Mitigation Success Criteria Recommendations for Mine and Mitigation Bank Permits

Florida Department of Environmental Protection

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Abstract

Wetland mitigation is a common component of Environmental Resource Permits issued by the Department. The state rules require that permits specify the criteria for determining the success of the permitted mitigation. This report compiles the relevant rules, literature review, and past permit review of success criteria to recommend a set of criteria that can be applied to most, if not all, mitigation projects. Criteria specific to stream or riverine systems are also included. In the Appendix, examples of these criteria are provided for the most common native community types found in mitigation projects.

Introduction

A team of highly experienced, Department of Environmental Protection employees has been tasked with recommending success criteria for mitigation activities authorized by mitigation banking and mining environmental resource permits (ERPs). This study is in support of the Department's policy of continuous improvement and providing exceptional customer service.

The Applicant's Handbook (Section 10.1, effective 10/1/2013) states that the intent of the wetland regulatory provisions in the Environmental Resource Permitting program is, "…achieves a programmatic goal, and a project permitting goal, of no net loss in wetland or other surface water functions". Mitigation is key to achieving those goals by offsetting the loss of functions associated with proposed impacts.

The first wetland mitigation projects permitted were initiated following passage of the Warren S. Henderson Wetlands Protection Act of 1984, Sections 403.91 through 403.938, Florida Statutes (F.S.). Subsequent to passage of that bill, the Florida Department of Environmental Regulation (DER) adopted Chapter 62-312, Florida Administrative Code (F.A.C.), (effective December 10, 1984). Rule 62-312.350, F.A.C. (effective date January 3, 1989), provided guidance on mitigation success criteria. Although the rule was repealed in 2012, this section is still applicable for those mining projects that are grandfathered from the environmental resource permit rules. This language reads as follows:

"62-312.350 Determination of Success for Mitigation Projects.

(1) Success criteria. Due to the wide range of types of projects which may be used to create or enhance existing waters, specific success criteria will be determined on a case-by-case basis. A determination that the mitigation area will be compared to a reference water will be specified by conditions in the permit when there is insufficient information available to judge the successful creation or enhancement of the type of wetland involved. In comparing the mitigation area to a reference water, it is not the intent of the Department to require that the mitigation area exactly duplicate or replicate the reference water. The reference water is to be used as a guide to the Department to assure that the mitigation area will be sufficiently similar to the reference water to meet the permitting criteria. Success must be measured in terms of whether the objectives of the mitigation can be realized. The success criteria to be

included in the permit conditions must clearly address the minimum requirements necessary to attain a determination of success (e.g., percent cover by wetland vegetation, vegetation is reproducing naturally, target water quality standards are met, etc.). The mitigation will be judged to be successful if:

> *(a) All applicable water quality standards are met. However, where reference waters are used as a standard for dissolved oxygen, the daily and seasonal fluctuations of dissolved oxygen in the reference waters of the state shall be maintained;*
>
> *(b) The mitigation project has a hydrologic regime sufficient to sustain it in a viable condition; and*
>
> *(c) The specific success criteria contained in the permit are met.*
>
> *(2) Climatic impacts. The Department shall take the occurrence of extreme or unusual climatic conditions into consideration when evaluating the success of the created or enhanced waters.*
>
> *(3) Subsequent to determination of success by the Department, the waters of the state created or enhanced as mitigation can be used for purposes permittable pursuant to Chapters 62-6 and 62-25, F.A.C."*

The current Applicants Handbook, adopted as part of the statewide Environmental Resource Permit rule 62-330, F.A.C., October 2013, provides the following success guidance:

10.3.6 Mitigation Success

Mitigation success will be measured in terms of whether the objectives of the mitigation are expected to be realized. The success criteria to be included in permit conditions will specify the minimum requirements necessary to attain a determination of success. The mitigation shall be deemed successful by the Agency when all applicable water quality standards are met, the mitigation area has achieved viable and sustainable ecological and hydrological functions and the specific success criteria contained in the permit are met. If success is not achieved within the time frame specified within the permit, remedial measures shall be required. Monitoring requirements shall remain in effect until success is achieved as specified in the permit. Maintenance requirements shall remain in effect as specified in the permit.

Often mitigation areas must meet both state and federal standards. The US Army Corps of Engineers (COE) provides the following definition for performance standards (success criteria) in the Compensatory Mitigation for Losses of Aquatic Resources Rule adopted in 2008.

33 CFR 332.2 <u>Performance standards</u> *are observable or measurable physical (including hydrological), chemical and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives.*

The federal rule further elaborates on the application of performance standards as follows:

<u>§ 230.95 Ecological performance standards.</u>

(a) The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should

relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres).

(b) Performance standards must be based on attributes that are objective and verifiable. Ecological performance standards must be based on the best available science that can be measured or assessed in a practicable manner. Performance standards may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position. The use of reference aquatic resources to establish performance standards will help ensure that those performance standards are reasonably achievable, by reflecting the range of variability exhibited by the regional class of aquatic resources as a result of natural processes and anthropogenic disturbances. Performance standards based on measurements of hydrology should take into consideration the hydrologic variability exhibited by reference aquatic resources, especially wetlands. Where practicable, performance standards should take into account the expected stages of the aquatic resource development process, in order to allow early identification of potential problems and appropriate adaptive management.

Literature Review

The Society for Ecological Restoration (SER) defines ecological restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (SER, 2004). The SER Primer states that, "An ecosystem has recovered - and is restored – when it contains sufficient biotic and abiotic resources to continue its development without further assistance or subsidy. It will sustain itself structurally and functionally. It will demonstrate resilience to normal ranges of environmental stress and disturbance. It will interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions." (SER, 2004). Wetland mitigation performance standards or "success criteria" are used to determine whether restoration of the target ecosystem has been accomplished. Success criteria should be objective measurable targets that provide permit holders a clear goal to achieve regulatory success while also being indicative of the establishment of a viable and sustainable target ecosystem. Success criteria should be clear, measurable, cost-effective, and correlate strongly with restoration of ecosystem functions and services. The Society of Wetland Scientists (SWS) Position Statement on Performance Standards for Wetland Restoration and Creation (SWS, 2013) recommends that "1) wetland restoration and creation project-planning documents should include clearly articulated performance standards that are based on the best available science and that reflect the structural and functional objectives of projects and 2) research linking performance standards to wetland function should be encouraged."

Current regulations in the State of Florida (specifically FDEP 2012, FDEP 2013a, and FDEP 2013b) use the term "success" or "success criteria" to represent methods of assessing the efficacy of efforts aimed at creation, enhancement or restoration of wetland functions.

However, many practitioners (e.g., Zedler, 2007; Zedler et al., 2001; Streever, 1999b; SWS, 2013; Matthews and Endress, 2008) have identified the term "mitigation success" as subjective and unclear. As a result, the majority of reports on the subject of wetland mitigation instead use terms such as "performance standards" or "compliance criteria" to describe criteria used to assess whether a mitigation site is achieving desired outcomes. For simplicity, the terms "success criteria" and "performance standards" are used interchangeably in this review, and should be taken to convey the same idea to the reader.

Development of appropriate success criteria is critical to restoration efforts. Inappropriate success criteria can negatively affect mitigation in a number of ways, including promotion of management activities contradictory to ecosystem recovery; release from mitigation responsibility before the work is completed or the site sustainable; and confusion of restoration efforts due to ambiguous or unclear criteria. Prescription of inappropriate performance standards could result in a situation where highly-functioning mitigation sites cannot be deemed "successful" because the standards were set too high. On the other hand, a mitigation site may meet all performance standards easily and not result in a sustainable restoration.

