Cameron Prairie National Wildlife Refuge

Habitat Management Plan

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region

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Submitted by: _____ Date: 11 Mar 2011
Rob Gosnell, Complex Wildlife Biologist, SWLA NWR Complex

Concur: _____ Date: 14 March 2011
Matthew Johnson, Fire Management Officer, SWLA NWR Complex

Submitted by: _____ Date: 1 March 2011
Glenn Harris, Refuge Manager, CPNWR

Concur: _____ Date: 11 Mar 2011
Don Voros, Project Leader, SWLA NWR Complex

Concur: _____ Date: 2 May 2011
Chuck Hunter, Chief, Division of Planning and Resource Management

Concur: _____ Date: 5/2/2011
Ricky Ingram, Regional Supervisor, Southeast Region

Approved by: _____ Date: 5/3/2011
For *David Viker, Regional Chief, Southeast Region*

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1.0 INTRODUCTION

Cameron Prairie National Wildlife Refuge (CPNWR) encompasses a complex range of habitats, including freshwater and brackish marshes, coastal prairie, and actively managed freshwater impoundments. Impoundments are managed to accommodate early successional wetland plants beneficial to migratory waterfowl and other wetland wildlife. The refuge is located in central Cameron Parish, Louisiana, and is within the US Fish and Wildlife Service's Gulf Coast Prairie Landscape Conservation Cooperative. The US Fish and Wildlife Service (USFWS) manages land in southwest Louisiana through a strategic habitat management conservation approach. We consult with neighboring land owners, both private and public, on habitat management strategies to achieve long-term goals identified in various state and local planning documents, including Comprehensive Conservations Plans for all the National Wildlife Refuges in Southwest Louisiana.

The CPNWR Habitat Management Plan (HMP) is a step-down management plan of the Refuge Comprehensive Conservation Plan (CCP). The CCP describes the desired future conditions of a refuge or planning unit, and provides long-range guidance and management direction to achieve the purposes of the refuge. The CCP insures each refuge contributes to the National Wildlife Refuge System (system). The mission of the system is to provide a network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The CCP for CPNWR was completed in 2006 (USFWS 2006).

Global climate change is a transformational issue which is also being addressed through the implementation of the HMP. Over the last five years, Refuges within the Southwest Louisiana National Wildlife Refuge Complex (NWRC) were subjected to several high water and wind events which included four named storms; Hurricanes Rita, Gustav, and Ike and Tropical Storm Edouard. These storms were devastating to coastal marshes. Powerful tropical systems, such as hurricanes, can create large open water areas in previously contiguous marshes; which, when intact, would normally slow down destructive storm surges; thus protecting adjacent marshes, municipal structures, and oil and gas industrial infrastructure throughout coastal Louisiana. Management actions associated with the HMP will be a dynamic process as climate change evolves.

There is some evidence that hurricane intensity, and perhaps frequency, has increased over the past 30 years, and that this trend may be due to observed increases in sea surface temperatures (Webster et al. 2005). Dynamic weather conditions such as tropical depressions, tropical storms, hurricanes, high and low tides, droughts, severe freezes, wildfires and invasive plant

species responding to global climate change may significantly alter management strategies over time. Natural Resource Managers must be prepared to be flexible in order to work with these natural events and to fulfill the purposes for which the Refuges within the NWRC have been established.

1.1 Planning Process

Habitat Management Plans are dynamic working documents that provide refuge managers a decision-making tool; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the role of refuge habitat in international, national, regional, tribal, State, ecosystem, and refuge goals and objectives; guides analysis and selection of specific habitat management strategies to achieve those habitat goals and objectives; and utilizes key data, scientific literature, expert opinion, and staff expertise.

1.2 Refuge Purpose and Vision

The purpose for which Cameron Prairie NWR was established is set forth in the Comprehensive Conservation Plan for the refuge (USFWS 2006):

> Cameron Prairie National Wildlife Refuge was established "*... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds*" (16 U.S.C. 715d (Migratory Bird Conservation Act)). During acquisition planning, justification for the Refuge included the following:
> 1) provide additional sanctuary to wintering waterfowl that would offer additional management opportunities, particularly for geese;
> 2) assure long-term preservation of important wintering habitat for waterfowl as the Louisiana coastline continues to move further inland;
> 3) provide additional sanctuary for wintering waterfowl in the leading harvest parish in North America;
> 4) provide additional relief or another alternative resting location to the high concentrations of waterfowl found at Lacassine National Wildlife Refuge; and
> 5) provide a variety of quality recreational opportunities such as hunting, fishing, wildlife observation, photography, and other compatible wildlife-dependent activities.
>
> Since establishment, management goals for Cameron Prairie are to:
>
> - Provide the highest quality wintering waterfowl habitat possible.
> - Allow compatible public uses, such as hunting, fishing, environmental education,
> - wildlife observation, and photography.
> - Promote research on marsh and aquatic wildlife (USFWS 2002).
> - Provide for the needs of any endangered plants and animals.

Similarly, the CCP laid out a Vision for the refuge:

> Cameron Prairie National Wildlife Refuge will become a haven of prime habitat for the benefit of migratory birds and other wildlife. Visitors to the Refuge will enjoy a quality outdoor experience which will result in an enhanced appreciation of wildlife and their habitats. The Refuge will be a showcase of excellent land management stewardship, demonstrating a balance between intensive wildlife management strategies and safeguarding the Refuge's ecological integrity, for the conservation and preservation of wildlife and their habitats. The Refuge will serve as the Headquarters for the Southwest Louisiana National Wildlife Refuge Complex which will support the needs, resources, and staff of Cameron Prairie, Lacassine, and Sabine National Wildlife Refuges.

1.3 Legal Mandates

Legal mandates are discussed in detail in the CPNWR CCP (2006). However, a synopsis is warranted to give the reader some insight as to the legal authorities under which habitat management operates.

1.3.1 Establishment of the Refuge

Created in 1988, Cameron Prairie National Wildlife Refuge was the 447th refuge established within the National Wildlife Refuge System and the first created under the goals of the North American Waterfowl Management Plan, a continental conservation effort among Canada, Mexico, and the United States. Land was purchased on December 28, 1988, with funding provided by the Migratory Bird Stamp Act (USFWS 2003; 1998).

1.3.2 Federal Laws, Mandates, and Policies

CPNWR operates under a variety of laws and policy statements. The principle ones are listed.

- The National Wildlife Refuge System Administration Act of 1966
- The Endangered Species Act
- National Wildlife Refuge System Improvement Act of 1997
- Title 50 of the Code of Federal Regulations
- U.S. Fish and Wildlife Service Manual – specifically 601 3(D2G), which states: " Through the comprehensive conservation planning process, interim management planning, or compatibility reviews, determines the appropriate management direction to maintain and, where appropriate, restore, biological integrity, diversity, and environmental health, while achieving refuge purpose(s)."

1.4 Relationship to Other Plans

In addition to the legal and policy mandates, management on CPNWR is influenced by other plans, those that are national or regional in scope, those that relate to activities of local entities, and those that relate to the refuge itself. Many of these plans are consistent with refuge goals and objectives, but, since different agencies have varying missions, it is inevitable that conflicts will arise. When this occurs, the refuge will recognize the differences of opinions and take measures to address the other agency's concerns, where possible. However, the refuge would continue to manage with the mission, goals, objectives, and purpose of the refuge taking precedence.

1.4.1 National and Regional Plans

1.4.1.1 North American Bird Conservation Initiative

The North American Bird Conservation Initiative aims to ensure that populations and habitats of North America's birds are protected, restored and enhanced through coordinated efforts at international, national, regional and local levels guided by sound science and effective management. It is designed to increase the effectiveness of existing and new initiatives through: effective coordination, building on existing regional partnerships, and fostering greater cooperation among the nations and the peoples of the continent.

The U.S. North American Bird Conservation Initiative (NABCI) Committee is a forum of government agencies, private organizations, and bird initiatives helping partners across the continent meet their common bird conservation objectives. The Committee's strategy is to foster coordination and collaboration on key issues of concern, including coordinated bird monitoring, conservation design, private land conservation, international conservation, and institutional support in state and federal agencies for integrated bird conservation. Cameron Prairie NWR will contribute to the goals of the NABCI by participating in the Gulf Coast Joint Venture and by contributing directly to bird conservation through the actions detailed in this plan.

1.4.1.2 North American Waterfowl Management Plan

The North American Waterfowl Management Plan (NAWMP) was signed by the United States and Canadian governments in 1986 and undertook an intensive effort to protect and restore North America's waterfowl populations and their habitats. With its update in 1994, Mexico became a signatory to the Plan. Restoration of wetlands and associated ecosystems is the main premise of the plan in order to restore waterfowl populations to levels observed in the 1970's.

Cameron Prairie NWR will contribute to the goals of the NAWMP by providing 4796 acres of impounded freshwater marsh, 2,228 acres of passively managed wetlands, and 2,074 acres of early-successional wetland, to sustain wintering ducks and geese, including mallard (*Anas platyrhynchos*), northern pintail (*A. acuta*), American wigeon (*A. americana*), green-winged teal (*A. crecca*), blue-winged teal(*A. discors*), northern shoveler (*A. clypeata*), Canada goose (*Branta canadensis*), snow goose (*Chen caerulescens*), and greater white-fronted goose (*Anser albifrons*).

1.4.1.3 North American Waterbird Conservation Plan

The North American Waterbird Conservation Plan was developed under a partnership, the Waterbird Conservation for the Americas, which is a group of individuals and organizations having interest and responsibility for conservation of waterbirds and their habitats in the Americas. Cameron Prairie is located in the Southeast U.S. Regional Waterbird Conservation Planning Area. The Refuge can contribute to a key objective of this region, which is to standardize data collection efforts and analysis procedures to allow better tracking of regional movements and the association of these movements with environmental or land use changes.

1.4.1.4 U.S. Shorebird Conservation Plan

The United States Shorebird Conservation Plan is a partnership involving organizations throughout the United States committed to the conservation of shorebirds. Cameron Prairie National Wildlife Refuge is located within the Lower Mississippi, Western Gulf Coast Shorebird Planning Region. On a regional scale, the Refuge can help ensure that adequate quantity and quality of habitat is identified and maintained to support the different shorebirds that breed in, winter in, and migrate through the area. Cameron Prairie NWR manages 4796 acres of impounded freshwater marsh, 2,228 acres of passively managed wetlands, and 2,074 acres of early-successional wetland used by migrating shorebirds during August to April.

1.4.1.5 Partners in Flight Bird Conservation Plans

The National Fish and Wildlife Foundation led efforts in the 1990's to form the Partners in Flight program to combine resources and knowledge of many people to jointly protect the natural diversity of our continent. Many partners have made the program successful by participating in Working Groups to develop Regional Bird Conservation Plans. Cameron Prairie is located within the Coastal Prairie Physiographic Area 6 and can contribute to the plan's actions for marsh restoration projects to benefit migrant land birds.

1.4.1.6 Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)

In 1990, Congress passed the Coastal Wetlands Planning, Protection and Restoration Act that generates $50 to $60 M annually for Louisiana coastal wetland projects via a 85/15 Federal-State cost share, and which provided for the development of the 1993 comprehensive Louisiana Coastal Wetlands Restoration Plan. Funding of proposed restoration projects is determined by the Louisiana Coastal Wetlands and Conservation and Restoration Task Force, which is composed of five Federal agencies and the State of Louisiana. As mandated by CWPPRA, the task force developed a detailed Coastal Wetlands Restoration Plan in 1993 that describes what restoration actions and projects should be implemented to address Louisiana's coastal land loss crisis. A Priority Project List is developed and approved by the task force each year, outlining which projects will receive CWPPRA funding.

1.4.1.7 Gulf Coast Joint Venture (Chenier Plain Initiative)

Regional partnerships or joint ventures composed of individuals, sportsmen's groups, conservation organizations, and local, state, provincial, and Federal governments were formed under the NAWMP. One such partnership—the Gulf Coast Joint Venture (GCJV)—formed to conserve priority waterfowl habitat range along the Western United States Gulf Coast, one of the most important waterfowl areas in North America. The Gulf Coast is the terminus of the Central and Mississippi Flyways which provides both wintering and migration habitat for significant numbers of the continental goose and duck populations. The Gulf Coast Joint Venture's greatest contribution to the North American Waterfowl Management Plan is to provide wintering grounds for waterfowl. A great diversity of birds, mammals, fish, shellfish, reptiles and amphibians also rely on the wetlands of the Gulf Coast for part of their life cycles.

The GCJV is divided geographically into six initiative areas, one of which is the Chenier Plain Initiative area of southwest Louisiana and southeast Texas. The goal of the Chenier Plain Initiative is to provide wintering and migration habitat for significant numbers of dabbling ducks, diving ducks and geese (especially snow and greater white-fronted), as well as year-round habitat for mottled ducks (*Anas fulvigula*).

The Refuge contributes to the objectives of this Initiative by increasing moist soil management capabilities on 1,391 acres through cooperative efforts with Ducks Unlimited, providing resting and breeding habitat for mottled ducks, banding approximately 200 mottled ducks per year in cooperation with the Louisiana Department of Wildlife and Fisheries, and managing fields and creating grit sites to promote use by geese. In addition, Refuge personnel have been instrumental in improving wintering waterfowl habitat through cooperative efforts with the multi-agency

Cameron Creole Watershed Project. Through partnerships, 55,000 feet of terraces were constructed on the East Cove Unit of Sabine National Wildlife Refuge, which is managed and administered by Cameron Prairie National Wildlife Refuge

1.4.2 Local and State Plans

1.4.2.1 Coast 2050: Towards a Sustainable Coastal Louisiana

Coast 2050 is a comprehensive, ecosystem-based plan developed to address coastal wetland loss throughout southern Louisiana by private citizens, local, state and Federal agencies, and the scientific community. This plan, which is recognized by the state of Louisiana, five Federal agencies, and local coastal parish governments, serves as the joint coastal restoration plan for CWPPRA. The goals of the plan are to assure vertical accumulation (soil, vegetation and other organic material) to achieve sustainability, maintain estuarine gradient to achieve diversity, and to maintain exchange and interface to achieve system linkages. Cameron Prairie National Wildlife Refuge is included in Region 4 of this plan.

1.4.2.2 Louisiana Coastal Area Ecosystem Restoration Plan

The Louisiana Coastal Area Ecosystem Restoration Plan (LCA) evolved from the Coast 2050 Plan with the overarching goal of reversing the current trend of degradation of the coastal ecosystem. This plan formed the basis for the Louisiana Coastal Area Ecosystem Restoration Study, designed to identify critical ecological needs, identify restoration efforts, establish restoration priorities, and identify scientific uncertainties to present a strategy for addressing long-term needs of coastal Louisiana restoration.

Cameron Prairie National Wildlife Refuge is located within Sub-province 4 for LCA. The restoration plans identified in LCA relate directly and indirectly to the Refuge through long-term efforts to explore large scale restoration projects that will influence the entire coastal zone of Louisiana.

1.4.2.3 Louisiana Comprehensive Wildlife Conservation Strategy (Wildlife Action Plan)

The Louisiana Department of Wildlife and Fisheries produced the state's wildlife action plan in 2005 (Lester et al. 2005). This plan details the conservation needs and strategies for aquatic and terrestrial systems across the state, and lists a number of high priority actions for imperiled species and systems. In the Gulf Coast Prairies and Marshes ecoregion, both freshwater marsh and coastal prairie are listed as high priorities for conservation action because of the severe

threats they face. Strategies described in this document that Cameron Prairie NWR supports include:

Coastal Prairie

- Partner with NGOs, state and federal agencies, private landowners, etc. to promote protection, restoration, and expansion of coastal prairie habitat.
- Promote fire as [an] essential management tool. Burn these areas as needed and promote alternatives to fire where prescribed burning is not an option.

Freshwater Marsh

Shorebirds, Wading Birds

- Provide public education regarding the importance of waterbird nesting colonies and shorebird feeding areas. Reduce the negative effects on these areas from recreational and other uses.
- Work with landowners to implement management and conservation recommendations for waterbirds (especially rails) . . .

Waterfowl

- Continue to encourage the creation/enhancement/maintenance of high-quality habitat across Louisiana.
- Work with DU, DW, and USFWS to assur[e] that quality habitat, including refuge from hunting and other disturbance, is distributed across the landscape.

2.0 ENVIRONMENTAL SETTING AND BACKGROUND

2.1 Location

Cameron Prairie National Wildlife Refuge is located about 25 miles south of Lake Charles, Louisiana, in north-central Cameron Parish. The Refuge is one of four administered through the Southwest Louisiana Refuge Complex (Figures 1, 2) and comprises two units, the 9,621-acre Gibbstown Unit (Figure 3) and the 14,927-acre East Cove Unit (Figure 4), originally established under nearby Sabine National Wildlife Refuge but now managed as part of Cameron Prairie NWR. The refuge contains habitats including fresh and brackish marsh, coastal prairie, and moist soil units (Table 1).

2.2 Management Compartments and Descriptions

CPNWR, Gibbstown Unit is divided into 21 management units (Figures 3): management units; prescribed burn units; impoundments. The East cove unit of Sabine NWR, managed by CPNWR, is divided into 7 management compartments (Figure 4). Habitat type, size, soil type, current condition and past management history for each unit are described in Table 1 and Appendix C.

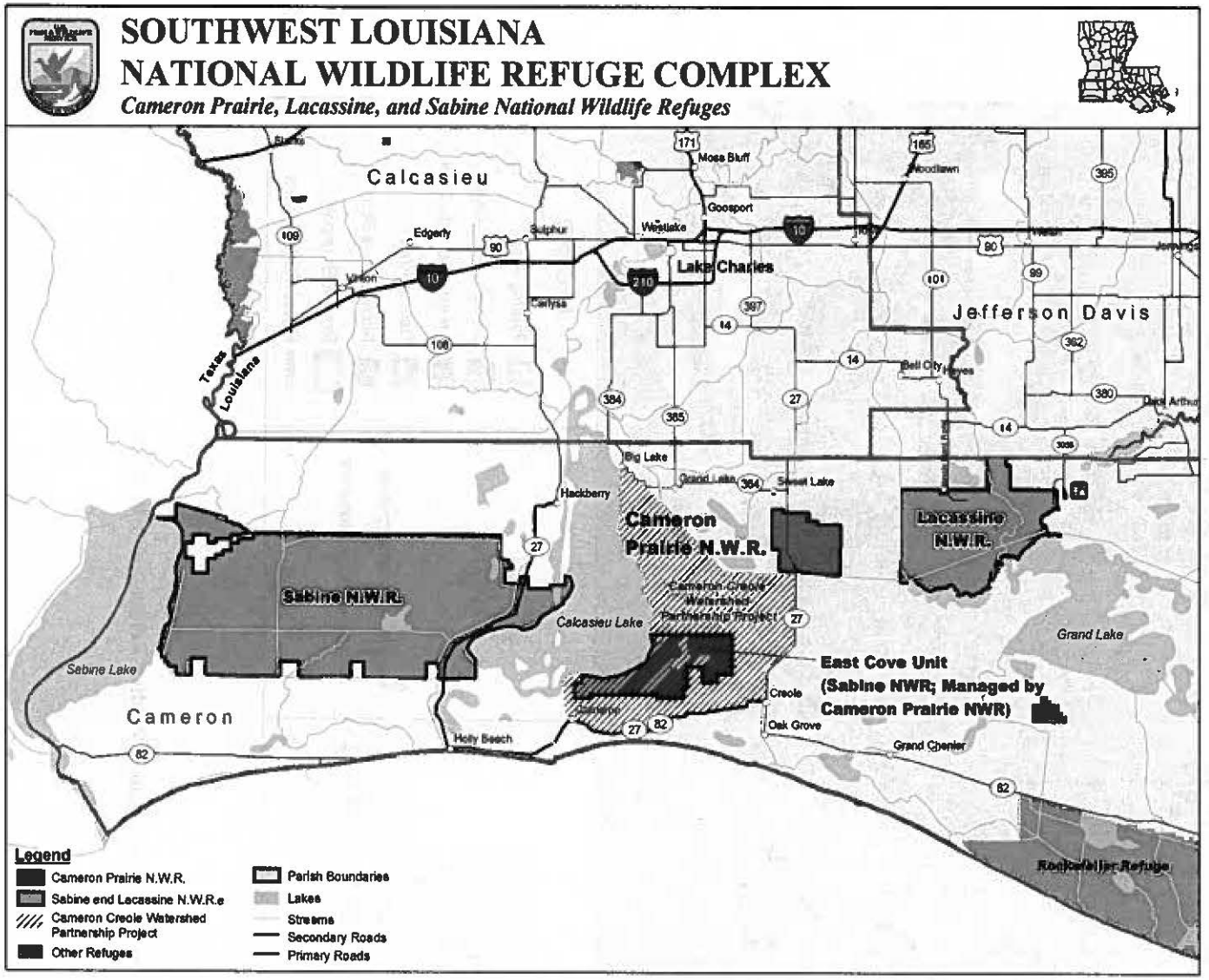

Figure 1. Location of Cameron Prairie NWR within the Southwest Louisiana Refuge Complex.

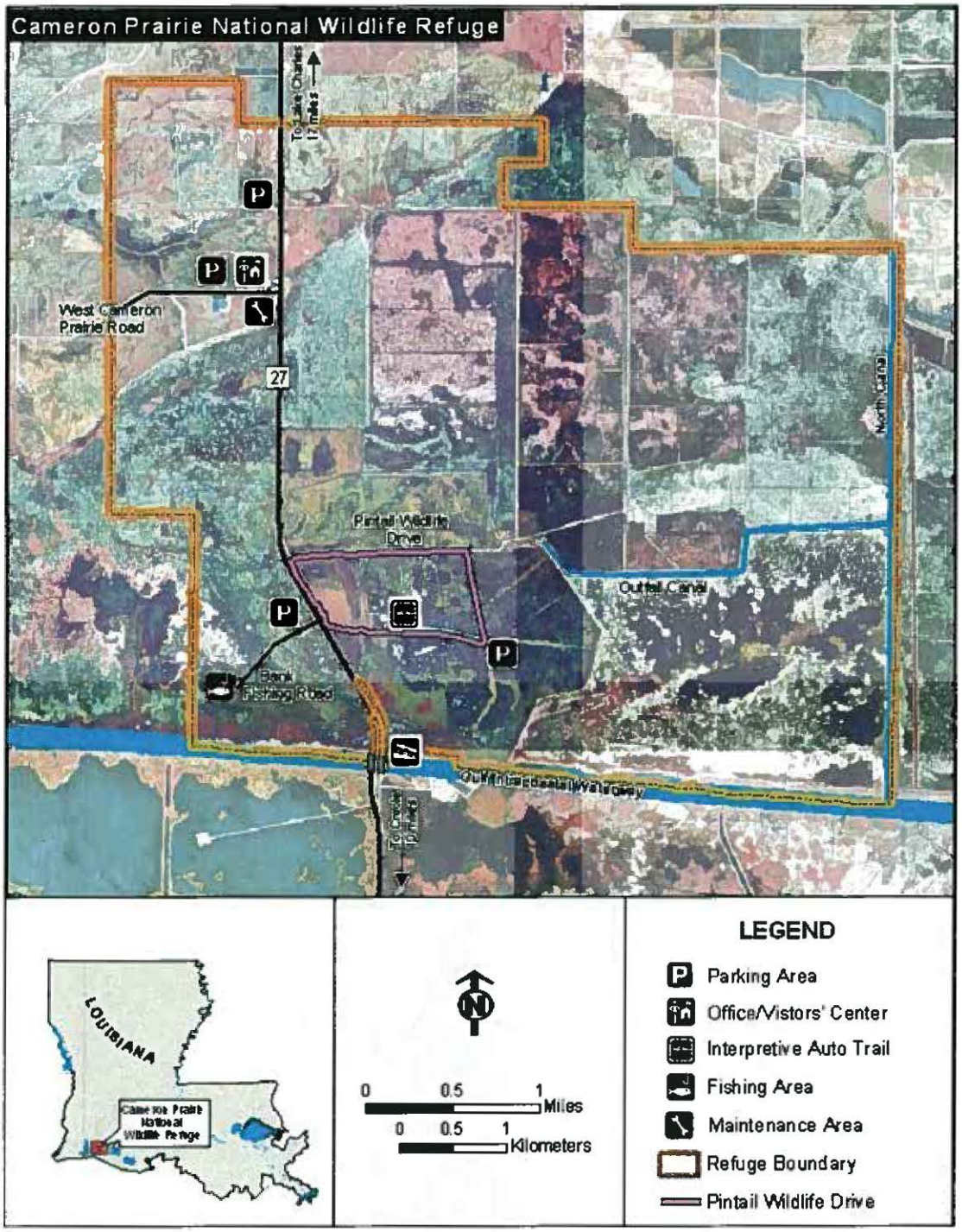

Figure 2. Cameron Prairie National Wildlife Refuge, Gibbstown Unit.

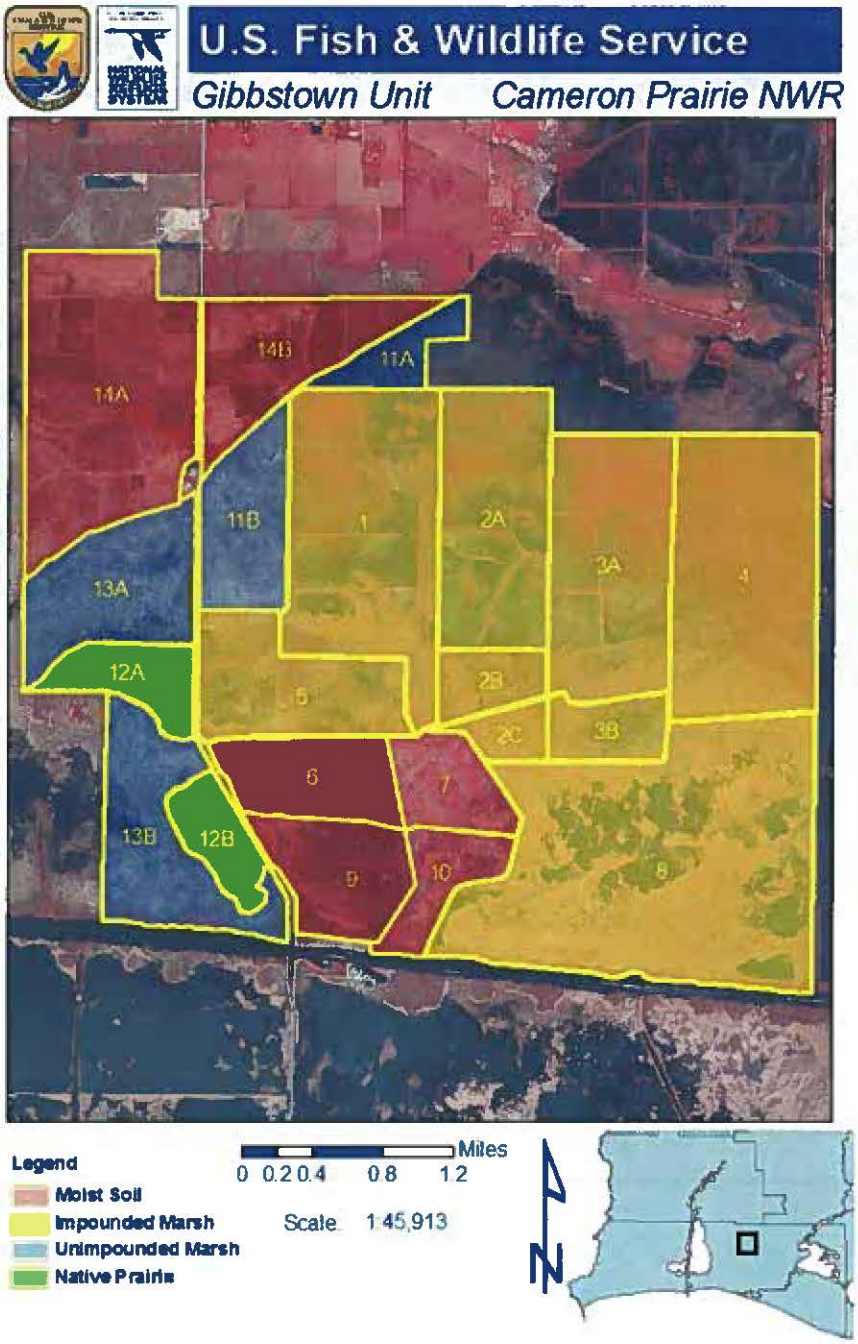

Figure 3. Habitat types, Gibbstown Unit, Cameron Prairie NWR.

