

Inventory, Assessment, and Restoration Potential of Ephemeral Wetlands on FFWCC Wildlife Management Areas

Half Moon WMA Final Report



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EXECUTIVE SUMMARY

Ephemeral wetlands are biologically unique systems that serve as focal points of animal and plant diversity in the southeastern United States. Despite their typically small size, these wetlands are extremely valuable in terms of biological diversity and ecological function. Historically, ephemeral wetlands were largely ignored by scientists, regulatory agencies, and land managers. Because of their small size, they were believed to have lower biological diversity and less significant ecological function than larger, more permanent water bodies. Consequently, many smaller, isolated wetlands have been destroyed or their ecological integrity degraded through human activities that include logging, ditching, draining, fire suppression, and mechanical site preparation. After over 20 years of research on hundreds of sites across the country, we now know that ephemeral wetlands are not just subsets of larger wetlands, but rather they hold their own unique and intrinsic biological value.

This pilot project was created to provide the Florida Fish and Wildlife Conservation Commission (FWC) with the site-specific tools and knowledge it needs in order to carry out the long-term ecological management of Florida's ephemeral wetlands by identifying them using remote sensing tools such as GIS, DOQQs, and topographic maps, conducting on-the-ground assessments of ephemeral wetland conditions using quantitative and qualitative metrics, and recommending restoration strategies for each identified wetland or management unit. Seven FWC-lead Wildlife Management Areas (WMAs) were selected for study: Aucilla WMA, Big Bend WMA, Caravelle Ranch WMA, Chassahowitzka WMA, Guana River WMA, Half Moon WMA, and Triple N Ranch WMA.

We used Digital Orthophoto Quarter Quadrangles (DOQQs) and topographic maps to remotely identify potential ephemeral wetlands on each property. We then ground-truthed potential ephemeral wetlands, obtained a GPS location, and conducted a standardized quick assessment of wetland and surrounding upland conditions. The data were entered into a GPS unit on site in order to generate a spatially referenced database for each property. Additional data were collected on a per property basis as requested by WMA personnel. Multiple photographs were taken of each wetland to provide a current "snapshot" of their physical appearance. We made restoration recommendations for each wetland based on wetland concerns identified in the field and the custom needs and challenges of each WMA.

We inventoried a total of 1513 isolated, ephemeral wetlands across the 7 WMA properties. The majority of wetlands (72%) were marshes. Forested swamps accounted for 9% of wetlands visited, shrub swamps 9%, and mixed swamps 8%. Another 2% of wetlands were of another classification such as borrow pits and sinkhole ponds. A total of 424 wetlands (28%) were in excellent condition with no associated wetland concerns. The three most prevalent wetland concerns were woody encroachment, feral hog damage, and roads/firelines.

Woody encroachment was the most ubiquitous wetland concern across all WMAs. A total of 494 wetlands (33%) were affected by woody plant encroachment. The percentage of wetlands impacted by woody plant encroachment varied per property from 3% of inventoried wetlands up to 74%. Half of all wetlands with woody encroachment were marshes. Within marshes, the

majority of woody encroachment was in the form of slash pine and wax myrtle encroaching from the wetland edge. Woody plant establishment in marshes represented a major threat to ephemeral wetlands in many of the visited WMAs and is largely a result of the lack of fire in the wetland basin. Canopies formed by woody plants in a marsh over time will shade out herbaceous marsh vegetation, eventually transforming the marsh into a swamp. To combat woody plant encroachment in marshes, we recommended that land managers remove encroaching woody plants in a single treatment using a variety of techniques depending on the situation, and subsequently implement long-term fire management in the wetland, if it wasn't already in effect.

There were 352 wetlands (23%) that were impacted by some degree of observable past or present feral hog activity. Some properties were more impacted by hogs than others, the percentage of wetlands impacted varied per property from 4% of inventoried wetlands up to 67%. Feral hogs can alter the plant and animal composition of wetlands and damage wetland soils. We made recommendations on feral hog management based on the severity of the damage and, using the generated database, the spatial extent of the damage. We recommended that trapping be used in combination with sport hunting and control hunting as a 3-pronged approach to reduce the impacts to ephemeral wetlands in heavily damaged areas of some properties.

Roads and firelines affected 2-19% of wetlands inventoried per property, a total of 125 wetlands (8%) were impacted project-wide. The placement of firelines and roads through or tangential to wetlands is detrimental to wetland habitat because the swath of exposed soil and denuded vegetation is a direct alteration of wetland habitat, can impact wetland hydroperiod, and can facilitate the spread of invasive species. Most, if not all, observed road-related impacts were created in the past. Now, current land managers must decide how to implement ephemeral wetland restoration of road impacts while balancing the need to access and partition the property for both public and managerial use. We made recommendations on a case-by-case basis.

Cattle grazing was permitted on 3 of the WMAs we visited. Cattle grazing pressure over time can degrade both wetland and upland habitats by altering plant communities and subsequently reducing landscape biodiversity. Furthermore, cattle frequently congregate in ephemeral wetland basins. Impacts to wetlands include nutrient overloading from concentrated urine and feces, trampling, altering plant community structure, facilitating the spread of invasive/exotic species, and soil compaction. We observed varying degrees of cattle impacts to wetlands during this project. Immediate recommended actions varied per property but in general we recommended cattle be phased out of WMAs altogether as part of a longer-term management strategy to maintain long-term ecological health of ephemeral wetlands and their surrounding uplands.

This pilot study has illuminated the need for future scientific research in several areas of ephemeral wetland restoration. There is a paucity of experimental data and peer-reviewed literature relating to the management of ephemeral wetlands. While some experimental data do exist, and we relied on it heavily for this report, most of the information we have compiled was acquired from our field expertise or through personal communications with land managers and other scientists. One major area that needs to be studied is the ecological response of wetlands to woody plant encroachment and the most effective methods for restoring wetlands impacted by woody encroachment. The long term effects of feral hogs on ephemeral wetland biodiversity

and community composition is another area for which there is little research. A final information gap we have identified is the fire ecology of ephemeral wetlands including targeted fire return interval, impacts of dormant versus growing season fires, and community composition response to varying fire regimes.

Although we've identified information gaps, this report is the most comprehensive compilation of knowledge about ephemeral wetland management and restoration to date. Results from this project provide an enormous database of the ecological status of ephemeral wetlands on state managed properties in Florida. This project also supplies baseline data that can be used in future studies of wetland response to management techniques and a template for future studies to identify, inventory, assess, and implement restoration actions for ephemeral wetlands on other properties.

The deliverables for this project include a final report for each of the 7 WMAs (of which this is one report), a spatially-referenced database of wetlands inventoried (in the form of a shapefile per property), and a catalog of wetland photographs. A DVD of reports, shapefiles, and photographs was sent to each of the 7 WMAs and to the AHRES project manager, Beacham Furse. The reports also were posted on, and the shapefiles made available upon request from, Coastal Plains Institute's website: www.coastalplains.org.

ACKNOWLEDGEMENTS

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INTRODUCTION

Ephemeral wetlands are biologically unique systems that serve as focal points of animal and plant diversity in the southeastern United States. Despite their typically small size, these wetlands are extremely valuable in terms of biological diversity and ecological function. For example, at least 12 Florida amphibians, including the federally listed flatwoods salamander (*Ambystoma bishopi*, *A. cingulatum*) and other candidate species (e.g., striped newt (*Notophthalmus perstriatus*) and gopher frog (*Rana capito*)), breed exclusively in this wetland type (Dodd and Charest 1988, Means and Means 1998, Printiss and Hipes 1999, Enge and Wood 2000, Greenberg et al. 2003). Even small wetlands (<1 ha) can support a high diversity and density of species (Dodd 1992, Semlitsch 2000, Means 2007).

Ephemeral wetlands are usually small and isolated with a cyclic nature of drying and refilling. Termed “hydroperiod,” the duration an ephemeral wetland holds water can vary from 1 or 2 weeks to 1 or 2 years, and hydroperiod can vary from year to year and wetland to wetland. The water-holding capacity of a wetland is a function of multiple factors including underlying geology, soil characteristics, rainfall, wetland depth and size, evaporation, evapotranspiration, and tree canopy cover (Williams 1987, Hart and Newman 1995, Blood et al. 1997, Tiner et al. 2002). Bands of herbaceous vegetation around the wetland periphery, known as the littoral zone, move upslope and downslope depending on the water level of the wetland and reflect soil moisture conditions (LaClaire and Franz 1990).

The ephemeral nature and isolation of these wetlands make them unsuitable for fauna requiring longer hydroperiods, such as predatory fish. While some amphibians can breed in the presence of fish, the lack of predatory fish in ephemeral wetlands is essential to the successful reproduction of a large portion of Florida’s amphibian species.

Our region’s biological diversity is greatly enhanced by the presence of ephemeral wetlands. Ephemeral wetlands provide habitat to a large diversity of plants, invertebrates, reptiles, mammals, and birds (LaClaire 1992, Tiner et al. 2002, Comer et al. 2005, Scheffers et al. 2006, Means 2007). At least 10 federally and state-listed species facultatively or obligately utilize isolated wetlands for some portion of their life cycle (Hart and Newman 1995). These wetlands also serve as water sources for game species such as white-tailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), and waterfowl. Additionally, the aesthetic value of small wetlands is of great importance to a society that places a major emphasis on the value of water bodies.

The longleaf pine ecosystem, once widespread across the southeastern Coastal Plain, has been reduced to <2.2% of its original extent (Frost 2006). In just the past 50 years, a quarter of Florida’s forest and wetland habitats have been cleared (Cox et al. 1994). The cumulative effect of ephemeral wetland destruction in Florida has not been measured, but studies by Semlitsch and Bodie (1998) and Gibbs (1993) illuminate the problems associated with the loss of small wetlands. Small wetlands are crucial for maintaining

regional biological diversity and are important because they support plants, microcrustaceans, and aquatic insects that would be negatively impacted by their loss. From an amphibian metapopulation standpoint, reducing the number of wetlands reduces the amount of young individuals dispersing into surrounding uplands. Ephemeral wetland reduction also increases the dispersal distance among wetlands. While some amphibians can travel up to 2 km (Franz et al. 1988), these dispersal distances appear to be rare. The majority of individuals appear to stay within 1 km of their breeding wetland (Johnson 2003, Rosnik 2007), so increasing dispersal distance could negatively impact amphibian populations. An increase in dispersal distance also may increase the extinction rate of populations of small mammals, turtles, and other less vagile species (Gibbs 1993).

Historically, ephemeral wetlands were largely ignored by scientists, regulatory agencies, and land managers. These wetlands were generally thought to be subsets of larger wetlands. Because of their small size, they were believed to have lower biological diversity and less significant ecological function than larger, more permanent water bodies (Moler and Franz 1987). Studies over the past 20 years have dispelled that notion. We now know that ephemeral wetlands are not just subsets of larger wetlands, but rather they hold their own unique and intrinsic biological value. However, wetland regulations and management plans maintain their focus on larger wetlands. Consequently, many smaller, isolated wetlands have been destroyed or their ecological integrity degraded through human activities that include logging, ditching, draining, and mechanical site preparation. Additionally, fire suppression or improper use of prescribed fire has altered the natural conditions of many ephemeral wetlands.

Coastal Plains Institute (CPI) biologists recently completed a Florida Fish and Wildlife Conservation Commission (FWC) State Wildlife Grant project entitled “Management Strategies for Florida’s Ephemeral Ponds and Ephemeral Pond-Breeding Amphibians” (Means 2008). Through that project, CPI identified and prioritized the necessary steps to improve the management of ephemeral wetlands in Florida. Upon completion of that project, the next logical step in the goal of proper ecological management of Florida’s ephemeral wetlands was the development of the current project. Proper ephemeral wetland management was given the highest priority at “Ephemeral Pond-Breeding Amphibians: Threats and Research Gaps,” a 2007 meeting of amphibian biologists at which research needs of ephemeral wetlands and associated biota were identified and prioritized. The current project will provide FWC with the site-specific tools and knowledge it needs in order to carry out the long-term ecological management of Florida’s ephemeral wetlands by:

- 1) Identifying ephemeral wetlands using remote sensing tools such as GIS, DOQQs, and topographic maps
- 2) Conducting on-the-ground assessments of ephemeral wetland conditions using quantitative and qualitative metrics
- 3) Recommending restoration strategies for each identified wetland or management unit

Seven FWC-lead Wildlife Management Areas (WMAs) were selected for study based on FWC-identified restoration potential priorities and the distribution and occurrence of amphibian Species of Greatest Conservation Need, as identified from CPI's geo-referenced database developed as part of the recent CPI project funded by a State Wildlife Grant (Figure 1). This current project serves to assist FWC land managers by identifying, inventorying, and assessing the restoration need of ephemeral wetlands on the following WMAs:

- Aucilla (AWMA)
- Big Bend (BBWMA)
- Caravelle Ranch (CRWMA)
- Chassahowitzka (CWMA)
- Guana River (GRWMA)
- Half Moon (HMWMA)
- Triple N (TNWMA)

This draft report provides an inventory, characterization, and restoration assessment for ephemeral wetlands on HMWMA, the fifth of the 7 WMA's visited as part of this project.



Figure 1. Seven FWC-lead WMAs targeted for this study.

EPHEMERAL WETLAND ECOLOGY AND RESTORATION

Ephemeral wetlands also are known as temporary ponds, isolated wetlands, Carolina bays, seasonal ponds, cypress domes, sinkhole wetlands, seasonal marshes, intermittent ponds, pineland depressions, depressional wetlands, and vernal pools. They can be classified as either marshes, shrub swamps, or forested swamps (Whitney et al. 2004). Marshes are dominated by herbaceous vegetation; grasses and forbs that can be emergent, submergent or floating. Swamps are wetlands dominated by woody vegetation. Shrub swamps are dominated by shrubs and forested swamps are dominated by trees.

Both fire and water residency time (hydroperiod) play major roles in shaping the ecological function and the physical appearance of isolated wetlands in Florida landscapes. In the case of marshes, fire and hydroperiod work in unison to produce open, ephemeral, herbaceous marshes. A marsh is likely to succeed into a shrubby or forested swamp over time if two things occur in the wetland: 1) dry conditions ensue long enough for woody plants to become established in the newly exposed wetland floor; 2) fire is absent in the wetland during the dry period.

Historically, wildfires occurred during dry periods and burned across the Florida landscape. The absence of fire from an ephemeral wetland during a prolonged dry period enables the establishment of woody plants in a marsh. Woody invaders into marshes will create a shading effect over time and eliminate low-lying herbaceous vegetation through competitive exclusion. Succession of a marsh into a swamp can be a natural process but much more often, on lands that have been impacted by humans over the long-term, marshes are succeeding into shrub and forested swamps. Over the last century of human growth and development in Florida, a great many marshes in Florida may have succeeded into shrubby and forested swamps as a result of fire suppression induced by humans. This conversion of wetland type may be a factor in the decline of some ephemeral wetland-breeding species such as the striped newt and the gopher frog.

Just as it is possible for marshes to succeed to swamps, it is also possible for marshes to become too choked with herbaceous vegetation (i.e. sawgrass or maidencane) if they do not burn frequently enough. High densities of a single species in wetlands can eliminate open water pools, create a shading effect, and reduce species diversity. Grass-choked marshes are usually best managed with fire.

Dry periods coupled with lack of fire in an ephemeral marsh will lead to woody encroachment, competitive exclusion of herbaceous vegetation, and subsequent loss of marsh habitat. We have observed significant woody shrub and tree encroachment in many ephemeral marshes and swamps in most of the WMA's visited as part of this project. All wetlands exhibiting signs of fire suppression should be encouraged to burn during landscape level prescribed fires. Various other restoration techniques are available to catalyze restoration of fire-suppressed marshes. These additional techniques are discussed in the Wetland Concerns portion of the Site Assessment section. In the short term, marshes should be given higher restoration priority over swamps. Marshes

will rapidly succeed to swamps if not properly managed, whereas swamps are more enduring, already canopied, wetland habitats.

The most important management strategy for ephemeral wetlands and the surrounding landscape is to actively maintain or restore historic fire regimes. Fire suppression was identified as one of the top 8 threats to amphibian conservation (Means 2008) and frequently is cited as a cause for decline in wetland-breeding amphibian populations (Palis 1997, Franz and Smith 1999, Hipes 2003, Jensen and Richter 2005, Means 2007) as well as other taxa (Stoddard 1931, Mushinsky 1985, Brennan et al. 1998, USFWS 2003). The Florida Comprehensive Wildlife Conservation Strategy ranked “incompatible fire” as one of the highest overall threats across all Florida’s terrestrial habitat (FWC 2005). Most land managers recognize the necessity of fire to maintain the longleaf pine ecosystem, but there is debate regarding the importance of fire season versus fire frequency (Bishop and Haas 2005) and as to the appropriate fire frequency (Schurbon and Fauth 2003, Means et al. 2004, Robertson and Ostertag 2004). Additionally, many managers have to contend with managing units or entire properties that have heavy fuel loads resulting from long-term fire suppression. These heavy fuel loads present specific fire safety and ecological concerns.

Regardless of upland burn season and frequency, managers should ensure ephemeral wetland basins burn at least every 1-4 years (Wade et al. 1980, Printiss and Hipes 2000, Ripley and Printiss 2005, Means 2007). Because some wetlands may be severely fire suppressed, several treatments of annual or biennial burns may be necessary to initially suppress the hardwoods (Printiss and Hipes 2000). Historically, fires were ignited by lightning during the spring and early summer and had the potential to burn across large portions of the landscape (Robbins and Myers 1992). Wetlands were often dry during this time and fires were more likely to burn through the wetland basin. Fire reduces hardwood encroachment and buildup of organic matter (Wade et al. 1980). Fire also encourages growth of the herbaceous vegetation around the wetland edge, an area referred to as the littoral zone. This shallow zone is extremely important to adult amphibians for use as breeding and ovipositioning sites and to amphibian larval for food and cover habitat.

We primarily recommend the use of growing season prescribed fires in Florida landscapes in order to mimic the historical fire regimes that occurred here prior to European induced fire suppression. Embedded ephemeral wetlands within upland landscapes should be allowed and encouraged to burn. However, we recognize that dormant season burning may have to be conducted by land managers in many cases, especially in the initial phases of landscape restoration.

From an amphibian conservation perspective, burning of the wetland basin may be as important as the attention given to upland burn frequency and season. The U.S. Forest Service (USFS), in cooperation with Florida State University (FSU), are experimenting with whether dormant season upland burns combined with intentional burning of wetlands will improve conditions for flatwoods salamander populations in the Apalachicola National Forest (C. Hess, USFS/FSU, pers. com.). The uplands

surrounding the wetlands were burned during the USFS's normal winter burning season, but the researchers returned later when the wetland basin was dry and conducted a burn through the wetland basin. Because the fuel load of the surrounding area had been eliminated during recent burns, the researchers were able to conduct a hot, ring fire in the wetland basin. The resulting elimination of woody vegetation and the creation of an herbaceous community in the wetland basin were dramatic and extremely successful (C. Hess, USFS/FSU, pers. comm.). This method can be implemented to improve the ecological condition of ephemeral wetland basins suffering from fire-suppression due to dormant season burning when wetlands are typically filled with water.

The ecological health of an ephemeral wetland is unequivocally connected to that of the surrounding upland habitat (Semlitsch and Jensen 2001, Gibbons 2003, Semlitsch 2003). Wetlands are part of a larger landscape unit comprising a network of energy transfers and chemical interactions among organisms that are directly or indirectly dependent on surface water when it is present (Gibbons 2003). Studies of amphibians in ephemeral wetlands illuminate the enormous wetland-upland biomass exchange. In Florida, 14 amphibian species exclusively or principally breed in ephemeral wetlands and at least a dozen more species utilize the habitat opportunistically (Means 2008). These species spend the majority of their life cycle in the uplands, migrating to wetlands to breed. Travel distances of greater than 400 m have been recorded for many species (Lannoo 2005). The number of individual amphibians entering and exiting a wetland in a given year is often in the thousands (Dodd 1992, Johnson 2001, Means 2007) and even tens of thousands (Semlitsch et al. 1996, Means 2007).

