Information Sheet on Ramsar Wetlands (RIS)

1. Name and address of the compiler of this form:

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DD MM YY

Designation date

Site Reference Number

2. Date this sheet was updated: June 16, 2006

3. Country: USA

4. Name of the Ramsar site: Okefenokee National Wildlife Refuge

5. Map of site included:

a) hard copy (required for inclusion of site in the Ramsar List): *yes* X -or- *no*
Hard copies of site location and site boundary attached and in digital format (jpg) on CD.

b) digital (electronic) format (optional): *yes* X -or- *no*
Boundary of Ramsar site is a shapefile (refbnd) on enclosed CD. (NAD27 – UTM) Metadata file is also on the CD.

6. Geographical coordinates (latitude/longitude): 30° 48' 21.5"N / 82° 20' 02.625"W

7. General location:
The refuge is located in the southeast region of the United States on the coastal plain of Georgia and Florida. The refuge falls within the Georgia counties of Ware, Charlton, and Clinch and also in Florida's Baker County. The nearest town to the main refuge entrance is Folkston, Georgia. Other towns surrounding the refuge include Waycross, Homerville, Fargo, and St George, Georgia. The largest city is Jacksonville, Florida and is located 60 miles from the refuge.

8. Elevation: 128 ft MSL (39 m) to 105 ft MSL (32 m)

9. Area: 162,635 ha (401,880 acres)

10. Overview:
The Okefenokee Swamp covers approximately 438,000 acres forming one of the largest wetland complexes in the U.S.A.. The majority of this acreage (401,880 acres) is administered by the U.S. Fish and Wildlife Service as the Okefenokee National Wildlife Refuge. The Okefenokee Swamp is a vast peat bog filling an area of sandy depressions. The swamp is considered the headwaters of the Suwannee River, which flows to the Gulf of Mexico from the western edge of the swamp, and the St Marys River, which flows to the Atlantic Ocean from the southeast corner of the refuge. The swamp is a mosaic of habitats from wet marshes, lakes, scrub-shrub, cypress forests, and islands of oak and pine. Fire and water define the swamp's habitats. Habitats provide for endangered and threatened species such as red-cockaded woodpeckers, wood storks, indigo snakes and a wide variety of other wildlife species. It is world renowned for its diverse amphibian populations.

11. Ramsar Criteria:

1 • **2** • **3** • 4 • 5 • **6** • 7 • 8

12. Justification for the application of each Criterion listed in 11. above:

Criterion 1: Okefenokee NWR protects the unique qualities of the large, freshwater Okefenokee Swamp system. The Okefenokee Swamp is a complex of acidic, blackwater wetlands and forested uplands, and can be considered an ecosystem in itself. This expanse of wetlands blends 17 classified wetland vegetation communities which include: open water; aquatic grasses; sedges-ferns-water lily; water lily; bay-shrub; briar-shrub; ogeechee-cypress; gum-maple-bays; gum-bay-cypress-shrub; mixed wet pine; cypress-gum-shrub; loblolly bay; shrub; mixed upland/wetland shrub; pine-cypress-hardwoods; sparse pine; dense pine from open water to old growth cypress stands. The associated forested uplands on the refuge are being restored to native longleaf pine communities that were widespread in the south but now only remain on 3% of the original range.

Criterion 2: The wetlands are used as a feeding ground by nationally endangered wood storks (*Mycteria americana*), while the Alligator Snapping Turtle (*Macroclemys temminckii*) (Vulnerable; IUCN, 2006 and CITES Appendix III) are found year-round within the waters of the Okefenokee NWR. The communities of native longleaf pine (*Pinus palustris*), considered vulnerable by IUCN, are being restored on the uplands of the refuge and also support the nationally-endangered and IUCN-vulnerable Red-Cockaded Woodpecker (*Picoides borealis*); and the Gopher Tortoise (*Gopherus polyphemus*), this last one considered nationally threatened, IUCN vulnerable and included in CITES Appendix II.