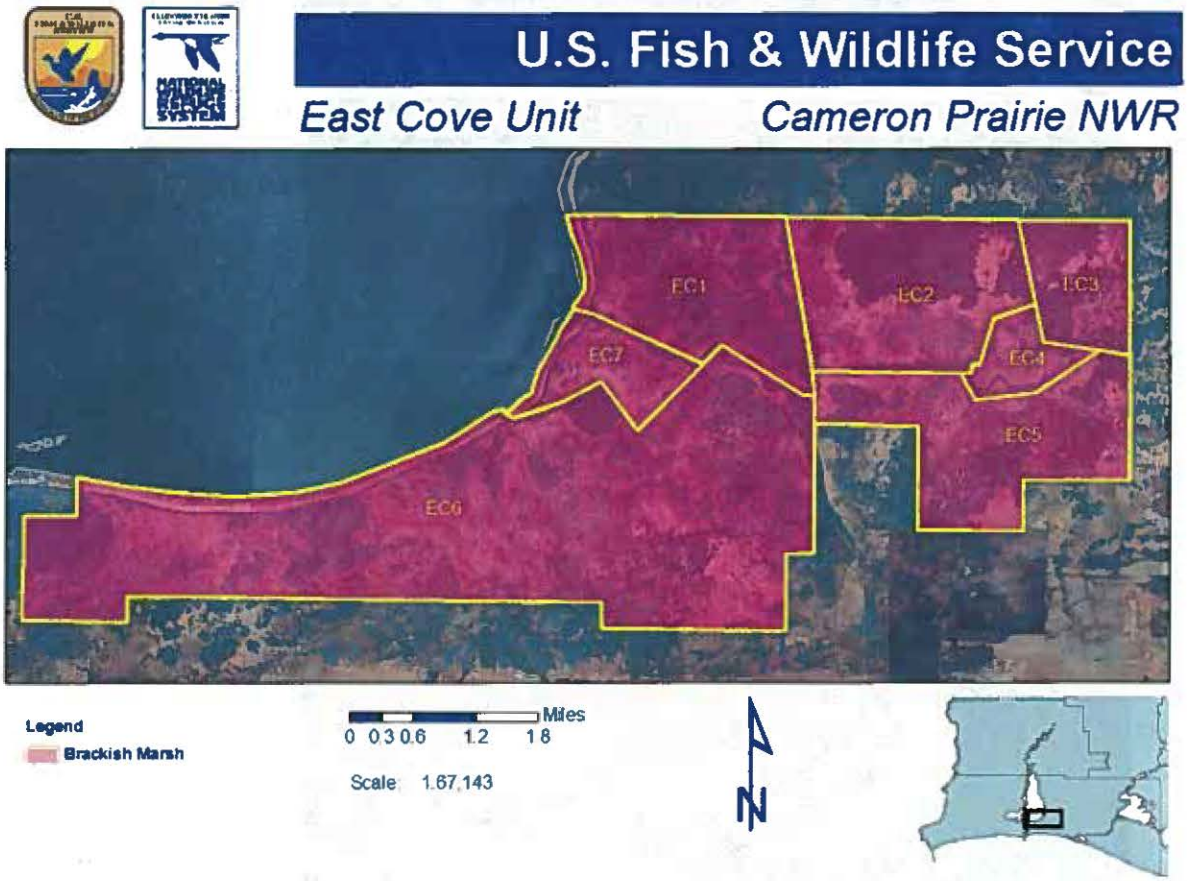

Figure 4. Habitat type, East Cove Unit, Cameron Prairie NWR.

Table 1. Habitat types, condition, and treatment history for management units on Cameron Prarie NWR.

Unit	Size	Habitat Type	Current Condition	Treatment History
1	903	impoundment	50% Aquatic vegetation (white water lily (*Nymphaea odorata*), water shield (*Brasenia schreberi*), American lotus (*Nelumbo lutea*), Eurasian watermilfoil (*Myriophyllum spicatum*)) 40% Emergent vegetation (cattail (*Typha spp.*), bullwhip (*Schoenoplectus californicus*), maidencane (*Panicum hemitomon*)); 10% Woody Vegetation (Chinese tallow (*Triadica sebifera)*), black willow (*Salix nigra*), Macartney rose (*Rosa bracteata*))	Water levels managed through use of water control structures and limited pumping. Water control structures are basically set in a static mode and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl as brood & winter habitat. Areas are important as feeding and nesting areas for numerous species of wading birds.
2A	603	impoundment	50% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 40% Emergent vegetation (cattail, bullwhip, maidencane); 10% Woody Vegetation (Chinese tallow, black willow, Macartney rose)	Water levels managed through use of water control structures and limited pumping. Water control structures are basically set in a static mode and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl.
2B	135	impoundment	70% emergent wetland vegetation (maidencane, marshhay cordgrass (*Spartina patens*), bulltongue (*Sagittaria lancifolia*), phragmites (*Phragmites australis*) etc.); 20% aquatics (Eurasian watermilfoil, white water lily, etc.); 10% woody vegetation (baccharis (*Baccharis halimifolia*), marsh elder (*Iva frutescens*), Chinese tallow)	Water levels managed through use of water control structures and limited pumping. Water control structures are basically set in a static mode and water levels allowed to fluctuate with rainfall and/or evaporation. Fire is used on approximately 10 yr. cycle, last record of prescribed fire 1997.

Unit	Size	Habitat Type	Current Condition	Treatment History
2C	89	impoundment	70% emergent wetland vegetation (maidencane, marshhay cordgrass, bulltongue, phragmites etc.); 20% aquatics (Eurasian watermilfoil, white water lily, etc.); 10% woody vegetation (baccharis, marsh elder, Chinese tallow)	Water levels managed through use of water control structures and limited pumping. Water control structures are basically set in a static mode and water levels allowed to fluctuate with rainfall and/or evaporation. Fire is used on approximately 10 yr. cycle, last record of prescribe fire 1997.
3A	664	impoundment	50% Aquatic vegetation (white water lily, water shield, American Lotus, Eurasian watermilfoil) 40% Emergent vegetation (cattail, bullwhip, maidencane); 10% Woody Vegetation (Chinese tallow, black willow, Macartney rose)	Water levels managed through use of water control structures. Water control structures set in a static mode at/or near marsh elevation, and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl as brood & winter habitat. Impoundments are also important as feeding and nesting areas for numerous species of wading birds.
3B	166	impoundment	40% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 50% Emergent vegetation (cattail, bullwhip, maidencane); 10% Woody Vegetation (Chinese tallow, black willow, baccharis, marsh elder, Macartney rose)	Water levels managed through use of water control structures. Water control structures set in a static mode at/or near marsh elevation, and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl as brood & winter habitat. Impoundments are also important as feeding and nesting areas for numerous species of wading birds.
4	889	impoundment	40% Aquatic vegetation (white water lily, water shield, American Lotus, Eurasian watermilfoil) 50% Emergent vegetation (cattail, bullwhip, maidencane); 10% Woody Vegetation (Chinese tallow, black willow, baccharis, marsh elder, Macartney rose)	Water levels managed through use of water control structures. Water control structures set in a static mode at/or near marsh elevation, and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl as brood & winter habitat. Impoundments are also important as feeding and nesting areas for numerous species of wading birds.

Unit	Size	Habitat Type	Current Condition	Treatment History
5	427	impoundment	30% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 60% Emergent vegetation (cattail, bullwhip, maidencane); 10% Woody Vegetation (Chinese tallow, black willow, baccharis, marsh elder, Macartney rose)	Water levels managed through use of water control structures. Water control structures set in a static mode at/or near marsh elevation, and water levels allowed to fluctuate with rainfall and/or evaporation. Impounded units are important to waterfowl as brood & winter habitat. Late summer/early fall (Aug. - Oct.) prescribed fires used to improve wintering habitat for migratory & wading birds. Last fire occurrence was a wildfire Oct. 2003.
6	291	moist soil	5% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 80% Emergent vegetation (Walter's millet(*Echinochloa walteri*), fall panicum (*Panicum dichotomiflorum*), cattail, bullwhip, maidencane, seashore paspalum (*Paspalum vaginatum*), sesbania (*Sesbania spp.*)); 15% Woody Vegetation (Chinese tallow, black willow, baccharis, marsh elder, Macartney rose)	Water levels managed through the use of water control structures and mechanical pumping. Areas have been dewatered and manipulated (disked, mowed, water buffaloed) to promote annual grasses and forbs. However, following hurricanes in 2005 & 2008 no manipulation has occurred.
7	213	moist soil	90% Emergent aquatic vegetation (cattail, marshhay cordgrass, bullwhip, etc.); 10% Woody shrubs (Baccharis, marsh elder., Chinese tallow)	Water levels managed to promote wetland plant species and provide habitat for wetland dependent wildlife. Hurricanes in 2005 & 2008 inundated the area with saltwater, reducing overall vegetation coverage, improving habitat for waterfowl & other migratory birds.

Unit	Size	Habitat Type	Current Condition	Treatment History
8	1677	impoundment	50% open water; 40% Emergent aquatic vegetation (cattail, marshhay cordgrass, bullwhip, etc.); 10% Woody shrubs (Baccharis, marsh elder, Chinese tallow)	Water levels managed to provide habitat for wetland dependent species. Fire periodically (3-5 yr. rotation) used to set back vegetation succession. Following Hurricane Rita levees repaired and Water Control Structures replaced. However, following Hurricane Ike a levee breach occurred along GIWW and remains. No water control capabilities until repairs are made.
9	309	moist soil	Early successional plant community: 50% annual grasses & forbs, 30% perennial grasses & forbs, 20% woody shrubs & trees.	Approximately 50% of area was disked, mowed and/or water buffaloed annually and flooded during fall/winter months until early 2003. During 2003-2004 efforts were being made to improve management capabilities. In 2005 & 2008 Hurricanes inundated areas with high saline waters reducing large portions of the woody vegetation.
10	189	moist soil	50% open water; 40% Emergent aquatic vegetation (cattail, marshhay cordgrass, bullwhip, etc.); 10% Woody shrubs (Baccharis, marsh elder, Chinese tallow)	Water levels passively managed in association with the Mermentau/GIWW basin. Fire occurrence approximately every 7- 8 years to reduce overall vegetation cover. Water levels managed to promote wetland plant species and provide habitat for wetland-dependent wildlife. Hurricanes in 2005 & 2008 inundated the area with saltwater, reducing overall vegetation coverage, improving habitat for waterfowl & other migratory birds.

Unit	Size	Habitat Type	Current Condition	Treatment History
11A	118	marsh (unimpounded)	30% open water with sparse submerged aquatics, 65% emergent aquatic vegetation (cattail, phragmites, bulltongue, maidencane, etc.); 5% woody vegetation (baccharis, Chinese tallow, black willow.	Water levels passively managed in association with the Mermentau/GIWW basin. Fire occurrence approximately every 7-8 years to reduce overall vegetation cover and reduce encroaching woody vegetation. Hurricanes in 2005 & 2008 reduce dominant stand of maidencane by approximately 70%. However, the area is fast becoming re-vegetated with cattail, bulltongue and other early successional plants associated with disturbances.
11B	343	unimpounded marsh	30% open water with sparse submerged aquatics, 65% emergent aquatic vegetation (cattail, phragmites, bull tongue, maidencane, giant saw grass, etc.); 5% woody vegetation (baccharis, Chinese tallow, black willow.	Water levels passively managed in association with the Mermentau/GIWW basin. Fire occurrence approximately every 15 years with minimal effects in reducing overall vegetation cover and reduce encroaching woody vegetation. Hurricanes in 2005 & 2008 reduce dominant stand of maidencane by approximately 70%. However, area is fast becoming re-vegetated with cattail, bull tongue and other early successional plants associated with disturbances.
12A&B	322	native prairie	60% grass & herbaceous vegetation (Phragmites, juncus, spike rush, marshhay cordgrass, etc.) 40% woody vegetation (Chinese tallow, black willow, waxmyrtle, baccharis, marsh elder, etc.)	Area passively managed, with fire used as a management tool in attempts to control expansion of woody vegetation. Fire occurrence approximately on a 10 year cycle, with last burn occurring in 2006.

Unit	Size	Habitat Type	Current Condition	Treatment History
13A&B	933	unimpounded marsh	5% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 80% Emergent vegetation (Walter's millet, fall panicum, cattail, bullwhip, maidencane, seashore paspalum, sesbania, bulltongue); 15% Woody Vegetation (Chinese tallow, black willow, baccharis, marsh elder, Macartney rose)	Water levels passively managed in association with the Mermentau/GIWW basin. Fire occurrence approximately on a 10 year cycle, with last burn occurring in 2006. Prescribed fire used to reduce overall vegetation cover and reduce encroaching woody vegetation. Fire occurrence must be increased to obtain desired results.
14A&B	1333	moist soil	10% Aquatic vegetation (white water lily, water shield, American lotus, Eurasian watermilfoil) 70% Emergent vegetation (cattail, bullwhip, phragmites, sawgrass(*Cladium jamaicense*) , maidencane, marshhay cordgrass); 20% Woody Vegetation (Chinese tallow, black willow, hackberry, baccharis, marsh elder, Macartney rose)	933 Water levels managed through the use of water control structures and mechanical pumping. Areas dewatered annually and manipulated (disked, mowed, water buffaloed) to promote annual grasses and forbs. Following hurricanes in 2005 & 2008 limited manipulation (water level management & water buffalo) has occurred, as desired species responded well to disturbances (salt water intrusion).
East Cove Units 1-7	14,927	Brackish to saline marsh	50% emergent vegetation including *Spartina spartinae, S. Patens, S. alterniflora, Scirpus olneyi, Paspalum vaginatum, Baccharis halimifolia*, 30% aquatic vegetation including Ruppia maritima, and 20% open water	Managed since 1989 in accordance with the Cameron Creole Watershed Resource Management Plan (1987) (Appendix I)

2.3 Physical and Geographic Setting

2.3.1 Climate

2.3.1.1 General climatic conditions

The primary factors influencing climate at Cameron Prairie National Wildlife Refuge are latitude and the proximity of large bodies of water. Generally, the climate at the refuge can be described as subtropical with short, mild winters and hot, humid summers, with no substantial spring or fall seasons. Summer weather patterns usually begin in April and prevail for seven months. However Global Climate Change has shed some light on future issues which will need to be addressed. Climate change and subsidence for the southeast region are discussed in Appendix H.

Figure 5. Hurricane Rita (NASA)

On September 24, 2005, Hurricane Rita (Figure 5) —a Category 3 hurricane—moved across southwest Louisiana with winds in excess of 100 knots, leaving a panoptic path of destruction in her wake. As a measure of the power of her destructive impact to one key industry alone, Rita demolished 69 offshore oil and gas platforms and four drilling rigs, and extensively damaged another 32 platforms and 10 drilling rigs.

Hurricane Ike came ashore on September 10, 2008. A storm surge larger than Rita's caused considerable damage to the refuge. Salt water intrusion, as well as persistent flooding on the refuge for weeks led to major losses of flora and fauna alike. Recovery of vegetation and wildlife has shown progress through early 2010.

2.3.1.2 Temperature

Summer temperatures (degrees Fahrenheit) range from the low 70s to the upper 80s and into 90s during the afternoon. November may have cool days, but winter weather typically starts in December and lasts through March. Average temperatures during the winter range from lows in the 40s to highs in the mid 60s. Temperature extremes range from a low of 19° to a high of 101° (National Weather Service, 2005).

2.3.1.3 Precipitation

The average annual precipitation for the refuge, as recorded at CPNWR headquarters (CPNWR) ([1971] – [2000]), is 57.19 inches (National Climatic Data Center 2009). Rainfall follows a weak bimodal distribution, with dry periods February-April and October (Figure 2). Summer weather patterns and associated southwest winds bring moist warm air on shore from the Gulf of Mexico, leading to the formation of thunderstorms. These rainfall events are short-duration, high-intensity localized storms.
From November to February, the weather patterns are influenced by cold continental air masses. Rainfall during this period comes from the effects of frontal passages. Rain events are more widespread and less intense than those in the summer. The transitional periods between these two wet seasons tend to be dry. Although rare, snow does occur on the refuge. Snow has been reported in both December and January; however accumulations were less than 0.05 inches.

Annual precipitation amounts can vary widely. In the years 2005 and 2008 Hurricanes Rita and Ike struck Southwest Louisiana, bringing coastal flooding from storm surge (which inundated the refuge) but not much rain; rainfall totals for those years were 44.47 and 39.21inches—well below average. Fluctuations in precipitation can impact refuge management operations to a great extent. Wet conditions can make the maintenance of unpaved roads difficult if not impossible, and can result in decreased opportunities for prescribed burning and/or moist soil management manipulation such as disking and/or buffaloing units. Drought years can also have profound effects on habitat and management. In 2009, for example, many of the impoundments on the refuge dried out completely. The dry conditions contributed to wildfire and vegetation loss.

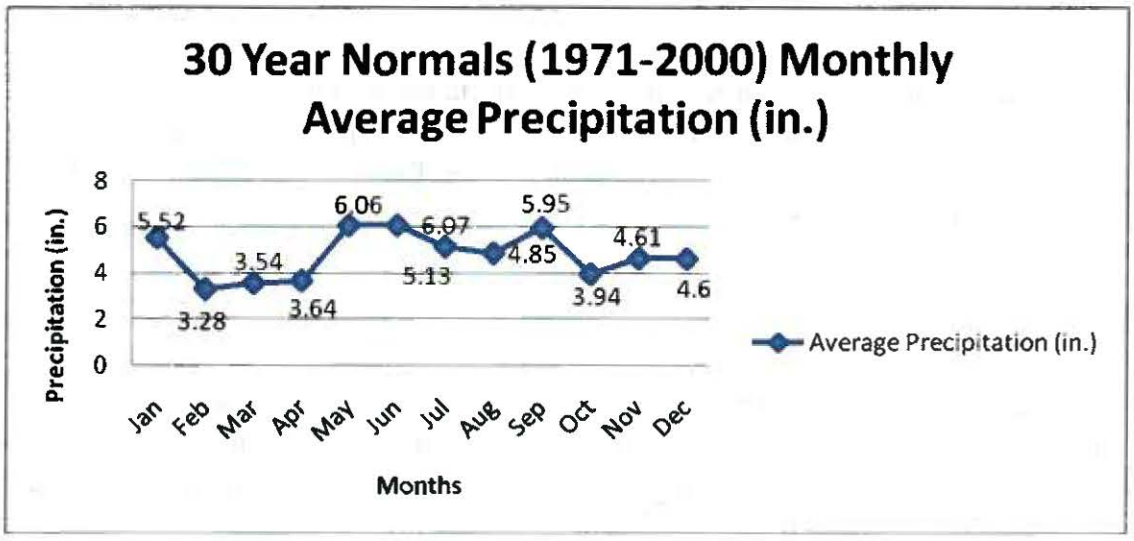

Figure 6. Monthly average precipitation over 30 years at Cameron Prairie NWR

2.3.1.4 Atmospheric moisture

As would be expected, with large bodies of water in and around the refuge, relative humidity (RH) is typically high. Morning mean RH is generally between 88% and 95% throughout the year, while readings in the mid-afternoon are between 55% and 67%. RH values of 100% are not uncommon, with fog occurring 100 days per year on average.

2.3.1.5 Lightning

Due to its importance in fire management, a refuge management activity, lightning deserves to be addressed. Vaisala's National Lightning Detection Network states that Southwest Louisiana has an 8 to 10 average flash per sq. km/yr. (Vaisala NLDN Poster). VNLDN data indicate that over 22,000 lightning strikes occur in Southwest Louisiana each year. Lightning is the main source of ignition for non-anthropogenic fires in southwest Louisiana.

2.3.2 Air Quality

CPNWR is considered to be a clean air area, under the Clean Air Act. The ambient air quality is influenced by prescribed burning, vehicle traffic, and off site emission sources. Off-site sources include Gulf Intracoastal Waterway traffic (which runs on the southern boundary of the refuge), oil and gas operations, and the Gulf menhaden processing plant in Cameron, as well as prescribed burning and wildfires.

2.3.3 Geomorphology and Topography

The Chenier Plain of southwestern Louisiana is a geologically young (Holocene) region characterized by cheniers, or sandy ridges which lie parallel to the shoreline. Cheniers are the remains of ancient shorelines that formed after the sea level rose to its current level following the most recent glaciation and as sediments were deposited by the Mississippi River over the past 600 to 2800 years (Louisiana Geological Survey staff 2008, Spearing 1995). This region stretches from extreme southeast Texas 120 miles eastward into south-central Louisiana, and reaches inland 10-20 miles. Elevations range from sea level to 20 feet. Cheniers historically supported stands of oaks (the word *chenier* comes from French "*chêne*", which means "oak"). Between the cheniers lie freshwater marshes bisected by rivers and bayous draining the adjacent uplands to the north (Penland and Suter 1989, Spearing 1995).

Underlying much of Louisiana, including the Chenier Plain, is the Louann Salt, a layer of ancien salt deposits left as a shallow inland sea which became the Gulf of Mexico repeatedly evaporated and re-filled during Triassic and Jurassic time (245-144 million years before present). Salt from this layer, which is thousands of feet thick, has intruded upwards ten miles through overlying

alluvial sediment and formed "salt domes," several of which are found on the Chenier Plain. Salt domes are best known for their role in trapping and accumulating petroleum, and some are significantly elevated above the surrounding landscape (Spearing 1995).

2.3.4 Hydrology

East Cove is a part of the Cameron Creole Watershed Project which was instituted in 1989 to reduce saltwater intrusion on more than 64,000 acres of Refuge and contiguous privately owned marsh. A 19-mile protective levee and five water control structures were constructed along the eastern shore of Calcasieu Lake to facilitate management of water level and salinity within the marsh.

In addition to East Cove, numerous moist soil management units are on the refuge. In the early 1900's, the area was brought into agriculture, mostly rice production. Levees crisscrossed the landscape, allowing for introduction of water manipulation practices commonly used by rice farmers.

Surface waters on the refuge are generally soft to moderately hard due to calcium bicarbonate. Monitoring of water quality is conducted by both The Office of Coastal Protection and Restoration (OCPR) and the refuge.

2.3.4.1 Surface Water

Chenier Basin is located between the Mermentau Basin and the Gulf of Mexico, and is unique in that it no longer contains any true estuarine Gulf habitat, although historically the basin served as a productive estuarine nursery ground. Presently, several large freshwater lakes (Grand Lake, White Lake) and confined wetlands dominate the region. These habitats are confined within the mainland and isolated from the influence of saltwater by a series of water control structures or "locks" (Gosselink 1979).
The Catfish Locks are used to maintain water depth in the Mermentau Basin to benefit shipping in the Gulf Intracoastal Waterway as well as to maintain a freshwater head upstream for agricultural purposes. This management affects the hydrology of the refuge by artificially increasing water levels and maintaining fresh water during periods when brackish water would otherwise intrude.

Hydrology in East Cove unit is affected by rainfall and by tidal influences through Calcasieu Lake.

Surface water can be contaminated from either point sources or non-point sources. Many hazardous chemicals have been used to support farming and oil and gas operations over the years, and, especially in the early years, less-than-adequate care was taken in the handling and disposing of these chemicals. Point -source pollution has not been documented on Cameron Prairie National Wildlife Refuge.

2.3.5 Soils

Soils on Cameron Prairie NWR range from upland mineral soils which developed under grassland to organic mucks of salt marshes. All are poorly drained with a clay soil component (Table 2).

Table 2. Classification and characteristics of soil series found on Cameron Prairie NWR; all information taken from Soil Conservation Service (1995).

Series	**Classification**	**Description**	**Management Considerations**
Allemands muck	clayey, montmorillonitic, euic, thermic Terric Medisaprists	Frequently flooded, very poorly drained organic soils of freshwater marshes	Allemands muck is suitable for wildlife habitat, but not for crop production due to severe restrictions imposed by poor drainage and shrinkage/subsidence potential.
Bancker muck	very fine, montmorillonitic, nonacid, thermic Hydraquents	Very poorly drained, very slowly permeable, slightly saline, very fluid, mineral soils in brackish marshes.	Bancker soils are ponded most of the year and are not suited for crop production or pasture. Most use is for wetland wildlife habitat and recreation.
Clovelly muck	clayey, montmorillonitic, euic, thermic Terric Medisaprists	Very poorly drained, very slowly permeable, organic soils of brackish marshes	Clovelly soils are not suited for crops or pasture; limitations are flooding, ponding, and salinity.

Series	Classification	Description	Management Considerations
Creole mucky clay	fine, montmorillonitic, nonacid, thermic Typic Hydraquents	Very poorly drained, very slowly permeable, slightly saline or moderately saline soils in coastal brackish marshes	Creole soils are not suited for crops or pasture; limitations are flooding, ponding, and salinity. These soils are moderately suited for rangeland; however associated soils (Bancker, Larose, Scatlake) have low load-bearing properties and pose an entrapment hazard for cattle. Creole soils are well suited for wildlife habitat.
Ged mucky clay	very fine, mixed, thermic Typic Ochraqualfs	Very poorly drained, very slowly permeable soils of freshwater marshes	Ged mucky clay is suitable for wildlife habitat, or if properly drained and managed, for rice production.
Midland silty clay loam	fine, montmorillonitic, thermic, Typic Ochraqualfs	Poorly drained, very slowly permeable soils formed in late Pleistocene clayey and silty alluvium	Midland soils occur on broad flats and slight depressions. This soil is moderately well suited for crop production, and well suited for pasture. Cultivation is only possible within a narrow range of moisture content.
Morey silt loam	fine-silty, mixed, thermic Typic Argiaquolls	Poorly drained, slowly permeable soils in loamy and clayey late-Pleistocene alluvium	This soil is moderately well suited for crop production, limited by wetness and medium fertility, and well suited for pasture. Morey soil is friable and responds well to tillage; however, traffic when the soil is wet will cause formation of a traffic pan.

Series	Classification	Description	Management Considerations
Mowata silt loam	fine, montmorillonitic, thermic Typic Glossaqualfs	Poorly drained, very slowly permeable soils in loamy and clayey late-Pleistocene alluvium	This soil is moderately well suited for crop production, limited by wetness and medium fertility, and well suited for pasture. Crusting and a tendency to form traffic pans also limit the agricultural uses of this soil.
Scatlake mucky clay	very fine, montmorillonitic, nonacid, thermic Typic Hydraquents	Very poorly drained, very slowly permeable, moderately saline and strongly saline, very fluid, mineral soils	This is level, very poorly drained, very fluid mineral soil in saline marshes. It is suited for wetland wildlife habitat and recreation, but has severe limitations for other uses.

2.3.6 Subsidence & Sea Level Rise

Among the most serious consequences of forecast climate change are sea level rise and the likely increase in hurricane intensity and associated storm surge (U.S. Global Change Research Program 2009). Global sea level is projected to rise during the 21st century at a greater rate than during 1961 to 2003 (Intergovernmental Panel on Climate change 2007). The result will be shoreline retreat and inundation of inland areas. Subsidence, or land sinking, also contributes heavily to coastal erosion and land loss in Louisiana and the surrounding Gulf states. Geological modeling has suggested that the weight of Pleistocene sediments on the Earth's crust on the coast of Louisiana can explain between 0.1 and 0.8 centimeters (0.04 and 0.3 inches) of observed subsidence per year (NASA 2008). "These sediments contribute a part of the region's sinking that's inevitable and must be considered when predicting rates of sinking and future sea level change in coastal Louisiana," said study co-author Roy Dokka of Louisiana State University, Baton Rouge. Other impacts of sea level rise include increased risks of erosion, conversion of wetlands to open water, increase in salinity of estuaries and freshwater aquifers and flooding for coastal communities (Climate Change Science Program 2009). Rising sea temperatures are expected to increase the frequency and strength of hurricanes (Emanuel 2005). Stronger storms with higher wind speeds, more intense rainfall, and more powerful surges are expected to cause more severe damage (Knutson and Tuleya 2004).

