DRAFT ENVIRONMENTAL ASSESSMENT
CAJUN EXPLORATION, LLC'S
LACASSINE 3D WITHIN THE
CAMERON PRAIRIE AND LACASSINE NATIONAL WILDLIFE REFUGES

Prepared for
Cajun Exploration, LLC
&
U.S. Fish and Wildlife Service

Prepared by
Dixie Environmental Services Co., LP
26902 Nichols Sawmill, Suite A
Magnolia, TX 77355
281-252-9799

FEBRUARY 2009

Table of Contents

1.0 BACKGROUND 1
1.1 Introduction 1
1.2 Purpose and Need for Action 1
1.3 Decisions to be Made 4
1.4 Seismic Survey Area Overview 6
1.5 Public Scoping and Issue Identification 6
2.0 ALTERNATIVES 7
2.1 Alternatives Considered in Detail 7
2.1.1 Alternative A – Proposed Action 7
2.1.2 Alternative B – No Action 8
2.2 Description of the Proposed Action 8
2.2.1 Method of Operations 9
2.2.2 Phases 9
2.2.2.1 Phase 1: Planning and Permitting 9
2.2.2.2 Phase 3: Surveying 9
2.2.2.3 Phase 4: Drilling 9
2.2.2.4 Phase 4: Recording 18
2.2.2.5 Phase 5: Cleanup and Reclamation 18
2.2.2.6 Safety and Offsets 19
2.2.2.7 Staging and Storage 19
2.2.2.8 Equipment 19
2.2.2.9 Schedule 20
2.2.2.10 Mitigation Measures 20
2.2.2.11 Monitoring 27
2.2.2.12 Operators and Lessors 28
2.2.2.13 Lease Agreement Authorization 28
2.3 Alternatives Considered But Eliminated From Analysis 28
2.3.1 Alternative Project Locations 28
2.3.2 Alternative Operational Methods 28
2.3.3 Alternative Shothole Depth 29
2.3.4 Alternative Shothole Spacing 29
2.3.5 Alternative Explosives Charge Size 29
2.3.6 2-D Alternative 30
2.3.7 “Cable-Only” Alternative 31
2.3.8 Alternative Energy Sources 31
2.4 Comparison of Alternatives 31
3.0 AFFECTED ENVIRONMENT 33
3.1 Introduction 33
3.2 Fish and Wildlife Resources 37
3.2.1 Introduction 37
3.2.2 Threatened and Endangered Species 37
3.2.3 Species of United States Fish and Wildlife Service (USFWS) Management Concern 38
3.2.4 Species of Refuge Management Concern 40

3.2.5 Birds 40
3.2.5.1 Waterfowl 41
3.2.5.2 Wading Birds (Water and Marsh Birds) 42
3.2.5.3 Sandhill Cranes 43
3.2.5.4 Shorebirds, Gulls, Terns, and Allied Species 43
3.2.5.5 Raptors 44
3.2.5.6 Other Migratory Birds 44
3.2.6 Mammals 45
3.2.7 Amphibians and Reptiles 45
3.2.8 Aquatic Species 46
3.2.9 Non-native/Invasive Animal Species 46
3.3 Habitat 47
3.3.1 Wetlands 48
3.3.2 Forest 49
3.3.3 Prairie 49
3.3.4 Croplands 50
3.3.5 Wilderness Review 50
3.3.6 Non-native/Invasive Plant Species 51
3.4 Public Use 52
3.4.1 Education and Visitor Services 52
3.4.2 Hunting and Trapping 52
3.4.3 Fishing and Boating 55
3.4.4 Wildlife Observation and Photography 56
3.4.5 Environmental Education and Interpretation 56
3.4.6 Roads 57
3.5 Socioeconomics 58
3.6 Archaeological or Historical Resources 59
3.7 Oil and Gas Activity 61
4.0 ENVIRONMENTAL CONSEQUENCES 62
4.1 Overview 62
4.2 Effects Common to Both Alternatives 63
4.2.1 Fish and Wildlife Resources 63
4.2.2 Habitat 65
4.2.3 Public Use 66
4.2.4 Socioeconomics 66
4.2.5 Archeological or Historical Resources 67
4.2.6 Oil and Gas Activity 67
4.3 Effects from Implementing Alternative A (The Proposed Action) 68
4.3.1 Fish and Wildlife Resources 68
4.3.2 Habitat 70
4.3.3 Public Use 74
4.3.4 Archaeological or Historical Resources 75
4.4 Effects from Implementing Alternative B (No Action Alternative) 75
4.4.1 Fish and Wildlife Resources 75
4.4.2 Habitat 76
4.4.3 Public Use 78

4.4.4 Archeological or Historical Resources 78
5.0 REFERENCES AND CITATIONS..... 78

List of Tables

Table 1: Specifications of Drilling Equipment Proposed for Use in Areas Managed by USFWS 17
Table 2. Minimum Safe Offset in Feet as a Function of Explosive Charge Size in Pounds for Typical Objects 19
Table 3. Mitigation Measures 21
Table 4. Extent that Alternatives Meet Objectives 32
Table 5. Birds of Management Concern Known or Expected to Occur on Cameron Prairie and Lacassine National Wildlife Refuges 39
Table 6. Peak Waterfowl Numbers from Annual Surveys 42
Table 7. Land Cover and Habitat Types on Cameron Prairie and Lacassine Refuges 47
Table 8. Occupations of employed civilian population 16 years and older in Cameron Parish (2000).....58
Table 9. Employment of civilian population 16 years and older by industry in Cameron Parish (2000).....59

List of Figures

Figure 1. Project Area (in relation to State).....2
Figure 2. Pre-Plot Point Locations.....10
Figure 3. Highland Drill.....11
Figure 4. Highland Drill with Terra Tires.....12
Figure 5. Lightweight Aluminum Marsh Drill 13
Figure 6. Single Engine Airboat Drill.....14
Figure 7. Pontoon Drill 14
Figure 8. Marooka Drill 15
Figure 9. Swamp Buggy 16
Figure 10. Pull Boat 16
Figure 11. Lacassine National Wildlife Refuge – Management Units and Habitat Types34
Figure 12. Cameron Prairie National Wildlife Refuge – Management Units and Habitat Types.....36
Figure 13. Cameron Prairie National Wildlife Refuge – Hunting Areas and Visitor Services 53
Figure 14. Lacassine National Wildlife Refuge – Hunting Areas and Visitor Services....54

Appendices

Appendix A. Species Checklist for Refuges

1.0 BACKGROUND

1.1 Introduction

This Environmental Assessment for Cameron Prairie National Wildlife Refuge (CPNWR) and Lacassine National Wildlife Refuge (LNWR) has been prepared in compliance with the National Environmental Policy Act (NEPA). It discusses the purpose and need for a three dimensional (3-D) seismic survey, which is located in Cameron and Jefferson Davis Parishes, Louisiana. It provides an analysis of the environmental impacts that could be expected from the seismic survey. This analysis assists the U.S. Fish and Wildlife Service (USFWS) in determining if it will need to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) for the proposed 3-D seismic survey.

The USFWS is the nation's primary conservation agency concerned with the protection and long-term management of wildlife resources. The agency administers the National Wildlife Refuge System, which is a system of more than 545 national wildlife refuges encompassing over 95 million acres, much of which is primarily managed for the enhancement of migratory bird populations and federally listed threatened and endangered fish, wildlife, and plant species. Of particular concern in the Lower Mississippi Valley Ecosystem and the adjacent Texas Gulf Coast Ecosystem is the plight of migratory bird populations—migratory waterfowl and shorebirds, as well as neotropical migratory songbirds—and the loss of coastal marshland from both natural and human causes.

1.2 Purpose and Need for Action

Cajun Exploration, LLC (Cajun Exploration) is proposing to conduct a three dimensional seismic survey within the Cameron Prairie and Lacassine National Wildlife Refuges (Refuges) during the spring and summer of 2009 on behalf of Alta Mesa Holdings, LP. The project area encompasses a total of approximately 17,190.40 acres (26.86 square miles) within the Refuges (**Figure 1**); 4,588.80 acres (7.17 square miles) within the CPNWR and 12,601.60 acres (19.69 square miles) within the LNWR.

The purpose of Cajun Exploration's proposed 3-D seismic survey is to provide a high-resolution image of subsurface geological features, allowing them to effectively evaluate the hydrocarbon reserves underlying the project area. Data gathered from proposed activities will help to alleviate the need for more numerous two dimensional (2-D) exploration projects, as well as decrease the likelihood of drilling dry wells. As a result, adverse impacts to natural resources would be minimized.

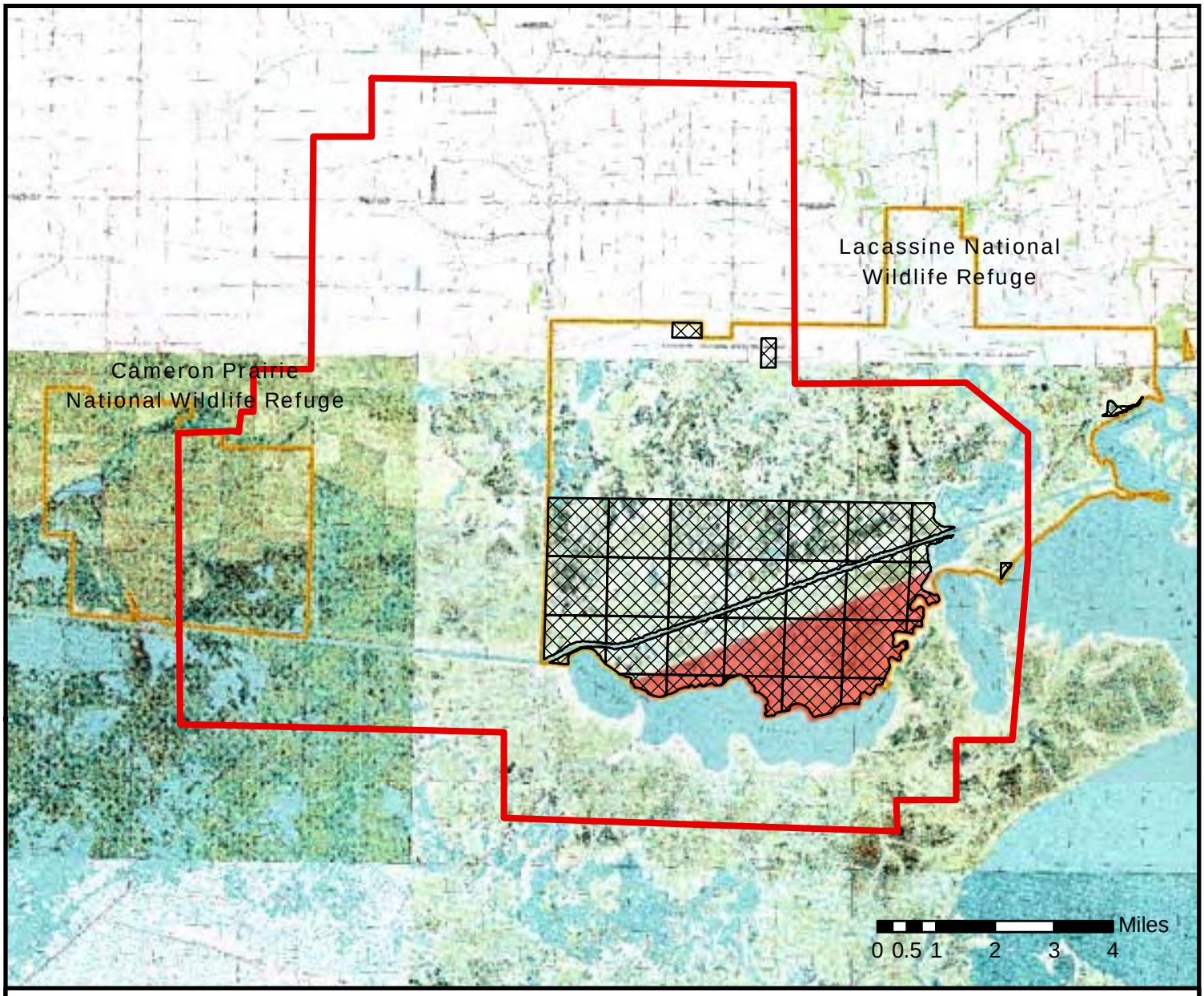
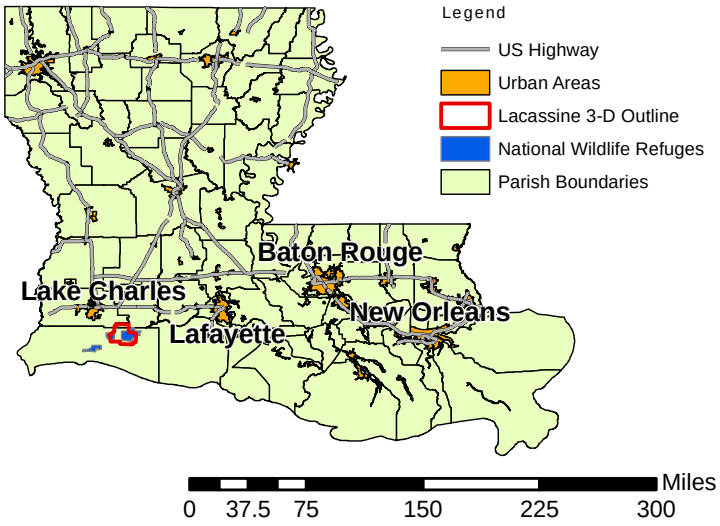


Figure 1. General Project Area
Lacassine 3-D Seismic Survey
Cameron and Jefferson Davis Parishes, Louisiana

Legend

- Lacassine 3-D Outline
- Federal Mineral Tracts
- National Wildlife Refuge Lands
- Wilderness Area

N



Map Produced 01/16/09

Dixie Environmental Services Co., LP

The USFWS maintains surface ownership of the CPNWR and LNWR; however, Cajun Exploration holds valid leases from the legal owners of portions of the Refuge subsurface. Copies of all mineral leases/permits/options have been provided to the USFWS.

The federal government owns the mineral rights of a 12,601 acres (19.69 square mile) area with in the LNWR. The federal government has opted not to lease the subsurface to Cajun Exploration and therefore this area will not be included in the seismic survey project area. **Figure 1** shows the 12,601 acres area within the LNWR that will not be included in the seismic survey. This mineral rights exclusion area includes the Lacassine Pool and a congressionally designated wilderness area.

With respect to subsurface mineral rights in the State of Louisiana, the mineral leaseholder has specific rights to pursue recovery of the minerals, rights that supersede many rights of the surface landowner. For example, a surface landowner may not prohibit or hinder a subsurface mineral rights owner from pursuing exploration activities (seismic operations and exploratory drilling) as long as the surface owner is compensated for damages to surface property. The legal concept is commonly described as the mineral estate being the dominant estate and the surface estate being the subordinate estate.

The USFWS legally must provide "reasonable access" to the owners (or their agents) of the subsurface mineral estate for exploration and development of these minerals. In accordance with current Fish and Wildlife Service policy, which is derived from a July 17, 1986 Department of the Interior Solicitor's opinion, and Louisiana state mineral rights law, owners of subsurface 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. All roads damaged however slightly by the seismic survey activity will be completely restored to their original condition upon completion of the seismic survey. The USFWS will document the conditions of the roads prior to the beginning of the survey and once the survey is completed.

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.

The USFWS manages oil and gas operations on refuge lands through the Special Use Permit (SUP) process, which is prepared in accordance with USFWS Policy – 612-FW2, Oil and Gas. 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. When oil and gas exploration and development companies representing the underlying mineral owners request access to refuge lands, the USFWS reviews the planned activities and develops a set of stipulations necessary to provide refuge resource protection. The stipulations, which contain both requirements and limitations, are attached to and become part of the SUP as Special Conditions. The oil and gas exploration/development company is then offered the SUP conditioned on their acceptance of the stipulations contained in the SUP. The terms of the SUP and the proposed oil and gas operation must comply with applicable sections of federal regulations dealing with minerals management on National Wildlife Refuges. The specific Code of Federal Regulations (CFR) dealing with "mineral rights reserved and expected" is 50 CFR 29.32.

Cajun Exploration has agreed to submit a plan of operations and perform work for the entire project within CPNWR and LNWR under a SUP. Stipulations of the SUP are being developed through this ongoing planning process and according to USFWS policies. Development of the Operations Plan and Environmental Assessment should provide the best opportunity for public notice, public comment, and conflict resolution. In this way the rights and interests of the general public who utilize or share concerns and interest in CPNWR and LNWR and its resources will be addressed and impacts to these resources lessened.

The environmental assessment (EA) is necessary to set forth and evaluate a range of reasonable alternatives for accomplishing project objectives within the Refuges. Each alternative was evaluated and the predicted biological, physical, social, and economic impacts of implementing each alternative are disclosed within the EA.

1.3 Decisions to be Made

The Federal action being considered within this EA is the issuance of a Special Use Permit by the USFWS to Cajun Exploration in order to access surface lands of the Cameron Prairie and Lacassine National Wildlife Refuges to conduct a 3-D seismic survey.

The USFWS is required to assess the conditions of all natural resources within and immediately adjacent to the proposed project area, as well as the potential impacts that

Cajun Exploration's operations could have on these resources prior to issuing authorization to conduct operations. The assessment of resources and potential impacts is necessary so that operations and equipment can be tailored to protect and minimize any adverse impacts.

This environmental assessment is designed to aid the USFWS in the decision-making process, and it describes and evaluates two alternatives in detail. The first alternative (Alternative A, Proposed Action) consists of Cajun Exploration's proposed plan of operations. The second alternative (Alternative B, No Action) includes a scenario in which the USFWS takes no action. In this case, No Action means that the USFWS would not issue an SUP to Cajun Exploration; however, Cajun Exploration would still exercise its mineral rights and conduct the survey across Refuge lands without restrictions. There would be no permit stipulations or guidelines to minimize and mitigate impacts to Refuge resources, nor would non-service Refuge representative(s) be present to ensure adherence to the permit stipulations and assist in least impact equipment choices and methodology. Under the No Action alternative, there could be additional impacts on the affected environment.

The following resources and other concerns were identified for evaluation in this environmental assessment: fish, wildlife, and habitat; public use; cultural resources; and oil and gas activities.

Baseline and reference information used in the preparation of this EA was obtained from available literature, Refuge representatives, and from two environmental assessments prepared for previous projects: *Draft Comprehensive Conservation Plan and Environmental Assessment for Cameron Prairie National Wildlife Refuge* (USFWS 2006a) and *Draft Comprehensive Conservation Plan and Environmental Assessment for Lacassine National Wildlife Refuge* (USFWS 2006b).

The Service identified issues, concerns, and needs through discussions with the public, agency managers, conservation partners, and others. The Service worked with Cajun Exploration and its environmental services contractor, Dixie Environmental Services Co., LP (DESCO), to identify a range of alternatives, evaluated the possible consequences of implementing each, and selected Alternative A as the proposed action, based on the assessment described in this document. In the opinion of the Service and the planning team, Alternative A is the best for the Refuges.

The USFWS will evaluate the alternatives, and determine whether or not they are able to issue a "Finding of No Significant Impact" (FONSI) for the Proposed Action. A FONSI is a statement explaining why the selected alternative will not have a significant effect on the quality of the human environment. This determination is based on an evaluation of the predicted environmental consequences of the Proposed Action, the Service and refuge system mission, the purpose(s) for which the refuge was established, and other legal mandates. Assuming no significant impact is found, the Special Use Permit will be granted and operations can proceed as proposed.

If a FONSI can't be issued for the Proposed Action, an Environmental Impact Statement must be prepared, disclosing unavoidable significant impacts of the proposed action.

1.4 Seismic Survey Area Overview

The CPNWR and LNWR, located approximately 20 to 25 miles southeast of Lake Charles, Louisiana are among over 545 National Wildlife Refuges governed by the USFWS.

Lacassine National Wildlife Refuge is located at the edge of Grand Lake and 15 miles from the Gulf of Mexico in Cameron Parish in southwestern Louisiana. It is strategically located on the boundary between coastal marsh and agricultural habitats, as well as at the southern terminus of the North American segment of the Mississippi and Central Flyways, making the refuge critically important to migratory birds, especially wintering waterfowl.

Cameron Prairie National Wildlife Refuge is located approximately 25 miles southeast of Lake Charles, Louisiana, in north central Cameron Parish, and consists of two separate and distinct units. The Gibbstown Unit, which is encompassed within Cajun Exploration's proposed project area, contains 9,621 acres of freshwater marsh, coastal prairie, and early successional wetlands and is managed to preserve and protect wintering waterfowl and their habitat. This unit is located four miles west of the western boundary of Lacassine National Wildlife Refuge, and is bordered on the north and west by private land. The Gulf-Intracoastal Waterway forms the southern boundary of the unit, while North Canal forms the eastern boundary (USFWS 2003a).

Cameron Prairie and Lacassine National Wildlife Refuges are part of the Southwest Louisiana National Wildlife Refuge Complex, which also includes Sabine National Wildlife Refuge to the west within Cameron Parish, and Shell Keys National Wildlife Refuge in offshore waters in Iberia Parish. While these four refuges within the Complex share certain staff and coordinate on a good deal of planning and management activities, this environmental assessment, and the comprehensive conservation plans it covers, focuses only on the Lacassine National Wildlife Refuge and the Gibbstown Unit of the Cameron Prairie National Wildlife Refuge.

1.5 Public Scoping and Issue Identification

The USFWS, Cajun Exploration, and DESCO hosted a public scoping meeting to discuss Cajun Exploration's proposed operations within the Lacassine and Cameron Prairie National Wildlife Refuges and to solicit comments, concerns, and input that would aid in the development of the EA and the decision making process. Announcements giving the location, date, and time of the scoping meeting appeared in local newspapers and were distributed to organizations and individuals included on a mailing list compiled by USFWS to ensure that a wide array of "stakeholders" was contacted, including interested people; users like hunters, bird watchers, and anglers; agencies representing tribes; the State of Louisiana, and local jurisdictions. The public scoping meeting was held in the

conference room of America's Best Inns and Suites, 401 Lakeshore Drive, Lake Charles, LA 70601 on February 10, 2009, and attendees were invited to register their comments, input, observations, and preferences on the proposed action.

Input obtained from the scoping meeting and discussions held with state and local officials, civic groups, and conservation organizations were used to develop the draft plan.

Beginning with the preparation of the draft plan, the planning team developed a list of issues and concerns likely to be associated with the proposed action. These issues and concerns were expanded to include those ideas generated by citizens from the local community.

Together with refuge goals, key issues, and a range of management options, a basis was formed for the development and comparison of the alternatives described in this document. Comments received from the internal agency review, and other responses from the public will be forthcoming following review of this draft plan and environmental assessment, and will assist the Service in the decision-making process.

2.0 ALTERNATIVES

Two alternatives, the Proposed Action and the No Action, are described in this section and analyzed throughout the EA. The USFWS, Cajun Exploration, and DESCO examined the issues and evaluated alternatives to develop the Proposed Action, which addresses the major issues identified during public scoping and meets the need for action.

2.1 Alternatives Considered in Detail

2.1.1 Alternative A – Proposed Action

Under the Proposed Action Alternative, the USFWS would issue a Special Use Permit (SUP) to Cajun Exploration governing all aspects of the proposed 3-D seismic survey activities. The Special Use Permit contains a full range of stipulations and regulations (as described in **Section 2.3 Mitigation Measures**) aimed at protecting natural and cultural resources on the Refuges as well as minimizing conflicts with public uses and other USFWS management activities. Through the issuance of a Special Use Permit and its subsequent administration to ensure strict adherence to its provisions and stipulations by Cajun Exploration, the USFWS is actively managing the proposed activity to provide maximum protection of natural and cultural resources and public safety on the CPNWR and LNWR.

By agreeing to conduct the proposed project within the CPNWR and LNWR under all provisions of the USFWS Special Use Permit, overall environmental impacts of Cajun Exploration's proposed project would be reduced. In addition to the Special Use Permit provisions and stipulations, the USFWS would enforce all applicable state and federal statutes and regulations.

2.1.2 Alternative B – No Action

The No Action Alternative is required under the National Environmental Policy Act of 1969 (NEPA) and establishes a baseline for comparing the present management direction and environmental consequences of the action alternative. Since the USFWS is considering taking a new action, issuance of a Special Use Permit (SUP) for a 3-D seismic survey program, the NEPA "No Action Alternative" is the USFWS not acting at all. Therefore, the "No Action Alternative" addresses not issuing a SUP for the proposed project.

With respect to subsurface mineral rights in the State of Louisiana, the mineral leaseholder has specific rights to pursue recovery of the minerals, rights that supersede many rights of the surface landowner. For example, a surface landowner may not prohibit or hinder a subsurface mineral rights owner from pursuing exploration activities (seismic operations and exploratory drilling) as long as the surface owner is compensated for damages to surface property.

The agreements between Cajun Exploration and the leaseholders require that Cajun Exploration actively pursue exploration of the mineral resources covered by the leases within a specified timeframe or the agreements expire.

It can be reasonably anticipated that several operational aspects of the proposed 3-D seismic exploration project on the CPNWR and LNWR without the issuance of a SUP by the USFWS would differ from a project whose operations are governed by the general provisions and specific stipulations contained in the SUP. For example, a SUP for a seismic operation would typically limit the types of equipment, size and placements of charges, access routes, number of passes along seismic lines, etc. to minimize impacts to natural and cultural resources and/or disturbance to wildlife species or members of the public utilizing the area for recreation.

Without a SUP, Cajun Exploration would still conduct exploration activities in the area, but there would be no restrictions. This could negatively impact the natural and cultural resources of the area, as well as result in interference with USFWS management activities and/or public use of the project area.

Under the No Action alternative, it can reasonably be expected that the proposed project would be conducted in a manner which would result in greater environmental impacts, as operational procedures which are restricted or modified by the stipulations of a USFWS SUP would not be implemented.

2.2 Description of the Proposed Action

The proposed 3-D survey requires the deployment of motion sensing devices (receivers/geophones/hydrophones) at regular intervals (220 feet) along lines oriented north to south, with spacing between receiver lines of 1,320 feet. The survey design would also incorporate a *Pentolite* energy source, which would be placed at regular intervals (220 feet) in a diagonal pattern with a southwest to northeast orientation and

spacing between source lines of 1,760 feet. As proposed, there are approximately 2,089 source points or shot holes and 2,766 receiver stations located within the boundaries of the CPNWR and LNWR. **Figure 2** illustrates pre-plot locations of source and receiver points within the operations area, and **Section 2.2.1** contains a detailed description of proposed operations.

2.2.1 Method of Operations

Cajun Exploration would use equipment that is well-suited for coastal marshes and wetlands. Cajun Exploration has met with the Refuge Managers and understands that the company has a duty to minimize its effect on the resources of the Refuges and to maintain its occupancy to the minimum compatible with safe and efficient operations.

Field operations associated with the proposed 3-D survey are separated into five phases:

Phase 1: Planning and Permitting
Phase 2: Surveying
Phase 3: Drilling
Phase 4: Recording
Phase 5: Clean-up and Reclamation

A brief discussion of the activities associated with each of these phases is presented below.

2.2.2 Phases

2.2.2.1 Phase 1: Planning and Permitting

The initial phase includes typical planning tasks associated with developing the program and acquiring leases, permits, and regulatory approvals. Many of these tasks have been underway for some time. Most leases and/or options have been procured, and final regulatory approvals are being obtained.

2.2.2.2 Phase 3: Surveying

In this phase, several crews would survey and mark the proposed sites for source holes and locations of geophones utilizing inertial and/or global positioning systems (GPS) surveying technology. No clearing would be necessary for line-of-sight. Each source hole and receiver point location would be marked using pin flags, survey lath, or cane poles (in open water areas) and flagging. Approximately three to four two-person survey crews would be used to complete operations within the CPNWR and LNWR.