Criterion 3: Okefenokee NWR is a reservoir of biological resources that supports and supplies surrounding lands. It is a stronghold for the Florida black bear (*Ursus americanus floridianus).* Wading birds abound and songbirds also find refuge. The site is world renowned for the diversity of amphibians and reptiles that are found here, which are biological indicators of global health. Old growth cypress still exists along with three species of pitcher plants and other carnivorous plants. On the associated uplands, longleaf pine communities are successfully being restored with visions focused on 200-300 years into the future. These native communities are highly diverse in fauna and flora, including many species of woodpeckers, fox squirrels, gopher tortoise, indigo snakes, gopher frogs, striped newts, and the bachman's sparrow. With its diversity of habitats, Okefenokee NWR is home to over 620 plant, 39 fish, 37 amphibian, 64 reptile, 234 bird and 50 mammal species.

Criterion 6: The Florida sandhill cranes (*Grus canadensis pratensis*) are non-migratory and are considered to be isolated from other populations in the southeast. In the mid-1980's the population at the refuge was estimated at 403 individuals. Since this time, it appears that there has been a decline in the population, which nevertheless still exceeds the 1% threshold of 50 Florida sandhill cranes. During the winter, large numbers (up to 1,000) of greater sandhill cranes (*G. canadensis*) migrate to the swamp and overwinter.

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13. Biogeography

a) biogeographic region: Eastern Temperate Forests

b) biogeographic regionalisation scheme: Ecological Regions as described by the North American Commission for Environmental Cooperation: http://www.cec.org/files/pdf/BIODIVERSITY/eco-eng_EN.pdf

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14. Physical features of the site:

Okefenokee National Wildlife Refuge preserves the Okefenokee Swamp where several arc-shaped sand ridges extrude through the surface of the bog to form the many sandy ridges and islands in the swamp. Although the high points of the major islands are 3-6 ft above the bog surface, there are many ridges that lie below the water surface that form a terracing effect and contribute to the formation of five major water basins (Loftin 1998). Along the swamp's eastern edge is a large sand ridge known as Trail Ridge. It rises to an elevation of 150 ft. and then slopes into the St Marys drainage.

The Okefenokee Swamp is located on the Wicomico Terrace (Malcolm, McKnight and Averett, 1989; Davis, 1987). Its eastern margin is an ancient beach-sand deposit called Trail Ridge. The Wicomico

Terrace is underlain by the 200 ft thick impenetrable calcareous clay layer called the Hawthorn Formation. The Hawthorn Formation overlays the carbonate formation forming the Floridan Aquifer.

Soils-The *Dasher* soil series comprises most of the swamp. This is a very poorly drained, deep organic soil. The organic material extends to a depth greater than 51 inches. This soil is generally continuously flooded. Permeability is moderately rapid, and available water capacity is high. As elevation increases, soils tend to go from *Dasher* to *Croatan*, to *Surrency*, to *Sapelo*, and then to *Leon* or *Mandarin*.

Origins-The origin of the Okefenokee Swamp has been a subject of continuous debate among geologists and historians. It is a natural, elevated depression formed by water and soil movement on an ancient ocean shoreline. The swamp formed within this depression only about 7000 years ago.

Climate –The watershed is located in the humid subtropical climatic zone. All four seasons are apparent. May through September is hot and wet followed by a warm, dry fall (October-November), a cool, moist winter (December-February), and a warm moist spring (March-April).

Summer days are warm and humid. Average summer temperatures range between 47^{o}F and 101^{o}F. The flow of moist air from the Gulf of Mexico over the warm land surface results in frequent afternoon convective thunderstorms. Lightning is frequent during this time of year causing the majority of Okefenokee's wildland fires. In autumn, long periods of mild sunny weather are the rule. Winter temperatures vary daily. Mid-December through mid-March, most storm development occurs over the Gulf of Mexico and moves northeast across the Okefenokee Swamp to the Atlantic Ocean. Moisture-laden clouds move northeast bringing the seasonal winter rains. Spring is usually short and blustery with rather frequent periods of storms of varying intensity that generally originate in the Great Plains (Phernetton 2001).

Rainfall varies considerably from year to year, but averages 52.63 inches (1,337 mm) annually at the refuge's east entrance. The wettest months are generally July and August, with November and December being the driest.

Relative humidity averages are fairly high due to the refuge's location between the Gulf of Mexico and the Atlantic Ocean. Year-round averages at 7:00 a.m. are about 85%. Minimum relative humidity (about 1430 EST) averages about 52%. Maximum relative humidity reaches 100% nightly except during the very driest seasons (Phernetton 2001).

