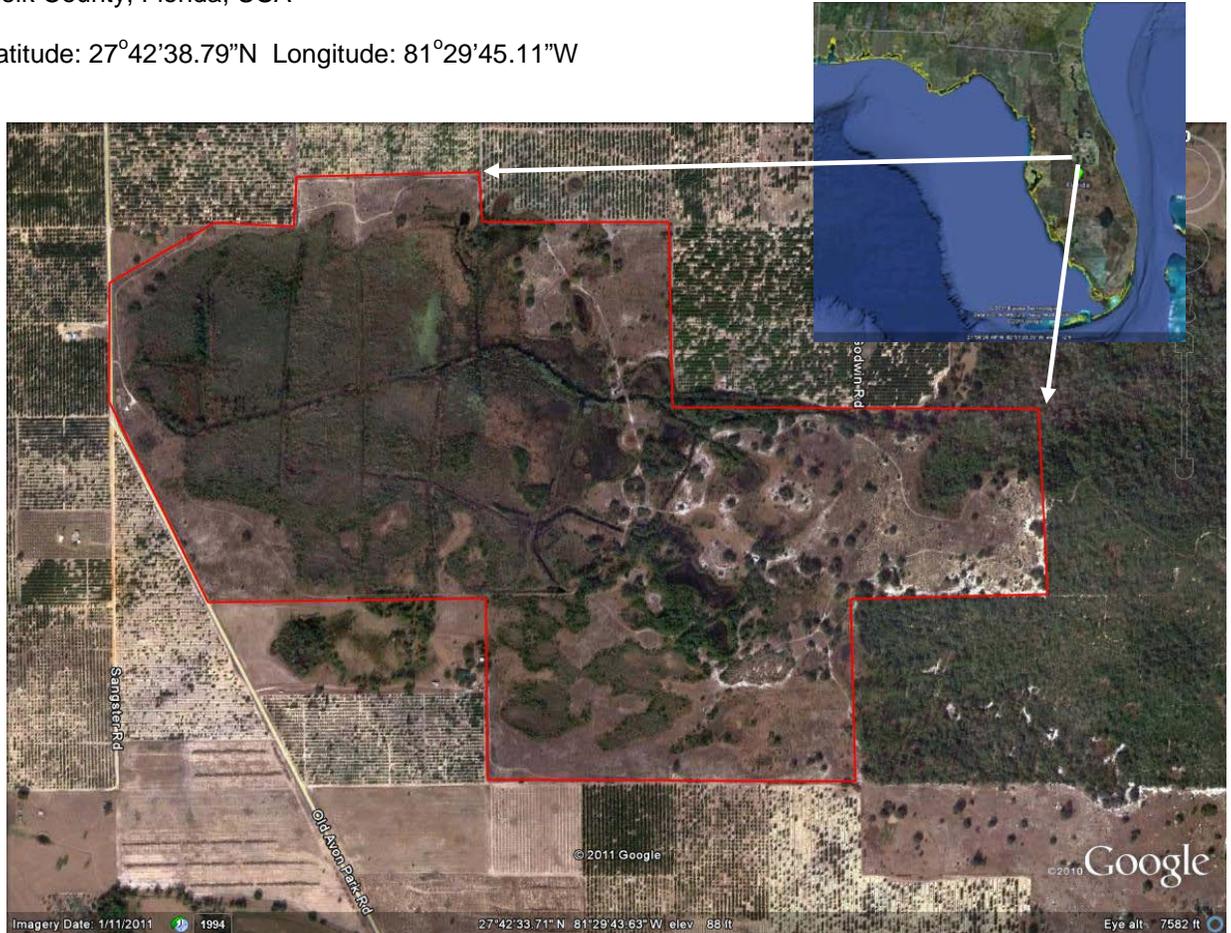


Proposed Wetland Restoration Case Study Submittal

1. Project Name and Location:

Restoration of Agricultural Land to Native Upland and Wetland Habitats
Polk County, Florida, USA