When considering how to properly restore and manage ephemeral wetlands, it is important to note that landscapes typically contain a multitude of ephemeral wetlands that may vary in hydroperiod, floral and faunal species composition, and other ecological characteristics. Whereas some ephemeral wetlands appear quite similar to one another, each is a unique ecological entity possessing unique ecological qualities and processes. Ephemeral wetlands are dynamic ecosystems that constantly undergo ecological succession, responding to abiotic (e.g. climate change, hydroperiod, fire) and biotic (e.g. plant succession, faunal reproductive activity, alteration by humans) factors that are continually ongoing. Whereas in some cases we will recommend how to manage wetlands that need specific attention, the goal of ephemeral wetland management should be to manage at a landscape level for long-term ecological health and biodiversity of the entire ecosystem, including all embedded ephemeral wetlands.

In cases where wetlands can be restored to mimic the natural condition that existed before alteration occurred, we make recommendations on how to accomplish this. We make every effort to tailor our recommendations to the specific needs of each WMA visited. Because little work has been conducted in the field of ephemeral wetland restoration, we may recommend experimenting with different restoration techniques. Any or all of the following techniques may be recommended for the proper, long-term, ecological management of specific ephemeral wetlands or management units that contain multiple similarly impacted wetlands visited within this project:

-
- Landscape (or ecosystem) management
 - Prescribed growing season fire
 - Prescribed dormant season fire
 - Fireline placement
 - Spot use of herbicide on exotic or invasive flora
 - Filling or plugging of drainage ditches
 - Physical elimination/reduction of damaging exotic wildlife (e.g. hogs)
 - Grazing reduction/elimination
 - Hand removal of encroaching vegetation
 - Mechanical removal of encroaching vegetation
 - Mechanical flattening of bedding or windrows
 - Re-routing roads

STUDY AREA

Half Moon Wildlife Management Area is approximately 3,836 ha in size and is located in Sumter County between the towns of Inverness and Wildwood and to the east of the Withlacoochee River (Figure 2). The major vegetation community within HMWMA is hardwood swamp. Other prevalent habitat types include improved pasture, unimproved pasture, and pinelands. Historically, land use in the area was concentrated around cattle grazing. The state purchased half of the property in 1989 and, in 1992, leased the other half through an agreement with the Southwest Florida Water Management District. Cattle leases are still allowed on HMWMA, except for 7 MUs previously owned by the Water Management District.

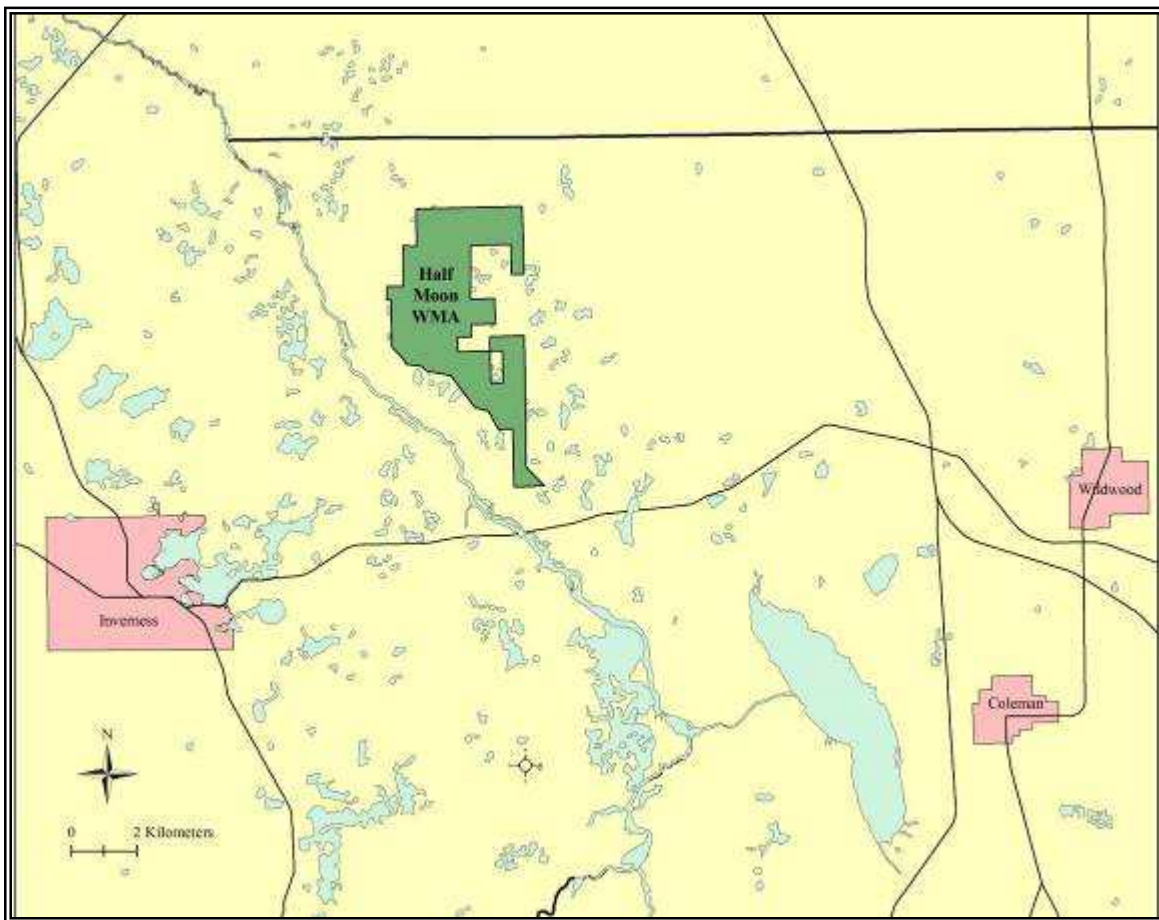


Figure 2. Location of Half Moon Wildlife Management Area.

METHODS

We conducted an initial meeting with HMWMA staff Nancy Dwyer, Area Manager, and Kevin Kemp, Freshwater Wildlife Legacy Biologist and AHRES representative, to familiarize ourselves with land access, burning schedules, management priorities and concerns, and other pertinent issues. We used Digital Orthophoto Quarter Quadrangles (DOQQs) and topographic maps to remotely identify potential ephemeral wetlands on the property. We identified and generated maps for 292 potential ephemeral wetlands on the property.

For this study, ephemeral wetlands were defined as depressional features containing wetland-indicating vegetation, isolated from much larger and deeper wetland strands, swamps, basins, lakes, or other more permanent wetlands. Unless specifically requested by a land manager, we did not visit wetlands surrounded by swampy lowlands such as hydric hammock and tidal marsh. No minimum or maximum size was required to designate a wetland as an ephemeral wetland, but this study focused on inventorying wetlands that were relatively small in size to assist land managers in potentially discovering wetlands that they formerly did not know existed.

We obtained a GIS location at each wetland using a TDS Recon 400x with a Garmin 10 Bluetooth. A quick assessment of wetland and surrounding upland conditions was conducted and recorded on an ephemeral wetland inventory datasheet (Appendix A) and entered into the Recon datalogger. Multiple photographs were taken of each wetland to provide a current “snapshot” of their physical appearance. Clarification of select data collected follows.

Wetland ID

Wetlands were given an ID that corresponds to the Management Unit (MU) number then the wetland number. For example, 04-01 is the first wetland inventoried in MU 4.

Wetland Type

We placed each wetland into one of 5 generalized categories based on descriptions from Ewel (1990), Kushlan (1990), and Whitney et al. (2004):

Marsh – dominated by herbaceous vegetation rooted in or emergent from shallow water - examples include basin, depressional, swales, and wet prairie

Shrub swamp – dominated by shrub or midstory woody vegetation

Forested swamp – forested or wooded wetland - examples include heads, bogs, domes, strands, and hammocks

Mixed swamp – forested wetland with a heavy shrub midstory

Altered – damaged wetland whose original ecological classification is unrecognizable -examples include drained, logged, or mechanically altered wetlands

Basin Area

Length and width of wetland were measured using a range finder, where feasible. Basin area was estimated using the measure tool and DOQQs in ArcMap.

Hydroperiod

Highly Ephemeral – wetlands with a very short hydroperiod, estimated to have standing water only a few months out of a year. Estimations are based on wetland vegetation, soil conditions, and amount of standing water during site visit.

Ephemeral – wetlands with an intermediate hydroperiod, estimated to have standing water for up to 8-10 months out of a year. Estimations are based on wetland vegetation, soil conditions, and amount of standing water during site visit.

Semi-permanent – wetlands with a long hydroperiod, estimated to have standing water for more than a year. Estimations are based on wetland vegetation, soil conditions, and amount of standing water during site visit.

Comments

As requested by N. Dwyer, we indicated which wetlands were potential striped newt breeding habitat. We designated a wetland “striped newt potential” based on current wetland conditions and on our experience with striped newt habitat, not on any quantitative variables. We provided this information to help concentrate future amphibian sampling efforts in wetlands with the greatest potential of supporting striped newts. Striped newts have been recorded on HMWMA in 2 locations, but additional locations may be identified in the future after repeated sampling efforts.

SITE ASSESSMENT

We began our inventory of wetlands on 20 October 2009 and completed the assessment on 25 November 2009. We were unable to inventory all potential ephemeral wetlands on the property in our allotted time frame. As per N. Dwyer's request, we assessed between 2 and 4 wetlands per management unit in most units, and every wetland in 9 select management units. The selected management units included 2 that were identified for intensive management and 7 that were previously owned by SWFWMD on which cattle grazing was excluded. We inventoried a total of 150 wetlands on the property (Figure 3).

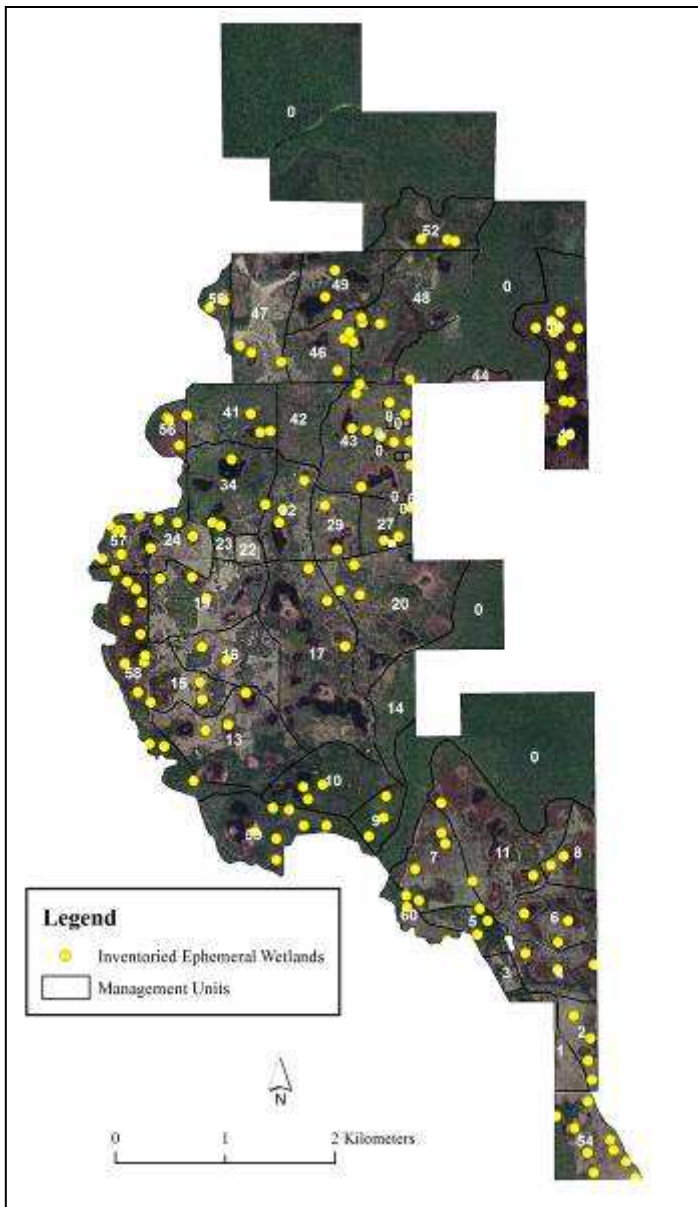


Figure 3. Map of the 150 ephemeral wetlands inventoried on Half Moon WMA.

The majority of restoration concerns on this property were related to problems associated with cattle, direct impacts of cattle as well as the indirect impacts of cattle on the upland ecosystem (i.e. Upland condition). The other major wetland concern on HMWMA was woody encroachment.

Cattle were a wetland concern in 92 wetlands (61%). Cattle are allowed to graze on most of HMWMA, including in some MUs with intact flatwoods ecosystems. Although wetlands and uplands in these MUs currently are in good ecological condition overall, we observed some minor cattle-related effects to some areas in both wetlands and uplands. To protect this high quality flatwoods ecosystem from eventual further degradation by cattle, we recommend removal of cattle from the MUs as soon as possible.

Upland condition was a concern affecting 72 wetlands (48%) on HMWMA. While not an issue for which we provide restoration actions, we made note of this impact because of the close connection between uplands and wetland. When considering the restoration of ephemeral wetlands, the condition of the uplands and upland corridors connecting multiple wetlands is a vital part of that endeavor.

We encountered 60 wetlands (40%) that were affected by woody encroachment to some degree. Most of the woody encroachment was in the form of pine trees growing in dense rings around the wetland. These trees created a shading effect, which reduces the growth of herbaceous vegetation in the wetland. In almost all cases, we recommended thinning the pine trees surrounding the wetlands.

Wetland Concerns

Wetland Concerns were identified for each wetland to highlight areas that may need to be addressed. When deciding what concerns to address, we first recommend using a landscape perspective. The condition of an individual wetland is not as important as the condition of the wetlands as a whole over the landscape. In addition, there is no universally-accepted target condition for every wetland. A mosaic of different wetland conditions is desirable and increases the diversity of the property. For example, if only 1 or 2 wetlands in an area are impacted by woody encroachment, WMA personnel may decide to address this concern by using general landscape management techniques such as periodic, prescribed fire. However, if multiple wetlands are impacted, it may signify a larger issue that may need to be addressed and/or the affected wetlands may need to be custom managed through vegetation removal, burning when the wetland is dry, removing fire breaks, etc. We provided a database for each property to facilitate the use of GIS to spatially identify problem areas (see Database section below).

Depending on resource constraints, landscape conditions, the presence of focal species, or other factors it may be more advantageous to manage at an individual wetland level. Therefore, we also provided restoration actions for each individual wetland. These actions may need to be prioritized (see Restoration Prioritization section below).

Below we detail the impacts of each Wetland Concern and how it pertains to HMWMA. Not all Wetland Concerns were identified on each property but we included them as a reference for WMA personnel. Occasionally we note a Wetland Concern because it has the potential to become a problem in the future, not because it is a current issue (e.g. woody encroachment in wetlands)

Bedding

Historically, much of Florida's flatwoods were bedded in order to provide higher, less water-logged sites on which to plant pine trees. Sometimes bedding was constructed through the edge or center of wetlands. Typically this practice occurred with smaller wetlands. We generally recommend allowing bedding to erode over time. However, more severely damaged wetlands, such as those with severe feral hog damage or altered hydrology, may provide a good experimental situation for mechanically flattening bedding in or around a wetland basin when the wetland is dry. If bedding removal proves successful (i.e. retention of native wetland plants, maintenance of hydroperiod), the method could be used on other, less severely damaged wetlands to restore bedding impacts. In some cases we may recommend specific wetlands where experimental bedding removal could be undertaken. All mechanical activity must be conducted when the wetland is completely dry to minimize soil damage and rut formation.

We encountered no wetlands impacted by bedding on HMWMA.

Cattle

Impacts of cattle grazing to a natural landscape in both wetlands and uplands include nutrient overloading from concentrated urine and feces, trampling, altering plant community structure, facilitation of invasive/exotic species colonization, and soil compaction. We recommend that cattle-grazing be phased out of WMAs altogether as part of a longer-term management strategy to maintain long-term ecological health of ephemeral wetlands and their surrounding uplands. Due to their affiliation with water sources, cattle are a danger to the ephemeral wetland community. If cattle cannot be removed from the property, we recommend continuing the current management practice of keeping them on habitat already degraded by past land use practices. Grazing densities should be kept as low as possible, particularly in MUs with ephemeral wetlands. The use of excluder fencing may be needed for severely damaged wetlands or wetlands with SGCN or other target species.

We identified 92 ephemeral wetlands (61%) in which cattle are a restoration concern on HMWMA. Some of these wetlands have the potential for cattle impacts based on management activities in the MU and some are already impacted to varying degrees by cattle grazing. Cattle grazing is more concentrated on some MUs than others. MUs with heavier grazing tend to look more like pastures with large, open grassy understory and less diverse upland vegetation. Ephemeral wetlands therein sustain heavier grazing and tend to be the most impacted by grazing.

Cattle are allowed to graze in 5 MUs that have intact upland communities: 27, 43, 46, 48, and 49. We strongly recommend eliminating cattle from these MUs as soon as possible to preserve the ecological health of the uplands and wetlands, before the effects of grazing become more severe, and the MU loses much of its plant community structure. Within well-intact yet grazed MUs, there are 20 wetlands that are potential striped newt breeding ponds. This factor, combined with the importance of maintaining healthy upland ecosystems in a state where development already claims a large percentage of upland habitats, are reasons to move cattle out of ecologically well-intact MUs. In the short-term, we recommend moving cattle from the more intact MUs to MUs that already are overgrazed and impacted (e.g. 20, 24, 32). It is crucial to act quickly before the intact MUs are impacted by cattle.

Drainage Ditching, Culverts, Berms, and Roadside Ditching

Ditches have been used in Florida to drain wetlands for decades. Drainage ditches alter the hydrological regime, and therefore the ecological character, of a wetland over time. Culverts associated with wetlands generally are constructed for flood control and/or to drain the wetland or maintain the connectivity of a bisected wetland system. Culverts can allow for unnatural wetland floods or fish inoculations to occur within isolated wetlands. Berms are linear, earthen raised rows usually running parallel to a ditch. These features sometimes run near, through, or around wetlands. Berms can alter wetland hydrology and provide a platform for the establishment of upland plant species through a wetland. Many times berms are created during road-building. The result is an elevated road with ditches on one or both sides of the road. In many cases, access roads run tangent to wetland edges, and have associated roadside ditches of varying depth and hydroperiod. Roadside ditches along wetland edges can provide an unnatural avenue for connectivity to other wetlands located along the road. Roadside ditches may also become refuges for fish if they are deeper with longer hydroperiods than the affected wetland.

It is important to break the connection between ditches and wetlands. We typically recommend filling in all drainage ditches, because it is likely that ditches affect the long-term hydrological regime of a wetland. If filling in the ditch is not an option, the ditch should be plugged as close to the wetland edge as possible.

In the case of roadside ditches tangent to isolated wetlands, we suggest experimental restoration of 1 or 2 wetlands. In order to preserve the drainage functionality of the ditches as well as sever the connectivity between ditches and wetland, 2 culverts could be employed to divert all water to the ditch on the opposite side of the road. The recipient ditch may need to be expanded to accommodate the increase in flow. The modified ditch and culvert system would need to be monitored during heavy rains and, if successful, the method could be used property-wide. An explanatory diagram is provided as Appendix B.

Sometimes ditches themselves are ephemeral and the wetland does not appear to be hydrologically impacted by the ditch. Although priority should be given to filling/plugging deep ditches, we still recommend filling ephemeral ditches because there

may be unseen effects difficult to ascertain in a short period of time without ecological monitoring.