Average monthly precipitation (inches) for 1945-2005 on the east side of Okefenokee NWR:

Month	Average 1945-2005	Month	Average 1945-2005
January	3.38	July	7.53
February	3.52	August	7.31
March	4.26	September	5.37
April	3.30	October	3.25
May	3.65	November	2.17
June	5.97	December	2.92
		TOTAL	**52.63**

Hydrology- The Okefenokee Swamp is considered a deep water swamp containing peat soils. Although most of the area has no perceptible surface flow, the water is not stagnant and flows across the swamp through a series of depressions stair-stepping towards the outlets of the swamp. The swamp receives water via precipitation (70%) and surface runoff (30%) (Rykiel 1977). Groundwater contributions are assumed to be insignificant but may have been important in the past. Rykiel (1977) determined that in general 80% of the water output from the swamp left through evapotranspiration and 20% left via river and stream flow. The principal drainages are the Suwannee River (85% of the surface water outflow), the St Marys River (11%), and Cypress Creek (4%).

Loftin (1998) defined five major hydrologic basins within the swamp. Although they are partially connected and demonstrate similar seasonal trends, the amplitudes of these trends vary regionally. The water level varies from 117.6 ft in dry years to 123 feet in wet years on the east side and from 110.4 ft to

118.6 ft on the west side. Average water level on the east side is 120.0 ft and 115.2 ft on the west side. The swamp has experienced extreme highs and lows throughout history. Often large fires have accompanied droughts. In 1960, a low earthen levee approximately 4.8 miles long was constructed partially across the swamp's outflow to the Suwannee River to prevent drainage during periods of drought. However, Loftin (1998) found the area of influence from the Sill to be only 1% of the swamp during drought conditions. Following the preferred action within an Environmental Assessment addressing the future management of the Suwannee River Sill, the two water control structures within the levee were opened in 2001. When funding becomes available, four additional breaches will be constructed, increasing the connection between the Suwannee River and the Okefenokee Swamp.

Water Quality-The slow moving waters of the Okefenokee Swamp are tea-colored due to the tannic acid released from decaying vegetation. Researchers have found pH values between 3.1 and 4.86 (Bosserman 1984). Certain plants influence the acidic levels within the swamp and cause local variation in acidity. With such low pH levels, Rykiel (1977) expressed the importance of rainfall and atmospheric deposition over the Okefenokee in the mineral cycling and nutrient availability within the system.

Dissolved oxygen is also a factor in slow-moving water and areas of high decomposition of plant material.

Mercury is a natural occurring element of this peat system. Winger (1997) found elevated levels in the water, sediment and biotic communities within the swamp. Mercury concentrations in rainfall were sufficiently high to account for these elevated levels. There is a limited fish consumption advisory for the Okefenokee Swamp.

Like mercury, lead is more soluble and bioavailable to aquatic biota under low pH conditions. The mean wet weight lead concentrations in 35 fish fillets was 0.505±0.51 mg/L (Masson and Bowers 1995).

15. Physical features of the catchment area:
See 14 for geology, soils, and climate.

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16. Hydrological values:
This expanse of wetland no doubt contributes to flood control, groundwater recharge, and filtering of contaminants. With increased water demands along the coast of Georgia and on surface groundwater, the Okefenokee may be contributing water to these aquifers as water is pulled downward. This direction of flow is detrimental to the swamp.

17. Wetland Types

a) presence:

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • **M** • **N** • **O** • P • Q • R • Sp • Ss • **Tp** **Ts** • **U** • Va •
Vt • **W** • **Xf** • **Xp** • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • **9** • Zk(c)

b) dominance:
Xp (47,600 ha); W (46,600 ha); Xf (44,600 ha); U (7,600 ha); Tp (5,058 ha); M (40 ha); O (34 ha); 9 (30 ha); N (24 ha). Ephemeral pools (Ts) are also present.