The performance of wetland mitigation is typically assessed via metrics or indicators of ecological conditions, ecosystem structure, ecological processes, and ecosystem stability and self-sustainability (Zedler, 2007). The SER identifies three general strategies for evaluating restoration outcomes: *direct comparison, attribute analysis* and *trajectory analysis* (SER, 2004).

Direct Comparisons using Reference Ecosystems

Direct comparison involves determination of appropriate metrics based on reference sites and/or literature, and comparing the observed attributes in the reference site to the mitigation site. The SER and the SWS both advocate for the use of reference ecosystems for development of performance standards for wetland mitigation (SER, 2004 and SWS, 2013). However, there are important considerations to be addressed when using reference ecosystems. The user must keep in mind that a reference wetland represents only one of many states or expressions of the target ecosystem. Therefore, multiple reference sites in addition to other sources of information should be utilized to develop a *composite description* to guide restoration planning and expectations. In addition to the need to develop a composite description, two additional factors must be kept in mind when utilizing reference ecosystems:

1. A typical reference site is selected due to its being well-developed, diverse, and relatively undisturbed. In contrast, creation or mine reclamation mitigation projects will represent an earlier stage of succession. Therefore, use of a reference ecosystem usually requires some degree of interpolation back to a prior developmental phase; and
2. Most, if not all, reference ecosystems have been impacted to some degree by man. Therefore, the some interpretation is required to separate those impacts from observations.

Costs associated with data collection from reference ecosystems could be minimized through a coordinated effort to collect and share data from high-quality reference ecosystems. For example, research has been conducted by the Washington State Department of Transportation to develop recommended benchmark values for commonly used success standards (e.g. percent cover of woody vegetation) (Ossinger, 1999). Literature is another resource that is of value in development of performance standards. Potentially useful reference literature for development of wetland mitigation performance standards in Florida include FNAI, 2010; Myers and Ewel, 1990; Mitsch et al, 2007; USDA-SCS, 1989; and Wade et al., 1980). Matthews and Endress (2008) point out that benchmarks for performance standards could take into consideration the past performance of similar restorations in addition to using natural wetlands as references.

Attribute Analysis

In attribute analysis, "key" ecosystem attributes of the reference ecosystems are selected and measured for attainment. Target goals are set and quantitative or semi-quantitative data are used to determine if the project goals have been met. Section 3 of the SER Primer (SER, 2004) lists the following nine ecosystem attributes that provide a basis for determining when restoration has been accomplished:

1. similar diversity and community structure in comparison with reference sites;
2. presence of indigenous species;
3. presence of all functional groups (e.g. primary producers, herbivores, carnivores, decomposers, nitrogen fixers, pollinators),necessary for long-term stability;
4. capacity of the physical environment to sustain reproducing populations;
5. normal functioning;
6. integration with the landscape (ecological matrix);
7. elimination of potential threats;
8. resilience to natural disturbances; and
9. self-sustainability.

According to the SER Primer, all nine attributes do not have to be fully expressed to indicate the achievement of restoration. In fact, in an evaluation of all academic studies published in the first eleven volumes of the Journal, *Restoration Ecology*, Ruiz-Jaen and Aide (2005a) found that none of the academic studies measured all the SER Primer attributes. Ruiz-Jaen and Aide go on to recommend that, "at least two variables within each of the three ecosystem attributes that are clearly related to ecosystem functioning (diversity; vegetation structure; and ecological processes) should be included to evaluate restoration success".

Several authors (e.g., Matthews and Endress, 2008; Breaux and Serefiddin, 1999) report that the most measured feature of compensatory mitigation sites is vegetation, and it is widely assumed that the recovery of fauna and ecological processes will follow appropriate vegetation establishment. Vegetation is relatively easy and rapid to measure and usually there is little seasonal variation (Ruiz-Jaen and Aide, 2005). The most common measures of vegetation were plant cover, density, biomass, and height. Other examples of vegetation structure include: crown cover, tree basal area, and litter depth. Breaux and Serefiddin (1999) report that hydrology-based criteria are also common, but occur at a much lower frequency than vegetation-based success criteria. Other, less common measures of success included qualitative evidence of use by wildlife; water quality; soils; invertebrates; and functional assessments.

In 2004, The Environmental Law Institute (ELI) published a report (ELI, 2004) discussing the potential use of a wide array of biological and abiotic metrics for use as indicators of restoration of wetland function, including: amphibians; fish; invertebrates; birds; algae; mammals; vegetation; hydrology; and soils, sediments, and nutrients. The report recommends strategic use of a combination of metrics to accentuate the strengths of some while minimizing the weaknesses of others. The majority of the metrics evaluated (e.g. amphibians, fish, invertebrates, birds, algae, mammals, and soils) have characteristics that make them impractical for use as performance attributes in most situations. The most practical metrics in most cases appear to be vegetation and hydrology.

Trajectory Analysis

In trajectory analysis, the results of repeated measurements of ecosystem attributes are plotted in relation to measurements representing the reference condition in order to establish trends toward the reference condition (SER, 2004; Ruiz-Jaen and Aide, 2005). While it is often assumed that wetland mitigation projects follow a smooth trajectory towards desired conditions, Zedler (1999) provided evidence that restoration sites may not always follow linear trajectories. Ecosystem development may proceed along complex paths that are difficult or impossible to predict. The literature based on developmental trajectories for wetlands is growing. However, the long-term validity of many trajectory performance standards in predicting restoration of the full range of wetland functions and values remains to be demonstrated (ELI, 2004).

A near consensus among the literature surveyed is the need to clearly articulate project goals prior to attempting to develop performance standards. A project goal is a broad statement of what the mitigation project seeks to accomplish (Ossinger, 1999), and should allow visualization of the desired mitigation site *a priori*. Project goal statements should include a list of the major wetland functions and values to be achieved

Wetland mitigation is typically aimed towards restoration of wetland functions. Many authors and organizations (e.g., Herrick et al., 2006; Ossinger et al., 1999; Ruiz-Jaen and Aide, 2005b; SER, 2004) have concluded that assessment of restored functional processes is a critical component of wetland mitigation assessment. Ruiz-Jaen and Aide (2005a) found that the most common indicators for restoration of ecological processes in academic studies were measures of biological interactions, followed by nutrient pools and soil organic matter. Other examples they identify include the presence of mycorrhizae; indirect measures of herbivory, dispersal, pollination, predation, and parasitism; and soil nitrogen, soil organic matter, organic carbon, and litter dynamics to measure the recovery of soil and abiotic conditions.

However, ecological processes are rarely measured because they are slower to recover in comparison with diversity or vegetation structure (Ruiz-Jaen and Aide, 2005). In addition, ecological processes require multiple measurements, which can increase the time and cost of a project.

Because it is usually impracticable to measure many functions directly due to limitations imposed by time, cost, and confounding factors that cannot be controlled (Ossinger et al., 1999), measures of dynamic processes are atypical in mitigation project assessments and most criteria are based on structural attributes, most often plant community characteristics (Matthews and Endress, 2008). More costly and detailed academic studies have attempted to link restoration of wetland functions to simpler indicators of wetland function that are commonly used in wetland mitigation performance standards. For example, Ruiz-Jaen, M. C., & Aide, T. M. (2005b) compared four measures of vegetation structure, four measures of species diversity, and six measures of ecosystem processes. Their work suggests that vegetation structure and diversity may be reliable indicators of the restoration of other wetland functions that are more difficult to measure. Herrick et al., (2006), however, provide evidence that short-term plant composition alone may be insufficient to predict long-term restoration success, and propose that vegetation-based indicators be supplemented with one or more ecological process indicators.