Latitude: 27°42'38.79"N Longitude: 81°29'45.11"W



2. **Wetland Hydro-geomorphicType(s):** Freshwater herbaceous and forested

3. **Project size:** 398.5 acres

Watersheds: Lake Arbuckle; Kissimmee River; Everglades Headwaters

Spatial Location: Polk County, Central Florida, USA 27° 42'N 81° 29'W

4. **Project sponsor:** Gulfstream Natural Gas System, LLC

5. **Role:** Kevin L. Erwin Consulting Ecologist, Inc. identified the property as suitable for environmental mitigation and net environmental benefits; was lead consultant for the design and environmental permitting through a team permitting process (i.e. multiple government agencies and non-governmental organizations); conducted wildlife surveys; mapped historic and current vegetation communities; conducted soils evaluations; designed a hydrologic monitoring network (i.e., piezometers, staff gauges, rain gauges); conducted hydrologic monitoring; designed the restoration including location of adjustable water control structures; provided oversight for the restoration construction, planting, and maintenance; conducted habitat monitoring; recommended and implemented adaptive management techniques; compiled annual monitoring reports.

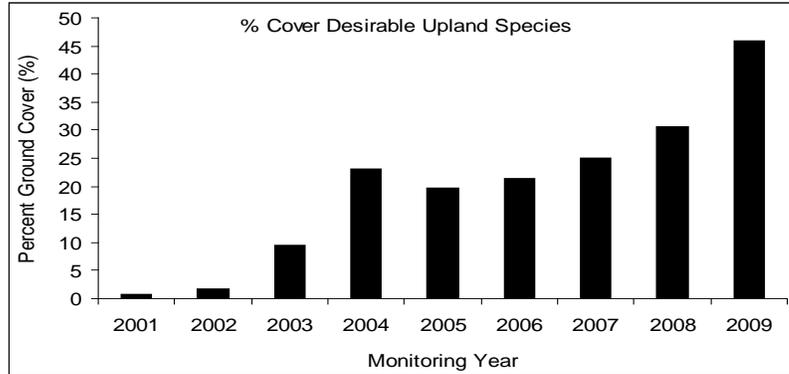
- 6. Purpose/drivers:** Gulfstream Natural Gas System was required to offset the environmental impacts of installing a 300 mile natural gas pipeline in near-by sections of the state. This site provides wetland compensation and net environmental benefits to fulfill State and Federal regulatory rules/laws. This property was chosen due to its location within the Lake Wales Scrub Ridge which includes rare xeric scrub habitat intermixed with wetlands and lakes. Additionally, the property historically contained headwater wetlands that had been drained, cleared, seeded, and managed as improved pasture for cattle rearing providing an opportunity to restore a headwater wetland system which ultimately feeds the Everglades wetland complex in southern Florida, a Ramsar designated Wetland of International Importance. Added regional benefits include the connectivity of the property for both wildlife and water resources to the state-owned Lake Wales Ridge State Forest along the eastern property boundary, and by citrus groves to the north, south and west.

Note: Agricultural activities had severely impacted this area over the past 60 years through activities such as wetland draining and clearing for cattle/citrus production. However, the most significant change occurred approximately 40 years ago when a large canal system was installed throughout the wetland breaching an isolating sandhill ridge. This activity ultimately drained the site into the Lake Arbuckle system and the property was subsequently cleared and converted to improved pasture for use by cattle. However, the native soils remained along with a native seed bank making the site an excellent candidate for habitat restoration.

7. Project goals and degree of goal attainment:

- **Goals for Upland Restoration Areas**

- Dominated by native, desirable species – Goal achieved
- Developed into a pyrogenic vegetation community that can be managed primarily by prescribed burning – Goal achieved
- An ecologically significant increase in use by wildlife is reflected through scheduled monitoring and other recorded observations – Goal achieved
- Exotic or nuisance species are present at a sufficiently low level to not inhibit the growth and propagation of native species (i.e. <10%) – Goal achieved with <5% cover of exotic or nuisance species
- A density of trees (approximately 200 trees per acre) exhibiting a strong similarity to those found in similar type natural habitats in the region (i.e. reference sites) with an indication of active growth of planted trees. Success reference sites were identified and monitored to determine the density of trees in similar natural habitats, and adjust the assumed 200 trees per acre density – Goal achieved
- Total vegetation ground cover is equivalent to that of similar type natural ecosystems (approximately 30% vegetation cover) and reference sites approved and monitored to record range of vegetation ground cover within representative preserved natural areas in close proximity to the restoration site. An appropriate number of native species are present representing the natural diversity of the reference sites – Goal achieved



