Historically, the federal government provided incentives for the draining, filling or altering of wetlands. The 1930 census indicates that in 1929 there were more than 84 million acres of land in drainage projects (Kenney and McAtee 1938). More recently, the

U.S. Fish and Wildlife Service has estimated that wetlands once covered 200 million acres of the 48 lower United States (U.S. Fish and Wildlife Service 1991). Today, approximately half of these original wetland areas, remain as wetlands.

More recently, the public has recognized that flood control, groundwater recharge, water pollution prevention, biological diversity, and wildlife habitat are direct benefits of wetland preservation (Dahl 1990). Some benefits of wetlands are shown in Table I.

Table I

Benefits of Wetland Preservation

Flood Control: Often called natural sponges, wetlands help control floodwater by absorbing water during heavy rainfall then slowly releasing it downstream.

Erosion Control: Plants within wetland areas bind soil with their roots and help to absorb impacts from wave action.

Fish and Wildlife: Most fish and shellfish we eat live in wetlands when they are young. Wildlife migrate through wetland corridors that serve as a home for endangered species.

Hunting: Wetlands support an annual commercial fur and hide harvest of $300-$400 million (U.S. Department of Agriculture 1994).

Water Quality: Wetlands purify water by processing nutrients, suspended materials, and other pollutants.

Biological Diversity: Wetlands provide important habitat for an enormous diversity of plants and animals, including a large portion of federally listed threatened or endangered species.

Source: Long and Putman 1995, Meeks and Runyon 1990, Mungle 1996.

Many states have established wetland protection programs aimed at preventing further conversion of wetlands to other uses. New efforts to preserve remaining wetlands have emerged as public awareness of wetlands' 'intrinsic' values has grown. Today, approximately 95 million acres of wetlands remain in the lower 48 states (U.S. Department of Agriculture 1997). Habitat destruction has been widespread with more than 100 million acres of wetlands drained or filled for agriculture. In response to these losses, the 1995 National Wetlands Policy Forum set two goals for protecting and managing the nation's wetlands: 1) to achieve 'no net loss' of our remaining wetlands; and, 2) to increase the quality and quantity of the nation's wetlands resource base (Doust and Doust 1995; U.S. Department of Agriculture 1997).

There are many definitions of wetlands used in the United States. For the U.S. Department of Agriculture, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (U.S. Department of Agriculture 1997). The single feature most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. This creates severe physiological problems for all plants and animals except those that are adapted for life in water or in saturated soil. Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (See Table II). For purposes of this classification, wetlands must have one or more of the following three attributes: 1) the land supports predominantly hydrophytes, at least periodically, 2) the substrate is predominantly undrained hydric soil, and, 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (U.S. Department of Agriculture 1997). The current regulatory definition of wetlands, as adopted by the Environmental Protection Agency

(EPA) and U.S. Army Corps of Engineers (Corps), and stated in Section 404 of the Clean Water Act is:

> Those areas that are inundated or saturated by surface groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamp, marsh, bog, and similar areas (U.S. Army Corps of Engineers p.114b).

Table II

Types of Wetlands

Swamps	Wetland dominated by trees or shrubs.
Marsh	A frequently or continually inundated wetland characterized by vegetation adapted saturated soil conditions.
Bog	A peat-accumulating wetland that has no significant inflows or outflows and supports mosses, particularly sphagnum.
Slough	A swamp or shallow lake system in northern and midwestern U.S. or slowly flowing shallow swamp or marsh in southeastern U.S.
Pothole	Shallow, marshlike pond formed by ancient glaciers.
Playa	Marshlike pond similar to pothole, but with geologic origin in the southwest U.S.

Source: Mitsch and Gosselink 1986.

Wetland conservation has been on the rise with the implementation of the U.S. Department of Agriculture's Wetland Reserve Program, which was outlined in the Food and Security Act of 1985 (U.S. Department of Agriculture 1997). Under this program, landowners are paid for restoration of wetlands on their property. Data released in January 1999 show over 665,000 acres enrolled in the program nationwide since 1985.

Almost 40% of the enrollment is in three states: Louisiana, Mississippi, and Arkansas (Zinn and Copeland 1999). Oklahoma has 24,293 acres enrolled in the program as of April 1999.

Oklahoma Wetland Conservation

Oklahoma began its wetland conservation program by adopting an official wetland definition. For regulatory purposes, the state of Oklahoma has adopted the definition of wetland used by the EPA and Corps. Other states may use the same or a similar definition for wetlands, or they may observe definitions used by other federal agencies. As noted by Votaw (1996), definitions are fundamentally alike and generally address the three critical elements of wetlands; wetland hydrology, hydrophytic plants, and hydric soils (See Table III).

Table III

Critical Elements of Wetlands

Wetland Hydrology: an area that is inundated or saturated to the surface for at least 5% of the growing season in most years.

Hydrophytic Plants: any macrophyte that grows in water that is at least periodically deficient in oxygen as a result of excessive water content.

Hydric Soils: soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper portion.

Source: Kesselheim 1995.

Urban wetland restoration is a new area of wetland research that, until 1998, has not been implemented in Oklahoma. In 1998, the City of Stillwater in Payne County began construction of Oklahoma's first urban wetland project after the area's acceptance into the U.S. Department of Agriculture Wetland Reserve Program (Tully, personal communication, 1998). Stillwater is located in north central Oklahoma and has a population of approximately 40,000. The 23-acre project is expected to provide many research opportunities for local schools including Oklahoma State University, an 1890 Land Grant College. The purpose of this study is to investigate the process and design of the wetland on Stillwater Creek.

Problem Statement and Significance of the Study

This study will focus on the new concept of urban wetland restoration in Oklahoma. The study area was selected because Stillwater Creek will be Oklahoma's first wetland restoration project in an urban setting managed through the U.S. Department of Agriculture's Wetland Reserve Program. The study of wetlands is important because societal demands for wetland restoration in urban areas will increase as community leaders receive exposure to the benefits of wetlands and as federal funding continues to grow for wetland projects. At the present time, there is no planning model available to guide urban wetland restoration projects at the local level. Therefore, this project will investigate goals and objectives of rural ecosystem and wetland restoration in Oklahoma. In addition, this study will examine plans for the wetland on Stillwater Creek within an urban setting and will highlight barriers to establishing an urban wetland. It should be noted that barriers associated with the Stillwater Creek project have not been encountered when establishing other wetland sites in rural settings since they have lower population concentrations. By identifying these obstacles and methods of resolving conflict, it is hoped that this study will serve as a model for establishing similar wetland sites in urban settings. Finally, a comparison of the Stillwater Creek project to the Red Slough rural wetland restoration project in McCurtain County, will demonstrate similarities or differences in biodiversity and species richness associated with wetland areas.

Research Objectives

Objective 1. Evaluate wetland restoration administrative policies, which guide the development of the Stillwater Creek wetland and future restoration projects.

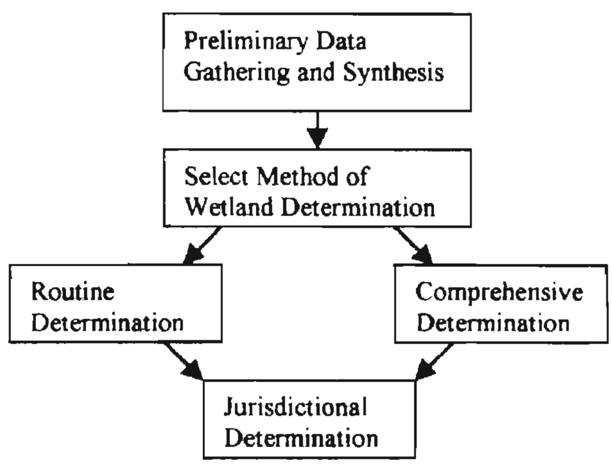
Restoration should replace hydrologic, water quality, and habitat functions. This should be done where sites are not too depleted. It is important to this study that state and federal regulation policy reviews uncover past and current trends regarding these functions in wetland restoration.

Objective 2. Investigate barriers to obtaining funding for wetland restoration through the Wetland Reserve Program.

Potential wetland sites must meet rigorous state and federal regulations. It is important that this study investigate wetland eligibility by evaluating how the wetland restoration project meets federal requirements for entry into the U. S. Department of Agriculture's Wetland Reserve Program. Wetland Reserve Program eligibility is based upon available federal funds and the project's current status in a set of ranking criteria. In many cases, there are more applications than available funds in a given year (Tully, personal communication, 1998). Wetland projects having special features, such as endangered species habitat, or educational and research opportunities receive higher rankings in the program. With urban wetlands located in residential areas, future eligibility requirements should address urban issues such as trespassing, dangers to children, pest infestation, etc. Steps needed to complete this objective will include: 1) program eligibility overview, 2) Title 440 Conservation Plan Manual review, 3) evaluation of Wetland Reserve Program ranking criteria and wetland determination. Figure 1 provides a general schematic diagram of the activities leading up to two types of wetland/nonwetland determination. The approach used by the Wetland Reserve Program to determine what constitutes a wetland is based primarily on the complexity of the area in question. Two types of wetland determinations used in the Wetland Reserve Program will be evaluated in this study, the routine and comprehensive approach.

Figure 1.

Types of Wetland Determination



Objective 3. Investigate a wetland restoration project in a rural setting to determine methods, which may or may not be applicable to an urban wetland restoration project in Stillwater.

A comparison between the Red Slough rural wetland in Oklahoma and the Stillwater Creek urban wetland will provide data to develop an urban wetland model for the Stillwater project. This model will guide local leaders and developers through the wetland restoration process and provide information for future urban wetland scenarios. Biodiversity will be studied to evaluate variety in plant life, soils, and wildlife. Some species found in a rural wetland setting may be unsuitable in an urban environment. Ideal natural features, suited to an urban context, will be uncovered through this rural/urban comparison.

CHAPTER II

REVIEW OF THE LITERATURE

The History, Culture and Theory of Wetlands

Introduction

This discussion begins with a review of the history of human efforts to drain wetland areas not suited to farming during the 1930's, also examined are changing attitudes towards the role of wetlands in conservation. Other topics addressed include the philosophical western cultural theory and the negative outlook toward wetlands as so-called "black waters." The later portion of the review examines the large volume of published information on wetlands devoted to development and restoration techniques. The Delphi Method used in decision making and wetland policy is also reviewed.