2.2.2.3 Phase 4: Drilling

The drilling phase includes activities associated with drilling the source holes, loading the drilled holes with charges, and plugging the holes after loading. Drill crews would follow the survey crews, traveling least impact routes flagged for the equipment and in consultation with the environmental monitor. Each drill crew would consist of two to six men, depending on the type of equipment being used and the difficulty of terrain in the area. Ideally, each source hole would be drilled to a depth of 100 feet, loaded with a 5.5 pound *Pentolite* charge, and plugged in accordance with applicable rules and regulations.

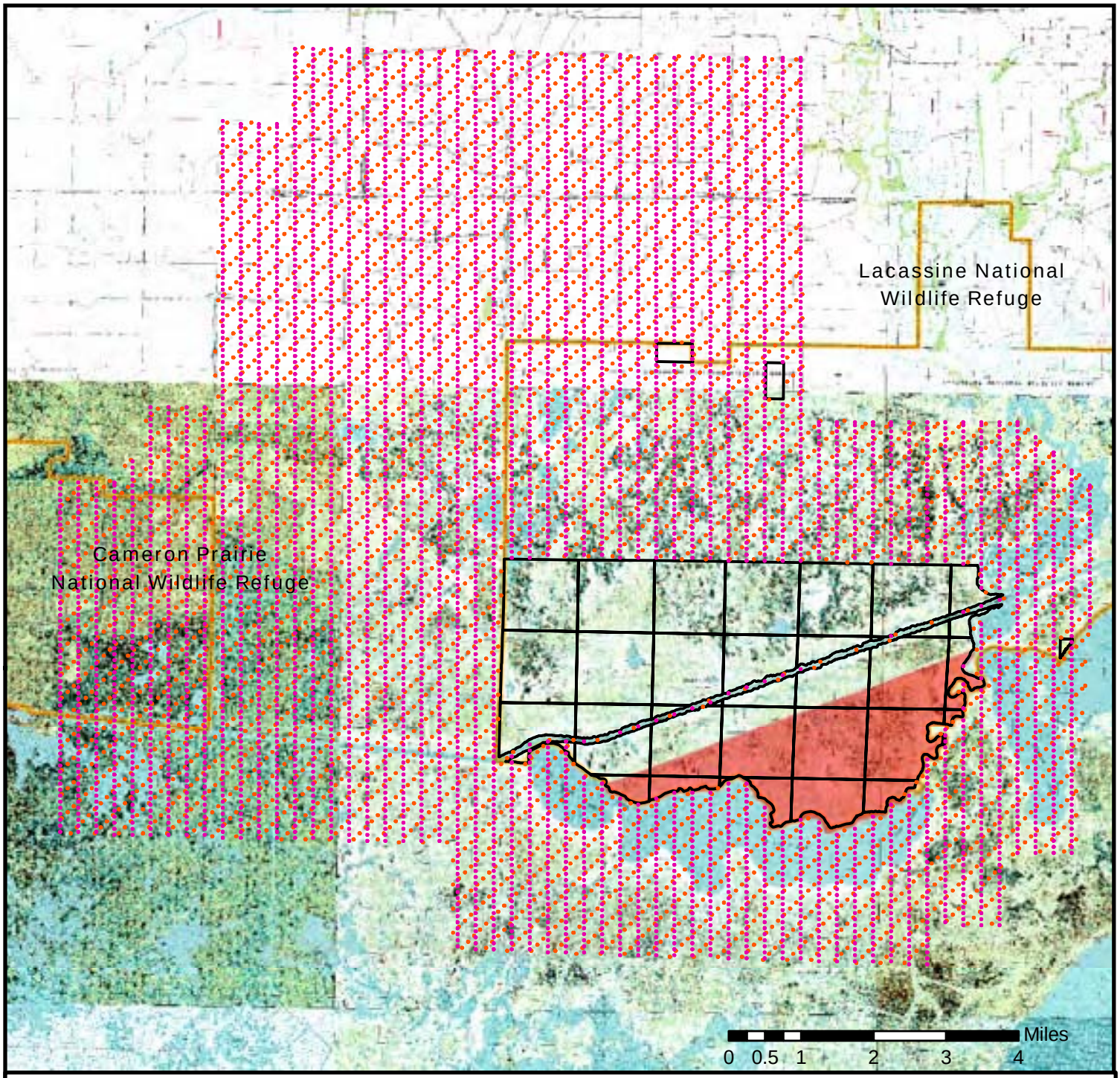


Figure 2. Pre-Plot Point Locations
Lacassine 3-D Seismic Survey
Cameron and Jefferson Davis Parishes, Louisiana

Map Legend

- Pre-Plot Receiver Locations
- Pre-Plot Source Point Locations
- Wilderness Area
- Federal Mineral Tracts
- National Wildlife Refuges

N

Map Produced 01/16/09

Dixie Environmental Services Co., LP

Due to the unpredictability of conditions within the project area during the proposed time period of operations, several types of equipment have been considered for drilling and support within the CPNWR and LNWR. Water levels are highly variable, making it likely that a combination of different types of drilling equipment would be required to accomplish objectives. Each type of equipment that may be necessary is described below.

Drill Equipment Options

Highland Drill accompanied by a Water Buggy – The weight and size of this type of equipment limits its capabilities in sensitive areas. It is best suited for drier areas that can support its 18,000 pounds (**Figure 3**). The rig is less maneuverable than smaller equipment due to the fact that it is 24 feet long, 8 feet wide, and 10.5 feet high. The drill is easily able to reach the desired depth of 100 feet using water and casing pipe. A water buggy, which transports several hundred gallons of water, accompanies the highland rig, enabling it to drill holes located away from water sources.

Highland drills can be equipped with 42 inch wide terra tires (**Figure 4**), which more evenly distribute the weight of the rig and help to minimize impacts.

Figure 3. Highland Drill

Figure 4. Highland Drill and Water Buggy Equipped with Terra Tires

Lightweight Aluminum Marsh Buggy Drill- This drill (**Figure 5**) is well-suited for marsh habitats containing stable substrates, wet transition habitats, and/or ecotones between uplands and wetlands. The drill is capable of drilling to depths of 100 feet using casing pipe and water, 60 feet using auger pipe and water or air, and 40 feet without water. The weight of the marsh buggy drill is distributed evenly over the tracks, exerting less than 2 pounds per square inch (psi) of pressure on the substrate. As a result of this even distribution, impacts to vegetation and substrate in the path of the marsh buggy drill are generally minimal. Vegetation impacts typically consist of flattening and/or crushing of above-ground portions of plants; however, the root systems remain intact, allowing for quick re-growth of the vegetation and short term recovery of the ecosystem. Substrate impacts typically include soil compaction and/or displacement in the path of the equipment; however, even distribution of the drill's weight greatly minimizes the potential for impacts of this nature.

Figure 5. Lightweight Aluminum Marsh Buggy Drill

Airboat Drill - This drill (**Figure 6**) is capable of drilling to 100 foot depths with water and is best suited for shallow water habitats. The airboat travels easily over areas that hold even as little as a few inches of water. Generally, vegetation is only flattened in its path, and compaction is non-existent or minimal, depending on the depth of the water.

Figure 6. Airboat Drill

Pontoon Drill – This rig is capable of drilling to depths of greater than 100 feet. It is used in open water areas that are too deep or too rough for the airboat drill (**Figure 7**). Like the airboat drills in open water, the pontoon drills lower spuds into the substrate to hold the drilling rig in place, providing more stability in rough water. A support boat also accompanies this drill. The support boat is a flatboat with outboard engines that would move the pontoon rig between source points. The support boat is also used to move equipment and crews into and out of the field.

Figure 7: Pontoon Drill and Support Boat

Marooka Drill **(MST 600VD & 600VDL Morooka Rubber Track Carriers)-** This drill is capable of drilling to depths of 100 feet with water. It has a turning radius of 96 inches, and is small enough (12-15 feet long, 6.5 feet wide, and 7.5 feet high) for maneuverability in forested areas (**Figure 8**). The drill is heavier (8,800 lbs.) than the tractor drill and other types of equipment, but the rubber tracks provide an even distribution of weight that helps to minimize impacts to the substrate. The drill exerts a ground pressure of only 3.6 pounds per square inch (PSI) without a load, and 7.2 PSI loaded.

Figure 8. Marooka drill

Swamp Buggies and Pull Boats-Swamp buggies (**Figure 9**) and pull boat drills (**Figure 10**) would be used in inundated bottomland hardwood swamp habitats. Swamp buggies are similar to marsh buggy drills (described above), in that their weight is distributed evenly over the tracks, minimizing impacts, and the buggies are capable of floating. Swamp buggies are smaller than marsh buggies, allowing them to maneuver easily through wooded wetland habitat. Swamp buggies are 9 feet wide, 21 feet long, and weigh approximately 16,000 pounds. Pull boats, mounted with drilling equipment are pulled behind the swamp buggies. The pull boats are 7 feet wide, 24 feet long, and weigh approximately 12,000 pounds, providing a suitable platform for swamp drilling.

Figure 9: Swamp Buggy

Figure 10: Pull Boat Drill

Table 1 summarizes the specifications of each type of equipment described above.

Table 1: Specifications of Drilling Equipment Proposed for Use in Areas Managed by USFWS							
Equipment Type	**Weight (pounds)**	**Height (feet)**	**Width (feet)**	**Length (feet)**	**Depth [1] (feet)**	**Drill Type**	**Suitable Habitats**
Highland Rig with terra-tires	18,000	10.5	8	24	40	Auger	Sparsely wooded or open dry areas.
					100	Flush	
					300	Flush	
Lightweight Aluminum Marsh Buggy	20,000	11	14	24	40	Auger	Sensitive habitat, marsh, flooded fields.
					60	Auger[2]	
					150	Flush	
Airboat Drill	8,000	8	14	22	180	Flush	Areas holding water.
Pontoon Drill	12,000	8	11'6	30	150	Flush	Open water
Marooka Drill	8,800	7.5	6.5	12-15	100	Flush	Wooded, open, or wetland areas
Swamp Buggies	16,000		9	21	N/A	N/A	Wooded wetland habitat
Pull Boats	12,000		7	24	150	Flush	Wooded wetland habitat

[1]Depth to which equipment can drill under optimal conditions. N/A- Data not applicable or not available.
[2] Wet Auger drill, in which water is used in the drilling process.

Water for Drilling

Water would be required in order to attain 100 foot depths and subsequently load dynamite to these depths with the proposed drilling equipment. Quantities of water necessary for the drilling of each hole would vary based on substrate conditions. Water necessary for drilling operations would be pumped from sources within the CPNWR and LNWR approved by the Refuge Managers. The necessary water would be acquired through the use of three to five horsepower gasoline-powered water pumps or by digging pits in wetland areas.

Minimization of potential rutting from water hauling vehicles within sensitive wetland areas containing saturated soils would be achieved by obtaining water from source point locations by excavating two foot by four foot pits. Pits would be refilled and leveled upon completion of operations in order to restore the areas as nearly as possible to pre-project conditions.

Hoses connected to water pumps would be screened at the opening through which water is suctioned. This is a precautionary measure necessary to ensure that aquatic species are not taken up by the hoses.

There should be no need to transport water onto the Refuges, other than minor quantities of drinking water.

Backfilling and Plugging Shotholes

Holes on land would be plugged with bentonite (natural clay) and drill cuttings in accordance with applicable rules and regulations. Louisiana Department of Wildlife and Fisheries, Wildlife and Fisheries (LDWF) Commission, Title 76, Subchapter A, Seismic Exploration § 301 Regulation Q states that:

> "In accordance with good industry practice, Permittee shall, after drilling and loading shot holes, backfill holes with cuttings or another material authorized by the Department, and place the shot hole plug near the surface to avoid wash-in."

LDWF approved guidelines for plugging source holes are as follows: a plastic plug is placed in the hole at approximately 17 feet below grade; then filled with 1.5 sacks (75 lbs.) of bentonite; a second plastic plug is placed at 18 to 24 inches below grade; the remainder of the hole is filled with natural cuttings; and lastly the remaining cuttings are spread on the surface to less than an inch in thickness (Maryman 2008).

While bentonite and cuttings produced from shothole drilling would be used to backfill holes on land, these cuttings would naturally cave back into the hole in areas containing standing water. Holes in wetland areas would not be plugged with bentonite, as the walls of these holes naturally collapse, filling the holes to the surface. All cuttings in upland or wetland areas that are not utilized as backfill for the source hole would be spread in a thin layer around the surface of the hole so that no mounds remain.

2.2.2.4 Phase 4: Recording

After shotholes are drilled and loaded, geophones, sensors, and cables would be lowered along the receiver lines by helicopter to minimize surface impacts. The equipment would be deployed along the receiver lines by the recording crew. This would be accomplished using low-impact equipment (airboats, marsh buggies, etc.) or by crews on foot. A shooter with a backpack mounted shooting system would then travel along the source lines and hook into each detonating cap. The shots would be remotely detonated, one at a time, and the resulting energy wave recorded by the recording truck located outside of the Refuge. The seismic layout, troubleshooting, and recording crew would consist of approximately 150 individuals.

2.2.2.5 Phase 5: Cleanup and Reclamation

This phase is initiated when Phase 2 begins, and continues through the completion of the project. When recording operations are completed, the geophones, cable, survey markers, flagging and all other equipment and materials would be removed from the project area.

2.2.2.6 Safety and Offsets

Project personnel would perform contract operations in a careful and conscientious manner, and all explosive charges would be discharged at a safe distances from water wells, buildings, and other applicable installations to avoid unnecessary risk of damage by concussion or otherwise. Safe operating distances commonly accepted by the geophysical industry were obtained from the International Association of Geophysical Contractors and are presented in **Table 2**.

Table 2. Minimum Safe Offset in Feet as a Function of Explosive Charge Size in Pounds for Typical Objects

OBJECT(S)	MINIMUM OFFSET FOR CHARGES (POUNDS)	
	1	**5.5**
Pipeline less than 6” in diameter	100 ft	200 ft
Pipeline 6” to 12” in diameter	150 ft	300 ft.
Pipeline greater than 12” in diameter	200 ft	300 ft
Electric Power Line	20 ft	40 ft
Telephone Line	20 ft	40 ft
Railroad track or main paved highway	100 ft	150 ft
Water wells, buildings, underground cistern, and all other objects not mentioned including all living things	300 ft	700 ft

Crews can exercise flexibility in the placement of source and receiver points to accommodate local topographic, hydrologic, biological, or cultural features. Additional setbacks/offset distances would be incorporated into operations for the protection of these features, as required by the Refuge Manager.

2.2.2.7 Staging and Storage

The seismic survey would require a staging area(s) for storing equipment and supplies, helicopter operations, and performing routine equipment maintenance (e.g. vehicle fueling and oil/filter changes). The staging area(s) would be located outside of the CPNWR and LNWR.

2.2.2.8 Equipment

Equipment for the proposed seismic survey would include: crew trucks and/or vans, four-wheeled all terrain vehicles (ATVs), single and double wide airboats, lightweight aluminum tracked vehicles (transition zones), highland terra tire vehicles (for upland areas), pontoon boats, geophones, hydrophones, recording equipment, GPS based navigation systems, RF radio telemetry recording equipment, and a helicopter for transport of equipment and personnel.

Vegetative cover, hydrologic conditions, and wetland habitat types within the project area would dictate the types of equipment used to complete the seismic survey. Any one or a combination of drilling equipment types described in **Section 2.2.2.3** would be utilized to drill source holes in the project area, as the conditions of the substrate in the CPNWR and

LNWR would be highly variable during the project period. Prior to entering an area, the conditions would be evaluated by Cajun Exploration in conjunction with the environmental monitor(s) and the Refuge Manager to determine which equipment to use and how to best access the sites. In general:

- For submerged lands and shallow water conditions, airboats would be required for transportation of personnel and drilling equipment.
- For emergent wetlands operations, lightweight aluminum tracked vehicles would be used to minimize compaction/rutting.
- For upland operations, rubber-tired or terra-tired vehicles may be used where necessary for drilling and/or deploying and picking up receiver line equipment. Surveyors and line troubleshooters would use four wheelers in areas where soil conditions would allow use without causing rutting or walk whenever possible.

For submerged land and shallow water habitats, most personnel transportation and light equipment transportation, including recording equipment, would be accomplished with airboats. The use of marsh buggies would be approved by the Refuge on a case-by-case basis. Existing natural and man-made travel lanes (roads, trails, ditches, bayous) would be used to the extent possible to minimize the number of passes along source and receiver lines. Only airboats and tracked vehicles would enter wetland areas. All other support vehicles would be restricted to designated roads and trails. Should it become necessary for a support vehicle to gain off-road access to any given area, the access route would be approved by the environmental monitor and the Refuge Manager on a case-by-case basis. Passenger vehicle access would be limited to designated roads. One recording truck would be located outside the Refuges. All-terrain vehicles (ATVs) would be used to access the project area on existing levees, pipelines, and seismic lines, as designated by the Refuge Managers and environmental monitor.

2.2.2.9 Schedule

The proposed seismic survey would require approximately three and a half months of fieldwork from the commencement of surveying to the completion of recording and cleanup; however, the timetable for operations is dependant on a number of factors, including but not limited to regulatory agency requirements, authorizations, and permits.

The project is tentatively scheduled to begin on March 15, 2009 and should be completed by July of 2009. Flagging and surveying may begin as soon as the Refuge Manager provides authorization. Shothole drilling may begin following approval of the operations plan and issuance of the SUP. The drilling phase of operations is tentatively scheduled to start in April and be completed by mid-June, 2009. Recording operations would likely begin by mid-May and should be completed before July, 2009.

2.2.2.10 Mitigation Measures

Table 3 contains a list of mitigation measures that would be incorporated into operations for the protection of Refuge resources.

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
1	The Permittee will consult with the Complex Oil and Gas Specialist or his authorized representative on equipment to be used in certain designated areas. Airboats and /or aluminum wide tracked marsh buggies might be deemed more appropriate depending on habitats e.g. grass or open water.	• All resources/concerns
2	Airboats will be used exclusively for seismic operations on the refuge where appropriate, unless aluminum wide tracked marsh buggies have been approved by the Complex Oil and Gas Specialist or his authorized representative. All airboats/buggies should meet and/or exceed all State and Federal boating regulations. All airboat/buggies crossing grassy terrain will avoid using the same track twice.	• All resources/concerns
3	All airboat/buggy operators should remain in the designated work areas. All travel to and from work areas will be confined to designated access routes. No cross country travel will be permitted. All airboat/buggies crossing grassy terrain will attempt to avoid using the same track twice. Any questions airboat drivers have about where and how to access work areas must be directed to the Refuge Representative for guidance.	• All resources/concerns
4	All survey lines will be laid by airboats/buggies. Crews will be moved by airboats or helicopters. Air-driven drill rigs may be left in the marsh on work lines instead of going to canal banks. Access routes will be established for airboat use and will be used to the greatest extent possible. In areas not designated as access routes, airboats will not be allowed to use the same trail twice when traveling in the marsh. In the event an airboat drill cannot be used, a special aluminum tracked buggy of smallest size possible, with drill will be used to minimize surface damages. Use will be approved on a case-by-case basis by the Complex Oil and Gas Specialist or his authorized representative.	• Vegetation

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
5	The cutting of woody vegetation (dead or alive) would be limited by size to six (6) inches in diameter, measured diameter at breast height (DBH). Tree damage applies to the trunk, all limbs, and the entire root system. No oak tree species or cypress trees are to be damaged regardless of tree size. Additional damage assessments may be made during the course of the survey.	• Vegetation • Fish and Wildlife
6	Vegetation would be selectively cut along receiver lines. Vegetation would be cut in a manner that facilitates access for crews, while minimizing the amount of vegetation cut.	• Vegetation
7	Helicopters would be used to lower equipment (at a minimum altitude of 100 feet), via cable, along receiver lines in order to minimize surface impacts in the area. The helipad would be located outside of the Refuge boundaries. The use of helicopters to move personnel, supplies and equipment is highly recommended to reduce airboat trips.	• Geology and Soils • Vegetation • Water Resources, Floodplains and Wetlands • Fish and Wildlife • Cultural Resources
8	All access paths for foot traffic would be chosen in a manner that would minimize path length and avoid areas designated as "off limits" or "offset areas."	• All resources/concerns
9	Areas designated as "off limits" by USFWS would be identified on a map provided by Cajun Exploration and would be absolutely avoided throughout the operation. There would not be any entry into or transit through the designated avoidance areas.	• Geology and Soils • Vegetation • Water Resources, Floodplains and Wetlands • Fish and Wildlife • Visitor Use and Experience • Cultural Resources • Natural Soundscapes
10	Harassing, injuring, or destroying wildlife would be prohibited (including all snakes). Damaging or destroying the nests or dens of wildlife would be prohibited, and appropriate measures would be employed to avoid these areas.	• Wildlife
11	An incidental take of a federally listed species would be immediately reported to the USFWS and USFWS; all other protected species would be reported to the USFWS. [Endangered Species Act, 16 USC §§ 1531 – 1544, 50 CFR Parts 402, 450]	• Species of Management Concern

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
12	Firearms of any kind are prohibited on the Refuges. Killing or harassing of wildlife is prohibited. It is illegal to molest or destroy the home or dens of wildlife. All alligator nests and muskrat beds should be avoided with equipment. If nests are found during the normal course of operations, cane poles with distinctive flagging will be use to alert airboat operators to the nests. Adverse impacts on fish, wildlife and the environment shall be kept to an absolute minimum.	• Health and Human Safety • Fish and Wildlife
13	Self-contained toilets must be provided and maintained.	• Health and Human Safety
14	All refuge regulations will be in force and the Permittee shall be responsible for the actions of all exploration and support personnel. Feeding alligators or any wildlife is prohibited. No fishing will be permitted while on location. Crew members can fish on their own time when properly licensed and in areas open and accessible to the general public. No pets or other animals are allowed on the Refuges. Violations of applicable laws or regulations may subject the Permittee and/or his employees to prosecution under States and/or Federal laws, and put this permit in jeopardy.	• Fish and Wildlife
15	Any cultural artifacts or features found would be flagged with a buffer zone of at least 100 feet. Cultural resource structures would be flagged with a buffer zone of 200 feet. As specified by the USFWS, no shot hole would be placed within a minimum of 100 feet away from any cultural artifacts or features.	• Cultural Resources
16	Cajun Exploration shall immediately bring to the attention of the Manager any cultural or scientific resource encountered that might be altered or destroyed by the operation and shall leave such discovery intact until told to proceed by the Manager. The Manager would evaluate the discoveries, and would determine within 10 working days what action would be taken with respect to such discoveries. GPS measurements in NAD 83 datum of any newly discovered sites would be recorded and provided to the USFWS in the daily compliance report.	• Cultural Resources

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
17	Cemeteries would be avoided by a distance of 200 feet, regardless of whether or not the cemetery is located within the boundaries of the Refuges.	• Cultural Resources
18	The Refuge Manager may stop any work or activity that threatens to harm a threatened or endangered species or active bird rookeries, or any other activity which would cause significant harm to the Refuge resources, which threatens historic or cultural resources, or which endangers public safety.	• All resources/concerns
19	All equipment used prior to entering Refuges to conduct seismic operations will be cleaned; all connections and hoses will be inspected prior to entering Refuges to insure that they are in workable conditions to prevent leaks. Oil may not be changed in the field, all oil and filters will be changed prior to entering Refuges. Any major repairs to equipment will be performed off Refuges. If spilled oil is found, all seismic operations will be stopped. It will require immediate cleanup before operations can be continued anywhere on the Refuges. Oil absorbent pads and containment booms will be carried on drilling rigs at all times. All equipment entering Refuge property is subject to inspection prior to unloading by the Complex Oil and Gas Specialist or his authorized representative.	Water Resource, Floodplains and Wetlands • Vegetation • Fish and Wildlife
20	Each shot hole would be plugged with bentonite (natural clay) in accordance with Louisiana Department of Wildlife and Fisheries Wildlife and Fisheries Commission Title 76 Subchapter A, Seismic Exploration § 301 Regulation Q, for the prevention of commingling of surface and ground water.	• Water Resources, Floodplains and Wetlands • Geology and Soils
21	Any drill cuttings not returned to the hole during plugging would be spread in a thin layer around each shot hole.	• Water Resources, Floodplains and Wetlands • Geology and Soils • Vegetation
22	Disturbed soils from seismic operations (excess drill cuttings and from equipment travel) would be manually restored to reasonably conform to pre-project conditions.	• Geology and Soils • Water Resources, Floodplains and Wetlands
23	Water for drilling would be pumped from approved sources within the Refuges.	• Water Resources, Floodplains and Wetlands

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
24	Hoses used to pump water for drilling would be screened at the opening to prevent the intake of aquatic species. Water would not be pumped or otherwise used from water bodies known to contain exotic species.	• Water Resources, Floodplains and Wetlands • Vegetation • Fish and Wildlife
25	Cajun Exploration would discharge explosives at a safe distance from pipelines, telephone lines, railroad tracks, roads, power lines, water wells, oil and gas wells, oil and gas production facilities, buildings, etc., using accepted industry minimum safe offset distances, unless otherwise specified [36 CFR § 9.37(a)(1)]. Cajun Exploration would not place any source points within 300 feet of pipelines within the Refuges.	• Human Health and Safety
26	All explosive materials will be kept in a secure location. All defective, damaged, or otherwise unusable blasting caps will be disposed of in the following manner; the faulty cap will be placed between charges and put downhole to be disposed when shooting the line. Daily explosive counts will be provided to the Complex Representatives along with shot hole drilling counts and re-drilling records.	• Human Health and Safety
27	Shots that fail to detonate would be reported to USFWS and mapped. The wires would be removed and the hole covered with native soil.	• Human Health and Safety
28	Cajun Exploration would provide and display signs in public use areas to inform the public of their activities.	• Visitor Use and Experience • Human Health and Safety
29	Littering is prohibited. All cans, bottles, paper, and other operational trash generated by the seismic crews would be removed from the Refuges daily. All airboats will be equipped with a container to carry out trash.	• All resources/concerns
30	All equipment and debris incidental to the survey (e.g., flagging, wire, poles, etc.) would be removed from the Refuges following seismic operations.	• All resources/concerns

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
31	Cajun Exploration would be responsible for equipment/supplies stored within Refuge boundaries.	• Human Health and Safety
32	Seismic operations would not be conducted during times of extreme weather (i.e. hurricanes, tropical storms). In the event of a hurricane, procedures from Cajun Exploration's Hurricane Evacuation Plan would be followed.	• Human Health and Safety
33	The Permittee is allowed access into the seismic area is restricted to legal sunrise to fifteen (15) minutes before sunset.	• Human Health and Safety • Natural Soundscapes
34	All crewmembers would wear bright orange vests in order to make them visible to visitors and hunters.	• Human Health and Safety • Visitor Use and Experience
35	Cajun Exploration would advise the Refuge Manager at least 72 hours in advance of initial seismic activities and would coordinate all activities during the seismic survey on the Refuge with the Refuge Manager or his representative.	• All resources/concerns
36	Cajun Exploration would protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration, or damage from operations. Cajun Exploration shall be responsible for the reestablishment, restoration, or referencing of any monuments, corners or bearing trees which are destroyed, obliterated, or damaged by such operations. [36 CFR § 9.41(b)].	• All resources/concerns
37	Entry across refuge levees or banks will require a cleared crossing with a method approved by the Complex Oil and Gas Specialist or his authorized representative to protect the toe of the levee or bank. No other method of entry will be permitted. Wooden ramps for wide tracked aluminum buggies are recommended.	• Water Resources, Floodplains and Wetlands
38	Seismic lines that run within 1000 feet of active bird nesting rookeries will be halted until the Complex Oil and Gas Specialist or his authorized representative can be contacted and an alternate route can be selected to minimize disturbance. Crew members and/or environmental monitors would immediately report the discovery of any bird rookeries that are spotted during the course of operations to the Refuge Manager.	• Fish and Wildlife

Table 3. Mitigation Measures for 3-D Seismic Survey on Cameron Prairie and Lacassine National Wildlife Refuges		
Number	**Mitigation Measures**	**Resource/Concern Protected**
39	All fences breached by the seismic survey would be repaired at Cajun Exploration's expense in a timely manner, and in a manner agreed upon by the Refuge Manager.	• All resources/concerns
40	Cajun Exploration would to the greatest extent practicable, conduct all exploration in such a manner as to minimize damage, erosion, pollution or contamination to the lands, waters, facilities and vegetation of the area. Shot holes will be placed in open water to the greatest extent possible. All mud and dirt from drilling sites, from charge holes and mud pits, must be back filled and leveled immediately after each shot hole is drilled and loaded. After the shots are discharged, the cap wires must be completely removed from the ground and carried to a disposal location.	• Water Resources, Floodplains and Wetlands
41	All Refuge regulations shall be adhered to by all seismic personnel at all times, except where explicitly exempted by the Refuge Manager. Seismic personnel shall comply with all applicable ordinances, laws, decrees, statutes, rules, and regulations of all state and federal entities.	• All resources/concerns

2.2.2.11 Monitoring

Non-service refuge representatives would be present during each phase of operations to identify sensitive species/resources for avoidance and assist crews with least impact routes, equipment choices, and field methodology. These individuals would also insure compliance with permit stipulations and document impacts to Refuge resources. The non-service refuge representatives would work closely with the seismic crews and Refuge representatives to help minimize impacts while accomplishing project objectives in an efficient manner.