- **Goals for Wetland Restoration Areas**

- The successful establishment of at least 275 trees per acre for restored forested hardwood swamp and 200 trees per acre for restored hydric pine – Goal achieved
- A minimum 33% aerial coverage, evidence of reproduction, healthy color, and vigorous growth consistent with the species, will be required - Goal achieved

- Invasive plant presence must not exceed 10% by area. Invasive plant control must be self-sustaining for a minimum of one full year – Goal achieved.
- The hydrology of the wetland system is adequate to ensure the long-term viability of the restored/enhanced wetlands and resembles historical and natural (pre-disturbance) conditions – Goal achieved

Note: The hydrology of the site was restored to near historical conditions by the installation of four control structures within the agriculture drainage ditches onsite. The restored hydrology resulted in the direct increase of over 165 acres of wetland habitat and was the basis for the restoration planting plans. One of the structures had repeatedly lost containment due to breaches in the berm's mucky soils. This structure was determined by the site manager to be unnecessary and was abandoned in 2006. The other three structures are functioning and maintaining the water levels at the desired seasonal wetland hydroperiods to successfully maintain the restored wetland habitats.

- The success criteria above has been met continuously for a period of at least one (1) year, without intervention in the form of irrigation, removal of undesirable vegetation, or replanting of desirable vegetation – Goal achieved

Note: The quantitative monitoring data demonstrated that the restored areas have vegetation compositions which have shifted from pasture to native wetland and upland vegetation communities based on site location, restored hydrology, and vegetation management. The State and Federal government agencies officially released the restoration site from further monitoring in 2010 because the success criteria were achieved.

8. Methods of restoration and approximate time to complete:

The major restoration work began in 2001 and was completed in 2003. The restoration included the installation of drainage control structures, the eradication and maintenance of non-desirable vegetation, and the seeding and planting of native vegetation. Management of the site has been on-going since 2001 with periodic exotic vegetation management and supplemental plantings to increase the vegetation diversity and seed sources.

Hydrologic Restoration: In order to eliminate the past drainage and allow temporary management of water levels within three basins, a series of adjustable water control structures were installed within the existing drainage canal system. The drainage canals were not back filled, to allow for the naturalization of these deeper water areas (i.e. 1+/- meter of water during high water wet season conditions) and provide greater habitat diversity as well as fish and wildlife refugia during the dry season and periods of drought.

Employing adjustable water control structures also allowed the use of adaptive management to achieve the appropriate hydroperiods for the target habitats. Modeling during the planning stages provided a starting point for the control structure elevations, but the final elevations of the control structure boards were determined through monitoring the actual site conditions during restoration to verify that appropriate hydroperiods were established for the targeted habitats. The ground water levels were raised by two to three feet across the site resulting in a net increase of over 165 acres of wetlands on site.

Invasive Exotic & Nuisance Vegetation Control & Maintenance: Initial herbicide treatment methods varied and depended on the plant species being targeted, as well as whether the area was classified as a wetland or upland. Less intensive treatment methods (i.e. spot treatments) were utilized within the wetlands because the enhanced hydrology eliminated most of the undesirable pasture species. However, the upland areas were dominated by pasture grasses requiring a more intensive treatment plan consisting of a series of broadcast herbicide application followed by disking, and a second broadcast herbicide application. Areas with tall vegetation were cut, hay-baled, and removed from the site before herbicide application. Areas with dense cover of exotic grasses were sprayed with herbicide. Germinating non-native/nuisance species were spot treated using a backpack sprayer. Ditches were spot treated. Initial non-native/nuisance treatment and removal was completed in November 2001.

Semi-annual maintenance and spot treatments have been ongoing since 2002 focusing on the invasive exotic vegetation included in the current Florida Exotic Pest Plant Council list. Invasive exotic and nuisance species coverage has diminished as the restored habitats continue to mature. The treatments are conducted to maintain less than 10% cover of invasive exotic vegetation (i.e. <3% in 2010) as required by a State issued environmental permit.