We encountered 6 wetlands with berms. In all cases we recommended removing the berm. We encountered 16 wetlands with a drainage ditch. We recommended filling drainage ditches to break the connectivity with the wetland.

Dug-outs

Dug-outs are features that were created primarily to serve as watering holes for cattle. These structures commonly were excavated within already existing wetland basins. Dug-outs alter the original hydrology of the surrounding wetland by providing a deep, permanent water body that may harbor predatory fish in wetlands that otherwise would not support fish. The unnatural presence of fish in ephemeral wetlands makes them unsuitable for certain rare amphibian species to breed such as the striped newt, gopher frog, and ornate chorus frog (*Pseudacris ornata*).

We recommend that deep dug-outs within ephemeral wetland basins be filled and leveled with the surrounding wetland bottom in order to restore the natural topography and hydrology of the original wetland basin. Existing earthen mounds can be the fill material source. Established permanent wetland animals (e.g. fish, turtles, alligators) could be trapped and moved to other suitable natural wetlands prior to filling the dug-out. Wetland vegetation should quickly reestablish over the filled area.

We encountered 8 wetlands with deep, man-made, dug-out pits within the wetland basin. Additional wetlands with pits occur on HMWMA, but were not visited. These “dug-outs” were all filled with water and most contained fish. Nearby or along each dug-out was an earthen mound representing the dirt that was scooped out to create the pit.

Feral Hog Damage

Feral hogs (*Sus scrofa*) have occupied Florida for almost 500 years (Belden and Frankenberg 1977) and have been recorded in all 67 counties of the state (Layne 1997). Among exotic mammals in Florida, feral hogs have the most destructive impact on natural habitats (Layne 1997). The list of these impacts is long and includes preventing the natural regeneration of native plants such as the longleaf pine (Lipscomb 1989), facilitating the spread of exotic species (Jensen and Vosick 1994), adversely affecting soil microarthropods (Vtorov 1993), transmitting disease (Forrester 1991, Maffei 1997), destroying the nests of birds, turtles, and snakes (Maffei 1997), and affecting species composition (Randall et al. 1997). Habitat damage by feral hogs is most pronounced in wet environments (Choquenot et al. 1996). From an amphibian conservation perspective, rooting and subsequent habitat alteration can destroy amphibian breeding habitat as well as upland refugia (Printiss and Hipes 2001, Means and Travis 2007). Foraging by feral pigs during amphibian breeding events has been observed and could result in the consumption of significant numbers of breeding adults (Jolley 2007).

Most land managers, biologists, and conservationists agree that feral hog reduction and removal should take place to reduce the many impacts hogs have on the natural environment. However, the removal of feral hogs from a property is problematic from both a political and ecological standpoint. The main political obstacle to hog removal often is a strong sport hunter's lobby. Even if managers decide to reduce or remove hog populations, it is extremely difficult to fully eradicate them due, in part, to their high fecundity and the substantial resources required for total eradication. However, it is possible to significantly reduce hog populations and their impacts on a landscape with the use of certain removal techniques.

Sport hunting and direct culling have been used with varied success (Belden and Frankenberger 1977, Ferriter et al. 1997, Engeman et al. 2007). Other possible techniques include fencing of wetlands or wetland clusters (Hone and Atkinson 1983, Lipscomb 1989) and immunocontraception (Killian et al. 2006). Trapping hogs in baited pen traps is one of the most successful techniques to reduce feral swine in a landscape (Engeman et al. 2007; D. Printiss, The Nature Conservancy, pers. com.). In a study on Eglin Air Force Base, hogs were trapped and control hunted on a portion of the property closed to sport hunting where hog populations were relatively high (Engeman et al. 2007). In this study, hog populations and impacts to seepage slopes were dramatically reduced within the closed-to-hunting zone in the first year of hog removal and reduced further in subsequent years. Furthermore, reductions of hogs and impacts also occurred property-wide where hunting has taken place for decades. The researchers calculated economic valuations of seepage slopes and demonstrated substantial benefit-cost ratios to application of swine removal over a three-year period.

Funding to manage feral swine and restore habitat is finite and must be carefully managed to optimize the positive impact on the protected resources (Engeman et al. 2007). In spite of the difficulties encountered with feral hog removal, trapping and hunting can be used to successfully reduce hog populations and their impacts on a given property (e.g., Engeman et al. 2007).

On WMA's where hog populations are dense, sensitive areas that are sustaining heavy hog damage and areas with SGCN could be identified through ecological monitoring. Once identified, these areas could be targeted for hog removal as in the Engeman et al. (2007) study. Benefits mostly would occur in the targeted area, adjoining areas likely would also profit.

Feral hog damage affected 18 of the 150 wetlands (12%) on HMWMA. No wetlands were severely damaged and much of the damage was either old or minor. Affected wetlands were not concentrated in one area of the property, but were spread throughout (Figure 4). We do not recommend aggressive action such as trapping and/or harvesting on HMWMA at this time. If feral hog damage increases in the future, it may be necessary to take aggressive action to prevent wetland degradation.

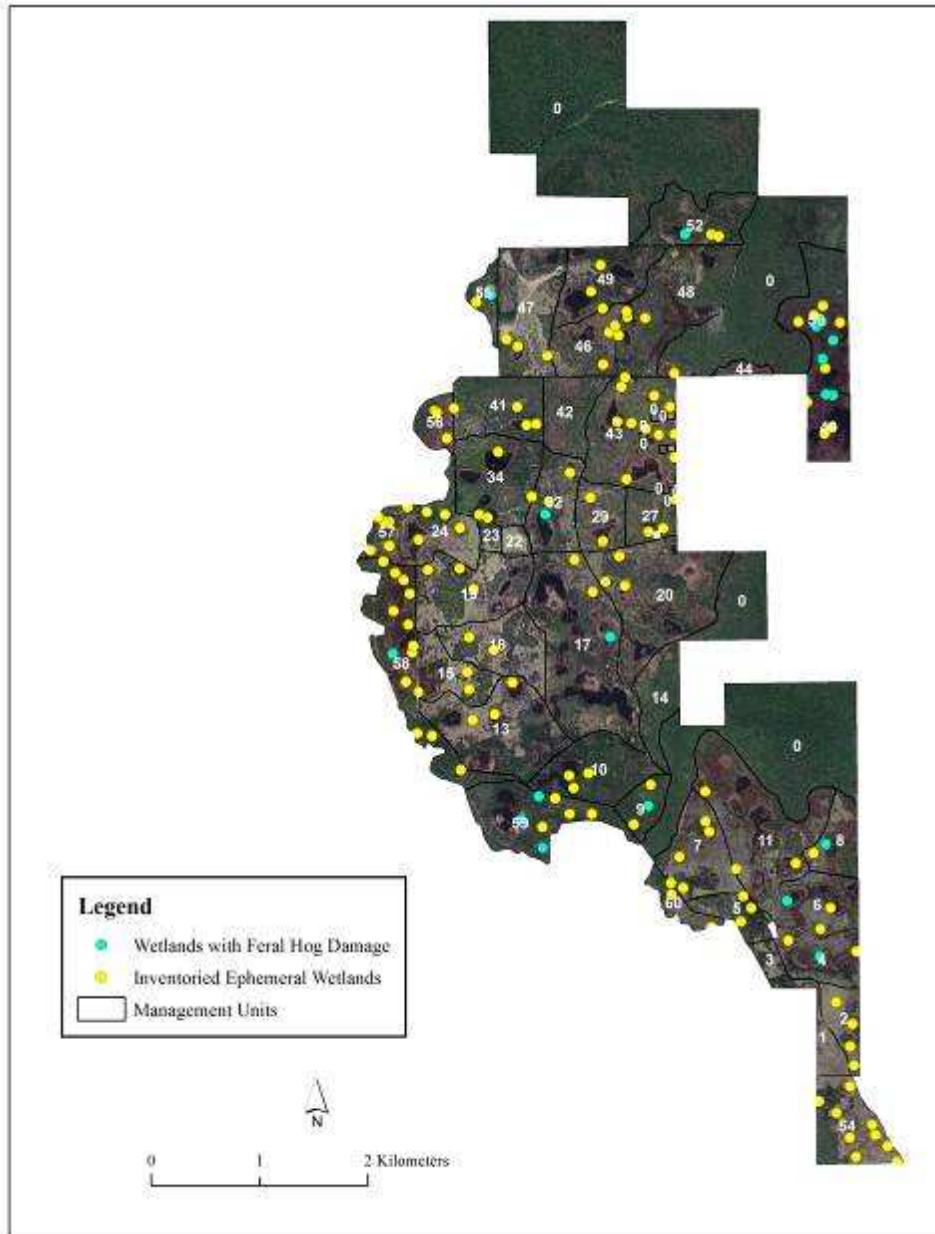


Figure 4. Map depicting the spatial extent of feral hog damage on HMWMA.

If feral hog damage increases, it may be necessary to take aggressive action in target areas. We recommend that trapping be used in combination with sport hunting and control hunting as a 3-pronged approach to reduce the impacts to ephemeral wetlands on these MUs. Hog-trapping can be conducted using WMA personnel or by soliciting the services of the US Department of Agriculture Wildlife Services, the federal agency responsible for managing conflicts with wildlife (Engeman et al. 2007, US Department of Agriculture 1997). To simultaneously provide hunting opportunities and reduce hog impacts to sensitive areas, hunting could take place year-round and in management units (MU's) that have fewer sensitive areas and SCGN while the most sensitive areas are targeted for hog removal.

Firelines/Management Unit Boundaries/Roads

The placement of firelines and roads through wetlands is detrimental to wetland habitat because the swath of exposed soil and denuded vegetation is a direct alteration of wetland habitat and can impact wetland hydroperiod. We recommend firelines and roads be rerouted at least 15m from a wetland edge to prevent damage to the wetland littoral zone. For wetlands that are located adjacent to MU boundaries, we recommend delineating the wetland edges with flagging or some other method so the machine operators will be alerted to diverge from their straight line paths.

We typically recommend allowing abandoned firelines to fill in with vegetation over time. However, WMA personnel have employed mechanical treatments to rework and restore fire plow lines in and around wetlands. Using a low-ground pressure bulldozer and disc for minimal ground disturbance, old wildfire suppression plow lines have been rehabilitated on CRWMA. WMA personnel have observed a more natural hydroperiod and the ability to reintroduce fire into the wetland basin (J. Slater, CRWMA, pers. com.). Firelines bisecting wetlands also have been reworked on GRWMA to address hydrological impacts (J. Ellenberger, GRWMA, pers. com.).

In some instances, a road does not appear to be negatively impacting a wetland and we do not recommend moving the road. In these cases, the action of re-routing a road might be more destructive than leaving it in place. Additionally, we recognize that there are cases where firelines and roads in or near wetlands cannot be rerouted. If firelines/roads cannot be moved, the affected wetlands can be monitored to ensure they burn periodically and do not become impacted by encroaching woody vegetation, sand run-off, or other disturbances. Firelines can be plowed and maintained when wetland is completely dry to prevent large ruts from developing. Vehicular traffic should be discouraged along these firelines.

Where MU boundaries mark a property line with a private landowner, we recommend contacting the private landowner to see if the MU boundary can be moved to encompass the entire wetland. If the wetland is of particular interest (surrounded by intact uplands, potential breeding location for striped newt, etc.), a land swap may be an option to acquire ownership of the entire wetland.

If the road cannot be re-routed, it may be appropriate to experiment with filling in a roadside ditch where it connects to the wetland (see Ditching section). More severely damaged wetlands provide a good opportunity for such an experiment. If successful at these wetlands, the method could be used on other, less severely damaged wetlands to restore ditch impacts. All activity must be conducted when the wetland is completely dry to minimize soil damage and rut formation.

Firelines affected 25 wetlands (17%) on HMWMA. All but one fireline was associated with a MU boundary or a private property boundary. Roads affected 3 wetlands on HMWMA. All of the roads were internal to the property.

Herbaceous Plant Density

The herbaceous community within a wetland is in constant ecological flux. Between fire and inundation, the density of herbaceous vegetation changes over time. For example, immediately following a fire, standing crop biomass of herbaceous vegetation is almost or completely eliminated; however, roots, rhizomes, and seeds of these plants remain resident in the soil and regenerate quickly following fire. Over time, herbaceous vegetation grows back and, if too much time passes between fires or inundation, becomes extremely dense. Wetlands with dense herbaceous vegetation have low plant species diversity and often are completely dominated by one species, usually maidencane or sawgrass. Additionally, these wetlands provide poor habitat for amphibian reproduction and for other species.

For any given WMA property that has a multitude of isolated ephemeral wetlands, the optimum ecological condition is a mosaic of wetlands in different stages of flux. Unless multiple wetlands in an area exhibit dense herbaceous vegetation, long-term ecological fire management of the landscape is sufficient to favor ecological health of a single wetland. We highlight these wetlands so that WMA personnel can monitor their condition. If the condition becomes more severe over time, the wetland may need to be custom burned by waiting until the wetland is dry or intentionally lighting the wetland if a firebreak is present. Prescribed burning of a choked herbaceous marsh reduces vegetation density, increasing sunlight into the wetland ecosystem, and increases overall ecological productivity of the wetland.

We encountered no wetlands affected by dense herbaceous vegetation on HMWMA.

Logging

Old tree stumps or stump hummocks were observed in many ephemeral wetlands on multiple properties during this project, direct evidence of past logging practices. Most of the stumps appeared to be cypress. Sometimes, old logging stumps became hillocks or hummocks onto which woody shrubs established. This process was particularly prevalent on AWMA.

In most cases, stumps and hummocks were observed within swampy ephemeral wetlands that currently are forested by cypress trees. This indicates that the original plant community of the wetland reestablished after logging within the wetland basin. In some wetlands, dense brush established on the old stump hummocks and the cypress canopy did not reestablish. These wetlands became mixed shrub swamps or marshes.

We did not report logging as a Wetland Concern in the Wetland Characterization section because all the logging we encountered occurred long ago and most logged wetlands we observed had reforested. We did describe the presence of stumps or hummocks in the wetland description paragraph in an effort to be as descriptive as possible. In general, we do not recommend that any action be taken to remove old stumps or hummocks, unless they exist within a densely brushy wetland that is a candidate for experimental brush removal, or otherwise needs some other restoration attention. If a wetland becomes

densely brushy, and this process is facilitated by the presence of stump hummocks, periodic fire should keep brush in check and stump hummocks should oxidize.

Planted Pine Trees

Public lands previously owned by timber companies often have evidence of past silviculture practices. Pine trees were planted through small wetland basins, often associated with bedding. Both the shade from the tree canopy and the needle duff can eliminate the herbaceous vegetation vital to the ecological health of a marsh. In most cases, we recommend removing the planted pine trees in an ephemeral wetland.

We encountered no wetlands affected by planted pine trees on HMWMA.

Push Piles

Push piles are earthen mounds commonly formed during the process of land clearing. Heavy machinery is used to scrape clean the harvested landscape. After tree removal, remaining limbs, branches, small trees and shrubs often are pushed into piles and prepared for elimination by burning. Sometimes push piles are not burned, but left behind. In either case, an earthen hillock usually is created in the process, and logged landscapes can have these so-called “push piles” present for decades. Push piles can be several feet high and dozens of feet in diameter. During logging operations of the 20th century, it was not uncommon for land clearing personnel to create push piles within dried ephemeral wetland basins.

Push piles in wetlands can alter the original wetland ecology in at least 2 ways. First, there is the issue of direct reduction of wetland habitat. Second, a raised pile of dirt in a wetland favors establishment of small upland habitats where upland plants and trees can grow. If allowed to grow to maximum height, upland trees (most frequently pine trees) can create a canopy over a potentially large portion of a wetland. If the wetland in question originally was a marsh, the problem mirrors that of woody encroachment into a marsh, namely the shading and subsequent exclusion of native herbaceous wetland vegetation.

Push piles are unnatural and undesirable structures in wetlands. Depending on severity, push piles in ephemeral wetlands should be removed mechanically or be allowed to erode over time, depending on the size and impact of a given pile. Small piles having little impact on a given wetland should be allowed to erode over time. Large push piles in wetlands that are significantly impacting a given wetland should be mechanically removed when the wetland basin is dry. The dirt and any established trees can be removed and distributed in nearby uplands in such a way as to not damage uplands. Alternatively, dirt from push piles could be used for other purposes such as road and ditch fill, etc. A pile should be removed down to the level of the rest of the wetland basin.

We encountered no wetlands affected by a push pile on HMWMA.

Slash

Slash is a term used to describe the treefall and brush byproducts of logging operations. After tree removal, slash is scraped into piles for burning or left to decompose, or the slash is scattered across the ground to decompose. Sometimes slash is left in a wetland. Unless it is a minor amount, we do not recommend slash be left in a wetland. The slash we encountered within wetlands was usually a byproduct of recent mechanical tree thinning or brush removal as part of the restoration process. Depending upon the amount of brush left in a wetland, we recommend two different approaches to eliminate slash within wetlands.

If a significant portion of the wetland is covered with slash, the slash pile is dense, and/or mechanical treatment is needed for some other restoration concern, we recommend removal by root rake or mechanical means when the wetland is completely dry. Slash can be distributed in the uplands and should decompose and/or burn during the next prescribed fire. If the slash amount is minor and is not covering significant proportion of a wetland basin, we recommend encouraging fire in the wetland basin to eliminate the slash.

We encountered no wetlands affected by slash on HMWMA. .

Upland Condition

Discussing upland management is beyond the scope of this project. However, we briefly characterized the uplands around each visited wetland. We used the phrase “Upland Condition” to identify wetlands surrounded by altered uplands or uplands needing restoration attention. When managing for the long-term ecological health of ephemeral wetlands, the ecological condition of surrounding uplands and upland corridors connecting multiple wetlands is equally important. For more information about wetland buffer zones, upland corridors and managing the uplands surrounding wetlands see Semlitsch and Jensen 2001, Semlitsch 2003, and Means 2008.

We encountered 72 wetlands (48%) that were surrounded by uplands impacted by cattle grazing on HMWMA. The full ecological function of these wetlands will not be restored unless the uplands also are restored.

Vehicular damage

Vehicles as a wetland concern usually are related to either recreational use or a result of mechanical activity related to vegetation clearing. Vehicles can impact ephemeral wetlands by compacting soil, destroying the wetland littoral zone, creating ruts that can alter hydrology, and/or facilitating the spread of invasive species. Additionally, the open soil left from vehicular damage can encourage further damage from feral hogs. In the case of recreational vehicles, gates, fencing, and road closures may be needed to reduce access and have been used successfully in some areas (C. Petrick, U.S. Forest Service, pers. com.).

In general, ruts and tracks can be left to erode and revegetate over time. If a wetland is highly damaged and mechanical activity is recommended for another reason, the vehicular damage could be treated mechanically. We acknowledge that some minor vehicular ruts may be created along the edge of wetlands while personnel are working to mechanically remove dense vegetation for the purpose of habitat restoration. To keep rut formation and soil damage to a minimum, all mechanical activity should be conducted when the wetland is completely dry.

We encountered 3 wetlands on HMWMA affected by vehicular traffic. None of the vehicular activity was associated with management activities.

Woody Vegetation Encroachment

Throughout the evolutionary history of the longleaf pine-wiregrass ecosystem, wildfires frequently occurred during the growing season and were common across the Florida landscape, particularly during dry periods (Means, 1996, Platt 1999). Since European colonization, humans have altered the natural fire regime in Florida by suppressing fire during the hot, dry growing season or, more recently, by prescribe burning during the dormant season. Suppressing fire during the growing season allows for dried, exposed wetland soils to be colonized by encroaching woody shrubs and trees. The practice of prescribed dormant season burning, while frequent, corresponds to the time when wetlands typically hold water, a condition which prevents thorough burning of wetlands. During this project, we have observed many ephemeral wetlands with dense, encroaching woody vegetation. This change in community structure has altered the fire feedback mechanism necessary to maintain a fire-adapted wetland community (Martin and Kirkman 2009).