In its white paper titled *Performance Standards for Wetland Restoration and Creation*, the SWS (2013) makes the following recommendations:

1. stakeholders should carefully consider project objectives and the link between these objectives and performance standards;
2. as a general rule, performance standards should be monitored for a minimum of 5 years or until the standards have been met for at least 3 consecutive years;
3. if wetland assessment techniques have been developed for the wetland type to be restored or created, they may provide a useful starting point for discussion of performance standards;
4. because hydrology is a key factor driving wetland function, performance standards based on hydrology may be useful in many circumstances;
5. if project objectives include restoration or creation of a site to a condition similar to that of nearby natural wetlands, performance standards should be based on conditions found in the natural wetlands; and
6. survival of planted stock or percent cover by vegetation, although often used as performance standards, do not reflect wetland function and should not be relied on as a sole measure of performance in most cases.

The Association of State Wetland Managers (Stelk, 2014) recommends that monitoring for assessment not be limited to 3 – 5 years, but that it be of sufficient length of time to measure the intended wetland functions. The performance standards for mitigation should keep pace with current science and technology and be focused on the identified wetland type.

Permit review summary

In 2013, the same DEP staff that are the authors of this report were tasked with compiling mitigation success criteria and evaluating those criteria to identify successes and shortcomings. To accomplish this, we looked at success criteria from recent permits that were issued by three wetland permitting groups with generally large and complex wetland mitigation projects: mitigation banking, phosphate mining, and non-phosphate mining. The success criteria were compiled from the range of mitigation project types including creation, restoration, preservation and enhancement of both wetland and upland communities. Although the permits included a wide range of community types for mitigation, the majority of the mitigation fell into the following broad categories: sandhill, flatwoods (mesic and hydric), freshwater marsh, freshwater forested, prairies, riverine, and saltwater/tidal marsh.

In general, the mitigation success parameters were very similar in nature among the permits we surveyed. A key reason for this is based on the common use of the same statutes, rules and policies.

It was noted that success criteria did diverge to take into consideration different types of mines and site conditions at the time wetland mitigation construction begins. For example, the starting point for the phosphate and heavy minerals mining mitigation projects typically was wetland creation on a mine reclamation substrate consisting of newly deposited tailings and overburden. These success criteria were focused on the establishment of a plant community and required relatively high values for groundcover and shrub species, and relatively high density of trees. Mitigation banks and aggregate mines tended to focus more on restoration and enhancement of existing, but degraded, communities. Peat mines typically provide restoration within the footprint of mining operations in addition to creation, restoration and enhancement nearby.

Even with site-specific variations, most of the permits had similar success criteria.

The majority of the success criteria focused on documenting establishment of specific vegetation community characteristics. The vegetation criteria were usually the most quantitative in nature and included cover or density measures for the canopy, subcanopy, and ground cover strata, as appropriate for the target community type. Each permit identified the desired species which was often based on literature. Some mitigation bank and most phosphate permits required the use of one or more reference communities to account for biogeographic variation. Permits required that conditions exist that will allow the plants to be healthy and to spread via vegetative growth and reproduction, as expected for the species present. All of the permits contained success criteria limiting the presence or extent of nuisance and invasive exotic plant species, although the actual language and numeric standards varied.

Hydrologic criteria were universal amongst the permits and, for the most part, were narrative criteria requiring that hydroperiods and depths of inundation be within the range of conditions expected for the target community type. Several of the phosphate permits included criteria requiring that hydroperiods be consistent with values observed in reference wetlands during the same time period or the range of values predicted by modeling.

Several permits required that the mitigation area be able to meet the overall success criteria without active management or corrective action for a specified period of time, as indication that the site is generally sustainable. This often included cessation of activities to remove exotic and nuisance species and active altering of the water levels. The required period of non-intervention prior to release or success determination ranged from one to three years depending on the permit.

The mitigation bank permits commonly made use of functional assessments following the completion of mitigation activities to determine if the mitigation has resulted in the degree of increase in ecological function that was contemplated before implementation of the mitigation plan. In contrast, the mining permits did not typically include functional assessments following implementation of the mitigation plan.

Permits identified the minimum number of acres that each target community type must achieve. For wetland communities the extent of the wetland area must be based on the wetland delineation criteria, either referencing Chapter 62-340, F.A.C., or Section 373.421, F.S.

Most phosphate permits and a few mitigation bank permits included hydric soil characteristics as success criteria. These success criteria may be useful where the starting point for mitigation construction is backfilled tailings and overburden, or a hydrologically-impacted wetlands.

Faunal-based success criteria were generally not used, except for riverine and stream communities. Only six of the mitigation bank permits reviewed had faunal criteria.

In the surveyed permits, the mitigation success criteria for uplands were nearly exclusive to mitigation banks; though some of the recent phosphate permits had limited amounts of upland mitigation and/or sites restored as "other surface waters" due to a requirement in the phosphate mine reclamation rule (Rule 62C-16, F.A.C.) to restore non-wetland floodplain.

The riverine and stream criteria were almost exclusive to the phosphate mining permits. Some flowing water systems were present in the mitigation bank permits, though stream-specific criteria were not identified.

Recommendations

Based upon the review of success criteria in previously issued permits, review of relevant current rules and regulations, and literature review, we identified a suite of success criteria parameters that would be applicable to virtually every type of mitigation and another suite of parameters that would be the basis for specific communities within a mitigation area. The former are termed "General" success criteria and the latter are called "Common" in the discussions below. Examples of how these common parameters can be applied to different wetland and upland native communities are provided in the Appendix.

General Success Criteria

These parameters are generally applicable to the entire mitigation area, regardless of target community type or form of mitigation activity (restoration, creation or reclamation "from scratch", or enhancement).

Target Communities and Acres

Key to future determination of success is an understanding of the intent/goal/objective of the mitigation. The overall goal of the mitigation should be stated as one of the first success criteria and clearly specify the target native communities and their respective acreages that are expected. This expectation can either be expressed in a table, such as shown below if the mitigation includes multiple types of native community targets, or stated in a sentence format.

Target Native Community **(name based on FNAI, 2010 edition)**	**Acres**	**Associated Polygon(s)/Wetland ID**

The supporting information, provided in monitoring reports, for this criteria can include maps based on aerial photography and ground-truthing that distinguish the community types, and include the acreage and configuration each. A permit may allow for acceptable deviation, such as within 5 -10% of permit values, under circumstances where there is a degree of uncertainty on the community development.

Wetlands Are Jurisdictional

For target communities that are intended to be wetlands, as described above, the permit should also specify that those requisite acres of mitigation be determined to be wetlands or other surface waters, as delineated pursuant to Ch. 62-340, F.A.C. It is understood that in some cases, such as in creation and mine reclamation sites, the formation of hydric soils will be limited; in these cases, evidence that a site has the appropriate hydrology is not limited to soil formation. Rather, presence of hydrologic indicators as listed in 62-340.500 should be observable.

Hydrology

Similarly, for target communities that are intended to be wetlands or other surface waters, hydrology should be within the range of conditions expected for the target community type. This determination can be made based on hydrologic indicators, plant condition, and field measurements, as appropriate. Some plant communities have very different hydroperiods from one another (ie, basin marsh compared to wet flatwoods). Hydrologic indicators should not only be present and observable, but also appropriate for the target community.