Native Vegetation Seeding & Planting: The restoration of native vegetation began following the initial treatment of the non-native/nuisance plants that were established during the site being managed as improved pasture. Since many of these undesirable species were

eliminated with the hydrological restoration of the wetland areas, native herbaceous wetland plants germinated from the existing seed bank. Nursery grown native tree and shrub species were planted to expedite the establishment of a variety of forested and shrub wetland habitats including bay swamp, cypress swamp, mixed hardwood forest, and buttonbush marsh. The adjustable aluminum boards incorporated into the control structures were used to manipulate the water levels during supplemental planting to allow nursery grown wetland trees to establish and adapt to the depth of inundation that naturally germinated seedlings and mature wetland trees endure.

The restoration of native upland vegetation from the existing seed bank was enhanced through seeding and planting following the intensive treatments to eradicate the existing pasture grasses. Seed was collected from a private ranch in Polk County. The site was a dry prairie, and offered a good mix of species commonly found in xeric to hydric flatwoods. Seeds from various tree, shrub, grass, and forb species were also hand collected from multiple private and state lands for both direct seeding of the restored uplands and for creating a nursery of tree, shrub, and forb seedlings for supplemental plantings. Selected species were those that would not be collected in the machine harvest and would enhance the species diversity for each system.

Supplemental planting with nursery grown bare-root and various container size native trees, shrubs, and ground cover were installed throughout the site between 2005 and 2010 based upon field assessments conducted on an annual basis to insure the establishment of the target habitats.

Note: Adaptive habitat management including annual vegetation monitoring, supplemental plantings, and exotic/nuisance species maintenance were conducted from 2004 through 2010 when the success criteria required by the State and Federal environmental permits were achieved and officially acknowledged by the government agencies. Site management and maintenance continue while the landowner pursues donating the restored land to the United States Fish and Wildlife Service who will manage in the preserve in perpetuity. A long term management plan is currently under review.

9. How was the project monitored?

Hydrological Monitoring:

A hydrologic monitoring system was developed and installed to document the ground and surface water levels and rainfall amounts. A network of piezometers, staff gauges, and rain gauges was established. The ground water levels were recorded through a series of piezometers (i.e. a shallow monitoring well constructed to measure water levels up to six feet below the ground surface) placed within each of the target wetland types to record the restored hydroperiods and allow for adaptive management where the projected hydroperiods differed from the actual restored water levels and periods of inundation. Water level data was collected monthly during the dry season (November through April) and bi-weekly (i.e. twice a month) during the wet season (May through October). Additionally, water levels were recorded within the habitat monitoring transects during the annual monitoring conducted between September and November.

Note: Hydrological monitoring pre- and post-restoration allowed the site managers to target restoration communities and assess success of the restoration effort. By 2008, site hydrologic restoration success was established and monitoring was scaled back.

Vegetation Monitoring: Monitoring transects were established within representative areas for each of the habitat typed restored. Quantitative vegetation monitoring was conducted annually to document tree growth and survival, percentage of vegetation cover, percentage of native vegetation, and percentage of invasive exotic and nuisance plant species. Vegetation

sampling methods include the point-intercept method and the "line strip" (belt transect) technique (Lindsay 1955, Woodin and Lindsay 1954, Bauer 1943).

The point-intercept method records 100 data points on each transect, which equate directly to percent cover. A measuring tape was stretched along the right side of the sample transect and the plant species occurring directly below (ground cover) the tape were recorded at three-foot intervals for a total of 100 points per transect. The first plant touched by a small metal pointer was recorded. Ground cover vegetation includes all herbaceous species and woody species less than three feet in height. The percent cover of bare ground was also recorded.

The line strip technique was used to facilitate an intensive and accurate sampling of planted trees and was incorporated on sample transects located in restored forested/shrub wetland and upland habitats. Belt transects, 300 feet in length and 32.8 feet in width, are permanently established using rebar and staked PVC poles. Within each plot, the height and canopy of each planted and recruited tree species was measured. Canopy diameter of each tree or shrub was estimated in the field by averaging its widest and narrowest points. Water depths and the condition of each tree, including evidence of seed production or natural recruitment, were also recorded.