18. General ecological features:

Okefenokee NWR is a vast natural wilderness area that is fire-dependent. Fires have historically preserved its unique mosaic of plant communities. This landscape is dominated by the Okefenokee Swamp, which is within the drainage divide area between the Atlantic Ocean and the Gulf of Mexico. It is composed of a mosaic of dense swamps, freshwater marshes, small lakes and ponds, upland islands and upland forests. Swamp forests of pond cypress (*Taxodium ascendens*), titi (*Cyrilla racemiflora*), hurrahbush (*Lyonia lucida*), black gum (*Nyssa sylvatica*), and loblolly bay (*Gordonia lasianthus*) cover the majority of the swamp. Shrub-dominated wetlands are prominent in the landscape providing shelter and food for a diverse group of wildlife. These wetlands are dominated by titi, hurrahbush, and fetterbush (*Leucothoe racemosa*) and covered with bamboo greenbriar (*Smilax laurifolia*) and Walter's greenbriar (*S. walteri*). Shallow emergent marshes are dominated by yellow-eyed grass (*Xyris spp.*) and Walter's sedge (*Carex walteriana*) and deeper rooted golden club (*Orontium aquaticum*) or floating fragrant water lily (*Nymphaea odorata*). Forested uplands of slash pine (*Pinus elliottii*), longleaf pine (*P. palustris*), saw palmetto (*Serenoa repens*) and gallberry (*Ilex glabra*) occur on the sandy islands and ridges.

19. Noteworthy flora:

There are two known sites within the swamp that have old growth cypress. These escaped logging in the early 1900's with some trees aged at 400-500 years old. Another area that escaped logging was Number One Island where there is an old growth slash pine stand that is approximately 250 years old.

Large hooded pitcher plants (*Sarracenia minor*) are a significant component of Durdin Prairie. The trumpet pitcher plant (*S. flava*) is also found in this area of the swamp. In addition, the parrot pitcher plant (*S. psittacina*) is found in the swamp.

The major emphasis on the uplands is the restoration of the native longleaf pine community. The diversity of plant species within the groundcover is characteristic of this habitat and promotes frequent low-intensity fires. Grasses such as wiregrass (*Aristida beyrichiana*) and dropseed (*Sporobolis curtissii*) are desirable.

20. Noteworthy fauna:

The majority of active management on the refuge is focused on the upland pine forests surrounding the swamp and the habitats used by the endangered Red-cockaded woodpecker (RCW) (*Picoides borealis*). Currently there are 38 active clusters of which 24 are on wilderness islands.

Fragmentation of suitable habitat is the primary threat to this species on the refuge. The refuge does not own a continuous upland area around the swamp's edge. Agreements with adjacent landowners and/or purchase of additional uplands are necessary for stabilizing the RCW population on this site. The management to enhance RCW habitat also enhances the native habitat of the gopher tortoise (*Gopherus polyphemus*), indigo snake (*Drymarchon corais couperi*), and the Bachman's sparrow (*Aimophila aestivalis*). The maintenance of the ephemeral pools associated with the longleaf pine communities is critical for species such as the striped newt (*Notophthalamus perstriatus*) and other amphibians.

A healthy population of Florida black bear (*Ursus americanus floridianus*), numbering about 800 individuals, roam the Okefenokee NWR and surrounding timberlands. The abundance of black gum fruit is critical in determining the fall distribution of the bears. A poor crop of black gum fruit sends the bears off the refuge in search of acorns and other foods. This brings them into more contact with bear hunters. For this reason, the number of bears killed each year ranges from 30-80 causing fluctuation in the population and reproduction effort. The refuge provides quality denning sites in old hollow cypress trees.

Wading birds are a prominent feature of the Okefenokee Swamp. The major species are the great egret (*Ardea alba*), great-blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), white ibis (*Eudocimus albus*), wood stork (*Mycteria americana*), and green-backed heron (*Butorides striatus*). All but the wood stork nest regularly on the refuge.

The American alligator (*Alligator mississippiensis*), considered a sentinel of the swamp, is also one of its prime landscape architects. The Okefenokee Swamp is criss-crossed with alligator trails and small alligator pools that have been excavated from the peat. This forms a network of travel corridors used by

many other species inhabiting the swamp. The population of alligators is estimated at around 10,000 to 12,000 individuals depending on water level fluctuations.

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21. Social and cultural values:
The following description helps to illustrate the historical and cultural background of this site:

"Man began settling in the Swamp around 2500 BC. For thousands of years Indians lived on the islands and around the rim of the Swamp.

Pioneer settlers grazed cattle and hogs in the pine woods and in the Okefenokee by the early 19th century, but the Indian Wars discouraged settlement. Populations grew by mid-century. The lumber and naval stores industry reached the Swamp by the 1850's.

An effort was made to drain the Okefenokee during the 1890's. It failed.