Increasing intensity and frequency of storms, combined with sea level rise and local land subsidence, mean that over time, Cameron Prairie NWR and the surrounding lands will become more saline and more frequently inundated by salt water or brackish water. If the magnitude of the change is great enough, even freshwater impoundments will be affected, as they were in the recent storms. As salinity increases, vegetation zones will migrate inland; present salt marsh will convert to open water, brackish marsh will become saline, freshwater marsh will become brackish, and freshwater swamps and shrub communities will convert to herbaceous systems as episodes of salt water intrusion become more frequent and occur further inland. Management of the refuge and the Cameron Creole Watershed Partnership Project will need to be flexible and adaptive to successfully fulfill the purpose for which they were established.

2.3.7 Flyways

Cameron Prairie and the larger Gulf Coast Vegetation Region (Gould 1975) are a part of the Mississippi Flyway (Figure 7), and have influence and exchange from the Central Flyway (Figure 8). The Mississippi and Central Flyways are corridors for over two thirds of waterfowl species in the Northern Hemisphere. The immense southern coastal marshes of these flyways constitute an irreplaceable habitat resource for wintering waterfowl. The region is the terminus of the Mississippi flyway and the destination of scores of species of migrant waterfowl not undertaking the lengthy trans-Gulf flight to more southerly habitats.

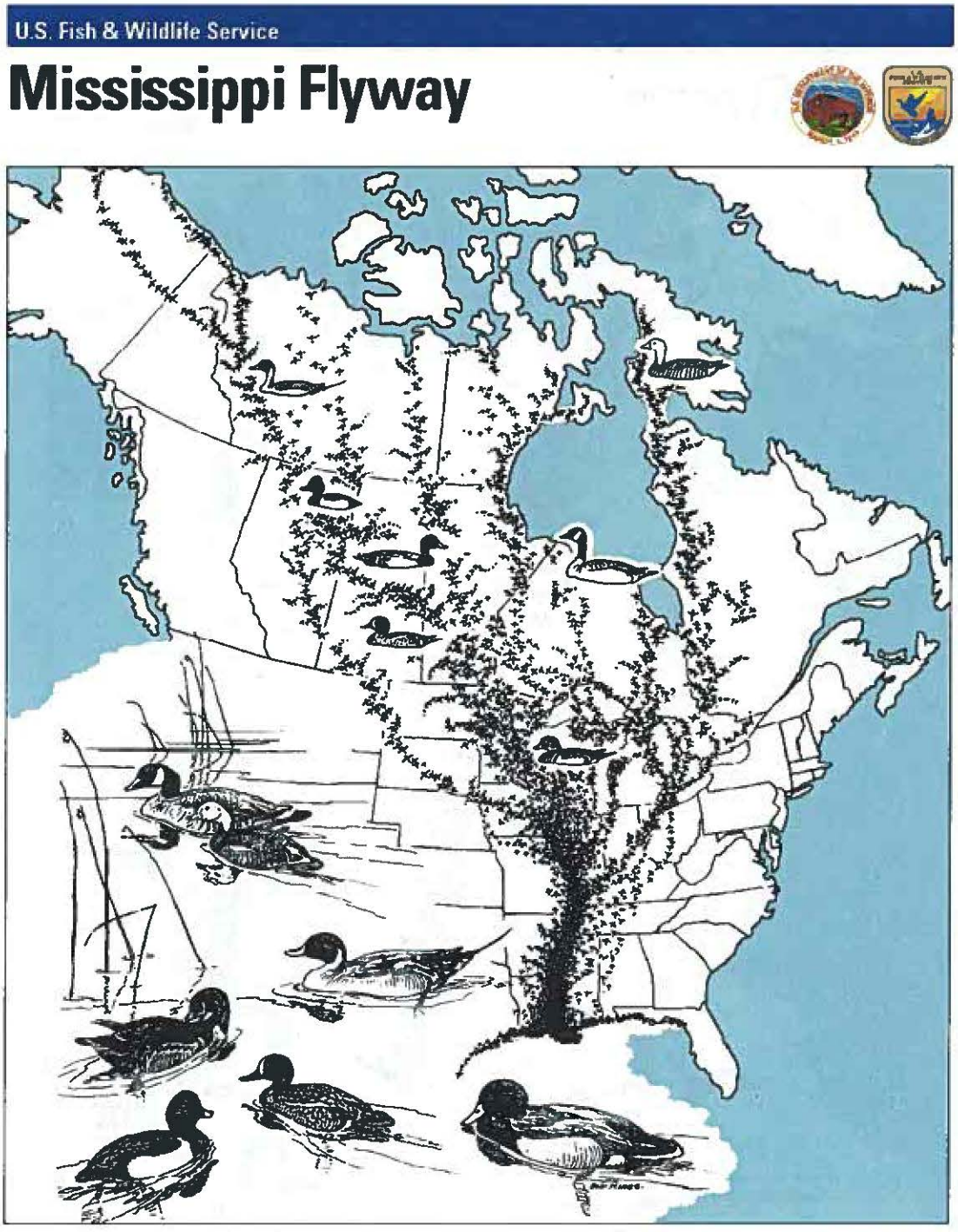

Figure 7. Mississippi Flyway.

U.S. Fish & Wildlife Service

Central Flyway

Figure 8. Central Flyway.

2.4 History of Refuge Lands

2.4.1 Historic Habitat Conditions

2.4.1.1 Prehistoric human occupation

Prior to the arrival of Europeans, the area of southwestern Louisiana now occupied by Cameron Prairie NWR was inhabited by the Atakapa Indians. The Atakapa people were hunters, fishers, and gatherers whose livelihood depended on the productivity of wetland and aquatic ecosystems in southwestern Louisiana and southeastern Texas. When Spanish explorers arrived, the Atakapa people had occupied the area for at least two millennia, but they succumbed quickly to European diseases and were mostly gone by the start of the Nineteenth Century (Couser 2002).

2.4.1.2 Historical human occupation

Spanish exploration of the Gulf Coast began as early as 1502, and by the end of the Seventeenth Century, Spanish and French settlements had been established in what was to become Louisiana (Kniffen 1968). France ceded Louisiana to the Spanish in 1763, but regained control of the territory east of the Red River, exclusive of the Florida Parishes, in 1803, prior to its sale to the United States later that year. However, the southwestern portion of what is now Louisiana was claimed by France and Spain, and remained a "no man's land" known as the "Neutral Ground" until 1821, when it became part of the United States (Handbook of Texas Online 2010).

European colonization of southwestern Louisiana began in earnest after the Acadians were expelled from British Canada, and began to settle in the area in 1765. The Acadians, or "Cajuns," as they became known, were farmers, herders, fishers, and hunters, and began transforming the landscape to further those pursuits (Hebert 2003). Immigrants of many origins, including Native Americans from other regions of the continent, African-American, African-Caribbean, English, German, Irish, and Spanish joined the Acadians in southwestern Louisiana and contributed to the unique culture found there today (Owens 1997).

2.4.1.3 Recent history

- 1873—Calcasieu Pass is dredged
- 1926---First producing Oil and Gas Well (well #5215) in Cameron Parish was the Pure Oil Company's Fount Lee No. 3
- 1934--the Gulf Intracoastal Waterway was completed at its present location, creating a dredged waterway through what was to become the refuge.
- 1941—Calcasieu Ship Channel extended to Lake Charles

- 1951—Catfish Locks (a series of weirs) were completed at the southwest end of Grand Lake across a portion of the original channel of the Mermentau River.
- 1988—Cameron Prairie NWR was created
- 1989--Construction of levee and water control structures in Calcasieu Lake
- 2005—Hurricane Rita
- 2008—Hurricane Ike

2.4.2 Prehistoric Habitat Conditions

Before southwestern Louisiana was colonized by European settlers, the land currently occupied by CPNWR ranged from brackish marsh on the southern portions to wet coastal prairie to the north. Except for cheniers, vegetation was mostly herbaceous, maintained by frequent fires caused by lightning and early human occupants.

2.4.3 Current Habitat Conditions

See Table 2.

2.4.4 Changes in Habitat Conditions

The unbroken expanse of natural habitats that greeted Eighteenth Century European explorers in southwestern Louisiana is now gone, replaced by a patchwork of land uses which have displaced the natural habitats that preceded them, fragmented the landscape, and irreversibly changed ecosystem processes which formerly dominated the systems, especially hydrology and fire. Of 9 million acres of coastal prairie which covered southeastern Texas and southwestern Louisiana at the time of European settlement, only about 1% remains (White et al. 1998). Much of that is in poor condition due to fragmentation, fire exclusion, and invasive species (Teague 2003). A total of 1829 square miles of coastal wetlands, including fresh, brackish, and salt marshes, have been lost since the 1950s due in part to human activity including dredging, oil and gas exploration, modification of hydrology for agricultural and other purposes, and the influence of exotic species, particularly nutria (Barras et al. 2008). Projected losses through 2050 total 500 square miles, with current restoration efforts being taken into account (Barras et al. 2003). These changes fall into three broad categories, each of which will be discussed below: vegetation conversion, alteration of hydrology, and alteration of fire regime.

2.4.4.1 Vegetation conversion

Humans have been converting natural systems to agricultural systems for thousands of years, and long-term vegetation change is an unavoidable consequence of agricultural development. Upland portions of the Chenier Plain in southwestern Louisiana have been under cultivation for rice and other grains, soybeans, and, more recently, crawfish, for many decades. Agricultural landscapes function as habitat for many wildlife species, but others, notably grassland birds, have declined as the coastal prairie has been reduced to remnant patches (Allain et al. 2000). Upland portions of Cameron Prairie NWR have mostly been converted to agricultural croplands, and are now managed either as crop production areas or as moist soil units. These areas contribute to the purpose of the refuge by providing high quality waterfowl and waterbird habitat, but are highly altered systems.

2.4.4.2 Hydrological alteration

Alteration of hydrology in the Chenier Plain has been undertaken for a variety of purposes, including facilitating transportation, providing fresh water for irrigation, conducting oil and gas extraction, preventing saltwater intrusion, protecting infrastructure from hurricanes, and promoting drainage of agricultural and urban lands. Landscapes change, often in unintended ways, when their hydrology is altered. For example, drainage of organic soils can result in severe shrinkage and subsidence (SCS 1995), and can make the soil vulnerable to ground fires which consume the organic portions of the soil profile. Artificially extending the flood period on seasonally flooded wetlands will result in vegetation changes which may or may not be desirable from a management standpoint.

On Cameron Prairie NWR, hydrology has been altered on the entire refuge. The Gulf Intracoastal Waterway extends along the southern boundary of the Gibbstown Unit of the refuge and generally increases water levels and decreases salinity because of lock management by the US Army Corps of Engineers. Former agricultural lands on the refuge in management units 6, 7, 9, 10, 12 A&B, and 13 A&B have been altered with levees and drainage for rice cultivation, and this infrastructure is used to manage them as moist soil units. A large portion of the refuge is a freshwater impoundment, in which water levels are maintained artificially high through the use of levees and water control structures. Other structures, including levees, water control structures, and terraces on the East Cove Unit, have been constructed in an effort to restore marsh and slow the intrusion of saltwater into formerly freshwater systems. Taken together, the hydrological alterations on and around CPNWR are extensive and, at least in the short term, irreversible, not least because many of them are outside the control of FWS managers. Management of the refuge must proceed within the context of this fact, and managers must

recognize that to fulfill the refuge purposes, active management of water will be necessary for the foreseeable future.

2.4.4.3 Alteration of fire regime

Alteration of fire regimes is probably one of the first ways that humans changed their envirounent, and most human-influenced landscapes exhibit some degree of change due to modification of the fire regime (Pyne 1995). As in most of North America, early human occupants probably decreased the fire return interval on the Chenier Plain, and may have modified seasonality and other aspects, in order to change the landscape to their liking. European settlers had a much different relationship with fire, along with more intensive agricultural practices which tended to break the landscape into smaller units and decrease natural fire frequency by reducing the area affected by each individual fire. Currently, reduction in fire frequency is a major threat to grassland ecosystems across North America, and prairie remnants along the Gulf Coast are no different. Lester et al. (2005) list fire suppression as a "very high" threat to coastal prairie systems in Louisiana, along with development, invasive species, land use conversion, and incompatible grazing practices.

Fire management on CPNWR is, in large part, an attempt to mimic a prehistoric (but probably still anthropogenic) fire regime on selected portions of the refuge to create or maintain desirable fire-maintained communities. Restoring fire as an ecosystem function in coastal prairie will retard the development of woody vegetation, including woody invasives like Chinese tallowtree, and promote grassland habitat preferred by grassland birds and other species (Grace et al. 2005). In freshwater marsh, fires during dry periods will set back the natural accumulation of organic material in the soil and promote vegetation diversity and habitat structure (Chabreck 1988).

3.0 RESOURCES OF CONCERN

3.1 Identification of Refuge Resources of Concern

Priorities associated with wildlife and habitat management for NWRS are determined through directives, policies, and legal mandates. Resources of concern include species, species groups, and/or communities that support refuge purposes as well as FWS trust resources responsibilities (including threatened and endangered species and migratory birds). Resources of Concern are also native species and natural, functional communities such as those found under historic conditions that are to be maintained and, where appropriate, restored on a refuge (601 FW 3.10B[1]).

Resources of concern for CPNWR were selected after taking into account the conservation needs identified within international, national, regional, or ecosystems goals/plans; state fish and wildlife conservation plans; recovery plans for threatened and endangered species; and previously approved refuge resource management plans as identified in the Comprehensive Conservation Planning Process policy (602 FW 3.4C[1][E]) as well as Section 1.3 of this HMP. The species/communities selected as resources of concern from these plans support the following NWRS mandates:

- Support refuge purposes and the NWRS mission;
- Conserve biological integrity, diversity, and environmental health
- Give special consideration to rare, declining or unique natural communities, species, and ecological processes within the refuge boundary
- Fulfill FWS trust resource responsibilities

Resources of concern identified for CPNWR include:

- Waterfowl, including northern pintails and other wintering ducks, mottled ducks, and geese
- Colonial waterbirds
- Other species with complementary needs

3.1.1 Waterfowl

3.1.1.1 Wintering ducks

Coastal Louisiana is one of the most important waterfowl wintering areas in North America. Cameron Prairie's freshwater marshes, moist soil management units, and impoundments support a diversity of plants favorable for waterfowl as well as provide loafing and roosting sites to many species of ducks and geese.

CPNWR is located in the Mississippi and Central flyways, which is a critical ecoregion for migrating ducks and geese in North America (Reinecke et al. 1989). The refuge attracts tens of thousands of blue-winged teal, cinnamon teal, green-winged teal, gadwall (*Anas strepera*), northern shovelers, ring-necked ducks (*Aythya collaris*), northern pintail, and several species of geese during the winter with mallards being the most numerous species. Management actions envisioned by this plan would support and improve the freshwater marshes, moist soil management units, and impoundments on CPNWR. Migratory waterfowl use the refuge as a feeding, loafing, and roosting site. Protecting and managing the hydrology of the refuge will preserve important wintering habitat.

Because of historic and ongoing habitat losses due to agricultural development, oil and gas exploration and extraction, and climate change, suitable habitat for wintering waterfowl has decreased over the past two centuries, leading to a decrease in waterfowl populations in North America (Batt et al. 1992). When large, unbroken expanses of wetlands and coastal prairies were available for use by waterfowl, the entire system was more resilient in the face of natural disturbances such as fire, drought, and tropical storms. In the current, anthropogenically modified landscape, habitat loss, habitat fragmentation, the introduction of exotic plant and animal species, and disruption of natural hydrological and pyric processes mean that remaining habitat, in order to function in the larger context of the continent-wide ecosystem, must be actively managed. Small fragments of habitat are less resilient to disturbances, and without management of vegetation, hydrology, fire, and animal populations, will change over time so that they no longer serve as high quality habitat for waterfowl or other desirable species.

Northern Pintails once were one of the most abundant ducks in North America but have suffered a disturbing population decline since the 1970's because of losses of breeding and wintering habitat (USFWS 2004). They are among the first ducks to migrate south in the fall. Pintails using the Central Flyway winter in the Texas Panhandle and on the Gulf Coast of Texas and western Louisiana (Moon et al. 2006). The majority of pintails using the Mississippi Flyway winter in Louisiana, with smaller numbers wintering in Arkansas, Tennessee, Mississippi and Alabama. CPNWR is a key wintering area for Northern pintails which concentrate on shallow fresh or brackish estuaries, brackish and saline marshes, and scattered freshwater impoundments (Johnsgard 1978). They will also use flooded agricultural land, especially corn, rice, wheat, soybeans and pastures. Wintering habitat has declined in this region as a result of decreased rice

production and other land use changes. Because pintails exhibit high winter site fidelity, more pintails are likely to rely on CPNWR and adjacent coastal habitats during winter as freshwater habitats along the Gulf coast disappear (Ballard et al. 2004).

3.1.1.2 Mottled Ducks

The Mottled Duck is a year-round resident in coastal marshes along the western Gulf Coast (western subspecies, Texas and Louisiana; *Anas fulvigula maculosa)* and in the wetlands of Florida *(*eastern subspecies, *Anas fulvigula fulvigula)* (Rorabaugh and Zwank 1983). A report by The Gulf Coast Joint Venture (a partnership between state and local wildlife agencies and nonprofit organizations) showed a dramatic and consistent downward trend in the western mottled duck population between 1966 and 2002. However, only in nearby Texas has the population declined; in Louisiana populations appear stable. Declining recruitment is the most likely source of the population decline (Wilson 2007).Wetland habitat drainage, declining rice farming, lead exposure, and increasing predator populations have also contributed to population declines (Wilson 2007).

Flooded rice fields appear to be important loafing and feeding habitat for mottled ducks in agricultural lands, especially during drought periods when other wetland types are not available or where natural wetlands have been eliminated (Durham and Afton 2006). Mottled ducks depend on tall, dense, undisturbed stands of grass for nesting (Rorabaugh and Zwank 1983). CPNWR has the ability to provide important habitat for breeding mottled ducks and can contribute to the sustainability of the species.

3.1.1.3 Geese

Several species of geese migrate southward during the fall in large flocks and spend the winter on the Louisiana-Texas Gulf coast, including on CPNWR. Geese have long life spans and, like many other large water birds, they imprint along migratory corridors, using stopovers repetitively year after year. Maintaining habitat for these important waterfowl is part of the refuge purpose (see section 1.2). Goose forage (Figure 9) consists of invertebrates, roots, tubers, and leaves of various food plants which are locally abundant. Geese ingest sand and pebbles to supply their gizzards with a mechanical aid for the purpose of breaking down hard foods, such as seeds.

Figure 9. Foraging geese on CPNWR

3.1.2 Colonial Waterbirds

Cameron Prairie NWR provides habitat for colonial waterbirds throughout the year. Thirteen species of colonial waterbirds are documented to breed on Cameron Prairie. One other species (the reddish egret) is documented as occurring on the refuge but is not known to breed there (USFWS 2009, Table 3). Eight of the species are ranked "Moderate" or "High" risk conservation status by Kushlan et al. (2002), including the following birds which breed on the refuge: snowy egret, little blue heron, tricolored heron, white ibis, and roseate spoonbill. Providing breeding habitat for these birds is a priority for the refuge. Management of impounded and unimpounded marsh and moist soil units and artificial upland areas benefits colonial waterbirds throughout the year by providing high quality feeding and roosting habitat.

Table 3. Colonial waterbird species known to utilize habitats on Cameron Prairie NWR.

COMMON NAME	SCIENTIFIC NAME	WINTER	SUMMER	BREEDS ON REFUGE
Great Blue Heron	*Ardea herodias*	x	x	x
Great Egret	*Ardea alba*	x	x	x
Snowy Egret	*Egretta thula*	x	x	x
Reddish Egret	*Egretta rufescens*	x	x	
Little Blue Heron	*Egretta caerulea*	x	x	x
Tricolored Heron	*Egretta tricolor*	x	x	x
Cattle Egret	*Bubulcus ibis*	x	x	x
Black-crowned Night-Heron	*Nycticorax nycticorax*	x	x	x
Yellow-crowned Night-Heron	*Nyctanassa violacea*	x	x	x
Green Heron	*Butorides virescens*	x	x	x
Roseate Spoonbill	*Plantalea ajaja*	x	x	x
White Ibis	*Eudocimus albus*	x	x	x
White-faced Ibis	*Plegadis chihi*	x	x	x
Glossy Ibis	*Plegadis falcinellus*	x	x	x

A number of rookery areas are used on CPNWR (Figure 10). These are areas of shrubs and trees growing on artificial upland habitats such as levees and road banks. The refuge manages rookeries by controlling access to reduce human disturbance during the breeding season. Woody plant control in these areas would be restricted to selective removal of exotic invasive plants including Chinese tallow. The refuge also provides abundant habitat for wading birds throughout the year on impounded and unimpounded marsh areas and moist soil management units, as described in Table 1.

Figure 10. Locations of colonial waterbird rookeries on Cameron Prairie NWR. Rookeries are shown as orange lines.

3.1.3 Other Species with Complementary Needs

While habitat objectives and strategies will be established based primarily on the habitat needs of the above identified Resources of Concern, it is recognized that refuges can and should be managed through a strategic habitat management approach that includes Resources of Concern for the purpose of habitat management planning and those others that represent the intricacy and diversity of the ecosystem which includes adjacent lands. The following Resources with Complementary Needs (Table 3) are identified in the CCP for the refuge (USFWS 2006) as important objectives of management (Objectives B-4 through B-9). They have habitat needs that are largely complementary to those of the Resources of Concern, and are expected to benefit from management designed to meet the needs of the Resources of Concern.

Table 3. Resources with complementary needs to those of the Resources of Concern on Cameron Prairie NWR.

Common Name	Moist Soil Units	Impounded Freshwater Units	Unimpounded Freshwater Units	East Cove
SHOREBIRDS				
American Avocet		x	x	x
American Golden-Plover	x			
American White Pelican		x	x	x
American Woodcock	x			
Black Tern				x
Black-necked Stilt	x	x	x	x
Buff-breasted Sandpiper	x			
Caspian Tern			x	x
Common Snipe	x	x	x	
Dunlin	x	x	x	x
Forster's Tern	x	x	x	x
Glossy Ibis	x	x	x	x
Greater Yellowlegs	x	x	x	x
Gull-billed Tern			x	x
Herring Gull			x	x
Killdeer	x	x	x	x

Common Name	Moist Soil Units	Impounded Freshwater Units	Unimpounded Freshwater Units	East Cove
Laughing Gull	x	x	x	x
Least Sandpiper	x	x	x	x
Lesser Yellowlegs	x	x	x	x
Long-billed Dowitcher	x	x	x	x
Pectoral Sandpiper	x	x	x	x
Ring-billed Gull	x	x	x	x
Royal Tern			x	x
Ruddy Turnstone	x	x	x	x
Semipalmated Plover	x			
Semipalmated Sandpiper	x	x	x	x
Short-billed Dowitcher	x	x	x	x
Solitary Sandpiper	x	x	x	x
Spotted Sandpiper	x	x	x	x
Stilt Sandpiper	x	x	x	x
Western Sandpiper	x	x	x	x
Whimbrel				x
Willet		x	x	x
Wilson's Plover	x			
NONGAME MIGRATORY LAND BIRDS				
Acadian Flycatcher	x	x	x	
American Goldfinch	x			
American Kestrel	x	x	x	x
Bald Eagle	x	x	x	
Barn Swallow	x			
Black Vulture	x	x	x	x
Black-and-white Warbler	x			
Blue Jay	x	x	x	
Blue-gray Gnatcatcher	x			
Blue-headed Vireo	x			
Brown Thrasher	x			
Carolina Chickadee	x			
Carolina Wren	x			
Cedar Waxwing	x	x	x	
Cerulean Warbler	x			

Common Name	Moist Soil Units	Impounded Freshwater Units	Unimpounded Freshwater Units	East Cove
Cooper's Hawk	x	x	x	
Downy Woodpecker	x			
Eastern Bluebird	x			
Eastern Kingbird	x	x	x	x
Eastern Phoebe	x	x	x	
Eastern Wood Pewee	x	x	x	
Fish Crow		x	x	x
Gray Catbird	x			
Groove-billed Ani	x			
Hermit Thrush	x			
Hooded Warbler	x			
Indigo Bunting	x			
Merlin	x	x	x	x
Mourning Dove	x	x	x	
Mourning Warbler	x			
Northern Caracara	x	x	x	
Northern Cardinal	x	x	x	
Northern Flicker	x	x	x	
Northern Mockingbird	x	x	x	
Northern rough-winged Swallow	x	x	x	x
Orange-crowned Warbler	x	x		
Orchard Oriole	x	x	x	x
Osprey	x	x	x	x
Painted Bunting	x	x	x	
Palm Warbler	x			
Peregrine Falcon	x	x	x	x
Purple Martin	x	x	x	
Red-bellied Woodpecker	x	x	x	
Red-eyed Vireo	x			
Red-shouldered Hawk	x	x	x	
Red-tailed Hawk	x	x	x	x
Ruby-crowned Kinglet	x			
Ruby-throated Hummingbird	x	x	x	

Common Name	Moist Soil Units	Impounded Freshwater Units	Unimpounded Freshwater Units	East Cove
Scarlet Tanager	X	X	X	
Sharp-shinned Hawk	X	X	X	
Summer Tanager	X	X	X	
Tree Swallow	X	X	X	X
Turkey Vulture	X	X	X	X
White-eyed Viren	X			
White-winged Dove	X	X	X	
Wilson's Warbler	X			
Winter Wren	X			
Wood Thrush	X			
Yellow Warbler	X	X		
Yellow-bellied Sapsucker	X			
Yellow-billed Cuckoo	X			
Yellow-rumped Warbler	X	X	X	
Yellow-throated Warbler	X			
GRASSLAND BIRDS				
American Pipit	X	X		
American Robin	X	X	X	
Chipping Sparrow	X			
Common Yellowthroat	X	X	X	X
Dickcissel	X			
Eastern Meadowlark	X	X	X	
Loggerhead Shrike	X			
Marsh Wren	X	X	X	X
Northern Bobwhite Quail	X			
Northern Harrier	X	X	X	X
Red-winged Blackbird	X	X	X	X
Savannah Sparrow	X	X	X	X
Scissor-tailed Flycatcher	X	X		
Sedge Wren	X			
Swamp Sparrow	X	X	X	X
Vesper Sparrow	X	X		
White-crowned	X			

Common Name	Moist Soil Units	Impounded Freshwater Units	Unimpounded Freshwater Units	East Cove
Sparrow				
White-throated Sparrow	X			
MARSH BIRDS				
American Coot	X	X	X	X
Belted Kingfisher	X	X	X	
Black Rail	X			
Clapper Rail				X
Common Moorhen	X	X	X	X
King Rail	X	X	X	
Pied-billed Grebe	X	X	X	X
Purple Gallinule	X	X	X	
Sora	X	X	X	
Virginia Rail	X	X	X	X
Yellow Rail	X			
ALLIGATORS				
American alligator		X	X	X
FISHERIES				
Alligator Gar		X	X	X
Banded Pygmy Sunfish		X	X	
Black Bullhead		X	X	
Black Crappie		X	X	
Blue Catfish		X	X	
Bluegill		X	X	
Bowfin		X	X	X
Channel Catfish		X	X	
Gizzard Shad			X	X
Green Sunfish		X	X	
Inshore Lizardfish				X
Largemouth Bass		X	X	
Longnose Gar		X	X	X
Redear Sunfish		X	X	
Spotted Gar		X	X	X
Striped Mullet		X	X	X
Threadfin Shad		X	X	X
Warmouth		X	X	
White Mullet		X	X	X

3.2 Habitat Requirements of Resources of Concern

3.2.1 Waterfowl

3.2.1.1 Wintering Ducks

North American waterfowl have seasonally dynamic life-cycle needs that are fulfilled by use of a diversity of habitats and foods throughout their annual range, which, for most species, is continental in scale in contrast to resident wildlife. Indeed, habitat (both its quantity and quality) is the primary template for ecological strategies of waterfowl (and all wildlife) and a critical determinant of their survival and productivity. Hence, sustaining viable and harvestable populations of waterfowl depend on conservation and management of habitats throughout the flyways of North America. During winter, dabbling ducks need a diversity of wetland habitats including the following: (1) flooded crop land, (2) natural wetlands, and (3) refuge (i.e., sanctuary) (Reinecke et al. 1989).