All non-service refuge representatives or environmental monitors would be hired with prior approval from the Refuge Managers and would report directly to the Refuge Managers. The number of monitors on site at any given time would vary depending on the monitors' ability to access each of the crews. If the crews are working in close proximity to each other, it may be possible for one monitor to cover multiple crews; however, if travel time between crews prohibits effective monitoring efforts, one monitor may be required for each crew. The decision on the required number of environmental monitors would be made by the Refuge Managers and the environmental monitors upon consultation with Cajun Exploration.

As equipment is removed from an area, a complete evaluation of the area's conditions would be made by Cajun Exploration, with the assistance of the environmental monitor(s), to determine if additional clean-up or remediation is necessary.

2.2.2.12 Operators and Lessors

Cajun Exploration is the operator, on behalf of Alta Mesa Holdings, LP, with respect to the proposed action. United World Energy Corp. is the holder of mineral leases underlying the project area. Documentation of lease option agreements executed to date has been provided to and approved by the USFWS.

2.2.2.13 Lease Agreement Authorization

Cajun Exploration will comply with applicable sections of federal regulations in 50 CFR dealing with mineral management on federal wildlife refuges. Specifically, this seismic survey has been developed to satisfy the following provisions:

> 50 CFR 29.32 "Mineral rights reserved and excepted" governing mineral operations on refuge states "Persons holding mineral rights in wildlife refuge lands…(1) shall, to the extent practical, conduct all exploration, development, and production operations in such a manner as to prevent damage, erosion, pollution, or contamination to the lands, waters, facilities and vegetation of the area. (2) So far as is practicable, such operations must also be conducted without interference with the operation of the refuge or disturbance to the wildlife thereon. (3) Physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations… (4) Upon the cessation of operations the area shall be restored as nearly as possible to its condition prior to the commencement of operations…"

2.3 Alternatives Considered But Eliminated From Analysis

Several alternative methods for accomplishing project objectives were considered during the development of the Proposed Action, each of which addressed one or more of the issues identified during the scoping process. Descriptions of each of the alternative methods, as well as the reason(s) that each method was eliminated from detailed analysis, are included in the following paragraphs.

2.3.1 Alternative Project Locations

No alternative locations were considered for project operations, Cajun Exploration's mineral leases specifically define the project area. Conducting the 3-D survey within the boundaries of the CPNWR and LNWR is necessary to acquire the data relevant under those leases.

2.3.2 Alternative Operational Methods

Various alternative operational methods were considered during the planning and design of the proposed action including alternative shothole depths, alternative shothole spacing, alternative charge sizes, alternative methods of exploration, and alternative energy sources. These alternatives, along with reasons for their selection or elimination, are discussed in the sections below.

2.3.3 Alternative Shothole Depth

Alternatives to shothole depth and spacing were assessed during the planning phases of this project. Due to the nature of seismic recording, more shotholes would be required at shallower depths and fewer shotholes would be required at greater depths. In order to determine the best depth to place the charges, three things were considered: safety, minimization of impacts, and data quality.

The number of shotholes drilled at shallow depths (approximately 10 feet) would need to be three to five times that of holes drilled to the proposed depth of 100 feet in order to obtain similar data. An increase in the number of shotholes would result in greater disturbance during the drilling and recording phases of the survey. In addition to the disturbance directly resulting from the drilling of a greater number of holes, there is an increased risk of experiencing a "blowout," during which substrate/media is expelled from the shothole when the charge is detonated. Such an event is considered to be a safety hazard and can result in greater impacts at the surface surrounding the hole.

Shotholes drilled at greater depths would likely result in fewer blowouts, thereby minimizing impacts. The most desirable shothole depth for the project, based on review of existing geologic information, is 100 feet. At this depth, the media is mostly clay, which is considered an efficient energy conductor and would provide better seismic data retrieval. Similarly, charges detonated at this depth would provide the data sufficient to image the subsurface features within the geologic formations targeted by the survey.

The 100 foot shothole depth proposed for the survey was selected due to the fact that it would reduce the risk of blowouts, minimize surface disturbance, and provide the most accurate data on the subsurface features of the area.

2.3.4 Alternative Shothole Spacing

The placement of shotholes proposed for the survey (220 feet) is synonymous with today's industry standards. Shotholes placed at distances greater than 220 feet apart would not provide sufficient data in the area, and shotholes placed at distances less than 220 feet apart would increase impacts. The 220 foot spacing proposed reflects Cajun Exploration's ideal project design; however, points can be offset from these locations, within reason, and still allow for the collection of accurate data. Cajun Exploration would offset shothole locations for the protection of sensitive species/resources in accordance with Refuge requirements.

2.3.5 Alternative Explosives Charge Size

All detonations release some fraction of both shock energy and expansion (gas) energy. The total amount of energy released and the ratio of shock energy to expansion energy varies between types of explosives. At detonation, the shock wave passes into the soil surrounding the explosive. When an explosive is detonated in a drill hole, as planned during the seismic survey, the shock wave crushes, fractures and/or compresses the soil to a distance of several drill hole diameters. The use of energy to produce these effects on the soil and the ever-expanding surface of the compression front causes the shock wave to slow to the sonic velocity of the medium. Particle disturbance at this transition

distance from the explosive becomes the commonly known compression wave. The shock wave within the supersonic zone, called the near field, exceeds the elastic strength of the medium producing fractures and permanent deformation in the immediate down hole vicinity of the explosive charge. The compression wave beyond the transition distance, termed the far field, remains within the elastic limits of the material. Soil particles in the far field return to their original position following passage of the compression wave, and no lasting effect occurs in the soil. For the size and depth of the explosives planned, the near field will be contained well below ground, and only the compression wave can be a potential low impact on terrestrial or aquatic wildlife or manmade structures at distances away from the shot point.

Pentolite is the explosive being proposed by Cajun Exploration for operations. *Pentolite* is presently the more commonly used explosive in 3-D seismic surveys. *Pentolite* is comprised of a mixture of 50% Pentaerythritol tetranitrate (PETN) and 50% Trinitrotoluene (TNT). Cajun Exploration is proposing to use five and a half pounds of *Pentolite* in each shothole. *Pentolite* has an energy content of 2100 calories per gram; therefore, the energy content of each shothole on the proposed survey would be 5,239.08 kilocalories (453.6 grams/lb x 5.5 lbs x 2100 calories/gram ÷ 1000 calories).

Lower energy content would result in a lower compression wave and lower pressure being released at the substrate/water interface. This being said, smaller charge sizes could be used in source holes, where necessary for the protection of structures or sensitive features. Any necessary charge size adjustments would be coordinated with the Refuge Manager. The explosive *Pentolite* is available in lesser charge sizes.

Pentolite, made by Dyno Nobel Inc., has bioremediation technology which involves casting millions of freeze-dried microorganisms (along with nutrients for those microorganisms) directly into the *Pentolite* seismic booster during production. When these naturally occurring organisms are submerged in water, they become activated, as designed, and begin to slowly biotransform the undetonated *Pentolite*. When biotransformation is complete, the compounds are no longer explosive. Complete and continuous submersion in water is required to sustain the bioremediation process. Additionally, the process is dependent on various other factors and environmental conditions.

Pentolite's bioremediation technology should help to minimize any risks associated with explosives that do not detonate and remain buried in shotholes within the project area.

2.3.6 2-D Alternative

Two dimensional (2-D) seismic surveys require shotholes and receiver points to be located on a single line, with little flexibility. A 2-D seismic survey essentially provides a picture of a slice of the earth underlying the line. In order to get information somewhat comparable to that obtained using 3-D technology, several 2-D lines would have to be located within the project area. Even then, the data collected would not be as accurate as 3-D data; therefore, the likelihood of drilling a dry hole is greater than that associated with 3-D seismic data.

In addition, the lack of flexibility in source point locations could possibly result in additional impacts to natural or cultural resources, as a 2-D line may encroach on environmentally or structurally sensitive areas. This being the case, 2-D seismic surveying was eliminated from analysis.

2.3.7 "Cable-Only" Alternative

Conducting all or a greater part of the 3-D survey as a "cable-only" operation was considered as an alternative. Under this alternative, operations within the CPNWR and LNWR would consist of only surveying activities, and equipment layout, pickup, and troubleshooting. This method would eliminate the use of drilling equipment in the Refuge, and minimize impacts on Refuge resources, namely vegetation, soils, and natural soundscapes.

Due to the size of the CPNWR and LNWR, this alternative was not considered technically feasible, as it would leave a gap in the data set being collected as a result of the operations. If no source holes were drilled within the 17,190.4 acres of land under USFWS jurisdiction, Cajun Exploration would not be able to acquire an accurate image of the subsurface underlying that area; therefore, this alternative would not accomplish Cajun Exploration's objectives or allow the company to fully capitalize on their mineral interests in the area. For the above reasons, it was eliminated from analysis.

2.3.8 Alternative Energy Sources

An alternative source of energy for geophysical exploration is vibration. Vibroseis operations require heavy, truck-mounted equipment, which is not suited for wetland environments. Vibroseis trucks are typically used on dry, fairly level surfaces for operations. This type of equipment would result in a severe rutting and compaction in wetland areas and would not be permitted under conditions of the Refuge SUP; therefore, it was eliminated from analysis.

2.4 Comparison of Alternatives

Table 4 identifies and compares the Proposed Action and the No Action alternatives as a means of responding to the issues raised by Service managers and the public. These alternatives were summarized based on how they accomplish both Refuge and project objectives.

Table 4. Extent that Each Alternative Meets Objectives		
Objectives	**Does Alternative A: Proposed Action meet objective?**	**Does Alternative B: No Action meet objective?**
Avoid, minimize, or mitigate impacts on resources and values, visitor use and experience, and human health and safety within the Refuges.	**Yes** The 3-D seismic survey would be conducted within the Refuge with the application of mitigation measures designed to avoid and minimize impacts to Refuge resources in accordance with a SUP.	**No** Impacts would not be avoided or minimized, as the project would not be conducted under a SUP and the client would not be required to adhere to restrictions designed to protect Refuge resources.
Provide Cajun Exploration, as the lessee of nonfederal oil and gas mineral interests, reasonable access to conduct a seismic survey.	**Yes** Cajun Exploration would be allowed to accomplish their objectives under the guidance of a SUP, while minimizing impacts to the environment.	**Yes** Cajun Exploration would conduct the 3-D seismic survey on Refuge lands with no restrictions on access
Preserve, restore, and enhance diverse habitats to provide favorable conditions for migratory and native wildlife species.	**Yes** Impacts to habitat would be short-term and minimal. USFWS management of the operations would, through the issuance of the SUP and monitoring, ensure strict compliance to its provisions and numerous stipulations designed to protect vegetation, soil, and water resources.	**No** Overall damage to vegetation, soils, and aquatic habitats would be increased. Refuge management would not be consulted and would have no input into how activities would be conducted in sensitive vegetative habitats.
Promote and protect native and migratory wildlife populations on the Refuges to contribute to the purpose for which it was established and to the mission of the National Wildlife Refuge System	**Yes** The proposed action incorporates measures that would prevent or minimize effects to fish and wildlife populations and their habitat from most impacts.	**No** There would be no stipulations restricting hunting, fishing, harassment or destruction of wildlife, destruction of nests or dens, or other protections offered through an SUP.

Table 4. Extent that Each Alternative Meets Objectives		
Objectives	**Does Alternative A: Proposed Action meet objective?**	**Does Alternative B: No Action meet objective?**
Provide opportunities for safe, quality, compatible, wildlife-dependent public use and recreation, which includes hunting, fishing, environmental education, interpretation, wildlife observation, and photography.	**Yes** Cajun Exploration would work with Refuge representatives to minimize interference with Refuge management actions, educational opportunities, and other Refuge uses. Impacts on public use are expected to be minimal.	**No** Increased impacts to infrastructure such as roads and fences are expected, and increased conflicts with Refuge public waterfowl hunting and refuge management programs would occur as a consequence of the lack of issuance of a SUP.
Protect Refuge cultural resources in accordance with Federal and state historic preservation legislation and regulations	**Yes** Under this alternative, historic and archeological sites would be protected, as operations would be offset from all known sites. If a site of potential historical, archaeological or cultural interest is encountered during the seismic survey, work would be stopped in the immediate area and the appropriate authorities notified.	**No** Without consultation with Refuge management or environmental monitors, identification and subsequent avoidance may not occur if historical or archeological resources should happen to be present within the project area on the Refuges. Additionally, without oversight of project activities, crews could remove artifacts from sites, changing site characteristics.

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

Lacassine National Wildlife Refuge is located at the edge of Grand Lake and 15 miles from the Gulf of Mexico in Cameron and Evangeline Parishes in Louisiana (**Figure 11**). LNWR was established in 1937 by the following: 1) Executive Order 7780, "*...as a Refuge and breeding ground for migratory birds and other wildlife...*;" 2) the Migratory Bird Conservation Act, "*... for use as an inviolate sanctuary, or any other management purpose, for migratory birds*," (USC 715d). Additional lands were added to the refuge under the Fish and Wildlife Act of 1956 "*...for the development, advancement, management, conservation, and protection of fish and wildlife resources...*" [16 USC 742f(a) and "*...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services*" [16 USC 742f(b)(1)]. LNWR was the 123rd refuge instituted within the National Wildlife Refuge System.

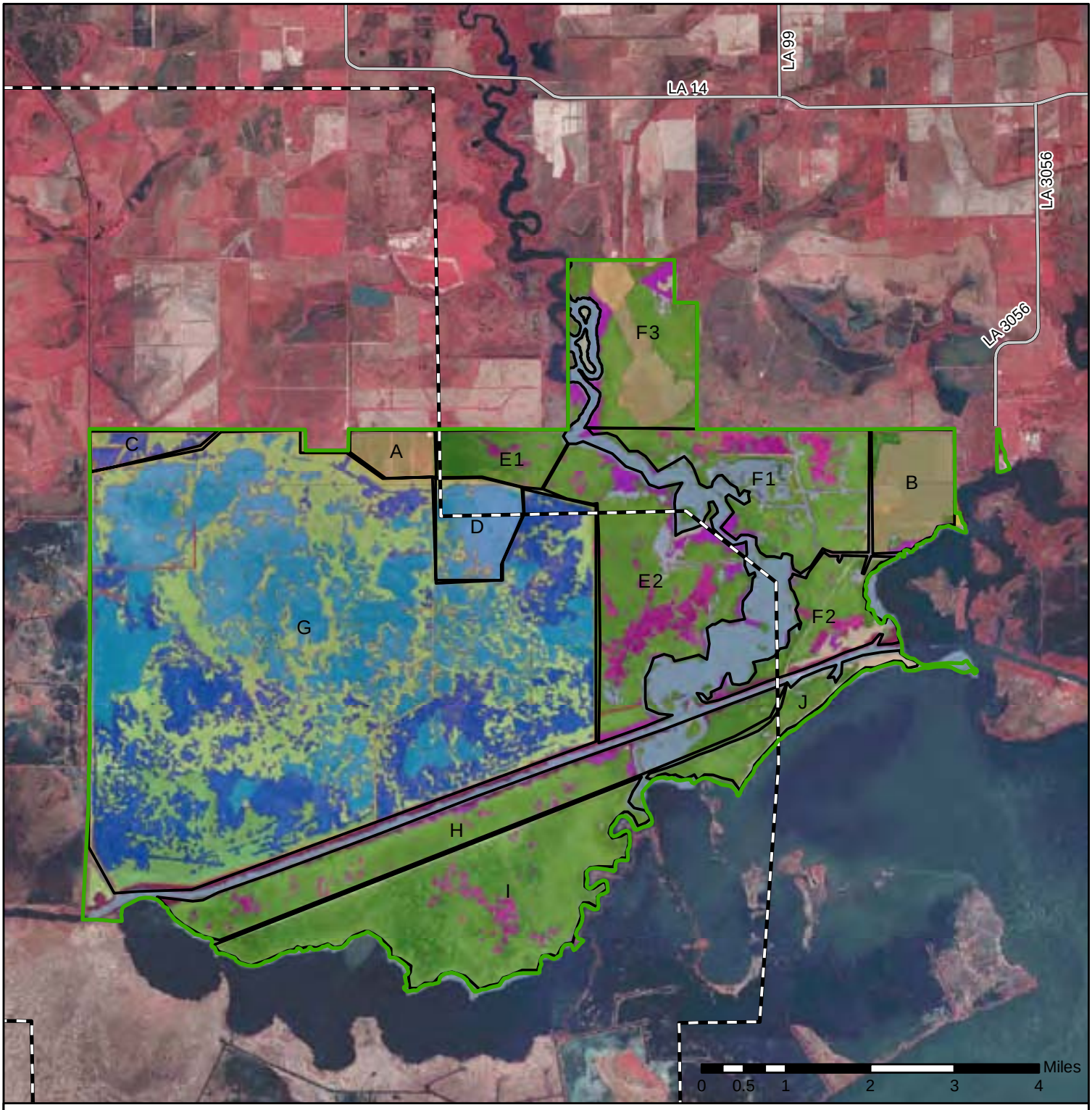


Figure 11. Management Units and Habitat Types
Lacassine National Wildlife Refuge
Cameron and Jefferson Davis Parishes, Louisiana

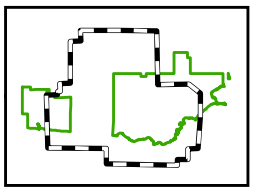
Legend

- Primary Roads
- Lacassine Outer Boundary
- Project Boundary
- Management Units

Habitat Types (1995)

Description

- Beach/Bar/Flat
- Emergent Marsh
- Emergent Marsh Impoundment
- Open Water
- Open Water Impoundment
- Submerged Aquatics
- Submerged Aquatics Impoundment
- Upland Agriculture
- Upland Forested
- Upland Range
- Upland Scrub Shrub
- Upland Urban
- Wetland Forested
- Wetland Forested Impoundment
- Wetland Scrub Shrub
- Wetland Scrub Shrub Impoundment



N

Map Produced 1/15/09

Dixie Environmental Services Co., LP

Cameron Prairie National Wildlife Refuge is located about 25 miles southeast of Lake Charles, Louisiana, in north central Cameron Parish (**Figure 12**). The CPNWR was the 447th refuge established in 1988 "*... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds*" (16 U.S.C. 715d (Migratory Bird Conservation Act)). It was the first refuge created under the goals of the North American Waterfowl Management Plan, a continental conservation effort among Canada, Mexico, and the United States. Funding for CPNWR lands was provided by the Migratory Bird Stamp Act (USFWS 2003a, 1998).

The Cameron Prairie Refuge administers two units, the 9,621-acre Gibbstown Unit (**Figure 12**) and the 14,927-acre East Cove Unit, originally established under nearby Sabine National Wildlife Refuge but managed by Cameron Prairie.

Both the LNWR and CPNWR are strategically located on the boundary of coastal marsh and agricultural habitats, as well as at the southern terminus of the Mississippi and Central Flyways in North America, making the refuge critically important to migratory birds, especially wintering waterfowl.

Most of the 34,724 total acres in LNWR consist of freshwater marsh with only a few natural ridges and levees. The dominant feature of the refuge is Lacassine Pool, created by enclosing a 16,000-acre marsh with a low levee. The refuge is bisected from east to west by the Gulf Intracoastal Waterway and north to south by Lacassine Bayou. Habitat types and approximate acreage on the Refuge include: 14,700 acres of fresh marsh; 16,000 acres of impounded fresh marsh; 1,048 acres of open water; 352 acres of forested wetlands; 348 acres of shrub wetlands; 1,109 acres of croplands (e.g., rice and fallow), 307 acres of managed fresh marsh (e.g., moist-soil plant impoundments); and 334 acres of coastal prairie plus roads, levees, etc.

About 3,300 acres south of the Gulf Intracoastal Waterway are set aside with wilderness designation. The vegetative types occurring on the refuge are primarily water-tolerant grasses, sedges, and shrubs. The types vary according to the frequency, depth, and length of time water covers the area. Vegetation in the unmanaged marshes is predominantly bulltongue (*Sagittaria lancifolia*). Vegetation in Lacassine Pool consists primarily of bulltongue, maidencane (*Pancium hemitomon*), watershield (*Brasenia schreberi*), waterlily (*Nymphaea sp.*), spikerush (*Eleocharis sp.*), and southern bulrush (*Schoenoplectus sp*.).

LNWR habitat is managed for use by all native wildlife, with special emphasis on waterfowl. Because of this management emphasis, an outstanding recreational fisheries resource was developed. Management techniques used at LNWR include prescribed burning, managing for early successional wetland and emergent aquatic wetland plants, planting food crops (e.g., predominately rice) and water level manipulation. Approximately 2,129 acres are managed for early successional wetland (e.g., moist-soil) plants and agricultural crops to provide desirable waterfowl food. LNWR also uses several management techniques to provide suitable conditions for waterfowl within Lacassine Pool.

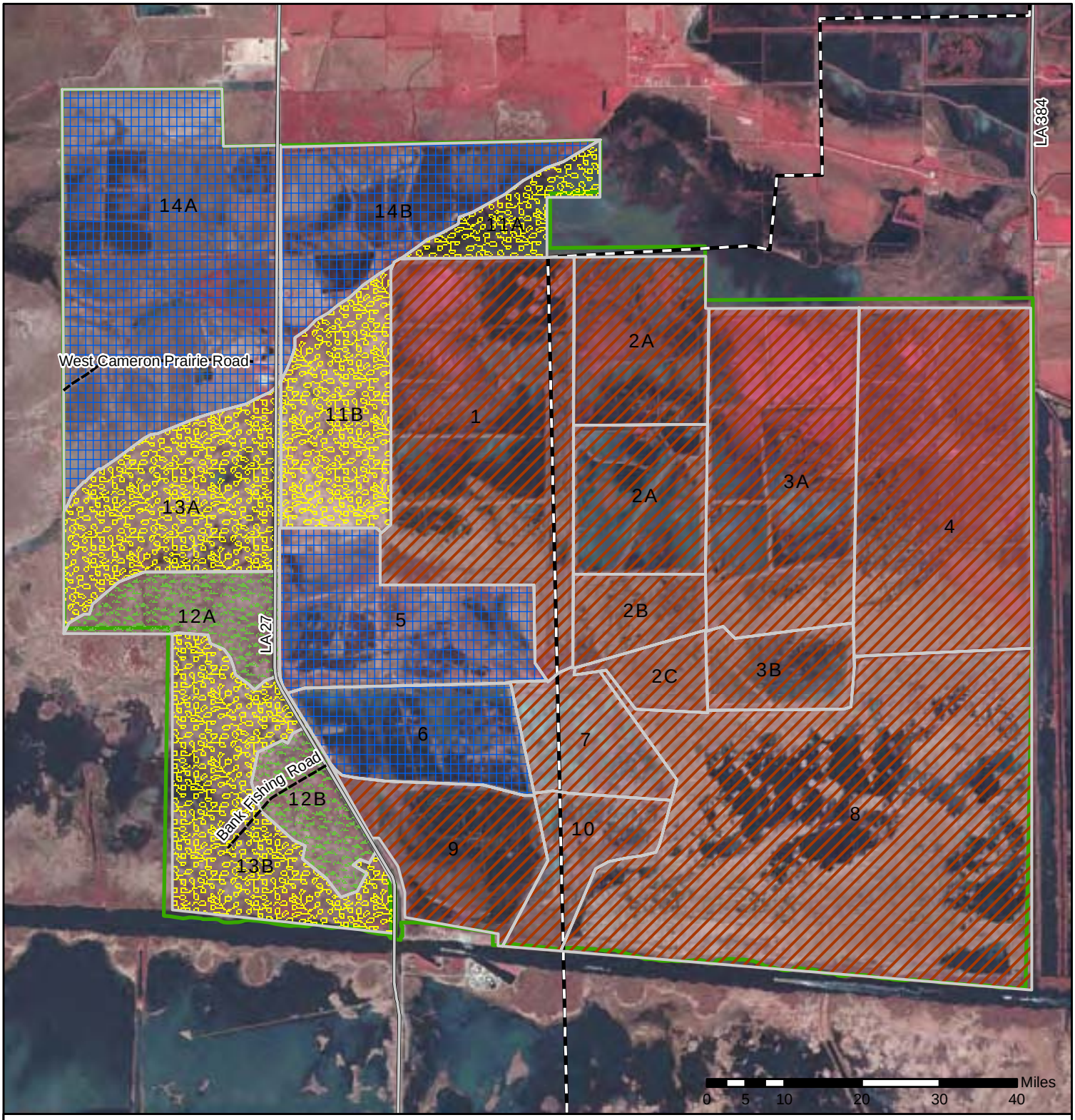


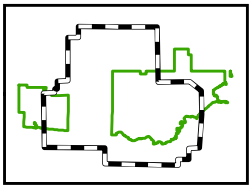
Figure 12. Management Units and Habitat Types
Cameron Prairie National Wildlife Refuge
Cameron and Jefferson Davis Parishes, Louisiana

Legend

- Primary Roads
- Management Units
- Project Boundary

Habitat Types

- Impounded Fresh Marsh
- Moist Soil Area
- Natural Prairie
- Unimpounded Natural Marsh



N

Map Produced 1/15/09

Dixie Environmental Services Co., LP

The CPNWR contains freshwater marsh, coastal prairie, and moist soil units and is managed to preserve and protect wintering waterfowl and their habitat. Resource management programs on CPNWR are directed at preserving, protecting, and improving wildlife habitat. Historically, approximately 4,969 acres within the CPNWR were farmed for rice. This land is now managed for annual plants that provide food for wildlife. Prairie lands within the CPNWR are being restored by periodic burning, discing, and mowing, while earthen levees and water control structures have been repaired or installed to maximize water management in the marshes. Certain marshes are drained or burned periodically to promote the growth of natural waterfowl and shorebird foods.

CPNWR was administratively combined with nearby Sabine National Wildlife in 2000, and is now part of the Southwest Louisiana National Wildlife Refuge Complex (USFWS 2001). Lacassine National Wildlife Refuge joined the Complex in April of 2004. The CPNWR Office serves as the headquarters of the Complex.

3.2 Fish and Wildlife Resources

3.2.1 Introduction

Both the Cameron Prairie and Lacassine National Wildlife Refuges are located in the transition zone of higher agricultural land (historic tallgrass prairie) and the coastal marshes. Both refuges have considerable acreage of marsh and agriculture within its boundaries and contain species from both habitat types. Both refuges also have a high plant and animal species diversity due to the many different elevations and water depths present; although in this flat part of the country, these elevation differences are measured in inches and feet rather than hundreds or thousands of feet.

A large population of alligators (*Alligator mississippiensis*) and furbearers, such as nutria (*Myocastor coypos*) and raccoon (*Procyron lotor*), are present within both of the refuges. Alligators are often seen sunning along the wildlife drive and in the canals adjacent to Louisiana State Highway 27 in CPNWR.