Lumber companies purchased the Okefenokee and removed millions of feet of cypress timber by railroad built on piling between 1909 and 1942. With the valuable timber gone, the Swamp was sold to the U.S. government as a biological preserve in 1936" (Trowell 1989).

Numerous Indian mounds are found throughout the refuge on slightly elevated ground, providing evidence of pre-settlement times.

The Okefenokee Swamp has shaped the culture of southeast Georgia through recent times. Most residents of Charlton, Clinch, and Ware counties have ancestors who once lived or worked in the swamp and view the swamp as a part of their heritage. These individuals continue to enjoy the swamp through fishing or wildlife observation.

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22. Land tenure/ownership:
(a) within the Ramsar site: Okefenokee NWR Ramsar site is administered entirely by the U.S. Fish and Wildlife Service. The site is on federal lands.

(b) in the surrounding area: The surrounding area is managed by private timber companies and private individuals. There are 10 private commercial timberlands surrounding the refuge. Georgia Forestry Commission administers Dixon Memorial Forest on the north edge of the refuge. It is state land. South of the refuge is Osceola National Forest. It is administered by the National Forest Service as part of the Federal Department of Agriculture.

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23. Current land (including water) use:
(a) within the Ramsar site:
The refuge today is entirely surrounded by high value commercial forest land, most of it in slash and loblolly pine plantations. There are currently 10 major commercial landowners with small parcels of private lands mixed within.

Georgia Forestry Commission has property bordering the refuge along the north edge. Osceola National Forest sits to the south of the refuge. Combining Okefenokee NWR with Osceola National Forest, private timberlands, and state-owned forests, over 1 million contiguous acres (approx. 404,686 ha) provide wildlife habitat and recreational opportunities.

Okefenokee NWR has three major manned entrances and two un-manned entrances that provide access to the interior of the refuge. About 400,000 people visit the refuge on an annual basis.

- The East Entrance, near Folkston, Ga., is the major administrative entrance that houses staff of the Administrative, Biological, Forestry/Fire, and Visitor Services programs. This entrance also provides Visitor Service facilities (visitor center, hiking trails, etc.) as well as a private commercial concessionaire operating under a multi-year contract.
- The West Entrance, near Fargo, Georgia, utilizes Georgia Department of Natural Resources, Georgia Parks and Historic Sites facilities developed through a long-term lease on 82 acres of refuge land. Visitor facilities and services offered at this entrance are very comparable to those at the East Entrance.

- The North Entrance, near Waycross, Georgia, utilizes lands leased from the Georgia Forestry Commission, but also uses some refuge lands (for buildings and facilities) and refuge boat trails for conducting guided interpretive boat tours.
- Kingfisher Landing is an un-manned entrance located between Folkston and Waycross, Georgia. A boat ramp with attached parking lot is available. This site provides access to fishing and boating in the northern third of the refuge.
- The Suwannee River Access Area, is located on the western edge of the refuge near where the Suwannee River exits the swamp on its journey to the Gulf of Mexico. This is primarily a fishing access point with boat ramp and attached parking lot.

The U.S. Fish and Wildlife Service policy mandates six recreational activities that can be managed within the Visitor Services program for the refuge system: environmental education, interpretation, fishing, hunting, wildlife observation and photography.

Within the United States, Okefenokee National Wildlife Refuge preserves the unique qualities of the Okefenokee Swamp for future generations to enjoy. Eight Research Natural Areas have been designated to preserve examples of natural habitats. The refuge manages for a diversity of native habitats that provide for endangered and threatened species such as red-cockaded woodpeckers, wood storks, indigo snakes and hundreds of wildlife species. Management emphasizes the restoration of the longleaf pine communities. Okefenokee contains the third largest National Wilderness Area east of the Mississippi River. People from all over the country visit this famous swamp to view alligators and other creatures in their natural surroundings. Okefenokee is the 16th most visited refuge in the National Wildlife Refuge System.

The universities and colleges of Georgia and Florida, along with schools across the country, conduct research within the swamp and its surrounding ecosystem.

(b) in the surroundings/catchment:
The majority of the surrounding uplands adjacent to the refuge are in timber production. Slash pine plantations are generally on a 17-20 year rotation. Hunt clubs lease these timberlands. Otherwise these lands are not accessible by the general public. The Georgia Forestry Commission owns land adjacent to the north boundary and Osceola National forest lies to the south of the refuge. With these lands and the refuge, over 1 million contiguous acres provide for a diversity of wildlife and recreational opportunities.