In a very broad sense, optimum wintering waterfowl habitat is identified as approximately 50% vegetation and 50% water, dispersed in a mosaic pattern with the largest edge effect possible. Natural wetland habitats that ducks have used historically in Southwest Louisiana are marshes and moist soil habitats. These natural wetlands are critical foraging and resting habitats. Both marshes and moist soil habitats are rich in high-energy natural seeds (e.g., grass-sedge seeds, roots, tubers, etc.) and aquatic invertebrates (Kaminski et al. 2003; Heitmeyer 1988, 2006). Wintering waterfowl satisfied their nutritional and other physiological needs in these wetlands before conversion to agriculture in southwest Louisiana.

Several species of waterfowl utilize marshes and moist soil habitats in winter for resting and foraging for annual seeds, tubers, and invertebrates. Mallards, gadwall, teal, American wigeon, shovelers, and geese all utilize marsh and moist soil units as preferred habitats (Fredrickson and Heitmeyer 1988). These areas are vital to waterfowl for pair bonding, loafing, sanctuary, thermal cover and feeding (Reinecke et al. 1989). The high seed production of moist soil plants and their value as waterfowl foods have been known since at least the 1940's (Low and Bellrost 1944). However, managing seasonally flooded wetland impoundments or "moist soil units" only became a widely accepted practice after many years of research in southeastern Missouri (Fredrickson and Taylor 1982, Fredrickson 1996). Today, more than 20,000 acres of moist soil habitat are managed in more than 300 impoundments on state and federal lands in the LMV (LMVJV 2010).

Although geese sometimes use moist soil impoundments and eat shoots of germinating plants, rhizomes, roots, or tubers, the primary emphasis of moist soil management is to produce seeds that will provide food for ducks. Most research has focused on estimating seed production and studies have shown that, under intensive management, species of barnyard grass (*Echinochloa*

crusgalli), sprangletop (*Leptochloa fascicularis*), flatsedge (*Cyperus spp.*), smartweed (*Polygonum* spp.) and panicum (*Panicum* spp.) can produce more than 1,000 lbs./ac of seed (Fredrickson and Taylor 1982). Moist soil impoundments are highly recommended as a means of diversifying habitat (Fredrickson and Taylor 1982; Reinecke et al. 1989) and supplying food with nutrients not generally available in agricultural grains.

Another essential component of waterfowl wintering habitat is sanctuary. Waterfowl need sanctuary from human, predator and mechanical disturbance. Winter is a biological preparatory period during which many ducks and geese pair and perform other life functions (e.g., female of some species [e.g., mallard] undergo a prebasic molt to acquire their breeding season plumage) in readiness for reproduction. Disturbance-free habitat enables some species of waterfowl to prepare biologically for spring migration and reproduction (Reinecke et al. 1989; Strickland and Tullos 2009). Disturbance can interrupt resting and feeding bouts resulting in a loss of energy and lowering body weight (Henry 1980; Heitmeyer and Raveling 1988; Kahl 1991). Paulus (1984) found in Louisiana that increased foraging time by gadwalls was insufficient to counterbalance disturbance factors.

3.2.1.2 Mottled Ducks

Preferred habitats include treeless marshes, prairies, and rice fields with the highest densities of nesting mottled ducks found in brackish to fresh coastal marsh (Rorabaugh and Zwank 1983). Mottled ducks are primarily vegetarians and feed in shallow water with depth as an important variable for autumn habitat (Singleton 1953; White and James 1978). However, their diet may be highly varied, and considerable animal mass may be consumed (Singleton 1953). Invertebrates are especially important for young ducklings. Singleton (1953) and Stutzenbaker (1979) found that from hatching to 3 weeks, 80% of the diet of broods consisted of insects, insect larvae, small fish, snails, and amphipods. Ducklings began their transition to plant foods in the fourth week.

Nesting habitat in coastal marshes is characterized by tall, dense stands of grass located on elevated sites above high tide and generally within 150m of water (Rorabaugh and Zwank 1983). They nest on the ground under bushes or in the concealing grasses such as bulrush (*Scirpus spp.*) in or near the marsh (Terres 1980). Engeling (1950) and Singleton (1953) found nests on levees, road sites, and fallow rice fields with little grazing pressure in rice production areas.

Mottled ducks use a variety of plant species for nesting cover which may include clumps of cordgrass (*Spartina spp.*), saltgrass (*Distichlis spicata*), and false indigo (*Baptisia sphaerocarpa*) where grasses are sparse or short. However, wet soil conditions with an abundance of rushes, bulrush, and cattails lower nesting habitat quality and areas with dense woody cover are avoided entirely (Rorabaugh and Zwank 1983).

Adequate brood habitat can seriously affect duckling survival and reproductive success. Hens with newly hatched ducklings prefer a high water to land ratio with emergent and shoreline vegetation that may be used as cover (Rorabaugh and Zwank 1983). Engeling (1950) found that in Texas coastal marshes brood rearing sites which were bordered by cordgrass, saltgrass, and bulrush were the most successful. Flooded rice fields are also used as brood-rearing sites, but the quality of this habitat is disputed.

Louisiana State University (LSU) has an ongoing research project studying habitat use, survival, and movement patterns of mottled ducks implanted with radio transmitters. Currently 131 hens have been marked in and around CPNWR.

3.2.1.3 Geese

Wintering geese require food and foraging habitat, escape cover, and roosting habitat (Tesky 1993, Kaminsky 1986). In addition, they require a source of grit for gizzard function. Wintering geese preferentially forage in rice fields in the fall after final harvest until availability of rice grains drops off due to consumption and/or decomposition (Hobaugh1984, Kaminski 1986). Moist soil units provide wild seed and green browse. Geese also forage on seeds of wetland graminoid plants (Hobaugh 1984, Kaminski 1986, Laskowski no date) and utilize green browse and invertebrates in impounded and unimpounded freshwater marsh. Tall marsh vegetation and vegetation on levees and spoil banks provide escape cover for geese, while moist soil units and impoundments are most often used for roosting. Geese prefer quartz-based grit over calcium carbonate-based grit. Artificial sources are very readily utilized in coastal Louisiana because of the scarcity of preferred silica grit.

CPNWR provides habitat with standing water, green browse, grit areas and protection. CPNWR focuses on managing 200-300 acres of green browse in open sites. Forage for geese include: snails, cordgrass, widgeon grass (*Ruppia maritima*.), bulrush, sedge, and spikerush found on CPNWR. The soil on CPNWR contains little grit; therefore, maintaining artificial grit sites (piles of sand and pebbles) is a benefit to geese. Recent scientific research documented snow geese traveling from Sweet Lake and Thornwell, Louisiana, to use these sites; some documented distances are approximately 36 miles (USFWS 2006).

3.2.2 Colonial Waterbirds

Colonial waterbirds on CPNWR are a taxonomically and ecologically diverse group of animals. However, they can be considered as a single Resource of Concern because their general habitat requirements are similar, and management actions taken to benefit one species will generally benefit all. Hafner (1997) divides the general habitat requirements of these wading birds into

three components: colony site requirements (rookeries), feeding habitat during breeding season, and feeding habitat during nonbreeding season.

Nesting sites, or rookeries, must provide the nesting birds with nest substrates, protection from weather, and security from predation. Rookeries where ground-nesting takes place are therefore usually surrounded by water, but can be protected by dense vegetation instead. In the absence of these components, most colonial wading birds require tall woody vegetation as nest substrate in order to secure the nest from ground-based predators (Hafner 1997). Great blue herons prefer nest sites 7-10 m high in trees, while black-crowned night herons, snowy egrets, little blue herons, and great egrets tend to nest on islands in shrubby vegetaton (Habitat Objectives Workgroup 1991). Protection from wind, rain, and flooding must be adequate for successful nesting to occur. Rookeries also must have nearby food and nest material resources adequate for the number of birds using the rookery (Hafner 1997).

Feeding habitat during the breeding habitat must provide sustenance for adults as well as chicks, and must be located within some maximum radius of the rookery that allows foraging adults to efficiently capture and transport food to the nest (Gibbs 1991, Hafner 1997). The size of the rookery (number of nesting pairs) is often limited by availability of suitable feeding habitat within this radius (Hafner 1997). This has been shown for great blue herons (Gibbs 1991) and black-crowned night herons (Fasola and Barbieri 1978) among other species. Fasola and Barbieri (1978) reported that heron rookeries in Italy were spatially arranged to efficiently divide up the available feeding habitat. Gibbs (1991) likewise reported that great blue heron rookeries in Maine were located near optimum locations relative to dispersed, disjunct wetland feeding habitat. Birds are able to exploit different prey and feeding habitats at different times of the day when prey are most available; therefore, habitat diversity within the available radius is an important factor as well (Hafner 1997).

Nonbreeding season feeding habitat requirements for Gulf Coast wading birds are similar to those during the breeding season, except that white ibises, which forage in saltwater during the nonbreeding season, require freshwater prey for feeding nestlings during the breeding season (Chavez-Ramirez and Slack 1995). Types of habitat used during the nonbreeding season include shallow open water and water margins. Vegetated areas are much less likely to be utilized by wading birds on the Gulf Coast (Chavez-Ramirez and Slack 1995).

Some researchers have reported that multi-species populations of wading birds partition feeding habitat use. Partitioning can occur by water depth, with longer-legged birds able to forage in deeper water (Hafner 1997), by time of day (Post 2008), or size/configuration of open water area (Chavez-Ramirez and Slack 1995). Recent work has questioned the idea that resource partitioning occurs among diurnal wading birds, especially when food resources are not limiting (Post 2008).

4.0 HABITAT MANAGEMENT GOALS AND OBJECTIVES

4.1 Wetlands and Native Prairie Habitat Goal

Preserve, restore, and enhance diverse wetland and prairie habitats that provide favorable conditions for migratory and native wetland species (Objective A-1, CCP, 2006).

4.1.1 Moist Soil Habitat

Objective 4.1.1 *Establish adaptive management capabilities on Units 6, 7, 9, 10, and 14A and B (2,335 acres), to provide 70-80% 6-8" of water from mid Aug. to early Mar. and 15-20% coverage in flatsedges (*Cyperus spp.*), 45-55% coverage of a diverse mixture of walter's millet (*Echinochloa walteri*), spike rushes, fall panicum, smartweeds and no more than 25-30% coffee bean (*Sesbania exaltata*). (Supporting CCP Objective A.1)*

Resource of Concern: waterfowl, colonial waterbirds.

Rationale: Habitat requirements for wintering waterfowl, mottled ducks, northern pintails, and geese center on productive habitat. CPNWR has the capacity to provide 2,335 acres of highly productive moist soil management areas which produce a diverse mixture of native seed. Maintaining a balance of species requires limiting sesbania to no more than 30% to avoid shading and suppression of other food plants. Up to 20% cover of flatsedges provide seed and tubers, while having approximately half of the total cover in walter's millet, spike rushes, fall panicum, and smartweeds ensures a continuous supply of seed through the wintering period and increases dietary diversity and nutritional quality. Moist soil management areas also function as foraging habitat for colonial waterbirds, and serves as feeding habitat for many other species of birds (see Table 3).

Adaptive Management Monitoring Elements: Moist Soil	
Habitat Response Variables	**Probable Methods**
• Aquatic vegetation composition • Emergent wetland vegetation composition and productivity for wildlife • Early successional plant community composition • Woody vegetation	• Quadrant/transect sampling method (spring/summer/fall)
Wildlife Response Variables	**Probable Methods**
• Waterfowl species composition and abundance	• Aerial winter surveys (3x yr.) • Ground fall/winter surveys (3x yr.)

•	• Ongoing waterfowl research (various projects)

4.1.2 Impounded Marsh Habitat

Objective 4.1.2 *Actively managed impoundment Units 1, 2A, 2B, 2C, 3A, 3B, 4, 5, and 8 (5,553 acres), to improve food sources, protection and loafing areas, 45-55% coverage of emergent vegetation; control water hyacinth (*Eichhornia crassipes*), common salvinia (*Salvinia minima*) and maidencane (*Panicum hemitomon*); maintain 40-50% open water with 50-60% aquatics such as water shield (*Brasenia schreberi*), white water lily (*Nymphaea odorata*), American lotus (*Nelumbo lutea*); and maintain woody vegetation at 20-25% including wax myrtle (*Morella cerifera*), hackberry (*Celtis laevigata*), willow (*Salix spp.*), Macartney rose (*Rosa bracteata*), and persimmon (*Diospyros virginiana*) on levee systems. (Supporting CCP Objectives A-2, B1)*

Adaptive Management Monitoring Elements: Impoundments	
Habitat Response Variables	**Probable Methods**
• Aquatic Vegetation cover • Emergent Wetland Vegetation Composition • Woody Vegetation cover	• Quadrant/transect sampling method (spring/summer/fall)
Wildlife Response Variables	**Probable Methods**
• Waterfowl species composition and abundance • Migratory bird species composition and abundance	• Aerial winter surveys (3x yr) • Ground fall/winter surveys (3x yr) • Ongoing waterfowl research (various projects)

Resource of Concern: waterfowl, colonial waterbirds.

Rationale: Freshwater impoundments provide foraging habitat, loafing habitat, escape cover and sanctuary for waterfowl and other resources of concern.
Maintaining roughly 50% cover of open water is critical for providing habitat for waterfowl. While cattails and maidencane provide some benefit as escape cover and as structure for invertebrate species on which waterfowl feed, if allowed to grow unchecked they will dominate impounded areas to the exclusion of other desirable plant species and open water. The exotic invasives common salvinia and water hyacinth provide very little benefit to waterfowl species and will quickly cover open water areas and outcompete native submerged vegetation if not controlled. Providing a diverse mix of native forage species and tall emergent vegetation for escape cover increases the usefulness of impounded freshwater marsh habitat by increasing the number and kind of resources that it provides for the Resources of Concern. Impounded marsh

habitat is protected from hunting to provide sanctuary for waterfowl on CPNWR. Impounded freshwater habitat increases habitat diversity and availability for colonial waterbirds which breed and winter on CPNWR. Other species with complementary habitat needs also utilize the impounded marsh, including alligators, fisheries, shorebirds, marsh birds, and others. Impounded marsh provides freshwater foraging areas during dry periods when unimpounded areas may be dry or saline.

4.1.3 Unimpounded Marsh Habitat

Objective 4.1.3 *Increase plant species diversity and decrease the vegetation density in unimpounded marsh Units 11A & B and 13A & B (1,394 acres) to improve wildlife habitat by: maintaining cover of maidencane and cattail below 15%, maintaining cover of Eurasian water-milfoil (*Myriophyllum spicatum*) and parrot feather (*Myriophyllum aquaticum*) at 6-10% of total open-water area, maintain 45-50% open water, 5-10%cover of waxmyrtle, 35% cover of flatsedge, spike rushes, cordgrass, 15-25% widgeon grass and southern naiad (*Najas guadalupensis*). (Supporting CCP Objectives A-3, B-1, B-2, B3)*

Resource of Concern: waterfowl, colonial waterbirds

Rationale: More diverse vegetation provides a greater variety of food plants, making available not only a more varied diet for wildlife, but also increased temporal continuity of food supply. Diverse vegetative communities tend to be more resilient to disturbance, and require fewer management inputs. Although maidencane and cattail are native plants which provide some benefit to wildlife, keeping their cover below 10% maintains the cover and foraging benefits these plants provide while making room for other food plants. As in the case for impounded marsh, increasing the proportion of area covered by open water in unimpounded marsh will improve duck brooding habitat. Unimpounded marsh habitat is protected from hunting to provide sanctuary for waterfowl on CPNWR. Unimpounded areas of marsh complement the impounded units, contributing to overall habitat diversity across the refuge. This added diversity benefits colonial waterbirds (Hafner 1997) as well as most of the species with complementary habitat needs (Table 3).

Adaptive Management Monitoring Elements: Unimpounded Marsh	
Habitat Response Variables	Probable Methods
• Open Water (% cover) • Submerged Aquatic Vegetation • Emergent Aquatic Vegetation • Woody Vegetation	• Quadrant/transect sampling method (spring/summer/fall) • Open water visual inspection
Wildlife Response Variables	**Probable Methods**
• Waterfowl species composition and	• Aerial winter surveys (3x yr.)

abundance • Migratory bird species composition and abundance	• Ground fall/winter surveys (3x yr.) • Ongoing waterfowl research (various projects)

4.1.4 Native Prairie Grass Habitat

Objective 4.1.4 *Preserve, enhance, and restore native prairie grasses in Units 12A and B (322 acres). Use prescribed fire to reduce waxmyrtle and Chinese tallowtree (*Triadica sebifera*) to less than 10% cover, and to encourage native herbaceous species including flatsedge, brownseed paspalum (*Paspalum plicatulum*), whitetop sedge (*Rhynchospora colorata*) eastern gamma grass (*Tripsacum dactyloides*), nuttall false indigo (*Baptisia nuttalliana*), and milkweeds (*Asclepias spp.*) . (Supporting CCP Objective A-4, A-6, A-7, B-6, B-7)*

Resource of Concern: waterfowl, particularly wintering geese, nesting mottled ducks.

Adaptive Management Monitoring Elements: Native Prairie Grass	
Habitat Response Variables	Probable Methods
• Grass & herbaceous vegetation composition • Woody vegetation **(% cover)**	• Quadrant/transect sampling method (spring/summer/fall)
Wildlife Response Variables	**Probable Methods**
• Grassland bird species composition and abundance • Wintering geese composition and abundance	• Aerial winter surveys (3x yr.) • Ground fall/winter surveys (3x yr.)

Rationale: Coastal prairie vegetation serves as nesting areas for mottled ducks and as feeding areas for wintering geese, especially after a growing-season burn has removed the rough and released fresh regrowth. Many other species with complementary needs use coastal prairie habitat, and maintaining this habitat contributes to overall biodiversity on the refuge.

4.1.5 Brackish Marsh (East Cove) Management

Objective 4.1.5 *Preserve and restore emergent marshes, vegetative diversity, and open water fisheries in Units 1,2,3,4,5,6,7 (14,927 acres). Eliminate saltcedar (*Tamarix spp.*), construct 360 acres of terraces to reach goal of 646 acres in Cameron Creole Watershed Project, and maintain 55-65% open water. (Supporting Sabine NWR CCP (East Cove Unit) Objective F-1.*

Resource of Concern: wintering waterfowl

Adaptive Management Monitoring Elements: East Cove	
Habitat Response Variables	Probable Methods
• Emergent wetland vegetation composition • Water Quality sampling OCPR (salinity and water level—measured every 2 weeks by FWS personnel and by remote automated stations on a continuous basis.	• Point intercept sampling on 5 year cycle conducted by NRCS •
Wildlife Response Variables	**Probable Methods**
• Wintering waterfowl species composition and abundance •	• Quadrant/transect sampling method (spring/summer/fall) • International Shore Bird Survey • Summer ground survey (Jun-Aug) •

Rationale: Brackish marsh provides habitat for wintering ducks and geese as well as breeding habitat for mottled ducks. Maintaining and/or restoring this habitat ensures continued habitat availability for these species. Keeping sparse cover of woody species on levees ensures that mottled ducks will continue to use the levees for nesting sites while keeping woody vegetation available for rookery sites used by colonial waterbirds.

4.2 Species of Special Concern Goal

Contribute to the long-term protection and recovery of threatened, endangered, and species of special concern populations in CPNWR and Southwest Louisiana ecosystem (p. 13, CCP 2006).

4.2.1 Mottled Duck

Objective 4.2.1 *In Management Units 1 – 13B and East Cove provide minimum nesting habitat for mottle ducks by maintaining 40-45% tall, dense, stands of vegetation (grasses) on elevated sites, above high tide within 150m of water, maintain a high proportion (60-65%) of open water, with 35-40%, bullwhip, spike rush (*Eleocharis spp.*),cordgrass, saltgrass, primrose willow (*Ludwigia peruviana*), giant cutgrass(*Zizaniopsis miliacea*), cattail and coffee bean, with 40-60%, widgeon grass, pondweed, water lily, spadderdock (*Nuphar lutea*), American lotus, water shield, and duckweed (*Lemna minor*) in open-water areas. (Supporting CCP Objective A1, A2, A3, B1, B2)*

Resource of Concern: Waterfowl (Mottled Duck)

Adaptive Management Monitoring Elements: Mottled Duck	
Habitat Response Variables	**Probable Methods**

• Tall, dense, stands of vegetation (grasses) • Nesting habitat	• Quadrat/transect sampling method (spring/summer/fall)
Wildlife Response Variables	**Probable Methods**
• Mottled duck abundance and use	• Mottled duck banding in cooperation with Louisiana Department of Wildlife & Fisheries/Ongoing research • Mottled Duck radio-telemetry (spring/summer) in cooperation with ongoing research

Rationale: Mottled ducks are year-round residents which must meet all of their habitat requirements on or near the refuge. In addition to their wintering habitat requirements, which are similar to those of other wintering ducks discussed in section 3.2.1, they use the habitats on CPNWR for breeding during the summer. Mottled ducks require open water with shoreline and emergent cover for brood rearing. As for other waterfowl, a diverse food resource increases continuity and improves nutritional profile.

5.0 HABITAT MANAGEMENT STRATEGIES

The following management strategies will be employed to satisfy the habitat objectives stated in Section *4. Habitat Goals and Objectives* and the population objectives stated in the priority species accounts. Management strategies are described by habitat type.

5.1 Moist Soil Management Strategies

Units 6, 7, 9, 10, and 14A and B (2,335 acres)

Moist soil areas have been shown to be beneficial to a broad range of waterfowl (Fredrickson and Heitmeyer 1988, Reinecke et al. 1989, Fredrickson and Taylor 1982, Fredrickson 1996). Moist soil management areas are maintained at an early successional stage by frequent disturbance, and water levels are manipulated to promote the growth and availability of desirable forage for wildlife habitat at the proper time of year. Annual forbs such as smartweed (*Polygonum spp.*), and grasses including fall panicum (*Panicum dichotomiflorum*), sprangletop (*Leptochloa spp.*), walter's millet (*Echinochloa walteri*), and other large-seeded annual grass species are desirable moist soil forage species for waterfowl (Kaminski et al. 2003; Heitmeyer 1988, 2006, Low and Bellrost 1944). Perennial species, both herbaceous and woody, as well as exotic invasives, will increase and outcompete early-successional annuals in the absence of some type of disturbance on these areas. Therefore, management broadly consists of repeated disturbance coupled with carefully timed manipulation of water levels (Strader and Stinson 2005).

5.1.1 Potential Strategies

Potential strategies to create regular disturbance to produce the conditions described in 4.1.1 above on these areas include mechanical methods such as water buffaloing, disking, and mowing, as well as chemical treatments applied to reduce the cover of undesirable woody plants and perennial herbs.

A water buffalo (Figure 11) is an apparatus used in flooded conditions to knock down vegetation. It consists of a heavy pipe mounted on a frame which rolls freely when pulled behind a tractor. Shovel like projections on the pipe penetrate the soil with a chopping effect (CPNWR Narrative 1993). The water buffalo creates a mosaic pattern of vegetation and open moist soil, which benefits waterfowl as well as many other species of birds (Figure 12, Table 3).

In drier years, mowing and disking have been successful in producing desired annuals in moist soil units. Herbicide applications, although technically feasible have had minimal effect on woody plants and invasive vegetation due to the lack of consistent financial resources to treat areas on an annual schedule. Prescribed fire, while a means of causing disturbance, has not been a viable option on CPNWR due to wet conditions and lack of fuels capable of carrying fire.

Hydrology is the most important tool in moist soil management. Draw-down and flood timing is crucial in producing diverse stands of desirable moist soil vegetation. The combination of water manipulation and disturbance will produce annuals, which sustain migrating waterfowl throughout the winter (Low and Bellrost 1944). The moist soil vegetation also serves as nurseries for invertebrates that are consumed by waterfowl preparing for the return migration north and by many species with complementary needs, notably shorebirds.

Management should be directed at gradual flooding and draining of impoundments at appropriate times during the spring and fall migration to create optimal foraging conditions for extended periods of time. Water depth should be maintained at optimum foraging depths of ≤ 10 inches (Fredrickson and Heitmeyer 1991). Water buffaloing or burning and flooding rice stubble increases Pintail use by providing open water <10 inches deep with abundant grain in the sediment (Fredrickson and Heitmeyer 1991).

Managed moist soil units should be flooded from August through March for early migrating waterfowl such as blue-winged teal, pintail, and shorebirds. Units should be dewatered by late March (Strader and Stinson 2005). Ideal depths in moist soil units are 6" – 8" to favor dabbling ducks, with sheetwater (<6") in other areas to support migrating geese and shorebirds.

Figure 11. Water Buffalo (Lawson Aerators)

Figure 12. Mosaic buffaloing in Moist Soil Unit 14A CPNWR

5.1.2 Moist Soil Management Strategy Prescription

To meet objectives 4.1.1 in Management Units 6, 7, 9, 10, and 14A and B (2,335 acres) for wintering waterfowl, the following strategies will be used to manage moist soil habitat:

- Disc, mow (April-October) and/or water buffalo (October-April) annually to reduce woody plants and promote early stage vegetative succession. Disking and mowing will be used in dry years; water buffaloing will be used under wet conditions. All of these actions will result in setting back succession to annuals, which are desirable for waterfowl food production.
- Flood units August - October adjusting board placement in water control structures to maintain a 6" – 8" average depth. This procedure, which should be performed after seeds have matured on desirable annual food plants, will increase availability of seeds to waterfowl as they arrive after the fall migration.
- Dewater units in late March –May. Dewatering is accomplished in one action by opening water control structures. Dewatering the units in the spring allows the next crop of annual food plants to germinate and develop.
- Monitor vegetation growth for valuable waterfowl food production. Monitoring will consist of measurements of cover by species or species class as well as sampling to determine seed maturity.

- Monitor vegetative growth for undesirable invasive and perennials, if distribution exceeds 30% cover, mechanical and/or chemical management tools will be used as needed, including:
    - mowing
    - rolling with aerator (water buffalo)
    - disking
    - hack and squirt woody stem control. Approved herbicides will be used in all cases.
    - broadcast herbicide application by tractor or airplane; an approved list of herbicides is on file at the refuge complex office.
- Record water management actions, levels, flora and fauna response in a manner suitable for future use.
- Accommodate waterfowl hunting opportunities

5.2 Impounded Marsh Habitat Management Strategies

(Units 1, 2A, 2B, 2C, 3A, 3B, 4, 5, and 8 (5,553 +/- acres)

Emergent vegetation such as bullwhip, spikerushes, and cattail; submerged and floating aquatic vegetation such as white water lily, water shield and American lotus; and woody plants like waxmyrtle, hackberry, willow, Macartney rose, and persimmon on levee systems all play a role in the life of waterfowl, diversity in vegetation supplies food, cover, nesting and brooding habitat. Water manipulation and/or prescribed fire are vital in maintaining the desired vegetative species. Invasive aquatic, herbaceous and woody plants would outcompete desirable species without water manipulation and/or prescribed fire, reducing desirable waterfowl food production.

5.2.1 Potential Strategies

Potential strategies for achieving the conditions described in 4.1.2 above include manipulation of water levels and the application of prescribed fire. Together, these two management practices can be used to maintain 40-50% open water and 50-60% desirable emergent and floating vegetation. Manipulating water levels allows managers to control the depth and timing of flooding, which in turn affects the extent and growth of aquatic plants. Dry periods allow organic matter which has accumulated in the sediment to oxidize, reversing the accumulation of muck and decreasing overall cover of emergent vegetation. Applying fire during the dry periods can accelerate this process by removing organic matter from sediment much more quickly (ground fire), and also by killing back patches of vegetation which have established in organic soils. To avoid excessive open water, fire conditions should be selected that will produce patchy

ground fire distribution. Drawdowns implemented for this purpose should coincide with drought conditions to be most effective and mimic natural processes. The net effect of combining periodic draw-downs with fire is to increase or maintain open water as a component in the impoundment and to increase the diversity of the emergent and floating vegetation by increasing plant habitat diversity (depth, substrate). Deep flooding in August-September (26-30 inches) can assist with controlling spread of vegetation, and serves to knock over cured emergent vegetation to make it available both to waterfowl and to the invertebrates on which the waterfowl feed. Diverse marsh vegetation coupled with adequate open water will produce high quality habitat for wintering and year-round resident waterfowl and colonial waterbirds, and will benefit most of the species with complementary habitat needs listed in Table 3. Ideal depth for October-April is 8-18 inches to provide support for diving ducks (Strader and Stinson 2005).