Plants are healthy and reproductive

There is a range of appropriate plant species for every native upland and wetland community. Factors such as geographic location, hydrologic regime, and former/current land-use can greatly affect the occurrence and diversity of flora. In some cases, especially for creation and mine reclamation sites, seeding or planting is often necessary to drive the plant community towards a desired target community. Regardless of the actions taken to establish the plant community, a general criteria or indicator of success is that the non-nuisance, native groundcover, shrub, and tree species appropriate to the target community are healthy and reproducing naturally, either by normal, healthy vegetative reproduction or through seedling establishment, growth, and survival.

Invasive Exotic Plant Species

Generally, a mitigation area that has sufficient cover and establishment of the expected suite of native plant species appropriate to the target communities will not have much, if any, presence by invasive exotic plant species. Exotic plant species are defined in Applicants Handbook, Volume 1, 2.0(a) 42; additional information is provided at www.fleppc.org. However, some mitigation areas are more vulnerable to invasive plant species growth due to the starting condition, the type of mitigation activities, and adjacent land use. In all cases, cover by Category I and II invasive exotic plant species (list established by the Florida Exotic Pest Council at www.fleppc.org) should be minimal (i.e., 1% cover or less).

Nuisance Plant Species

Similarly, nuisance species, as defined in Applicants Handbook, Volume 1, 2.0(a) 64, would not be expected to be prevalent in successful mitigation areas. Although these plant species are native or naturalized (unlike the exotic species), they are often indicative of early successional or ruderal conditions and may interfere with the establishment of the native community when they are in sufficient number, biomass, or areal extent. Therefore, these species should be expected to be limited in cover (i.e., 5% to 10%) as a general indication that the mitigation area has either already met or is on a clear trajectory to meeting the target community plant composition.

Provide Habitat

It is generally agreed that gathering evidence or proof of wildlife utilization can be difficult and time consuming. Furthermore, habitat structure is an easier or more effective tool to assess wildlife utilization. Evidence of fish or wildlife use may be necessary when the mitigation area must be used to offset impacts to listed species habitat. This being said, evidence of use by native fish and wildlife expected for the target community should be demonstrable. Examples of evidence can include direct observation, photographs, recordings of vocalizations, tracks, scat, nests, dens, and burrows.

Viability (Non-Intervention Period)
A general theme in determining mitigation or wetland restoration success is ensuring that the area is self-sustaining before releasing the site from monitoring and correcting actions. This criteria for success can be best expressed in a requirement that there be a period of non-intervention once all of the other site-specific success criteria have been met. In particular, hydrologic and vegetation criteria should be met without intervention in the form of irrigation, artificial manipulation of water levels, exotic/nuisance plant species treatment, or additional planting or seeding for at least two years prior to release. Due to the aggressive nature of some invasive exotic plants; however, it would be acceptable to treat them up to one year prior to release.

Common Success Criteria

We identified a number of success criteria with numeric parameters specific to the communities or mitigation goals, but with underlying common themes. These themes were generally based on quantification of plant community characteristics. In addition, pyrogenic communities should include prescribed fire-based success criteria and created or mine reclamation sites may include a criteria on soils and substrates.

Ground cover
This numeric criteria is common to virtually all community and mitigation types, except for open water bodies, for a number of reasons. For previously disturbed, created, or mine reclamation sites, the initial goal may be the stabilization of the soil by appropriate ground cover. This initial establishment of groundcover is also important to prevent or minimize the presence of both nuisance and invasive, exotic plant species. In the long term, the goal is the establishment of the native ground cover that is within the normal range for the target community, in order to provide the expected habitat. This condition should specify the minimum or acceptable range of percent total cover by species appropriate to the target native community.

An additional ground cover condition may also specify the percent cover of a suite of species relative to reference site information contained in the permit application file or the relative cover by certain species or suite of species. This species-specific information may be a critical measure for the target community, such as cover by pyrogenic bunchgrasses sufficient to carry effective fires, or emergent vegetation critical as food for water fowl.

The number of appropriate native ground cover species in a sampling unit, as a measure of diversity, can also provide essential information on the structure of the mitigation site, relative to the target community. Some communities, such as flag marsh or forested floodplain, may be expected to have relatively low plant diversity in the groundcover, while others, such as hydric and mesic flatwoods, are characterized by high plant diversity in the groundcover.

In all cases, the plant species nomenclature for wetland communities should adhere to that used in Chapter 62-340, FAC. In the event that plants have been re-named since the wetland delineation rule was adopted, the newer name may also be provided in addition to the name in rule and statute.

Shrub/subcanopy

The shrub/subcanopy stratum is applicable to most communities, although the importance and measurements can vary, depending upon the target community and the mitigation type. The most common shrub/subcanopy criteria is the presence of these woody species, usually measured as density (# per sampling unit), but the numeric expression of this criteria varies depending upon the community. For flatwoods and marsh systems, this criteria should be the maximum density appropriate for those groundcover dominated communities. For shrub bogs and forested systems, there should be a minimum value or a range of density values appropriate for that community.

The number of species in the sampling unit, expressed as diversity, may also be an important characteristic of a target community, ensuring that there is not an un-natural monoculture or dominance by one species, such as titi. Similarly, there may be a limit on the presence (density) of early successional species, such as willow, as this would not be indicative of the target community and condition. These criteria would be most applicable to created and mine reclamation areas or those being converted from formerly disturbed site that was characterized by a near monoculture of early successional species.

In pyrogenic communities, shrub height reduction by fire and regrowth by coppice is a good measure of effective prescribed fire and is indicative of the target community condition.

Canopy

The criteria for canopy are generally only applicable to forested and flatwood communities. The canopy is distinguished as trees that are in the uppermost stratum and have a 4 inch or greater dbh (diameter at breast height).

For forested and flatwoods communities, the number of appropriate canopy trees per sample area (density) is one of the most standard indicator of canopy establishment or enhancement. The actual density success criteria may be a minimum value for forested systems, depending upon both the specific forested community and the starting point (ie, creation, mine reclamation, or enhancement of existing community) or a range of values for flatwoods, which generally have relatively low number of trees. A specified minimum amount of canopy cover may also be required, especially for creation and mine reclamation sites, as indication that the mitigation area provides the appropriate forest habitat in general and sufficient shade for forest groundcover species.

In addition to the presence of trees, the success criteria should specify either a list of target tree species characteristic of the community goal or a certain number of tree species (diversity), or both. These success criteria are generally most applicable for creation and mine reclamation mitigation sites.

Another canopy success criteria most applicable to creation and mine reclamation mitigation sites is a specified increase in growth and height, particularly for planted trees.

Fire

Fire is a critical component for the establishment and management of pyrogenic communities, particularly flatwoods, sandhills, wet prairies, and glades. The combination of plant success criteria for these types of communities, along with a specified minimum frequency and intensity of applied prescribed fire, is generally required to achieve the mitigation target.

Soils/substrate

The soils or substrate of a mitigation site is generally not modified from pre-mitigation conditions, except in the case of created mitigation areas and mine reclamation sites. In those cases, the soils and substrates should have criteria that are reflective of the target community and its natural soils and substrates. In particular, the success criteria should specify if the materials should be sandy, organic/mucky, or clay/fine textured.

Unique or Special Success Criteria

Streams need to have a different set of criteria than most other upland or wetland community types to determine success. At a minimum, these criteria are unique measures of hydrology, floodplain connectivity, channel stability and the geomorphologic features of the stream channel. Additional criteria based on in-stream habitat, biology and vegetation should also be included. Some of the following discussion is derived from a 2012 EPA document entitled A function-Based Framework for Stream Assessments and Restoration Projects that may be very useful for developing success criteria for streams (Harman, et al. 2012).