History of Known Efforts to Drain Wetlands

At the beginning of the 20th century, the U.S. Supreme Court claimed that wetlands were the cause of malaria and malignant fevers and it was understood that police power could be legitimately employed in removing such nuisances (Williams 1996). Generations of Americans grew up believing this concept. Drainage of these lands assisted in the development of prosperous communities where agriculture production was formerly severely handicapped or impossible. Much of this land proved to be well adapted to agriculture, and prosperous communities resulted from its cultivation. Large areas of land were made available for farming by drainage projects. Some of the lands, however, was not suited to crop production resulting in farmers failure to pay their taxes, a lower standard of living, and the loss of wildlife (Kenney and McAtee 1938). As a result, some of the drained lands were never settled.

Both Kenney and McAtee strongly express their appreciation for the conservation of wetlands. In their article, "The Problem: Drained Areas and Wildlife Habitat," they witnessed the widespread development of farm ponds and felt there was a growing trend to protect this natural resource. They go one step further and suggest the creation of large public reservations as a way in which land can be restored for the benefit of wildlife and mankind.

Culture and Theory

Wetlands were not considered to be pleasant places. In western culture they have been associated with death and disease and have been seen as a threat to health and sanity (Giblett 1996). Part of the problem lies in the fact that wetlands are neither strictly land or water. Wetlands often represent a temporal and spatial transition from open water to dry land, what could be called the "quaking zone" (Niering 1991). Atwood stated "If not in transition, many wetlands are physically halfway between the water and the land" (1991 p.87). Cole agreed with Atwood and stated "Bogs are a different kind of halfway world, neither water nor land yet part of both" (1989 p.151). The typical response to the horrors and threats posed by these "black waters" was simple and decisive: dredge, drain or fill.

Walt Whitman summed up people's feeling toward wetlands in 1860 when he noted the "...strange fascination of these half-known/half-impassable swamps, infested by reptiles/resounding with the bellow of the alligator, the sad noise of the rattlesnake" (as cited in Miller 1989 p.60). Wetlands were known as the homes of monsters lurking in the murky depths. William Byrd described the swamps as not only a place of disease, but also a "...miserable morass where nothing can inhabit, nether lands, not fit for human creatures to live in ..." (Giblett 1996 p.14).

On the other hand, Aldo Leopold celebrated wetlands, and mourned their loss (Giblett 1996). For Leopold, marshes were melancholy places, not because of their occasional negative visual impact, but because he mourned the loss of cranes that once inhabited wetlands (Leopold 1949). He viewed conservationists as "...monstrous dredgers in search of sterile concrete" (Giblett 1996 p. 18). He further states that farms and marshes must live in mutual toleration (Giblett 1996).

Much of the early literature viewed wetlands as disgusting places, with little or no value. Yet for some, wetlands would not be regarded as ecologically valuable until they were seen as aesthetically pleasing (Giblett 1996). To see these areas as pleasing would entail rethinking what constituted a beautiful landscape. However, the cultural rehabilitation of wetlands involves treating them as valuable.

Wetland Planning and Development

Much of the literature suggests that, despite the importance of wetlands, their biggest threat continues to be human development. In the article "Partnerships in Wetland Restoration" we get a clear message regarding the environmental impact of destroying these fragile ecosystems, the importance of private property and the role government should play in the protection of wetlands (Burde et al. 1998). The importance of individualism to Americans is argued at the same time that it is pointed out that there are times when the philosophy of development comes face-to-face with ecological reality. They make a very good case by stating the over-utilization of natural resources is not a "free lunch," and argue the role of nutrient cycling and biochemical processes that occur in wetland habitat and their major role in the food chain. Other authors suggest the realization that wetlands contribute significantly to our nation's well-being (Clark and Shutler 1999).

Conflicts between development and environmental protection are not new and likely will become increasingly common as urban communities continue to expand into rural areas. These conflicts become particularly acute in areas that are rich in wetlands or endangered species and that also have strong real estate markets in areas such as Austin, Texas; San Diego, California; and Orlando, Florida (Lipske 1998). While federal laws and some state laws protect wetlands and endangered species habitats, they also allow some development to occur in these environmentally sensitive areas. Lipske provides examples of eroding houses and frustrated owners who have built on or near wetlands. Among other findings, the author notes that to "...build your house in a wetland and you've got a hobby for life" and "...you will be fighting that water forever"(1998 p.10). More recently, the public has come to appreciate the value of natural areas to society, such as wetlands and in most situations, recognizes the often times high engineering costs of not building in harmony with nature. Over the last 20 years, such factors have led to the enactment of environmental laws and local land use ordinances that protect natural resources and the public interest by discouraging the use of sensitive natural areas for new development (U.S. Environmental Protection Agency 1998). For development interests and others, the result is a limited range of options available to reconcile environmental protection interests with development plans in a manner that respects both sets of objectives. Environmentalists and developers have charged that the existing federal and state regulatory programs neither adequately protect wetlands and endangered species nor guide urban growth in a rational, consistent manner (Porter and Salvesen 1995). While each individual development project may only minimally impact a particular wetland, cumulative impacts over time become significant as each project gradually reduces an entire habitat ecosystem (Porter and Salvesen 1995).

The concept of collaborative, area-wide planning was born out of the need to address problems with greater local significance. Area-wide planning differs from traditional regional planning, however, in its focus on conflicts between development and protection of natural resources in a specific geographic area, such as a watershed, estuary, or endangered species habitat (Galuzzi and Pflaum 1996). They generally focus on only one or two resources, such as wetlands or endangered species. Probably the most important distinction, however, is the way plans are developed. Area-wide planning is a collaborative, often voluntary, ad hoc process that brings developers, environmentalists, and government regulators to the negotiating table to balance natural resource protection with the development for a particular area (Seideman 1998, Shapard 1997). The downside to collaborative planning is that it consumes large amounts of time and talent. Funding is also needed for the necessary studies, countless meetings, and negotiations to develop and implement the plan (Guillory et al. 1998).

Schiller and Flanagan (1997) argue that protecting wetlands provides benefits for business and local governments and highlights the importance of local officials in their role of understanding and responding to the needs and concerns of communities. Wetlands design, construction, and operation are facilitated by identifying potential problems and opportunities early in the project with careful site evaluation (Hammer 1992). In this capacity, local governments play a key role in protecting and restoring wetlands and watersheds while promoting and sustaining economic growth all in the interests of the general public.

Wetland Restoration Techniques

Restoration can be used to accommodate various degrees of reinstatement, repair, and reconstruction. The restoration of wetlands may encompass a broad spectrum of activities, from minor repair of damage to reconstruction of a completely new wetland (Wheeler and Shaw 1995). Ecosystem creation and restoration in general, which is sometimes referred to as ecological engineering, is a relatively new field. Although well developed in practice, attempts to put ecosystems back together, has shown that theory doesn't always match the results. William Mitsch (1998) describes cases in which attempts were made to determine the functional success of replacement wetlands. He found that the success rate of restoration in South Florida was approximately 70%. Failure was generally attributed to improper hydrologic conditions. A seven acre urban wetland in Ohio was well designed but lacked similarity to natural marshes because of the artificially deep hydrology and the lack of nutrients and carbon in the soils (Grace 1998). Karr (1982) summarized a number of studies and offers a more optimistic assessment, asserting that with careful attention to design and detail, humans can duplicate much of nature's wetland work. While the objective is certainly commendable, the fact remains that restored or newly created wetlands cannot effectively replace the natural wetlands that we continue to lose each year (Grace 1998). Ecologists warn that the results of restoration and construction projects do not compare to natural wetlands. Constructed wetlands are not as complex as natural marshes. Scientists are learning that a passive approach that gives nature a place in the process is the most effective restoration approach (Nadis 1998).

The Delphi Method

The scientific study of planning and recreation is relatively recent, leaving developers with a limited body of knowledge, theory, and methods from which to draw (Stynes 1983). The Delphi method is one of the best qualitative techniques for evaluating expert opinion. This technique relies on the expertise of selected individuals to plan future recreation and management trends. Qualitative methods directly incorporate human judgement, while quantitative methods usually involve mathematical models. Feedback of the information generally results in the convergence of opinions toward a consensus (Stynes 1983). The Delphi method is characterized by three features, which distinguish it from other consensus-achieving group forecasts: anonymity, feedback, and statistical response (McNamee 1985). A panel of experts must be identified to participate in the study. While group members may not necessarily know each other, they are informed of current consensus so majority and minority opinions can be maintained. Answers are shown as the median prediction of the group as well as the dispersion of opinions (Campbell and Hitchin 1978). Carrick (1995) states that in comparing the three categories of questions, it is interesting to note that the area in which the participants expertise was the greatest was forecast not just more accurately, but more conservatively. Delphi is particularly appropriate when decision-making is required in a political or emotional environment, or when the decisions affect strong factions with opposing preferences (Cline 1997). The technique is intended to provide an expert perspective on a project or event rather than exact information (Moeller and Shafer 1983). The number of questions used in the study depends on the consensus of the answers and the point at which it is determined by the study director, that the responses have begun to stabilize.

The Delphi technique has pros and cons. Experts may be difficult to contact regarding a particular topic (Peterson 1995). Once a panel of experts is located, it may be difficult to ask them to participate in the study due to their time constraints. The study director may also influence the results by the questions chosen in the study and thereby contribute to misinterpretation. On the other hand, it is useful where decisions have to be made quickly with limited knowledge. This technique can also help identify possible dangers or opportunities of the project by such a survey of expert opinion (Tempelman 1998).

The study uses the Delphi Method to survey expert opinion regarding the Red Slough and Stillwater Creek wetland restoration sites. Panel members were carefully chosen for their wetland expertise across Oklahoma. The questions led to a general consensus regarding the urban and rural wetlands investigated in this study.

Wetland Policy

The principal federal program that provides regulatory protection for wetlands is found in Section 404 of the Clean Water Act. Its intent is to protect water and adjacent wetland areas from adverse environmental effects due to discharges of dredged or fill material (Mungle 1996). Established in 1972, Section 404 requires landowners or developers to obtain permits from the U. S. Army Corps of Engineers to carry out activities involving disposal of dredged or fill materials into waters of the United States, including wetlands (Zinn and Copeland 1999).

The Bush and Clinton Administrations have made wetland protection a priority. Their plans require using the best available science to define and delineate wetlands; improving the regulatory program and encouraging non-regulatory options, and expanding partnerships in wetland protection (Casagrande 1997). In February 1998, the Clinton Administration announced a Clean Water Action Plan intended to address the nation's remaining water quality challenges. Restoring and protecting wetlands is a key feature of the plan (Raloff 1998). It calls for a coordinated strategy to achieve a net gain of as many as 100,000 acres of wetlands annually by the year 2005 (U.S. Department of Agriculture 1998). Questions of federal regulation of private property stem from the belief that landowners should be compensated when a "taking" occurs and alternative uses are prohibited to protect wetlands (Dugan 1990).