Proper timing of water level manipulation is crucial to the timely provision of habitat for migrating waterfowl; therefore, managers must have as much control over water levels as is practicable. Currently, managers of CPNWR do not have adequate tools or resources to effect proper water level manipulation in a timely fashion. Specifically, drawdowns in the spring are sometimes delayed because funding is not available for pumping water out of the impoundment. Pumping is required during wet years when water levels outside of the impoundment are too high to allow gravity drainage. Inadequate or late drawdown contributes to loss of open water habitat over time.

Potential strategies to increase control over water levels include installation of additional pumps and water control structures, dividing large impounded units into smaller, more manageable units by constructing additional levees, and maintaining new and existing levees at 4-5 ft. elevation with 50 ft. base and 15 ft. wide crown.

5.2.2 Impounded Marsh Habitat Management Strategy Prescription

To meet the objectives 4.1.2, 4.2.1, 4.2.2, and 4.2.3 in units 1, 2A, 2B, 2C, 3A, 3B, 4, 5, and 8 (5,553 +/- acres) for wintering waterfowl and nesting mottled ducks, the following strategies will be used to manage impoundment habitat:

- Purchase and install 2-3 pumps and water control structures to allow drawdowns. Currently, spring drawdowns in impounded marsh units, although desirable for habitat management, introduce the risk that fresh water will not be available in August-September for flooding the units. Presently, it is only possible to flood the impoundments by closing the control structures and allowing rainfall to fill the unit, or by opening the structures during periods of high freshwater flow in the supply/drainage ditches and allowing fresh water to flow into the units. If rainfall and/or fresh water flow is inadequate, flooding the units in time for fall migration is not possible. Pumps would

allow more precise timing of flooding by allowing managers to use groundwater to flood the units during dry periods.

- Create smaller manageable cost-effective sub-units. Currently, management units 4 and 8 are too large to manage effectively. A plan to divide these two management units will be devised and implemented.
- Rehabilitate and/or construct levees in these sub-units with approximately 15' crown, 50' base, and 4-5' height. Levee maintenance is essential to the ongoing management of the impounded marsh habitat on Cameron Prairie NWR.
- Draw down annually during February-March to promote moist-soil plants; water control structures are opened completely and kept open to accomplish this. Dewatering the impoundments during the growing season allows large-seeded annual plants to grow and produce seed, which can then be made available to wintering waterfowl in a manner much like the moist soil units.
- prescribe burn in sub-divided impoundments during growing season to set back succession and remove accumulations of organic matter. Burn conditions will be selected to provide a patchy burn which maximizes habitat heterogeneity and diversity. Fire return interval will be at least 5 years.
- Deep-water flood (26" – 30") during August-September to reduce vegetative cover and knock down standing vegetation to make it accessible to waterfowl. Late summer flooding prepares the habitat by causing the annual plants which have grown through the summer to fall over. Their seeds are released and become available to waterfowl during the winter.
- Maintain water depths of 8" – 18" during October-April. Water depths of 8-18 inches are optimum for diving ducks (Strader and Stinson 2005).

5.3 Unimpounded Freshwater Marsh Strategies

Units 11A & B and 13A & B (1,394 acres)

5.3.1 Potential Strategies

Unimpounded marsh habitat on Cameron Prairie NWR is managed to achieve the conditions described in Objective 4.1.3. Two potential strategies exist to increase plant diversity, favor desirable plants, and increase the amount of open water: prescribed fire, and application of herbicides. Since no water control structures exist in these units, precise manipulation of water levels is not an option. Likewise, mechanical treatments such as disking, water buffaloing, and mowing are not possible because the units are inaccessible to equipment. Prescribed fire can be applied in these units during late summer/early fall, after most bird species have finished nesting and before the cold-front-related rains of October-November occur. As in the impounded marsh

units, fire has the effect of keeping undesirable vegetation such as maidencane and cattails in check, while opening space for more desirable plant species such as flatsedge, spikerushes, and cordgrass. Fire also has the effect of causing seeds to be released to the marsh floor where they are accessible to waterfowl (Gordon 1989). During dry years, prescribe fires will help remove accumulated muck and increase the coverage of open water. Increasing open water will in turn improve water flow through the units and improve habitat for waterfowl, including mottled ducks, and colonial waterbirds.

5.3.2 Unimpounded Freshwater Marsh Strategy Prescription

To meet the objectives in 4.1.3 and 4.2.1 in units 11A & B and 13A & B (1,394 acres) the following strategies will be used to manage unimpounded freshwater marsh habitat:

- Burn unit during late summer of dry years (i.e. when prescription conditions occur) to control undesirable vegetation, promote desirable perennials and annuals, increase the proportion of open water, promote water flow through the habitat, and increase availability of seeds of annual plants on the marsh floor. Fire should be applied on a 3 to 5 year return interval, depending on the occurrence of dry periods. Fire prescriptions are beyond the scope of this plan and must be developed through a fire management plan for the refuge.
- Control undesirable vegetation (cattails, maidencane, giant/common salvinia) by taking advantage of salt water after storm surge events. This will be accomplished by closing water control structures in the drainage ditches while the refuge is flooded by storm surge. Closing these structures has the effect of holding water on the unimpounded as well as the impounded units; separate control of the unimpounded units is not possible because they do not have their own water control structures.
- Provide sanctuary for wintering waterfowl by closing units 11A, 11B, 13A, and 13B during September-April to public access. Sanctuary is essential for wintering waterfowl to allow them to build energy stores for the spring migration and breeding season (Reinecke et al. 1989).

5.4 Native Prairie Strategies

Units 12A and 12B (322 acres)

5.4.1 Potential Strategies

The ultimate objective is to develop the knowledge and strategies, including public education, required to ensure survival of native biota in the face of anthropogenic change. Achieving this objective will involve understanding land management (sedimentation, fire ecology, invasive exotic species, and altered hydrology), changes in land-use (habitat loss and fragmentation, climate change), and the impacts of human activities on native wildlife and their habitats (modified predator communities). Other focal areas will include quantification of carbon sequestration in prairie wetlands, promoting natural resource conservation, assessing the status of native communities and populations, developing quantitative monitoring protocols, and addressing issues affecting conservation of endangered or threatened species.

The wetland prairie ecosystem on CPNWR is unique to southwest Louisiana and an important part of our natural heritage. Only 1% of the original coastal prairie remains intact, and it is disappearing at alarming rates. Consequently, prairie flora and fauna are rare, and many are endangered. Ecological processes acting in prairie ecosystems are complex and are the subject of ongoing research. Prairie restoration, like the restoration of any ecosystem, involves the re-integration or re-creation of the structural components of the ecosystem with its critical processes. In grasslands, this means making sure that at least dominant grass species and more important forb species are present, and removing or decreasing species which do not belong in a prairie system, such as shrubs, trees, and exotics. It also means restoring fire to its preeminent place as an ecosystem process. Each of these will be discussed below. Potential strategies for replacing plant species which are absent include direct seeding, either with commercially available seed or with seed harvested from nearby intact prairie, and planting of nursery-grown grass seedlings.

<u>Restoring Prairie Plants</u>

Direct seeding. The most cost-effective method of restoring large areas of native grassland is usually to sow seed of the desired species onto prepared seedbeds at the appropriate time of year (winter, in the case of southwestern Louisiana). Since native plants vary over relatively small geographic and even topographic distances, seed from nearby sources, and similar sites if possible, should always be used. Provenance of commercially available prairie grass seed is often distant from the Gulf Coast, and the resulting plants, though they may be the proper species, will not necessarily thrive if planted there. Therefore, the best way to obtain seed is to

harvest it from nearby intact native prairie, if that is available. The following caveats should be observed when collecting seed from wild sources:

- Make sure that undesirable species, especially invasive exotics, are not present in the seed production area, or at least are not in fruit at the time of seed collection.

- Collect seed at different times of the year to ensure that as many (desirable) species as possible are included in the mix.

- Fresh seed is better; seed of some species do not store well.

If local wild seed are not available, some prairie species are commercially available. However, efforts should be made to use provenances within 250 miles (100 miles is best) of the restoration site (USFWS and USGS 1999).

Planting seedlings. Seedlings of some native prairie species are commercially available from nurseries, and seedlings can also be contract-grown from locally produced seed. These seedlings are typically grown in containers ("plugs") designed for winter planting. Planting seedlings is more expensive than sowing seed, but if done properly is more reliable and will result in a more uniform stand.

Removing Undesirable Plants

Herbicide application. Undesirable plants can be removed by application of herbicides. This method is particularly useful on sites where prairie plants have not yet been restored, although selective application can be done in established prairie as well.

Mechanical removal. Undesirable plants, especially woody plants, can be mechanically removed from restoration sites or from existing prairie, either by manual or mechanized methods. Woody plants which are cut will usually resprout, requiring follow-up treatment for greatest efficacy. Cutting can be combined with selective herbicide application (e.g. "cut-stump application") for better results.

Fire. Fire, properly timed, will kill or top-kill susceptible plants and, over time, result in their decline in a prairie system. Tallowtree and eastern baccharis are top-killed by fire, and burning

during the growing season under dry conditions can increase the effectiveness of fire at removing these two species (Grace 2005). Fire is discussed more completely in the next section.

Restoring Fire as an Ecological Process

Tallgrass prairie, including coastal prairie, is a fire-dependent system. Restoring fire is crucial to keep grasslands from succeeding to woody systems or becoming dominated by exotic species such as tallowtree. The prairies of the Louisiana and Texas Gulf Coast evolved under a natural regime of fires which were set by lightning and probably burned over very large areas (Grace et al. 2005). Humans have interacted with these systems, and in particular, manipulated the fire regime, for many millennia, and continue to do so today. Native Americans used fire as their primary land management tool, and they had a profound effect on the ecology of North America, including the grasslands of the Gulf Coast (Pyne 1982). Habitat fragmentation now requires that these "natural" fire regimes be mimicked by prescribed burning if prairie vegetation is to be maintained. There has been much discussion of, and research on, what the best fire return interval is for restoring and maintaining various types of prairie; however, a general consensus is that fire should be applied at least every 3-5 years, and as often as annually (e.g. Heisler et al. 2003, Marx et al. 2008), and there is evidence that the timing (both seasonal and year-to-year) and intensity should vary from application to application (Hamilton 2007).

5.4.2 Native Prairie Strategy Prescription

To meet objectives in 4.1.4 and 4.2.1 in Management Units 12A and B (322 acres) for wintering waterfowl and nesting mottled ducks the following strategies will be used to manage native prairie.

- Burn when fuel load can carry fire, on a 3 to 5 year return interval, stagger the burn season (i.e. early and late growing seasons).
- Obtain and sow native prairie seeds such as green flatsedge, brownseed paspalum, and white top sedge, increase eastern gamma grass, nuttall indigo, and milkweeds
- Reduce Chinese tallow, baccaris, waxmyrtle and other undesirable and/or invasive species by application of prescribed fire, herbicide and/or mechanical means (mowing)
- Survey, inventory, and monitor grassland bird populations using area searches and transect protocols focusing on wintering species. Archive data for future use. Monitoring is necessary to measure the effectiveness of habitat restoration at achieving the objectives.

5.5 East Cove Unit Strategies

Units EC 1, 2, 3,4,5,6,7 (14927 acres)

Wetland loss in the East Cove unit is the major threat to the brackish marsh habitat in the East Cove Unit of CPNWR. Loss of marsh habitat in southwestern Louisiana is caused by a combination of natural and anthropogenic processes, including geologic subsidence, sea level rise, storm surge, wave-induced erosion, trapping of sediment upstream, saltwater intrusion resulting from construction of waterways for shipping, oil and gas operations, and drainage, and increased salinity caused by diversion of freshwater flow from upstream. Human-caused climate change is enhancing some of these processes, with the effect that conversion of marsh habitat to open water has greatly accelerated over the past century. Slowing and reversing this trend will not only preserve valuable wildlife habitat, but will also maintain vital protection for human coastal settlements from storms. To that end, the Cameron-Creole Project was initiated in 1987 as a cooperative program among the USDA-NRCS, the USFWS, the National Marine Fisheries Service, the Louisiana Department of Natural Resources, and the Louisiana Department of Wildlife and Fisheries. The primary objective was to restore habitat conditions which had existed in 1972, when monitoring data were first collected. The project involved the construction of water control structures to prevent saltwater intrusion through shipping canals and reverse wetland loss. These structures are operated by the US Fish and Wildlife Service with the objective of maintaining stable isohaline lines at 5 and 12 ppt while maximizing access for migrating marine organisms (National Water Management Center no date; see also Appendix I).

5.5.1 Potential Strategies

Potential strategies for restoration and management of marsh habitat in the East Cove Unit of CPNWR include continued operation of the water control structures according to the Cameron-Creole Project Resource Management Plan (Appendix I), construction of terraces in open water, addition of sediment from dredging operations ("beneficial use"), and control of invasive exotic plant species, including saltcedar and giant salvinia, with selective application of appropriate herbicides. Terraces are linear berms constructed from existing sediment in open water areas by excavating and filling. They are constructed perpendicular to prevailing wind direction, and serve to break up wave action by reducing the fetch length and producing quiet water areas on the lee side (Rozas and Minello 2001). Reducing the fetch length reduces wave intensity, which in turn decreases erosion. Deeper water areas adjacent to the terraces (where the material for the terrace was removed) trap sediments and serve as habitat for submerged aquatic vegetation. Terracing has been shown to increase habitat quality for shorebirds, aerialists, and dabbling foragers (O'Connell 2006) and for important fishery species (Rozas and Minello 2001). Beneficial use of dredge spoil is the application of dredge spoil in open water areas to restore marsh. Beneficial use of this material not only restores marsh areas but also reduces the need to dispose of dredge material in in spoil banks or other, less desirable ways. Dredge spoil obtained from the Calcasieu Ship Channel has been successfully used on nearby Sabine NWR for marsh restoration. There, spoil is pumped through a pipeline and deposited into open water areas

enclosed by levees. Deposited spoil is quickly colonized by *Spartina patens* without recourse to artificial regeneration. However, because of cost and access issues, dredge spoil has not been available in the past for use on Cameron Prairie NWR. While it is possible that this will change, for the foreseeable future, beneficial use of dredge spoil will not be considered a viable strategy for CPNWR. Herbicide application is the best option for controlling invasives like giant salvinia and saltcedar, both of which are management problems on East Cove. Giant salvinia can be controlled by a number of herbicides: diquat (Reward), fluridone (Sonar, Avast, Whitecap), glyphosate (Rodeo, Aquamaster, Eraser AQ, etc.), and penoxsulam (Galleon) (Smith 2011a). Because giant salvinia is not tolerant of salinities higher than 7-10 ppt (Savoie 2003) flooding with saltwater is an effective control method which can be used on East Cove. Drawdown of water levels is also effective at controlling giant salvinia, but control of water levels on East Cove is limited. Saltcedar, likewise, has a number of chemical control options, but imazapyr (Arsenal) gave the best results in a recent Texas study of aerial applications (Hart et al. 2009).

5.5.2 East Cove Unit Strategy Prescription

The East Cove unit is managed under a multi-agency association under the Cameron-Creole watershed agreement. To meet objectives 4.1.5 and 4.2.2 for wintering waterfowl, nesting mottled ducks and fisheries in units 1, 2, 3, 4, 5, 6 and 7 the following strategies will be used to manage the East Cove unit.

- Work in cooperation with Cameron Creole Watershed Project partners to establish fresh, intermediate and brackish marsh conditions in accordance with the Resource Management Plan for the Cameron Creole Watershed (Appendix I).
- Close Water Control Structure 65% (i.e. stop down the opening to 35% of capacity) during high salinity periods (hot summers and drought periods) in order to reduce saltwater intrusion.
- Maintain 50:50 land/water ratio for fisheries and estuarine species nurseries. Continued marsh restoration will be necessary to maintain this ratio.
- Control giant salvinia (*Salvinia molesta*) by herbicide application and/or by increasing salinity by WCS manipulation (>7ppt).
- Continue to install terraces to restore marsh, improve habitat, and reduce erosion.
- Monitor effectiveness of terraces and record results (done by USGS office in Lafayette—vegetation and water quality are monitored).
- Minimize detrimental waterfowl disturbance by closing the unit to all operations (oil & gas activities) from 1 October – 15 March.

- Monitor and record vegetative species sharing information with the Cameron Creole Watershed group, LDWF and interested NGO's

5.6 Undesirable Flora

5.6.1 Potential Strategies

Invasive and exotic plant species can alter the functioning of native ecosystems and negatively affect wildlife. Effects can include decreased habitat suitability, loss of native species, reduction of native food sources, and increased soil erosion and alluviation. Therefore, a management strategy is required to control and attempt to eradicate exotic invasive species.

Exotic plant species threatening the biological integrity of CPNWR are Chinese tallowtree, water hyacinth, salt-cedar, giant salvinia, and common reed (*Phragmites australis*). Maidencane is a native wetland grass which can outcompete more desirable plants in wildlife habitat.

Chinese tallowtrees are small, fast-growing trees with high reproductive capability. The tree grows in a variety of habitats, is extremely invasive, and can form monoculture stands quickly. Potential strategies for controlling Chinese tallowtree include herbicide application, prescribed fire, and mechanical removal, either with or without herbicide "cut stump" treatment. Herbicide, although expensive, is the only practical way to achieve effective control of this exotic weed. Both imazapyr (Arsenal) and triclopyr (Garlon) are effective on tallowtree. Garlon can be applied as a basal bark spray or a cut-stump application, while Arsenal is applied as a foliar spray (Demers et al. 2008). Mechanical top removal and fire both achieve top-kill, but without further treatment, tallowtree quickly resprouts. (Grace et al. 2005).

Water hyacinth is a perennial, floating herb, introduced from South America, which can cover open freshwater very quickly and cause catastrophic changes to aquatic ecosystems in the Gulf Coast region. This plant forms extensive mats which are nearly impenetrable to boat traffic. Water hyacinth produces very little in the way of wildlife habitat value, and crowds out other, more beneficial plants (Lazarine no date, Fassett 1960). Water hyacinth can be controlled by physical removal of plants or by herbicide application. A number of insects have been used as biological control agents, but while they can reduce the vigor and reproductive capacity of water hyacinth, they are not capable of fully controlling it (Cervone no date). Physical removal is labor-intensive and most applicable to small infestations. Herbicides, while expensive, are the only real option for effective control of water hyacinth. Herbicides which can be used for removing water hyacinth include 2,4-D (Weedar 64), diquat (Reward), glyphosate (Rodeo, Aquamaster, Eraser AQ, Touchdown Pro, and AquaNeat), imazamox (Clearcast), imazapyr (Habitat), triclopyr (Renovate), and penoxsulam (Galleon) (Smith 2011b).

Salt-cedar (*Tamarix spp.*) is a shrub or small tree ≤8 m tall (Weber 2003). It was introduced from Asia to the western US and has spread rapidly along water courses and wetlands, displacing native vegetation and habitat. Salt cedar is thought to lower water tables by rapid transpiration, and apparently causes increased soil salinity, among other negative effects (Lovich 2006). Despite its invasive nature and negative ecosystem effects, however, it is still being recommended by at least one cooperative extension service (Texas) for ornamental planting in landscapes on the Gulf Coast (Welch 2010). Imazapyr (Arsenal) gave the best results in a recent Texas study of aerial applications for controlling salt cedar (Hart et al. 2009).

Giant salvinia is a free-floating fern with rootless stems which was introduced from Brazil and escaped cultivation (Wunderlin and Hansen 2003). Able to reproduce year-round, it spreads very rapidly. Giant salvinia has the capacity to clog waterways and displace native vegetation with higher value for wildlife. Giant salvinia can be controlled by a number of herbicides: diquat (Reward), fluridone (Sonar, Avast, Whitecap), glyphosate (Rodeo, Aquamaster, Eraser AQ, etc.), and penoxsulam (Galleon) (Smith 2011a). Because giant salvinia is not tolerant of salinities higher than 10 ppt (Savoie 2003) flooding with saltwater is an effective control method.

Common reed is a cosmopolitan grass species with native and exotic ecotypes in the southeastern US. Exotic ecotypes are invasive and tend to produce monospecific stands, while the native ecotypes grow in association with other wetland plant species (Swearingen and Saltonstall 2010). Exotic forms of common reed displace more desirable habitat species in marshes on the Gulf Coast, reducing habitat quality and biological diversity (Chambers et al. 1999). A number of control options are available including chemical and mechanical treatments. Herbicides effective against common reed include amitrole, dalapon, and glyphosate (Cross and Fleming 1991). Mechanical control techniques can include disking, rolling, and other forms of soil disturbance (Cross and Fleming 1991).

Maidencane is a native warm season, rhizomatous, perennial grass that may displace more desirable habitat elements without proper management. It can tolerate a variety of conditions, including anaerobic soils, allowing it to establish quickly after disturbances such as hurricanes. It has extensive rhizomes and narrow, leaning or erect stems up to 6 ft. long. Maidencane can be valuable in erosion control if kept in check by management procedures. Maidencane can be controlled by prescribed fire which removes organic soil horizons (ground fire) and by salt water flooding (Walsh 1994).

Herbicide application is a management option on national wildlife refuges, but it is costly and labor intensive. This treatment should be reserved for species with the highest degree of impact and the greatest negative effects on native habitat. Herbicides will be used primarily to

supplement, rather than as a substitute for, practical damage control measures of other types (fire, mechanical removal, mechanical soil disturbance, water manipulation). All chemicals will be approved through the Pesticide Use Proposal process and will follow Integrated Pest Management Policy (569 FW 1).

5.6.2 Management Strategy Prescription

To satisfy Management Unit objectives for all resources of concern, the following strategies will be implemented to control exotic and invasive species:

- GPS/GIS data collection to identify areas of infestation
- Monitor and treat maidencane once density exceeds 35% of vegetative cover. Maidencane will be treated by fire or saltwater flooding as described above should conditions allow (either drought conditions or storm surge). Otherwise, herbicide (Diquat, Glyphosate) will be used.
- Treat all water hyacinth with 2-4D as needed from April until October.
- Treat all saltcedar with Habitat from April thru early May (prior to flowering) on an annual basis.
- Treat all giant salvinia with Clearcast and Aquamaster from May thru October annually. Other approved chemicals that are developed in the future may be used.
- Monitor and treat common reed once density exceeds 40% of vegetative cover. Common reed will be treated by fire as described above should conditions allow. Ground fire should consume 8-12 inches of organic soil to control common reed. If weather conditions are not conducive to ground fire application, herbicide (Rodeo or Reward) will be used.

5.7 Undesirable Fauna

5.7.1 Potential Strategies

Feral swine (*Sus scrofa*) have recently been found on CPNWR. This animal poses a number of threats to wildlife and native systems on the refuge. Hogs damage natural vegetation through their feeding and rooting behavior, they negatively impact native wildlife populations through competition and direct predation, and they are reservoirs of diseases and parasites which can affect native animals, livestock, and even humans (Missouri Department of Conservation no date, Miller and Synatzke 1993). By rooting and digging for food, feral hogs destroy fragile wetland plants and cause soil erosion and changes in successional patterns. They are omnivores, and will eat acorns, tubers, fruits, roots, and other plant material, decreasing the availability of

these resources for native wildlife. They will also prey on eggs of ground-nesting birds and reptiles, and on the young of mammals such as rabbits and deer (Missouri Department of Conservation no date). Diseases such as brucellosis and trichinosis are known to have been transmitted to humans and livestock by feral swine (Missouri Department of Conservation no date).

Currently, no harvest of feral hogs is conducted on the CPNWR. Potential strategies for controlling this animal include:

- Public hunting. This strategy has been used on other refuges and managed lands, but has the disadvantage that it creates perverse incentives among the public to perpetuate the population of feral swine on the refuge, either by selectively taking boars, avoiding the take of sows with young, or even by actively (and illegally) releasing swine on the refuge.

- Removal by refuge personnel or contractors. This strategy is expected to be implemented at Sabine NWR, and could be implemented at CPNWR as well.

5.7.2 Management Strategy Prescription

Currently there is a Hog Management Plan in draft for nearby Sabine NWR (a part of SWLA NWR Complex) being reviewed in the Regional Office. Upon approval of the plan we will conform to the strategies within that document while addressing specific needs for Cameron Prairie NWR, including the use of:

- wildlife services (NRCS) night gunnery and traps

- opportunistic shooting by FWS employees

During the interim the following authorities will be followed:

- Authority to control wildlife populations for management is governed by Title 50 CFR, Part 31, Section 14:

(a) Animal species which are surplus or detrimental to the management program of a wildlife area may be taken in accordance with federal and state laws and regulations by federal or state personnel or by permit issued to private individuals

(b) Animal species which damage or destroy federal property within a wildlife refuge area may be taken or destroyed by federal personnel

- Title 50 CFR, Part 30, Section 11 (a) states that feral animals, including horses, burros, cattle, swine, sheep, goats, reindeer, dogs, and cats, without ownership that have reverted to the wild from a domestic state may be taken by authorized federal or state personnel or by private persons operating under permit in accordance with applicable provisions of federal or state law or regulation.

- Also, Executive Order 13112 (Federal Register/ Vol. 64 No. 25 / Monday, Feb. 8, 1999/ Presidential Documents 6183) states in Sec. 2. Federal Agency Duties. that we should; (i) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (ii) monitor invasive species populations accurately and reliably; (iii) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (iv) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species.

5.8 Prescribed Fire Strategies

5.8.1 Potential Strategies

All prescribed burns on Cameron Prairie NWR are conducted under the authority of the Cameron Prairie NWR Fire Management Plan. Prescribed burns are carried out in variable ways such as seasonal, burn intensity, flanking, backing and head fires. Once one of the most cost effective management tools available, prescribed fire is now an expensive, administratively prohibitive, and limited action. Constraints associated with prescribed fire include staff training, availability of qualified personnel, and equipment. Smoke may be a human safety/health hazard when burns occur close to highways and residences. Improperly timed fires may reduce vegetative vigor or cause death in bunch grasses and shrubs.

Prescribed fire may cause short-term negative effects by eliminating and/or reducing the quality of nesting cover for species such as northern bobwhite, eastern meadow lark (*Sturnella magna*), dickcissel, least bittern (*Ixobrychus exilis*), king rail (*Rallus elegans*), purple gallinule (*Porphyrio martinica*), common moorhen (*Gallinula chloropus*), and black-necked stilt (*Himantopus mexicanus*).

Longer term, fire effectively removes accumulations of undesirable or dangerous levels of fuel, prevents succession to woody systems, promotes seed production of herbaceous plants, and improves viability of seeds which are produced (Gordon 1989).

A mid-spring prairie fire sets back undesirable "cool season" weeds, which come up earlier than prairie plants. By waiting until these undesirable plants have initiated spring growth before burning, the fire will destroy their new growth and set them back, favoring the warm season prairie plants, most of which are dormant under the soil. Growing season fires, conversely, may open up space for spring-flowering plants, reduce cover of woody vegetation, and in some cases will promote flowering and viable seed production of warm-season perennial grass species. A mix of fire intensities, timing, and coverage will ensure the most diverse, resilient habitat.

5.8.2 Management Strategy Prescription

To meet objectives 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, and 4.2.3 in Management Units 1, 2A, 2B, 2C, 3A, 3B, 4, 11A, 11B, 12A, 12B, 14A, and 14B

- Prescribed fire will be used to mimic natural wildfire seasonality and frequency

- Units 1, 2A, 2B, 2C, 3A, 3B, and 4B should be dewatered and burned every 2-3 years during the growing season using backing and flanking fire to allow slow, low intensity burns. The fires should be allowed to burn in a mosaic to encourage "edge effects" and diversity. The slow burn will allow heat to penetrate deep rhizomes of cattail and maidencane.

- Units 11A, 11B, 13A, and 13B (unimpounded marsh units) should be burned in drought years during any seasonal period using fire technique dictated by climatic events. This treatment would mimic the natural fire regime, allowing fire to perform its role in the ecosystem by removing accumulated organic matter during dry periods. No significant long-term negative impact to wildlife is expected from this treatment, although it is possible that local, transitory negative impacts could occur. Positive impacts from this treatment would include maintaining a balance of open water and emergent marsh vegetation and maintaining a diverse plant community.