3.2.2 Threatened and Endangered Species

One federally de-listed threatened species is known to occur within the LNWR, the bald eagle (*Haliaeetus leucocephalus*). In June of 2007, the announcement to delist the bald eagle was made by the USFWS, and the 30-day comment period was initiated. This comment period ended on August 8, 2007. The USFS now evaluates the bald eagle as a sensitive species and will manage and evaluate future projects based on bald eagle management guidelines. Current threats are loss of nesting habitat due to development along the coast and near inland rivers and waterways. Bald eagles have been observed within LNWR and the refuge contains habitat that could contribute to the well-being of this species.

LNWR may also attract transient Louisiana black bears, a federally listed threatened species. The Louisiana black bear was first listed on January 7, 1992. It is currently designated as threatened in its entire range of Louisiana, Mississippi, and Texas. LNWR

is outside of known occupied habitat (i.e., defined as an area with resident reproducing female Louisiana black bears) however, it may receive rare use by transient animals. Male Louisiana black bears can travel far from occupied habitats and have been documented in every parish in Louisiana at least once. LNWR does not provide habitat typically used by bears, but such long-ranging individuals may pass through and use the area.

No threatened or endangered species (USFWS 2002b) is currently known to occur within the CPNWR.

3.2.3 Species of United States Fish and Wildlife Service (USFWS) Management Concern

The paddlefish (*Polyodon spathula*), a USFWS Region 4 species of management concern could potentially be present within the project area. Louisiana Department of Wildlife and Fisheries personnel have identified Lacassine Bayou and the Mermentau River as extremely important areas for paddlefish. Paddlefish populations have declined throughout much of their historic range in North America due to habitat changes and overfishing, mostly to supply the caviar market. Due to their scarcity, and to threats posed from overharvest, no harvest of paddlefish is currently allowed in Louisiana. Despite prohibitions on harvest, some incidental take of paddlefish in nets and with other tackle sometimes occurs. The refuge prohibits commercial fishing in the portions of the streams that are within its boundaries and jurisdiction.

A 1988 amendment (Public Law 100-653, Title VIII) to the Fish and Wildlife Conservation Act of 1980 mandated the Service to "identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." *Birds of Conservation Concern 2002* is the most recent effort to carry out this mandate (USFWS 2002c). The report strives to accurately identify migratory and non-migratory bird species, beyond those already designated as federally threatened or endangered, that represent the Service's highest conservation priorities in order to draw attention to species in need of conservation action. *Birds of Conservation Concern 2002* lists birds of conservation concern at three geographic scales – North American Bird Conservation Initiative Bird Conservation Regions, Fish and Wildlife Service regions, and national – to maximize the utility of the lists for partners, agencies, and organizations.

Three national plans were used to place birds on the lists: Partners In Flight, U.S. Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. Current conservation assessment scores for each species were taken from the three plans, which were based on several factors, including population trends, threats, distribution, abundance, and area importance.

While all the bird species included in *Birds of Conservation Concern 2002* are priorities for conservation action, the list makes no findings with regard to whether they warrant consideration for Endangered Species Act listing. The Service's goal is to prevent or remove the need for additional listings by implementing proactive management and conservation actions.

Table 5 lists birds known or expected to occur on Cameron Prairie and Lacassine National Wildlife Refuges that are of management concern.

Table 5. Birds of Management Concern to Cameron Parish and Lacassine Refuges

Common Name	Scientific Name	Refuge	Birds Conservation Region 37 List	USFWS Region 4 List	National List
American Bittern	*Botaurus lentiginosus*	Both	x		
Little Blue Heron	*Egretta caerulea*	Both		x	x
Reddish Egret	*Egretta rufescens*	Both	x	x	x
White Ibis	*Eudocimus albus*	Both	x		
Northern Harrier	*Circus cyaneus*	Both	x		
Peregrine Falcon	*Falco peregrinus*	Both	x	x	x
Black Rail	*Laterallus jamaicensis*	CPNWR	x	x	x
Yellow Rail	*Coturnicops noveboracensis*	Both	x	x	x
American Golden-Plover	*Pluvialis dominica*	Both	x		x
Upland Sandpiper	*Bartramia longicauda*	Both			x
Whimbrel	*Numenius phaeopus*	Both	x	x	x
Long-billed Curlew	*Numenius americanus*	Both	x	x	x
Marbled Godwit	*Limosa fedoa*	Both	x	x	x
Red Knot	*Calidris canutus*	Both	x	x	x
Stilt Sandpiper	*Calidris himantopus*	Both	x		x
Short-billed Dowitcher	*Limnodromus griseus*	Both	x		x
Gull-billed Tern	*Sterna nilotica*	Both	x	x	x
Common Tern	*Sterna hirundo*	Both			x
Least Tern	*Sterna antillarum*	Both	x	x	x
Black Tern	*Childonias niger*	Both	x		
Black Skimmer	*Rynchops niger*	Both	x	x	x
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Both			x
Burrowing Owl	*Athene cunicularia*	Both		x	x
Short-eared Owl	*Asio falmmeus*	Both	x	x	x
Chuck-will's Widow	*Caprimulgus carolinensis*	Both		x	x
Whip-poor-will	*Caprimulgus vociferous*	Both			x
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Both	x	x	x
Scissor-tailed Flycatcher	*Tyrannus forficatus*	Both			x
Sedge Wren	*Cistothorus platensis*	Both	x		x
Wood Thrush	*Hylocichla mustelina*	Both			x
Golden-winged Warbler	*Vermivora chrysoptera*	Both		x	x

Table 5. Birds of Management Concern to Cameron Parish and Lacassine Refuges					
Common Name	**Scientific Name**	**Refuge**	**Birds Conservation Region 37 List**	**USFWS Region 4 List**	**National List**
Prairie Warbler	*Dendroica discolor*	Both		x	x
Cerulean Warbler	*Dendroica cerulea*	Both		x	x
Prothonotary Warbler	*Protonotaria citrea*	Both	x	x	
Worm-eating Warbler	*Helmitheros vermivorus*	Both		x	x
Louisiana Waterthrush	*Seiurus motacilla*	Both			x
Kentucky Warbler	*Oporornis formosus*	Both	x		x
Canada Warbler	*Wilsonia canadensis*	Both			x
LeConte's Sparrow	*Ammodramus leconteii*	Both	x	x	x
Saltmarsh Sharp-tailed Sparrow	*Ammodramus caudacutus*	LNWR			x
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	CPNWR		x	x

3.2.4 Species of Refuge Management Concern

Species of management concern on the CPNWR include the black rail (*Laterallus jamaicensis*), buff-breasted sandpiper (*Tryngites subruficollis*), and loggerhead shrike (*Lanius ludovicianus*) (USFWS 2003a).

The northern pintail has become a species of special concern to the LNWR as populations have steadily decreased over the years. LNWR hosted numbers well over 100,000 until the mid-1980s and then saw peaks reduced by half in the 1990s. Northern pintails, however, are one of the few ducks that continue to lag far behind their North American Waterfowl Management Plan population objective. Southwest Louisiana is one of the key wintering areas for pintails and the open, shallow water habitats of flooded and managed rice fields are ideal for the species. Specifically targeting pintails as a species of refuge management concern is therefore appropriate.

The alligator snapping turtle (*Macroclemys temminckii*), one of the world largest freshwater turtles, is a common concern to both Refuges (USFWS 2003a and 2003b). Alligator snapping turtles are becoming increasingly rare throughout their range. Commercial harvest is allowed in Louisiana, despite being outlawed in all other states. These turtles are known to occur in Lacassine Bayou and are occasionally taken on trout lines. Although there is currently no federal or state protection, such protection may be needed, since these long-lived creatures do not reach sexual maturity for many years. They are vulnerable to over-harvest, from which populations may take a long time to recover.

3.2.5 Birds

Although established to provide wintering habitat for waterfowl, Lacassine National Wildlife Refuge supports many communities of terrestrial and aquatic wildlife. Wildlife species on the LNWR are those indigenous to the marshes of coastal Louisiana. Several

nesting colonies of wading and water birds, such as ibises, roseate spoonbills (*Platalea ajaja*), and egrets are found here. Lacassine Pool serves as a sanctuary for wintering waterfowl with a large concentration of birds using the area to feed or rest. There have been 236 bird species recorded at LNWR (USFWS 2002d, 1989) and more than 200 bird species recorded on CPNWR (USFWS 2002a). A bird checklist, indicating the species present within each refuge, is presented in **Appendix A**.

The CPNWR is predominantly freshwater marsh, which also provides valuable habitat for resident and migratory populations of ducks, geese, shorebirds, and wading birds. Its moist prairies are home to songbirds, Northern bobwhite quail (*Colinus virginianus*), mourning doves (*Zenaida macroura*), and white-tailed deer (*Odocoileus virginianus*). Every winter, CPNWR welcomes thousands of waterfowl escaping frozen northern breeding grounds.

3.2.5.1 Waterfowl

Historically supporting over 524,000 ducks and 158,000 geese at peak population, the Refuges serve as two of the major wintering grounds for waterfowl in the Mississippi Flyway (USFWS 1998; USFWS 2002a).

The LNWR serves as host to large concentrations of northern pintails and greater white-fronted geese (*Anser albifrons*), two species of particular concern in the Mississippi Flyway. Other common wintering species include blue-winged (*Anas discors*) and green-winged teal (*Anas crecca*), gadwall (*Anas strepera*), American widgeon (*Anas americana*), northern shoveler (*Anas clypeata*), mallard (*Anas platyrhychos*), ring-necked duck (*Aythya collaris*), and snow geese (*Chen caerulescens*). The LNWR also provides wintering and nesting habitat for wood (*Aix sponsa*) and mottled ducks (*Anas fulvigula*), black-bellied (*Dendrocygna autumnalis*) and fulvous whistling-ducks (*Dendrocygna bicolor*), and blue-winged teal.

Additionally, LNWR is in the heart of rice farming country, which supports large numbers of geese. LNWR's largest concentration of white-fronted, snow, Ross (*Chen rossii*), and Canada (*Branta canadensis*) geese are found on its farm units. Small numbers of white-fronted and Canada geese use the Lacassine Pool; however, snow geese are the most abundant goose species observed within the CPNWR.

The most abundant ducks within the CPNWR during the spring and summer are the mottled and fulvous whistling ducks. These species are year-round residents and frequently nest on the CPNWR each spring. By May and June, young mottled duck broods can be observed using a variety of the CPNWR's habitat types (USFWS 2001). In 2000, 26 mottled duck pairs with fairly well established territories were frequently observed using the CPNWR. The total estimated number of nesting mottled ducks was 37 pairs (USFWS 2002b).

Aerial waterfowl surveys are periodically conducted to estimate the number of birds using the CPNWR. Fluctuations in waterfowl numbers are often attributed to environmental conditions beyond the refuge's control (i.e. temperature, rainfall, etc.).

Approximately 3,230 acres (34 percent) of the CPNWR are surveyed, and an expansion multiplier of 2.94 is used to estimate the total number of waterfowl across the entire CPNWR (USFWS 2001). Data and trends for peak populations of ducks and geese on the CPNWR are presented in **Table 6**, as are peak waterfowl numbers at LNWR for three recent years.

Table 6. Peak Waterfowl Numbers from Annual Surveys

Year	Approximate Number of Ducks Observed		Approximate Number of Geese Observed	
	LNWR	CPNWR	LNWR	CPNWR
1990		25,500		22,000
1991		23,500		3,000
1992		23,000		5,000
1993		31,000		3,000
1994		20,000		2,500
1995		34,500		4,000
1996		21,500		11,000
1997		45,500		3,500
1998		18,000		12,000
1999		6,500		2,500
2000		24,000		8,250
2001		16,500		20,000
2002		17,500		10,000
2003	101,685	20,924	2,104	17,858
2004	66,823		2,169	
2005	109,740		33,425	

Sources: LNWR: USFWS 2006, CPNWR: USFWS 2001, 2002b, 2003

In the spring, just as neotropical migratory songbirds are arriving, the majority of the waterfowl species in the area depart for their northern nesting grounds.

3.2.5.2 Wading Birds (Water and Marsh Birds)

Wading birds common to both Refuges are the white-faced (*Plegadis chihi*) and white ibis (*Eudocimus albus*); great (*Ardea alba*), cattle (*Bubulcus ibis*), and snowy (*Egretta thula*) egrets; great blue (*Ardea herodias*), Louisiana or tricolor (*Egretta tricolor*), and little blue herons (*Egretta caerulea*); and roseate spoonbills (USFWS 2002b, 2002d; 2001; 1998). LNWR provides nesting and feeding areas for large numbers of wading and marsh birds. Historically, Black Grove and Blue Grove, located in the southern portion of the Lacassine Pool, and Unit C have been the main rookery sites and some are still used. Smaller rookeries in cypress (*Taxodium distichum*), buttonbush (*Cephalanthus occidentalis*), giant bulrush (*Shoenoplectus californicus*), and willow (*Salix nigra*) trees, as well as shrubs, have been located around Lacassine Pool. In addition to the above

listed, a few of the more common species found on LNWR include anhingas (*Anhinga anhinga*) and neotropical cormorants (*Phalacrocorax brasillianus*).

CPNWR boasts high wading bird diversity and abundance with a peak of 15,000 or more wading birds roosting on the refuge. In addition to the above listed, common nesting and visiting water birds on the CPNWR include: purple gallinules (*Porphyrio martinica*), common moorhens (*Gallinula chloropus*), glossy ibis (*Plegadis falcinellus*); green herons (*Butorides striatus*); yellow-crowned (*Nycticorax violacea*) and black-crowned (*Nycticorax nycticorax*) night herons; and American (*Botaurus lentiginosus*) and least bitterns *(Ixobrychus exilis*) (USFWS 2002b; 2001; 1998).

LNWR was recognized as a Globally Important Birding Area in 1998. The refuge has a sizeable breeding population of purple gallinules, common moorhens, bitterns, and rails, and provides habitat for globally significant numbers of white-faced ibis and waterfowl, as well as nationally significant numbers of roseate spoonbills.

Nesting and roosting habitat for wading birds on CPNWR is provided by levees and old oil locations grown over by shrubs and trees, such as willow, Chinese tallow (*Triadica sebiferum*), and Macartney rose (*Rosa bracteata*). Stands of giant bulrush provide good nesting habitat for the white, white-faced, and glossy ibises, as well as black-crowned night herons. Unit 1 on the CPNWR typically has the highest populations of roosting and nesting birds; however, the largest rookery for roseate spoonbills and snowy, great, and cattle egrets is located at an old oil operation in Unit 2. The preferred nesting area for green herons consists of shrubs in Unit 1 (USFWS 2002b; 2001).

3.2.5.3 Sandhill Cranes

Sandhill cranes (*Grus canadensis*) have been observed in the Holmwood area, approximately eight miles north of the CPNWR, outside of the project area. Annual surveys have been conducted since 1989 to determine the wintering population in the area. This number increased from 12 in 1989 to approximately 670 sandhill cranes within ten years. During the winters of 2001 and 2002, approximately 550 and 650 sandhill cranes were estimated in the Holmwood area, respectively (USFWS 2003a).

3.2.5.4 Shorebirds, Gulls, Terns, and Allied Species

The strategic locations of the Refuges are enhanced by a diversity of habitat types favored by shorebirds, including beaches, marsh, estuarine tidal flats, rice fields, and crawfish ponds. The Refuges provide resting and feeding habitat mainly for spring migrating shorebirds. Commonly present shorebirds include killdeer (*Charadrius vociferus*), long (*Limnodromus scolopaceus*) and short-billed (*Limnodromus griseus*) dowitchers, greater (*Tringa melanoleuca*) and lesser (*Tringa flavipes*) yellowlegs, black-necked stilts (*Himantopus mexicanus*), and common snipe (*Gallinago gallinago*) at different times during the fall and winter. If conditions are favorable, Forster's terns (*Sterna forsteri*), killdeers, and black-necked stilts nest on the Refuges. Black-bellied plovers (*Pluvialis squatarola*) and sandpipers (*Tringa* spp.) are common on the LNWR. In addition, four woodcocks (*Scolopax minor*) were repeatedly observed on the CPNWR in early 2000 (USFWS 2001).

3.2.5.5 Raptors

Raptors observed within the Refuges include many species of hawks, owls, and vultures. Raptors such as osprey (*Pandion haliaetus*), sharp-shinned (*Accipiter striatus*) and Cooper's (*Accipiter cooperii*) hawks, Northern Harrier (*Circus cyaneus*) and American kestrel (*Falco sparverius*) are common to both Refuges.

Other year-round residents of the LNWR include the black (*Coragyps atratus*) and turkey (*Cathartes aura*) vultures, red-shouldered (*Buteo lineatus*) hawk, as well as barn (*Tyto alba*), great horned (*Bubo virginianus*), and barred (*Strix varia*) owls (USFWS 2002c, 1989). Additionally, the golden eagle (*Aquila chrysaetos*), a state-listed rare species, has been recorded on several Christmas Bird Counts from LNWR and the vicinity.

In addition to the species discussed above, raptors observed within CPNWR include red-tailed hawks (*Buteo jamaicensis*), merlins (*Falco columbarius*), northern harriers (*Circus cyaneus*), and occasional sightings of peregrine falcons (*Falco peregrinus*) dating between 1999 and 2001 (USFWS 2002b, 2001). The CPNWR recorded a new raptor species, the Crested caracara (*Caracara cheriway*), in March of 2000. A single caracara was observed on a newly created bare earth area during rehabilitation of moist soil units in Unit 14b (USFWS 2001). Currently crested caracaras are occasionally observed in the vicinity and on both refuges.

3.2.5.6 Other Migratory Birds

LNWR is not the first landfall that neotropical birds reach following their migration across the Gulf of Mexico, but the wilderness area and spoil bank areas of the refuge do provide stopover habitat to these birds in addition to spring and summer nesting and foraging habitat. In addition rice field borders on the Refuge have been noted to provide stopover habitat to neotropical prairie species such as bobolink (*Dolichonyx oryzivorus*). The encroaching, non-native Chinese tallow has decreased the value of the habitat to neotropical birds, however in spite of this invasive species the LNWR has acreage that can support the preferred species of trees and other vegetation important to neotropical migratory birds.

A considerable number of neotropical migratory birds rest at the CPNWR each spring after their trans-Gulf flight. The CPNWR is a critical stopover point, providing a spring and summer home to numerous migrating songbirds (USFWS 1998; USFWS 2002a).

While neither refuge has many trees or shrubs for these species to use, the trees that are available are extremely important to the migrants. Mourning doves and Eastern meadowlarks (*Strunella magna)* are commonly seen along fencerows, levees, roads, and disked fields at the Refuges. Red-winged blackbirds (*Agelias phoeniceus*), Common grackles (*Quiscalus quiscula*), and boat-tailed grackles (*Quiscalus major*), are common on both Refuges (USFWS 2001). Yellow-headed (*Xanthocephalus xanthocephalus*) and rusty (*Euphagus carolensis*) blackbirds are rare species on the LNWR.

3.2.6 Mammals

Both Refuges provide suitable habitat for armadillos (*Dasypus novemcinctus*), rabbits, squirrels, nutria, mink (*Mustela viso*), muskrats (*Ondatra zibethicus*), skunks, opossums (*Didelphis virginiana*), otters (*Lutra candensis*), raccoons, and coyotes (USFWS 2001). Both Refuges have three game species found in abundance: whitetail deer, cottontail rabbits (*Sylvilagus floridanus*), and swamp rabbits (*Sylvilagus aquaticus*).

It is estimated that the deer population on the LNWR is approximately 100 individuals. Approximately 50 percent of the refuge, or 16,000 acres can be considered deer habitat. The Louisiana Department of Wildlife and Fisheries estimates that excellent freshwater marsh habitat can support a potential density of one deer per 100 -150 acres. On LNWR, this species is concentrated on the spoil banks and agricultural fields found throughout the refuge. Deer utilize marsh areas primarily for feeding and escape cover.

A recent study shows that both cottontail and swamp rabbits breed throughout the entire year at the latitude of the Refuges and the number of rabbits produced annually in this type of habitat is greater than that of rabbits in more upland habitats. Even though many predators prey on these rabbits, their population numbers are considered high.

3.2.7 Amphibians and Reptiles

As freshwater marshes, Cameron Prairie and Lacassine National Wildlife Refuges are a haven for reptiles and amphibians. Despite the dominance of these creatures in the landscape, little is known about their populations on the Refuges, as the American alligator is the only member of this group that is managed. Both Refuges have participated in alligator harvesting programs, as well as amphibian and reptile surveys in efforts to learn more about present species.

Alligators are opportunistic carnivores and a top predator on the Refuges. Alligator populations have been managed in most areas of the state by a harvest program that is closely regulated by the Louisiana Department of Wildlife and Fisheries. LNWR's harvest program has followed the state's recommendations; however, in some years the harvest has been below the allotted quota. Harvest quotas for CPNWR are determined annually, approximating limits set by the Louisiana Department of Wildlife and Fisheries. These harvest quotas are based on annual aerial alligator nesting surveys (USFWS 2002b).

Alligator nest densities are much higher in Lacassine Pool in comparison to the fresh marshes located outside the pool on the Refuge. The 5-year average (1997-2001) nest density for Lacassine Pool is one nest per 43 acres, while the 5-year average nest density outside the pool at Lacassine NWR is one nest per 106 acres. A 2002 survey discovered 18 alligator nests in Unit 8 of the CPNWR.

Little is currently known about reptile and amphibian populations in Lacassine Bayou. This habitat should support a different assemblage of species than are found in the Lacassine Pool. The bayou is also known to harbor alligator snapping turtles, which have been identified as a species of concern (USFWS 2003b).

In 2001, the LNWR began participating in a statewide monitoring program for frogs known as the Louisiana Amphibian Monitoring Program. Three permanent sites have been established and are monitored during specific periods of the year. In addition to the amphibian monitoring program surveys, drift fences were in place on the LNWR from 2000 to 2002 to monitor terrestrial reptiles and amphibians as part of a graduate study.
A reptile and amphibian survey was conducted by Kansas State University on the CPNWR in 2001, which resulted in the identification of 11 species (USFWS 2002b). Species identified were: American alligator, eastern narrow-mouthed toad (*Gastrophryne carolinensis*), Gulf Coast toad (*Bufo valliceps valliceps*), Northern cricket frogs (*Acris crepitans crepitans*), eastern hog-nosed snake (*Heterodon platirhinos*), western ribbon snake (*Thamnophis poximus proximus*), common kingsnake (*Lampropeltis getulus*), slider (*Trachemys scripta*), green anole (*Anolis carolinensis*), and ground skink (*fasciatus*). Personal observations by staff include: pig frog (*Rana grylio*), bullfrog (*Rana catesbeiana*), mud snake (*Farancia abacura*), cottonmouth (*Agkinstodon piscivorous*), and stinkpot turtle (*Sternotherus odoratus*).

3.2.8 Aquatic Species

Fish species present on both Refuges include catfish, bowfin (*Amia calva*), largemouth bass (*Micropterus salmoides*), crappie, and gar (USFWS 2002e, 2001). LNWR lists an additional species, bream, while bluegill (*Lepomis macrochirus*) is also found on CPNWR (USFWS 2002e, 2001). Fish populations on LNWR have periodically suffered from the negative effects of drought. In the early 1990s, levees were upgraded so that the level of the Lacassine Pool could be raised. The deeper water areas provide a more stable water quality (e.g., temperature and dissolved oxygen) that supports better fish habitat. As a result, fishing grew increasingly popular with the public; fishing tournaments became a common, almost weekly, event on the LNWR.

Creel surveys are conducted at Lacassine Pool during the months the area is open for public fishing; however, the Refuges do not closely monitor aquatic species outside of Lacassine Pool.

3.2.9 Non-native/Invasive Animal Species

An abundant mammal on the both Refuges is the non-native but naturalized nutria, introduced to the United States from South America in 1899 (Willner et. al. 1979). Nutria were released, either intentionally or accidentally, in the Louisiana marshes in the 1930's. The nutria is an exotic herbivore that can cause significant damage to marsh habitats when populations become elevated, an event referred to as eat-outs. Currently, nutria populations throughout the Refuges and in the general area are relatively low, causing minimal damage to habitats and requiring a minimum of population control. Change in vegetative communities outside of Lacassine Pool may occur again in future years on LNWR. With favorable habitat conditions and the nutria's high reproductive potential, the population can expand rapidly.

Although nutria can be destructive to levees and vegetation, the species is beneficial in that it is available as a food source for alligators, coyotes, and bobcats (USFWS 2003b). Control of other invasive species will be managed if need arises.

No exotic reptiles and amphibians are known to occur on LNWR but a few are established in nearby parishes and others are expanding their range out of Florida. Of special concern is the brown anole (*Anolis sagrei*) that displaces native green anoles (*Anolis carolinensis*). Efforts are made to monitor reptile and amphibian populations; however, little may be done to stop species, such as the brown anole, once they are established (USFWS 2003b).

The domestic cat *(Felix catus*) has established wild, free-roaming populations throughout most of the United States. Feral cats can be devastating to native birds, but they also prey very heavily on other native wildlife, such as snakes, lizards, and rabbits. What effect feral cats have on the LNWR's wildlife population is unknown.

The Eurasian collared dove (*Streptopelia decaocto*) occurs on the LNWR, but apparently is harmless to other species.

3.3 Habitat

The Refuges are comprised of coastal prairies, agricultural habitats, and wetlands, including open water, freshwater marsh, moist soil areas, as well as forested and shrub wetlands (**Figures 11 and 12**). **Table 7** shows a breakdown of land cover and habitat types on the Refuges. Both Refuges are located on the boundary of the costal marsh and agricultural habitats.

Table 7. Land Cover and Habitat Types on Cameron Prairie and Lacassine National Wildlife Refuges

Habitat/Cover	Acres	
	Cameron Prairie	Lacassine
Agricultural Land (Fallow Pasture; Reverted to Marsh)	1,093	1,109
Natural (Unimpounded) Freshwater Marsh	1,402	14,700
Impounded Freshwater Marsh	4,796	16,000
Moist Soil Areas	1,493	
Prairie (Coastal)	315	334
Canals, Roads, Levees, Spoil Banks, Etc.	522	526
Forested wetlands		352
Shrub wetlands		348
Open Water		1,048
Managed Fresh Marsh (moist-soil plant impoundment)		307
Total Acres	**9,621**	**34,724**

Sources: USFWS, 2003a; 2003b, 2002b, 2001 (CPNWR)

Much of the LNWR is impounded and is divided into management units (**Figure 9**) that are both impounded (Units A, B, C, D, E1, F3, and G) and unimpounded (Units E2, F1, F2, H, I, and J). About 3,300 acres south of the Gulf Intracoastal Waterway is designated as wilderness.

Much like LNWR, the CPNWR is located at the point of transition between prairie habitat and coastal marsh habitat. The 9,621-acre refuge contains these habitat types along with habitats created through purposeful human manipulations of the land. Prior to the establishment of the CPNWR, these manipulations were for commercial production of rice. Current manipulations are for the creation of early successional wetlands.

3.3.1 Wetlands

The most prominent feature on the Lacassine National Wildlife Refuge is the 16,000-acre impounded fresh marsh known as the Lacassine Pool (Unit G), which provides sanctuary and food for thousands of ducks, geese, shorebirds, and wading birds in peak years. The pool is also a popular fishing area and is heavily utilized during the fishing season. The pool was created by enclosing a 16,000-acre marsh with a low levee during the 1940s.

Biologists refer to the Lacassine Pool as a closed aquatic ecosystem. This means there are no tidal influences or flushing activities to aid in dispersing the tons of dead plant material generated each year within the pool. Water is replenished by rainfall. When constructed in the early 1940s, the pool was designed to be managed at approximately four feet mean sea level (MSL). There are deeper areas (e.g., lakes) within the pool that reach seven feet in depth when its three spillways are set approximately four feet MSL.
In an effort to manage the pool for both wintering waterfowl and fully aquatic species (e.g., fish for recreational fishing), water levels are maintained at full pool, or as close to it as possible, during the spring and summer months. In the winter, water levels are lowered so the waterfowl foods that are produced can be made more available to waterfowl. This water level regime is highly dependent upon weather conditions in any given year. A hurricane or tropical depression can completely flood the area for an entire year. A heavy spring rain can do the same. A severe drought can do the complete opposite so LNWR managers must be flexible and have the ability to work with the dynamic weather conditions of the area.