Hydrology

Hydrology addresses the transport of water from the watershed to the stream channel. Watershed based criteria include (1) bankfull channel dimensions are within the acceptable range based on watershed size as shown on regional curves, (2) bankfull events are occurring at the expected frequency, and (3) flow duration curves.

Channel Stability

Proper channel design is critical to ensure that the stream is stable and will not significantly erode or fill in with sediment. The dimension, pattern and profile of the stream should fall within the range of variability present in the reference data used for the design. The dimension of the channel refers to the cross sectional shape and includes measurements like width, depth, area, etc. Channel pattern refers to the form taken when viewed from aerial photos or topography maps and includes measurements like sinuosity, distance between curves, radius of channel curves, amplitude of the channel curves, etc. The channel profile refers mainly to the slope of the channel which can be irregular based on variations in sediment type, bed shape and pool and riffle features. Reference data can come from a one or several stable natural stream or from regional curves based on data derived from multiple streams with varying watershed sizes within a defined geographic area. Success criteria should require as-builts and subsequent monitoring events designed to demonstrate that the appropriate bankfull width, depth and cross sectional area was constructed and that the channel remains stable and is not enlarging or filling in.

Floodplain Connectivity

Floodplain connectivity is a driving force behind many ecological functions of streams including nutrient removal, flood storage, and habitat diversity. Success criteria to verify that floodplain connectivity is maintained can be based on measurements such as bank:height ratio and entrenchment ratio. The bank:height ratio is a direct measure of channel incision and is measured at a riffle. It is the ratio of the channel depth from the thalweg, or the deepest part of the channel, to the lowest top of the bank, divided by the depth of the channel from the thalweg to the bankfull elevation. Values greater than 1 indicate some level of channel incision. The entrenchment ratio is a measure of the floodprone area width in relation to the bankfull width. The floodprone width is the width at the elevation that is twice the bankfull maximum depth as measured at riffle. Entrenchment ratio varies by stream type and higher values mean there is wider potential floodplain access. This value is typically 2.2 or greater for the most common streams in Florida (C and E types).

Bank Migration/Lateral Stability

Bank stability is another important parameter to evaluate in stream restoration projects. There are various methods of measuring bank stability available such as determining lateral erosion rate through the installation of bank pins that are permanently installed flush with the banks. Exposed areas along the pins are then measured periodically to determine the amount of material lost. Permanent bank profiles or cross sections with permanent toe pin markers can also be used and compared between monitoring events to look for excess erosion and instability. For instance, increases in the bankfull width/depth ratio are often associated with increased bank erosion rates and bed aggradation. A comparison of the width/depth ratio with those of reference streams can also be made and an index developed to determine stability.

Bed Form Diversity

Bed form diversity can be used to verify both geomorphology and habitat functions. Several methods can be used to evaluate this parameter such as percent riffles, pool-to-pool spacing and depth variability.

Riffle-pool percentages have been observed to be between 60:40 and 80:20 in Rosgen C and E streams in the Southeastern US. However, the percentages of pools are likely higher in Florida and success criteria should be based on data from regional reference reaches. For pool spacing, when distances become too low this often indicates instability in the banks. In the southeast, this instability and increased bank erosion has been shown in C and E streams when pool to pool spacing ratios are less than 3.0 to 3.5. The spacing ratio is calculated as the distance between the deepest point of 2 pools divided by the bankfull riffle width. Success criteria could be based on meeting a ratio range or the pool to pool spacing requirements could be compared to the design for each stream or reference reach data.

Depth variability is a measure of bankfull pool depth divided by the mean bankfull depth at a riffle, often called the Pool Max Depth Ratio. Ideally, a range of ratios is present indicating a greater variety of pool depths and higher habitat diversity, especially for fish. Measured over time, this information also can indicate if the stream is continuing to process sediment effectively or if the pools are filling in.

Large Woody Debris

The amount of large woody debris can be used as a success criteria to measure both geomorphology and habitat creation. Large woody debris serves as structural control and can decrease bank erosion, provide flow resistance, create pools, and retain sediment and organic matter. Large woody debris also increases habitat diversity directly by providing habitat for fish and macro-invertebrates. Success criteria for this parameter can be based on comparing the site conditions to the amounts specified in the design plans or in reference streams.

Riparian Vegetation

Riparian vegetation provides numerous benefits for the adjacent stream channel including bank stability, cover and shade, nutrient retention and recycling, flow moderation, sediment retention, recruitment of woody debris, and organic matter contribution. Maximum benefits are provided by a wide area of mature, native vegetation. Success criteria for the riparian vegetation, whether upland or wetland, can be similar to those for forested wetlands requiring minimum densities and/or cover for the groundcover, canopy and subcanopy, species richness or diversity requirements and limits on nuisance and exotic species cover. The width is another important success criteria since reductions in width are related to reductions in stream function. Buffer width requirements may need to vary by stream type and stream size and should therefore be specified in the permit.

Macro-invertebrate and Fish Communities

Criteria for the biota can be based on evaluations of habitat such as requirements to meet a minimum score on the Department’s Stream Habitat Assessment, or preferably on sampling of the macro-invertebrate and/or fish community. Passing the Department’s macro-invertebrate-based stream condition index (SCI) could be utilized in perennial and some intermittent streams with longer flow periods. The SCI is not applicable in many of the smaller non-perennial streams, however. In those situations, macro-invertebrates can be compared to reference streams of similar type, size and hydrology.

Although common in other states, there are currently no criteria for fish community structure in Florida streams. However, criteria could be included that rely on comparisons of the fish communities to that of reference streams of similar size and type and hydrology.

Discussion

The recommended success criteria presented in this report represent a combination of qualitative and quantitative parameters that are indicators of wetland function. Although they are not generally direct measures of wetland functions, they collectively indicate whether or not the mitigation has achieved a condition that serves to offset the loss of wetland function specified in the permit. This is consistent with the no-net-loss of wetland function guideline that is central to issuance of an Environmental Resource Permit with mitigation (10.1, Applicants Handbook).

The success criteria recommendations in this report are not intended to circumvent reasonable scientific judgment or the consideration of project-specific factors. A great deal of thought is required to develop an appropriate suite of success criteria for a mitigation project. The suite of criteria chosen should complement one another and should work together as a unit to mandate the achievement of the project goals. Stating project goals *a priori* may be useful for development of success criteria, as the stated goals allow visualization of the desired outcome and the attributes that will be necessary to establish that outcome. The stated goals can also be reviewed *post*-hoc to determine whether the success criteria were effective measures of the desired outcome.

It is important that the targets established in success criteria account for the variation found in natural systems. The ecosystem attributes (e.g. hydroperiod, percent cover, tree density) reported in literature often represent the central tendency of observations collected from a range of communities. As such, success criteria should allow expression of a range of values around those central tendencies, provided the target community is established.

Finally, it is recommended that proposed success criteria be presented to and discussed with the permit applicant/permittee and entity responsible for implementing the mitigation project prior to finalization of the mitigation project design. This will help to minimize or eliminate conflicts between the site design and how "success" is to be measured. Knowing the criteria that will be used to determine success ahead of time will allow the permittee to tailor the site design to achieve those success criteria.

Both regulatory permitting staff and permittees would benefit from permits that:

- Consistently and clearly express the objectives of the mitigation,
- Base the mitigation expectations on the natural communities of Florida and their respective ecosystem attributes and function,
- Provide reasonable and measurable expectations of success, and
- Accurately reflect both the starting condition and release conditions.