Habitat along the St Marys and Suwannee Rivers, which includes lands in both Georgia and Florida, is currently experiencing commercial developmental pressures as prime locations for residential subdivisions. In addition, timberlands surrounding the refuge are selling small parcels of land for homes and may be encouraged to sell to developers. Trail Ridge, running along the refuge's east boundary has been of interest to mining companies and those individuals seeking sites for landfills, prison, amphitheaters, and airports.

As more people and industry move into the area, demands of water supplies increase. Locally, water taken from the upper aquifer may have effect on the swamp. Industrial demands on the Floridan aquifer along the coast of Georgia may also have an impact by drawing water from further away and increasing the "cone of depression". It is speculated that Okefenokee water is being drawn downward rather than being maintained or replenished from the aquifer.

24. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:
(a) within the Ramsar site:
The Okefenokee Swamp is often thought of as an intact or pristine wetland but its existence has been threatened in the past and still is today. Light, noise, contaminants, water demands, adjacent land use practices, and alteration of natural processes threaten the quality of Okefenokee NWR.

Public Use: Increases in public use activities need to be evaluated as to their impacts on the wilderness and other resources and modified when necessary.

(b) in the surrounding area:
Mining/Oil/Gas
Strip mining for titanium has been proposed on 22,000 acres directly adjacent to the southeastern boundary of the swamp. The Fish and Wildlife Service has many concerns regarding strip mining and its proximity to this globally unique swamp. Potential impacts include:

- Alternations to water table elevation in the swamp as a result of changes to surface and ground water quantities and flows of the Trail Ridge.
- Destruction of endangered species and their habitats.
- Destruction of wetlands.
- Reduction of air and water quality through the release of contaminants.
- Degradation of the wilderness experience for refuge visitors.

This same threat was recently eliminated from 16,000 (6,475 ha) acres adjacent to the northeastern boundary of the refuge when E.I. DuPont De Nemours and Company, Inc. donated it to the Conservation Fund. The Conservation Fund in turn donated approximately 6,800 acres to the refuge.

Wetland Management
Water quality is being degraded as a result of increased use of fertilizers and herbicides on surrounding timberland, contaminant deposition from the atmosphere, and increased water withdrawals from the aquifer along the coast. This degradation influences the survival of certain species, limiting food sources, restricting reproduction, and decreasing the health of the entire ecosystem.

Floods/Droughts/Natural Disasters/Climate Change
Wildland fire is a natural, frequent, and desirable occurrence in the Okefenokee habitat. However, adjacent private industrial forestland, refuge facilities, and the growing urban interface areas create challenges to managing natural fire.

Timber Management
Short rotation silviculture with heavy mechanical site preparation, including the application of herbicides, is eliminating the habitat suitable for at-risk animals, on adjoining industrial forestlands.

Industrial and Commercial Development
Demands for groundwater are increasing in the coastal plain. With paper mills and other industrial interests along the coast, the area from which they draw groundwater from (cone of depression) increases and may actually be affecting the Okefenokee Swamp. Where once the groundwater was replenishing the swamp, the swamp may now be replenishing the aquifer. This would be detrimental to the health of the swamp by creating drier conditions and the loss of wetlands, concentrating contaminants and degrading the system.

Air Pollution
The amount of substances dispersed in the atmosphere and deposited by precipitation, aerosols, and gasses is of great concern and is expected to continue to increase throughout North America. Okefenokee NWR serves as a regional base for air quality by participating in two air quality programs - The National Atmospheric Deposition Program (measuring substances introduced into precipitation falling on the refuge) and the Interagency Monitoring of Protected Visual Environments (measuring the substances

filtered from the air). The primary purpose is to protect the visibility in this Class 1 air shed and to characterize the regional haze. Trends related to hydrogen, major and trace elements from sodium to lead, nitrates, chloride, organic and elemental carbon, and PM 10 size particles are examined. Mercury and lead is also deposited by precipitation in the swamp (see Section 14). Continued monitoring and implementation of industrial limits is required to protect this air shed.

Urbanization
Charlton, Ware, and Clinch Counties in Georgia and Baker County, Florida all touch portions of the Okefenokee. Home and subdivision developments have shown a marked increase in numbers over the past 10 years. These homes are encroaching on and further fragment the habitats around the refuge. In addition, this development requires the withdrawal of ground water for water systems and increases pollution of air, water, light, and noise. These developments also create significant problems in protecting structures and fighting wildfires in the area.