- Units 12A and 12B should be burned every 1-3 years with a "hot" fire. This encourages "scoring" necessary for numerous prairie plant seeds to propagate. Fire in coastal prairie systems also prevents succession to woody communities and helps control invasion of woody exotics like tallowtree (Grace et al. 2005).

- Burn road sides and levees to enhance wildlife viewing opportunities. As in the prairie units, fire helps control tall woody vegation and maintain a diverse herbaceous community.

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Appendix B: Authors and Contributors

- Rob "Goose" Gosnell, Complex Wildlife Biologist, author
- Denise McInturff, Wildlife Biologist, co-author
- Shelby Richard, STEP, formatting
- Glenn Harris, Complex Deputy Project Leader, contributor
- Matthew Johnson, Complex Fire Management Officer, contributor
- Billy Leonard, Oil & Gas Specialist/Wildlife Biologist, contributor
- Thomas Greene, Natural Resource Planner, editor

Appendix C: History of Units

Unit 1

During the 1950's, approximately 852 acres of freshwater marsh was leveed and pumped to create agriculture fields. From the 1950's to 1985 the areas were dewatered and rice cultivated on a 2-3 year rotation. Two large low-lift pumps were used to dewater the area to allow soil manipulation with farm equipment. Personal conversations with individuals with knowledge of these farming operations disclosed that the pumps were run practically year-round to keep areas dry. Fuel costs during this time were of no concern, since the pumps were fueled by natural gas supplied by pipelines crossing the property at no cost to property owners. For roughly 25-30 years the area was drained and disked. Farming operations ceased in 1985.

Upon termination of farming operations the properties were leased for a commercial duck hunting facility. Dewatering of the area on a yearly basis ceased. Years of drying and disking caused the rich organic soils in the area to oxidize, eventually lowering the soil levels. When the commercial hunting facility was established, the areas were allowed to fill with water. Field depths were approximately 18 - 36 inches deep, with deeper areas in old canals. Water shield (*Brasenia schreberi*) and white water lily (*Nymphaea odorata*) quickly became established in the area. With water shield being the predominant aquatic species, numerous wintering waterfowl were attracted to the area.

To facilitate access and travel between several impounded areas, the farming infrastructure (drainage and flood canals) was breached to allow boat traffic between units. This created approximately two large units of 1,500 acres or more. When the Refuge was purchased, several of the breaches in the levees were closed to try and facilitate better water control and management in these units. However, with deterioration of canal systems through vegetation encroachment and lack of funds to operate pumps year round, the units began to close in through vegetation succession. Since purchase of the Refuge in 1988, the quality of wintering waterfowl habitat in these areas has declined due to the expansion of emergent vegetation, primarily California bullwhip (also called Bullwhip) and maidencane.

Prior to Service acquisition, the water-to-emergent vegetation ratio in these units was approximately 75 percent water to 25 percent emergent vegetation. Currently (2000) the water-to-emergent ratio is roughly 35 percent water to 65 percent emergent vegetation. The Refuge

currently has partial control capabilities through pumping to dewater the area; however, water can no longer be pumped into the units.

Unit 2A

From the 1950's until 2001-2002, the history of this sub-unit is very similar to that of Unit 1 above. During 2001 – 2002, the Refuge constructed a levee across Unit 2 to create two units of approximately the same size. The plans were to dewater a small area, thus decreasing time required prior to manipulation. The southern unit created by the cross levee was dewatered and an initial disking took place in the late summer. Unfortunately, a tropical storm producing heavy rains flooded the area. With the fall and winter quickly approaching, the water was left on the unit.

Unit 2B

From the 1950's until 1985, the history of this sub-unit is very similar to that of Unit 1 above. When farming operations stopped, the properties were leased for a commercial duck hunting facility. Annual dewatering of the area ceased. By the time the Refuge was purchased, Unit 2B was dominated by maidencane, with very little open water. Over the years these open water areas have all but disappeared. The area now has very little or no value as waterfowl habitat.

Unit 2C

The history of this sub-unit is identical to that of Unit 2B above. Unit 2C has very little or no value as waterfowl habitat, as in the case of Unit 2B.

Unit 3A & 3B

The history of this unit, with its two sub-units, is similar to the history of the previous units. The Refuge currently has minimal capabilities to manage water within this unit.

Unit 4

Much of this unit's history was similar to that of Unit 1. However, only a small portion of the unit was ever pumped for rice production; most was generally used for cattle grazing. Because Unit 4 was not farmed, the soils did not oxidize to the same extent as the farmed units. Under private ownership, the area was dominated by maidencane with small open water areas. With the cattle grazing aspect removed from the area, maidencane stands began to become very dense and encroached into the watered areas. The unit is now virtually 100% dominated by maidencane. Over the past four years two wildfires have occurred within this unit.

Unit 5

Unit 5 has a similar history to most of the others. During the 1950's approximately 435 acres of freshwater marsh was impounded by a levee system and pumped to create agriculture fields on which rice was cultivated until 1985 on a 2-3 year rotation. One large low-lift double discharge pump was used to dewater and flood the area and for 25 - 30 years the area was drained and disked.

Upon termination of farming operations the properties were leased for a commercial duck hunting facility. Dewatering of the area on a yearly basis ceased. When the Refuge was purchased, the dominant vegetation within the unit was four corner grass (*Eleocharis quadrangulata*), maidencane, and other vegetation with low wildlife value. The old pump and engine were replaced; however, the deteriorated canals and levees made water management difficult. Pumps had not been operated adequately to maintain the area in an early vegetation stage, thus the unit began to close in through vegetation succession.

Unit 6

Unit 6's history is much like Unit 5's: from the 1950's to the mid-1980's, it was drained and disked regularly to cultivate rice on 2-3 year rotations. Later it was leased for commercial duck hunting. When the Refuge was purchased, the dominant vegetation within the lower areas within the unit was four corner grass, maidencane, and other vegetation with low wildlife value; the higher elevations were dominated by Vasey grass, sumpweed (*Iva annua*), and other grasses and forbs. With no agricultural practices the levees and higher portions of the fields were being colonized by wax-myrtle, marsh elder (*Iva frutescens*), Chinese tallow and other woody plants. The old pump and engine were replaced. The Refuge tries to maintain this area in early succession, since it is contained within the Pintail Wildlife Drive.

Unit 7

During the 1950's approximately 184 acres of coastal prairie and freshwater marsh were impounded by a levee system and pumped to create agriculture fields. With the same low-lift pump used practically year-round on Units 6, 9, and 10, Unit 7 was dewatered, a total of 921 acres were disked and cultivated for rice. Farming operations stopped in 1985, at which time Unit 7, along with others, was leased for commercial duck hunting. When the Refuge was purchased, the dominant vegetation within the unit was four corner grass, maidencane, cattail, and other plants with little wildlife value. The old pump, engine and pump house have been replaced. The pump is inefficient at managing water within all four units. The Refuge has attempted to improve water management capabilities through levee and canal maintenance; however, it has proven to be difficult and costly.

Unit 8

During the 1950's approximately 1,600 acres of freshwater marsh were impounded to create a reservoir for farming operations. From the 1950's - 1985 the area was maintained as a reservoir in case of low rainfall for irrigation purposes. After farming ceased, the area was utilized for waterfowl hunting. With little maintenance, levees deteriorated, eventually breaching near the Gulf Intracoastal Waterway. Water level management within the unit is difficult, if not impossible.

Dominant vegetation within the unit is four corner grass, maidencane, cattail, white water lily (*Nymphaea odorata*), water shield and other submerged and emergent vegetation. The unit has proven to be very attractive to wintering pintail and mallards utilizing the Refuge. The Refuge has attempted to improve water management capabilities through levee and canal maintenance but this is difficult and expensive.

Unit 8 was proposed as a public fishing area in February, 1992. Fishery biologists recommended the area be opened for fishing in March of 1992. It was announced shortly after in a news release by the Refuge that "Work continues on renovation and development of the 1,600-acre impoundment that will be stocked with sport fish for future fishing opportunities." It was determined that a levee on the south end of the unit would have to be constructed and other surrounding levees improved sufficiently to maintain water levels two feet deeper than existing water levels.

In 1992, the Refuge submitted requests for funding this project through its fiscal database. Current guidance on project funding will be available in the year 2011.

Unit 9

The history of Unit 9 from the 1950's to the 1980's parallels that of units 6, 7, and 10. Like those units, Unit 9's 317 acres were dominated by plants with low wildlife value when the Refuge was purchased. In addition to four corner grass, maidencane, and cattail, Unit 9 had large quantities of Chinese tallow, black willow, and wax-myrtle. The Refuge has attempted to improve water management capabilities through levee and canal maintenance, but this is difficult and costly.

Unit 10

This unit's 157 acres share a common history of rice cultivation, dewatering, disking, and subsequent duck hunting with units 6, 7, and 9. As in the case of those units, water management in Unit 10 has proved difficult and costly.

Unit 11A & 11B

While most of the lands that now comprise the Refuge were converted to agricultural fields, Units 11A & 11B remained unimpounded and in a somewhat natural state. The areas were used for cattle grazing and for recreational hunting. Prior to the purchase of the Refuge these activities kept several ponds and canals free of vegetation and accessible. However with removal of these activities, many of the ponds and canals became vegetated, reducing water flow, access and value as wildlife habitat. On several occasions the Refuge has been approached by local officials as to the possibility of improving water movement from the area, as it affects a small community north of the Refuge.

Dominant vegetation within the unit is maidencane, giant cut-grass (*Zizaniopsis miliacea*), sawgrass (*Cladium jamaicense)*, Roseau cane (*Phragmites australis*), and cattail (*Typha domingensis*). On higher elevations and along canal banks, black willow and Chinese tallow have become established.

Unit 12A & 12B

Like Unit 11, Units 12A & 12B remained unimpounded, in a somewhat natural state, and were used for cattle grazing and recreational hunting. The previous landowners utilized these activities as well as using fire in attempts to control unwanted vegetation while providing access and recreation activities. However, with removal of these activities much of the area has become dominated by undesirable vegetation, reduced water flow, decreased access and reduced value as wildlife habitat. In the 14-year history of the Refuge this area has been prescribed burned only once. Unique features of the area are pimple mounds, small mounds 30 – 40' round and one to two feet higher in elevation than the surrounding area. Shrubs growing on these pimple mounds are important to many grassland dependent birds, both migratory and non-migratory. Dominant vegetation within the unit is identical to Unit 11's with the addition of wax-myrtle on higher elevations and canal banks.

Unit 13A & 13B

Like Unit 12A & 12B, Units 13A & 13B remained unimpounded, in a somewhat natural state, and were used for cattle grazing and recreational hunting. The previous landowners utilized these activities as well as using fire in attempts to control unwanted vegetation while providing access and recreation activities. However, with removal of these activities much of the area has become dominated by undesirable vegetation, reduced water flow, decreased access and reduced value as wildlife habitat. In the 14-year history of the Refuge this area has been prescribed burned only once. Unique features of the area are pimple mounds, small mounds 30 – 40' round and one to two feet higher in elevation than the surrounding area. Shrubs growing on these pimple mounds are important to many grassland dependent birds, both migratory and non-migratory. Dominant

vegetation within the unit is identical to Unit 11's with the addition of wax-myrtle on higher elevations and canal banks.

Unit 14A & 14B

Units 14A & 14B are located in the margin or ecotone where historical coastal marshes met the more upland coastal prairies. During the 1950's approximately 1,400 acres of coastal prairie were impounded by a levee system, pumped, and leveled for commercial rice production. These areas were farmed on a 2-3 year rotation until the Refuge was established in 1988, after which farming acreage declined each year until it ceased altogether in 1995. After farming stopped, the plant community changed and came to be dominated by Vasey grass by 1999. The Refuge has been trying to improve water management capability in 14A & 14B to create quality moist soil units for reliable food production each fall. This has been achieved by creating more manageable units or fields. Portions of Units 14A & 14B will be managed for restoration of native prairie.

Appendix D: Refuge Biota

Species identified as occurring on Cameron Prairie National Wildlife Refuge (source: USFWS 2006)

Common Name	Scientific Name
BIRDS	
Loons	
Common Loon	*Gavia immer*
Grebes	
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps nigricollis*
Pelicans and their Allies	
American White Pelican	*Pelecanus erythrorhynchos*
Double–crested Cormorant	*Phalacrocorax auritus*
Neotropic Cormorant	*Phalacrocorax brasilianus*
Anhinga	*Anhinga anhinga*
Magnificent Frigatebird	*Fregata magnificens*
Herons, Egrets, and Allies	
American Bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*

Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Reddish Egret	*Egretta rufescens*
Cattle Egret	*Bubulcus ibis*
Green Heron	*Butorides virescens*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Yellow-crowned Night-Heron	*Nycticorax violacea*

Ibis, Spoonbill, and Stork

Glossy Ibis	*Plegadis falcinellus*
White Ibis	*Eudocimus albus*
White-faced Ibis	*Plegadis chihi*
Roseate Spoonbill	*Platalea ajaja*
Wood Stork	*Mycteria americana*
Sandhill Crane	*Grus canadensis*

Waterfowl

Fulvous Whistling-Duck	*Dendrocygna bicolor*
Black-bellied Whistling Duck	*Dendrocygna autumnalis*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Ross's Goose	*Chen rossii*
Canada Goose	*Branta canadensis*
Wood Duck	*Aix sponsa*
Green-winged Teal	*Anas crecca*
American Black Duck	*Anas rubripes*
Mottled Duck	*Anas fulvigula*

Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
American Wigeon	*Anas americana*
Canvasback	*Aytha valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Lesser Scaup	*Aythya affinis*
Common Goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*

Vultures, Hawks, and Allies

Black Vulture	*Coragyps atratus*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*

Broad-winged Hawk	*Buteo platypterus*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Northern Caracara	*Caracara cheriway*

Gallinaceous Birds (Quail, Turkey, and Allies)

Northern Bobwhite Quail	*Colinus virginianus*

Rails, Gallinules, Coots, and Cranes

Yellow Rail	*Cotumicops noveboracensis*
Black Rail	*Laterallus jamaicensis*
Clapper Rail	*Rallus longirostris*
King Rail	*Rallus elegans*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Purple Gallinule	*Porphyrio martinica*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica Americana*

Shorebirds

Black-bellied Plover	*Pluvialis squatarola*
American Golden-Plover	*Pluvialis dominica*
Wilson's Plover	*Charadrius wilsonia*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*

Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Spotted Sandpiper	*Actitis macularia*
Upland Sandpiper	*Bartramia longicauda*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Red Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
White-rumped Sandpiper	*Calidris fuscicollis*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt Sandpiper	*Calidris himantopus*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Buff-breasted Sandpiper	*Tryngites subruficollis*
Common Snipe	*Gallinago gallinago*
American Woodcock	*Scolopax minor*

Laughing Gull	*Larus atricilla*
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus Philadelphia*
Ring-billed Gull	*Larus delawarensis*
Herring Gull	*Larus argentatus*
Gull-billed Tern	*Stema nilotica*
Caspian Tern	*Stema caspia*
Royal Tern	*Stema maxima*
Common Tern	*Stema hirundo*
Forster's Tern	*Stema forsteri*
Least Tern	*Stema antillarum*
Black Tern	*Childonias niger*
Black Skimmer	*Rynchops niger*
Pigeons and Doves	
Mourning Dove	*Zenaida macroura*
White-winged Dove	*Zenaida asiatica*
Cuckoos	
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Yellow-billed Cuckoo	*Coccyzus americanus*
Groove-billed Ani	*Crotophaga sulcirostris*
Owls	
Barn Owl	*Tyto alba*
Eastern Screech Owl	*Megascops asio*
Great Horned Owl	*Bubo virginianus*
Burrowing Owl	*Athene cunicularia*

Short-eared Owl	*Asio flammeus*
Nightjars	
Common Nighthawk	*Chordeiles minor*
Chuck-will's widow	*Caprimulgus carolinensis*
Whip-poor-will	*Caprimulgus vociferus*
Swifts and Hummingbirds	
Chimney Swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Kingfishers	
Belted Kingfisher	*Megaceryle alcyon*
Woodpeckers	
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Downy Woodpecker	*Picoides pubescens*
Northern Flicker	*Colaptes auratus*
Red-bellied Woodpecker	*Melanerpes carolinus*
Hairy Woodpecker	*Picoides villosus*
Flycatchers	
Olive-sided Flycatcher	*Contopus cooperi*
Eastern Wood-Pewee	*Contopus virens*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Acadian Flycatcher	*Empidonax virescens*
Eastern Phoebe	*Sayomis phoebe*
Vermilion Flycatcher	*Pyrocephalus rubinus*

Great Crested Flycatcher	*Myiarchus crinitus*
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird	*Tyrannus tyrannus*
Scissor-tailed Flycatcher	*Tyrannus forficatus*
Martins and Swallows	
Purple Martin	*Progne subis*
Tree Swallow	*Iridoproche bicolor*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Jays and Crows	
Blue Jay	*Cyanocitta cristata*
Fish Crow	*Corvus ossifragus*
Nuthatchers	
Red-breasted Nuthatch	*Sitta canadensis*
Creepers	
Brown Creeper	*Certhia ameicana*
Wrens	
Carolina Wren	*Thryothorus ludovicianus*
Winter Wren	*Troglodytes troglodytes*
Sedge Wren	*Cistothorus platensis*
Marsh Wren	*Cistothorus palustris*
House Wren	*Troglodytes aedon*

Carolina Chickadee	*Poecile carolinensis*
Kinglets and Gnatcatchers	
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Bluebirds, Thrushes and Robins	
Eastern Bluebird	*Sialia sialis*
Veery	*Catharus fuscescens*
Gray-cheeked Thrush	*Catharus minimus*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
Wood Thrush	*Hylocichla mustelina*
American Robin	*Turdus migratorius*
Thrashers	
Gray Catbird	*Dumetella carolinensis*
Brown Thrasher	*Toxostoma rufum*
Northern Mockingbird	*Mimus polyglottos*
Pitpits	
American Pitpit	*Anthus rubescens*
Waxwings	
Cedar Waxwing	*Bombycilla cedrorum*
Starling	
European Starling	*Sturnus vulgaris*

Shrike

Loggerhead Shrike	*Lanius ludovicianus*

Vireos

White-eyed Vireo	*Vireo griseus*
Blue-headed Vireo	*Vireo solitarius*
Yellow-throated Vireo	*Vireo flavifrons*
Warbling Vireo	*Vireo gilvus*
Red-eyed Vireo	*Vireo olivaceus*
Philadelphia Vireo	*Vireo philadelphicus*

Warblers

Blue-winged Warbler	*Vermivora pinus*
Golden-winged Warbler	*Vermivora chrysoptera*
Tennessee Warbler	*Vermivora peregrine*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficapilla*
Yellow Warbler	*Dendroica petechia*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Green Warbler	*Dendroica virens*
Blackburnian Warbler	*Dendroica fusca*
Yellow-throated Warbler	*Dendroica dominica*

Prairie Warbler	*Dendroica discolor*
Palm Warbler	*Dendroica palmarum*
Bay-breasted Warbler	*Dendroica castanea*
Blackpole Warbler	*Dendroica striata*
Cerulean Warbler	*Dendroica cerulea*
Black-and-white Warbler	*Mniotilta varia*
American Redstart	*Setophaga ruticilla*
Prothonotary Warbler	*Protonotaria citrea*
Worm-eating Warbler	*Helmitheros vermivorus*
Ovenbird	*Seiurus aurocapilla*
Northern Waterthrush	*Seiurus noveboracensis*
Louisiana Waterthrush	*Seiurus motacilla*
Kentucky Warbler	*Oporornis formosus*
Mourning Warbler	*Oporonis philadelphia*
Hooded Warbler	*Wilsonia citrina*
Canada Warbler	*Wilsonia canadensis*
Yellow-breasted Chat	*Icteria virens*
Northern Parula	*Parula americana*
Common Yellowthroat	*Geothlypos trichas*
Wilson's Warbler	*Wilsonia pusilla*

Tanagers

Summer Tanager	*Piranga rubra*
Scarlet Tanager	*Piranga olivacea*
Western Tanager	*Piranga ludoviciana*

New World Finches

Northern Cardinal	*Cardinalis cardinalis*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Blue Grosbeak	*Passerina caerulea*
Indigo Bunting	*Passerina cyanea*
Painted Bunting	*Passerina ciris*
Dickcissel	*Spiza Americana*

Sparrows

Eastern Towhee	*Pipilo erythrophthalmus*
Field Sparrow	*Spizella pusilla*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Savannah Sparrow	*Passerculus sandwichensis*
LeConte's Sparrow	*Ammodramus leconteii*
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
White-crowned Sparrow	*Zonatrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Chipping Sparrow	*Spizella passerina*

Blackbirds, Grackles, Cowbirds and Orioles

Red-winged Blackbird	*Agelais phoeniceus*
Eastern Meadowlark	*Stumella magna*

Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Rusty Blackbird	*Euphagus carolinus*
Boat-tailed Grackle	*Quiscalus major*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Orchard Oriole	*Icterus spurious*
Altamira Oriole	*Icterus galulris*
Bobolink	*Dolichonyx oryzivorus*
Great-tailed Grackle	*Quiscalus mexicanus*

Old World Finches

Purple Finch	*Carpodacus purpureus*
American Goldfinch	*Carduelis tristis*

Weaver Finches

House Sparrow	*Passer domesticus*

MAMMALS

Marsupials

Virginia Opossum	*Didelphis marsupialis*

Edentates

Nine-banded armadillo	*Dasypus novemcinctus*

Insectivores

Least Shrew	*Cryptotis parva*

Bats

Red Bat	*Lasiurus borealis*
Seminole Bat	*Lasiurus seminolus*
Yellow Bat	*Lasiurus ega*
Carnivores	
Coyote	*Canis latrans*
Gray Fox	*Urocyon cinereoargenteus*
Red Fox	*Vulpes vulpes*
Raccoon	*Procyon lotor*
Mink	*Mustela vison*
Striped Skunk	*Mephitis mephitis*
River Otter	*Lutra canadensis*
Bobcat	*Lynx rufus*
Ungulates	
White-tailed Deer	*Odocoileus virginianus*
Feral swine	*Sus scrofa*
Rodents	
Marsh Rice Rat	*Orysomys palustris*
Fulvous Harvest Mouse	*Reithrodontomys fulvescens*
Hispid Cotton Rat	*Sigmodon hispidus*
Muskrat	*Ondatra zibethicus*
House Mouse	*Mus musculus*
Black Rat	*Rattus rattus*
Norway Rat	*Rattus norvegicus*
Nutria	*Myocastor coypus*
Fox Squirrel	*Sciurus niger*

Lagomorphs

Swamp Rabbit	*Sylvilagus aquaticus*
Eastern Cottontail	*Sylvilagus floridanus*

REPTILES AND AMPHIBIANS

Alligator

American Alligator	*Alligator mississippiensis*

Lizards

Green Anole	*Anolis carolinensis*
Broadhead Skink	*Eumeces laticeps*
Ground Skink	*Scinella lateralis*
Five-lined Skink	*Eumeces fasciatus*
Slender Glass Lizard	*Ophisaurus attenuates*

Turtles

Snapping Turtle	*Chelydra serpentina*
Alligator Snapping Turtle	*Macroclemys temminckii*
Mississippi Mud Turtle	*Kinosternon subrubrum hippocrepis*
Common Slider	*Trachemys scripta*
Spiny Softshell Turtle	*Apalone spinifera*
Chicken Turtle	*Deirochelys reticularia*
Eastern Box Turtle	*Terrapene carolina carolina*
Stinkpot Turtle	*Sternotherus odoratus*

Snakes

Southern Water Snake	*Nerodia fasciata*
Mississippi Green Water Snake	*Nerodia cyclopion*

Diamondback Water Snake	*Nerodia rhombifer*
Brown Snake	*Storeria dekayi*
Western Ribbon Snake	*Thamnophis proximus proximus*
Glossy Crayfish Snake	*Regina rigida*
Eastern Hognose Snake	*Heterodon platirhinos*
Mud Snake	*Farancia abacura*
Racer	*Coluber constrictor*
Rat Snake	*Drymobius elaphe*
Common Kingsnake	*Lampropeltis getulus*
Southern Copperhead	*Agkistrodon contortrix contortrix*
Cottonmouth	*Agkistrodon piscivorus*
Pigmy Rattlesnake	*Sistrurus miliarius*
Yellow-bellied Water Snake	*Nerodia erythrogaster flavigaster*
Rough Green Snake	*Opheodrys aestivus*
Graham's Crayfish Snake	*Regina grahamii*

Salamanders

Three-toed Amphiuma	*Amphiuma tridactylum*

Frogs and Toads

Gulf Coast Toad	*Bufo valliceps valliceps*
Northern Cricket Frog	*Acris crepitans crepitans*
Green Treefrog	*Hyla cinera*
Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*
Bullfrog	*Rana catesbeiana*
Pig Frog	*Rana grylio*
Southern Leopard Frog	*Rana utricularia*

Squirrel Tree Frog	*Hyla squirella*
Woodhouse Toad	*Bufo woodhousii woodhousii*

CRUSTACEA

Crustaceans

White River Crayfish	*Procambarus acutus*
Red Swamp Crayfish	*Procambarus clarkii*
White shrimp	*Litopenaeus setiforus*
Brown shrimp	*Farfantepenaeus aztecus*

Isopods and Amphipods

Wood-boring Isopod	*Limnoria tripunctata*
Rock Louse	*Ligia exotica*
Smooth-backed Isopod	*Sphaeroma quadridentatum*
Fish Louse	*Cymothous spp.*
Wharf Roach	*Ligia spp.*
Beach Flea	*Orchestia grillus*
Marsh Hopper	*Talorchestia spp.*

FISH

Gars

Spotted Gar	*Lepisosteus oculatus*
Longnose Gar	*Lepisosteus osseus*
Alligator Gar	*Atractosteus spatula*

Bowfins

Bowfin	*Amia calva*

Herrings	
Gizzard Shad	*Dorosoma cepedianum*
Threadfin Shad	*Dorosoma petenense*
Lizardfishes	
Inshore Lizardfish	*Synodus foetens*
Carps	
Common Carp	*Cyprinus carpio*
Golden Shiner	*Notemigonus crysoleucas*
Suckers	
Bigmouth Buffalo	*Ictiobus cyprinellus*
Freshwater Catfishes	
Blue Catfish	*Ictalurus furcatus*
Black Bullhead	*Ictalurus melas*
Yellow Bullhead	*Ictalurus natalis*
Channel Catfish	*Ictalurus punctatus*
Sunfishes	
Banded Pygmy Sunfish	*Elassoma zonatum*
Warmouth	*Lepomis gulosus*
Bluegill	*Lepomis macrochirus*
Redear Sunfish	*Lepomis punctatus*
Bantam Sunfish	*Lepomis symmetricus*
Green Sunfish	*Lepomis cyanellus*
Largemouth Bass	*Micropterus salmoides*
White Crappie	*Pomoxis annularis*

Black Crappie	*Pomoxis nigromaculatus*

Drums

Freshwater Drum	*Aplodinotus grunniens*
Spot	*Leiostomus xanthurus*

Mullets

Striped Mullet	*Mugil cephalus*
White Mullet	*Mugil curema*

PLANTS

Alligator Weed	*Alternanthera philoxeroides*
American Lotus	*Nelumbo lutea*
Baccharis	*Baccharis halimifolia*
Baldcypress	*Taxodium distichum*
Banana Water Lily	*Nymphaea mexicana*
Barnyard Grass	*Echinochloa crusgalli*
Black Needlerush	*Juncus roemerianus*
Black Willow	*Salix nigra*
Beggar'sTick	*Bidens laevis*
Bird's Eye Bush	*Ochna serrrulata*
Blue Water Lily	*Nymphaea elegans*
Brazilian Vervain	*Verbena brasiliensis*
Brownseed Paspalum	*Paspalum plicatulum*
Bulrush	*Scirpus spp.*
Bulltongue	*Sagittaria lancifolia*
Bushy Bluestem	*Andropogon glomeratus*
Buttonbush	*Cephalanthus occidentalis*