The encroachment of woody vegetation usually manifests as a dense brush ring around the wetland edge, gradual encroachment from the wetland edge, and/or the colonization of plants throughout the wetland basin. Slash pine and wax myrtle are the two most predominant encroaching species into marshes we observed. These native Florida plant species normally occur in the upland/wetland ecotone and along the edge of wetlands and are maintained at low densities under a natural fire regime. However, during drought and fire suppression, these species can vigorously colonize open wetlands in unnaturally high densities along the edge and across the wetland basin. Once established, these species can shade out and exclude herbaceous vegetation, particularly in marshes.

Woody encroachment in marshes is considered on a case by case basis but generally we define it as having greater than 5% of the wetland basin covered by off-site, encroaching species that clearly have become established across the wetland basin during a dry period and fire suppression. Woody-encroached marshes should be managed in the short-term both by fire and other techniques that focus on the direct thinning of invading species. Encroaching woody vegetation in marshes, particularly slash pine and wax myrtle, should be addressed as soon as possible because succession and subsequent exclusion of marsh habitat can happen relatively quickly. Woody encroachment in a forested swamp is defined by having greater than 50% of the wetland midstory covered by shrubs.

There are some woody species that naturally grow in parts of marshes. Buttonbush, for example, is a wetland shrub that often becomes established in deeper sink depressions within marshes where a natural fire shadow exists in the wetland because of increased hydroperiod. Deep areas are less likely to burn over time because they are usually water-filled. These deep areas will and should burn during dry periods. Any native shrubs or trees that become established in the deepest part of a marsh should not be removed—prescribed fire alone is the proper management tool.

Our primary recommendation to reduce encroaching woody vegetation is the use of prescribed fire. If upland burning occurs during a period of wetland inundation, fire crews can return later in the year when the wetlands are dry and provide fire to any unburned wetlands. Because the surrounding uplands will have little to no fuel load, a hot, ring fire can be ignited around the wetland basin, thereby improving chances the entire basin burns. This technique has been successful in restoring an herbaceous community to hardwood-encroached wetlands (C. Hess, USFS/FSU, pers. com.) and has been used successfully as a management technique (N. Dwyer, HMWMA, pers. com.). Sometimes specific attention to lighting fire at the edges or center of a wetland during regular upland burns may be all that is needed. If a fire shadow exists around the wetland, a combination of mowing and chopping of shrubs can be very effective to get fire into the wetland and change the vegetation composition, particularly with saw palmetto (J. Ellenberger, GRWMA, pers. com.).

We recognize that some wetlands are dominated by deciduous hardwoods that will not readily burn and there are cases with larger wetlands where hardwood encroachment is too extensive and/or budget or logistical constraints prevent the use of prescribed fire alone. Some of these wetlands provide a good experimental situation for mechanically removing the vegetation. If the desired results are achieved, the method could be used to restore other wetlands.

Below we provide alternative restoration recommendations for each of the 3 woody encroachment scenarios. These alternative recommendations should be used as a tool to return the wetland to a restored state, after which the wetland can be managed by fire alone. Martin and Kirkman (2009) were able to re-establish the herbaceous community-fire feedback mechanism in hardwood dominated wetlands by removing hardwoods and taking advantage of a persistent seed bank. Their paper is an important reference and represents one of the only published experiments on hardwood removal in southern ephemeral wetlands.

In cases where there is uncertainty about how to manage an impacted ephemeral wetland, we recommend acting on the side of caution and simply manage the surrounding landscape and associated wetlands with frequent prescribed fire. Assuming that everything else in the landscape is functioning close to naturally, frequent fire and periodic inundation will ultimately restore wetland function.

Dense brush rings occur when fire is not allowed to burn to the wetland edge, usually due to the presence of a fireline or because burning occurs when the wetland contains water.

Mechanical removal can be used to reduce a thick and potential hazardous fuel load, after which the use of regular, growing-season fire can be used to maintain the natural ecology and prevent re-sprouting. Where mechanical treatment prior to burning is necessary, we recommend using a gyrotrack or bushhog (mower). Single pass, single drum roller-chopping, followed by burning, also has successfully been used around wetland edges to reduce the midstory component while allowing grasses and herbs to germinate (J. Slater, CRWMA, pers. com.). All mechanical activity must be conducted when the wetland is completely dry to minimize soil disturbance and rut formation.

Woody vegetation encroaching from the wetland edge occurs during a dry period when the wetland is dry for an extended period of time. Woody vegetation (primarily pine and wax myrtle) from the surrounding uplands then has an opportunity to encroach and establish if fire is not allowed to burn into the wetland (e.g. 06-02). Sometimes, there are large, mature slash and loblolly pine trees established around the outer wetland margin or in slightly elevated regions that connect multiple depressions within a single large marsh. Large pine trees should be thinned and harvested using the least disruptive techniques to the wetland. Similarly, wax myrtle shrubs encroaching from the wetland edge can be thinned by chopping or bush hogging, depending on severity of encroachment. We recommend a single thinning of encroaching woody species per marsh in the short-term. After the thinning event, a marsh could be managed solely by periodic prescribed fires over the long-term.

Establishment of woody vegetation in a wetland basin also occurs during a dry period when the wetland is dry for an extended period of time accompanied by a lack of fire. In this scenario, woody vegetation (primarily slash pine trees and wax myrtle) sprouts and colonizes across the entire wetland basin, not just along the wetland edge. There are cases where simply hand chopping young slash pine trees will suffice in small wetlands. Very small pine trees and wax myrtle likely would be killed by the next inundation or fire. If the marsh is large, there are hundreds of invading slash pine trees or wax myrtle, and/or the dbh of the woody vegetation is too large then a bush hog or shredder may be more suitable.

As part of the restoration of a hydrologically modified wetland on GRWMA, approximately 12 ha of willow and wax myrtle were successfully treated using a shredder followed by the reintroduction of fire into the wetland basin (J. Ellenberger, GRMWA, pers. com.). On AWMA, where heavily encroached titi swamps were also impacted by hummocks and old push piles, a low ground pressure track hoe and dozer combination was used to remove the titi and thick organic material down to the mineral soil. The herbaceous vegetation response was variable but generally positive (M. Wilbur, AWMA, pers. com.). In severely disturbed wetlands with dense shrub encroachment Martin and Kirkman (2009) successfully used an industrial mower to remove all small saplings (up to 10 cm dbh) from wetland basins. Large trees can be removed by hand or girdled. Spot herbicide may be necessary on some tree species to prevent re-sprouting (Martin and Kirkman 2009).

All mechanical and herbicide treatments must be conducted when the wetland is completely dry to minimize soil damage and rut formation and to reduce the risk of

herbicide entering the aquatic system. We were unable to locate any sufficient references that unequivocally show herbicides are safe in wetlands. We did find references related to the toxicity of herbicides to amphibians (Berrill et al. 1994, Cheek et al. 1999, Relyea 2005a, Relyea 2005b) as well as the long-term persistence of herbicides in soil (Bell 1997). Herbicide treatments should be selected as a last resort and used with extreme caution. Some general guidelines to follow include: minimizing non-target vegetation spread, using chemicals only on one patch of the site at a time and evaluating the impact, conducting treatments when the wetland is during the dry season when the wetland is completely dry and not expected to hydrate, and using the chemical with the least impact. We found 3 publications that may be useful if herbicide is selected as a management tool: Langeland 2006, Ferrell et al. 2006, Langeland et al. 2009.

We encountered 60 wetlands (40%) on HMWMA impacted by some degree of woody encroachment. Most of the woody encroachment was in the form of dense rings of trees surrounding the wetland. The trees created a canopy and shaded out the herbaceous vegetation. The other common encroachment issue was in the form of shrubs and small trees encroaching from the wetland edge.

Restoration Prioritization

Because resources are finite, not all recommended restoration actions can be employed immediately. Ultimately, the prioritization of wetland restoration is up to the land manager and their objectives, resource availability, and logistical constraints. However, we provide here some general ideas to assist managers in prioritizing restoration of wetlands:

- Conduct biological surveys for rare species, particularly amphibians and other species dependent on ephemeral wetlands. Prioritize restoration actions based on the results of these surveys (i.e. feral hog control or other aggressive actions).
- Prioritize the filling of ditches that are either permanent or connect to permanent water sources over the filling of ephemeral ditches that connect to ephemeral water sources.
- Address woody encroachment in marshes before swamps because succession and subsequent exclusion of marsh habitat can happen relatively quickly.
- Consider resources required and condition of the uplands

Database

In addition to this report, a shapefile was provided that includes all the wetlands inventoried on the property. The shapefile includes an attribute table with fields associated with the following information:

- Wetland ID
- Wetland type
- Basin area
- Hydroperiod
- Canopy coverage (%)
- Dominant canopy species
- Midstory coverage (%)
- Dominant midstory species
- Herbaceous coverage (%)
- Dominant herbaceous species
- Herbaceous distribution
- Wetland concerns
- Upland community type
- Upland conditions

This database provides a quick reference for land managers to not only locate ephemeral wetlands on each property, but to know wetland attributes associated with each location and spatially identify major wetland concerns (e.g. Figure 4).

Wetland Characterizations and Descriptions

The following pages provide photographs and descriptions of the 150 ephemeral wetlands assessed on HMWMA. The MUs are organized numerically. The wetland nomenclature uses the MU number and the wetland number. For example, 04-01 is the first wetland inventoried in MU 4. Additional photographs were provided on the accompanying CD.

Wetland ID: 00-01

Description: This wetland is a 1.3 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This wetland is a good example of an ecologically healthy marsh and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and hardwood hammock. Cattle are allowed to graze in this unit but do not appear to have impacted this wetland significantly.

Wetland Concerns: Cattle

Restoration Action Recommended: While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat.

Wetland ID: 02-01

Description: This wetland is a 0.1 ha highly ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This wetland does not have classic wetland plants but is a depression and will fill with water infrequently. Large pine trees form a ring around the wetland. The adjacent uplands are grazed pasture with oaks and pine, and are currently managed with prescribed fire and herbicide.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 02-02

Description: This wetland is a 0.1 ha semi-permanent, dug-out cattle pond. There is no tree canopy or midstory cover. Sedges/grasses grow in a ring around the wetland edge, and cover 5-25% of the basin. A berm surrounds the pond. Cattle are impacting the wetland, as evidenced by the excess nutrient load. The adjacent uplands are pasture and sandhill, and are currently managed with prescribed fire and herbicide.

Wetland Concerns: Berm, Cattle, Upland condition

Restoration Action Recommended: While this wetland is man-made, it has the potential to function as an ephemeral wetland if desired. The berm could be removed to allow for a more natural hydroperiod in the wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 02-03

Description: This wetland is an 8.1 ha ephemeral marsh. A few small and large pine trees are growing in the wetland, but cover <5% of the basin. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A property boundary with a fence and fireline bisect the wetland. There are cattle trails in the wetland. The adjacent uplands are pasture and sandhill, and are currently managed with prescribed fire and herbicide.

Wetland Concerns: Cattle, Fireline/private property boundary, Upland condition

Restoration Action Recommended: The boundary should be re-routed away from the wetland if feasible. If the fireline cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. Encourage fire in the wetland basin. Monitor the wetland to ensure pine trees are killed with the next fire or inundation. If they become established, the encroaching pine trees will need to be removed from the wetland. Alternatively, the pine trees can be removed now. In order to restore the full ecological potential of this wetland, the cattle should be removed and the uplands restored.

Wetland ID: 02-04

Description: This wetland is <0.1 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout, this herbaceous vegetation covers 50-75% of the wetland basin. This depressional marsh is over-utilized by cattle, as evidenced by the trampling of soil and vegetation and the nutrient pollution. The adjacent uplands are pasture and sandhill, and are currently managed with prescribed fire and herbicide.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, cattle should be removed and the uplands restored.

Wetland ID: 04-01

Description: This wetland is 6.1 ha semi-permanent marsh. Pine trees grow in a dense ring around the wetland, and cover 5-25% of the basin. Willow grow in the deeper wetland center, and cover 5-25% of the wetland. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is cattle and feral hog damage in the wetland. The adjacent uplands are pasture and sandhill with a dense palmetto ring. The uplands are currently managed with prescribed fire.

Wetland Concerns: Cattle, Feral hog damage, Upland condition, Woody encroachment

Restoration Action Recommended: Thin the dense ring of pine trees that grow around the wetland edge. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 04-02

Description: This wetland is a 0.5 ha ephemeral marsh with a semi-permanent dug-out. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The north side of the wetland has been dug-out, likely to provide water for cattle. This deeper section of the wetland has high levels of nutrients and is surrounded by a tall berm. The adjacent uplands are pasture and old field, and are currently managed with prescribed fire.

Wetland Concerns: Berm, Cattle, Dug-out, Upland condition

Restoration Action Recommended: Remove the berm and fill in the dug-out. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 04-03

Description: This wetland is a 0.6 ha ephemeral marsh. Pine trees form a ring around the wetland, and cover 5-25% of the basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary bisects the western side of the wetland. Some small pine trees were killed by a recent fire in the wetland basin; a few small pine trees remain. Cattle have grazed the herbaceous vegetation in the wetland. The adjacent uplands are pasture and old field, and are currently managed with prescribed fire.

Wetland Concerns: Cattle, Fireline/private property boundary, Upland condition, Woody encroachment

Restoration Action Recommended: The boundary should be re-routed away from the wetland if feasible. If the boundary cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. Hand-remove interior pine trees and thin larger pine trees around wetland edge with a chainsaw. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 05-01

Description: This wetland is a <0.1 ha semi-permanent, dug-out cattle pond. There is no tree canopy or midstory cover. Emergent vegetation grows in a ring around the edge of the wetland and cattails grow in the wetland center. The herbaceous vegetation covers 25-50% of the wetland basin. The pond is over-utilized by cattle, as evidenced by the trampling of soil and vegetation and the nutrient pollution. The adjacent uplands are pasture and old field and grazed pineland.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: While this wetland is man-made, it has the potential to function as an ephemeral wetland if desired. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 05-02

Description: This wetland is a 0.5 ha ephemeral marsh. Pine trees grow in a ring around the wetland and large oaks lean over the wetland edge. The tree canopy covers 5-25% of the wetland basin. A few small pine and gum trees grow throughout the basin but cover <5% of the wetland. Maidencane grows throughout the wetland, and covers >75% of the basin. The cattle impact is minor. A fenceline bisects the southwest corner of the wetland. The adjacent uplands are pasture and old field and grazed pineland.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: The Fireline/MU boundary should be re-routed away from the wetland if feasible. If the fireline cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. Thin the dense pine trees around the wetland edge and encourage fire in the wetland basin to prevent further woody encroachment. While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 05-03

Description: This wetland is a 0.1 ha ephemeral marsh. Large and small pine trees surround the marsh, and cover 5-25% of the wetland basin. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is some evidence of grazing in and around the wetland. The adjacent uplands are pasture and old field and grazed pineland.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Thin pine trees in the dense ring around the wetland. Encourage periodic fire to prevent encroachment of small pine trees. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 06-01

Description: This wetland is a 0.7 ha ephemeral marsh. Pine trees grow in a stand at the south end of the wetland, and cover 5-25% of the wetland basin. Small pine trees are encroaching from the edge of the wetland but cover <5% of the wetland. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is a ditch connected to the northwest corner of the wetland. The adjacent uplands are pasture and old field.

Wetland Concerns: Cattle, Ditching, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Remove or thin pine stand. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now. While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 06-02

Description: This wetland is a 3.4 ha semi-permanent marsh. Pine trees grow around the wetland edge, and cover 5-25% of the wetland basin. Small pine trees are encroaching from the edge of the wetland but cover <5% of the wetland. Maidencane, sedges/grasses, and emergent vegetation grow throughout the wetland, and cover >75% of the basin. There is a ditch connected to the south side of the wetland. Cattle grazing and feral hog damage is light. The adjacent uplands are pasture and old field.

Wetland Concerns: Cattle, Ditching, Feral hog damage, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 06-03

Description: This wetland is a 1.4 ha ephemeral marsh. Large and small pine trees, and a few wax myrtles, are encroaching from the edge of the wetland, especially along the west side. The tree canopy covers 5-25% of the wetland basin. There is no significant midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are pasture and old field.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Monitor the wetland to ensure encroaching woody vegetation is killed with the next fire or inundation. If they become established, the pine trees and wax myrtle will need to be removed from the wetland. Alternatively, the encroaching vegetation can be hand-chopped now. While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 07-01

Description: This wetland is a 0.4 ha ephemeral marsh. Pine trees grow in a ring around the wetland and large oak trees lean into the edge of the wetland. The tree canopy covers 5-25% of the wetland basin. There is no midstory cover. Maidencane grows throughout and covers >75% of the wetland basin. There is evidence of cattle in the wetland basin. The adjacent uplands are oak hammock and pasture.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: The pine and oak trees could be thinned from around the wetland edge. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 07-02

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle are grazing in the wetland, although the impact is light. The adjacent uplands are old field and pasture.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 07-03

Description: This wetland is a 0.2 ha ephemeral marsh. There is an extensive pine ring around the wetland and large pine trees growing in the center of the wetland. The tree canopy covers 5-25% of the wetland. There is no midstory layer. Maidencane and emergent vegetation grow throughout the wetland, and cover >75% of the basin. A recent fire burned all the way through the wetland. Cattle are grazing in the wetland interior. The adjacent uplands are old field and pasture.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Remove pine trees from the wetland interior and thin pine trees from the ring around the wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 07-04

Description: This wetland is a 0.8 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane and emergent vegetation grow throughout the wetland, and cover >75% of the basin. There is a ditch connected to the northeast side of the wetland. This large marsh has diverse herbaceous vegetation, although plants have grazed tips. A pine ring in the upland surrounds the wetland but is not yet encroaching into the basin. The adjacent uplands are old field and pasture.

Wetland Concerns: Cattle, Ditch, Upland condition

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored. The pine ring in the uplands could be removed during upland restoration efforts. The pine trees are not yet encroaching into the wetland basin but may potentially do so in the future.

Wetland ID: 08-01

Description: This wetland is a 3.5 ha ephemeral marsh. Pine trees grow on a land ridge that bisects the wetland. A few pine trees also are encroaching from around the wetland edges. The tree canopy covers 5-25% of the wetland basin. There is no midstory layer. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. Feral hog and cattle impacts are minor. The marsh is large and open and in relatively good ecological condition. The wetland is surrounded by a dense palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Feral hog damage, Upland condition, Woody encroachment

Restoration Action Recommended: Remove encroaching pine trees and thin pine trees growing on the land ridge. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 08-02

Description: This wetland is a 0.1 ha highly ephemeral marsh. Large pine trees grow in the wetland basin and live oak trees hang partially over the wetland. The tree canopy covers 25-50% of the wetland. There is no midstory layer. Sedges/grasses grow in the wetland center, and cover 25-50% of the basin. The wetland is surrounded by an extremely dense palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Thin the pine and oak trees surrounding the wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 09-01

Description: This wetland is a 0.3 ha ephemeral marsh. This depression marsh is extensively encroached by pine trees. Small pine trees are scattered throughout the wetland interior, and the needle fall and shading from the pine ring hinder herbaceous vegetation growth. Large pine trees grow in a ring around the wetland and cover 25-50% of the wetland basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a dense brush ring and scrubby flatwoods. The uplands appear to have been fire suppressed but now are managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Remove large pine trees from the wetland interior and thin pine trees in the ring around the wetland. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now.

Wetland ID: 09-02

Description: This wetland is a 0.6 ha ephemeral marsh. Large pine trees grow in a loose ring around the wetland and cover 5-25% of the wetland basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Feral hog damage is patchy. The adjacent uplands are scrubby flatwoods. The flatwoods appear to have been fire suppressed but now are managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: Feral hog damage, Woody encroachment

Restoration Action Recommended: Thin the encroaching pine trees around the wetland edge.