The Wetland Reserve Program, administered through the U.S. Department of Agriculture can place easements on farmed wetlands in return for payments that are based on the reduction in value. Congress authorized the Wetland Reserve Program under the Food Security Act of 1985, as amended by the 1990 and 1996 Farm Bills (Botts and McCoy 1997). The U.S. Department of Agriculture Natural Resources Conservation Service administers the program in consultation with the Farm Service Agency and other federal agencies. The Wetlands Reserve Program is a voluntary program to restore and protect wetlands on private property. It is an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal agricultural land (U.S. Department of Agriculture 1997). Landowners who choose to participate in the Wetland Reserve Program may sell a conservation easement or enter into a cost-share restoration agreement with the U.S. Department of Agriculture to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership. The landowner and the Natural Resources Conservation Service develop a plan for the restoration and maintenance of the wetland. The program offers landowners three options: 1) permanent easements, 2) 30-year easements, 3) and restoration cost-share agreements of a minimum 10-year duration.

With a permanent easement, payment will be the lesser of: the agricultural value of the land, an established payment cap, or an amount offered by the landowner. In addition to paying for the easement, the U.S. Department of Agriculture pays 100 percent of the cost of restoring the wetland.

The 30-year easement is a conservation easement lasting 30 years. Easement payments are 75 percent of what would be paid for a permanent easement. The U.S. Department of Agriculture also pays 75 percent of the restoration costs.

The restoration cost-share agreement (generally for a minimum of 10 years in duration) is used to re-establish degraded or lost wetland habitat. This does not place an easement on the property. The landowner provides the restoration site without reimbursement. Other agencies and private conservation organizations may provide additional assistance of easement payment and wetland restoration costs as a way to reduce the landowner's share of the costs (U.S. Department of Agriculture 1997). To be eligible for the Wetland Reserve Program, land must be restorable and be suitable for wildlife benefits (U.S. Department of Agriculture 1997).

After a landowner is accepted into the Wetland Reserve Program he/she continues to control access to the land and may lease the land for hunting, fishing, and other undeveloped recreational activities. At any time, a landowner may request that additional activities be evaluated to determine if they are compatible uses for the site. Compatible uses are allowed if they are fully consistent with the protection and enhancement of the wetland (U.S. Department of Agriculture 1997). For FY2000, the Clinton Administration will propose to enroll approximately 200,000 acres in the program (Zinn and Copeland 1999).

Oklahoma's environmental statutes do not specifically address wetlands. On the state level, the Oklahoma Water Resources Board evaluates how Oklahoma's Water Quality Standards protect wetlands (Mungle 1996). However, within the definition of "Waters of the State," marshes receive special attention as do all other bodies or accumulations of water (Mungle 1996). Oklahoma currently has two predominant statewide wetland inventories. They are the U.S. Fish and Wildlife Service's National Wetlands Inventory and the Natural Resource Conservation Service's Wetland Inventory. The Oklahoma Conservation Commission is responsible for preparation of the Comprehensive Wetlands Conservation Plan. The Commission has a network of 89 local conservation district offices that are responsible for conservation of renewable natural resources (Mungle 1996). The Oklahoma Department of Wildlife Conservation provides protection for state wildlife resources. They are very interested in wetlands because of the importance of wetlands habitat to many wildlife species (Stacey, personal communication, 1999).

Individually, no agency or group has either the mandate or the resources to adequately protect wetlands. Wetlands conservation and management in Oklahoma are accomplished only through the cooperative and continued efforts of these groups and individuals.

CHAPTER III

METHODOLOGY

Objective 1. Evaluate wetland restoration administrative policies, which guide the development of the Stillwater Creek wetland and future restoration projects.

Research throughout this study suggested that local leaders interested in pursuing an urban wetland project must have a clear understanding of the federal requirements and their administration through the Natural Resources Conservation Service. This study evaluated key components of the U.S. Department of Agriculture's Wetland Reserve Program through the research of published journal articles and books on wetland restoration administration policy.

The Delphi technique offered great potential to this study by providing expert opinion from a panel of specialists involved in the planning and management of the Stillwater Creek and Red Slough projects. The panel members were carefully chosen for their expertise in wetlands across Oklahoma. A survey by telephone with each individual led to a general consensus regarding wetland life expectancy and probable wildlife species in both urban and rural wetlands investigated in this study. The interviewees included Alan Stacey, (Oklahoma Department of Wildlife Conservation), Jennifer Myer, (Wetland Coordinator, Oklahoma Conservation Commission), Steve Tully, (Wetland Reserve Program Coordinator, U. S. Department of Agriculture, Natural Resources

Conservation Service), and Gary Cook (National Project Wet Coordinator). Interviews were carried out between January and March 1999. The results of the Delphi technique are represented in tabular format to assess the level of restoration through a proposed listing of dominant plant and wildlife species suitable for this habitat. This information provides interested community leaders a list of possible species they can expect to find in an urban wetland environment. Questions asked in the Delphi survey are listed in Appendix C. A list of observed species will be compiled in the following years to determine the dominant types of species represented. This information will assist conservationists in assessment and monitoring of the site. It will provide an inventory to local communities interested in the development of an urban wetland, and a record of indicator species can be used in wetland determination within the Wetland Reserve Program.

Objective 2. Investigate barriers to obtaining funding for wetland restoration in the Wetland Reserve Program.

Research was carried out through an examination of published journal articles and books on wetland policy and funding including federal documentation on the Wetland Reserve Program. This information provided an outline of the requirements and eligibility for acceptance into the program. Sources examined fell primarily with documents developed by the U.S. Department of Agriculture. This agency is responsible for administering the program through the Natural Resources Conservation Service.

This study also evaluated ranking criteria, which allowed us to decide which wetland determination method was applicable: the routine or comprehensive determination. The approach used for wetland determinations will vary, based on the complexity of the area in question.

The routine approach is used in the vast majority of determinations. It requires a minimal amount of effort, using primarily qualitative procedures. Federal biologists visit each project onsite and determine if the project will meet the hydrology, hydrophytic plant, and hydric soil wetland requirements.

The comprehensive wetland determination approach requires application of quantitative procedures for making wetland determinations. This requires biologists to visit the location onsite and transect every 20 feet taking samples of a variety of hydrophytic vegetation and dig soil pits at each stop to collect soil samples. This type of quantitative determination is lengthy and seldom necessary. Its use is restricted to situations in which the wetland is very complex or is the subject of likely or pending litigation (U.S. Department of Agriculture 1997). There are not any unusual issues expected at the Stillwater Creek or Red Slough restoration sites, both will require a routine determination.

Objective 3. Investigate a wetland restoration project in a rural setting to determine methods, which may or may not be applicable to an urban wetland restoration project in Stillwater.

Rural – Urban Wetland Comparison

Rural and wetland projects across Oklahoma were extensively researched through files located at the Natural Resources Conservation Service with primary focus on the Red Slough wetland in McCurtain County. Research was conducted on the Stillwater

Creek Wetland and its probable design. Features suitable to an urban context were evaluated through this rural/urban comparison.

This study provides tabular data, which compares the two wetland sites. Plant life, wildlife habitat, wetland size, and expected level of restoration are represented to show the similarities and differences between these types of wetlands. This information provides a summary of the key components used in the ranking criteria for wetland determination of each site. These data highlight the issues faced in wetland restoration occurring in both rural and urban environments.

Residential concerns are an important factor in urban wetland restoration. Although each situation may be slightly different due to the location of the restoration site, it is necessary to explore issues, which may have adverse effects on the community and nearby residents. Residential concerns will be addressed in an urban wetland determination model. The urban wetland determination model designed in this study can be used in future urban wetland scenarios. It is important that the urban model address urban issues that may not have been critical in rural settings.

This study provides a detailed model of the steps in federal wetland determination and assessment of an urban wetland restoration site. Steps lead local leaders through the Wetland Reserve Program process for constituting a wetland, from the initial onsite visit to the final wetland boundary delineation. Each step outlines the routine determination process and evaluation steps in a Wetland Reserve Program project. The model will be helpful to local community leaders as they evaluate the benefits and barriers to possible wetland restoration in their communities. Components in the model were derived through a comprehensive review of the literature, onsite field visits with local biologists, and analysis of Delphi interview results. This allows future urban wetland restoration project coordinators use of the model as a reference and guide for wetland determination.

CHAPTER IV

FINDINGS

Objective 1. Evaluate wetland restoration administrative policies, which guide the development of the Stillwater Creek wetland and future restoration projects.

This review evaluates key components of the program that would be applicable to a wetland restoration project. It is intended to inform the public and interested parties about the policy and regulations currently in place within the Wetland Reserve Program.

Wetland Reserve Program

The U.S. Department of Agriculture's Wetland Reserve Program is administered by the Natural Resources Conservation Service in concurrence with the Farm Service Agency and in consultation with the U.S. Fish and Wildlife Service and other cooperating agencies and organizations. The Wetland Reserve Program objectives are to: 1) purchase conservation easements from, or enter into cost-share agreements with, willing owners of eligible land; 2) help eligible landowners, protect, restore and enhance the original hydrology, native vegetation, and natural topography of eligible lands; 3) restore and protect the functions and values of wetland in the agricultural landscape; 4) help achieve the national goal of "no net loss of wetlands" and 5) improve the general environment of the country. The emphasis of the Wetland Reserve Program is to protect, restore, and enhance the functions and values of wetland ecosystems to attain: 1) habitat for wildlife and migratory bird, including threatened and endangered species; 2) protection and improvement of water quality; 3) attenuation of water flows due to flooding; 4) recharge of ground water; 5) protection and enhancement of open space and aesthetic quality; 6) protection of native flora and fauna; 7) benefits to education and scientific scholarship (U.S. Department of Agriculture 1997).