Though Lacassine Pool is recognized as a feeding area for some species of waterfowl, one of its most important contributions to wintering waterfowl is serving as a sanctuary and resting area for pintails. Recent research has documented the value of the pool as a key diurnal roost site for harboring pintails in southwest Louisiana, with pintails making frequent long, round-trip journeys to foraging habitat at night (Cox and Afton 1996).

Wetlands within the CPNWR are managed for the production of annual plants that produce both vegetation and seeds for use by geese, ducks, and other wetland bird species. Early successional wetlands are commonly known as moist soil habitats. The name, moist soil, refers to the way water is used to create the desired plant community.

As was done with rice farming, moist soil habitats are manually disturbed using mechanical equipment, tractors and disks. Following this artificial disturbance, native plant seeds already existing within the soil are allowed to germinate and then the soil is flooded to a shallow depth. Once plants reach maturity, fields are once again disturbed using tractors and water buffalos to create interspersed open water areas. The target is to produce a 50:50 ratio of open water to standing vegetation in a design that produces

maximum amounts of edge habitat between the two areas. Once accomplished, these broken vegetation styles are referred to as a "hemi-marsh". The hemi-marsh areas of mixed open water and emergent vegetation at a ratio of one part open water to one part vegetation are preferred by many species of wildlife and provide nesting areas and cover.

Marsh and moist soil habitat account for 8,784 acres on the CPNWR. Water level management in the marshes is conducted with the use of earthen levees and other water control structures. Some of the marshes are occasionally drained or treated with prescribed fire to promote native vegetation and reduce undesired species. These areas are flooded in early winter to benefit waterfowl (USFWS 1998).

3.3.2 Forest

A limited bottomland hardwood forest (e.g., approximately 400 acres) is present within the LNWR, primarily in the riparian areas along the Mermentau River and Lacassine Bayou. There may be opportunities for forest restoration within the existing refuge, and for acquisition of additional bottomland hardwood forests within the LNWR acquisition boundary. Additional woody vegetation is present on canal and stream banks, and also on a series of ring levees in Lacassine Pool that are associated with former oil and gas exploration sites. Chinese tallow, an invasive exotic plant species, is a dominant woody species on the ring levees. Refuge staff have worked to eliminate tallow from some levees, and to replant native species, such as bald cypress, tupelo gum (*Nyssa aquatica*), black gum (*Nyssa Sylvatica*), red maple (*Acer rubrum*), common persimmon (*Diospyros virginiana*), sugarberry or hackberry (*Celtis laevigata*), live oak (*Quercus virginiana*), Nuttall oak (*Quercus nuttalli*), swamp dogwood (*Cornus foemina*), red mulberry (*Morus rubra*), wax myrtle (*Myrica cerifera*), and buttonbush. The staff is monitoring the use of treated ring levees as compared to control sites on other untreated levees, which remain dominated by Chinese tallows.

Trees on the CPNWR are limited to those along levees and spoil banks. The most common trees include black willow (*Salix nigra*), hackberry, Chinese tallow, and toothache tree (*Zanthoxylum clava-herculis*). Woody shrubs include wax-myrtle (*Morella cerifera*) and baccharis (*Baccharis halimifolia*). There are also a few pine and cypress trees, which are important to perching birds (USFWS 2001).

3.3.3 Prairie

The coastal prairie plant community, located along the Gulf Coast of the United States, once encompassed an estimated 8.6 million acres. Today, only a tiny fraction survives: less than 100 acres of upland prairie in small, narrow patches paralleling railroad tracks; and another 100 to 300 acres of wet prairie in disjunctive remnants on private land. There are approximately 315 acres of high marsh habitat classified as "prairie" on the CPNWR.

Like midwestern prairies, coastal prairie is dominated by grasses, such as little bluestem (*Schizachyrium scoparium*), gamma grass (*Tripsacum dactyloides*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii*). Coastal prairies are diverse with over 500 species of grasses, sedges, and

wildflowers. However, coastal prairie is distinct in several ways, including the presence of species that are not found in the midwestern prairies, such as slender bluestem (*Schizachyrium tenerum*), brownseed paspalum (*Paspalum plivatulum*), and sweet goldenrod (*Solidago odora*). Prairie nymph (*Herbertia lahue*), Oklahoma grass pink orchid (*Calopogon oklahomensis*), and prairie parsley (*Polytaenia nuttalli*) are a few of the rare species found in coastal prairie habitat. Prairie habitat on the CPNWR is interspersed with "pimple mounds," geologic formations about 20 to 40 feet in diameter that are 1 to 1.5 feet above the elevation of the surrounding terrain. One species of interest occurring in prairie habitat on the CPNWR is gamma grass, which has been identified as a native plant to coastal prairies (USFWS 2001).

LNWR, along with other partners, is in the process of actively restoring a significant acreage of coastal prairie on a former Farm Service Agency property, known as Duralde Prairie. The LNWR currently plays a significant role in coastal prairie restoration and is working closely with the Cajun Prairie Habitat Preservation Society to restore this unique, threatened habitat. This effort adds to the knowledge of prairie restoration technology and increases the sources of plant material, both of which are limited.

3.3.4 Croplands

Management of the 307-acre Unit A of LNWR began with farming in 1950 and continued with either cooperative farming or refuge farming until 1981. LNWR continued farming Unit A in a rotation with moist-soil, rice, millet, milo, and green browse through 2000. In 2001, LNWR reworked levees and water control structures in Unit A to improve water management capability in the eight fields that range in size from 12 to 48 acres. Water can usually be gravity-flowed into Unit A from the pool. A two-way pump is used to drawdown these fields and to provide a reliable method for flooding the unit.

LNWR's Unit B is a 724-acre area, which includes 579 acres of rice impoundments that have been managed since 1990 by a cooperative farmer. Rice is planted in a field every other year, alternating with fallow. The farmer harvests the first crop of rice and leaves the second crop for waterfowl, which works out to be about 20-25 percent of the total rice crop.

LNWR acquired the 530-acre Unit F in 1996, and, since then, it has been cooperatively farmed similar to Unit B. On average, 327 acres of rice are planted in a field every other year, alternating with fallow.

3.3.5 Wilderness Review

As part of the planning process, lands within the legislative boundaries of the Refuges were reviewed for wilderness suitability. About 3,300 acres south of the Gulf Intracoastal Waterway were officially designated as a Wilderness Area in the late 1970s. The Wilderness Area is managed under the provisions of the 1964 Wilderness Act as a unit of the National Wilderness Preservation System. It is "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain" (The Wilderness Act, September 3, 1964; [16 U.S.C. 1121 (note), 1131-1136]).

Other than setting prescribed fires from helicopters, the staff carries out no active management in this Wilderness Area. Visitation by the public is permitted, but due to the area's difficult access (by boat only), it is not heavily used.

No additional lands on the Refuges were found suitable for designation as wilderness as defined by the Wilderness Act on 1964. The Refuges do not contain an additional 5,000 contiguous roadless area, nor do they have any units of sufficient size to make their preservation practicable as wilderness. The lands and waters of the Refuges have been substantially altered by humans, particularly through agriculture, water manipulation, levee and canal construction, pipeline laying, oil and gas development, and seismic exploration. As a result of both extensive modification of natural habitats and ongoing manipulation of natural processes, adopting a "hands-off" approach to management at the Refuges would not facilitate the restoration of a pristine or pre-settlement condition, which is the goal of wilderness designation.

3.3.6 Non-native/Invasive Plant Species

Also known as exotic species, these plants pose problems at the Refuges because they displace native vegetation, on which native animal species have come to depend over many millennia of adaptation and co-evolution. There are several invasive species present on the refuges, with the Chinese tallow being the most prevalent. In Louisiana, old fields and pastures that once provided grassland bird habitat are being replaced with forests of the exotic, invasive Chinese tallow.

The Chinese tallow tree, a non-native small to medium-sized tree, has been reduced in occurrence on the CPNWR through moist soil management, but remains a problem on several levees around moist soil units (USFWS 2002b). Tallow trees typically grow on elevated and undisturbed ground along fencerows and levees (USFWS 2001). Staff from both Refuges have worked to eliminate Chinese tallow from some levees, and to replant with native species. Chinese tallow control is a major management concern for the Refuges, with prescribed burning and herbicides used to control it. The best control methods for this species on the Refuges have been herbicides on the levees and manipulation of the fields (USFWS 2002b). However, the tallow tree is a very resilient species, and tends to re-sprout shortly after the herbicide is no longer available (USFWS 2001). Its coppicing ability also restricts the usefulness of fire as a control measure, although studies have found that in areas with sufficient fuel, such as in prairies with good grass cover, summer burns kill or top-kill trees as tall as three meters (The Nature Conservancy 2003).

Other non-native, or invasive, species common to both Refuges are water hyacinth (*Eichhornia crassipes*), common salvinia (*Salvinia minima*), and hydrilla (*Hydrilla verticillata*) (USFWS 2003a and 2003b). Alligator weed (*Alternanthera philoxeriodies*) (USFWS 2000), bamboo (species unknown), Chinaberry (*Melia azedarach*), St. Augustine grass, Bermuda grass, Lantana (*Lantana camera*), and water lettuce (*Pistia stratiotes*) are problems on LNWR. Eurasian milfoil (*Myriophyllum spicatum* L.), frogbit *(Limnobium spongia*), cattail (*Typa spp.*), maidencane (*Panicum hemitomon*), cutgrass (*Zizaniopsis miliacea*), and giant bulrush are problems on CPNWR (USFWS 2003a).

Water hyacinth and common salvinia have clogged the majority of CPNWR canals, delaying water movement to the point that pumping operations have become more expensive to operate (USFWS 2003a). CPNWR currently uses herbicides to try to control water hyacinth (USFWS 2001). Hydrilla and Eurasian milfoil prevent the establishment of native and more beneficial species (USFWS 2003a).

3.4 Public Use

3.4.1 Education and Visitor Services

The six priority general public uses of both Refuges are hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. These wildlife-dependent uses are the Service's primary focus for the development of visitor use programs to increase awareness and appreciation of fish and wildlife resources on the National Wildlife Refuge System. All of these uses are available on both refuges as described in more detail in the following paragraphs. The Refuges' visitor facilities are shown in **Figures 13 and 14**. There are no designated hiking trails on either refuge but visitors are permitted to walk along levees and dikes.

LNWR provides activities for more than 38,000 visitors annually (USFWS 2004). Until visitor facilities are improved, the preponderance of visitation will likely continue to be for recreational fishing and hunting. Until then, the more adventuresome will still come to drive its limited road system and to hike some of its miles of levees.

LNWR has no visitor center or tour route and the headquarters area is separated from the refuge proper. It is proposed to have exhibits in the Southwest Louisiana National Wildlife Refuge Complex Visitor Center, located at CNPWR, which will highlight the LNWR.

Annual visitation to CPNWR has been estimated at nearly 35,000 total between 1998 and 2004. These numbers include all hunters, fishermen, wildlife drive users, and visitor center visitors. CPNWR typically receives visitors from nearly all states and about 20 countries annually (USFWS 2003a; 2002b, 2001).

3.4.2 Hunting and Trapping

Hunting is allowed in designated areas of both Refuges during certain times of the year. Seasons and bag limits are within the guidelines established by the Louisiana Wildlife and Fisheries Commission but are generally more conservative to assure compatibility with other refuge objectives. Both Refuges receive their alligator trapping quota from the Louisiana Department of Wildlife and Fisheries.

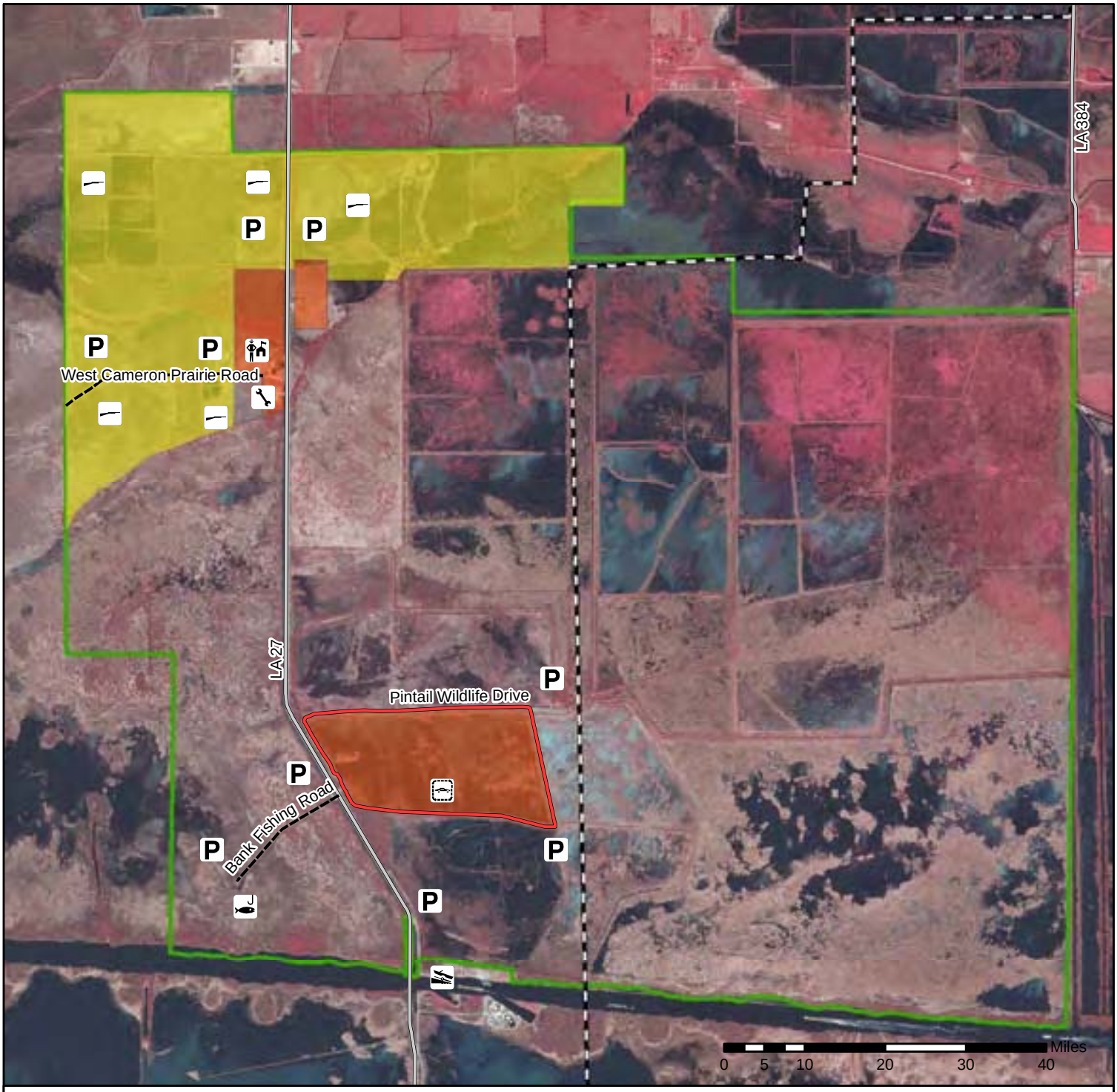
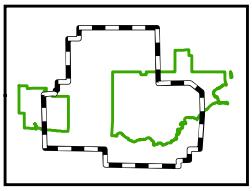


Figure 13. Hunting Areas and Visitor Services
Cameron Prairie National Wildlife Refuge
Cameron and Jefferson Davis Parishes, Louisiana

Legend

Public Facilities

- Boat Launch
- Fishing Area
- Interpretive Auto Trail
- Maintenance Area
- Parking
- Refuge Office
- Youth Waterfowl Hunt Blinds
- Unpaved Roads
- Pintail Wildlife Drive
- Primary Roads
- Snipe and Dove Open Areas
- Closed Hunting Areas
- Project Boundary
- Cameron Prairie Outer Boundary



N

Map Produced 1/15/09

Dixie Environmental Services Co., LP

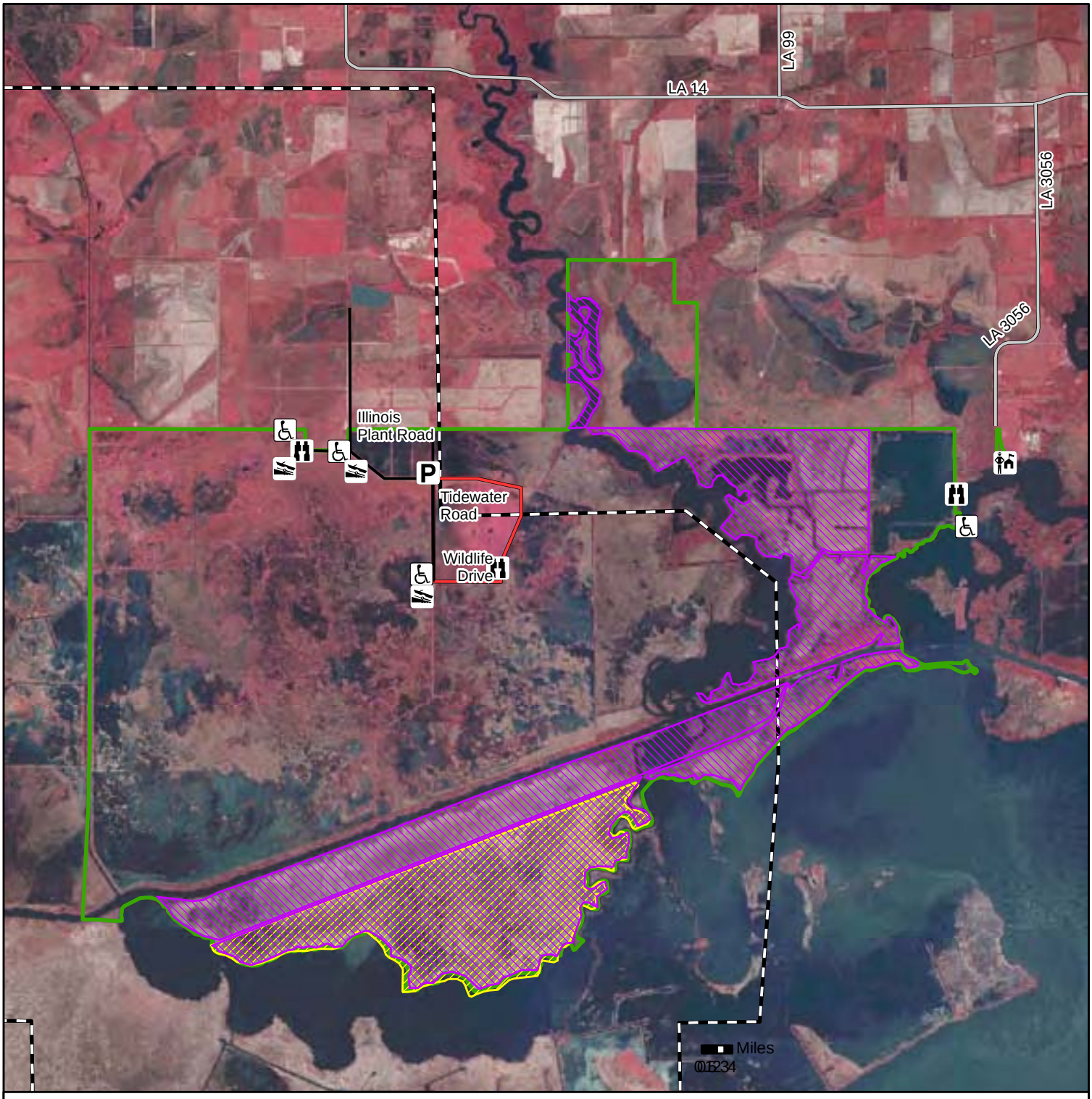


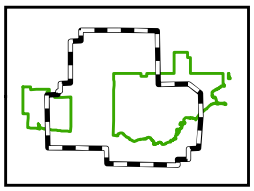
Figure 14. Hunting Areas and Visitor Services
Lacassine National Wildlife Refuge
Cameron and Jefferson Davis Parishes, Louisiana

Legend

Public Facilities

- Handicapped Fishing Pier
- Headquarters Complex
- Observation Area
- Parking Area
- Public Boat Launch

- Roads
- Wildlife Drive
- Primary Roads
- Waterfowl Hunting Area
- Wilderness Area
- Lacassine Outer Boundary
- Project Boundary



N

Map Produced 1/15/09

Dixie Environmental Services Co., LP

Currently, waterfowl hunting is allowed on 10,434 acres of the LNWR. The farm unit on Unit B is a lottery hunt area for senior hunters on Wednesdays, youth hunters on Saturdays, and is open during the second split of the state waterfowl season. The Duck Pond lottery hunt is open for adult hunters on Wednesdays and Saturdays during both splits of the state waterfowl season. The general public hunt area is open Wednesday, Thursday, Saturday, and Sunday for teal season and both splits of the regular state season. All hunters are required to obtain a hunting brochure, which serves as a permit when signed. Archery deer hunting is permitted annually during October on the entire refuge, excluding the headquarters area and the wildlife drive.

CPNWR's hunting program is reviewed annually, and consists of the following (see **Figure 13**):

- Big Game: Archery hunt for white-tailed deer, open October in all areas other than those listed as closed to all hunting.
- Waterfowl (ducks, geese, gallinules): Youth hunts including five blinds with decoys (two dozen duck and one dozen white-fronted geese). Participants are chosen by lottery for all Saturdays and select holidays during the State waterfowl season.
- Other migratory birds (initiated in 2002): Hunting for snipe is permitted during the remaining portion of the State-designated season following the closure of the State waterfowl season. Hunting for dove is permitted during the first split of the State-designated season. All state regulations are applicable for these two hunts.

3.4.3 Fishing and Boating

Fishing has been the most popular recreational activity since LNWR was established, while it is more of a seasonal and limited activity on CPNWR. The Lacassine Pool, created to provide migratory waterfowl habitat, has become a prime largemouth bass fishing area. Fishing tournaments have occurred on the refuge for a number of years. Persons participating in past tournaments have been encouraged to practice catch and release techniques by tournament sponsors.

Two boat ramps are available at Lacassine Pool for ingress and egress to interior fishing waters. Anglers are required to use launches off the refuge to access areas other than Lacassine Pool. The refuge impoundment is restricted to 25 horsepower motors. The Unit D impoundment within the pool is restricted to non-motorized boats. Canals and major bayous outside the impoundments have no restrictions on boat motor size. Only push poles and paddling are allowed in the marsh (USFWS 2002f).

Fishing on the CPNWR is permitted from March 15th through October 15th, and is limited to the canals adjacent to Bank Fishing Road, the State Highway 27 ditch (the most frequently used fishing area on the refuge), and the Outfall Canal (accessible only via boat) (USFWS 1998; 2002e). However, fishing has been minimal at best in recent years due to increases in undesirable aquatic vegetation (USFWS 2002e). There are no boat ramps available on CPNWR but boats can be launched from a public boat launch off State Highway 27. Motorized boat use is permitted only in Outfall Canal; the bank fishing area is restricted to non-motorized boat use (USFWS 1998; 2002e).

3.4.4 Wildlife Observation and Photography

Both Refuges have three-mile auto tours and viewing platforms, which provide excellent wildlife observation and photography opportunities. On LNWR, there is a three-mile auto tour with interpretive signs at the Lacassine Pool public use area (Unit D). Pull-offs are located along the drive to allow other visitors to continue along the drive. Visitors are encouraged to remain in their vehicles to minimize disturbance of wildlife and to enhance viewing. State Highway 14 passes by the LNWR and is designated as the Jean Lafitte Scenic Byway. Visitors can hike along levees for additional wildlife observation opportunities. A cypress swamp observation deck is located at the headquarters. The LNWR has two viewing platforms located at the Lacassine Wildlife Drive and Unit B. The platforms are well placed to see optimum wildlife populations while limiting disturbance to wildlife.

CPNWR has a three-mile graveled auto tour route, Pintail Wildlife Drive, which is located two miles south of the visitor center. There are five interpretive signs along the route describing wildlife species and marsh and plant ecology. Visitors can see wading birds, waterfowl, and alligators. The Service also maintains a photo-blind along Pintail Wildlife Drive which is available by reservation only and is typically used two to three times per year. In addition, State Highway 27, which bisects the CPNWR, is part of the Creole Nature Trail, a National Scenic Byway and an All American Road (USFWS 2002a; 1998). Visitors pass through several marsh habitats along the Creole Nature Trail and can pull into nine access areas for wildlife viewing and photography. The Cameron Prairie National Wildlife Refuge Visitor Center has an orientation video, species check lists, interpretive signs, wildlife displays, exhibits, dioramas, and a calendar of natural events to promote wildlife observation and appreciation. In addition, brochures listing optimum wildlife viewing times, access point information, and regulations are available at the Center (USFWS 2002a). Visitors are encouraged to use the CPNWR viewing platform located a short walk from the rear of the Visitor Center. From the platform, visitors can observe an example of moist soil management and birds that seek the annual plant seeds produced by this management technique.

3.4.5 Environmental Education and Interpretation

The primary themes interpreted at CPNWR include the area's ecology, native fauna and flora, the Service's mission, and why the Service manages for fish, wildlife, plants, and habitats. The majority of interpretation at CPNWR occurs in the Visitor Center.

Environmental education and interpretive programs at CPNWR are coordinated and managed by the Southwest Louisiana Refuges Complex Outreach Coordinator. The Coordinator is stationed at Cameron Prairie National Wildlife Refuge and provides guidance and oversight to the CPNWR. Currently, CPNWR staff conducts two to three on-site programs and four to five off-site programs annually. In addition, each year seven to eight school groups visit the CPNWR (USFWS 2002a).

CPNWR staff occasionally participates in radio and television interviews and distributes news releases off-refuge to inform the public of special events, openings, Refuge conditions, and wildlife viewing opportunities. Staff also host interpretive programs and

talks at schools, clubs, the Southwest Louisiana Convention and Visitor Bureau, etc. (USFWS 2002a). Topics range from basic plant and wildlife identification for elementary school students to refuge management seminars at the local university (USFWS 2001).

Environmental education programs are not available at Lacassine National Wildlife Refuge because limited staff and facilities do not allow for such programs. However, limited environmental education programs are currently brought into local schools. Students view a slide program, participate in a short activity, and receive an educational package. No formal training has been done to encourage local educators to lead and teach environmental education programs at LNWR (USFWS 2002f).

3.4.6 Roads

Roads and parking lots are limited on both Refuges. The headquarters office is accessed via Highway 3056. Visitor parking is available at four lots on CPNWR; two adjacent to State Highway 27, one at the walk-in hunting area, and one at the Visitor Center (USFWS 2002a). Parking lots located at two boat launches (e.g., Old and Tidewater) at Lacassine Pool and Unit B fishing area are graveled on LNWR. During peak fishing periods, visitors are limited by parking lot capacity.

Illinois Plant Road, Tidewater Road, and Streeter Road (i.e., Highway 127) provide access to LNWR. Streeter Road is the only road within the LNWR that is completely paved. It is maintained by the Cameron Parish Police Jury. A portion of Illinois Plant Road is paved and maintained by the Jefferson Davis Parish Police Jury. The graveled portion of this road is maintained by LNWR.

The most prominent road on CPWNR is Louisiana State Highway 27, which bisects the refuge and accesses the Visitor Center. About 20 percent of the CPNWR is to the west of State Highway 27, and 80 percent is to the east. This road is the only paved road on CPNWR and is maintained by the Louisiana Department of Transportation. While the Service has no regulatory authority on State Highway 27, which is designated as a Hurricane Evacuation Route, CPNWR cooperates with local law enforcement authorities during emergency situations (USFWS 2002a). During a mandatory hurricane evacuation, law enforcement officials maintain an Emergency Command Post on the visitor center parking lot, stopping all traffic going south. Three gravel roads provide the remaining public access on CPNWR. Bank Fishing Road is an old oil access road on the southern portion of CPNWR that provides access to the fishing area. West Cameron Prairie Road, which starts at the Visitor Center parking area, is used by hunters during CPNWR hunts and by private land owners to access their properties to the west of the Refuge. East Cameron Prairie Road, also known as Pintail Wildlife Drive, provides wildlife observation and photography opportunities. O'Blanc Road is open to CPNWR personnel only to access the northeastern portion of moist soil Unit 14B in CPNWR.