Wetland ID: 09-03

Description: This wetland is a 0.4 ha semi-permanent mixed swamp. Cypress trees dominate the canopy, and cover 50-75% of the wetland basin. The midstory is dominated by wax myrtle, and covers 50-75% of the wetland. Maidencane and emergent vegetation grow in scattered patches, and cover 25-50% of the wetland basin. This wetland appears to be a former marsh is succeeding into a swamp. The wetland has a marsh area on the south side. The adjacent uplands are scrubby flatwoods. The flatwoods appear to have been fire suppressed but now are managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: None

Restoration Action Recommended: Review historic aerial photographs. If wetland historically was a marsh, managers could experiment with restoring the wetland to its original condition before woody encroachment occurred. However, given the large number of marshes in this area and the fact that this wetland appears to be in good ecological condition, restoration of this wetland is a low priority.

Wetland ID: 10-01

Description: This wetland is a 3.5 ha ephemeral marsh. Pine trees grow in a ring around the wetland and cover 5-25% of the basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is evidence of fire in this large, L-shaped wetland. This marsh will connect with 10-02 during periods of high water. The wetlands are separated by a pine-encroached ridge. The adjacent uplands are mesic flatwoods managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin pine trees in the wetland back to the palmetto line and trees growing on the ridge as well.

Wetland ID: 10-02

Description: This wetland is a 2.2 ha ephemeral marsh. Pine trees grow in a ring around the wetland and cover 5-25% of the basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This marsh will connect with 10-01 to the southwest and 10-03 to the southeast during periods of high water. The wetlands are separated by a pine-encroached ridge. A recent fire killed many pine trees but many still remain. The adjacent uplands are mesic flatwoods managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin pine trees around the wetland and growing on the ridge.

Wetland ID: 10-03

Description: This wetland is a 0.4 ha ephemeral marsh. Pine trees grow in a loose ring around the wetland and cover 5-25% of the basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A recent fire killed half of the encroaching pine trees. The southwest corner of this wetland will connect with 10-02 during periods of high water. The adjacent uplands are mesic flatwoods managed with prescribed fire and mechanical vegetation removal.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin remaining pine trees to the palmetto line.

Wetland ID: 11-01

Description: This wetland is a 2.3 ha semi-permanent marsh. There is no significant tree canopy. Wax myrtle and small pine trees are encroaching from the wetland edge, and cover 5-25% of the wetland. Sedges/grasses, emergent vegetation, and maidencane grow throughout the wetland, and cover >75% of the basin. This large marsh has a dug-out on the north side with an associated berm. The wetland is surrounded by a dense pine/oak/palmetto ring and grazed uplands.

Wetland Concerns: Berm, Cattle, Dug-out, Upland condition, Woody encroachment

Restoration Action Recommended: Remove the berm and fill the dug-out. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching woody vegetation is killed with the next fire or inundation. If they become established, the woody vegetation will need to be removed from the wetland. Alternatively, the small pine trees and wax myrtle can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 11-02

Description: This wetland is a <0.1 ha semi-permanent marsh. There is no tree canopy or midstory layer. Sedges/grasses grow in a ring around the wetland, and cover 25-50% of the wetland basin. This pasture pond is over-utilized by cattle, as evidenced by the trampling of soil and vegetation and the nutrient pollution. A layer of duckweed coats the water surface. The adjacent uplands are grazed pasture and old field.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 11-03

Description: This wetland is a 2.0 ha ephemeral marsh. Large and small pine trees ring the wetland, and some small pine trees and wax myrtle are beginning to encroach into the wetland. There is no significant tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is a shallow ditch on the south side of the wetland associated with a culvert and a nearby road. The adjacent uplands are mesic flatwoods except on to the south where cattle graze on pasture.

Wetland Concerns: Ditch, Cattle, Upland condition

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching woody vegetation is killed with the next fire or inundation. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands to the south restored.

Wetland ID: 13-01

Description: This wetland is a 2.8 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This wetland has diverse herbaceous vegetation but suffers from the effects of cattle. There is a dug-out pond on the north side of the marsh and several cattle trails leading around and in the basin. The adjacent uplands are grazed uplands with some planted longleaf pine rows.

Wetland Concerns: Cattle, Dug-out, Upland condition

Restoration Action Recommended: Fill dug-out. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 13-02

Description: This wetland is a 1.7 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is evidence of cattle in the form of trampling, excrement, and grazing. The wetland is surrounded by a pine/oak ring and grazed uplands. The adjacent pasture has been planted in longleaf pine rows.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 13-03

Description: This wetland is a 0.3 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle have grazed within the wetland depression. The wetland is surrounded by a thick palmetto ring and grazed uplands. The adjacent pasture has been planted in longleaf pine rows.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 15-01

Description: This wetland is a 0.7 ha ephemeral marsh. Pine trees are encroaching into the wetland basin, mainly on the south end. There are a few patches of gallberry in the basin as well. The tree canopy covers 5-25% of the wetland basin. There is no significant midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle have grazed in the wetland basin. The wetland is surrounded by a palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Remove encroaching pine trees from the wetland basin and encourage periodic fire to prevent further woody encroachment. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 15-02

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is evidence of cattle grazing in the wetland. The wetland is surrounded by a palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 15-03

Description: This wetland is a 5.9 ha ephemeral marsh. Pine trees are encroaching into the wetland and cover 5-25% of the wetland basin. There is no midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The wetland is on the border with Water Management District land and a fireline and fence bisects the west side of the wetland. Pine tree and wax myrtle are establishing on the hillock along the fence. The wetland is surrounded by a palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Fireline/MU boundary, Upland condition, Woody encroachment

Restoration Action Recommended: The fireline/MU boundary should be re-routed away from the wetland if feasible. If the fireline cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. Remove pine trees and wax myrtle on the fenceline hillocks. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 16-01

Description: This wetland is a 4.9 ha ephemeral marsh. Pine trees are beginning to encroach along the wetland edge, and cover 5-25% of the wetland basin. There is no midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This large, open marsh has a deeper depression in the center. There is a fenced-off area in the center of the wetland, possibly a research plot. Maidencane grows thick within the fenced area and sparser outside the fenced plot. The wetland is surrounded by a palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: Encourage fire in the wetland to prevent further pine tree encroachment. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 16-02

Description: This wetland is a 1.5 ha ephemeral marsh. A few pine trees (<5% coverage) are encroaching from the edge. There is no midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The grass in the wetland has been grazed. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: Encourage fire in the wetland to prevent further pine tree encroachment. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 17-01

Description: This wetland is a 5.4 ha semi-permanent marsh. There is no tree canopy cover. Wax myrtle and willow cover 25-50% of the wetland basin. Sedges/grasses, maidencane, and emergent vegetation grow throughout the wetland, and cover >75% of the basin. This large marsh has several deeper areas in which the willow and emergent vegetation grow. Wax myrtle is encroaching around the edge of the entire wetland. The cattle impact is light but the feral hog damage is moderate in the wetland. There is a ditch on the north side of the wetland that connects this wetland with 17-02 and a ditch on the southwest side of the wetland that connects to a larger swamp system. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Feral hog damage, Ditching, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching wax myrtle is killed with the next fire or inundation. If it becomes established, the woody vegetation will need to be removed from the wetland. Alternatively, wax myrtle can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 17-02

Description: This wetland is a 1.5 ha ephemeral marsh. There is no tree canopy cover. A thin ring of wax myrtle is beginning to encroach from around the wetland edge and covers 5-25% of the wetland basin. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The cattle impact is light. There is a ditch on the south side of the wetland that connects to Wetland 17-01 and possibly one associated with a culvert under a road on the east side of the wetland. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Ditching, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching woody vegetation is killed with the next fire or inundation. If it becomes established, the woody vegetation will need to be removed from the wetland. Alternatively, the wax myrtle can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 17-03

Description: This wetland is a 0.7 ha ephemeral marsh. There is no tree canopy cover. A dense ring of wax myrtle is beginning to encroach from around the wetland edge and cover 5-25% of the wetland basin. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle are grazing in the wetland basin. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching woody vegetation is killed with the next fire or inundation. If it becomes established, the woody vegetation will need to be removed from the wetland. Alternatively, the wax myrtle can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 19-01

Description: This wetland is a 1.7 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane grows throughout the wetland, and covers >75% of the basin. This 3-lobed wetland has elevated land bridges between the deeper spots. Shrubs are beginning to encroach from the land bridges though there are no shrubs in the wetland interior. A ditch on the south side of the wetland connects to Wetland 19-02. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage periodic fire to prevent encroachment of woody vegetation. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 19-02

Description: This wetland is a 1.4 ha altered marsh. The wetland was an ephemeral marsh but a dug-out section has created a semi-permanent section, thereby allowing fish to persist. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is a ditch on the north side of the wetland that connects this wetland with 19-02 and a ditch on the southeast side of the wetland that connects to a larger wetland that was not inventoried. The ditch on the southeast side has been plugged. This marsh also has been impacted by cattle and is nutrient-polluted. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Ditching, Dug-out, Upland condition

Restoration Action Recommended: Fill the ditch and the dug-out. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 19-03

Description: This wetland is a 0.7 ha ephemeral marsh. There is no tree canopy cover. Wax myrtle shrubs grow throughout the wetland, and cover 5-25% of the wetland basin. A hot fire burned in the wetland and killed many of the shrubs and they are now re-sprouting. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. A connects the north side of the wetland with the bottom of Wetland 24-01. There is also a ditch on the south side of the wetland that connects with Wetland 58-10. This marsh also has been impacted by cattle. This wetland provides a great example of woody encroachment and how the encroachment can be managed by fire. The wetland is surrounded by a dense palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Ditching, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage periodic fire to prevent the encroachment of wax myrtle. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 20-01

Description: This wetland is a 0.8 ha ephemeral marsh. There is no tree canopy cover. Small pine trees are beginning to encroach into the wetland center, and 5-25% of the wetland basin. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is evidence of cattle in the wetland. The wetland is surrounded by a dense palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 20-02

Description: This wetland is a 0.2 ha ephemeral marsh. There is no tree canopy cover. Wax myrtle is encroaching from the wetland edge and covers 5-25% of the wetland basin. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is evidence of cattle grazing in the wetland basin. A shallow ditch connects the west side of the wetland to a culvert under the road. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Ditching, Upland condition, Woody encroachment

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. Encourage periodic fire to prevent further shrub encroachment. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 20-03

Description: This wetland is a 3.9 ha semi-permanent marsh. There is no tree canopy cover. A few wax myrtles and young pine trees (<5% cover) grow around the wetland edge. The woody vegetation is mostly on the wetland/upland ecotonal boundary. Cattle grazing is evident along this boundary. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: Encourage periodic fire to prevent encroachment of woody vegetation. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 24-01

Description: This wetland is a 6.0 ha ephemeral marsh. A large pine tree grows in the center of the wetland basin but provides <5% cover. There is no midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle have extensively grazed in the wetland basin. Two ditches in the southeast corner of the wetland connect to 19-01 to the east and Wetland19-03 to the south. A fireline/MU boundary bisects the south end of the wetland. The wetland is surrounded by a dense oak/palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Ditching, Fireline/MU boundary, Upland condition

Restoration Action Recommended: Fill the ditches to break connectivity with the wetlands. Alternatively, the ditches could be plugged and vegetation allowed to regenerate. The Fireline/MU boundary should be re-routed away from the wetland if feasible. If the fireline cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 24-02

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a dense brush ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 24-03

Description: This wetland is a 0.3 ha ephemeral marsh. Pine trees are encroaching, especially on the south side, and cover 5-25% of the wetland basin. There is no midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The south side of the wetland is impacted by cattle. A fireline/MU boundary bisects the center of the wetland. A recent fire burned into the wetland basin. The adjacent uplands are grazed uplands to the south and a pine/oak/palmetto community on the north side.

Wetland Concerns: Cattle, Fireline/MU boundary, Upland condition, Woody encroachment

Restoration Action Recommended: Move the fireline into the uplands and away from the wetland. Thin perimeter pine trees up to the palmetto/gallberry line. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 24-04

Description: This wetland is a 0.2 ha ephemeral marsh. Several gum trees grow in the wetland center, and cover 5-25% of the basin. There is no midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. The south side of the wetland is impacted by cattle. A fireline/MU boundary bisects the center of the wetland. The adjacent uplands are a pine/oak/palmetto community and grazed uplands.

Wetland Concerns: Cattle, Fireline/MU boundary, Upland condition

Restoration Action Recommended: Move the fireline into the uplands and away from the wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 27-01

Description: This wetland is a 1.2 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary bisects the northeast corner of the wetland. Heavy amounts of cattle tracks are in the fireline through the wetland. This wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods on the west side and planted pine trees to the east.

Wetland Concerns: Cattle, Fireline/private property boundary

Restoration Action Recommended: The boundary should be re-routed away from the wetland if feasible. If the boundary cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 27-02

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane grows in the center of the wetland and broomsedge grows around the wetland edges. The herbaceous vegetation covers >75% of the wetland basin. Even though cattle are allowed to graze in this area, there is no evidence of grazing or other impacts in the wetland basin. This wetland is a good example of a marsh without woody encroachment and is a potential striped newt breeding pond. The adjacent uplands are open scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat. The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 27-03

Description: This wetland is a 2.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is impacted by cattle; there are cow patties and evidence of cattle grazing in the wetland basin. This wetland is a good example of a marsh without woody encroachment and is a potential striped newt breeding pond. The adjacent uplands are open scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 29-01

Description: This wetland is a 6.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle impact is minimal with a few trails leading to the wetland edge. This wetland is a good example of a marsh with wax myrtle and slash pine in an ecological balance and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and oak/palmetto brush.

Wetland Concerns: Cattle

Restoration Action Recommended: While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat.

Wetland ID: 29-02

Description: This wetland is a 5.3 ha altered marsh. The wetland was an ephemeral marsh but a dug-out section on the west side created a semi-permanent section. There is no tree canopy cover. Small pine trees and wax myrtle grow in the wetland interior, and cover 5-25% of the wetland basin. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is a ditch on the west side of the wetland and evidence of cattle impacts throughout. The wetland is surrounded by a thick oak/palmetto ring, scrubby flatwoods, and oak hammock.

Wetland Concerns: Cattle, Ditching, Dug-out, Woody encroachment

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed. Fill the ditch and the dug-out. Encourage periodic fire in the wetland to prevent further woody encroachment.

Wetland ID: 32-01

Description: This wetland is a <0.1 ha ephemeral marsh. Oak trees are leaning over the wetland edge, and cover 5-25% of the wetland basin. Buttonbush and dog fennel dominate the midstory, and cover 5-25% of the wetland basin. Maidencane grows throughout the wetland, and covers 25-50% of the basin. The wetland is surrounded by a dense oak/palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 32-02

Description: This wetland is a 3.8 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedge/grasses grow throughout the wetland, and cover >75% of the basin. This oblong, large depression marsh has very diverse herbaceous vegetation but is impacted by extensive cattle grazing. The wetland is surrounded by a dense oak/palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 32-03

Description: This wetland is a 0.2 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. A fireline/MU boundary bisects the west side of the wetland. A ditch connects on the south side of the wetland connects to the larger Wetland 32-04. The adjacent uplands are grazed uplands and a longleaf pine stand.

Wetland Concerns: Cattle, Ditching, Fireline/MU boundary, Upland condition

Restoration Action Recommended: Move the fireline/MU boundary out of the wetland. Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 32-04

Description: This wetland is a 4.6 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. Impacts from feral hogs and cattle grazing are patchy in the wetland. There are ditches on the north and south sides of the wetland. A ditch on the north side of the wetland connects to Wetland 32-03 and a ditch on the south side of the wetland connects to a large wetland system that was not inventoried. The ditch on the south side of the wetland has been plugged. The wetland is surrounded by an oak/palmetto ring and grazed uplands.

Wetland Concerns: Cattle, Ditching, Feral hog damage, Upland condition

Restoration Action Recommended: Fill the ditch to the north to break connectivity with Wetland 32-03. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 34-01

Description: This wetland is a 1.8 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. This marsh appears to be in good ecological condition despite the presence of cattle. The adjacent uplands are a recently burned pine/oak/palmetto community.

Wetland Concerns: Cattle

Restoration Action Recommended: While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat.

Wetland ID: 34-02

Description: This wetland is a 1.0 ha ephemeral marsh with a small forested swamp on the south side. Cypress and pine trees dominate the canopy, and cover 5-25% of the wetland. There is no midstory layer. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is a grouping of large pine trees in the southwest corner of the wetland. A fireline/MU boundary bisects the south end of the wetland and a fenced plot is located in the western section of the wetland. Cattle impacts are light. The adjacent uplands are a recently burned pine/oak/palmetto community.

Wetland Concerns: Cattle, Fireline/MU boundary

Restoration Action Recommended: Move the Fireline/MU boundary away from the wetland. While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat.

Wetland ID: 34-03

Description: This wetland is an 8.3 ha altered marsh. The wetland was an ephemeral marsh but a dug-out section has caused a section to remain semi-permanent, thereby allowing fish to persist. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. This marsh would be a potential striped newt breeding pond if the marsh was restored and the dug-out filled. There is evidence of past cattle presence in the wetland. The adjacent uplands are a mix of scrubby flatwoods and upland pine forest.

Wetland Concerns: Cattle, Dug-out

Restoration Action Recommended: Fill the dug-out. In order to restore the full ecological potential of the wetland, the cattle would need to be removed.

Wetland ID: 40-01

Description: This wetland is a <0.1 ha highly ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This small, circular marsh is prime striped newt breeding habitat. There is some minor feral hog damage in the wetland. The adjacent uplands are fire-maintained scrubby flatwoods.

Wetland Concerns: Feral hog damage

Restoration Action Recommended:

Wetland ID: 40-02

Description: This wetland is a <0.1 ha highly ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. A fireline/MU boundary bisects the wetland. The wetland has past and present feral hog damage and is a potential striped newt breeding pond. The adjacent uplands are fire-maintained scrubby flatwoods.

Wetland Concerns: Feral hog damage, Fireline/MU boundary

Restoration Action Recommended: The fireline/MU boundary should be re-routed away from the wetland if feasible. If the fireline cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 40-03

Description: This wetland is a 0.9 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary bisects the wetland. This wetland is a potential striped newt breeding pond. The adjacent uplands are fire-maintained scrubby flatwoods.

Wetland Concerns: Fireline/private property boundary

Restoration Action Recommended: The boundary should be re-routed away from the wetland if feasible. If the boundary cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 40-04

Description: This wetland is a 3.2 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary bisects the western edge of the wetland. This wetland is a potential striped newt breeding pond. The adjacent uplands are fire-maintained scrubby flatwoods.

Wetland Concerns: Fireline/private property boundary

Restoration Action Recommended: The fireline/private property boundary does not appear to be movable away from the wetland and it affects a very small portion of the wetland. Monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 40-05

Description: This wetland is a 5.3 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary bisects the eastern edge of the wetland. The wetland is in great ecological condition and is a potential striped newt breeding pond. The adjacent uplands are fire-maintained scrubby flatwoods.

Wetland Concerns: Fireline/private property boundary

Restoration Action Recommended: The fireline/private property boundary does not appear to be movable away from the wetland and it affects a very small portion of the wetland. Monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 41-01

Description: This wetland is a 0.2 ha highly ephemeral marsh. Woody vegetation has heavily encroached into the wetland. Pine trees dominate the canopy, and cover 25-50% of the wetland basin. Small pine and sweet gum trees, and wax myrtle dominate the midstory, and cover 5-25% of the wetland. Sedges/grasses grow in scattered patches, and cover 50-75% of the wetland basin. Grazing is allowed in this MU, although there does not appear to be any cattle impact in the wetland. The adjacent uplands are scrubby flatwoods and pine/oak/palmetto thickets.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: Remove pine trees in wetland interior and thin perimeter pine trees and hardwoods up to the palmetto line. While cattle have not yet impacted the wetland, if they are present in the MU, they are a potential future threat.