Wetland Reserve Program Restoration Plan

The restoration plan will identify how the wetland ecosystem functions and values will be restored, improved and protected with special emphasis on habitat for wetland dependent migratory birds and other wetland dependent wildlife. Both the wetland and upland components of an easement or cost-share agreement area are restored to the maximum extent practicable. The Natural Resources Conservation Service works cooperatively with the landowner, U.S. Fish and Wildlife Service, and other conservation partners to restore native plant communities and achieve hydrologic regimes that provide for the original or improved conditions of the site for the benefit of wetland dependent wildlife (U.S. Department of Agriculture 1997). The agencies involved develop and maintain partnerships that will contribute to the restoration and maintenance of wetland and ecosystem functions and values during and beyond the life of the Wetland Reserve Program easement or agreement. Partners will request input from State Wildlife agencies, and Conservation Districts at the local level to obtain restoration planning and technical assistance to achieve maximum restoration potential (U.S. Department of Agriculture 1997).

In some cases, achieving maximum benefits for wildlife may require a diversity of habitat types that are different from the original plant community and hydrologic condition, such as some open water and emergent marsh in a wooded wetland site. The conservation planner must recognize that when declining and threatened and endangered species are used for ranking purposes, the restoration should be targeted to provide suitable habitat for the species. This may preclude maximizing diversity and require monotype restoration (U.S. Department of Agriculture 1997). When there is difficulty determining exactly what conditions originally occurred on the site, the restoration plan should be designed to provide for optimum habitat for wetland dependent wildlife with a priority for migratory birds, declining species, or other wetland dependent species of special concern. Artificial nest structures are an appropriate component of restoration actions. Examples of artificial structures include: wood duck boxes, hen houses for nesting mallards and other waterfowl species, and floating or permanent nesting islands. Native plant community restoration requires reestablishing the native plant community on at least 70 percent of the easement site, where it is practical to do so. If a 70 percent restoration level is not practical, a suitable precursor or subset of the original community may be established that will create conditions necessary for the native community to develop over time that provide wildlife habitat similar to pre-degradation conditions (U.S. Department of Agriculture 1994).

Post-restoration objectives can include the assessment of the restored ecosystem in comparison to the target ecosystem. The final determination of types of species may not be established until a period of time has passed to allow sufficient opportunity for species to inhabit the new area (U.S. Environmental Protection Agency 1994). Future monitoring of species is important to assess their viability. Success of the restoration project should be valued in terms of future economic, ecological, and social benefits to the restoration area (Robinson 1995).

It must be understood that the complete restoration of natural wetlands is impossible because of the complexity and variation in natural, as well as created or restored systems and the subtle relationships of hydrology, soils, vegetation, wildlife, and nutrients which develop over thousands of years in natural systems (Mungle 1991). Nevertheless, experience to date suggests that many wetland functions can be at least partially restored, created, or enhanced (Wheeler and Shaw 1995). It is often possible to restore or create a wetland with vegetation resembling that of a naturally occurring wetland. This does not mean, however, that it will have habitat equaling those of a natural wetland or that such a wetland will be a persistent, long term feature in the landscape, as are many natural wetlands (U.S. Department of Agriculture 1998).

Objective 2. Investigate barriers to obtaining funding for wetland restoration in the Wetland Reserve Program.

This review evaluates key eligibility components that would be applicable to a wetland restoration project. It is intended to inform interested parties about the opportunities and barriers to obtaining funding within the Wetland Reserve Program. The Wetland Reserve Program is administered through the U.S. Department of Agriculture, Natural Resources Conservation Service. Part 514 of Title 440 - Conservation Programs Manual sets forth guidelines for the Wetland Reserve Program as a whole. Each state has the responsibility of administering the program and adhering to the Conservation Program regulations.

Landowner Eligibility

There are three types of ownership eligible for consideration under the Wetland Reserve Program. The first is privately owned land, including land owned by conservation organizations, such as The Nature Conservancy or Audubon Society. Secondly, tribal land is eligible under certain conditions. However, a tribe may not be able to sell an easement to the United States without prior approval of the Bureau of Indian Affairs. Finally, state, county or nonfederal publicly owned land is eligible for participation, if all eligibility requirements are met. General priority will be given to easement offers made by non-government owners unless there are unique ecological reasons for doing otherwise (U.S. Department of Agriculture 1997).

Land Eligibility

To be eligible for the Wetland Reserve Program, land must be restorable and be suitable for wildlife habitat. In all cases, the landowner retains ownership and controls access to the land (U.S. Department of Agriculture 1997). A list which identifies categories of land eligible under the Wetland Reserve Program is summarized in Appendix A.

Wetland Hydrology

The term "wetland hydrology" encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface at some time during the growing season (U.S. Fish and Wildlife Service 1989). Areas with observable characteristics of wetland hydrology are those where the presence of water has an over-riding influence on characteristics of vegetation and soils due to anaerobic and reducing oxygen conditions. Such characteristics are usually present in areas that are inundated or have soils that are saturated to the surface for sufficient duration to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions. Indicators of wetland hydrology include drainage patterns, sediment deposition, watermarks, stream gage data, historic records, and visual observation of inundation. Hydrology is often the least exact of the parameters, and indicators of wetland hydrology are sometimes difficult to find in the field. However, it is essential to restore the wetland hydrology at a site that has been accepted into the Wetland Reserve Program (U.S. Department of Agriculture 1994).

Hydric Soils

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (U.S. Department of Agriculture 1994). A hydric soil may be either drained or undrained, and a drained hydric soil may not continue to support hydrophytic vegetation. Therefore, not all areas having hydric soils will qualify as wetlands. Only when a hydric soil supports hydrophytic vegetation and the area has indicators of wetland hydrology, may the soil be referred to as a "wetland soil." Although all soil-forming factors (climate, parent material, relief, organisms, and time) affect the characteristics of a hydric soil, the overriding influence is the hydrologic regime (U.S. Fish and Wildlife Service 1987). The unique characteristics of hydric soils result from the influence of periodic or permanent inundation or soil saturation for sufficient duration to effect anaerobic conditions. Prolonged anaerobic soil conditions lead to oxygen reduction, thereby lowering the oxygen available in the soil. This results in chemical reduction of some soil components (iron and manganese oxides), which leads to the development of grey soil colors and other physical characteristics that usually are indicative of hydric soils (U.S. Department of Agriculture 1994).

Hydrophytic Vegetation

Hydrophytic vegetation is the macrophytic plant life that occurs in areas where the frequency and duration of inundation of soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (U.S. Department of Agriculture 1994). The vegetation occurring in a wetland may consist of more than one plant community. Emphasis is placed on the assemblage of plant species that exert a controlling influence on the character of the plant community, rather that on indicator species. Therefore, the presence of scattered individuals of an upland plant species in a community dominated by hydrophytic species is not a sufficient basis for concluding that the area has hydrophytic vegetation (VanKooten and Porter 1995). Dominant plant species are those that contribute more to the character of a plant community than other species present. When dominant species in a plant community are adapted for life in anaerobic soil conditions, hydrophytic vegetation is present. Species that have an indicator status of obligate, facultative wetland, facultative, facultative upland, and obligate upland are considered to be typically adapted for life in anaerobic soil conditions (U.S. Department of Agriculture 1994).

Wetland Determination

The routine approach is used in the vast majority of wetland determinations. It requires a minimal amount of effort, using primarily qualitative procedures. Federal biologists visit each project onsite and determine if the project will meet the hydrology, hydrophytic plant, and hydric soil wetland requirements. They also examine the area to determine if the hydrology can be easily restored. If the wetland criteria are visible with an onsite visit, they make the decision to conduct a routine determination using qualitative procedures. Qualitative procedures allow the biologists to take samples of visible hydrophytic vegetation and dig a representative soil pit with a hand auger to determine the hydric soils present at the site. There are few samples needed and the location of each sample site is marked a map for record. A routine determination is required if information is available to complete the following steps: 1) locate the project area (determine spatial boundary of the area) 2) determine whether hydrophytic vegetation exists 3) determine whether hydrology is present 4) determine whether hydric soils are present 5) make wetland determination 6) determine wetland boundary.

The comprehensive wetland determination approach requires application of quantitative procedures for making wetland determinations. This requires the biologists to visit the location onsite and transect every 20 feet taking samples of a variety of hydrophytic vegetation and dig soil pits at each stop to collect soil samples. This type of quantitative determination is lengthy and seldom necessary. Its use is restricted to situations in which the wetland is very complex or is the subject of likely or pending litigation (U.S. Department of Agriculture 1997). Comprehensive wetland determinations require the steps listed in the routine determination along with more comprehensive information to make a quantitative determination. Additional steps include: 1) determine spatial location of vegetation 2) determine type and layers in each plant community 3) establish and mark transect locations for observation 4) characterize vegetation at observation points 5) sample for hydric soils 6) determine flow of wetland hydrology 7) make wetland determination 8) make wetland determinations at all other required observation points.

It was determined through the Delphi survey technique that there are critical factors that must be met if wetland projects are to qualify for acceptance in the Wetland Reserve Program. The panel of experts agreed that the restoration of adequate hydrology to the sites was critical in its determination as a wetland. Both sites have good drainage patterns and will hold an adequate amount of water to maintain hydric vegetation and hydric soils. It was also determined that size was critical in its ranking. Larger areas cost less per acre to restore which was a strong factor at the Red Slough restoration site. The Stillwater Creek site is a much smaller site, but its location near local schools which, will provide educational and research opportunities to the community gave it a higher priority in the ranking.

Objective 3. Investigate a wetland restoration project in a rural setting to determine methods, which may or may not be applicable to an urban wetland restoration project in Stillwater. The following narrative describes the site conditions at the Red Slough rural wetland in McCurtain County as well as site conditions at the Stillwater Creek wetland in Payne County.

Red Slough Wetland Restoration Site

Red Slough is a Wetland Reserve Program site in McCurtain County, Oklahoma. The site is one of the few places in which rice (2000 acres) has been grown in Oklahoma.

The project area is 6,821 acres and is about five miles long. The site is drained by Push Creek, which flows east through the middle of the property. The site lies approximately 1.5 miles from the Red River at the nearest point (See Appendix D)(Tully, personal communication, 1998).

Site Conditions

The site was largely a forested wetland prior to conversion to agriculture in the late 1960's or early 1970's. Tree species included overcup oak, willow oak, water oak, and a mix of other tree species such as ash, willow and dwarf palmetto. The conversion to agriculture has not included extensive land leveling (Tully, personal communication, 1998).

After the site's acceptance into the Wetland Reserve Program, plans to restore and develop the site began. Wetland Reserve Program sites normally have a requirement that 70% of the site must have the hydrology and native vegetation restored, but the strategy on this site is for a 50-50 split. A large percentage of the acreage will be reforested. The strategy is to plant seedlings that are grown in a state facility accompanied by some direct seeding. The three dominant species to be planted are willow oak, water oak, and overcup oak. Acorns were collected locally to improve the potential to have well adapted trees (Tully, personal communication, 1998).