3.5 Socioeconomics

Both Refuges are located in 1,313 square-mile Cameron Parish, Louisiana, one of the largest parishes in the state. Cameron Parish is situated in the extreme southwestern corner of Louisiana, abutting the Gulf of Mexico to the south and Texas to the west. In 2003, the population of the parish was estimated at 9,708, a slight decline (3 percent) from the 2000 Census (USCB 2004). The median household income of the parish in 1999 was $34,232, compared to $32,566 for Louisiana as a whole. The same relative prosperity is reflected in a poverty rate below the state average. Approximately 12% of Cameron Parish residents lived below the poverty line in 1999, compared to almost 20% for all of Louisiana. Educational attainment is below the state average however, with only 8% of the population aged 25 or higher having a Bachelor's degree or higher, as opposed to the statewide average of 19%.

In 2003, transportation and warehousing was the largest of 20 major economic and employment sectors in the parish (STATS Indiana 2004). The Census Bureau classified occupations in Cameron Parish as shown in **Table 8.**

Table 8. Occupations of employed civilian population 16 years and older in Cameron Parish (2000)

Occupation	Number	Percent (%)
Management, professional, and related occupations	772	18.5
Service occupations	718	17.2
Sales and office occupations	954	22.8
Farming, fishing and forestry occupations	199	4.8
Construction, extraction and maintenance occupations	594	14.2
Production, transportation, and material moving	947	22.6

Source: U.S. Census Bureau, Census 2000, Summary File 3, Profile of Selected Economic Characteristics

In terms of employment by industrial sector, the primary industries lumped as "agriculture, forestry, fishing and hunting, and mining" predominate in Cameron Parish, as shown in **Table 9**.

In terms of its racial and ethnic breakdown, as reported in the 2000 Census, Cameron Parish is 92.5 percent white or non-Hispanic, 3.9 percent black or African American, 0.4 percent American Indian, 0.4 percent Asian, and 2.2 percent Hispanic or Latino origin (USCB 2004). (The percentages do not add up precisely to 100 percent because of the difference between designated races — white, black, Native American, and Asian — and ethnicities, which are Latino and non-Latino.) In addition, 1.6 percent in the Census reported some other race or two or more races. Overall, the population of Cameron Parish has a greater percentage of non-Hispanic whites (92.5 percent) than the state as a whole (62.5 percent). That is, it is less diverse and has fewer minorities.

Table 9. Employment of civilian population 16 years and older by industry in Cameron Parish (2000)		
Industry	**Number**	**Percent**
Agriculture, forestry, fishing and hunting, and mining	696	16.6
Construction	470	11.2
Manufacturing	295	7.1
Wholesale trade	143	3.4
Retail trade	426	10.2
Transportation and warehousing, and utilities	396	9.5
Information	52	1.2
Finance, insurance, real estate, and rental and leasing	155	3.7
Professional, scientific, management, administrative, and waste management services	206	4.9
Educational, health and social services	677	16.2
Arts, entertainment, recreation, accommodation and food services	269	6.4
Other services (except public administration)	213	5.1
Public administration	186	4.4

Source: U.S. Census Bureau, Census 2000, Summary File 3, Profile of Selected Economic Characteristics

3.6 Archaeological or Historical Resources

In addition to the natural habitat and wildlife the Refuges conserve, they also encompass resources of archaeological and cultural value; these tell the long story of human habitation and endeavor in the area. The Refuges are located in a region with a rich human history and pre-history.

Prior to the arrival of European-Americans, it was inhabited by the Atakapa Indians. The Atakapa occupied the coastal and bayou areas of southwestern Louisiana and southeastern Texas until the early 1800s (Couser 2002). Archaeological evidence suggests that settlements have been present in this area since before Native Americans learned to make pottery, approximately two thousand years ago. While “Atakapa” means "eaters of men" in the language of the neighboring Choctaw, it is unknown whether the Atakapas' supposed cannibalism was for subsistence or ritual. Before the arrival of European-Americans, Atakapans were hunters, gatherers, and fishers. Their society consisted of loose bands that moved on a regular basis from place-to-place, gathering,

hunting, and fishing within a given territory. The alligator was very important to them because it provided meat, oil, hides, and even insect repellent (e.g., its oil). The Atakapan language has fascinated linguists and is among the better-recorded Native American languages. At one time, it was believed to be associated with other languages of the Lower Mississippi River, but later this theory was abandoned and it is now classified as an isolated language.

Most of what is known about the appearance and culture of the Atakapa comes from eighteenth and nineteenth century European descriptions and drawings. The Atakapan people were said to have been short, dark, and stout. Their clothing included breechclouts and buffalo hides. They did not practice polygamy or incest. Their customs included the use of wet bark for baby carriers and Spanish moss for diapers. According to another custom, a father would rename himself at the birth of his first son or if the son became famous. In the creation myth of the Atakapa, humans were said to have been cast up from the sea in an oyster shell. The Atakapa also believed that men who died from snakebite, and those who had been eaten by other men, were denied life after death, a belief that may have lent support to the notion that they practiced ritual cannibalism.

The various bands of the Atakapa were reported to have traded not only with other Indians but with early French and Spanish explorers and traders as well. After the appearance of these Europeans, the Atakapa dwindled rapidly. An estimated 3,500 still survived in 1698; by 1805, only 175 remained in Louisiana. Just nine known descendants were recorded in 1909. Their downfall was brought about primarily by the invasion of and devastation from European diseases, rather than through any direct confrontation with European settlers.

The next major phase of the area's human habitation occurred after the Treaty of Paris in 1763 concluded the French and Indian Wars (Feldman 1998). The British had already expelled French-speaking settlers—the Acadians—from Nova Scotia (in what is now one of the Maritime Provinces of Canada) in 1755. Their exile occurred as a result of the widespread turmoil and upheaval sweeping through French and British colonies in North America as England gained the upper hand in its struggle with France for the control of North America. The Acadians first arrived in "New Acadia," now Louisiana, then a colony of Spain, in 1764, and this migration continued for the next two decades (Hebert 2003). Even after all their wanderings after their expulsion from Acadia, the adjustment from Maritime Canada, with its sub-arctic climate and rocky, hilly terrain, to the Mississippi Delta, with its nearly subtropical climate and bayous, must have been difficult for the Acadians. Yet over time, the Acadians, later referred to as Cajuns, flourished and developed their own subsistence-based culture based on hunting, fishing, trapping, and some agriculture, that produced a unique cuisine and music, among other things.

Southern Louisiana is also known for its Creole culture and cuisine. While the Cajuns were specifically French in origin, the Creoles trace their heritage to Spanish, African, Italian, and French influences, indeed, to any other peoples who chose to live in New Orleans (Royal Café, no date). The roots of Creole culture date to the early 1700s, with

the French settlement of La Nouvelle Orleans under its founder Jean Baptiste Le Moyne, Sieur de Bienville, governor of the Louisiana Territory. In 1763, the Louisiana Territory was traded to Spain, and Spanish influence increased. German and Italian immigrants and African slaves also contributed heavily to Creole culture, cuisine, and music.

There are currently four listed sites within the project boundaries, all of which are within the LNWR. One of these sites is a fairly large shell mound located at Onion Hill on Bayou Misere, which was partially destroyed during the digging on the American-Louisiana Pipeline Canal. Another is located at Lacassine Point near Grand Lake. The smallest of these sites is located on Bayou Lacassine near Short Cut-off Island. The fourth is located near Lantania Hill, just off Lantania Lake, on the LNWR. Two of the four are listed as unknown for the National Register of Historic Places (NRHP), while the other two are listed as ineligible. This assessment is based on a search of the site files at the State Historic Preservation Office (SHPO).

While cultural resources or properties have yet to be discovered at CPNWR, it should be emphasized that they may well be present. The generally wet or even inundated condition of soils in the area, within marshes, bayous, and former rice fields, is not conducive to conducting archaeological surveys.

Presently, neither refuge has a cultural resources management plan. When one is written, it will specify what measures need to be taken at the Refuges to identify, protect, and interpret the area's rich cultural history.

3.7 Oil and Gas Activity

The Fish and Wildlife Service does not hold mineral rights on the majority of either refuge. Consequently, the Refuges have had numerous accounts of oil and gas exploration and production. Historically, a total of 19 wells have been dug on the land comprising CPNWR, with six of these occurring since the refuge was established. All well sites have been plugged. The earliest known well dug was in 1953. Since its inception in 1937, a total of 84 wells were drilled on the LNWR. Currently, only four of those original 82 wells are in production. Most of the wells that were drilled have been properly plugged and abandoned but five of the remaining wells are listed in the "shut-in" status. A "shut-in" well is not producing and either has mechanical problems down hole or is not economically feasible to produce hydrocarbons. Most of the "shut-in" wells on LNWR have been in that status for many years.

"Shut-in" wells can be a problem because wells that have received no attention after long periods of time can become potential environmental threats. Pressure can build up down-hole, and if not released, the pressure can cause blow-outs. These blow-outs can have major negative environmental implications because production, which includes hydrocarbons and highly saline produced water, can be released into the surrounding environment. Currently one of these well has been plugged and abandoned with an additional 3 wells scheduled for plugging. One of the wells is being reserved by the operator for future use.

Numerous seismic surveys have been conducted on the CPNWR. 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 CPNWR. These lines do not service producing wells on the CPNWR, but move product through it. Owners of the mineral rights infrequently request access to their oil and gas exploration rights. As recently as 2000, the CPNWR permitted an exploratory well in Unit 9. Nothing was found and the drilling activity required significant oversight and involvement by CPNWR personnel to ensure proper cleanup and disposal of hazardous materials.

As the need for oil and gas increases, the Refuges will likely find themselves 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 Refuges, but ultimately stated that the refuge could not prevent the sub-surface owner from exercising his rights to access and develop his minerals.

The Refuges have been able to use oil and gas funds for invasive plant control and marsh restoration projects. LNWR completed an invasive plant control mitigation project with oil and gas funds. Approximately 110 acres were sprayed in Units D and E to control Chinese tallows. CPNWR 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 CPNWR 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 CPNWR habitat.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Overview

Outlined below are the predicted impacts that could result from implementation of each of the two alternatives. Some effects will be common to both alternatives; whereas, others would be distinctly different. Since the seismic survey would occur under both the Proposed Action and No Action Alternatives, many of the potential impacts would be similar; however, the duration, range, and intensity of the impacts will differ between alternatives. Direct, indirect, and cumulative effects common to both alternatives are addressed in Section 4.2, and effects specific to each alternative follow in Sections 4.3 (Proposed Action) and 4.4 (No Action).

4.2 Effects Common to Both Alternatives

This section assesses the common environmental impacts of implementing either of the two alternatives on the biological, physical, social, economic, cultural, and historic resources of the Refuges.

4.2.1 Fish and Wildlife Resources

The abundant and diverse vegetation of the project area provides habitat for a variety of species of wildlife. Activities associated with Cajun Exploration's proposed 3-D survey may directly or indirectly affect wildlife that reside in or migrate through the project area. Proposed operations would potentially affect both terrestrial and aquatic habitat, as well as directly disturb and possibly attract wildlife.

Wildlife could be disturbed by both noise impacts and air pollution, and/or attracted by food brought into the operations area by crews. The detonation of energy sources would also produce noise and vibration that could directly damage fish or their eggs, as well as wildlife too close to the shot point. It would also be possible that fish or wildlife could be directly affected because of exploitation by crews, such as hunting or fishing, being crushed by equipment, or wildlife being killed because of the perceived threat to crews, as in snakes or biting/stinging insects. Exotic species could be introduced to the operations area, as well.

Noise from drilling equipment, support vehicles, helicopters, detonation of charges, and the presence of crews could temporarily displace wildlife into adjacent habitat and/or temporarily alter the normal behavior of certain species.

The travel of crews and equipment through the project area could impact some small, immobile species of wildlife, as they may be injured or killed in the paths of equipment. The majority of the species in the project area are mobile and able to move out of harm's way; therefore they are not likely to be impacted; however, nests of small animals, as well as bird species may be impacted along equipment access routes. In addition, ground dwelling species may be negatively impacted by soil compaction resulting from equipment travel and/or drilling activities.

The proposed project would potentially impact both resident and migrant bird species within the project area. The project area contains suitable habitat for colonial water bird rookeries, which have historically been known to occur within the project area. Most rookeries are not stationary and may shift seasonally.

There is the potential that aquatic species could be taken up in the hoses through which water is drawn for drilling purposes, causing mortality of aquatic species. Additionally, fish, other aquatic species or their eggs within the project area could be affected by the shock wave from close proximity energy source detonation. Fish with swim bladders have a greater likelihood of experiencing mortality than those without air-containing organs. Most terrestrial animal species that occur within the project area are not likely to experience any negative impacts from seismic detonations; however, some terrestrial species within the project area are considered to be aquatic in nature. These include some

species of mammals but more commonly, reptiles and amphibians. Keevin and Hempen (1997) indicated that in 1997 there was no single comprehensive study to determine the effects of open water explosions on either amphibians or reptiles, which defines the relationship between distance/pressure and mortality or injury. A number of studies demonstrate that sea turtles can be killed or injured by underwater explosions (Duronslet, et al, 1986; Gitschlag, 1990; Gitschlag and Herozeg, 1994; Gitschlag and Renaud, 1989: Klima, et al, 1988; O'Keefe and Young, 1984). For this report, no information was found which discusses the impact of confined, subsurface explosions on reptiles or amphibians.

Although untested, reptiles and amphibians with air-containing organs, such as lungs, probably have mortality comparable to fish with swimbladders (Keevin and Hempen, 1997). For impact assessment purposes, the relationship between distance/pressure and fish mortality/injury are probably similar. Further, amphibians without air-containing organs may be relatively immune to underwater explosions as are benthic fish species without swimbladders (Goertner, et al, 1994). Explosives placed in drill holes and adequately stemmed produce significantly less impact than open-water explosions (Keevin, 1997). Based on the size and depth of the charges to be used during the proposed seismic survey, no impacts from explosions are expected to occur to aquatic reptiles and amphibians. Further, the potential impacts of the confined, subsurface explosions to terrestrial reptile and amphibian species are expected to be insignificant.

DESCO has monitored several projects in which holes were drilled and detonated in open water environments in order to assess impacts to fish and other aquatic species. Aside from the hole depth and charge size, water depth and bottom substrate are the two factors that seem to have the greatest affect on impacts. Generally, the deeper the water, the greater the number of fish/aquatic species impacted. When conducting operations in shallow water, fish/aquatic species tend to scare easily, so very few, if any impacts are observed. Utilizing scare tactics like circling around the hole and/or banging on the bottom of the boat helps to insure that fish/aquatic species move out of the area. Generally, the harder the bottom, the greater the number of fish/aquatic species impacted. You will likely get more impacts in areas with hard, sandy bottoms than in areas with muddy or mucky bottoms because the energy that is released into the water column through harder substrates is more concentrated than in areas that allow for more movement/distribution of the energy through sediments. Fish mortality has been observed during DESCO's monitoring efforts; however, mortality of other aquatic species has not been observed. This can either be explained by the fact that other aquatic species were not present in close enough proximity to the hole to be affected at the time of detonation and/or the species are not affected as greatly as fish species are by subsurface detonation in open water environments.

Water depths within the majority of the project area are less than seven feet deep; therefore, fish and other aquatic species should scare easily from the area of operations. In addition, pressure experienced in the water column near to the shothole within the Refuges should be minimal, as the substrate in the area should allow for some dissipation of the energy wave due to the loose nature of the sediments present.

No state or federally threatened or endangered plant or animal species, USFWS species of concern, or Refuge species of concern is expected to come into direct contact with, or be affected by, the activities of the proposed seismic survey. However, the possibility exists that several threatened or endangered species and species of concern could be seen on the Refuges at the time of the survey. These species include: bald eagle, Louisiana black bear (rarely), and alligator snapping turtle. As with other species of wildlife, threatened, endangered, or sensitive species may be disturbed by the presence of crews and/or noise generated from operations.

4.2.2 Habitat

In addition to direct impacts on wildlife discussed above, Cajun Exploration's operations would potentially have indirect impacts on wildlife through negative effects on habitat values within the project area. Habitat values would potentially be affected by cutting/damage resulting from crew/equipment access, alteration of soils by crew or equipment travel, deposition of drill cuttings on the surface, leaks or spills of contaminants from equipment, and altered surface hydrology or erosion patterns. Vegetation and soils, and thus habitat values, could also be indirectly affected by water or air pollution such as increased suspended sediment, spilled contaminants, and/or particulates and emissions from internal combustion engines due to the operations.

Aquatic habitat could potentially be affected by erosion and subsequent sediment loading, spilled contaminants, drilling fluids and fill introduced to wetlands. Water quality could be indirectly affected by air or land pollution by particulates or contaminating substances, which could affect fish or aquatic wildlife. Water quantity would be minimally affected by water withdrawals for drilling.

The deposition of drill cuttings could damage or kill vegetation immediately surrounding shothole locations and potentially affect the hydrology of the area, which could in turn affect vegetation. The introduction and/or spread of non-native/invasive species also has the potential to adversely impact vegetation, as these species could out-compete native species and change the characteristics of the vegetation in localized areas. Areas accessed by equipment have the greatest potential for this to occur.

Pressure waves resulting from detonation of charges in shotholes could potentially affect tree roots and/or aquatic vegetation, both submerged and emergent. The majority of lands within the project area would be considered wetlands, and soils in the area are very poorly drained and have a very shallow water table. Based on this information, tree roots in the area are not expected to extend to great depths. Roots of wetland tree species tend to grow out, rather than up, and do not extend very far beyond the water table. Charges would be detonated 100 feet below the surface, well beyond the root base of trees, and pressure attenuates out from the source, decreasing toward the land surface; therefore, no negative impacts on tree roots are expected from the detonation of charges in deep holes.

Data on the effects of explosives on aquatic plants is very limited. Ludwig (1977) described removal of eelgrass (*Zostera marina*) by firing single charges and detonation cord underwater during channel construction at the Niantic Estuary at Waterford,

Connecticut. During an 8-week period following the explosions, eelgrass defoliation occurred within a radius of approximately 3.5 to 4 meters from each single charge. Defoliation occurred within a 1-2 meter zone along the length of the detonation cord. No information was reported concerning the weight or type of explosives used.

Examination of the eelgrass indicated defoliation occurred as a result of internal cell wall failure, while plant epidermal fibers continued to hold the plant structure together. Further, it was observed that green algae (*Codium* sp.) and rockweed (*Fucs* sp.) in the zone of defoliation suffered no apparent impacts following the explosions.

Explosives to be used during the seismic survey will be placed in drill holes at least 100 feet below ground surface or water bodies and will be confined by bentonite backfill in accordance with agency requirements. Consequently, emergent and submerged plant species will be exposed to substantially lower pressure waves than if detonation was to occur at the surface or underwater at the water body floor. Explosions associated with the seismic survey are not anticipated to have measurable adverse impacts to either aquatic or terrestrial plant species.

4.2.3 Public Use

Operations conducted under each of the alternatives have the potential to interfere with public use of the Refuges. Crew presence and noise may impact visitor experiences and/or cause the public to perceive that the Refuges are not desirable places to visit. Operations could also interfere with hunters if operations are conducted during the hunting season.

Additionally, infrastructure in the project area could be affected by drill and support equipment passage along source and access routes as a result of operational activities.

4.2.4 Socioeconomics

Socioeconomic issues include the effect of Cajun Exploration's proposed 3-D seismic survey on local and regional economies. The proposed action would generate an undisclosed amount of revenue for the local economy through private landowner access fee payments, as well as from purchases of food, fuel, lodging, incidental purchases for the seismic project crews, and potential local leasing or contracting of auxiliary services. There may be a beneficial impact to the local economy because of project operations; however, the short-term nature of the seismic operations would reduce the likelihood of most local residents being affected socially or economically because of the proposed action. There would be no difference in impacts to socioeconomic resources between the No Action Alternative and the Proposed Action Alternative.

Cumulative Effects

Cumulative impacts on socioeconomics within the project area and surrounding areas have occurred and would continue to occur because of visitor use, hunting, development including oil and gas operations, and other sources of economic development. An example of the latter would be residential or commercial development adding to the tax base of the area. The cumulative socioeconomic effect of future oil and gas drilling or

production in the project area cannot be quantified at this time, because it is not known if the project would identify any targets of interest for exploratory drilling, and whether any exploratory wells, if drilled, would encounter commercial quantities of oil or gas. As impacts from Cajun's proposed operations are not expected to create a measurable impact on socioeconomics within the project area, and the effect would likely end with the project, operations are not expected to add any cumulative impacts to socioeconomic values in the project area.

There would be no differences in socioeconomic effects between the two alternatives, as the survey would be conducted under each of the alternatives, surface use fees would be paid, and crews would be present in the area making expenditures.

4.2.5 Archeological or Historical Resources

There are currently four listed sites within the project boundaries, all of which are within the LNWR. One of these sites is a fairly large shell mound located at Onion Hill on Bayou Misere, which was partially destroyed during the digging on the American-Louisiana Pipeline Canal. Another is located at Lacassine Point near Grand Lake. The smallest of these sites is located on Bayou Lacassine near Short Cut-off Island. The fourth is located near Lantania Hill, just off Lantania Lake, on the LNWR. Two of the four sites are listed as unknown for the National Register of Historic Places (NRHP), while the other two are listed as ineligible. This assessment is based on a search of the site files at the State Historic Preservation Office (SHPO).

Travel of drill and support equipment through the project area could potentially damage historical or archeological resources, both known and unknown, as could the drilling of source holes within site boundaries. Additionally, removal of artifacts from sites could alter site characteristics. Each of these acts would be violations of the Historic Preservation Act and punishable by law.

4.2.6 Oil and Gas Activity

The most significant effect that would potentially result from the alternatives is increased oil and gas production based on the interpretation of the 3-D seismic data. If the data indicate that potential oil or gas reserves are present in marketable quantities within the project area, wells would likely be constructed in the area, and pipelines would likely be installed to transport the product(s) to storage and production facilities. Each well site would consist of an improved and hardened surface with potential access roads, support infrastructure, and increased industrial traffic, and each pipeline would likely be installed in a trench along its length. Construction and/or installation of these features could result in increased surface impacts, possible resource losses, and reduced visual quality. Increased oil and gas development and production in the area would also have socioeconomic consequences for the local community and landowners, as well as the regional area. The local economy would benefit from crew expenditures for lodging, fuel, food, and other amenities.

Should Cajun Exploration propose development in the area as a result of the 3-D seismic survey, the company would work with the USFWS to minimize impacts to CPNWR and LNWR resources while accomplishing project objectives. Any additional development proposed on USFWS lands by Cajun Exploration and/or any other applicant would undergo separate analysis through the NEPA process and conform to the management goals and objectives of the Refuges. The USFWS would work with the applicant to identify cost-effective and reasonable measures to minimize new surface disturbances. This can be accomplished by directionally drilling from locations outside of the CPNWR and LNWR; drilling multiple wells from the same well pad location; and locating facilities, access, and infrastructure in previously disturbed areas to the maximum extent possible and where economically and technically feasible.

Cumulative Effects

Previous oil and gas exploration and development have occurred and will continue to occur within the project area. Based on current and projected levels of exploration and development for the region, drilling activity will likely increase in the future both in the project area and region. The client has evaluated existing data on the geology of the area from well records, and past 2-D and 3-D seismic surveys in and around the project area, and is hopeful that marketable reserves will be identified as a result of the survey.

It is possible that the seismic data will not indicate the presence of marketable reserves within the project area or that reserves identified could be greater or less than the amount anticipated by the client; therefore, cumulative impacts as a result of future oil and gas exploration cannot be quantified at this time.

There would be no differences related to oil and gas activity between the two alternatives, as data indicating the presence/absence of potential marketable reserves would be obtained under each of the alternatives.

4.3 Effects from Implementing Alternative A (The Proposed Action)

4.3.1 Fish and Wildlife Resources

The proposed operation incorporates measures that would prevent or minimize effects to fish and wildlife populations and their habitat from most impacts. Noise impacts are expected to produce the greatest effect on wildlife populations because of their relatively high intensity level and large area of effect. As mentioned in Section 4.2, noise from drilling equipment, support vehicles, helicopters, detonation of charges, and the presence of crews could temporarily displace wildlife into adjacent habitat and/or temporarily alter the normal behavior of certain species. However, operations in any given area would occur intermittently for only a brief period before moving on. Additionally, Cajun Exploration would conduct operations, to the extent possible, between March 15th and October 15th, avoiding periods of highest migratory bird use (fall and spring migrations and wintering periods) to help minimize impacts. Suitable adjacent habitat would be widely available for displaced wildlife to utilize during operations, and impacts on habitat values are expected to be short term. The majority of species would likely return to areas of operation as soon as crews and equipment have vacated these areas. Therefore, while

fish and wildlife could be displaced and experience increased stress, decreased production and possibly mortality during the proposed operation, this effect would not be expected to be of a measurable intensity.

The Proposed Action could potentially impact both resident and migrant bird species within the project area. In order to minimize the likelihood of this occurrence, Cajun Exploration would offset operations a minimum distance of 1,000 feet from all trees or other rookery structures unless there are no feasible alternatives. Should seismic activities encroach closer than 1,000 feet from any rookery, a monitor would be on site to assist in minimizing any impacts that may impair the integrity of the rookery. A monitor recommended by Southwest Louisiana National Wildlife Refuges Complex will be present throughout survey activities to help ensure the protection of sensitive species/habitats.

Under this alternative, crews would not interact with fish or wildlife in the operations area. There would be no hunting or fishing allowed, and the harassment or destruction of wildlife would be prohibited. Similarly, the nests or dens of wildlife would not be damaged or destroyed, and areas containing nests or dens would be avoided. Cajun Exploration would also offset operations for the protection of any threatened, endangered or sensitive species in accordance with federal guidelines.

All cans, bottles, paper and other trash would be removed from Refuge lands daily to reduce the potential for wildlife attraction. All equipment would be washed before entering the operations area to help prevent the influx of exotic species. Additionally all equipment would be inspected for oil leaks, worn hydraulic hoses, and other potential hazards to the habitat, prior to entering the Refuges.

Under the Proposed Action, impacts to fish and wildlife would be less than those predicted for the No Action Alternative. USFWS management of the operations would, through the issuance of the SUP and monitoring, ensure strict compliance to its provisions and numerous stipulations designed to protect fish and wildlife.

Cumulative Effects

Cumulative adverse impacts on fish and wildlife resources within the project area have occurred and would continue to occur as a result of oil and gas operations, natural processes, hunting, recreational activities, on and off-road vehicle use, and other sources of disturbance or loss/modification of suitable habitat. USFWS management of the Refuges is expected to maintain or improve habitat for fish and wildlife resources, contributing to beneficial cumulative impacts. In addition, projects proposed within National Wildlife Refuge administered lands would be subject to restrictions designed to minimize impacts to natural resources, including fish and wildlife. Because impacts from Cajun Exploration's proposed operations on fish and wildlife resources would not be of measurable intensity and would only last for the duration of operations, the operations are not expected to increase adverse cumulative impacts on fish and wildlife resources.

4.3.2 Habitat

Under the Proposed Action, equipment access routes would be chosen following the route of least resistance in order to minimize impacts on vegetation and soils in both wetland and upland areas. Access routes would be subject to vegetation clearing in order to allow for the passage of equipment and crews. However, vegetation clearing would be limited to the minimum necessary to accomplish objectives, and cutting restrictions are in place to limit the size and species of vegetation that can be cut. The cutting of woody vegetation (dead or alive) would be limited by size to six (6) inches in diameter, measured diameter at breast height (DBH). Tree damage applies to the trunk, all limbs, and the entire root system. No oak tree species or cypress trees are to be damaged, regardless of tree size. Additional damage assessments may be made during the course of the survey.