Wetland ID: 41-02

Description: This wetland is a 2.2 ha ephemeral marsh. Medium to large-sized pine grow in a ring around the wetland, and cover 5-25% of the basin. There is thick needle duff under the pine trees. There is no midstory layer and the wetland interior is open. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle grazing impacts are patchy. This wetland will connect with 41-03 during periods of high water. This marsh is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and pine/oak/palmetto thickets.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: Thin perimeter pine trees up to the palmetto line. In order to restore the full ecological function of this wetland, the cattle should be removed.

Wetland ID: 41-03

Description: This wetland is a 1.0 ha ephemeral marsh. Several large pine trees grow around the wetland edge, and cover 5-25% of the wetland basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle trails are present through the wetland. This wetland will connect with 41-02 during periods of high water. The wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and pine/oak/palmetto thickets.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: Thin pine trees in connector region between the two ponds. In order to restore the full ecological function of this wetland, the cattle should be removed.

Wetland ID: 43-01

Description: This wetland is an 11.7 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane grows in the deeper holes and broomsedge grows around the wetland edges. The herbaceous vegetation covers >75% of the wetland basin. Cattle impact is minimal and patchy in the wetland basin. This wetland appears to be in great ecological condition, is an excellent example of a wetland with no woody encroachment, and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods with patchy oak thickets.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 43-02

Description: This wetland is a 0.5 ha ephemeral marsh. Large pine trees form a ring around the wetland edge, and cover 5-25% of the wetland basin. Small pine trees are encroaching from the wetland edge and grow in patches in the wetland interior. The small pine trees cover 5-25% of the wetland. Maidencane grows throughout the wetland, and covers >75% of the basin. Cattle impacts include grazing and trails. The wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods with patchy oak thickets.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Encourage fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now. The larger pine trees around the perimeter could be thinned.

Wetland ID: 43-03

Description: This wetland is a <0.1 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. This wetland provides an excellent example of a pristine sink depressional marsh and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 43-04

Description: This wetland is a 1.0 ha ephemeral marsh. There is no tree canopy or midstory cover. One large live oak grows on the west side, up on a hill along the wetland edge. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This wetland is bisected by a fireline/private property boundary. Grazing is allowed though no impact is evident in the wetland basin. The wetland appears to be in excellent ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Fireline/private property boundary

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Contact landowner to see if the boundary can be moved to encompass the entire wetland. If the boundary cannot be moved, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 43-05

Description: This wetland is a 0.7 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This wetland is bisected by a fireline/private property boundary. Grazing is allowed though no impact is evident in the wetland basin. The wetland appears to be in excellent ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Fireline/private property boundary

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Contact landowner to see if boundary can be moved to encompass the entire wetland. If the boundary cannot be moved, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 43-06

Description: This wetland is a 3.2 ha ephemeral marsh. There is no tree canopy or midstory cover. The marsh has very diverse herbaceous vegetation that covers >75% of the wetland basin. There is a minor patch of cattle grazing on the wetland edge. The wetland appears to be in excellent ecological health, is a great example of a wetland with no woody encroachment, and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 43-07

Description: This wetland is a <0.1 ha ephemeral marsh. There is no tree canopy. A ring of buttonbush surrounds the wetland, and covers 5-25% of the wetland basin. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This wetland is a great example of a very small sinkhole marsh. The buttonbushes exist in a natural fire shadow due to the steep slope and the wetland hydroperiod. The wetland appears to be in excellent ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 43-08

Description: This wetland is a 0.8 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is an automobile track through the east side of the wetland. A roller chopper passed along the wetland edge and left chop-gouges in the wetland soil. The wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Vehicular damage

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Discourage vehicular access to the wetland. To avoid future damage, operate machinery only when wetland is completely dry.

Wetland ID: 43-09

Description: This wetland is a 6.9 ha ephemeral marsh. There is no tree canopy or midstory cover. A few small pine trees are scattered sparsely around the wetland. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. An auto track is beginning to form along the eastern edge of the wetland. Cattle have grazed on a patch of the eastern wetland basin. The wetland provides a good example of how slash pine naturally occurs sparsely around a wetland edge. The wetland appears to be in good ecological condition and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Vehicular damage

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Discourage vehicular access to the wetland.

Wetland ID: 43-10

Description: This wetland is a 0.8 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. A fireline/private property boundary runs along a small portion of the wetland's eastern edge but is not much of an impact. The wetland provides a great example of an open marsh with no woody encroachment and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Fireline/private property boundary

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 43-11

Description: This wetland is a 1.9 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland appears to be in excellent ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 46-01

Description: This wetland is a 0.3 ha ephemeral marsh. There is no tree canopy cover. A few small pine trees are growing in the wetland interior, and cover 5-25% of the wetland basin. A fire killed many of the small pine trees but a few remain. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle are grazing the wetland grasses. The wetland provides a good example of fire managing encroaching pine trees. The wetland appears to be in excellent ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and oak/palmetto thicket.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Encourage periodic fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now.

Wetland ID: 46-02

Description: This wetland is a 0.1 ha ephemeral marsh. There is no tree canopy cover. A recent fire burned through the entire wetland basin, killing some buttonbushes. The remaining buttonbushes cover 5-25% of the wetland basin. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle are grazing the wetland grasses. The wetland appears to be in good ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 46-03

Description: This wetland is a 0.1 ha ephemeral marsh. Pine trees grow along the wetland edge, and cover 5-25% of the wetland basin. A recent fire burned through the wetland, killing some buttonbushes. The remaining buttonbushes cover 5-25% of the wetland basin.

Maidencane grows throughout and covers >75% of the wetland basin. Cattle are grazing the wetland grasses. The wetland appears to be in good ecological health and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Thin large perimeter pine trees.

Wetland ID: 47-01

Description: This wetland is a 0.8 ha ephemeral marsh. Pine trees grow in a patch on the south side of the wetland, and cover 5-25% of the basin. There is no midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle are grazing in the wetland. A fence and fireline bisects the eastern side of the wetland. The wetland is surrounded by a dense brush ring and grazed uplands.

Wetland Concerns: Cattle, Fireline, Upland condition, Woody encroachment

Restoration Action Recommended: Use the adjacent MU boundary to serve as a fireline and allow the current fireline to recover, and remove patch of pine trees on south side of wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 47-02

Description: This wetland is a 2.7 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle are grazing in the wetland. There is an outcropping of chert boulders on the north end of the wetland. This wetland will connect with 47-03 during periods of high water. The wetland is surrounded by a dense brush ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 47-03

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. Cattle are grazing in the wetland. This wetland will connect with 47-03 during periods of high water. The wetland is surrounded by a dense brush ring and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed or eliminated and the uplands restored.

Wetland ID: 48-01

Description: This wetland is a 1.3 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane grows in the wetland center and broomsedge grows around the outer edge. The herbaceous vegetation covers >75% of the wetland basin. Grazing is allowed in this MU but there are no observable impacts. This wetland is an example of a pristine, large, open marsh and is a potential striped newt breeding pond. The wetland is surrounded by scrubby flatwoods.

Wetland Concerns: Cattle

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands.

Wetland ID: 48-02

Description: This wetland is a 0.8 ha ephemeral marsh. Pine trees, with thick needle duff below, are encroaching on the north and west edges of the wetland. The tree canopy covers 5-25% of the basin. There is no midstory layer. Pickerelweed grows in the wetland's deep center; sedges/grasses and maidencane surround the center. The herbaceous vegetation covers >75% of the wetland basin. There is a pine-covered land bridge between this wetland and 48-03, which likely floods during periods of high water. This wetland will also connect with 48-04 on the east side during periods of high water. The eastern edge of the wetland has a few young encroaching pine trees. This circular depressional marsh is a potential striped newt breeding pond. The wetland is surrounded by scrubby flatwoods and oak hammock.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. The pine trees on the east side of the wetland likely will be killed during the next fire or inundation. Thin the larger pine trees on the north and west side of the wetland and along the land bridge connecting to 48-03.

Wetland ID: 48-03

Description: This wetland is a 0.1 ha semi-permanent marsh. Gum trees grow in the deeper wetland center and pine trees grow in a ring around the wetland edge. The tree canopy covers 25-50% of the wetland. The midstory is dominated by buttonbush, and covers 5-25% of the wetland. Maidencane, sedges/grasses, and emergent vegetation grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by scrubby flatwoods and oak hammock.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Thin the pine trees around the wetland edge.

Wetland ID: 48-04

Description: This wetland is a 0.9 ha ephemeral marsh. Pine trees dominate the canopy, and cover 5-25% of the wetland basin. Small pine trees are encroaching from the wetland edge and cover 5-25% of the wetland. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland will connect with 48-03 during periods of high water. The connector zone on the southwest side is being populated by small pine trees and a few larger pine trees. The southwest side of the wetland provides a good example of how young pine trees will invade from the wetland edge during a drought and with the absence of fire. The rest of the marsh provides a good example of wax myrtle kept in check. The wetland is surrounded by hardwood hammock.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. The connector between this wetland and 48-03 could be burned promptly to thin encroaching pine trees; alternatively the pine trees could be chopped.

Wetland ID: 49-01

Description: This wetland is a 0.2 ha ephemeral marsh. Pine trees grow in a ring around the wetland edge, and cover 25-50% of the wetland. There is no midstory layer. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. This circular depression marsh is a potential striped newt breeding pond. The wetland is surrounded by scrubby flatwoods.

Wetland Concerns: Cattle, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Thin the pine trees around the wetland edge.

Wetland ID: 49-02

Description: This wetland is a 6.3 ha altered marsh. The wetland was an ephemeral marsh but a dug-out section on the east side created a semi-permanent section, thereby allowing fish to persist. Pine trees grow around the wetland edge and cover 5-25% of the wetland. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. If the dug-out were filled and the fish eliminated, the wetland would be a potential striped newt breeding pond. The wetland is surrounded by scrubby flatwoods and grazed uplands.

Wetland Concerns: Cattle, Dug-out, Woody encroachment

Restoration Action Recommended: The uplands in this MU are in good ecological condition, although we have observed some minor cattle-related effects in both wetlands and uplands in some areas. We recommend removing cattle from this unit to prevent destruction of the intact flatwoods community and the embedded wetlands. Fill the dug-out and thin the pine trees around the wetland edge.

Wetland ID: 49-03

Description: This wetland is a 0.2 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This circular depression marsh is a potential striped newt breeding pond. The wetland is surrounded by a dense palmetto/fetterbush/gallberry ring, a mixed pine/oak/palmetto community, and grazed uplands.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: Most of uplands in this management unit are in good ecological condition. We recommend removing cattle from this unit to prevent destruction of the intact scrubby flatwoods community. In order to restore the full ecological potential of this wetland, the uplands need to be restored.

Wetland ID: 50-01

Description: This wetland is a 0.4 ha ephemeral marsh. A small island of gum trees grows in the deeper center of the wetland, and covers 5-25% of the wetland basin. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This wetland provides a good example of a healthy marsh and is a potential striped newt breeding pond. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: None

Restoration Action Recommended: None

Wetland ID: 50-02

Description: This wetland is a 1.3 ha semi-permanent mix of marsh and forested swamp. The northern half of the wetland is a forested swamp dominated by cypress and gum trees. The southern half of the wetland is herbaceous marsh. The tree canopy covers 25-50% of the entire wetland basin. Holly and wax myrtle dominate the midstory, and cover 25-50% of the wetland. Sedges/grasses, sawgrass, and maidencane grow throughout the wetland, and cover 50-75% of the basin. The swamp portion of the wetland likely formed in a long-term fire shadow created by the hardwood hammock to the north. Pond pine scrubby flatwoods on the south side likely carried fire into the southern part of the wetland with a frequency sufficient to maintain the marsh. This wetland provides a good example of the results of frequent fire and infrequent fire within a single wetland. The adjacent uplands are scrubby flatwoods and hardwood hammock.

Wetland Concerns: None

Restoration Action Recommended: None

Wetland ID: 50-03

Description: This wetland is a 0.9 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Feral hog impacts are old and patchy, in the form of scalloped holes that are growing over with vegetation. The wetland provides a good example of a healthy marsh and is a potential striped newt breeding pond. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: Feral hog damage

Restoration Action Recommended:

Wetland ID: 50-04

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and redroot grow throughout the wetland, and cover >75% of the basin. Extensive, but old, feral hog rooting has grown over with redroot. The wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: Feral hog damage

Restoration Action Recommended:

Wetland ID: 50-05

Description: This wetland is a 0.1 ha highly ephemeral marsh. Several laurel oak trees have established on hillocks within the wetland and cover 5-25% of the wetland basin. There is no midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. There are 2 vehicular tracks along the south and west edges of the wetland. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: Vehicular damage

Restoration Action Recommended: Discourage vehicular access to the wetland. Smaller wetlands may need to be flagged to alert users of the existence of the wetland.

Wetland ID: 50-06

Description: This wetland is a 2.2 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and sawgrass grows throughout the wetland, and covers >75% of the basin. A fireline/private property boundary bisects a small portion of the eastern side of the wetland. This is a potential striped newt breeding pond. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: Fireline/private property boundary

Restoration Action Recommended: The fireline/private property boundary does not appear to be movable away from the wetland and it affects a very small portion of the wetland. Monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 50-07

Description: This wetland is a 0.1 ha highly ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and redroot grow throughout the wetland, and cover >75% of the basin. Old feral hog rooting has grown over with vegetation. An access road bisects the wetland. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Feral hog damage, Road

Restoration Action Recommended: If the access road is necessary, we recommend re-routing it through the thin strip of uplands between 50-03 and 50-07.

Wetland ID: 50-08

Description: This wetland is a 0.2 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Recent feral hog rooting is patchy in the wetland basin. This wetland is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods and oak hammock.

Wetland Concerns: Feral hog damage

Restoration Action Recommended:

Wetland ID: 50-09

Description: This wetland is a 1.9 ha semi-permanent marsh. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is an old dug-out on the north side of wetland that is providing refugia for fish. This wetland would be prime potential striped newt breeding pond if the dug-out were filled. A fireline/private property boundary bisects the east side of the wetland. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Dug-out, Fireline/ private property boundary

Restoration Action Recommended: Fill the dug-out. Contact the private landowner to see if boundary can be moved to encompass the entire wetland. If the boundary cannot be moved, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing.

Wetland ID: 52-01

Description: This wetland is a 1.6 ha ephemeral marsh. Pine trees grow in a dense ring around the wetland, and cover 5-25% of the wetland basin. There also are some young pine trees around the edge and in the wetland interior. Thick needle duff covers the wetland floor around the edges. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Feral hog damage is patchy. The adjacent uplands are planted pine forest with dense palmetto understory.

Wetland Concerns: Feral hog damage, Woody encroachment

Restoration Action Recommended: Thin large pine trees around the wetland edge. Encourage periodic fire in the wetland basin. Monitor the wetland to ensure encroaching pine trees are killed with the next fire or inundation. If they become established, the pine trees will need to be removed from the wetland. Alternatively, the small pine trees can be hand-chopped now.

Wetland ID: 52-02

Description: This wetland is a 0.1 ha ephemeral marsh. Several large and small pine trees grow around the wetland edge, and cover 5-25% of the wetland basin. There is no midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. The adjacent uplands are planted pine forest with dense palmetto understory.

Wetland Concerns: Woody encroachment (minor)

Restoration Action Recommended: The larger pine trees could be thinned during an upland thinning operation. The small pine trees should be eliminated by the next fire or wetland inundation. The woody encroachment at this wetland is not problem at this time but could become so in the future.

Wetland ID: 52-03

Description: This wetland is a 0.7 ha ephemeral marsh. Cypress trees grow in a strip along the east side of the wetland and pine trees are encroaching from the edge along the west and north sides. The tree canopy covers 5-25% of the wetland basin. The needle duff is not very thick. There is no midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are planted pine forest with dense palmetto understory.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin large perimeter pine trees. The woody encroachment at this wetland is minor.

Wetland ID: 54-01

Description: This wetland is a 0.2 ha ephemeral marsh. Pine trees grow around the wetland edge, and cover 5-25% of the wetland basin. There is no midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. A fireline/private property boundary bisects the western tip of the wetland. There is evidence of cattle in the wetland. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Fireline/private property boundary, Upland condition, Woody encroachment

Restoration Action Recommended: Contact private landowner to see if MU boundary can be moved to encompass the entire wetland. If the boundary cannot be moved, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored. Thin large perimeter pine trees.

Wetland ID: 54-02

Description: This wetland is a 0.1 ha ephemeral man-made pit/cattle pond. There is no tree canopy or midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. This man-made wetland is functioning as an ephemeral marsh. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: While this wetland is man-made, it has the potential to function as an ephemeral wetland if desired. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-03

Description: This wetland is a 0.3 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A ditch on the north side of the wetland connects to the larger Wetland 54-07. Cattle traffic is light but noticeable. The wetland is surrounded by an oak/palmetto ring and heavily grazed pasture and sandhills.

Wetland Concerns: Cattle, Ditch, Upland condition

Restoration Action Recommended: Fill the ditch to break connectivity with the wetland. Alternatively, the ditch could be plugged and vegetation allowed to regenerate. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-04

Description: This wetland is a 0.2 ha ephemeral marsh. Oak and pine trees are encroaching from the wetland edge, and cover 5-25% of the wetland basin. There is no midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. This wetland appears to be desiccated, possibly due to ditching on the property or to a long dry period. There is cow excrement in the wetland. The wetland is surrounded by a dense, tall oak/palmetto ring and grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: Thin trees around the wetland edge. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-05

Description: This wetland is a 1.9 ha ephemeral marsh. Large and small pine trees grow around the wetland perimeter. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle traffic is severe in the northeast corner and there is a green film on the water. The wetland may have been mechanically dug to increase the depth. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition, Woody encroachment

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored. Thin large perimeter pine trees and remove smaller pine trees.

Wetland ID: 54-06

Description: This wetland is a <0.1 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. The wetland appears to be healthy despite the presence of cattle. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-07

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is cattle traffic and a mud wallow area in the center. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-08

Description: This wetland is a 0.1 ha ephemeral marsh. There is no tree canopy cover. Young persimmon trees cover 5-25% of the wetland basin. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. Cattle are using the wetland. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: The next fire or inundation should eliminate the encroaching persimmons. If they become established, the persimmon trees will need to be removed from the wetland. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 54-09

Description: This wetland is a 0.5 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. The wetland appears fairly healthy despite the presence of cattle. The adjacent uplands are grazed pasture and sandhills.

Wetland Concerns: Cattle, Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 55-01

Description: This wetland is a 0.1 ha highly ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are pine/oak/palmetto and old field communities.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 55-02

Description: This wetland is a 1.5 ha semi-permanent marsh. There is no tree canopy or midstory cover. Maidencane grows throughout the wetland, and covers >75% of the basin. Feral hog damage is patchy. There is an earthen berm along the east side of the wetland associated with a deep ditch. The berm created 2 wetlands from one large wetland, this wetland on the west side of the berm and a larger wetland to the east that is in MU 47. This marsh would be more ephemeral if the berm and ditch were not present. The adjacent uplands are pine/oak/palmetto and old field communities.

Wetland Concerns: Berm, Ditch, Feral hog damage, Upland condition

Restoration Action Recommended: Remove the berm and fill in the ditch. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 56-01

Description: This wetland is a 0.3 ha ephemeral marsh. There is no tree canopy or midstory layer. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This circular marsh is in excellent condition and is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: None

Restoration Action Recommended: None

Wetland ID: 56-02

Description: This wetland is a 0.2 ha semi-permanent marsh. There is no tree canopy or midstory layer. Maidencane grows throughout the wetland, and covers >75% of the basin. This wetland, and 56-03 to the southeast, used to be a single wetland. They now are bisected by a 1.5m tall berm and road complex and function as two separate wetlands. This formerly ephemeral wetland was mechanically deepened along the edge it shares with the berm, lengthening the hydroperiod. The adjacent uplands are scrubby flatwoods to the east and pine/oak hammock to the west.