Rural Wetland Development

The site has the unique possibility of truly restoring hydrology because: 1) a significant area of the ridge topography remained intact, 2) Push Creek appears to be in excellent condition above the point of channelization, 3) there is a limited number of bridges and roads. This would allow re-creation of the floodplain where overflow would occur as a sheet flow and backwater. There were not funds or the need to develop an extensive levee system. These are the hydrologic conditions under which the native vegetation evolved. Thus, the expected response would be cost effective and restoration would remain closer to historic conditions (U.S. Department of Agriculture 1998).

Restoration of the site as a lowland forest has high potential to be an important area for some waterfowl species. Restoration to a forest condition would not influence use by mallards, but will enhance use by wood ducks. The mix of forest and emergent marsh type habitat benefit a wide array of plant and wildlife species that are adapted to these flooding regimes (Stacey, personal communication, 1999).

Stillwater Creek Wetland Restoration Site

Stillwater Creek, a major tributary of the Cimarron River in Payne County, transects the western and southern portion of the city limits as it flows in a southeasterly direction toward the Cimarron River. Due to the productive soils, most of the floodplain vegetation was cleared and converted to various agricultural uses during early settlement times (See Appendix E)(Tully, personal communication, 1999).

Site Conditions

In most areas along the creek, a narrow riparian zone composed of native hardwoods represents the only vegetative component of the floodplain that has not been substantially altered. Construction of upstream reservoirs, road construction, and various field drainage improvements enhancing farming capabilities have contributed to changes in the creek's floodplain hydrology. Nevertheless, much of the floodplain within the city limits remains subject to seasonal over bank flooding which frequently inundates roads and agricultural lands on a temporary basis (Stacey, personal communication, 1998).

Over the past 10-15 years, the southwest portion of the city has seen a steady increase in residential development in the area bordering the 100 year floodplain of Stillwater Creek. Recently, a limited amount of commercial development has also occurred within high portions of the floodplain zone. Due to city ordinances, all developments within the city limits are now required to comply with storm water retention criteria and account for increased runoff levels through the construction of retention structures or similar storage systems. Potential benefits from wetland restoration include improvements to water quality from urban runoff, reduced siltation, recreational and educational opportunities and enhancement or restoration of wildlife habitat (Stacey, personal communication, 1998).

Urban Wetland Development

A 23-acre wetland project located within the Stillwater Creek floodplain is currently planned for future restoration under the Wetland Reserve Program. Administered by the Natural Resources Conservation Service, the approved project area will be restored and protected under a perpetual conservation easement. The property is located in the southwest section of the city near both existing and planned residential developments. The former 23-acre wetland/buffer area is part of a larger 76-acre tract owned by a developer/wildlife artist who has a strong interest in wetland conservation. He has donated use of the acreage approved under the Wetland Reserve Program to develop a wetland demonstration project. The remainder of the property lies just outside the 100 year floodplain and will be developed for residential housing (Blaylock, personal communication, 1998).

The planned project presents opportunities to promote various aspects of wetland conservation through onsite demonstration. The City of Stillwater has approved a storm water retention design for the adjacent residential development, which will be incorporated into the wetland restoration project. Promotion of this aspect of the project will also include monitoring the wetland's effectiveness on reducing pollutants from urban development runoff. Restoration of the wetland will provide quality wetland habitat for a variety of wetland-dependent wildlife species. Development of a reliable water source will further enhance the area, allowing flexibility in managing water levels and manipulating vegetation (Tully, personal communication, 1999). In doing so, it will also provide viewing for visitors and create attractive breeding habitat important for many resident bird species. The demonstration project is also in a favorable location to attract several types of migratory birds including waterfowl, shorebirds, and wading birds. With the Stillwater project, nature trails, interpretive signs and a visitor center provide excellent educational and viewing opportunities for citizens. Hunting will not be allowed on the Stillwater wetland due to the close proximity of residential property and its location within the city limits. Seasonal inventory surveys will document how migratory, wintering, and breeding birds respond to the restoration/enhancement efforts (U.S. Department of Agriculture 1997).

A high potential exists to develop the demonstration project to promote educational opportunities. Located in close proximity to a growing residential area, public schools, and a major university, the project has the potential to serve a variety of audiences. Development of boardwalks and an outdoor classroom gazebo will allow users to access and more effectively view wetland activities as well as increase public understanding of wetland functions and values (Stacey, personal communication, 1998). These features will also enhance planned onsite training workshops. The workshops will target local educators and demonstrate activities for the purpose of incorporating curriculums, field techniques, and equipment into a outdoor classroom (Mungle 1996).

Results of the Delphi Interviews

The Delphi Technique proved to be an excellent tool to survey expert opinion concerning objectives in this study. The Delphi Technique is useful where decisions must be made quickly with limited knowledge. Experts in the field of wildlife ecology, biology, and wetland restoration participated as a panel of experts. It became apparent that an adequate consensus would be reached, satisfying the requirements of the Delphi Method.

The questions addressed in the first round involved expected levels of restorability at both the Red Slough rural site and Stillwater Creek urban site. In addition to answering questions, the panel provided explanations for the basis of their responses.

All panel experts agreed that that the level of restorability had high potential at both sites. Their response was based upon the ability to restore hydrology to both sites. In both areas run-off water from upland drainage and floodwater from Stillwater and Push Creek will facilitate restoration and improve water quality thereby, limiting sediment loading and siltation. The second round of questioning explored the proposed dominant plant and wildlife expectations at both sites. The panel had some difficulty limiting themselves to 5 dominant species of each. Their results were again, generally similar (See Table IV).

Table IV

Plant and Wildlife Species Expectations

	Plants	Wildlife
Stillwater Creek Site	Bulrush Smartweed Spikerush Cordgrass Cattail	Red-Winged Blackbird Mallard Giant Canada Goose Great Blue Heron Marsh Hawk
Red Slough Site	Wateroak Overcup Oak Water Hickory Foxtail Button Bush	Snow goose Northern Pintail White-faced Ibis Tree Frogs Northern Harrier

Source: Delphi Interviews 1999.

This information gives an excellent sample of possible dominant species that may be found at each site. Such species will qualify as indicator species, and can be used in the ranking criteria and ultimately for determining acceptance into the Wetland Reserve Program (U.S. Fish and Wildlife 1988).

The third and final round of interviews addressed threatened and endangered species that may find suitable habitat at both wetland sites. The panel was also asked to forecast the possible life expectancy of each wetland site.

The panel participants expect the Red-Cockaded Woodpecker, American Alligator, Bald Eagle and the Least Tern will find suitable habitat at the Red Slough site. They agreed that the size and location of the Stillwater Creek site may limit its potential to attract many threatened or endangered species. They also expect the Whooping Crane to find suitable habitat at the Stillwater site.

The second group of questions in the final round involved the life expectancy of each site. The panel agreed that with proper management, the site at Red Slough would last well beyond 50 years. Their recommendations included structure cleanout, dike mowing, and routine maintenance. The panel also mentioned the excellent water quality of both locations, suggesting that siltation and sediment loading would be very slow. The Stillwater Creek site should have a life expectancy from 30 –50 years. As with the Red Slough site, maintenance and management would be a primary factor in maintaining the site. The Stillwater Creek site has a slightly lower life expectancy due to the possibility of earlier siltation, urban influence, and lower rainfall to the area. It is the intent that these projects be managed for many years since both are perpetual easements and have excellent potential for sustainability.

Ranking Criteria

This study compared the ranking criteria and federal agency requirements of wetland projects to the proposed Stillwater Creek site. This information is of great value to others interested in how wetlands meet eligibility in the Wetland Reserve Program. Federal regulations state that the Natural Resources Conservation Service will consult with the U.S. Fish and Wildlife Service to rank Wetland Reserve Program applications. Ranking criteria sheets are filled out for each application during an onsite visit to the proposed wetland site. Ranking is based on the costs of restoration, availability of matching funds, significance of wetland functions and values, estimated success of restoration measures, and the duration of a proposed easement with permanent easements being given priority over non-permanent easements (U.S. Department of Agriculture 1997). The ranking system will ensure consistent and efficient Wetland Reserve Program implementation. The ranking criteria will also emphasize habitat for migratory birds and declining species. Also addressed are partnerships that will reduce Natural Resource Conservation Service's costs and prolong the wetland functions and values established. Additional wetland functions, such as water quality and floodwater retention, may be included in the ranking criteria (U.S. Department of Agriculture 1994).

The ranking criteria for the Red Slough and Stillwater Creek sites is used to determine the priority and benefits of restoration at each particular site. The amount of federal funds received each year by the U.S. Department of Agriculture Natural Resources Conservation Service determines which wetland applications will be approved for wetland restoration through the Wetland Reserve Program with funds distributed to projects with the highest ranking. Projects which have the potential to restore threatened or endangered species habitat or large areas of permanent shallow water with optimum hydrology restoration are awarded higher points in the ranking process. The extent of biodiversity, which includes a variety of wetland types within the project area can influence the ranking (See Table V). The cost of restoration and future maintenance is also a factor in the ranking process.

Table V

Plant Indicator Status Categories

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

Source: U.S. Department of Agriculture 1994.

The Red Slough project received an excellent ranking due to its size, shallow water, and biological benefits such as its ability to attract threatened and endangered species. The site has excellent topography allowing it to contain forest, emergent shrub, and open water wetland habitats. This diversity allows the site to attract a variety of wintering waterfowl, neotropical birds and migrating wildlife. Trees found within the Red Slough area include bald cypress, green ash, loblolly pine, and palmetto. Its location on Push Creek, make it feasible to restore hydrology to the site and provide a low cost maintenance environment for many years to come.

The Stillwater Creek site ranked high based upon its location within a floodplain easement. It also received high ranking due its shallow surface water (< 2ft. average depth) and permanent shallow water conditions. Although it may not attract a large number of threatened or endangered species, relative to other places, it provides four distinct wetland habitat types: forest, emergent marsh, shrub, and open water environments. Its cost per acre for restoration will be slightly higher than other areas due to its smaller size. However, once constructed, the future restoration and management costs will be relatively low. The area received special consideration ranking because of its potential to serve as an outdoor classroom, nature education area, or location for community recreation and research opportunities.