The recommended success criteria do not include, but clearly imply, a monitoring plan for each permit. The monitoring plan needs to be efficient, effective, and sufficient to support the permit-specific success criteria.

Future Needs

One of the key limiting factors in the recommended success criteria is the lack of a state-wide data base for reference communities. Ideally, each native community type would be paired with at least one regional reference site, and that the target plant community, hydrology and other relevant data from the reference site has already been collected and is readily available for use.

Similarly, development of a suite of potential or standardized monitoring plans appropriate for different success criteria would result in greater consistency in permitting and decrease individual staff reviewer time in review. Monitoring protocols, once established, can be applied to a variety of communities.

Our efforts were focused on the final success criteria, but there is also a need to understand and identify the indicators of trending towards success. Not all mitigation sites will be mature climax or subclimax communities, even a decade after construction or other mitigation activity, depending upon the starting condition of the mitigation site. For instance, the success criteria for a forested wetland creation site should not mandate characteristics that are only possible in a mature system. Some conditions may be more effective "early indicators" of success than others. For example, while the density of trees likely will change significantly after the initial planting and as wetlands develop, the species composition and diversity may be effective measures of eventual success.

Although outside of the scope of this project, the concept of adaptive management can plan an important role in mitigation. Adaptive management may identify means to achieve the performance standards, different from what was originally specified in the permit, to account for actual site conditions or events. The adaptive management process may also identify alternative success criteria or performance standards that better reflect the target community or mitigation goal.

For several of the stream criteria, additional work determining what degree of change is acceptable from as-built conditions to still consider the stream stable is needed. It is possible, for example that there will be some changes in the bankfull dimensions following construction. Similarly, some degree of lateral migration is also expected, especially in a newly constructed stream.

In order to ensure that success criteria are meaningful from both ecological and regulatory standpoints, staff development should address:

- Mechanisms of natural systems as succession progresses following disturbance or during primary succession,
- Hydrologic monitoring conditions that may be used to verify whether a mitigation area has achieved the ecological and hydrologic goal,
- The scientific study and practical application of ecosystem restoration,

- Community descriptions used by the Florida Natural Areas Inventory. This would include the range of characteristics that can be exhibited by a community, physical factors that influence these characteristics, and ecotones, and
- Monitoring for success.

Appendix

References

Breaux, A., & Serefiddin, F. (1999). Validity of performance criteria and a tentative model for regulatory use in compensatory wetland mitigation permitting. *Environmental Management, 24*(3), 327-336.

Brown, S. C., & Veneman, P. L. (2001). Effectiveness of compensatory wetland mitigation in Massachusetts, USA. *Wetlands, 21*(4), 508-518.

Cole, C. A., & Shafer, D. (2002). Section 404 wetland mitigation and permit success criteria in Pennsylvania, USA, 1986–1999. *Environmental Management, 30*(4), 508-515.

Environmental Law Institute (2004) *Measuring Mitigation: A Review of the Science for Compensatory Mitigation Performance Standards.* Environmental Law Institute, Washington, D.C. ISBN # 1-58576-084-6.

Florida Department of Environmental Protection (1995) *Dredge and Fill Activities.* Florida Administrative Code (F.A.C.) Rule 62-312.

Florida Department of Environmental Protection (2012) *Mitigation Banking.* Florida Administrative Code (F.A.C.) Rule 62-342.

Florida Department of Environmental Protection (2013a) *Environmental Resource Permitting.* Florida Administrative Code (F.A.C.) Rule 62-330.

Florida Department of Environmental Protection (2013b) *Environmental Resource Permit Applicant's handbook Volume I.* Florida Administrative Code (F.A.C.) Rule 62-330 (Incorporated by reference).

Florida Department of Transportation (1999) Florida Land Use, Cover and Forms Classification System, Third Edition (FLUCCS).

Florida Natural Areas Inventory (FNAI) (2010) Guide to the Natural Communities of Florida: 2010 edition. Florida Natural Areas Inventory, Tallahassee, FL.

Gallihugh, J. L., & Rogner, J. D. (1998). Wetland mitigation and 404 permit compliance study, Vol. 1. *Report and appendices A, B, C, D, E, 2.*

Godfrey, R. K. and Wooten, J.W. (1981). *Aquatic and wetland plants of southeastern United States: Monocotyledons*. University of Georgia Press, Athens, Georgia.

Godfrey, R. K. and Wooten, J.W. (1981). *Aquatic and wetland plants of southeastern United States: Dicotyledons*. University of Georgia Press, Athens, Georgia.

Godfrey, R. K. (1988). *Trees, shrubs, and woody vines of northern Florida and adjacent Georgia and Alabama*. University of Georgia Press, Athens, Georgia.

Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K.Suggs, C. Miller. (2012). *A Function-Based Framework for Stream Assessments and Restoration Projects.* US Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC EPA-843-K-12-006.

Herrick, J. E., Schuman, G. E., & Rango, A. (2006). Monitoring ecological processes for restoration projects. *Journal for Nature Conservation*, *14*(3), 161-171.

Matthews, J. W., & Endress, A. G. (2008). Performance criteria, compliance success, and vegetation development in compensatory mitigation wetlands. *Environmental Management*, *41*(1), 130-141.

Mitsch, William J., and James G. Gosselink (2007) Wetlands, 4th Edition, John Wiley & Sons, Inc., New York.

Myers, Ronald L. and John J. Ewel (ed.) (1991). *Ecosystems of Florida*. University of Central Florida Press, Orlando, Florida.

Ossinger, M. (1999) *Success Standards for Wetland Mitigation Projects – a Guideline*. Washington State Department of Transportation, Environmental Affairs Office.

Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology. Pagosa Springs, Colorado.

Ruiz-Jaen, M. C., & Aide, T.M. (2005a). Restoration success: how is it being measured? *Restoration Ecology*, 13(3), 569-577.

Ruiz-Jaén, M. C., & Aide, T. M. (2005b). Vegetation structure, species diversity, and ecosystem processes as measures of restoration success. *Forest Ecology and Management*, *218*(1), 159-173.

SER (Society for Ecological Restoration International Science & Policy Working Group) 2004. *The SER International Primer on Ecological Restoration*. (available from http//www.ser.org) accessed in January 2014. Society for Ecological Restoration International, Tucson, Arizona.

Society of Wetland Scientists (SWS) Position Paper (2013) *Performance Standards for Wetland Restoration and Creation.*

Stelk, Marla and Peg Bostwick. (2014) *Raising the Bar on Restoration.* Wetland News, Vol. 24 No.2.

Streever, W. J. (1999a) *An International Perspective on Wetland Rehabilitation.* Kluwer Academic Publishers, Dordrecht, The Netherlands.

Streever, W. J. (1999b) *Examples of performance standards for wetland creation and restoration in Section 404 permits and an approach to developing performance standards.* U.S. Army Engineer Research and Development Center, Vicksburg, MS, USA. WRP Technical Notes Collection (TN WRP WG-RS-3.3). (www.wes.army.mil/el/wrp).

USDA Soil Conservation Service (1989) *26 Ecological Communities of Florida.* USDA-SCS, Gainesville, Florida.

Wade, D., Ewel, J., and Hofsetter, R. (1980). *Fire in South Florida Ecosystems*. U.S. For. Serv. Gen. Tech Rep. No. SE-17. Southeast For. Exp. Stn., Asheville North Carolina.

Wunderlin, R.P. and Hansen, B.F. (2013) *Atlas of Florida Vascular Plants.* Institute for Systematic Botany, University of South Florida, Tampa, Florida (http://www.florida.plantatlas.usf.edu/).