Wetland Concerns: Road

Restoration Action Recommended: The road should be re-routed away from the wetland if feasible. Flatten the berm/road complex and resculpt the wetland floor to allow the 2 wetlands to reconnect.

Wetland ID: 56-03

Description: This wetland is a 0.1 ha semi-permanent marsh. There is no tree canopy cover. Buttonbush covers 5-25% of the wetland. Maidencane grows throughout the wetland, and covers >75% of the basin. This wetland, and 56-02 to the northwest, used to be a single wetland. They now are bisected by a 1.5m tall berm and road complex and function as two separate wetlands. This formerly ephemeral wetland was mechanically deepened along the edge it shares with the berm, lengthening the hydroperiod. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Road

Restoration Action Recommended: The road should be re-routed away from the wetland if feasible. Flatten the berm/road complex and resculpt the wetland floor to allow the 2 wetlands to reconnect.

Wetland ID: 56-04

Description: This wetland is a 1.7 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. A fireline/MU boundary bisects the middle of the wetland. This open marsh is a potential striped newt breeding pond. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Fireline/MU boundary

Restoration Action Recommended: Re-route the fireline/MU boundary away from the wetland.

Wetland ID: 57-01

Description: This wetland is a 0.6 ha ephemeral marsh. There is no tree canopy or midstory layer. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a dense brush/palmetto ring and oldfield with many large and small longleaf pine trees.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 57-02

Description: This wetland is a 0.1 ha ephemeral marsh. Large oak trees grow around the wetland edge, and cover 5-25% of the wetland basin. The oaks are established in the upland margin but are leaning over the wetland, shading the littoral zone. There is no midstory layer. Maidencane grows in the wetland center, covering 50-75% of the wetland basin. The adjacent uplands are a dense pine/oak hammock with thick palmetto.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: The perimeter oak trees could be thinned in order to reduce the shading effect and encourage the growth of more herbaceous vegetation. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 57-03

Description: This wetland is a <0.1 ha highly ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses grow in scattered patches, and cover 25-50% of the wetland basin. The adjacent uplands are a dense pine/oak hammock with thick palmetto.

Wetland Concerns: None

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 57-04

Description: This wetland is a 0.1 ha ephemeral marsh. A few gum trees grow in the wetland, but cover <5% of the wetland basin. A few small pine trees are beginning to encroach from the wetland edge but will be killed with the next fire or inundation. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the wetland basin. The wetland is surrounded by a palmetto ring, dense pine/oak hammock with thick palmetto, and oldfield.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 57-05

Description: This wetland is a 0.1 ha ephemeral marsh. Pine trees are encroaching into the wetland, and cover 5-25% of the basin. There is no midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This wetland, and 57-06 to the northwest, used to be a single wetland. They now are bisected by an earthen berm and function as two separate wetlands. The adjacent uplands are upland pine forest with thick palmetto.

Wetland Concerns: Berm, Woody encroachment

Restoration Action Recommended: Flatten the berm and resculpt the wetland floor to allow the 2 wetlands to reconnect. Remove pine trees from the wetland interior. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 57-06

Description: This wetland is a 0.1 ha ephemeral marsh. Pine trees are encroaching from the wetland edge and cover 5-25% of the wetland basin. There is no midstory cover. Maidencane is dense and covers >75% of the wetland basin. This wetland, and 57-05 to the southeast, used to be a single wetland. They now are bisected by an earthen berm and function as two separate wetlands. The adjacent uplands are hardwood hammock with pine.

Wetland Concerns: Berm, Woody encroachment

Restoration Action Recommended: Flatten the berm complex and resculpt the wetland floor to allow the 2 wetlands to reconnect. Encourage periodic fire to reduce the dense maidencane. Remove pine trees from the wetland interior.

Wetland ID: 58-01

Description: This wetland is a 0.1 ha ephemeral marsh. Pine trees are encroaching from the wetland edge and cover 25-50% of the wetland basin. There is no midstory cover. Pine needles and canopy shading have reduced the herbaceous vegetation. Sedges/grasses grow in the wetland center, and cover 25-50% of the basin. The wetland is surrounded by a dense palmetto ring, oldfield, and planted pine trees.

Wetland Concerns: Upland condition, Woody encroachment

Restoration Action Recommended: Thin perimeter pine trees to reduce the shading effect and encourage the growth of herbaceous vegetation. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-02

Description: This wetland is a 0.3 ha ephemeral marsh. There is no significant tree canopy or midstory cover. However, a few young pine trees are beginning to encroach from the north side. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. A fireline/MU boundary touches the northeast corner of the wetland. The wetland is surrounded by a dense palmetto ring and oldfield.

Wetland Concerns: Fireline/MU boundary, Upland condition

Restoration Action Recommended: Re-route boundary away from this wetland complex. The minor woody encroachment should be suppressed by the next fire or wetland inundation. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-03

Description: This wetland is a 1.8 ha ephemeral marsh. There is a small island of shrubs and trees in the wetland center and a few small pine trees encroaching in the northwest corner. The woody vegetation covers <5% of the wetland. Maidencane grows throughout the wetland, and covers >75% of the basin. A fireline/MU boundary bisects the eastern side of the wetland. The wetland is surrounded by a dense palmetto ring and oldfield.

Wetland Concerns: Fireline/MU boundary, Upland condition

Restoration Action Recommended: Re-route boundary away from this wetland complex. The island of woody vegetation in the wetland center is natural occurrence and can be left untouched. The minor woody encroachment should be suppressed by the next fire or wetland inundation. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-04

Description: This wetland is a 0.8 ha ephemeral marsh. There is no tree canopy or midstory cover. Sweet gum saplings are beginning to encroach from the northeast side of the wetland, but they likely will be eliminated with the next fire. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. There is a patch of feral hog damage in the wetland center. The wetland is surrounded by a dense palmetto ring and oldfield.

Wetland Concerns: Feral hog damage, Upland condition

Restoration Action Recommended: The minor woody encroachment should be suppressed by the next fire or wetland inundation. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-05

Description: This wetland is a 0.5 ha semi-permanent marsh. There is no tree canopy or midstory cover. Maidencane grows throughout the wetland, and covers >75% of the basin. A deep-water filled pool on the south side of the wetland harbors fish. This feature could be an old dug-out or a result of karst topography. A ditch on the east side of the wetland connects to Wetland 58-10 and a ditch on the south side connects to a larger wetland system. The wetland is surrounded by a dense palmetto ring and a brushy oak/pine/palmetto oldfield.

Wetland Concerns: Ditching, Possible dug-out, Upland condition

Restoration Action Recommended: Fill the ditches to break connectivity with the wetland. Alternatively, the ditches could be plugged and vegetation allowed to regenerate. Fill the deep hole if it is an old dug-out. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-06

Description: This wetland is a 0.2 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane grows throughout the wetland, and covers >75% of the basin. The wetland is surrounded by a dense brush ring, planted pine trees, and oldfield.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-07

Description: This wetland is a 0.1 ha ephemeral forested swamp. Gum trees dominate the canopy, and cover 50-75% of the wetland basin. There is no midstory layer. Sedges/grasses grow in scattered patches, and cover 25-50% of the wetland basin. The adjacent uplands are a fire-suppressed pine/oak/palmetto hammock.

Wetland Concerns: None

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-08

Description: This wetland is a 0.1 ha ephemeral marsh. There is no tree canopy cover. A patch of sweet gum saplings is beginning to encroach from the west edge of the wetland, and covers 5-25% of the wetland basin. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a dense brush and palmetto ring and oldfield with large longleaf pine trees.

Wetland Concerns: Upland condition, Woody encroachment

Restoration Action Recommended: Encourage fire to burn through the wetland basin to reduce sweet gum saplings. In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-09

Description: This wetland is a 0.3 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a dense gallberry ring and oldfield.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-10

Description: This wetland is a 0.4 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. The wetland is surrounded by a brush ring and oldfield.

Wetland Concerns: Upland condition

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 58-11

Description: This wetland is a 0.1 ha ephemeral marsh. Slash pine trees grow in a ring around the wetland, and cover 5-25% of the wetland basin. There is no midstory layer. Maidencane grows throughout the wetland, and covers 50-75% of the basin. This wetland is a potential striped newt breeding pond. The adjacent uplands are an upland pine forest community.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: The perimeter pine trees could be thinned in order to reduce the shading effect and encourage the growth of more herbaceous vegetation.

Wetland ID: 58-12

Description: This wetland is a <0.1 ha ephemeral marsh. Pine trees grow around the wetland edge, and cover 5-25% of the wetland. Needle duff is thick under the pine canopy. There is no midstory cover. Sedges/grasses grow in the wetland center, and covers 50-75% of the wetland basin. The wetland is a potential striped newt breeding pond. The adjacent uplands are an upland pine forest community.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: The perimeter pine trees could be thinned in order to reduce the shading effect and encourage the growth of more herbaceous vegetation.

Wetland ID: 58-13

Description: This wetland is a 0.3 ha ephemeral forested swamp. Gum trees dominate the canopy, and cover >75% of the wetland basin. There is no midstory cover. Sedges/grasses grow in scattered patches, and cover 5-25% of the wetland basin. This wetland provides a perfect example of a depressional, isolated gum swamp. The adjacent uplands are pine/oak/palmetto thicket.

Wetland Concerns: None

Restoration Action Recommended: In order to restore the full ecological potential of the wetland, the uplands would have to be restored.

Wetland ID: 59-01

Description: This wetland is a 0.2 ha ephemeral marsh. Pine trees dominate the canopy, and cover 25-50% of the wetland basin. There is no midstory layer. Maidencane grows in the wetland center, and covers 50-75% of the wetland basin. A fireline/MU boundary was constructed adjacent to the wetland on the north side. The boundary separated this wetland from a larger wetland system (Wetland 10-01). The wetlands likely will connect during periods of high water. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Feral hog damage, Fireline/MU boundary, Woody encroachment

Restoration Action Recommended: In order to restore the hydrology of this wetland and the larger wetland system, the road would have to be removed. Recognizing that this road is now a permanent attribute to the property, we do not recommend any action relating to the road. Remove interior pine trees to reduce the shading effect and encourage the growth of more herbaceous vegetation.

Wetland ID: 59-02

Description: This wetland is a 0.6 ha ephemeral marsh. There is no tree canopy or midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is some minor feral hog damage. The adjacent uplands are an upland pine forest community.

Wetland Concerns: Feral hog damage

Restoration Action Recommended:

Wetland ID: 59-03

Description: This wetland is a 7.9 ha ephemeral marsh. Pine trees are encroaching from the wetland edge, especially in the northern half, and cover 5-25% of the wetland basin. There is no midstory cover. Maidencane and sedges/grasses grow throughout the wetland, and cover >75% of the basin. There is some minor feral hog damage. The adjacent uplands are mesic flatwoods.

Wetland Concerns: Feral hog damage, Woody encroachment

Restoration Action Recommended: Thin the perimeter pine trees.

Wetland ID: 59-04

Description: This wetland is a 0.1 ha ephemeral marsh. Large pine trees grow throughout the wetland, and cover 25-50% of the basin. Needle duff is thick under the canopy. There is no midstory cover. Maidencane grows in scattered patches, covering 25-50% of the wetland basin. A recent fire burned through the wetland basin. This wetland provides a perfect example of pine (woody) encroachment. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Remove interior pine trees.

Wetland ID: 59-05

Description: This wetland is a 0.1 ha ephemeral marsh. Gum, pine, and maple trees are beginning to encroach, and cover 5-25% of the wetland basin. A needle duff layer is beginning to form under the pine trees. Sedges/grasses grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Encourage periodic fire in the wetland basin to reduce the encroaching woody vegetation. Alternatively, the encroaching trees could be hand-removed now.

Wetland ID: 59-06

Description: This wetland is a 0.1 ha ephemeral marsh. There is no tree canopy or midstory cover. Sedges/grasses and maidencane grow throughout the wetland, and cover >75% of the basin. This wetland provides a good example of a small, isolated marsh in a pineland ecosystem. The adjacent uplands are scrubby flatwoods.

Wetland Concerns: None

Restoration Action Recommended: None

Wetland ID: 59-07

Description: This wetland is a 1.5 ha ephemeral mixed swamp. Cypress trees dominate the tree canopy, and cover 50-75% of the wetland basin. Buttonbush, fetterbush, and wax myrtle dominate the midstory, and cover 50-75% of the wetland. The south side of the wetland is marsh-like with dense sawgrass. Herbaceous vegetation covers 25-50% of the wetland. This wetland shows impacts from fire suppression. A recent fire recently burned through the wetland edges. Hummocks have formed over old tree stumps. The adjacent uplands are scrubby and mesic flatwoods.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Encourage fire through the wetland basin to reduce the dense interior brush.

Wetland ID: 60-01

Description: This wetland is a 0.2 ha ephemeral marsh. Several gum trees grow throughout the wetland and pine trees are beginning to encroach. The tree canopy covers 5-25% of the wetland basin. There is no midstory cover. Sedges/grasses, rush, and maidencane grow throughout the wetland, and cover >75% of the basin. The adjacent uplands are fire-suppressed upland hammock.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin the pine trees in the wetland interior.

Wetland ID: 60-02

Description: This wetland is a 0.1 ha ephemeral marsh. A MU boundary that divides HMWMA with WMD-owned property bisects the wetland with a fence and firelines are both sides of the fence. The two halves of the wetland vary greatly in their character. Live oaks are shading out the herbaceous vegetation on the WMA side. The wetland basin is leaf-covered and grazed by cattle. The WMD side has encroaching pine vegetation and is choked with herbaceous vegetation. The adjacent uplands are grazed pasture and oak hammock on the WMA side and a fire-suppressed pine/oak community on the WMD side.

Wetland Concerns: Cattle, Fireline/MU boundary, Upland condition, Woody encroachment

Restoration Action Recommended: The fireline/MU boundary should be re-routed away from the wetland if feasible. If the boundary cannot be re-routed, monitor the wetland to ensure fire is not excluded. Maintain the fireline when the wetland is completely dry to prevent ruts from developing. The encroaching oak and pine trees could be thinned in order to reduce the shading effect and encourage the growth of more herbaceous vegetation. In order to restore the full ecological potential of the wetland, the cattle would need to be removed and the uplands restored.

Wetland ID: 60-03

Description: This wetland is a 0.1 ha ephemeral marsh. Pine trees are encroaching from the wetland edge, and cover 5-25% of the wetland basin. There is no midstory cover. Maidencane grows densely throughout the wetland, and covers >75% of the basin. The adjacent uplands are fire-suppressed pine/oak/palmetto thicket.

Wetland Concerns: Woody encroachment

Restoration Action Recommended: Thin perimeter pine trees and encourage a fire to burn through the wetland basin to reduce herbaceous density.

REFERENCES

- Belden, R., and W. Frankengerger. 1977. Management of feral hogs in Florida – past, present, and future. In G. W. Wood, editor. Research and management of wild hog populations: proceedings of a symposium. Belle W. Baruch Forest Science Institute of Clemson University, Georgetown, South Carolina, USA.
- Bell, C. E. 1997. Using arsenal for brushy species control. California Exotic Pest Plant Council Symposium Proceedings, Concord, CA.
- Berrill, M., S. Bertram, L. McGillvray, M. Kolohon, and B. Pauli. 1994. Effects of low concentrations of forest-use pesticides on frog embryos and tadpoles. *Environmental Toxicology and Chemistry* 13(4): 657-664.
- Bishop, D. C., and C. A. Haas. 2005. Burning trends and potential negative effects of suppressing wetland fires on flatwoods salamanders. *Natural Areas Journal* 25(3): 290-294.
- Blood, E. R., J. S. Phillips, D. Calhoun, and D. Edwards. 1997. The Role of the Floridan Aquifer in Depressional Wetlands Hydrodynamics and Hydroperiod. Pages 273-279 in K. J. Hatcher, editor. Proceedings of the 1997 Georgia Water Resources Conference, Athens, USA.
- Brennan, L. A., R. T. Engstrom, W. E. Palmer, S. M. Hermann, G. A. Hurst, L. W. Burger, and C. L. Hardy. 1998. Whither wildlife without fire? Trans. 63rd North American Wildlife and Natural Resources Conference: 402-414.
- Cheek, A. O., C. F. Ide, J. E. Bollinger, C. V. Rider, and J. A. McLachlan. 1999. Alteration of leopard frog (*Rana pipens*) metamorphosis by the herbicide acetochlor. *Archives of Environmental Contamination and Toxicology* 37(1): 70-77.
- Choquenot, D., J., McIlroy, J., and T. Korn. 1996. Managing vertebrate pests: feral pigs. Bureau of Resource Sciences. Australian Government Publishing Service, Canberra, AUS.
- Comer, P., K. Goodin, A. Tomaino, G. Hammerson, G. Kittel, S. Menard, C. Nordman, M. Pyne, M. Reid, L. Sneddon, and K. Snow. 2005. Biodiversity values of geographically isolated wetlands in the United States. NatureServe, Arlington, Virginia, USA.
- Cox, J., R. Kautz, M. Maclaughlin, and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Office of Environmental Services, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.
- Dodd, C. K., Jr. 1992. Biological diversity of a temporary pond herpetofauna in north Florida sandhills. *Biodiversity and Conservation* 1: 125-142.
- Dodd, C. K., Jr., and B. G. Charest. 1988. The herpetofaunal community of temporary ponds in north Florida sandhills: species composition, temporal use, and management implications. Pages 87-97 in R. C. Szaro, K. E. Severson, and D. R. Patton, technical coordinators. Proceedings of the symposium management of reptiles, amphibians, and small mammals in North America. U.S. Forest Service General Technical Report RM-166
- Enge, K. M., and K. N. Wood. 2000. A herpetofaunal survey of Chassahowitzka Wildlife Management Area, Hernando County, Florida. *Herpetological Natural History* 7(2): 117-144.

- Engeman, R. M., A. Stevens, J. Allen, J. Dunlap, M. Daniel, D. Teague, and B. Constantin. 2007. Feral swine management for conservation of an imperiled wetland habitat: Florida's vanishing seepage slopes. *Biological Conservation* 134: 440-446.
- Ewel, K. C. 1990. Swamps. Pages 281-323 in R. L. Myers and J. J. Ewel, editors. *Ecosystems of Florida*. University of Central Florida Press, Orlando, Florida, USA.
- Ferrell, J., Langeland, K., and B. Sellers. 2006. Herbicide application techniques for woody plant control. Document SS-AGR-260, Center for Aquatic and Invasive Plants, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
- Ferriter, A., D. Thayer, B. Nelson, T. Richards, and D. Girardin. 1997. Management in Water Management Districts. Pages 317-325 in D. Simberloff, D. C. Schmitz, and T. C. Brown, editors. *Strangers in paradise: impact and management of nonindigenous species in Florida*. Island Press, Washington, D.C., USA.
- Florida Fish and Wildlife Conservation Commission (FWC). 2005. Florida's Wildlife Legacy Initiative. Florida's Comprehensive Wildlife Conservation Strategy. Tallahassee, Florida, USA.
- Forrester, D. J. 1991. Parasites and diseases of wild mammals in Florida. University of Presses in Florida, Gainesville, Florida, USA.
- Franz, R., C. K. Dodd Jr., and C. Jones. 1988. *Rana areolata aesopus* Florida gopher frog Movement. *Herpetological Review* 19(2): 33.
- Franz, R., and L. L. Smith. 1999. Distribution and status of the striped newt and Florida gopher frog in peninsular Florida. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.
- Frost, C. C. 2006. History and future of the longleaf pine ecosystem. Pages 9-42 in S. Jose, E. J. Jokela, and D. L. Miller, editors. *The longleaf pine ecosystem – ecology, silviculture, and restoration*. Springer, U.S.A.
- Gibbs, J. P. 1993. Importance of small wetlands for the persistence of local populations of wetland-associated animals. *Wetlands* 13(1): 25-31.
- Gibbons, J. W. 2003. Terrestrial habitat: a vital component for herpetofauna of isolated wetlands. *Wetlands* 23(3): 630-635.
- Greenberg, C. H., A. Storfer, G. W. Tanner, and S. G. Mech. 2003. Amphibians using isolated, ephemeral ponds in Florida longleaf pine uplands: population dynamics and assessment of monitoring methodologies. Final Report to Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA.
- Hart, R., and J. R. Newman. 1995. The importance of isolated wetlands to fish and wildlife in Florida. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida, USA.
- Hone, J., and B. Atkinson. 1983. Evaluation of fencing to control feral pig movement. *Wildlife Research* 10: 499-505.
- Hipes, D. 2003. Field surveys for flatwoods salamander on under-surveyed publicly owned lands in Florida. Florida Natural Areas Inventory, Tallahassee, Florida, USA.