Wildlife Monitoring: Wildlife use was monitored and documented throughout the year to categorize use during all seasons. KLECE ecologists recorded wildlife observed within wetland and upland areas during land restoration and land management activities. These observations are sorted by season. Wildlife use records include direct observations and evidence such as tracks, nests, trails, rooting areas, snake skins, feathers, scat, bird and amphibian vocalizations, etc. Historically, Sherman traps were used to collect small mammals and herpetological drift fences were used to sample for reptiles and amphibians. These efforts were suspended after the 2006 monitoring season due to the abundance and diversity of wildlife documented on the site.

Note: 97 bird species, 18 mammal species, 33 reptile species, and 18 amphibian species have been documented utilizing the restored and enhanced habitats. The endangered Florida scrub-jay (Aphelocoma coerulescens) were found less than a quarter mile to the southeast in the Arbuckle Tract of the Lake Wales Ridge State Forest in October 2003 and are expected to immigrate to the site as the restored scrub habitat matures and corridors are established.

- 10. Is the project part of a larger initiative at a watershed or regional level?** Gulfstream Natural Gas System, LLC, is in the process of donating the restored property to the United States Fish and Wildlife Service to become part of the proposed Everglades Headwater National Wildlife Refuge and Conservation Area. The land transfer is scheduled to be completed by November 2011.
- 11. Is the project considered a success or failure? Please explain why.** The project is a successful restoration of a complex mosaic of hardwood swamp forests, freshwater marshes and xeric scrub habitat. Hydrologic improvements onsite have resulted in a net increase of over 165 acres of head water wetland habitats. The restoration has converted the 398.5 acre property from an improved pasture with a vegetation cover dominated by pasture grasses with scattered pockets of disturbed wetlands to a mosaic of native upland and wetland communities including mixed wetland hardwood, bay swamp, cypress forest, freshwater marsh, wet prairie, hydric pine forest, upland prairie, upland pine flatwoods, and xeric scrub habitats. Reproduction and recruitment of native species is evident within these restored habitats, showing signs of a self-sustaining system.

Wildlife utilization has increased in diversity following restoration with 97 bird species, 18 mammal species, 33 reptile species, and 18 amphibian species documented through species

surveys and incidental observation. The endemic, threatened sand skink (*Neoseps reynoldsi*) has moved into the restored xeric scrub habitats compared to being restricted to the fence line pre-restoration. Other endangered and threatened wildlife observed include the Audubon's crested-caracara (*Caracara cheriway*), Florida sandhill crane (*Grus Canadensis protensis*) [note: nesting confirmed], wood stork (*Mycteria Americana*), Florida black bear (*Ursus americanus floridanus*), American alligator (*Alligator mississippiensis*) [note: nesting confirmed], eastern indigo snake (*Drymarchon carais couperi*), and gopher tortoise (*Gopherus polyphemus*). The endangered Florida scrub-jay (*Aphelocoma coerulescens*) were found less than a quarter mile to the southeast in the Arbuckle Tract of the Lake Wales Ridge State Forest in October 2003 and are expected to immigrate to the site as the restored scrub habitat matures and corridors are established.

12. How could the project have been improved – e.g. location, design, hydrology, construction methods, data collection, etc?

13. Please provide any citations where additional information may be found.

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Logan, Tom H. 1997. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Division of Wildlife, Nongame Wildlife Section, Florida Game and Fresh Water Fish commission, Tallahassee, FL.

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Runde, D. E., *et al.* 1991. Florida Atlas of Breeding Sites for Herons and Their Allies. Update 1986-89. Division of Wildlife, Nongame Wildlife Section, Florida Game and Freshwater Fish Commission, Tallahassee, FL.

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14. Is there any other information on the project you would like to provide?

The location of the property within a predominantly agricultural area (i.e. citrus groves) provides an excellent example of how ecological restoration may be incorporated into the landscape while still maintaining viable agricultural activities.