Zedler, J. B., & Callaway, J. C. (1999). Tracking wetland restoration: do mitigation sites follow desired trajectories? *Restoration Ecology*, *7*(1), 69-73.

Zedler, J. B. (2007). Success: an unclear, subjective descriptor of restoration outcomes. Ecological Restoration, 25(3), 162-168.

Zedler, J., Shabman, L., Alvarez, V., Evans, R. O., Gardner, R. C., Gibbons, J. W., Gilliam, J.W, Johnston, C.A., Mitsch, W.J., Prestegaard, K., Simenstead, C. and **Turner, R. E. (2001).** Compensating for wetland losses under the Clean Water Act. *National Academy of Sciences, National Academy Press, Washington, DC, USA.*

Examples of Success Criteria

The following pages provide examples of success criteria for some of the most common mitigation target native communities for mining and mitigation banking permit. Factors such as geographic location, past land-use, landscape position, underlying geologic formations, surrounding plant communities/land-use, micro-climate, and successional pattern will affect the success criteria goals and metrics. These examples are intended to be a starting point, using the recommended success criteria, to account for wetland functions proposed to be provided in a mitigation area for the following general community types:

- Sandhills
- Flatwoods
  - Hydric Flatwoods
  - Mesic Flatwoods
- Prairies and Bogs
  - Seepage Slopes
  - Wet Prairie
  - Marl Prairie
  - Shrub Bog
- Freshwater Marshes
- Cypress-Tupelo Communities
  - Floodplain Swamp
  - Basin Swamp
  - Dome Swamp
  - Strand Swamp
- Hardwood Forested Communities
  - Baygall
  - Hydric Hammock
  - Bottomland Forest
  - Alluvial Forest
- Stream and Riverine Communities
- Saltwater Marshes

Sandhills

Sandhills are characterized by widely spaced pine trees with sparse midstory of deciduous oak trees and moderate to dense groundcover by pyrogenic grasses, herbs, and low shrubs. The indicator plant species of this community are longleaf pine (canopy), turkey oak (subcanopy), and wiregrass (groundcover). South Florida slash pine replaces long leaf pine south of Lake Okeechobee. Other subcanopy species may include bluejack oak, sand live oak, and sandpost oak, along with sparkleberry and saw palmetto. The greatest plant diversity is found in the groundcover, with many species of the legume and aster families present. Frequent (historically 1 – 3 year cycle) fires in the growing season maintain this community by reducing hardwood competition and perpetuating the fire-adapted pines, grasses, and forbs.

Synonym/variants: longleaf pine-turkey oak, FLUCCS 421 – xeric oak, FLUCCS 412- longleaf pine-xeric oak

Groundcover

- Representative data shall demonstrate at least 50% cover with appropriate native, non-nuisance *herbaceous* vegetation. Bare ground and leaf litter constitutes less than 40% cover. Groundcover trends over at least three years show increasing cover.

- Fire-adapted, native herbaceous species are of adequate density to carry a growing season prescribed fire over an average of at least 75% of the sandhill community on a 2 – 3 year cycle.

- Wiregrass and other perennial pyrogenic bunchgrasses have >10% cover in the herbaceous stratum.

- Transects shall have an average of ≥20 native, non-canopy species appropriate to sandhill communities as identified in literature such as the Florida Plant Atlas (USF), Guide to the Vascular Plants of Florida (Wunderlin 2003), and Guide to the Natural Communities of Florida, 2010 edition (Florida Natural Areas Inventory).

Shrub/Subcanopy

- Oak species (i.e. *Quercus incana*, *Q. geminata*, and *Q. laevis*) that are present are controlled by fire to an average height of 1.5 meter or less, and with <30% cover.

- Woody shrubs, other than the oaks above, constitute <10% cover.

Canopy

- [for mine reclamation and other “start from scratch” mitigation] Planted trees have doubled in height, canopy cover by both planted and volunteer trees (long leaf pine or South Florida slash, where appropriate) have increased annually and have a 10% canopy coverage at the end of the growing season.

- [for former pine plantations] The density of longleaf pine (Pinus palustris) [or South Florida Slash pine, south of Lake Okeechobee] in the canopy is between 50 - 100 trees/acre, with average height ≥ 8 ft.

- [for former pine plantations] The density of slash pine trees in the canopy or subcanopy is < 20 per acre.

Overall

- [For mine reclamation, grandfathered projects]Species richness and dominance in the canopy, sub canopy, and ground layer shall be within the range of values documented in the permit file for the previously identified sandhill reference wetlands.

Flatwoods

Hydric Flatwoods

Hydric flatwoods are characterized by a relatively thin canopy of pine, a sparse or absent mid-canopy, and dense groundcover dominated by perennial pyrogenic bunchgrasses with low-growing shrubs and a diversity of flowering hydrophytic herbs. The canopy is generally dominated by longleaf or South Florida slash (if south of Lake Okeechobee), along with pond and slash pine. In areas where limestone is near or at the surface, Cabbage palm may form a subcanopy; other subcanopy species may include scattered sweet bay, swamp bay, dahoon holly and pond cypress. Characteristic grasses include wiregrass, toothache grass, and Curtis's sandgrass; around the Lake Wales Ridge, cutthroat grass may replace wiregrass as the dominant. Hydric flatwood communities have a historic fire frequency of 1 – 3 years; fire suppression can lead to increase in woody species cover and concurrent decrease in cover by grass and flowering herb species.

Synonyms/variants: pine savanna, wet flatwoods, seepage savannas, FLUCCS 622 –Pond Pine, FLUCCS 624 – Cypress-Pine-Cabbage Palm

Groundcover

- Total groundcover by non-nuisance, non-exotic FAC, FACW, and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for the wet flatwoods communities shall be at least 70%. Bare ground, leaf litter and open water constitutes 20% or less cover. Groundcover trends over at least three years show increasing cover.

- Fire-adapted, native herbaceous species are of adequate density to carry a growing season prescribed fire over an average of at least 75% of the wet flatwoods community on a 2 – 3 year cycle.

- Wiregrass and other perennial pyrogenic bunchgrasses have >20% cover in the herbaceous stratum.

- Transects shall have an average of ≥35 native, non-canopy wetland species appropriate to hydric flatwoods as identified in literature such as the Florida Plant Atlas (USF), Guide to the Vascular Plants of Florida (Wunderlin, 2003 or 2011 editions), and Guide to the Natural Communities of Florida, 2010 edition (Florida Natural Areas Inventory).

Shrub

- Relative cover by woody shrub species shall be <30% in the groundcover and canopy strata combined.

- Gallberry, yaupon, XX, XX, titi and other woody shrubs shall be no taller than the coppice sprouts that could have arisen from root crowns following the most recent successful fire, averaging ≤1.5m in height. Any areas with shrubs averaging more than 1.5 meters in height shall be limited to random spots of 1 ac. or less where fire did not burn and shall represent an insignificant feature in the flatwoods.

Canopy

- [for mine reclamation and other “start from scratch” mitigation] Planted trees have doubled in height, canopy cover by both planted and volunteer trees (slash pine, long leaf pine, pond pine, or South Florida slash, where appropriate) have increased annually and have a 10% canopy coverage at the end of the growing season.

- [for former pine plantations] There are less than 50 canopy slash pine trees per acre, with d.b.h. ≥ 4”

- [for former pine plantations] The density of longleaf pine (Pinus palustris) {or South Florida Slash pine in South Florida, south of Lake Okeechobee] in the subcanopy and/or canopy is between 50 - 150 trees/acre.