There are 2,107 source points proposed within National Wildlife Refuge lands, totaling approximately 87.79 linear miles (2,107 points x 220 foot point spacing/5,280 feet per mile) of source line access. Due to the variability of the terrain, several types of drill equipment will be used within the project area. The type of equipment and terrain will determine the path width; however, the largest piece of equipment, the marsh buggy drill is approximately 14 feet wide. Assuming a 15 foot wide path along access routes, approximately 159.62 acres (87.79 linear miles x 5,280 feet per mile x 15 foot path width/ 43,560 square feet per acre) of National Wildlife Refuge lands would be subject to vegetation damage as a result of equipment access, which equates to approximately 0.009% of the 17,190.40 acres of NWR lands within the project area.

The selection of lightweight drilling and support equipment best suited for each habitat type, the strategic location of source points and access designed to allow for avoidance of sensitive resources, and the fact that environmental monitors will be onsite to ensure compliance with vegetation cutting/damage stipulations is expected to minimize rutting and confine impacts on vegetation to the herbaceous, shrub, and midstory layers within the operations area. Vegetation within the paths of the drills is likely to be crushed or killed, but would generally not be uprooted. The rootstock and plant material would remain in most impacted areas, allowing for quick recovery and the re-establishment of native vegetation.

The number of passes by equipment would be limited to the minimum necessary to accomplish objectives. Wherever possible, one drill (accompanied by support equipment) would travel only once down each source and access route. There would be instances where terrain limits the ability to travel from one source line to the next without traveling on the same path that was already used for access. In areas where this is the case, the drills and support equipment would move over on the line so that they are not traveling in the exact same path that was traveled during previous access, if feasible. Rutting could occur along vehicle access routes, but all ruts would be re-contoured, limiting the long-term impacts on soils, hydrology, and therefore vegetation, in the operations area.

Single engine airboats and marsh buggies would be utilized for equipment layout, pickup and troubleshooting along receiver lines within the project area, where access permits. Single-engine airboats are approximately 8 feet wide, and as mentioned above, marsh buggies are 14 feet wide. Points would either be offset from and/or crews would walk equipment into areas that these types of equipment cannot traverse. Vegetation would likely be impacted in a path that is less than double the width of the equipment along receiver lines, as multiple passes (at least two: one for layout and one for pickup) by equipment would be necessary along each of the lines and paths would be offset, as necessary, to minimize impacts to the substrate. Paths generally are not offset an entire width; however, for impact calculation purposes, the double path width is used to provide a conservative estimate.

There are 2,789 receiver stations proposed within National Wildlife Refuge lands, at least 245 of which are located in water. Receiver lines on land would span a distance of 106 linear miles (2,544 points x 220 foot point spacing / 5,280 feet per mile). Assuming a 28 foot wide path, approximately 360 acres (106 miles x 5,280 feet/mile x 28 foot path width / 43,560 square feet per acre) of NWR lands would be subject to vegetation cutting or impacts during survey efforts, which equates to approximately 0.02% of the 17,190.40 acres of NWR lands within the project area.

Impacts would be minimal and temporary in nature, as both types of equipment are lightweight and vegetation would likely be cut, crushed and/or killed in the paths of the equipment; however, it would generally not be uprooted. Vegetation along receiver lines would likely recover within one to two growing seasons.

Helicopter drops of equipment could potentially result in impacts on vegetation, but are expected to limit the effect to vegetation overall, as it would minimize travel of support equipment through the area for equipment transport.

The deposition of drill cuttings could damage or kill vegetation immediately surrounding shothole locations and potentially affect the hydrology of the area, which could in turn affect vegetation. Impacts on vegetation surrounding the hole as a result of the deposition of drill cuttings are expected to be minimal, as the vegetation would remain rooted, and the native soil displaced from the hole would be distributed over the area such that the vegetation can emerge through it and re-establish.

The introduction of contaminants into the environment from leaks, spills, or equipment emissions also has the potential to adversely impact vegetation, water quality, and soil characteristics. Several mitigation measures designed to limit the possibility of leaks or spills of contaminants would be incorporated into the proposed action. All equipment would be cleaned and all hoses and connections inspected prior to entering the Refuges, to insure that they are in workable condition and to help prevent leaks. Oil would not be changed in the field; all oil and filters would be changed prior to entering Refuges. Any major repairs to equipment will be performed off of the Refuges. Oil absorbent pads and containment booms will be carried on drilling rigs at all times and any spills would be cleaned up immediately.

The introduction and/or spread of non-native/invasive species also has the potential to adversely impact vegetation, as these species could out-compete native species and change the characteristics of the vegetation in localized areas. Areas accessed by equipment have the greatest potential for this to occur. In order to minimize the likelihood of introduction of non-native/invasive species, Cajun Exploration will wash all equipment prior to its use within the Refuges.

Impacts on soils within the operations area are expected to be minimized by the relatively low bearing pressure of drilling and support equipment and the fact that disturbed areas would be re-contoured as nearly as possible to pre-project conditions.

Several of the mitigation measures listed in the paragraph above, such as the low bearing pressure of equipment and re-contouring of disturbed areas are expected to reduce the impact of the proposed operation on aquatic habitat values by directly limiting erosion caused by drilling/support equipment, as well as rutting that could lead to further erosion or alteration of surface and subsurface water flows after rain events. Mitigation measures proposed that would limit the chances or severity of a leak or spill of contaminants would also minimize adverse effects on aquatic species/habitats. These measures would tend to limit the impacts of the operation on water quality and quantity, and thus aquatic habitat. Drill cuttings introduced into wetlands and floodplains are expected to temporarily increase turbidity.

Water withdrawals for drilling operations are expected to affect flow rates in area waterways by only fractions of a percent at any given time; however, there is the potential that aquatic species could be taken up in the hoses through which water is drawn, causing mortality of aquatic species. Intake hoses would be screened to prevent the uptake of aquatic species; therefore, this is not likely to occur.

Under this alternative, impacts to habitat would be short-term and minimal. USFWS management of the operations would, through the issuance of the SUP and monitoring, ensure strict compliance to its provisions and numerous stipulations designed to protect vegetation, soil, and water resources. The design of the project in the Proposed Action Alternative minimizes disturbance to the extent practical by using low impact equipment and helicopters to transport personnel, materials, and equipment. This would decrease the time necessary for the survey and the number of trips necessary to accomplish various tasks. The potential impacts are expected to be minimal and localized. Restoration of and/or mitigation for any unavoidable damages would be required. Examples of SUP stipulations which would reduce impacts to habitat would include:

1. Airboats will be used exclusively for seismic operations on the refuge where appropriate; unless aluminum wide tracked marsh buggies have been approved by the Complex Oil and Gas Specialist or his authorized representative. All airboats/buggies should meet and/or exceed all State and Federal boating regulations.

2. All airboat/buggy operators should remain in the designated work areas. All travel to and from work areas will be confined to designated access routes. No cross country travel will be permitted. All airboat/buggies crossing grassy terrain will attempt to avoid using the same track twice. Any questions airboat drivers have about where and how to access work areas must be directed to the Refuge Representative for guidance.
3. All survey lines will be laid by airboats/buggies. Crews will be moved by airboats or helicopters. Air-driven drill rigs may be left in the marsh on work lines instead of going to canal banks. Access routes will be established for airboat use and will be used to the greatest extent possible. In areas not designated as access routes, airboats will not be allowed to use the same trail twice when traveling in the marsh. In the event an airboat drill cannot be used, a special aluminum tracked buggy of smallest size possible, with drill, will be used to minimize surface damages. Use will be approved on a case-by-case basis by the Complex Oil and Gas Specialist or his authorized representative.
4. The use of helicopters to move personnel, supplies and equipment is highly recommended to reduce airboat trips.
5. Entry across refuge levees or banks will require a cleared crossing with a method approved by the Complex Oil and Gas Specialist or his authorized representative to protect the toe of the levee or bank. No other method of entry will be permitted. Wooden ramps for wide tracked aluminum buggies are recommended.
6. Shot holes will be placed in open water to the greatest extent possible. All mud and dirt from drilling sites, from charge holes and mud pits, must be back filled and leveled immediately after each shot hole is drilled and loaded. After the shots are discharged, the cap wires must be completely removed from the ground and carried to a disposal location.
7. The Permittee shall not remove or damage any trees with diameter at breast height (DBH) of 6 or more inches. Tree damage applies to the trunk, all limbs, and the entire root system. No oak tree species or cypress trees are to be damaged, regardless of tree size. Additional damage assessments may be made during the course of the survey.

Cumulative Effects

Cumulative adverse impacts on habitat within the project area have occurred and will continue to occur because of natural processes, recreational activities, oil and gas operations, off-road vehicle use, and impacts on ozone sensitive species from air pollution. Marsh loss is the most ominous problem faced by the Refuges. Marsh loss has occured and will likely continue to occur as a result of natural events such as hurricanes, salt water intrusion, and invasion of exotic species (mainly nutria), as well as conversion of habitat due to oil and gas operations and other actions. Because impacts from Cajun's operations would be short-term, localized, and minor in intensity, the proposed operation's contribution towards cumulative effects on habitat would be low.

The greatest contaminant issues that plague the Refuges are related to agricultural and urban pesticide use and mercury. Much of the watershed and area surrounding LNWR is agricultural, primarily rice. There is a possibility that some of the pesticides proposed

and/or used for rice cultivation could have impacts on the refuge as they accumulate in the watershed and flow through the refuge in Lacassine Bayou or other surrounding waterbodies. Airborne contaminants could find their way into the pool and accumulate due to the lack of flushing typical of most marshes. This being said, the proposed action is not expected to contribute to cumulative impacts on habitat related to contamination, as several measures would be incorporated to reduce the potential for leaks and spills, as discussed above.

Beneficial cumulative effects to habitat are expected to result from the Refuge's management of the refuge areas, as activities conducted in this area would be subject to restrictions designed to minimize impacts.

4.3.3 Public Use

Under the Proposed Action Alternative, impacts to infrastructure and conflicts with refuge public use and other management programs would be less than that of the No Action Alternative because of USFWS management of the project through issuance of the SUP and monitoring to ensure compliance with its provisions and stipulations.

Cajun Exploration would not conduct operations during the hunting season. Operations would be conducted between March 15 and October 15, in accordance with Refuge guidelines. Signs would be posted in public use areas to notify the public of operations, and crew members would wear bright colored safety vests to make them highly visible to hunters and visitors.

Cajun Exploration would work with Refuge representatives to minimize interference with Refuge management actions, educational opportunities, and other Refuge uses. Impacts on public use are expected to be minimal.

Cumulative Effects

Cumulative impacts on public use within the project area have occurred and would continue to occur due to habitat conversion/loss mainly as a result of oil and gas exploration and development and natural processes. Installation of past pipelines and wells within the project area has resulted in conversion and/or loss of wetland habitat. Additionally, nutria populations can cause significant damage to the marsh, and invasion of exotic species has occurred and will likely continue to reduce the amount of native habitat available for species that depend on it for resting, foraging, or nesting.

Conversion or loss of habitat and/or change in species composition could affect the number of visitors who utilize the area for hunting, fishing, wildlife viewing, etc. Management of the National Wildlife Refuges should minimize cumulative impacts on public use within the project area, as restrictions would be placed on operations for the protection of natural resources. Because Cajun Exploration's operations are of short duration and would not result in any permanent structures, the project should not contribute to cumulative impacts within the area.

4.3.4 Archaeological or Historical Resources

The National Historic Preservation Act, as amended in 1992 (16 U.S.C. 470 *et seq*.), and the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*.) require the consideration of impacts on cultural resources listed or eligible for listing in the National Register of Historic Places. Cajun Exploration proposes to conduct operations in a manner that would avoid unmitigated, long-term impacts on cultural resources that exist within the Refuges.

Under this alternative, historic and archeological sites would be protected, as operations would be offset at least 100 feet from all known sites. If a site of potential historical, archaeological or cultural interest is encountered during the seismic survey, work would be stopped in the immediate area and the appropriate authorities notified.

Cumulative Effects

Cumulative adverse impacts on cultural/historic resources within the project area have occurred and will continue to occur as a result of natural erosion and decomposition, development including oil and gas, and recreational activities. Management of the Refuge areas is expected to help minimize impacts to cultural/historic resources, as projects proposed within Refuge administered lands would be subject to compliance with the Historic Preservation Act and other laws, regulations, and policies that provide protection for these resources.

Because impacts from the proposed operation are not expected to adversely affect cultural/historic resources, the operations are not expected to contribute to cumulative impacts.

4.4 Effects from Implementing Alternative B (No Action Alternative)

4.4.1 Fish and Wildlife Resources

Under the No Action alternative, operations would still occur; however, they would not be conducted under the guidelines of a SUP. Under this Alternative, impacts to fish and wildlife would be greater than the Proposed Action.

Without a SUP, project activities could occur outside of the seasonal timeframes specified by the USFWS, potentially during periods of highest migratory bird use (fall and spring migrations and wintering periods). Conducting operations during migrational or wintering periods would result in greater overall disturbance to migratory waterfowl, shorebirds, wading birds, and other wetland-dependent migratory birds than operations conducted between the March 15 to October 15 seasonal timeframe specified by the USFWS. Additionally, operations may not be offset away from rookery locations, causing disturbance to nesting species.

Under this alternative, there would be no stipulations restricting hunting, fishing, harassment or destruction of wildlife, destruction of nests or dens, or other protections offered through an SUP. This being the case, there is a greater likelihood that wildlife could be killed, wounded, disturbed, or displaced.

Additionally, equipment may not be washed prior to use on the Refuge, so there is a greater likelihood of the introduction and/or spread of exotic species.

Cumulative Effects

Cumulative impacts of the No Action alternative would be similar to those described under the Proposed Action; however, the potential for contributing to cumulative impacts on fish and wildlife resources is greater under the No Action alternative due to the fact that operations would have greater impacts on habitat for aquatic and terrestrial species. Operations conducted under the No Action alternative could potentially result in hydrologic modification, accelerated erosion, habitat conversion, contamination of soils and water, and other factors that could affect fish and wildlife populations in the project area. Combined with past and future actions and natural processes that result in similar effects, the No Action alternative could contribute to negative effects on fish and wildlife resources over the long-term.

Threatened and Endangered Species

Under this alternative, the potential for disturbance or take of a threatened or endangered species or species of concern would be greater than under the Proposed Action. Without consultation with Refuge management and/or environmental monitors and in the absence of required offsets for the protection of sensitive species, identification and subsequent avoidance of species present within the Refuges may not occur. This could result in adverse affects to threatened or endangered species, violating the Endangered Species Act.

Cumulative Effects

Cumulative impacts of the No Action alternative would be similar to those described under the Proposed Action; however, the potential for contributing to cumulative impacts on threatened or endangered species is greater under the No Action alternative due to the fact that operations would have a higher likelihood of adversely affecting a federally-listed species. Operations could result in disturbance or taking of a threatened or endangered species. Disturbance or taking caused by the No Action alternative, combined with past and future actions that result in negative effects to threatened and endangered species, could contribute to decreased production or even extinction of a species over time.

4.4.2 Habitat

Under the No Action alternative, impacts to habitat would be greater than those associated with the Proposed Action, as there would be no SUP governing operations. Overall damage to vegetation, soils, and aquatic habitats would be increased. Refuge management would not be consulted and would have no input into how activities would be conducted in sensitive vegetative habitats. Similarly, environmental monitors would not be on hand to assist survey and drilling teams with least impact equipment choices and access routes appropriate for the protection of habitat. Access would not be restricted to a minimum number of passes necessary to accomplish objectives, and equipment operators would not be required to offset travel paths to minimize compaction and/or rutting. This would result in additional impacts to soils and vegetation. Impacted

acreage would likely be three to four times that estimated for the Proposed Action and the intensity of the impacts would be greater. In addition to crushing and killing of vegetation along access routes, the probability of uprooting vegetation and compaction of soils increases with each pass of equipment.

There would be no requirement to use lightweight equipment and no requirement to re-contour/restore impacted areas under the No Action alternative. If trenching or rutting occurs in the marsh due to the use of heavy equipment, and the areas are not restored as nearly as possible to pre-project conditions, it could result in hydrologic modification, salt water intrusion, accelerated erosion, and/or a change in species composition and habitat type/characteristics.

There would be no cutting restrictions in place limiting the size of vegetation that can be cut or damaged as a result of operations. This could result in removal of larger canopy trees in forested areas, increasing the potential for invasion by exotic species, including Chinese tallow, in certain areas. Additionally, impacting larger trees increases the time necessary for recovery of impacted areas.

Under this alternative, helicopters may not be used for support. This could result in additional passes of equipment through sensitive habitat, further increasing impacts to soils and vegetation. Damage to levees, ditch banks, and natural waterway banks may also occur without consultation and monitoring, which may increase the risk of erosion and/or salt water intrusion.

There would be no mitigation measures designed to minimize the possibility of leaks or spills in the area under the No Action alternative; therefore the likelihood of contamination would be greater than that of the proposed action.

The crews would not be required to wash equipment prior to use in the Refuge under this alternative, increasing the risk of introduction of invasive/exotic plant species. Additionally, intake hoses used to obtain water for drilling may not be screened, increasing the likelihood of uptake of aquatic species.

Overall, the No Action alternative would have greater impacts on habitat than the Proposed Action.

Cumulative Effects

Cumulative impacts of the No Action alternative would be similar to those described under the Proposed Action; however, the potential for contributing to cumulative impacts on habitat resources is greater under the No Action alternative. Operations conducted under the No Action alternative, combined with past and future actions and natural processes that result in similar effects, could result in hydrologic modification, accelerated erosion/land loss, habitat conversion, and/or contamination of soils and water.

4.4.3 Public Use

Under the No Action Alternative, it is expected that increased impacts to infrastructure such as roads and fences, and increased conflicts with Refuge public waterfowl hunting and refuge management programs would occur as a consequence of the lack of issuance of a SUP containing specific guidance and mitigative measures designed to minimize impacts and conflicts. Cajun Exploration would not be obligated to observe the hunting season and conduct project operations throughout the fall, winter, and spring.

Cumulative Effects

Cumulative impacts of the No Action alternative on public use would be similar to those described under the Proposed Action; however, the potential for conversion and/or loss of habitat available for public use is greater under the No Action alternative. Additionally, operations conducted under the No Action alternative could negatively affect fish and wildlife populations in the project area and result in a decrease in the amount of visitors who utilize the project area for hunting, wildlife viewing, fishing, etc. Combined with past and future actions and natural processes that result in similar effects, the No Action alternative could contribute to negative effects on public use over the long-term.

4.4.4 Archeological or Historical Resources

Under this Alternative, the unlikely possibility of disturbing a historical or archeological resource would be greater than the Proposed Action (USFWS would issue a SUP). Without consultation with the Refuge management or environmental monitors, identification and subsequent avoidance may not occur if historical or archeological resources should happen to be present within the project area on the Refuges. Additionally, without oversight of project activities, crews could remove artifacts from sites, changing site characteristics.

Cumulative Effects

Cumulative impacts of the No Action alternative would be similar to those described under the Proposed Action; however, the potential for contributing to cumulative impacts on cultural resources is greater under the No Action alternative. Operations conducted under the No Action alternative, combined with past and future actions and natural processes that negatively impact sites, could change site characteristics and potentially impact the ability of archeologists to adequately describe the sites. This could limit the amount of knowledge that is gained from cultural/heritage resources for purposes of education.

5.0 REFERENCES AND CITATIONS

Couser, D. 2002. Atakapa Indians. Handbook of Texas Online. Available online: http://www.tsha.utexas.edu/handbook/online/articles/view/AA/bma48.html .

Cox, R.R. and Afton, A.D. 1996. Evening Flights of Female Northern Pintails from a Major Roost Site. The Condor 98: 810 – 819.

Duronslet, M.J., C.W. Caillouet, S. Manzella, K.W. Indelicato, C.T. Fontaine, D.B. Revera, T. Williams, and D. Boss. 1986. The effects of an underwater explosion on the sea turtles *Lepidochelys kempi* and *Caretta caretta* with observations on effects on other marine organisms. Unpublished report submitted to National Marine Fisheries Service Biological Laboratory, Galveston, Texas.

Feldman, L.H. 1998. The Last Days of British Saint Augustine, 1784-1785. A Spanish Census of the English Colony of East Florida.

Gitschlag, G.R. 1990. Sea turtle monitoring at offshore oil and gas platforms, pp. 223-246 in Richardson, T.H., J.I. Richardson, and M. Donnelly (compilers). Proceedings of the 10th Annual Workshop of Sea Turle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFC-278.

Gitschlag, G.R. and B.A. Herozeg. 1994. Sea turtle observations at explosive removals of energy structures. Marine Fisheries Review. 56:1-8.

Gitschlag, G.R. and M. Renaud. 1989. Sea turtles and the explosive removal of offshore oil and gas structures, pp. 67-68 in Eckert, S.A., K.L., Eckert, and T.H. Richardson (compilers). 9th Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFC-232.

Goertner, J.F., M.L. Wiley, G.A. Young, and W.W. McDonald, 1994. Effects of underwater explosions on fish without swimbladders. Technical Report NSWC TR 88-114, Naval Surface Weapons Center, Dahlgren Division, White Oak Detachment, Silver Spring, Maryland.

Hebert, T. 2003. "The First Acadians in New Acadia, 1764-1784." History of the Cajuns: Cajuns in the 18th Century. Available online: http://www. Acadian-cajun.com/hiscaj2b.htm. Acadian-Cajun Genealogy and History.

Keevin, T.M. and G.L. Hempen. 1997. The environmental effects of underwater explosions with methods to mitigate impacts. U.S. Army Corps of Engineers, St. Louis District, St. Louis, Missouri.

Keevin, T.M. 1997. A review of natural resource agency recommendations for mitigating the impacts of underwater blasting. Reviews in Fishery Science.

Klima, E.F., G.R. Glitschlag, and M.L. Renaud. 1988. Impacts on the explosive removal of offshore petroleum platforms on sea turtles and dolphins. Marine Fisheries Review, 50:33-42.

Ludwig, M. 1977. Environmental assessment of the use of explosives for selective removal of eelgrass (*Zostera marina*). Pp. 63-68. In: G. A. Young (Editor). Proceedings of the Second Conference on the Environmental Effects of Explosives and Explosions. Naval Surface Weapons Center. NSWC/EOL YT 77-36.

Maryman, J. Marine Fisheries Biologist, Habitat/Seismic Section. Wildlife and Fisheries Louisiana. Personal Communication. October 2, 2008.

O'Keefe, D.J. and G.A. Young. 1984. Handbook on the environmental effects of underwater explosions. NSWC TR 83-240, Naval Surface Weapons Center, Silver Spring, Maryland.

STATS Indiana. 2004. Indiana Department of Commerce. 2004. USA Counties IN Profile. Available online: http://www.stats.indiana.edu/uspr/a/usprofiles/22/us_over_sub_pr22023.html .

Swenson, E.M. and R.E. Turner. 1987. Spoil banks: Effects on a coastal marsh on coastal marsh water-level regime. Estuarine, Coastal and Shelf Science 24, 599-609.

The Nature Conservancy. 2003. Wildland Invasive Species Team, Invasives on the Web. Available online: http://www.tncweeds.ucdavis.edu/esadocs/documnts/sapiseb.html.

U.S. Army Corps of Engineers. 2004. Louisiana Coastal Area, Louisiana – Ecosystem Restoration Study – July 2004. Draft Report.

U.S. Census Bureau, Census 2000, Summary File 3, Profile of Selected Economic Characteristics

U.S. Census Bureau (USCB). 2004. Louisiana QuickFacts: Cameron Parish. Available online: http://quickfacts.census.gov/qfd/states/22/22023.html.

U.S. Fish and Wildlife Service. 2006a. *Draft Comprehensive Conservation Plan and Environmental Assessment for Cameron Prairie National Wildlife Refuge.*

USFWS. 2006b. *Draft Comprehensive Conservation Plan and Environmental Assessment for Lacassine National Wildlife Refuge.*

U.S. Fish and Wildlife Service. 2003a. Cameron Prairie Refuge – Wildlife and Habitat (Biological Review). Draft Final Report.

USFWS. 2003b. Lacassine National Wildlife Refuge, Wildlife and Habitat Management (Biological) Review, May 20-24, 2002.

U.S. Fish and Wildlife Service. 2002a. CPNWR .U.S. Fish and Wildlife Service. 2002c. Southwest Louisiana Refuges Complex, Visitor Services Review, June 17-20, 2002.

USFWS. 2002b. CPNWR .U.S. Fish and Wildlife Service. 2002a. Cameron Prairie National Wildlife Refuge. Biological Review Notebook.

USFWS. 2002c. LNWR. U.S. Fish and Wildlife Service. 2002a. *Birds of Conservation Concern 2002* (BCC 2002). Division of Migratory Bird Management, Arlington, Virginia.

USFWS. 2002d. LNWR. U.S. Fish and Wildlife Service. 2002b. Lacassine National Wildlife Refuge Bird List.

USFWS. 2002e. CPNWR .U.S. Fish and Wildlife Service. 2002b. Cameron Prairie National Wildlife Refuge. Annual Narrative Calendar Year 2002.

USFWS. 2002f. LNWR. U.S. Fish and Wildlife Service. 2002c. Lacassine National Wildlife Refuge. Public Use Review report. Region 4.

U.S. Fish and Wildlife Service. 2001. Cameron Prairie National Wildlife Refuge. Annual Narrative Calendar Year 2001.

U.S. Fish and Wildlife Service. 1998. Expanding the Vision, 1998 Update, North American Waterfowl Management Plan.

U.S. Fish and Wildlife Service. 1989. Birds of Lacassine National Wildlife Refuge. U.S. Fish and Wildlife Service. Unpaginated. Jamestown, ND: Northern Prairie Wildlife Research Center Homepage. Available online: http://www.npwrc.usgs.gov/resource/othrdata/checkbird/r4/lacassine.htm.

Wang, J.D. 1987. Hurricane effects on surface Gulf Stream currents. Ocean Engineering 14(3): 165-180.

Wilner, G.R., Chapman J.A., and Pursley D., 1979, Reproduction, physiological responses, food habits, and abundance of nutria on Maryland marshes: Journal of Wildlife Management, Wildlife Monographs, no 65.