Urban Wetland Determination Model

The Urban Wetland Determination Model is designed to guide local community leaders through a routine wetland determination process. Parameters in the model were determined through a comprehensive review of rural wetland restoration literature. After visits to many rural wetland restoration sites in Oklahoma, it became apparent that restoration of a wetland in an urban environment would need urban components. The Title 440-Conservation Program Manual was also used to determine specific parameters that must be included so that all components of the wetland determination model meet eligibility requirements for acceptance into the Wetland Reserve Program. Fieldwork with local biologists and soil scientists from the Natural Resources Conservation Service provided valuable guidance to the eligibility process. Results received from the Delphi interviews provided excellent information on the possible indicator and dominant species sections of the model as well. Upon acceptance to the program, information regarding the project area can be collected (See Figures 2 and 3):

Step 1: Determine spatial location of the project area using U.S. Geological Survey topographic maps, aerial photos, or other appropriate information. The map should include current urban development so that special urban considerations can be investigated.

Step 2: Determine the field characterization approach to be used. Considering the size and complexity of the area, a decision should be made to proceed with routine or comprehensive determination. This model is designed to accommodate the routine approach since most wetland projects fall into this category.

Step 3: Identify plant community types. Staff with the Natural Resources Conservation Service and state wildlife agencies traverse the area and determine the number and locations of various plant community types. Community types should be named and noted on the map.

Step 4: Determine whether normal environmental conditions are present by noting if the area is presently lacking in hydrophytic vegetation or hydrologic indicators due to annual or seasonal fluctuations in precipitation or fluctuations in temperature.

Step 5: Select representative observation points in each community type. Representative observation points should be located where characteristics best represent the entire community.

Step 6: Characterize each plant community type by visually determining the dominant plant species in each vegetation layer.

Step 7: Record indicator status of dominant species in each community type.

Step 8: Determine whether hydrophytic vegetation is present. More than 50% of the dominant species must have an indicator status, which categorizes it as wetland vegetation.

Step 9: Apply wetland hydrologic indicators by examining areas dominated by hydrophytic vegetation community types.

Step 11: Determine whether wetland hydrology is present. Areas with wetland hydrology indicators have wetland hydrology. If positive wetland hydrology indicators are present in all community types, the entire area has wetland hydrology. The area is not a wetland if none of the community types have wetland indicators.

Step 12: Determine whether soils must be characterized by examining the vegetation information previously collected. Hydric soils are assumed to be present in any plant community type in which all dominant species have wetland indicator status. The wetland boundary should have a distinct difference in plant community types than the nonwetland areas surrounding the project. If this information is clear, then skip to step 15. If this information is not clear, proceed to step 13.

Step 13: Dig a soil pit using an auger or spade. Approximately 16 inches of the soil profile must be visible to determine the presence of hydric soils.

Step 14: Apply hydric soil indicators by examining the A-horizon to determine if reducing oxygen conditions are visible. The soils may have a grey mottled coloring with spots of manganese and iron oxides.

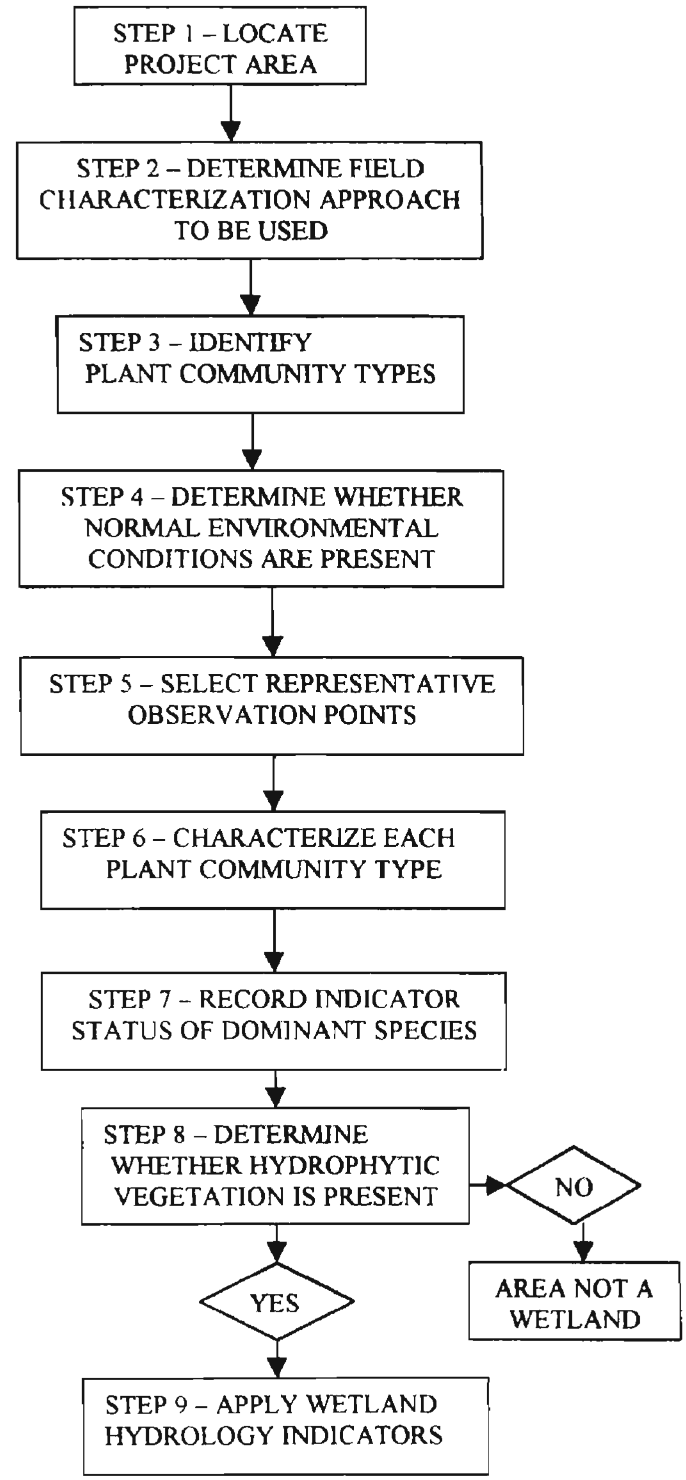
Step 15: Determine whether hydric soils are present. If hydric soils are present, then this area has hydric soil. If soils at all sampling locations have hydric soil indicators, then the entire project has wetland soils. If no hydric soils are found, the area is not a wetland.

Step 16: Make a wetland determination based upon whether or not the entire area presently or normally has wetland indicators of all three parameters. If the entire area lacks wetland indicators of one or more parameters, the entire area is not a wetland.

Step 17: Determine wetland boundary be marking the area on the base map. Make sure all wetland plant communities and indicators are delineated on the map.

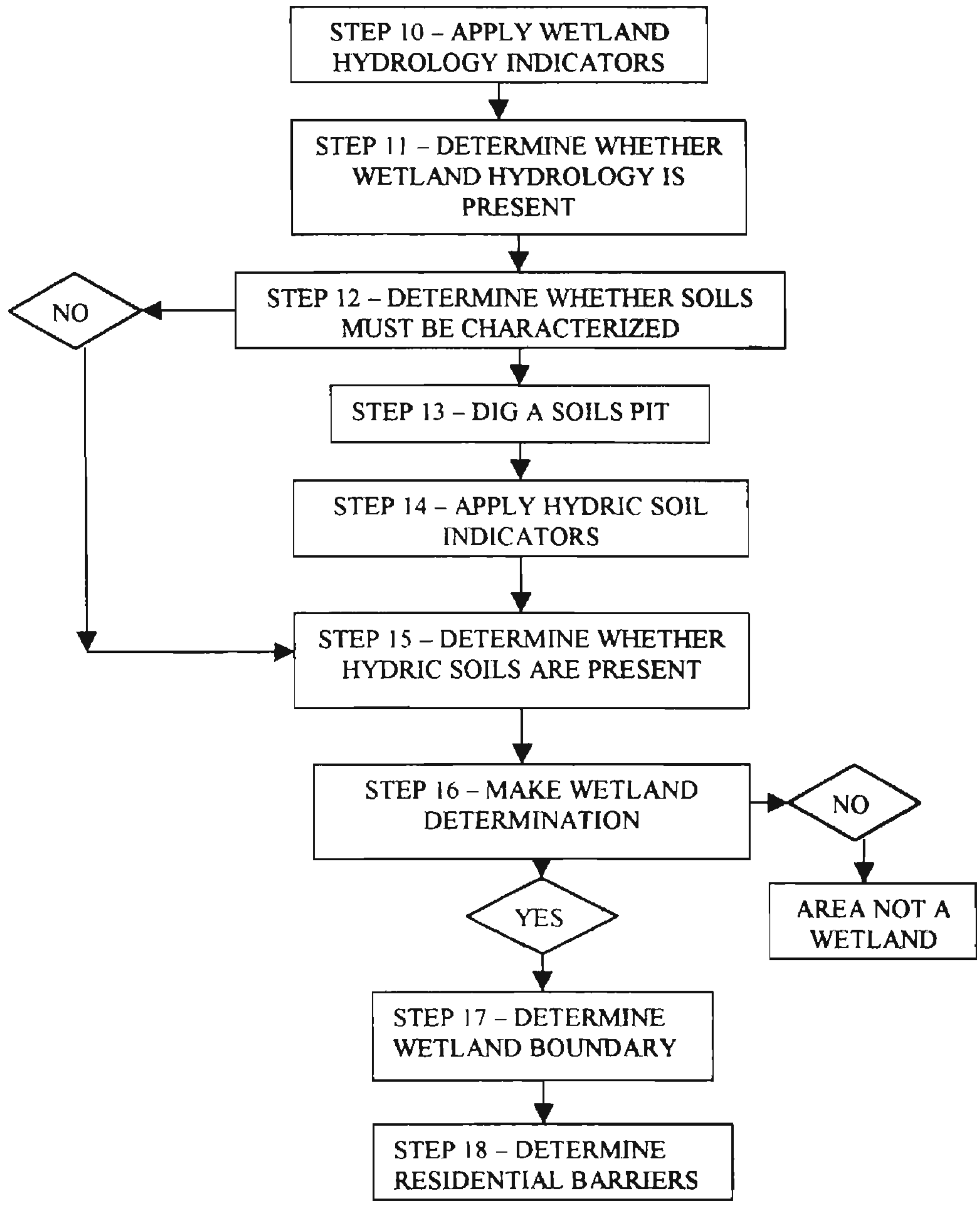
Step 18: Determine potential urban and residential barriers to the site. Examine indicator species and their proximity to the wetland boundary and residential area. Determine which wetland boundaries are closely located to neighborhoods, schools, parks or other areas used frequently by the general public. Communicate with local leaders and interested parties regarding options to protect children and others from possible dangers that may result from wildlife inhabiting the area. Possible options would be informational kiosks describing breeding habits and dangers in approaching wildlife. It is important that people and wetland areas coexist without damage to the resource. It may be necessary to educatc the public through brochures, town meetings, and interpretive information.