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25. Conservation measures taken:
Okefenokee NWR was established in 1936 and is managed under the National Wildlife Refuge system by the U.S. Fish and Wildlife Service. The Okefenokee Wilderness Act of 1974 designated nearly 90% of the Refuge (143,260 ha) as a wilderness area. The entire refuge is protected by numerous environmental legislative acts. Public use is restricted to limited duration camping at designated campsites and watercraft use along designated routes only. Management plans exist but are currently being rewritten into the refuge's Comprehensive Conservation Plan. Fire management is the primary tool used to improve and maintain desirable wildlife habitat conditions.

Floods/Droughts/Natural Disasters/Climate Change
Prescribed burning is a resource and fire prevention tool used to restore habitats and reduce the intensity of wildland fire. A landowner organization, the Greater Okefenokee Association of Landowners (GOAL), was formed to address the management of wildfires in a more effective manner. GOAL's combined efforts are helping to protect both refuge and private resources. The refuge must maintain the ability to work with our adjoining landowner and support the State Forestry organizations through grants, agreements, and fuels reduction burning.

Timber Management
The refuge has begun to enter into a Memorandum of Understandings (MOU) with agreeable landowners to grow forest products on a longer rotation. Less than 2% of adjoining lands are covered by MOUs at the present time. Land purchase and/or timber management of critical uplands by the Service is the long-term solution.

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26. Conservation measures proposed but not yet implemented:
A Comprehensive Conservation Plan for Okefenokee NWR is currently being printed for final distribution. This plan presents the goals, objectives, and strategies that the refuge staff will work towards in the next 15 years.

Although the Suwannee River Sill was constructed to retain water during drought, its greatest effects appear to be during high water. Due to a series of natural terraces in the swamp, the zone of influence during low water levels decreases to only about 1% of the swamp. An Environmental Assessment identified the preferred alternative to the future management of the sill as a "Phased removal of concrete water control structures and breaching of the sill in selected locations" that would restore the natural connection between the swamp and the Suwannee River, restore the river flood plain and the natural fire cycle of the swamp. The U. S. Geological Service (USGS) has completed the 4-year study of water level impacts downstream. Funding is now needed to remove the concrete structures and breach the sill in four locations.

27. Current scientific research and facilities:
Numerous surveys are conducted and additional ones proposed. Currently, surveys on the following species and groups are conducted: Sandhill cranes, Black bears, Red-cockaded woodpeckers, breeding birds, wading birds, and fish. Water levels and water quality are monitored at a network of stations within and surrounding the swamp.

Air quality monitoring includes the following programs:

- Interagency Monitoring of Protected Visual Environments (IMPROVE)
- National Atmospheric Deposition Program (NADP)
- Mercury Deposition Program (MDP)

The refuge has been a site in the U.S.G.S.'s Amphibian Research and Monitoring Initiative in south-eastern U.S. and U.S. Caribbean.

Other recent studies have included the following:

- Effects of alterations to the Suwannee River Sill on the Suwannee River flow and water-quality regime, Florida and Georgia.
- Assessing patterns and processes of landscape change in Okefenokee Swamp, Georgia.
- Wetland macroinvertebrate dynamics within the Okefenokee Swamp.
- Population ecology of black bears in the Okefenokee Swamp-Osceola Ecosystem

Approximately 20 researchers request Special Use Permits per year to conduct research at Okefenokee NWR. The Okefenokee Education and Research Center in Folkston,Georgia is starting to develop its research program. With these services available, the refuge anticipates more interest in conducting research within its boundaries.

28. Current conservation education:
The East Entrance to the refuge provides staff and facilities to support the Visitor Services program for all three manned entrances. Refuge personnel acquire specific training in communications as well as provision of interpretation, environmental education and other outdoor recreational activities. In this way the refuge also provides environmental education and technical information which enables the public to make informed decisions. Refuge staff train and utilize interns and volunteers to provide assistance with these programs. Facilities utilized for these activities at the East Entrance include an main administrative office; a recently re-modeled and updated Visitor Center with an introductory film; a concessionaire facility offering souvenirs, limited food service, guided interpretive tours, boat, motor, canoe and kayak rentals as well as shuttle service for wilderness canoe trips; a wildlife observation drive, restored historical homestead, ¾ mile long boardwalk with observation tower and several miles of hiking trail. Entrance fees are required.