Bullwhip	*Schoenoplectus californicus*
Cattail	*Typha spp.*
Chinese Tallow	*Triadica sebifera*
Chocolate Weed	*Melochia corchorifolia*
Coastal Water-Hyssop	*Bacopa monnieri*
Coffee Bean	*Sesbania drummondii*
Coffeeweed	*Sesbania macrocarpa*
Common Bladderwort	*Utricularia macrorhiza*
Common Salvinia	*Salvinia minima*
Coontail	*Ceratophyllum demersum*
Curly-leaf Dock	*Rumex crispus*
Desert false indigo	*Amorpha fruticosa*
Duckweed	*Lemna minor*
Dog Fennel	*Eupatorium capillifolium*
Dwarf Spikerush	*Eleocharis parvula*
Eastern gammagrass	*Tripsacum dactyloides*
Eurasian Watermilfoil	*Myriophyllum spicatum*
Fall Panicum	*Panicum dichotomiflorum*
False Garlic	*Nothoscordum bivalve*
False indigo	*Baptisia spp.*
Fanwort	*Cabomba caroliniana*
Flatsedges	*Cyperus spp.*
Floating Water Primrose	*Ludwigia peploides*
Four Corner Grass	*Eleocharis quadrangulata*
Frogbit	*Limnobium spongia*
Frogfruit	*Phyla nodiflora*

Giant Cutgrass	*Zizaniopsis miliacea*
Giant Ragweed	*Ambrosia trifida*
Giant salvinia	*Salvinia molesta*
Grasslike Fimbry	*Fimbristylis miliacea*
Green Flatsedge	*Cyperus virens*
Hackberry	*Celtis laevigata*
Horned Beakrush	*Rhynchospora corniculata*
Hydrilla	*Hydrilla verticillata*
Iris	*Iris virginica*
Jungle Rice	*Echinochloa colona*
Macartney Rose	*Rosa bracteata*
Maidencane	*Panicum hemitomon*
Marsh Elder	*Iva frutescens*
Marshhay Cordgrass	*Spartina patens*
Milkweeds	*Asclepias spp.*
Mosquito-Fern	*Azolla caroliniana*
Muskgrass	*Chara spp.*
Nuttall false indigo	*Baptisia nuttalliana*
Parrot Feather	*Myriophyllum aquaticum*
Pennywort	*Hydrocotyle spp*
Persimmon	*Diospyros virginiana*
Phragmites , Roseau cane, common reed	*Phragmites australis*
Pickerelweed	*Pontederia cordata*
Pond weed	*Potamogeton spp.*
Rattlebox, coffeebean	*Sesbania drummondii*
Red Rice	*Oryza sativa*

Sago Pondweed	*Stuckenia pectinatus*
Saltgrass	*Distichlis spicata*
Saltmarsh Mallow	*Kosteletzkya virginica*
Saltmarsh Morning Glory	*Ipomoea sagittata*
Sawgrass	*Cladium jamaicense*
Seashore Paspalum	*Paspalum vaginatum*
Smartweed	*Polygonum spp.*
Softstem Bullwhip	*Schoenoplectus tabernaemontani*
Southern Naiad	*Najas guadalupensis*
Southern Swamp Lily	*Crinum americanum*
Southern Wild Rice	*Zizania aquatica*
Spadderdock	*Nuphar lutea*
Spikerushes	*Eleocharis spp.*
Sprangletop	*Leptochloa fascicularis*
Squarestem Spikerush	*Eleocharis quadrangulata*
Sumpweed	*Iva annua*
Thalia	*Thalia dealbata*
Thin-leaf Pondweed	*Potamogeton pusillus*
Three-cornered Grass	*Scirpus olneyi*
Toothache Tree	*Zanthoxylum clava-herculis*
Vasey Grass	*Paspalum urvillei*
Walter's Millet	*Echinochloa walteri*
Water Hyacinth	*Eichornia crassipes*
Water Lettuce	*Pistia stratiotes*
Water Pepper	*Polygonum hydropiperoides*
Water Shield	*Brasenia schreberi*

Waxmyrtle	*Morella cerifera*
White-topped Sedge	*Rhynchospora colorata*
White Water Lily	*Nymphaea odorata*
Widgeon-grass	*Ruppia maritima*

Appendix E: Threatened and Endangered Species of Cameron Parish, Louisiana

E=Endangered T=Threatened C=Candidate CH=Critical Habitat *

Species	Occurrence	Taxonomic Group	Status
West Indian Manatee	Possible	Mammal	E
Piping plover	Known	Bird	T, CH
Gulf sturgeon	Known	Fish	T
Green sea turtle	Known	Reptile	T
Hawksbill sea turtle	Known	Reptile	E
Kemp's Ridley sea turtle	Known	Reptile	E
Leatherback sea turtle	Known	Reptile	E
Loggerhead sea turtle	Known	Reptile	T

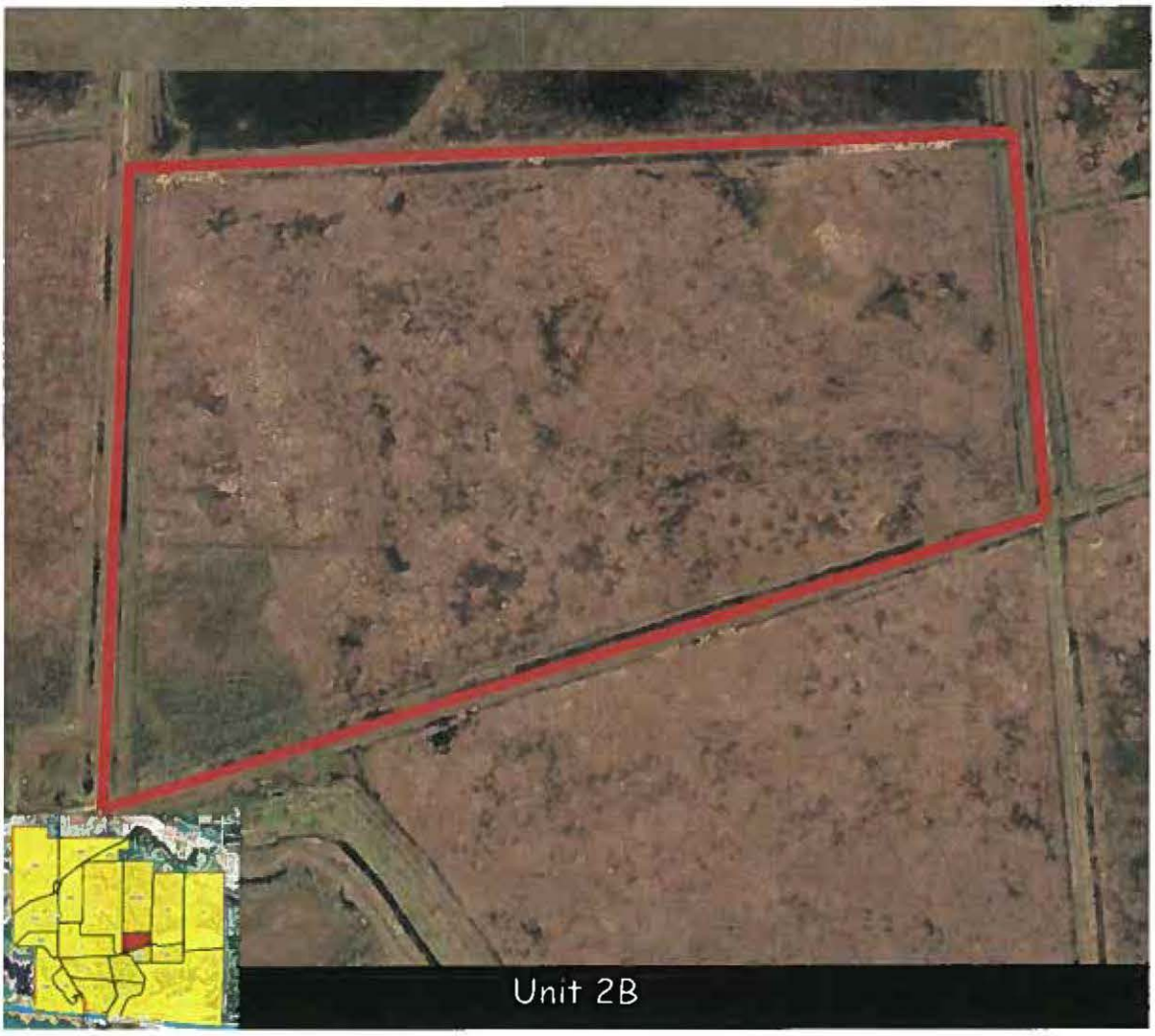
Appendix F: Moist Soil Management Data Collection and Actions

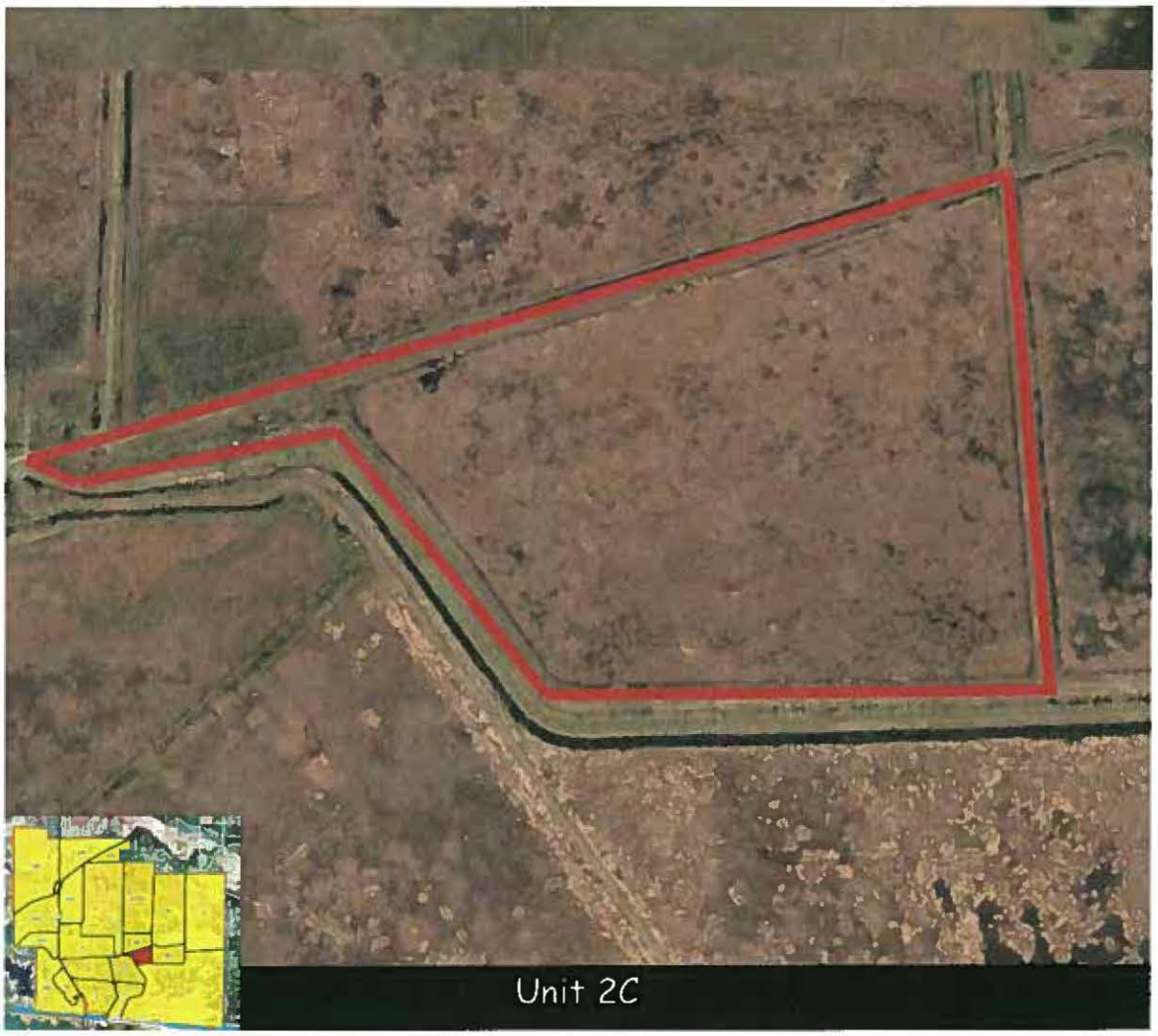
10 Year Plan	Refuge Units	Est. Acres to Assess	Total
2012	14A/14B	919/414	1333
2013	13A/13B	433/500	933
2014	12A/12B	182/140	332
2015	11A/11B	118/343	461
2016	9/10	309/189	498
2017	8	1667	1677
2018	5/6/7	427/291/213	931
2019	4	889	889
2020	3A/3B	664/166	830
2021	1/2A/2B/2C	903/603/135/89	1730
Grand Total:			9614

This "habitat management action" considers the instance of past agricultural operations and the revitalization time necessary for wetland vegetation to respond. This will occur before the next habitat management action is scheduled. The action also considers transitory disturbances from natural events (hurricanes, drought, etc.) and distributes these impacts across the refuge's landscapes over a 10-year period.

Appendix G: Management Unit Maps


Unit 2A


Unit 2B


Unit 2C


Unit 3A

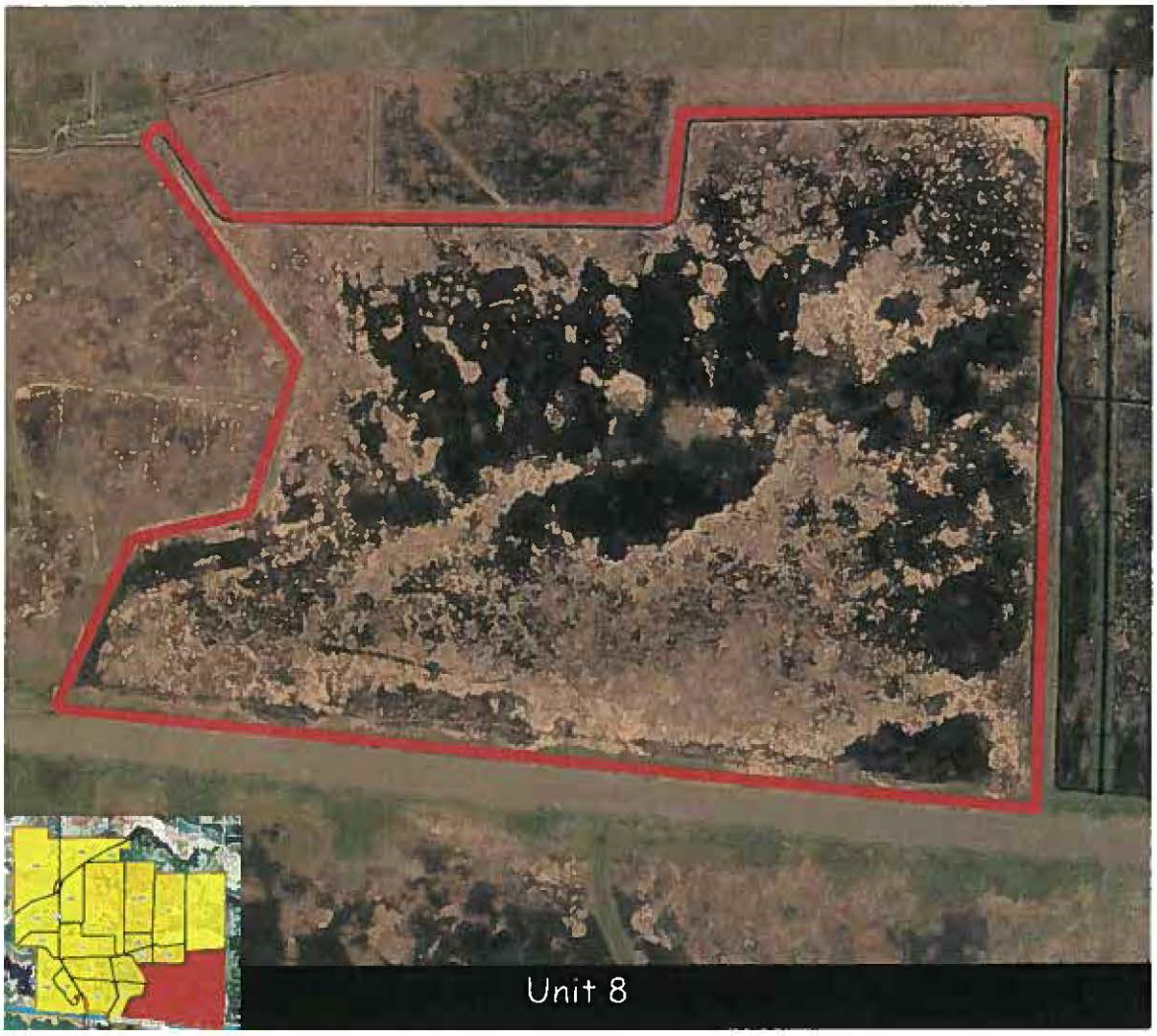

Unit 3B


Unit 4


Unit 5


Unit 6

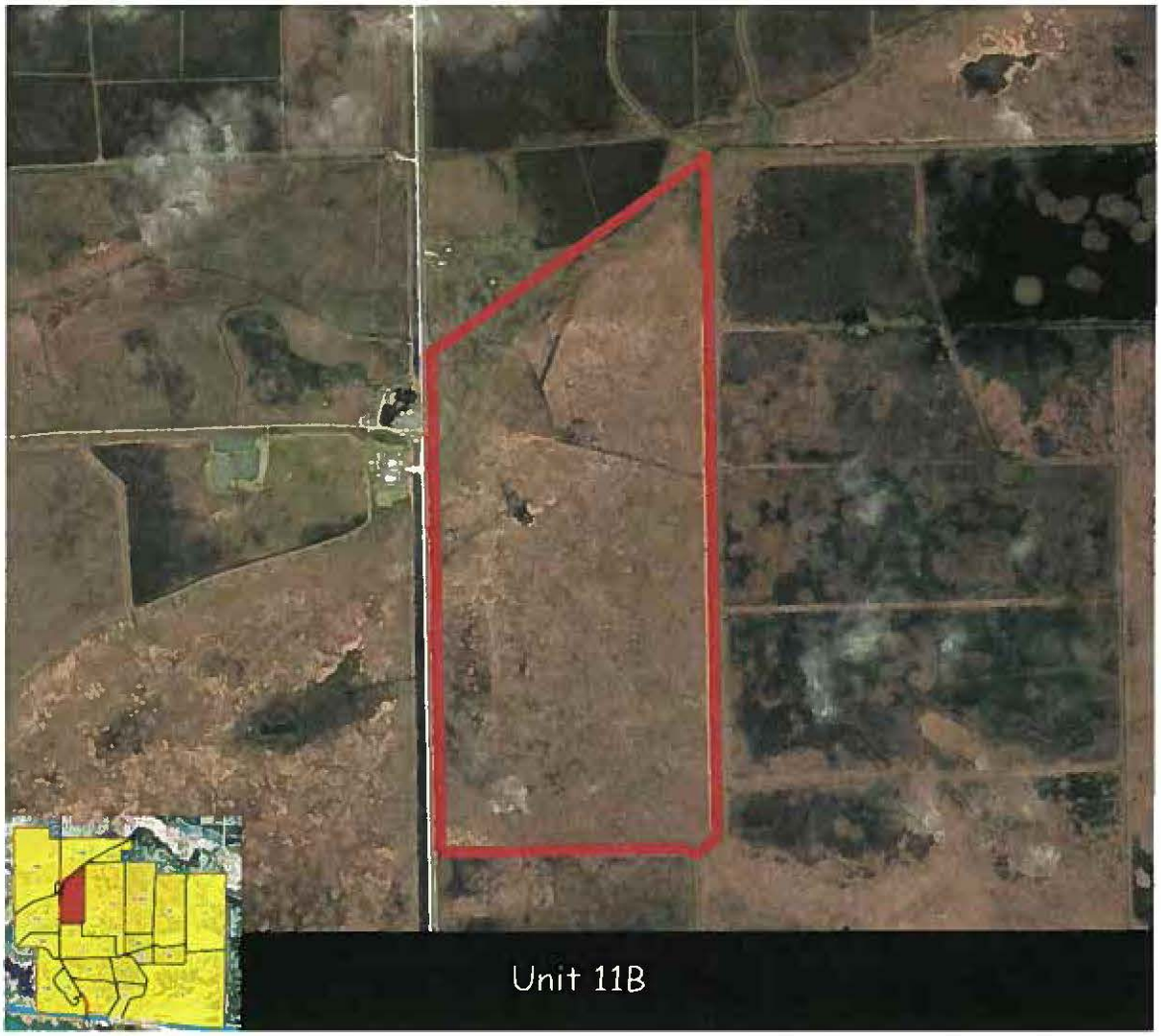

Unit 7


Unit 8


Unit 9

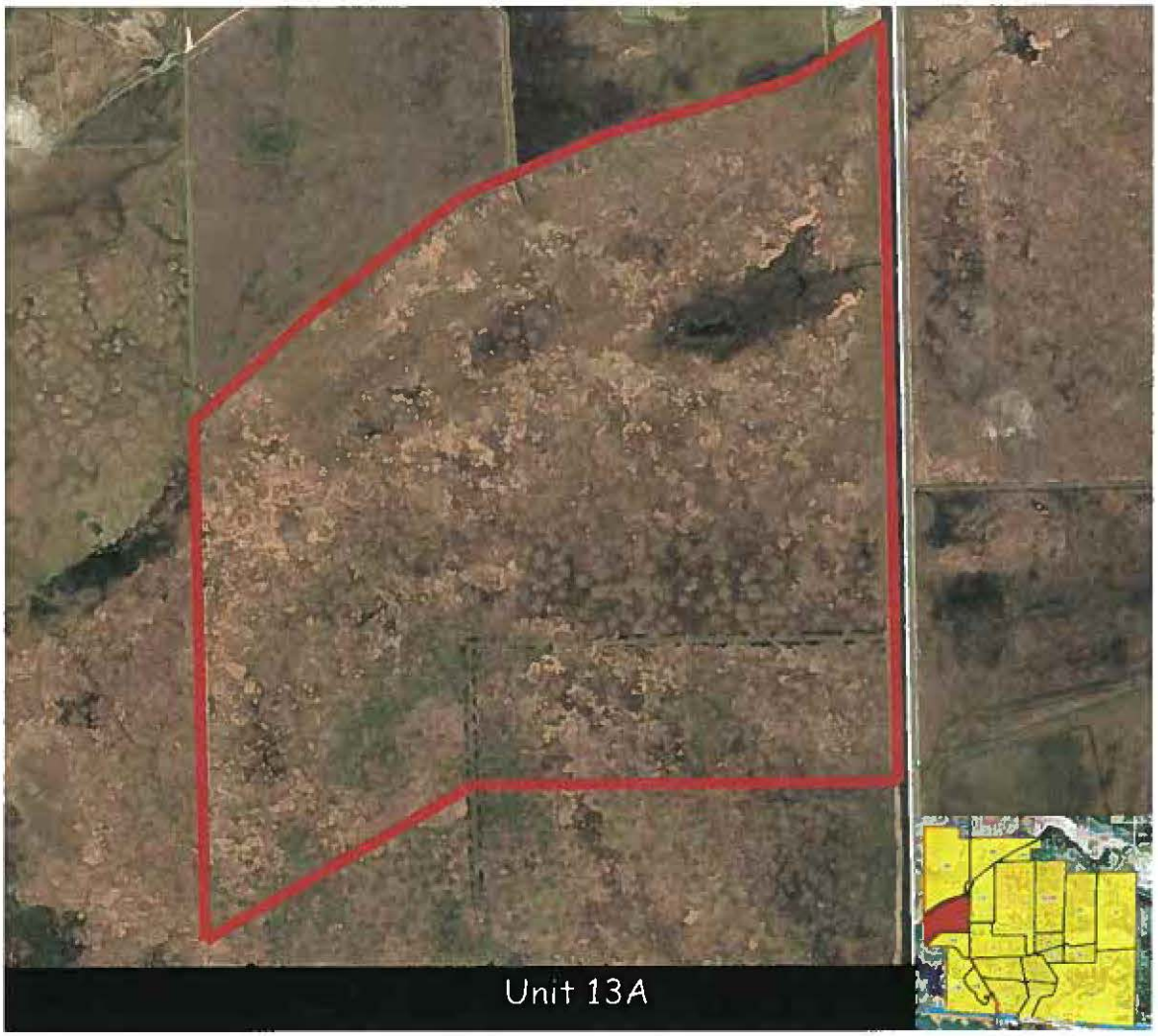

Unti 10


Unit 11A


Unit 11B


Unit 12A


Unit 12B


Unit 13A


Unit 13B


Unit 14A


Unit 14B

Appendix H: Climate Change Impacts

Anthropogenic climate change is causing increases in global average land and ocean temperatures (Bedoya 2008). This warming trend is likely to cause substantial impacts to precipitation levels, sea level, species and ecosystems (USFWS 2010). The Southeast United States may be one of the most vulnerable regions in the United States to climate change mainly due to its high biodiversity and long, low-lying coastline (Smith 2004; Karl et al. 2009).

In the Southeast region the increase in average temperature is expected to continue with the greatest increases occurring in summer. The magnitude of rise is expected to be between 4.5° and 9° Fahrenheit by 2100 along with an increase in frequency of very hot days (Titus 2009; Congressional Budget Office 2009). The number of freezing days for most of the Southeast has declined by four to seven days per year since the mid-1970's (Karl et al. 2009).

Seasonal precipitation is also changing dramatically in this region. Fall precipitation over most of the region is up about 30 percent with only a small decrease in South Florida (Karl et al. 2009). Summer precipitation has decreased in most areas of the Southeast, and during the past three decades there have been several severe droughts. Across the region the proportion of precipitation that falls in high-intensity storms has increased. High intensity storms cause an increased chance of flooding (Karl et al. 2009).

Currently, climate change is not the most important driver of changes in biodiversity; however, it could be the largest driver by the end of the 21st century (Millennium Ecosystem Assessment 2005). Even so, there have already been measurable changes in global biodiversity due to climate change, particularly with regard to changes in species distributions, population sizes, timing of reproduction or migration events, and increases in the frequency of pest and disease outbreaks (Millennium Ecosystem Assessment 2005; Janetos et al. 2008). In the United States, climate change has already impacted terrestrial ecosystems by changing the timing of growing season length, phenology, and species distributions and diversity (Janetos et al. 2008).

As climate change disrupts ecological processes with increasing severity, the Refuge system is likely to experience significant changes in its physical and biological resources. Regional Climate Science Centers are being established by the Department of the Interior. These centers will provide scientific information, tools and techniques needed to manage land, water, wildlife and cultural resources in the face of climate change. The USGS and the DOI centers will also

work closely with a network of Landscape Conservation Cooperatives in which federal, state, tribal and other managers and scientists will develop conservation, adaptation and mitigation strategies for dealing with the impacts of climate change (U.S. Geological Survey 2010) (USFWS 2009).

In summary, climate change effects which can be expected on Cameron Prairie NWR include increased temperatures, increasing fall precipitation coupled with decreased summer precipitation, increased frequency and severity of droughts, increased intensity of hurricanes with possible increased frequency as well, and rising sea level. Local subsidence will exacerbate the effects of global sea level rise on southern Louisiana. Management of the refuge will certainly be affected by these changes, though the details are uncertain. Some likely scenarios, however, include the following:

- Increased temperatures and concomitant decreases in severity of cold weather may lead to changes in species composition, including increases in tropical and subtropical exotic invasives such as water hyacinth, giant salvinia, tallowtree, and nutria. Additional management actions may be required to control these species in this case.

- Droughts may increase severity of prescribed fires, and frequency and severity of wildfires, and may lead to more frequent dewatering of marsh habitat. Ground fires, in which organic soil horizons are consumed, may become more frequent.

- If rainfall distribution becomes more uneven, salinity fluctuation in marsh habitat may be wider, leading to changes in plant and animal communities which may or may not be desirable from a management perspective.

- More intense tropical storms will lead to recurring impacts similar to that experienced from Hurricanes Rita and Gustav—inundation of freshwater habitats with salt water, deposition of debris, both of natural and human origin, and damage to refuge infrastructure.