Figure 2.
Urban Wetland Determination Model



Continue to Step 10

Figure 3.
Urban Wetland Determination Model (Cont'd)



Rural – Urban Comparison

Both the Red Slough and Stillwater Creek wetland restoration sites have similar restoration goals. Both sites are striving to achieve a high level of restorability, which will create suitable wetland habitat for many wildlife species. The following table illustrates the similarities and differences of each restoration site (See Table VI).

Table VI

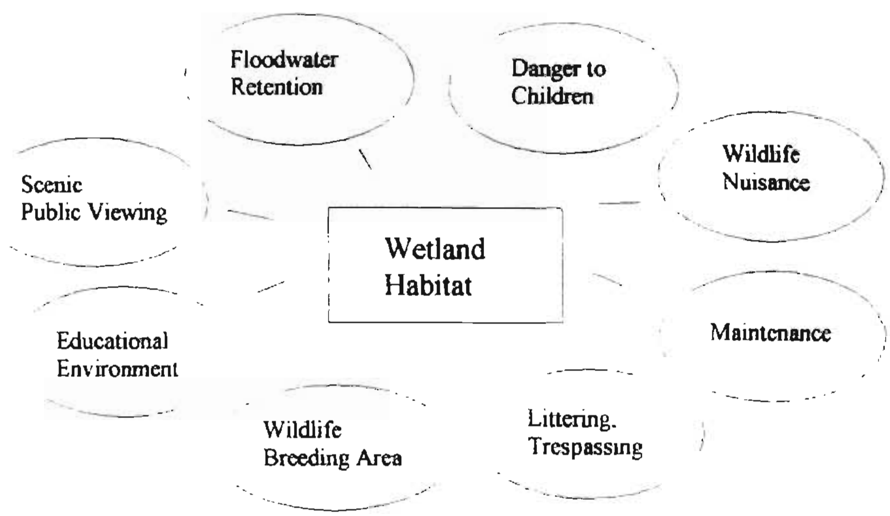
Rural – Urban Comparison

	Red Slough	Stillwater Creek
Size	6,821 acres	23 acres
Previous Landuse	Rice	Wheat
Prior Landcover	Forested	Forested
Topography	Undulating	Nearly Level
Levee System	No	Yes
Manmade Structures	Limited	Extensive

Source: Stacey 1999

Through this study, it became apparent that urban wetland restoration has similar construction requirements to rural wetland restoration projects (Stacey, personal communication, 1999). The two also have very similar restorability goals from which project coordinators implement the most practical and economical design. The difference is in the approach to wetland recreational use by the public and the possible problems that could occur through its misuse from an uninformed public. The following figure illustrates possible barriers that may be encountered when planning an urban wetland (See Figure 4).

Figure 4.
Residential Concerns



Urban wetland environments have a unique appearance which may be unappealing to some property owners. Although they serve a positive function, such as floodwater retention in both urban and rural areas, they may be seen by some as overgrown and unattractive. Others may enjoy learning about new plants or wildlife and may appreciate the opportunities of an educational environment and scenic public viewing. Wetland plants provide beautiful flowers, interesting foliage, and frequently attract a great variety of songbirds and other wildlife.

While rural wetlands seldom have visitors, an urban wetland will have children and pets exploring these areas. Children should be educated to respect deep water and soft soils. Pets must be prevented from disturbing wildlife breeding areas. Driving close to the area may lead to contact between vehicles or people and wildlife.

Rural environments welcome a variety of wildlife including skunks, snakes, and mosquitoes. In urban areas, this type of wildlife may become a nuisance. Rural areas seldom have littering or trespassing in wetland areas, and therefore require little maintenance. Urban wetlands may require management to maintain the beauty of these natural areas. With proper management and education, wetlands can enhance an urban area and provide a peaceful living experience with nature in your neighborhood.

CHAPTER V

SUMMARY AND CONCLUSIONS

Discussion of Findings

The findings of objective 1 provide interested parties insight into wetland restoration and the Wetland Reserve Program. For example, we now know *why* wetlands need to be restored: to replace hydrologic, water quality, and habitat functions. In addition, we have some ideas about *where* the greatest gains can be made in the shortest period of time: marginally productive agricultural lands (Steinhart 1990). One point that is clear from restoration studies to date is that the feasibility of restoration varies enormously from system to system (Wheeler and Shaw 1995). Some systems, such as certain tidal wetlands, that have few species of plants and relatively simple structure have been restored quite readily under favorable conditions. Others, such as peat bogs, where the peat has been removed or disturbed, increase the complexity of the restoration (Bedding and Hollis 1994).

The results of objective 2 encompass the complex process of wetland restoration. For instance, we now know *how* to restore wetlands where sites are not too damaged and where regional biodiversity is not too depleted: restore the hydrology, transplant the native vegetation, and wait for the animal populations to expand into the habitats (Delaney 1995). The success of wetland restoration lies primarily with initial planning and design. These findings also conclude that, extensive evaluation of the restorable area is required to determine the limits of restorability and evaluation of treatment needs (Bridgham and Johnston 1995).

The results of the Delphi interviews provided substantial information regarding wetland restoration in both a rural and urban setting for objective 3. The interviews provided valuable insight regarding wetland restoration from experts in the field. This information, along with field visits assisted by experts in the field and literature from the Title 440-Conservation Program Manual, provided a substantial base of information, which was used to develop the urban wetland determination model. Local communities interested in urban wetland restoration may find this information on the Wetland Reserve Program valuable along with the ranking criteria, to assist with future urban wetland restoration programs. These study objectives were intended to provide guidelines from which the new field of urban wetland restoration can expand in future research.

Future research could include the management, assessment, and monitoring of species in urban wetland restoration projects. Since this wetland is the first urban wetland accepted into the Wetland Reserve Program in Oklahoma, future assessment of habitat and the sustainability of species through a biodiversity monitoring program would be the next step in building upon this case study.

Concluding Comment

Wetland restoration, enhancement, and creation activities will provide long-term benefits for wildlife, but may cause adverse effects for a short time during construction (Tully, personal communication, 1999). The few adverse effects of wetland restoration are most always, minimal and temporary (Tully, personal communication, 1999). When goals are established for a restoration project, planners must be aware that most ecological systems are ever-changing, representing a moving target for the groups involved.

In this era when natural environments are vanishing and habitats are so frequently destroyed, conservation of our natural resources is essential. In the case of wetland restoration, suitable habitat must be available for sustainable development. Sustainable development should acknowledge the inherent worth of biodiversity apart from its benefits to humanity. It could be defined as "...human activities guided by acceptance of the intrinsic value of the natural world, the role of the natural world in human well-being, and the need for humans to live on the income from nature's capital rather than on the capital itself" (Meefe and Carroll 1997, p.496). In a way, this ecosystem approach represents a fundamental change in how people view themselves with respect to nature. Instead of perceiving nature as something that exists as a fenced-off patch in the middle of a human dominated landscape, the new approach is people living and pursuing activities and aspirations within nature. This study will promote the conservation and restoration of an urban wetland for an informed and educated public that understands and supports activities that sustain wildlife, endangered species and their habitats in the Stillwater area.

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APPENDICES

APPENDIX A

LAND ELIGIBILITY CATEGORIES

Wetland Reserve Eligibility Categories

Farmed wetlands
Prior converted cropland
Farmed wetland pasture
Farmland that has become a wetland as a result of flooding
Rangeland pasture, or production forestland where hydrology can be restored
Riparian areas, which link protected wetlands
Previously restored wetlands land is eligible if it meets WRP requirements

Source: U.S. Department of Agriculture 1997.

1) Farmed Wetlands are wetlands which were manipulated prior to December 23, 1985 and are used to produce an agricultural commodity. However, the areas are still wet enough to meet the criteria for wetlands determination. Agricultural production on these areas can bc continued, and any drainage systems that were installed before December 23, 1985 can be maintained. Additional manipulation is not allowed.

2) Prior converted cropland, are areas that were converted from wetlands prior to December 23, 1985 and no longer meet the criteria for wetland determination. Agricultural production on these areas is not affected by wetland determinations unless the area is abandoned.

3) Riparian areas are eligible providing the area provides a link between wetlands protected by an easement or wetlands protected by an interest that achieves the same purpose.

4) Lands altered by flooding are eligible if they have been scoured by flood or broken levees or lands having soil saturation and water table elevation changes as a result of offsite surface hydrologic changes (U.S. Department of Agriculture 1997).

APPENDIX B

STILLWATER CREEK DRAFT WORK PLAN

PROJECT GOALS

STILLWATER CREEK WETLAND

1. Enhance the wetland by developing a reliable water source to provide management flexibility in promoting wildlife use and wetland demonstration features.
2. Develop user access and interpretive features to promote viewing and educational opportunities.
3. Integrate urban storm water retention requirements with natural wetland functions.
4. Promote wetland conservation training of local educators through organized, onsite project workshops.
5. Implement an inventory/monitoring program to document success of the project including wetland inflow/outflow pollutant sampling comparisons and seasonal inventory surveys documenting migratory bird and other wildlife use.

DRAFT WORK PLAN

STILLWATER CREEK WETLAND

Time Frame: Work would begin in late summer of 1998 and end on September 30, 2001.

Task 1: Enhance the wetland project by developing a reliable water source including contract installation of groundwater well, single phase electric pump and water conveyance system.

Time Frame: December 30, 1998 Cost: $10,000

Task 2: Development of user access features including boardwalks, trails outdoor classroom gazebo, parking areas, and interpretive signs. All labor associated with construction and installation as well as some materials to be provided by several listed cooperative partners.

Time Frame: December 30, 1998 Cost: $24,000

Task 3: Onsite wetland education training for educators in the Stillwater, Oklahoma area. Workshop will demonstrate suggested activities and techniques for incorporating curriculums, field techniques and equipment into a wetland outdoor classroom. Wetland demonstrations will be conducted by the Oklahoma Department of Wildlife and Oklahoma Conservation Commission.