The West Entrance to the refuge at Stephen C. Foster State Park offers personnel trained in communications and provision of interpretation, environmental education as well as outdoor recreational activities. Facilities utilized for provision of Visitor Services includes a main administrative office with attached limited food service and boat, motor, canoe, and kayak rental. Additional facilities include a tent/RV campground, museum/ interpretive center, rental cottages, boardwalk and hiking trail. Volunteer campground hosts are intermittently used to assist with maintenance functions. Entrance fees are required.

The North Entrance to the refuge at Okefenokee Swamp Park provides personnel trained in communications and provision of interpretation and outdoor recreational activities. Facilities utilized for Visitor Services includes an administrative office with attached souvenir/sales area. Additional buildings are utilized for interpretation of live wildlife species in special wildlife habitat pen areas. A separate vendor supplies limited food service. Guided boat tours and canoe rentals are also available. For an additional fee visitors can board a narrow gauge railroad for an interpretive tour of the surrounding habitat. Entrance fee is required.

All three manned refuge entrances are currently equipped for and provide environmental education activities as needed to meet current demands. The future development of the Okefenokee Education and

Research Center (OERC) in nearby Folkston, Georgia, during 2005 and beyond will provide increased emphasis on environmental education at all entrances to the refuge from the surrounding communities, the States of Georgia and Florida and the United States at large. The OERC is now partially funded and beginning operations that will increase environmental education use and scientific research on the refuge. Special refuge accommodations related to facilities, staffing, budgeting, and carrying capacities will have to be planned in advance in order to accommodate these significant increases in activities.

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29. Current recreation and tourism:

The Okefenokee NWR is known for its recreational opportunities and attracts local, regional, national, as well as international visitors for wildlife observation, canoeing, fishing, boating, and camping. The site is home to a large diversity of wildlife.

Total visitation to the refuge is near 400,000 visitors per year. The East Entrance to the refuge attracts about 200,000 visitors per year. The West Entrance to the refuge attracts about 120,000 visitors per year. The North Entrance to the refuge attracts about 80,000 visitors per year. Visitation patterns are somewhat variable depending on rain and water levels within the swamp. Seasonally, the Spring months of March and April are the peak of public use for all three entrances. The Fall months of October and November offer a second but smaller peak in visitation. January and most of February are the months of least use, primarily due to cold and wet rainy weather.

Refuge tourism provides both a direct and indirect economic benefit to the local surrounding communities. Eco-tourism's economic effect as reported by the State of Georgia for 1998 was: $18.23 million for Charlton County, $53.94 million for Ware County, and $5.49 million for Clinch County. The combined effect on the three county areas was $77 million. Ecotourism has recently been promoted in the area, bringing money into the surrounding communities. The Okefenokee NWR serves as an advocate for wildlife and their habitat.

Two significant developments during 2004 provide the future promise of increased refuge visitation and additional positive impacts to the local economy. During June, 2004 the new Suwannee River Visitor Center was officially opened in Fargo, Georgia. This is a state-of-the-art visitor center featuring diorama and interactive exhibits. The Visitor Center is an addition to the Stephen C. Foster State Park facilities at the refuge's West Entrance. Development of this facility and a planned Eco-Lodge to house conventions, school groups, etc. evolved through local sponsorship and land donation to the State of Georgia for purposes of providing economic benefits from increased tourism to the area. The second positive economic impact to the area involved the development of the Okefenokee Education and Research Center (OERC), that began as a cooperative venture between the City of Folkston and the Georgia Wildlife Federation. The OERC provides classroom educational opportunities, as well as interactive and interpretive exhibits highlighting the many local recreational activities. It also includes a specially designed exemplary bog and upland garden area, and a 300 seat auditorium for special audio/visual programs. When not being used for educational purposes, the facilities will be available for rental by the general public. Provision of these additional opportunities is expected to increase tourism and economic impact to the area. These new facilities will also spread out public use to other areas and decrease the direct environmental impact on the refuge.

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30. Jurisdiction:
Department of the Interior
U. S. Fish and Wildlife Service
Region 4, Atlanta, GA

31. Management authority:

George Constantino
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Okefenokee National Wildlife Refuge
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