- Rising sea level, combined with local subsidence caused by geologic forces, will lead to increased salt water intrusion into surface waters and possibly into aquifers. Current salt marsh will convert to open water, while brackish and freshwater marsh habitats will become more saline. Management actions such as construction of levees and terraces may be used to mitigate these effects, but it is unknown whether they will provide a long-term solution.

Appendix I: Resource Management Plan for Cameron Creole Watershed

RESOURCE MANAGEMENT PLAN FOR CAMERON CREOLE WATERSHED
February 1987

BASIC OBJECTIVE:

Restore the project area to approximate the 1972 vegetative communities and salinity regimes.

SPECIFIC OBJECTIVES:

WEST OF 5 PPT ISOHALINE LINE

1. Curtail marsh erosion.

2. Maintain and improve the marsh and open water ponds for high value fisheries nursery and production areas.

3. Operate the water control structures to minimize reductions in access by estuarine organisms to nursery areas. Recruitment of estuarine dependent organisms will be accommodated to the greatest extent practicable to meet the overall basic objective.

4. Improve plant species diversity in emergent marshes which would improve the potential for wildlife habitat improvement.

5. Improve the aquatic vegetative component in the open water ponds.

EAST OF 5 PPT ISOHALINE LINE

1. Curtail marsh erosion.

2. Reclaim some of the emergent marshes that have been recently converted to open water by saltwater intrusion and subsequent marsh erosion.

3. Improve plant species diversity in the emergent marshes which would improve the potential for wildlife habitat improvement.

4. Improve aquatic plant species diversity.

5. Improve the marshes and open water ponds for freshwater fisheries.

SALINITY AND WATER LEVEL MANAGEMENT CRITERIA

1. Establish two isohaline lines based on historical vegetative communities and salinities to aid in guiding management procedures.

   A. Isohaline line no. 1 will be established at approximately 12 ppt (see attachment #1)

   B. Isohaline line no. 2 will be established at approximately 5 ppt (see attachment #1)

   C. Necessary salinity stations will be established and data gathered to monitor the salinity along these isohaline lines.

2. Water levels will be maintained in a range of 6 inches below normal marsh elevation up to 2 inches above normal marsh elevation based on water level readings taken along the 5 ppt isohaline line monitoring stations.

3. Deviation from the normal planned operation of these structures will be allowed in the event of unusual weather conditions (hurricanes, abnormal rainfall, etc) This would include utilizing the structures on Creole canal

PHASE ONE - TWO YEAR PERIOD

GENERAL: Phase I of the management plan will place primary emphasis on curtailing marsh erosion and reclaiming some of the emergent marshes that have been converted to open water ponds east of the 5 ppt isohaline line. These shallow, open water ponds are a result of recent deteriorating marshes and offer the greatest potential for revegetation to emergent marshes. If not revegetated in the near future, these shallow open water ponds will become too deep to practically revegetate.

FEBRUARY 15 TO JULY 15

1. Implement a partial drawdown of 6 inches below normal marsh elevation for the area east of the 5 ppt isohaline line. The open water ponds west of the 5 ppt isohaline line are much deeper and would maintain shallow water during the drawdown period. The drawdown would be accomplished by manipulation the water control structures during winter and spring frontal passages. At least one of the vertical slots in each structure will remain open this entire time period.

JULY 15 TO FEBRUARY 15

1. The partial drawdown will end on July 15 and water levels would be allowed to increase. On July 15 the crest of the variable structures will be set at 6 inches below normal marsh elevation and the vertical slots in all structures will be opened.

PHASE TWO

GENERAL: Phase II of the management plan will place primary emphasis on curtailing marsh erosion. Secondary emphasis on Phase II will be (1) maintain and improve fisheries habitat, (2) maintain and improve wildlife habitat, (3) increase plant diversity in emergent marshes that have been converted to open water ponds east of the 5 ppt isohaline line.

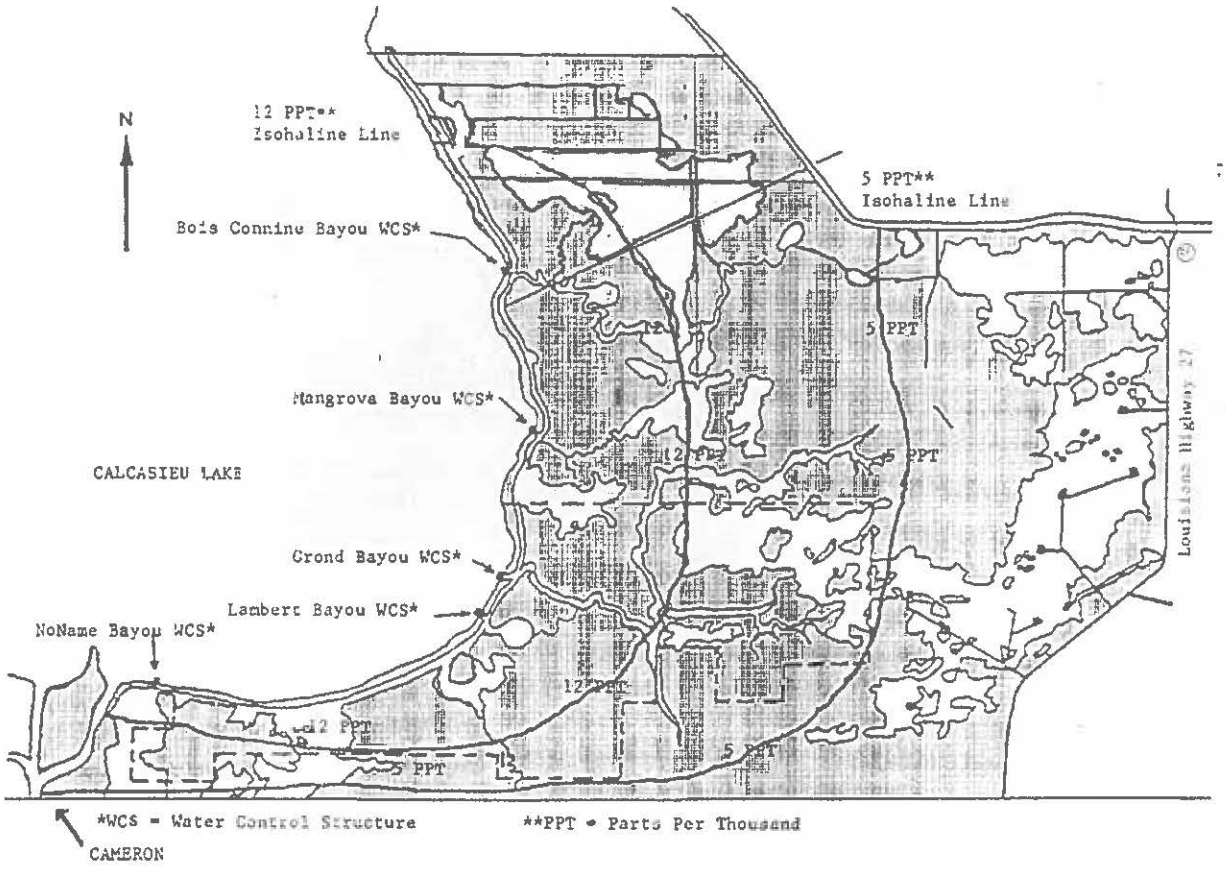
1. The Phase II basic management plan involves a "semi-static" water management scheme. The crests of all structures will be set at 6 inches below normal marsh elevations. The three, 6 inch slots in the structures will be left open. The boat bay on the Grand Bayou structure will be left open. (Boat Bay is serving same function as the slots for the Grand Bayou structure). Additionally, another flapgate on the Grand Bayou structure can be opened for fisheries purposes in (a) late winter and spring, (b) late summer and fall, ○ night, (d) in the winter with the approach of weather fronts expected to cause significant decrease in temperature, or (e) other special circumstances when conditions favor recruitment of young into the nursery areas.

NOTE: Temporary closures of the boat bay and other bays will be allowed if salinities exceed the 5 ppt limit at isohaline line no. 2.

2. Periodic partial drawdowns, as outlined in Phase One, can be carried out dependent on the success of the drawdowns in Phase One and recommendations of the advisory committee.

NOTE: The advisory committee will meet annually to review the progress of the management plan, and make recommendations regarding any needed changes. More frequent meetings can be held if the need arises.

CAMERON CREOLE WATERSHED PROJECT
ISOHALINE LINE



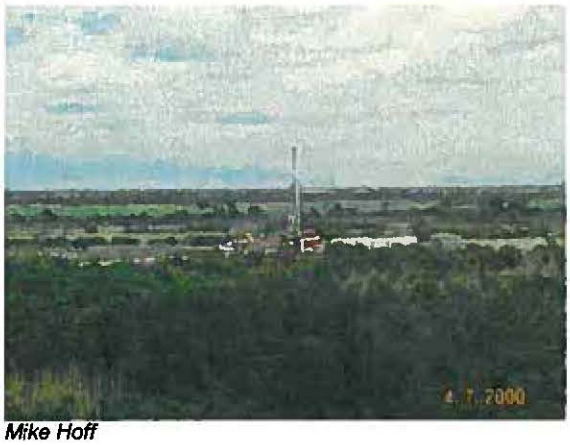
Appendix J: Oil and Gas Activities

The following is excerpted from the Cameron Prairie NWR Comprehensive Conservation Plan (USFWS 2006).

OIL AND GAS ACTIVITIES

General Information

Cameron Prairie does not hold the mineral rights for any of the acreage in its trust. Historically, a total of 19 wells have been dug on the land comprising Cameron Prairie National Wildlife Refuge, with 6 of these occurring since the Refuge was established. All have been plugged. The earliest known well dug was in 1953. Numerous seismic surveys have been conducted on the Refuge. The latest seismic activity occurred in 1996 on a total of 6,019 acres. Existing oil and gas infrastructure consists of three active underground transmission pipelines crossing the Refuge. These lines do not service producing wells on the Refuge, but move product through it.



Mike Hoff

Figure 22. Oil and gas test well.

Owners of the mineral rights infrequently request access to their oil and gas exploration rights. As recently as 2000, the Refuge permitted an exploratory well in Unit 9 (Figure 22). Nothing was found and the drilling activity required significant oversight and involvement by Refuge personnel to ensure proper cleanup and disposal of hazardous materials.

As the need for oil and gas increases, the Refuge will likely find itself with additional oil and gas related activities including wells, storage facilities, and pipelines. Additional coordination between oil companies and Refuge maintenance staff is required when actively managing the units containing these pipelines. Acquisition deeds stipulated that oil and gas operations were not to interfere with the purpose of the Refuge, but ultimately stated that the Refuge could not prevent the sub-surface owner from exercising their rights to access and develop their minerals. A mutually agreed upon Special Use Permit is issued for all oil and gas operations to communicate Service expectations and environmental concerns to all operating companies.

In accordance with current U. S. Fish and Wildlife Service policy which is derived from a July 17, 1986, Department of the Interior Solicitors Office Opinion and Louisiana State mineral rights law, owners of sub-surface oil and gas mineral rights must be granted a reasonable and necessary means of extraction and production.

In more explicit terms the Solicitor's opinion states:

The United States has a number of rights as a surface owner of refuge lands in Louisiana:

1. It may request the mineral owner to alter its proposed operation to accommodate existing and planned uses of the refuge, provided that the burden on the mineral owner is not unreasonable.
2. It may insist that the mineral owner use only the minimum amount of land that is

required to carry out the operations.
3. The necessary operations that are performed on the refuge must be carried out in a manner which is least injurious to refuge resources.
4. Upon conclusion of each separable phase of operation the mineral owner must restore the surface to its original condition, insofar as is practicable. This will include filling pits no longer required, leveling land, cleaning up spilled oil and salt water, reseeding, and repair or replacement of damaged improvements.
5. Access roads damaged by the mineral operator must be put in a condition for use by the United States, although they need not be completely regraded if damage is recurring and unavoidable.
The United States may not:
1. Charge a mineral operator for excavation of dirt on the lease where the dirt is required in order to carry out the operation.
2. Charge for destruction of timber unless such right was reserved by the United States "grantor".
3. Interfere with the reasonable and necessary operations of the mineral owner.

Mitigation

The Refuge initiated a 250-acre marsh restoration project in Unit 2 with mitigation funds from oil and gas activities. The goal of this project was to restore the southern half of Unit 2A to a state that mimicked the marsh conditions present when the Refuge was first acquired. Lack of soil manipulation had converted this unit from Brasenia flats to undesirable plants not attractive to waterfowl. Other oil and gas mitigation funds were used to acquire vegetation maps and a computer and software for geographic information databases which aid in monitoring and inventory of Refuge habitat.

Contamination

Historically, wells were drilled using open, earthen pits for mud circulation and storage during drilling operations. The drilling mud was oil based and the cuttings that were removed from down hole have been known to contain heavy metals, naturally occurring radioactive material (NORM), and other forms of contamination. These open earthen pits were closed or capped, but remain on the Refuge. Information exists on the locations of these closed pits, and plans for testing are being considered to try and detect if any leeching or other residual impacts have occurred.

Transmission Pipeline Right-of-Ways

Right-of-ways were inherited for transmission lines that traverse the Refuge for the purpose of transporting oil, natural gas, synthetic liquid or gaseous fuels, or any refined petroleum based product. Transmission lines are usually large in diameter and transport product to or from large processing plants. These pipelines do not service mineral production from sub-surface minerals, but require a corridor of refuge land for transportation. In contrast, flowlines are usually the smallest in diameter and transport raw product from individual wells, from sub-surface mineral production, through the production separation process. Gathering lines, similar to flowlines, usually "gather" the production from multiple wells and transport it to production facilities. Permits for right-ofways are not issued for flowlines and gathering lines.
Existing oil and gas transmission lines and their associated right-of-ways on Southwest Louisiana National Wildlife Refuges that have been in place for decades have become manageable over the years. Their long-term effects on the environment, which have been identified as creating pathways for saltwater intrusion into freshwater marshes, are being indirectly addressed through numerous wetlands management programs and laws such as the Louisiana Coastal Act, the Coastal Louisiana Wetlands Planning Protection and Restoration Act, the North American Wetlands Conservation Act and many local

government and private watershed initiatives such as the Cameron Creole Watershed Management Plan. These laws and initiatives have led to the development of significant wetland restoration projects which have mitigated the effects of some negative impacts associated with oil and gas transmission lines and associated right-of-ways.

Future Management

Existing oil and gas transmission lines on approved U.S. Fish and Wildlife Service right-ofways currently within a National Wildlife Refuge will be managed as per U.S. Fish and Wildlife Service Policy 603 FW 2 in general, and explicitly under section 2.11D which states: Existing right-of-ways: We will not make a compatibility determination and will deny any request for maintenance of an existing right-of-way that will affect a unit of the National Wildlife Refuge System unless (1) the design adopts appropriate measures to avoid resource impacts and includes provisions to ensure no net loss of habitat quantity and quality; (2) restored or replacement areas identified in the design are afforded permanent protection as part of the national wildlife refuge or wetland management district affected by the maintenance; and (3) all restoration work is completed by the applicant prior to any title transfer or recording of the easement, if applicable. Maintenance of an existing right-of way includes minor expansion or minor realignment to meet safety standards. Examples of minor expansion or minor realignment include: expand the width of a road shoulder to reduce the angle of the slope; expand the area for viewing on-coming traffic at an intersection; and realigning a road to reduce the amount of curve.

New construction for oil and gas transmission line right-of-ways will not be permitted because they can significantly contribute to further land loss on coastal Louisiana national wildlife refuges. Canals built for the construction and repair of oil and gas transmission lines allow saltwater to penetrate further inland, particularly during droughts and storms and can have severe effects on wetlands (Wang 1987). This is evident for the oil and gas transmission line right-of-ways which were established in accordance with the Federal Department of Transportation and Louisiana Department of Transportation regulations already established on Sabine National Wildlife Refuge. Oil and gas transmission lines constructed since the 1940's are still readily apparent. Compaction and displacement of hydric soils during oil and gas transmission lines repair or construction reduces water exchange and can result in increased waterlogging and plant mortality (Swenson and Turner 1987). Excavation necessary for oil and gas transmission line construction causes significant hydrological changes. Exposing hydric soil to oxygen changes the natural ecological processes, including chemical transformations, sediment transport, vegetation health, and migration of organisms. Furthermore, by altering salinity gradients and patterns of water flow, the natural process by which coastal marshes are replenished and protected cannot occur (U.S. Army Corps of Engineers 2004).

Restoration of coastal marsh is a priority on national wildlife refuges in the Louisiana coastal zone. Approximately $24 million from CWPPRA has been dedicated to construct 8 coastal restoration projects, and another $12 M is approved to construct two more projects within the Southwest Louisiana National Wildlife Refuge Complex. Extensive changes and alterations due to new pipeline right-of-ways could negatively affect restoration project predictability and life span. The stability created through these restoration projects could be jeopardized when major hydrologic changes occurred due to new pipeline construction. Therefore, managing existing pipelines and right-of-ways in accordance with current Service Policy, and state and Federal law is permissible under current conditions. Any expansion beyond the current conditions will be an inappropriate use considering the current status of Louisiana's coastal wetlands and the Fish and Wildlife Service's role in managing and protecting this state's coastal resource.

The following State of Louisiana regulations will be followed when granting pipeline rights-of-way on Cameron Prairie NWR. ROW width on Cameron Prairie NWR will be no more than 25 ft.

State of Louisiana

GRANTING OF RIGHTS-OF-WAY
TO
CORPORATIONS
OR
INDIVIDUALS

(As defined in R.S. 41:1173-1174 and provided for by R.S. 36:1 and 36:4 et seq.)
July 1,1990

Division Of Administration

State Land Office
P.O. Box 44124, Capitol Station
Baton Rouge, Louisiana 70804

RS 41:1173. Granting of rights-of-way to corporations or individuals.
The Governor and the Commissioner of Administration may grant rights-of-way across and through any public lands belonging to the State of Louisiana—to any individual or corporation doing business in this State—provided that adequate consideration is paid the state by the Grantee of the right. (Source: Acts 1916, No. 215 1.)

RS 41:1174. Disputed title; deposit of consideration in escrow.
Should the Governor and the Commissioner of Administration grant rights-of-way across and through any public lands, the title to which is in dispute, they may provide that the consideration to be paid the State by the Grantee of the right shall be deposited in escrow with the Commissioner of Administration, to be held by that officer pending the final determination of the validity of the title to the land or until the Governor and the Commissioner of Administration and the Grantee otherwise agree the payment should be made or released as provided for in the agreement. Added Acts 1964, No. 29 1.

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The following rules and regulations concerning the granting of rights-of-way have been adopted by the Commissioner of Administration.

1. Applicants are to use the State Right-of-Way form provided by the Division of Administration. A special form is used for escrow agreement permits.
2. The Right-of-Way form must be submitted in triplicate with a legal size plat(s) attached to each copy.
3. The description contained in the Right-of-Way form must indicate section, township and range, or area and block number(s) if offshore; name of the body of water to be crossed; the size of the pipe and the length of the right-of-way hi rods.
4. The plat(s) must revel the following:

a. Station numbers at the mean low water elevation on a river, the station numbers at the

mean high water elevation on a lake bay or Gulf of Mexico; or station numbers at ingress and egress of State properties. Said plat, when illustrating the mean low water line of a river or the mean high water line of a lake or the Gulf, will be authoritative only as to the date of the application for calculation of the State's consideration. The limits of State property reflected on said plat are illustrative only and recognized solely and only for computing the fee for this grant, and are not intended and shall not be construed as determinative of actual title for the benefit of any adjoining owners, whether a Grantee herein or a third party.

b. The section, township and range if in an area that has been surveyed.

c. The product to be transported.

d. The location of the pipeline with respect to the right-of-way.

5. Names of adjoining land owners cannot be shown on the plat unless necessary for legal description.

6. The Right-of-Way form must be accompanied by a letter of intent which shall contain the following information:

a. Initiating and terminating point of the pipeline.

b. Point of origination of product to be transported as a result of this construction.

c. Capacity or if a loopline added capacity as a result of this construction.

d. Estimated volume of product to be transported as a result of this construction.

e. A detail of construction.

f. Pipe specifications including size, wall thickness and type.

g. The proposed and maximum operating pressures.

7. Where State mineral leases are traversed, an applicant will furnish the Commissioner of Administration a copy of the letter of notification (with signed, certified returned receipt attached) which has been sent to the mineral lessees.

8. It is necessary that permission or clearance be obtained from the United States Corps of Engineers; State Office of Public Works, Department of Transportation and Development; Louisiana Department of Environmental Quality, Water Pollution Control Division; The Louisiana Department of Wildlife and Fisheries and both the Coastal Management Division and the Office of Conservation of the Department of Natural Resources if the operation is within their respective jurisdictions and from any other agency having permit authority over the proposed project.

9. Clearance shall be obtained from the Secretary of the Department of Wildlife and Fisheries when oyster leases are to be traversed.

10. Written consent must be obtained from the Secretary of the Department of Wildlife and Fisheries if the proposed right-of way crosses a State or Federal preserve. Similar clearance is required from any agency having jurisdiction over surface rights of state lands being crossed.

11. The State requires payment for all grants across State lands or navigable streams—regardless of size.

12. The proposed route of the pipeline shall be subject to approval of the Commissioner of Administration.

13. Fees for permits shall be as follows:

Class 1. Pipe 2 inches up to 19 niches outside diameter with a maximum of 75 feet right-ofway
during construction to revert to 35 feet after construction is completed with the additional right of ingress and egress for the purpose of maintenance, repairs, removal or modification— $25.00 per rod.
Class 2. Pipe 19 inches up to 36 inches outside diameter with a maximum of 100 feet right-ofway
during construction to revert to 50 feet after construction is completed with the additional right of ingress and egress for the purpose of maintenance, repairs, removal or modification— $35.00 per rod.
Class 3. Pipe over 36 inches outside diameter with a maximum of 200 feet right-of-way during construction to revert to 60 feet after construction is completed with the additional right of ingress and egress for the purpose of maintenance, repairs, removal or modification— $45.00 per rod.
The minimum fee for any application processed shall be $50.00 with a $100.00 fee assessed for any assignment of permit thereafter.
14. Contract term—20 years with option to renew for additional 20 year term. The option to renew shall be on the same terms and conditions as the original agreement except that the consideration shall be adjusted to reflect the percentage of increase or decrease in the cost of living index as established by the Consumer Price Index for Urban Wage Earners and Clerical Workers published by the Bureau of Labor Statistics of the United States Department of Labor or any revision or equivalent of any such index published by the United States Government, which has occurred from date of this instrument to the date of renewal provided, however, that in no event shall consideration of such renewal be less than the consideration paid herein for the original term.
15. There shall be no above-ground installations, i.e., valve setting, tie-overs, platforms, etc., without the express consent and approval of the Commissioner of Administration. The Commissioner shall have authority to establish the basis of compensation (which amount shall be in addition to the per-rod consideration referred to in these rules) for such aboveground installation. The application for pipeline rights-of-way shall contain a concise description of any such above-ground facility together with appropriate drawing, showing location of same and profile of design and style.
16. All pipelines constructed under permits granted by the State of Louisiana shall be in accordance with Parts 191, 192 and/or 195 of Title 49 of the Code of Federal Regulations, as amended, and other Federal and State Laws not in conflict therewith.
17. The State of Louisiana is held free from any and all liabilities.
18. A copy of the Right-Of-Way Grant, along with a pertinent plat(s) attached, must be filed with the Clerk of Court of the Parish or Parishes affected and the Division of Administration furnished recordation data.

Appendix K Environmental Action Statement

UNITED STATES FISH AND WILDLIFE SERVICE

ENVIRONMENTAL ACTION STATEMENT

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA), and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and determined that the action of implementing the goals, objectives and strategies within the Cameron Prairie National Wildlife Refuge (CNWR) Habitat Management Plan (HMP):

Check One:

__x__ is a categorical exclusion as provided by 516 DM 2, Appendix I and 516 DM 8. No further NEPA documentation will therefore be made.

____ is found not to have significant environmental effects as determined by the attached environmental assessment and finding of no significant impact.

____ is found to have significant effects and, therefore, further consideration of this action will require a notice of intent to be published in the Federal Register announcing the decision to prepare an EIS.

____ is not approved because of unacceptable environmental damage, or violation of Fish and Wildlife Service mandates, policy, regulations, or procedures.

____ is an emergency action within the contexr of 40 CFR 1506.11. Only those actions necessary to control the immediate impacts of the emergency will be taken. Other related actions remain subject to NEPA review.

Categorical Exclusion(s). Categorical Exclusion Department Manual 516 DM 6, Appendix 1 Section 1.4 B (10), which states "the issuance of new or revised site, unit, or activity-specific management plans for public use, land use, or other management activities when only minor changes are planned. Examples could include an amended public use plan or fire management plan.", is applicable to implementation to the proposed action.

Consistent with Categorical Exclusion (516 DM 6, Appendix 1 Section 1.4 B (10)) the HMP is a step-down management plan which provides guidance for implementation of the general goals, objectives, and strategies established in the CCP, serving to further refine those components of the CCP specific to habitat management. This HMP does not trigger an Exception to the Categorical Exclusions listed in 516 DM 6, Appendix 2.

Minor changes or refinements to the CCP in this activity-specfic management plan include:

- Habitat management objectives are further refined by providing numerical parameter values that more clearly define the originating objective statement.
- Habitat management objectives are restated so as to combine appropriate objectives or to split complicated objectives for improved clarity in the conrext of the HMP.
- Specific habitat management guidance, strategies, and implementarion schedules to meet the CCP goals and objectives are included (e.g. location, timing, frequency, and intensity of application).
- All details are consistent with the CCP and serve to provide the further detail necessary to guide the refuge in application of the intended strategies for the purpose of meeting the habitat objectives.

Permits/Approvals. Endangered Species Act, Intra-Service Section 7 Consultation was conducted during the CCP process. The determination was a concurrence that the CCP "would result in the implementation of the preferred alternative developed during the preparation of the Comprehensive Conservation Plan (CCP) for Cameron Prairie National Wildlife Refuge, a 9,621 acre refuge in Cameron Parish. Approval and subsequent implementation of the CCP will
direct management actions on the Refuge for the next 15 years. The preferred alternative identified for the CCP is to maximize the quality and quantity of habitat for wintering waterfowl by focusing on a more adaptive management approach through improved biological monitoring. This alternative supports the purpose for which the Refuge was established, "...for use as an
inviolate sanctuary, or for any other management purpose, for migratory birds" [16 U.S.C. 715d (Migratory Bird Conservation Act)]. The plan identifies 4 broad goals for habitat, wildlife, people, and cultural resources, and describes specific objectives for each of the goals. Detailed strategies are also outlined. The goals and objectives were developed to support regional and national plans and initiatives and in partnership with others such as the Louisiana Department of
Wildlife and Fisheries. (See Comprehensive Conservation Plan and Environmental Assessment for Cameron Prairie National Wildlife Refuge)"
No listed species were found to be at Cameron Prairie NWR.
Other items to incude that should be listed and can be found in the EAS accompanying the final CCP:

- Executive Orders 11988/11990 – May 31, 2006
- Floodplain Management and Protection of Wetlands, May 31, 2006
- Form DI-711, Intergovernmental Notice of Proposed Action, March 29, 2006
- National Historic Preservation Act, Protection of Cultural Resources, March 29, 2006

Public Involvement/Interagency Coordination. The proposed HMP is a step-down of the approved CCP for Cameron Prairie NWR. The development and approval of the CCP incuded approprate NEPA documentation and public involvement. An Environmental Assessment was developed (Draft CCP and EA 2002) which proposed and addressed management alternatives and environmental consequences. Public involvement included public notification and public meetings held in 2002 as follows: October 1, Carlyss, LA, October 8, Grand Lake, LA, October 10, Cameron, LA, October 16, Hackberry, LA, and October 17, Johnson Bayou, LA. Approximately 25 people in total attended these meetings. In addition, public open-house meetings were held in Lake Charles, LA, on January 16 and February 4, 2003, which were attended by a total of 33 people.
Other supporting documents (list):

1. CPNWR Comprehensive Conservation Plan and Environmental Assessment (On file at SWLA NWRC Headquarters Office)

Signature Approval:

David J Vose 4/1/2011
(1) Originator Date

Richard D Warren 04/20/2011
(2) Regional Refuge NEPA Coordinator Date