Time Frame: August 2000 Cost: $7,500

Task 4: Monitor the effectiveness of the proposed wetland enhancement on the reduction of pollutants from an urban development. Monitoring will occur during storm events and will include but not be limited to sediment loads, pesticides, and nutrients. Monitoring will be conducted by local conservation and civic groups and training will occur jointly through the Oklahoma Conservation Commission and the Oklahoma Water Resources Board.

Time Frame: October 1998 - September 2001 Cost: $10,000

Cost Summary:

State:	$12,875
Federal:	$38,625
Total	$51,500

DEVELOPMENT COORDINATION:

This project will be accomplished through a cooperative effort made up of local, state, and federal agencies and private organizations. Cooperative partners include:

Oklahoma Office of the Secretary of the Environment

Oklahoma Department of Wildlife Conservation

Oklahoma Conservation Commission

Natural Resources Conservation Service

U.S. Fish and Wildlife Service Partners Program

Student Chapter of The Wildlife Society

Payne County Conservation District

Local Stillwater Vendors

Blaylock Construction

The City of Stillwater

Payne County Audubon Society

Meridian Technology Center

Ducks Unlimited

Stillwater High School Environmental Club

Teal Ridge Neighborhood Association

PROJECT MANAGEMENT AND MAINTENANCE

The following agencies will provide technical assistance toward management of the project:

Oklahoma Department of Wildlife Conservation

Natural Resources Conservation Service

U.S. Fish and Wildlife Service

APPENDIX C

DELPHI SURVEY QUESTIONS

Round 1

1. What level of restorability do you expect will be achieved at the Stillwater Creek Wetland Reserve Program Project?
2. Explain why this level of restorability was chosen.
3. What level of restorability do expect will be achieved at the Red Slough Wetland Reserve Project in McCurtain county?
4. Explain why this level of restorability was chosen.

Round 2

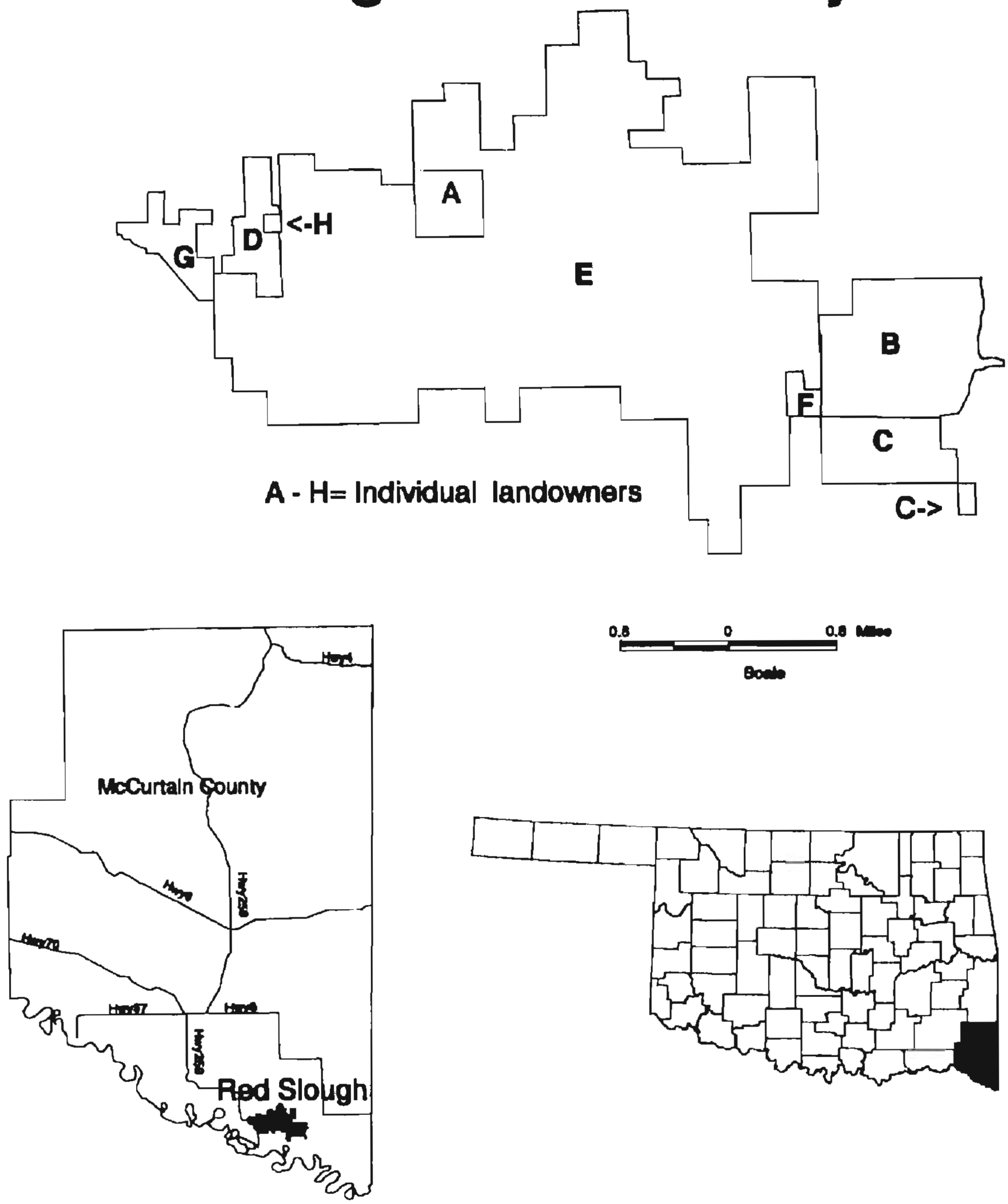
1. Name 5 dominant wildlife species and 5 dominant plant species at the Stillwater Creek site.
2. Name 5 dominant wildlife species and 5 dominant plant species at the Red Slough site.

Round 3

1. What threatened or endangered species would we find at the Stillwater Creek site?
2. What threatened or endangered species would we find at the Red Slough site.
3. What is the expected lifespan at the Stillwater Creek site? Why?
4. What is the expected lifespan at the Red Slough site? Why?

APPENDIX D

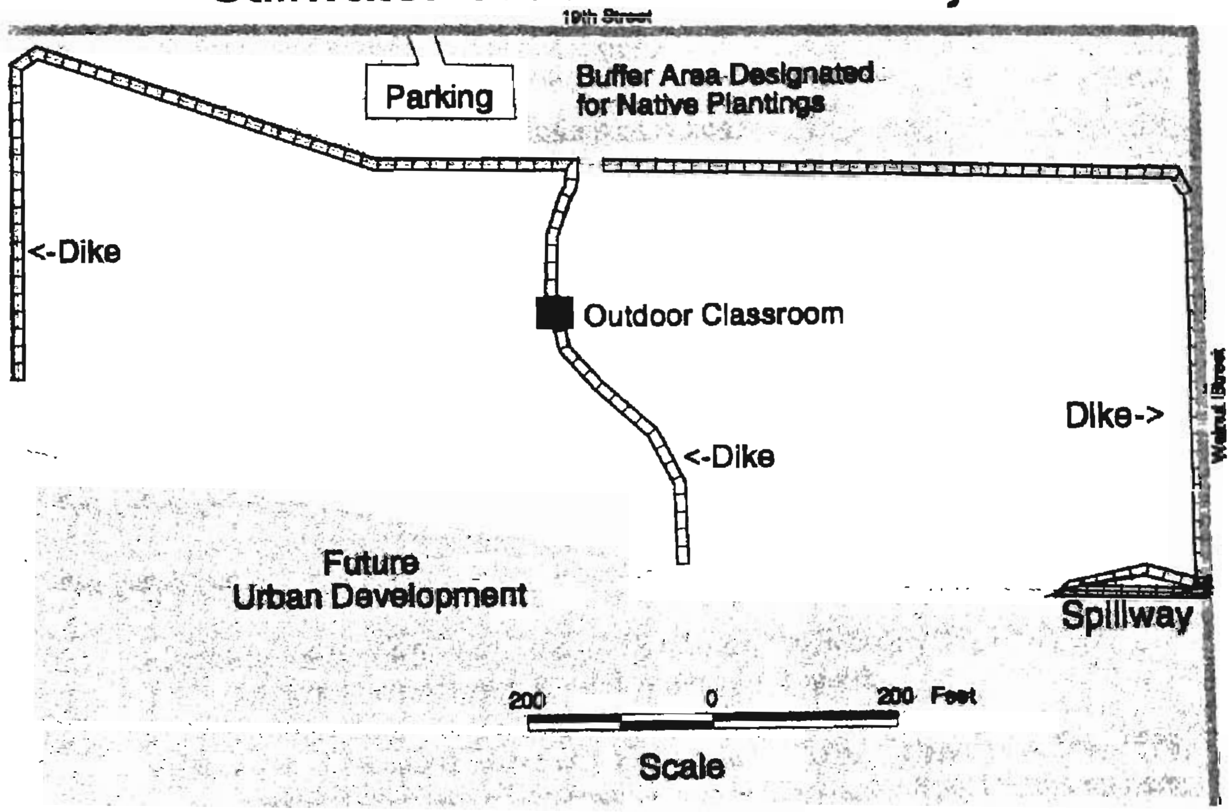
Red Slough Wetland Project

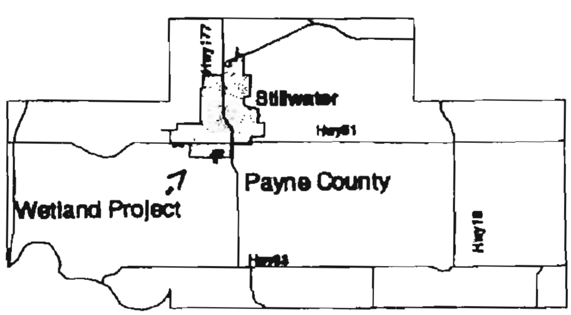


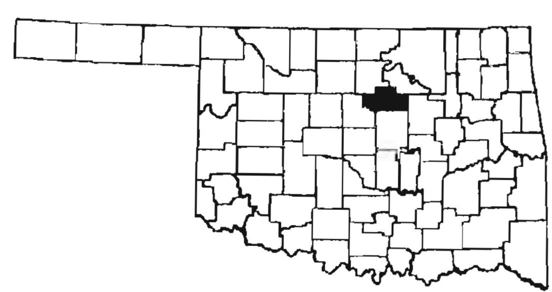
U.S.Department of Agriculture
Natural Resources Conservation Service
April 1999.

APPENDIX E

Stillwater Creek Wetland Project







U.S. Department of Agriculture
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