APPENDIX A
Species Checklist for the Refuges

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
BIRDS			
Loons			
Common Loon	*Gavia immer*	x	
Grebes			
Pied-billed Grebe	*Podilymbus podiceps*	x	x
Horned Grebe	*Podiceps auritus*	x	x
Eared Grebe	*Podiceps nigricollis*	x	
Pelicans and their Allies			
American White Pelican	*Pelecanus erythrorhynchos*	x	x
Double–crested Cormorant	*Phalacrocorax auritus*	x	x
Neotropic Cormorant	*Phalacrocorax brasilianus*	x	x
Anhinga	*Anhinga anhinga*	x	x
Magnificent Frigatebird	*Fregata magnificens*	x	
Herons, Egrets, and Allies			
American Bittern	*Botaurus lentiginosus*	x	x
Least Bittern	*Ixobrychus exilis*	x	x
Great Blue Heron	*Ardea herodias*	x	x
Great Egret	*Ardea alba*	x	x
Snowy Egret	*Egretta thula*	x	x
Little Blue Heron	*Egretta caerulea*	x	x
Tricolored Heron	*Egretta tricolor*	x	x
Reddish Egret	*Egretta rufescens*	x	x
Cattle Egret	*Bubulcus ibis*	x	x
Green Heron	*Butorides virescens*	x	x
Black-crowned Night-Heron	*Nycticorax nycticorax*	x	x
Yellow-crowned Night-Heron	*Nycticorax violacea*	x	x
Ibis, Spoonbill, and Stork			
Glossy Ibis	*Plegadis falcinellus*	x	x
White Ibis	*Eudocimus albus*	x	x
White-faced Ibis	*Plegadis chihi*	x	x
Roseate Spoonbill	*Platalea ajaia*	x	x
Wood Stork	*Mycteria americana*	x	x
Sandhill Crane	*Grus canadensis*	x	x
Waterfowl			
Fulvous Whistling-Duck	*Dendrocygna bicolor*	x	x
Black-bellied Whistling Duck	*Dendrocygna autumnalis*	x	x
Greater White-fronted Goose	*Anser albifrons*	x	x
Snow Goose	*Chen caerulescens*	x	x
Ross's Goose	*Chen rossii*	x	x
Canada Goose	*Branta canadensis*	x	x
Wood Duck	*Aix sponsa*	x	x
Green-winged Teal	*Anas crecca*	x	x
American Black Duck	*Anas rubripes*	x	x
Mottled Duck	*Anas fulvigula*	x	x
Mallard	*Anas platyrhynvchos*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Northern Pintail	*Anas acuta*	x	x
Blue-winged Teal	*Anas discors*	x	x
Cinnamon Teal	*Anas cyanoptera*	x	x
Northern Shoveler	*Anas clypeata*	x	x
Gadwall	*Anas strepera*	x	x
American Wigeon	*Anas americana*	x	x
Canvasback	*Aythya valisineria*	x	x
Redhead	*Aythya americana*	x	x
Ring-necked Duck	*Aythya collaris*	x	x
Greater Scaup	*Aythya marila*		x
Lesser Scaup	*Aythya affinis*	x	x
Common Goldeneye	*Bucephala clangula*	x	x
Bufflehead	*Bucephala albeola*	x	x
Hooded Merganser	*Lophodytes cucullatus*	x	x
Common Merganser	*Mergus merganser*	x	x
Red-breasted Merganser	*Mergus serrator*	x	x
Ruddy Duck	*Oxyura jamaicensis*	x	x
Vultures, Hawks, and Allies			
Black Vulture	*Coragyps atratus*	x	x
Turkey Vulture	*Cathartes aura*	x	x
Osprey	*Pandion haliaetus*	x	x
White-tailed Kite	*Elanus leucurus*		x
Mississippi Kite	*Ictinia mississippeinsis*		x
Bald Eagle	*Haliaeetus leucocephalus*	x	x
Northern Harrier	*Circus cyaneus*	x	x
Sharp-shinned Hawk	*Accipiter striatus*	x	x
Cooper's Hawk	*Accipiter cooperii*	x	x
Red-shouldered Hawk	*Buteo lineatus*	x	x
Broad-winged Hawk	*Buteo platypterus*	x	x
Red-tailed Hawk	*Buteo jamaicensis*	x	x
American Kestrel	*Falco sparverius*	x	x
Merlin	*Falco columbarius*	x	x
Peregrine Falcon	*Falco peregrinus*	x	x
Crested Caracara	*Caracara cheriway*	x	x
Gallinaceous Birds (Quail,Turkey, and Allies)			
Northern Bobwhite Quail	*Colinus virginianus*	x	x
Rails, Gallinules, Coots, and Cranes			
Yellow Rail	*Coturnicops noveboracensis*	x	x
Black Rail	*Laterallus jamaicensis*	x	
Clapper Rail	*Rallus longirostris*	x	
King Rail	*Rallus elegans*	x	x
Virginia Rail	*Rallus limicola*	x	x
Sora	*Porzana carolina*	x	x
Purple Gallinule	*Porphyrio martinica*	x	x
Common Moorhen	*Gallinula chloropus*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
American Coot	*Fulica americana*	x	x
Shorebirds			
Black-bellied Plover	*Pluvialis squatarola*	x	x
American Golden-Plover	*Pluvialis dominica*	x	x
Wilson's Plover	*Charadrius wilsonia*	x	
Semipalmated Plover	*Charadrius semipalmatus*	x	x
Killdeer	*Charadrius vociferus*	x	x
Black-necked Stilt	*Himantopus mexicanus*	x	
American Avocet	*Recurvirostra americana*	x	x
Greater Yellowlegs	*Tringa melanoleuca*	x	x
Lesser Yellowlegs	*Tringa flavipes*	x	x
Solitary Sandpiper	*Tringa solitaria*	x	x
Willet	*Catoptrophorus semipalmatus*	x	x
Spotted Sandpiper	*Actitis macularia*	x	x
Upland Sandpiper	*Bartramia longicauda*	x	x
Whimbrel	*Numenius phaeopus*	x	x
Long-billed Curlew	*Numenius americanus*	x	x
Marbled Godwit	*Limosa fedoa*	x	x
Ruddy Turnstone	*Arenaria interpres*	x	x
Red Knot	*Calidris canutus*	x	x
Sanderling	*Calidris alba*	x	x
Semipalmated Sandpiper	*Calidris pusilla*	x	x
Western Sandpiper	*Calidris mauri*	x	x
Least Sandpiper	*Calidris minutilla*	x	x
White-rumped Sandpiper	*Calidris fuscicollis*	x	x
Pectoral Sandpiper	*Calidris melanotos*	x	x
Dunlin	*Calidris alpina*	x	x
Stilt Sandpiper	*Calidris himantopus*	x	x
Short-billed Dowitcher	*Limnodromus griseus*	x	x
Long-billed Dowitcher	*Limnodromus scolopaceus*	x	x
Buff-breasted Sandpiper	*Tryngites subruficollis*	x	
Common Snipe	*Gallinago gallinago*	x	x
American Woodcock	*Scolopax minor*	x	x
Laughing Gull	*Larus atricilla*	x	x
Franklin's Gull	*Larus pipixcan*	x	x
Bonaparte's Gull	*Larus philadelphia*	x	x
Ring-billed Gull	*Larus delawarensis*	x	x
Herring Gull	*Larus argentatus*	x	x
Gull-billed Tern	*Sterna nilotica*	x	x
Caspian Tern	*Sterna caspia*	x	x
Royal Tern	*Sterna maxima*	x	x
Common Tern	*Sterna hirundo*	x	x
Forster's Tern	*Sterna forsteri*	x	x
Least Tern	*Sterna antillarum*	x	x
Black Tern	*Childonias niger*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Black Skimmer	*Rynchops niger*	x	x
Pigeons and Doves			
Mourning Dove	*Zenaida macroura*	x	x
White-winged Dove	*Zenaida asiatica*	x	x
Cuckoos			
Black-billed Cuckoo	*Coccyzus erythropthalmus*	x	x
Yellow-billed Cuckoo	*Coccyzus americanus*	x	x
Groove-billed Ani	*Crotophaga sulcirostris*	x	x
Owls			
Barn Owl	*Tyto alba*	x	x
Eastern Screech Owl	*Megascops asio*	x	x
Great Horned Owl	*Bubo virginianus*	x	x
Burrowing Owl	*Athene cunicularia*	x	x
Short-eared Owl	*Asio falmmeus*	x	x
Nightjars			
Common Nighthawk	*Chordeiles minor*	x	x
Chuck-will's widow	*Caprimulgus carolinensis*	x	x
Whip-poor-will	*Caprimulgus vociferous*	x	x
Swifts and Hummingbirds			
Chimney Swift	*Chaetura pelagica*	x	x
Ruby-throated Hummingbird	*Archilochus colubris*	x	x
Kingfishers			
Belted Kingfisher	*Megaceryle alcyon*	x	x
Woodpeckers			
Red-headed Woodpecker	*Melanerpes erythrocephalus*	x	x
Yellow-bellied Sapsucker	*Sphyrapicus varius*	x	x
Downy Woodpecker	*Picoides pubescens*	x	x
Northern Flicker	*Colaptes auratus*	x	x
Red-bellied Woodpecker	*Melanerpes carolinus*	x	x
Hairy Woodpecker	*Picoides villosus*	x	x
Flycatchers			
Olive-sided Flycatcher	*Contopus cooperi*	x	x
Eastern Wood-Pewee	*Contopus virens*	x	x
Yellow-bellied Flycatcher	*Empidonax flaviventris*	x	x
Acadian Flycatcher	*Empidonax virescens*	x	x
Eastern Phoebe	*Sayornis phoebe*	x	x
Vermilion Flycatcher	*Pyrocephalus rubinus*	x	x
Great Crested Flycatcher	*Myiarchus crinitus*	x	x
Western Kingbird	*Tyrannus verticalis*	x	x
Eastern Kingbird	*Tyrannus tyrannus*	x	x
Scissor-tailed Flycatcher	*Tyrannus forficatus*	x	x
Martins and Swallows			
Purple Martin	*Progne subis*	x	x
Tree Swallow	*Iridoproche bicolor*	x	x
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Cliff Swallow	*Petrochelidon pyrrhonota*	x	x
Bank Swallow	*Riparia riparia*	x	x
Barn Swallow	*Hirundo rustica*	x	x
Jays and Crows			
Blue Jay	*Cyanocitta cristata*	x	x
Fish Crow	*Coruus ossifragus*	x	x
Nuthatchers			
Red-breasted Nuthatch	*Sitta Canadensis*	x	x
Creepers			
Brown Creeper	*Certhia ameicana*	x	x
Wrens			
Carolina Wren	*Thryothorus ludovicianus*	x	x
Winter Wren	*Troglodytes troglodytes*	x	x
Sedge Wren	*Cistothorus platensis*	x	x
Marsh Wren	*Cistothorus palustris*	x	x
House Wren	*Troglodytes aedon*	x	x
Carolina Chickadee	*Poecile carolinensis*	x	x
Kinglets and Gnatcatchers			
Golden-crowned Kinglet	*Regulus satrapa*	x	x
Ruby-crowned Kinglet	*Regulus calendula*	x	x
Blue-gray Gnatcatcher	*Polioptila caerulea*	x	x
Bluebirds, Thrushes and Robins			
Eastern Bluebird	*Sialia sialis*	x	x
Veery	*Catharus fuscescens*	x	x
Gray-cheeked Thrush	*Catharus minimus*	x	x
Swainson's Thrush	*Catharus ustulatus*	x	x
Hermit Thrush	*Catharus guttatus*	x	x
Wood Thrush	*Hylocichla mustelina*	x	x
American Robin	*Turdus migratorius*	x	x
Thrashers			
Gray Catbird	*Dumetella carolinensis*	x	x
Brown Thrasher	*Toxostoma rufum*	x	x
Northern Mockingbird	*Mimus polyglottos*	x	x
Pitpits			
American Pitpit	*Anthus rubescens*	x	x
Waxwings			
Cedar Waxwing	*Bombycilla cedrorum*	x	x
Starling			
European Starling	*Sturnus vulgaris*	x	x
Shrike			
Loggerhead Shrike	*Lanius ludovicianus*	x	x
Vireos			
White-eyed Vireo	*Vireo griseus*	x	x
Blue-headed Vireo	*Vireo solitarius*	x	x
Yellow-throated Vireo	*Vireo flavifrons*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Warbling Vireo	*Vireo gilvus*	x	x
Red-eyed Vireo	*Vireo olivaceus*	x	x
Philadelphia Vireo	*Vireo philadelphicus*	x	x
Warblers			
Blue-winged Warbler	*Vermivora pinus*	x	x
Golden-winged Warbler	*Vermivora chrysoptera*	x	x
Tennessee Warbler	*Vermivora peregrine*	x	x
Orange-crowned Warbler	*Vermivora celata*	x	x
Nashville Warbler	*Vermivora ruficapilla*	x	x
Yellow Warbler	*Dendroica petechia*	x	x
Chestnut-sided Warbler	*Dendroica pensylvanica*	x	x
Magnolia Warbler	*Dendroica magnolia*	x	x
Cape May Warbler	*Dendroica tigrina*	x	x
Black-throated Blue Warbler	*Dendroica caerulescens*	x	x
Yellow-rumped Warbler	*Dendroica coronata*	x	x
Black-throated Green Warbler	*Dendroica virens*	x	x
Blackburnian Warbler	*Dendroica fusca*	x	x
Yellow-throated Warbler	*Dendroica dominica*	x	x
Prairie Warbler	*Dendroica discolor*	x	x
Palm Warbler	*Dendroica palmarum*	x	x
Bay-breasted Warbler	*Dendroica castanea*	x	x
Blackpole Warbler	*Dendroica striata*	x	x
Cerulean Warbler	*Dendroica cerulea*	x	x
Black-and-white Warbler	*Mniotilta varia*	x	x
American Redstart	*Setophaga ruticilla*	x	x
Prothonotary Warbler	*Protonotaria citrea*	x	x
Worm-eating Warbler	*Helmitheros vermivorus*	x	x
Ovenbird	*Seiurus aurocapilla*	x	x
Northern Waterthrush	*Seiurus noveboracensis*	x	x
Louisiana Waterthrush	*Seiurus motacilla*	x	x
Kentucky Warbler	*Oporornis formosus*	x	x
Mourning Warbler	*Oporonis philadelphia*	x	x
Hooded Warbler	*Wilsonia citrina*	x	x
Canada Warbler	*Wilsonia canadensis*	x	x
Yellow-breasted Chat	*Icteria virens*	x	x
Northern Parula	*Parula americana*	x	x
Common Yellowthroat	*Geothlypos trichas*	x	x
Wilson's Warbler	*Wilsonia pusilla*	x	x
Tanagers			
Summer Tanager	*Piranga rubra*	x	x
Scarlet Tanager	*Piranga olivacea*	x	x
Western Tanager	*Piranga ludoviciana*	x	x
New World Finches			
Northern Cardinal	*Cardinalis cardinalis*	x	x
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Blue Grosbeak	*Passerina caerulea*	x	x
Indigo Bunting	*Passerina cyanea*	x	x
Painted Bunting	*Passerina ciris*	x	x
Dickcissel	*Spiza americana*	x	x
Sparrows			
Eastern Towhee	*Pipilo erythrophthalmus*	x	x
Field Sparrow	*Spizella pusilla*	x	x
Vesper Sparrow	*Pooecetes gramineus*	x	x
Lark Sparrow	*Chondestes grammacus*	x	x
Savannah Sparrow	*Passerculus sandwichensis*	x	x
LeConte's Sparrow	*Ammodramus leconteii*	x	x
Saltmarsh Sparrow	*Ammodramus caudacutus*		x
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	x	x
Fox Sparrow	*Passerella iliaca*	x	x
Song Sparrow	*Melospiza melodia*	x	x
Lincoln's Sparrow	*Melospiza lincolnii*	x	x
Swamp Sparrow	*Melospiza georgiana*	x	x
White-throated Sparrow	*Zonotrichia albicollis*	x	x
White-crowned Sparrow	*Zonatrichia leucophrys*	x	x
Dark-eyed Junco	*Junco hyemalis*	x	x
Chipping Sparrow	*Spizella passerine*	x	x
Blackbirds, Grackles, Cowbirds and Orioles			
Red-winged Blackbird	*Agelais phoeniceus*	x	x
Eastern Meadowlark	*Sturnella magna*	x	x
Western Meadowlark	*Sturnella neglecta*	x	x
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	x	x
Rusty Blackbird	*Euphagus carolinus*	x	x
Boat-tailed Grackle	*Quiscalus major*	x	x
Common Grackle	*Quiscalus quiscula*	x	x
Brown-headed Cowbird	*Molothrus ater*	x	x
Orchard Oriole	*Icterus spurious*	x	x
Altamira Oriole	*lcterus galulris*	x	x
Bobolink	*Dolichonyx oryzivorus*	x	x
Great-tailed Grackle	*Quiscalus mexicanus*	x	x
Old World Finches			
Purple Finch	*Carpodacus purpureus*	x	x
American Goldfinch	*Carduelis tristis*	x	x
Weaver Finches			
House Sparrow	*Passer domesticus*	x	x
MAMMALS			
Marsupials			
Virginia Opossum	*Didelphis marsupialis*	x	x
Edentates			
Nine-banded armadillo	*Dasypus novemcinctus*	x	x
Insectivores			

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Least Shrew	*Cryptotis parva*	x	x
Bats			
Red Bat	*Lasiurus borealis*	x	x
Seminole Bat	*Lasiurus seminolus*	x	x
Yellow Bat	*Lasiurus ega*	x	x
Carnivores			
Coyote	*Canis latrans*	x	x
Gray Fox	*Urocyon cinereoargenteus*	x	x
Red Fox	*Vulpes vulpes*	x	x
Raccoon	*Procyon lotor*	x	x
Mink	*Mustela vison*	x	x
Striped Skunk	*Mephitis mephitis*	x	x
River Otter	*Lutra canadensis*	x	x
Bobcat	*Lynx rufus*	x	x
Ungulates			
White-tailed Deer	*Odocoileus virginianus*	x	x
Rodents			
Marsh Rice Rat	*Orysomys palustris*	x	x
Fulvous Harvest Mouse	*Reithrodontomys fulvescens*	x	x
Hispid Cotton Rat	*Sigmodon hispidus*	x	x
Muskrat	*Ondatra zibethicus*	x	x
House Mouse	*Mus musculus*	x	x
Black Rat	*Rattus rattus*	x	x
Norway Rat	*Rattus norvegicus*	x	x
Nutria	*Myocastor coypus*	x	x
Fox Squirrel	*Sciurus niger*	x	x
Lagomorphs			
Swamp Rabbit	*Sylvilagus aquaticus*	x	x
Eastern Cottontail	*Sylvilagus floridanus*	x	x
REPTILES AND AMPHIBIANS			
Alligator			
American Alligator	*Alligator mississippiensis*	x	x
Lizards			
Green Anole	*Anolis carolinensis*	x	x
Ground Skink	*Scinella lateralis*	x	x
Five-lined Skink	*Eumeces fasciatus*	x	x
Broadhead Skink	*Eumeces laticeps*	x	x
Slender Grass Lizard	*Ophisaurus attenuatus*	x	
Turtles			
Snapping Turtle	*Chelydra serpentina*	x	x
Alligator Snapping Turtle	*Macroclemys temminckii*	x	x
Painted Turtle	*Chrysemys picta*		x
Mississippi Map Turtle	*Graptemys kohnii*		x
Slider	*Trachemys scripta*	x	x
Chicken Turtle	*Deirochelys reticularia*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Eastern Box Turtle	*Terrapene carolina*	x	x
Stinkpot Turtle	*Sternotherus odoratus*	x	x
Eastern Mud Turtle	*Kinosternon subrubrum*		x
Spiny Softshell	*Apalone spinifera*	x	x
River Cooter	*Pseudemeys concinna*		x
Mississippi Mud Turtle	*Kinosternon subrubrum hippocrepis*	x	
Snakes			
Southern Copperhead	*Agkinstodon contortrix contortrix*	x	
Cottonmouth	*Agkinstodon piscivorus*	x	x
Racer	*Coluber constrictor*	x	
Rat Snake	*Elaphe obsoleta*	x	x
Mud Snake	*Farancia abacura*	x	x
Eastern Hognose Snake	*Heterodon platirhinos*	x	
Common Kingsnake	*Lampropeltis getulus*	x	x
Western Green Water Snake	*Nerodia cyclopion*	x	x
Plain-bellied Water Snake	*Nerodia erythrogaster*		x
Yellow-bellied Water Snake	*Nerodia erythrogaster flavigaster*	x	
Southern Water Snake	*Nerodia fasciata*	x	x
Diamondback Water Snake	*Nerodia rhombifer*	x	x
Rough Green Snake	*Opheodrys aestivus*	x	x
Graham's Crayfish Snake	*Regina grahamii*	x	x
Glossy Crayfish Snake	*Regina rigida*	x	x
Pigmy Rattlesnake	*Sistrurus miliarius*	x	
Brown Snake	*Storeria dekayi*	x	x
Western Ribbon Snake	*Thamnophis proximus*	x	x
Salamanders			
Three-toed Amphiuma	*Amphiuma tridactylum*	x	x
Western lesser Siren	*Siren intermedia*		x
Central Newt	*Notophthalmus viridescens louisianensis*		x
Frogs and Toads			
Gulf Coast Toad	*Bufo valliceps*	x	x
Northern Cricket Frog	*Acris crepitans*	x	x
Green Treefrog	*Hyla cinera*	x	x
Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*	x	x
Bullfrog	*Rana catesbeiana*	x	x
Pig Frog	*Rana grylio*	x	x
Southern Leopard Frog	*Rana utricularia*	x	x
Squirrel Tree Frog	*Hyla squirella*	x	x
Bronze Frog	*Rana clamitans*		x
Gray/Cope's Treefrog	*Hyla versiocolor/chrysoscells*		x
Woodhouse Toad	*Bufo woodhousii woodhousii*	x	
FISH			
Gars			
Spotted Gar	*Lepisosteus oculatus*	x	x
Longnose Gar	*Lepisosteus osseus*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Alligator Gar	*Lepisosteus spatula*	x	x
Bowfins			
Bowfin	*Amia calva*	x	x
Herrings			
Gizzard Shad	*Dorosoma cepedianum*	x	x
Threadfin Shad	*Dorosoma petenense*	x	x
Lizardfishes			
Inshore Lizardfish	*Synodus foetens*	x	x
Carps			
Common Carp	*Cyprinus carpio*	x	x
Golden Shiner	*Notemigonus crysoleucas*	x	x
Suckers			
Smallmouth Buffalo	*Ictiobus bubalus*		x
Bigmouth Buffalo	*Ictiobus cyprinellus*	x	x
Freshwater Catfishes			
Blue Catfish	*Ictalurus furcatus*	x	x
Black Bullhead	*Ameiurus melas*	x	x
Yellow Bullhead	*Ameiurus natalis*	x	x
Channel Catfish	*Ictalurus punctatus*	x	x
Sunfishes			
Flier	Centrarchus macropterus		x
Banded Pygmy Sunfish	Elassoma zonatum	x	x
Warmouth	Lepomis gulosus	x	x
Bluegill	Lepomis macrochirus	x	x
Redear Sunfish	Lepomis microlophus	x	x
Bantam Sunfish	Lepomis symmetricus	x	x
Green Sunfish	Lepomis cyanellus	x	x
Longear Sunfish	Leopomis megalotis		x
Largemouth Bass	Micropterus salmoides	x	x
White Crappie	Pomoxis annularis	x	x
Black Crappie	Pomoxis nigromaculatus	x	x
Drums			
Freshwater Drum	*Aplodinotus grunniens*	x	x
Spot	*Leiostomus xanthurus*	x	x
Mullets			
Striped Mullet	*Mugil cephalus*	x	x
White Mullet	*Mugil curema*	x	x
Pike			
Chain Pickerel	*Esox niger*		x
Temperate Bass			
Yellow Bass	Monore mississippiensis		x
INVERTEBRATES			
Crustaceans			
White River Crayfish	*Procambarus acutus*	x	x
Red Swamp Crayfish	*Procambarus clarkii*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Isopods and Amphipods			
Wood-boring Isopod	*Sphaeroma terebrans*	x	x
Rock Louse	*Ligia occidentalis*	x	x
Fish Louse	*Argulus spp.*	x	x
Wharf Roach	*Ligia spp.*	x	x
Beach Flea	*Orchestia grillus*	x	x
Marsh Hopper	*Talorchestia spp.*	x	x
Smooth-backed	*Sphaeroma quadridentatum*	x	
PLANTS			
Alligator Weed	*Alternanthera philoxeroides*	x	x
American Lotus	*Nelumbo lutea*	x	x
Baccharis	*Baccharis halimifolia*	x	x
Baldcypress	*Taxodium distichum*	x	x
Banana Water Lily	*Nymphaea mexicana*	x	x
Barnyard Grass	*Echinochloa crusgalli*	x	x
Black Needlerush	*Juncus roemerianus*	x	x
Black Willow	*Salix nigra*	x	x
Beggar's Tick	*Bidens laevis*	x	x
Bird's Eye Bush	*Ochna serrrulata*	x	x
Blue Water Lily	*Nymphaea elegans*	x	x
Brazilian Verbena	*Verbena brasiliensis*	x	x
Brownseed Paspalum	*Paspalum plicatulum*	x	x
Bulltongue	*Sagittaria lancifolia*	x	x
Bulrush	*Schoenoplectus californicus*		x
Bushy Bluestem	*Andropogon glomeratus*	x	x
Buttonbush	*Cephalanthus occidentalis*	x	x
Cattail	*Typha* spp.	x	x
Chinese Tallow	*Triadica sebifera*	x	x
Chocolate Weed	*Melochia corchorifolia*	x	x
Coastal Water-Hyssop	*Bacopa monnieri*	x	x
Coffeeweed	*Sesbania macrocarpa*	x	x
Common Bladderwort	*Utricularia vulgaris*	x	x
Coontail	*Ceratophyllum demersum*	x	x
Curly-leaf Dock	*Rumex crispus*	x	x
Duckweed	*Lemna minor*	x	x
Dog Fennel	*Eupatorium capillifolium*	x	x
Dwarf Spikerush	*Eleocharis parvula*	x	x
Eurasian Watermilfoil	*Myriophyllum spicatum*	x	x
Fall Panicum	*Panicum dichotomiflorum*	x	x
False Garlic	*Nothoscordum bivalve*	x	x
Fanwort	*Cabomba caroliniana*	x	x
Flatsedges	*Cyperus* spp.	x	x
Floating Water Primrose	*Ludwigia peploides*	x	x
Four Corner Grass	*Eleocharis quadrangulata*	x	
Frogbit	*Limnobium spongia*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Frogfruit	*Phyla nodiflora*	x	x
Gamma Grass	*Tripsacum dactyloides*	x	
Giant Cutgrass	*Zizaniopsis miliacea*	x	x
Giant Ragweed	*Ambrosia trifida*	x	x
Grasslike Fimbry	*Fimbristylis miliacea*	x	x
Horned Beakrush	*Rhynchospora corniculata*	x	x
Hydrilla	*Hydrilla verticillata*	x	x
Iris	*Iris virginica*	x	x
Jungle Rice	*Echinochloa colonum*	x	x
Macartney Rose	*Rosa bracteata*	x	
Maidencane	*Panicum hemitomon*	x	x
Marshhay Cordgrass	*Spartina patens*	x	x
Mosquito-Fern	*Azolla caroliniana*	x	x
Muskgrass	*Chara* spp.	x	x
Parrot Feather	*Myriophyllum aquaticum*	x	x
Pennywort	*Hydrocotyle* spp.	x	x
Phragmites	*Phragmites communis*	x	x
Pickerelweed	*Pontederia cordata*	x	x
Rattlebox	*Sesbania drummondii*	x	x
Red Rice	*Oryza functata*	x	x
Roseau Cane	*Phragmites australis*	x	x
Sago Pondweed	*Potamogeton pectinatus*	x	x
Saltmarsh Mallow	*Kosteletzkya virginica*	x	x
Saltmarsh Morning Glory	*Ipomoea sagittata*	x	x
Sawgrass	*Cladium jamaicense*	x	x
Seashore Paspalum	*Paspalum vaginatum*	x	x
Smartweed	*Polygonum* spp.	x	x
Softstem Bullrush	*Schoenoplectus tabernaemontani*	x	x
Southern Naiad	*Najas quadalupensis*	x	x
Southern Swamp Lily	*Crinum americanum*	x	x
Spadderdock	*Nuphar luteum*	x	x
Spikerushes	*Elecocharis* spp.	x	x
Sprangletop	*Leptochloa fascicularis*	x	x
Squarestem Spikerush	*Eleocharis quadrangulata*	x	x
Sumpweed	*Iva annua*	x	x
Thalia	*Thalia dealbata*	x	x
Thin-leaf Pondweed	*Potamogeton pusillus*	x	x
Three-cornered Grass	*Schoenoplectus americanus*	x	x
Toothache Tree	*Zanthoxylum calva-herculis*	x	x
Vasey Grass	*Paspalum urvillei*	x	x
Walter's Millet	*Echinochloa walteri*	x	x
Water Hyacinth	*Eichornia crassipes*	x	x
Water Lettuce	*Pistia stratiotes*	x	x
Water Pepper	*Polygomum hydropiperoides*	x	x
Water Shield	*Brasenia schreberi*	x	x

Appendix A. Species Checklist for CPNWR and LNWR			
Common Name	**Scientific Name**	**Refuge**	
		CPNWR	**LNWR**
Wax-Myrtle	*Myrica cerifera*	x	x
White-topped Sedge	*Rhynchospora colorata*	x	x
White Water Lily	*Nymphaea odorata*	x	x
Wigeongrass	*Ruppia maritima*	x	x