- Jensen, D. B., and D. J. Vosick. 1994. Introduction. *In* D. C. Schmitz and T. C. Brown, editors. An assessment of invasive non-indigenous species in Florida's public lands. Technical Report TSS-94-100. Florida Department of Environmental Protection, Tallahassee, Florida, USA.
- Jensen, J. B., and S. C. Richter. 2005. *Rana capito* (Le conte, 1855). Pages 536-538 *in* M. Lannoo, editor. Amphibian declines: The conservation status of United States species. University of California Press, Berkley, California, USA.
- Johnson, S. A. 2001. Life history, ecology, and conservation genetics of the striped newt (*Notophthalmus perstriatus*). Ph.D Dissertation, University of Florida, Gainesville, FL.
- Johnson, S. A. 2003. Orientation and migration distances of a pond-breeding salamander. Salamandridae, *Notophthalmus perstriatus*. Alytes 21: 3-22.
- Jolley, D. B. 2007. Reproduction and herpetofauna depredation of feral pigs at Fort Benning, Georgia. Master of Science Thesis, Auburn University, Auburn, Georgia, USA.
- Killian, G., L. Miller, J. Rhyon, and H. Doten. 2006. Immunocontraception of Florida feral wwine with a single-dose GnRH vaccine. American Journal of Reproductive Immunology 55: 378-384.
- Kushlan, J. A. 1990. Freshwater marshes. Pages 324-363 *in* R. L. Myers and J. J. Ewel, editors. Ecosystems of Florida. University of Central Florida Press, Orlando, Florida, USA.
- LaClaire, L. V. 1992. Ecology of temporary ponds in north-central Florida. Thesis, University of Florida, Gainesville, Florida, USA.
- LaClaire, L. V., and R. Franz. 1990. Importance of isolated wetlands in upland landscapes. Pages 9-15 *in* M. Kelly, editor. The role of aquatic plants in Florida's lakes and rivers. Proceedings of the 2nd Annual Meeting, Florida Lake Management Society, Orlando, Florida, USA.
- Langeland, K. A. 2006. Safe use of glyphosate-containing products in aquatic and upland natural areas. Document SS-AGR-104, Center for Aquatic and Invasive Plants, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
- Langeland, K. A., Ferrell, J. A., Sellers, B., Macdonald, G. E., and R. K. Stocker. 2009. Control of nonnative plants in natural areas of Florida. 2009. Document SP 242, Center for Aquatic and Invasive Plants, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
- Lannoo, M. (ed.). 2005. Amphibian declines: the conservation status of United States species. University of California Press, Berkeley, CA.
- Layne, J. N. 1997. Nonindigenous mammals. Pages 157-186 *in* D. Simberloff, D. C. Schmitz, and T. C. Brown, editors. Strangers in paradise: impact and management of nonindigenous species in Florida. Island Press, Washington, D.C., USA.
- Lipscomb, D. J. 1989. Impacts of feral hogs on longleaf pine regeneration. Southern Journal of Applied Forestry 13: 177-181.
- Maffei, M. D. 1997. Management in National Wildlife Refuges. Pages 267-274 *in* D. Simberloff, D. C. Schmitz, and T. C. Brown, editors. Strangers in paradise: impact and management of nonindigenous species in Florida. Island Press, Washington, D.C., USA.

- Martin, K. L. and L. K. Kirkman. 2009. Management of ecological thresholds to re-establish disturbance-maintained herbaceous wetlands of the south-eastern USA. *Journal of Applied Ecology* 46: 906-914.
- Means, D. B. 1996. Longleaf pine forest, going, going,... Pages 210-229 in M. B. Davis, editors. *Eastern old growth forests*. Island Press, Washington, DC.
- Means, D. B. 2007. Life cycles, dispersal, and critical habitat utilization of vertebrates dependent upon small isolated water bodies in the Munson Sandhills and Woodville Karst Plain, Leon County, Florida. Coastal Plains Institute, Tallahassee, Florida, USA.
- Means, D. B., C. K. Dodd, Jr., S. A. Johnson, and J. G. Palis. 2004. Amphibians and fire in longleaf pine ecosystems: response to Schurbon and Fauth. *Conservation Biology* 18(4): 1149-1153.
- Means, D. B., and R. C. Means. 1998. Distribution of the striped newt (*Notophthalmus perstriatus*) and gopher frog (*Rana capito*) in the Munson Sandhills of the Florida Panhandle. Coastal Plains Institute, Tallahassee, Florida, USA.
- Means, D. B., and J. Travis. 2007. Declines in ravine-inhabiting dusky salamanders of the southeastern US Coastal Plain. *Southeastern Naturalist* 6(1): 83-96.
- Means, R.P.M. 2008. Management Strategies for Florida's Ephemeral Ponds and Ephemeral Pond-Breeding Amphibians. Final Report to the Florida Fish and Wildlife Conservation Commission. Coastal Plains Institute, Tallahassee, Florida, USA.
- Moler, P. E., and R. Franz. 1987. Wildlife values of small, isolated wetlands in the southeastern Coastal Plain. Pages 234-241 in R.R. Odum, K.A. Riddleberger, and J.C. Ozier, editors. *Proceedings of the third southeast nongame and endangered wildlife symposium*. Georgia Department of Natural Resources, Atlanta, Georgia, USA.
- Mushinsky, H. R. 1985. Fire and the Florida sandhill herpetofaunal community: with special attention to responses of *Cnemidophorus sexlineatus*. *Herpetologica* 41(3): 333-342.
- Palis, J. G. 1997. Distribution, habitat, and status of the flatwoods salamander (*Ambystoma cingulatum*) in Florida, USA. *Herpetological Natural History* 5(1): 53-65.
- Platt, W. J. 1999. Southeastern pine savannas. Pages 23-51 in R. C. Anderson, J. S. Fralish and J. Baskin, editors. *The savanna, barren, and rock outcrop communities of North America*. Cambridge University Press, Cambridge, England.
- Printiss, D., and D. Hipes. 1999. Rare amphibian and reptile survey of Eglin Air Force Base, Florida. Florida Natural Areas Inventory, Tallahassee, Florida, USA.
- Printiss, D., and D. Hipes. 2000. Flatwoods salamander survey and habitat evaluation of Eglin Air Force Base, Hurlburt Field, and Tyndall Air Force Base. Florida Natural Areas Inventory, Tallahassee, Florida, USA.
- Printiss, D., and D. Hipes. 2001. Flatwoods salamander survey of St. Marks National Wildlife Refuge, Florida. Florida Natural Areas Inventory, Tallahassee, Florida, USA.
- Randall, J. M., R. R. Lewis III, and D. R. Jensen. 1997. Ecological restoration. Pages 205-219 in D. Simberloff, D. C. Schmitz, and T. C. Brown, editors. *Strangers in paradise: impact and management of nonindigenous species in Florida*. Island Press, Washington, DC., USA.

- Relyea, R. A. 2005a. The impact of insecticides and herbicides on the biodiversity and productivity of aquatic communities. *Ecological Applications* 15(2): 618-627.
- Relyea, R. A. 2005b. The lethal impact of roundup on aquatic and terrestrial amphibians. *Ecological Applications* 15(4): 118-1124.
- Ripley, R., and D. Printiss. 2005. Management plan for flatwoods salamander populations on National Forests in Florida. The Nature Conservancy Northwest Florida Program, Bristol, Florida, USA.
- Robbins, L. E., and R. L. Myers. 1992. Seasonal effects of prescribed burning in Florida: a review. Tall Timbers Research Station, Tallahassee, Florida, USA.
- Robertson, K. M., and T. E. Ostertag. 2004. Problems with Schurbon and Fauth's test of effects of prescribed burning on amphibian diversity. *Conservation Biology* 18(4): 1154-1155.
- Roznik, E. A. 2007. Terrestrial ecology of juvenile and adult gopher frogs (*Rana capito*). Masters Thesis, University of Florida, Gainesville, Florida, USA.
- Scheffers, B. R., J. B. C. Harris, and D. G. Haskell. 2006. Avifauna associated with ephemeral ponds on the Cumberland Plateau, Tennessee. *Journal of Field Ornithology* 77(2): 178-183.
- Schurbon, J. M., and J. E. Fauth. 2003. Effects of prescribed burning on amphibian diversity in a southeastern U.S. National Forest. *Conservation Biology* 17(5): 1338-1349.
- Semlitsch, R. D. 2000. Size does matter: the value of small isolated wetlands. *National Wetlands Newsletter*: 5-13.
- Semlitsch, R. D. 2003. Conservation of pond-breeding amphibians. Pages 8-23 in R.D. Semlitsch (editor). *Amphibian conservation*. Smithsonian Books, Washington D.C.
- Semlitsch, R. D., D. E. Scott, J. H. K. Pechmann, and J. W. Gibbons. 1996. Structure and dynamics of an amphibian community: evidence from a 16-year study of a natural pond. Pages 217-248 in M. L. Cody and J. Smallwood, editors. *Long-term studies of vertebrate communities*. Academic Press, New York, New York, USA.
- Semlitsch, R. D., and J. R. Bodie. 1998. Are small, isolated wetlands expendable? *Conservation Biology*: 1129-1133.
- Semlitsch, R. D., and J. B. Jensen. 2001. Core habitat, not buffer zone. *National Wetlands Newsletter* 23(4): 5-11.
- Stoddard, H. L. 1931. The bobwhite quail: its habits, preservation, and increase. Charles Scribner's Sons, New York, New York, USA.
- Tiner, R. W., H. C. Bergquist, G. P. DeAlessio, and M. J. Starr. 2002. Geographically isolated wetlands: a preliminary assessment of their characteristics and status in selected areas of the United States. U.S. Fish and Wildlife Service, Northeast Region, Hadley, Massachusetts, USA.
- US Department of Agriculture/Animal and Plant Health Inspection Service, US Department of Agriculture/Forest Service, and Department of Interior/Bureau of Land Management. 1997. Animal damage control program final environmental impact statement (revised). USDA/Animal and Plant health Inspection Service. Washington, D.C.

- Vtorov, I. P. 1993. Feral pig removal: effects on soil microarthropods in a Hawaiian rain forest. *Journal of Wildlife Management* 57: 875-880.
- Wade, D., J. Ewel, and R. Hofstetter. 1980. Fire in South Florida ecosystems. US Forest Service General Technical Report No. SE-17. Southeast Forest Experiment Station, Asheville, North Carolina, USA.
- Whitney, E., D. B. Means, and A. Rudloe. 2004. Priceless Florida: natural ecosystems and native species. Pineapple Press, Inc, Sarasota, Florida, USA
- Williams, D. D. 1987. The ecology of temporary waters. Blackburn Press, New Jersey, USA

Appendix A. Wetland Survey Form.

Management Area: _____ Date: _____ Wetland ID: _____ Photos: _____

Wetland Basin Assessment

Wetland Type:

☐ Marsh ☐ Shrub swamp ☐ Forested swamp ☐ Mixed swamp
☐ Altered ☐ Other:

Basin area: _____

Hydroperiod: ☐ Highly Ephemeral ☐ Ephemeral ☐ Semi-Perm

% Canopy Cover:

☐ <5% ☐ 5-25% ☐ 25-50% ☐ 50-75% ☐ >75%

Dominant Canopy:

☐ N/A ☐ Cypress ☐ Gum ☐ Pine ☐ Cypress/gum
☐ Holly ☐ Cypress/pine ☐ Cypress/holly ☐ Gum/pine ☐ Gum/holly
☐ Holly/pine ☐ Other:

Sub-canopy Cover:

☐ <5% ☐ 5-25% ☐ 25-50% ☐ 50-75% ☐ >75%

Dominant Sub-canopy:

☐ N/A ☐ Wax Myrtle ☐ Willow ☐ Titi ☐ Buttonbush ☐ Fetterbush
☐ Gallberry ☐ Holly ☐ Other:

% Herbaceous Cover:

☐ <5% ☐ 5-25% ☐ 25-50% ☐ 50-75% ☐ >75%

Dominant Herbaceous Groundcover:

☐ N/A ☐ Maidencane ☐ Sphagnum ☐ Rush ☐ Sedge/Grass
☐ Sawgrass ☐ Emergents ☐ Fern ☐ Redroot ☐ Other:

Herbaceous Distribution:

☐ Sparse ☐ Ring around edge ☐ Scattered patches ☐ Throughout ☐ Other:

Wetland Restoration Concerns:

☐ Hog damage ☐ Logging ☐ Slash ☐ Ditching ☐ Woody Encroachment
☐ Choked w/herb. ☐ Fireline ☐ Cattle ☐ Invasive Species ☐ Push Piles
☐ Bedding ☐ Desiccation ☐ Vehicular ☐ Other:

Comments:

Upland Assessment

Surrounding Community Type:

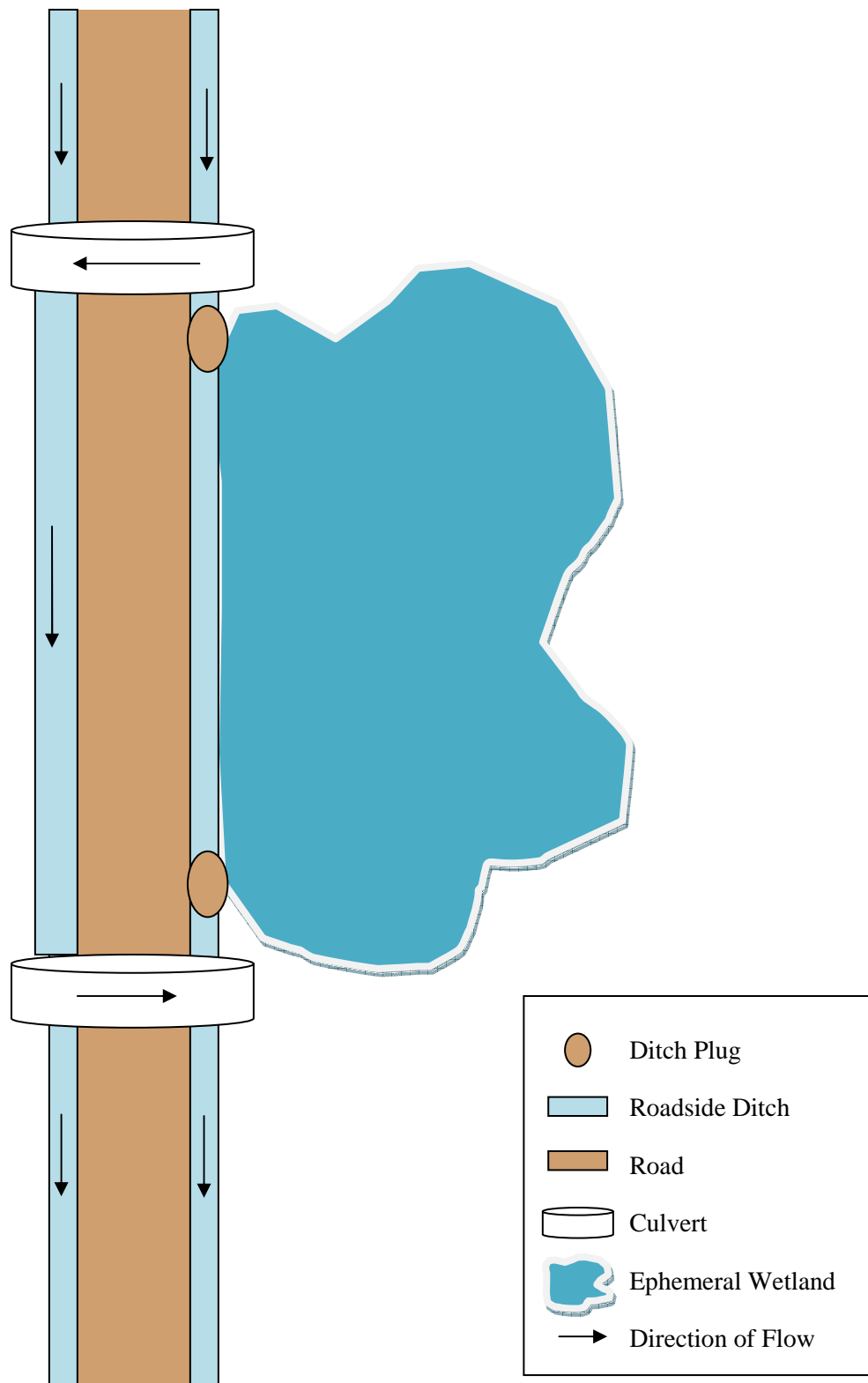
☐ Mesic flatwoods ☐ Wet flatwoods ☐ Scrubby flatwoods ☐ Upland pine forest
☐ Wet prairie ☐ Pasture ☐ Old field ☐ Sandhill ☐ Other:

Upland Condition:

☐ Fire suppressed ☐ Has burned ☐ Old bedding ☐ Pine plantation
☐ Hog damage ☐ Invasive species ☐ Grazing ☐ Other:

Comments:

Appendix B. Suggested method to break connectivity between an ephemeral wetland and tangent roadside ditch. This method is recommended as an experimental approach to restore the hydrology of wetlands connected to permanent ditches.



Appendix C. Scientific names of common plants encountered during this project, listed alphabetically by common name.

Bahia grass	<i>Paspalum notatum</i>
Black gum	<i>Nyssa sylvatica</i>
Broomsedge	<i>Andropogon sp.</i>
Buttonbush	<i>Cephalanthus occidentalis</i>
Cogongrass	<i>Imperata cylindrica</i>
Cordgrass	<i>Spartina sp.</i>
Corkwood	<i>Leitneria floridana</i>
Dog fennel	<i>Eupatorium capillifolium</i>
Fetterbush	<i>Lyonia lucida</i>
Gallberry	<i>Ilex glabra</i> (short gallberry), <i>Ilex tomentosa</i> (tall gallberry)
Hackberry	<i>Celtis sp.</i>
Japanese climbing fern	<i>Lygodium japonicum.</i>
Laurel oak	<i>Quercus laurifolia</i>
Lizard's tail	<i>Saururus cernuus</i>
Loblolly bay	<i>Gordonia lasianthus</i>
Maidencane	<i>Panicum hemitomon</i>
Muscadine grape	<i>Vitis rotundifolia</i>
Myrtle-leaved holly	<i>Ilex myrtifolia</i>
Persimmon	<i>Diospyros virginiana</i>
Pickernelweed	<i>Pontederia cordata</i>
Pond cypress	<i>Taxodium ascendens</i>
Red bay	<i>Persea borbonia</i>
Redroot	<i>Lachnanthes caroliniana</i>
Sawgrass	<i>Cladium jamaicense</i>
Sand pine	<i>Pinus clausa</i>
Slash pine	<i>Pinus elliottii</i>
Smartweed	<i>Polygonum hydropiperoides</i>
St. Johns wort	<i>Hypericum spp.</i>
Sweet gum	<i>Liquidambar styraciflua</i>
Sweet bay magnolia	<i>Magnolia virginiana</i>
Titi	<i>Cliftonia monophylla</i> (black titi), <i>Cyrilla racemiflora</i> (swamp titi),
Torpedograss	<i>Panicum repens</i>
Wax myrtle	<i>Myrica cerifera</i>