Fire

- There has been at least 2 growing-season prescribed fires, conducted in accordance with the burn plan approved in the permit. Each of these prescribed fires covered a minimum of 80% of the hydric flatwoods.

Overall

- [For mine reclamation, grandfathered projects]Species richness and dominance in the canopy, sub canopy, and ground layer shall be within the range of values documented within the previously identified hydric flatwoods reference wetlands, as specified in the permit file.

Mesic Flatwoods

Mesic flatwoods are identified by an open canopy of tall pine (longleaf; South Florida slash south of Lake Okeechobee) with dense low groundcover of low shrubs, grasses and herbs. The grasses include wiregrass, dropseeds, panic grasses, and broomsedges that provide fine fuel for frequent fires. Low, rhizomatous shrubs include runner oak, dwarf huckleberry and Darrow’s blueberry. Saw palmetto and gallberry also often contribute to the shrub layer. Mesic flatwoods are widespread natural communities in Florida, generally found on acidic, nutrient poor soils. Mesic flatwood communities are characterized by frequent fire (1 – 3 year cycle), with annual early summer or growing season burns resulting in the greatest cover by bunchgrasses and greatest diversity of fall-flowers forbs.

Synonyms/variants: pine barrens, longleaf pine, longleaf-slash pine, FLUCCS 411-Pine Flatwoods, FLUCCS 414-Pine-Mesic Oak, FLUCCS 428 – Cabbage Palm

Groundcover

- Total groundcover by non-nuisance, non-exotic species appropriate for the mesic flatwoods communities shall be at least 80%. Bare ground and leaf litter constitutes 20% or less cover. Groundcover trends over at least three years show increasing cover.

- Fire-adapted, native herbaceous species are of adequate density to carry a prescribed fire in the growing season over an average of at least 75% of the mesic flatwoods community on an average of 1 - 3 year cycle.

- Wiregrass and other perennial pyrogenic bunchgrasses have >20% cover in the herbaceous stratum.

- Transects shall have an average of ≥45 native, non-canopy species appropriate to mesic flatwoods as identified in literature such as the Florida Plant Atlas (USF), Guide to the Vascular Plants of Florida (Wunderlin 2003), and Guide to the Natural Communities of Florida, 2010 edition (Florida Natural Areas Inventory).

Shrub/Subcanopy

- Relative cover by woody shrub species shall be <30% in the groundcover and subcanopy canopy strata combined.

- Gallberry, fetterbush, XX, XX and other woody shrubs shall be no taller than the coppice sprouts that could have arisen from root crowns following the most recent successful fire, averaging ≤ 1.5m in height. Any areas with shrubs averaging more than 1.5 meters in height shall be limited to random spots of 1 ac. or less where fire did not burn and shall represent an insignificant feature in the flatwoods.

Canopy

- [for mine reclamation and other "start from scratch" mitigation] Planted trees have doubled in height, canopy cover by both planted and volunteer trees (slash pine, long leaf pine, pond pine, or South Florida slash, where appropriate) have increased annually and have a 10% canopy coverage at the end of the growing season.

- [for former pine plantations] There are less than 50 canopy slash pine trees per acre, with d.b.h. ≥ 4"

- [for former pine plantations] The density of longleaf pine (Pinus palustris) {or South Florida Slash pine in South Florida, south of Lake Okeechobee] in the subcanopy and/or canopy is between 50 - 150 trees/acre.

- Transects shall have an average of ≥45 native, non-canopy species appropriate to mesic flatwoods as identified in literature such as the Florida Plant Atlas (USF), Guide to the Vascular Plants of Florida (Wunderlin 2003), and Guide to the Natural Communities of Florida, 2010 edition (Florida Natural Areas Inventory).

Overall

- [For mine reclamation, grandfathered projects]Species richness and dominance in the canopy, sub canopy, and ground layer shall be within the range of values documented within the previously identified mesic flatwoods reference wetlands.

Prairies and Bogs

Seepage Slope
Seepage slopes are characterized by an open to sparse canopy of a very few pines and shrubs with a fire-maintained ground cover. These systems are kept continuously moist by groundwater seepage. Typically, these systems are situated within well-drained sandhill or upland pine habitat. The vegetation community is usually grass-sedge dominated. Drier portions of seepage slope are dominated by wiregrass (*Aristida stricta*). Other characteristic groundcover species include toothache grass (*Ctenium aromaticum*), cutover muhly (*Muhlenbergia expansa*), savannah meadowbeauty (*Rhexia alifanus*), flattened pipewort (*Eriocaulon compressum*), variableleaf sunflower (*Helianthus heterophyllus*), and club moss (*Lycopodiella* sp.). Wetter portions of seepage slope are dominated by several species of beaksedge (*Rhynchospora* spp.) and are characterized by carnivorous plants such as pitcherplants, sundews and butterworts. Florida **s**eepage slopes are located primarily in the Florida Panhandle, plus small areas in the northern peninsula (FNAI, 2010).
Natural fires enter seepage slopes from surrounding pinelands and burn through when they are dry enough to carry fire. The historic fire interval in the surrounding sandhill or upland pine communities is thought to be 1-3 years.
Synonyms/variants: wet flatwoods, wet prairies, pitcher plant bog, FLUCCS 641-Wet Prairies
Groundcover

- Total ground cover shall be at least 95%

- Relative ground cover by native grasses and sedges from the permit's target vegetation list shall be at least 50%

- At least 15 ground cover species from the permit's target vegetation list shall be present.

- Populations of at least 5 seepage slope specialist species from the permit's target vegetation list shall be present and self-sustaining.

Subcanopy

- The wetland area shall support at least 3 species of shrubs (from the permit's target vegetation list), and shall have a cumulative shrub density of at least 5 shrubs per acre.

- Total cover by woody shrubs shall not exceed 10 percent. For the purposes of success determination, "woody shrubs" includes those species, typically reduced by fire to coppice, such as titi (*Cyrilla racemifolia*, *Cliftonia monophylla*), gallberry (*Ilex glabra*), fetterbush (*Leucothoe racemosa*, *Lyonia* spp.), yaupon (*Ilex vomitoria*) and wax myrtle (*Myrica cerifera*) that tend to become dominant (weedy) and reduce the diversity of herbaceous species and desirable trees and shrubs in a fire suppressed system.

- Shrubs are reduced to coppice, averaging < 1.5m in height. Areas with shrubs averaging more than 1.5 meters in height and having a collective canopy coverage of more than 10 percent shall be limited to random spots of [5] acres or less where fire did not burn and shall represent an insignificant feature in this community type.

Canopy

- The wetland area shall support an average of at least 5 pine trees (*Pinus palustris*, *Pinus elliottii*, and/or *Pinus serotina*) per acre that are at least six feet in height. A minimum of 25 percent of all trees shall be slash pine (*Pinus elliottii*), a minimum of 25 percent of all trees shall be longleaf pine (*Pinus palustris*), and pond pine (*Pinus serotina*) shall be only a minor component, if present at all.

- Canopy species other than pines shall be maintained at less than 5 trees per acre. In no area shall tree density exceed 25 trees per acre.

Fire/Site Management

- A minimum of two successful prescribed fires have been implemented. A successful prescribed fire shall be defined as a fire which carries over a minimum of 70% of the wetland and its buffer during the burn.

- A long-term management plan has been implemented which includes provisions for regular prescribed burning with a fire return interval of 3-5 years.
- A long-term management plan has been implemented which includes control of feral pigs (*Sus scrofa*).

Hydrology

- Soils across at least 80 percent of the wetland area shall exhibit saturation to within six inches of their surface for at least nine months during any calendar year (or 12-month period) in which rainfall meets or exceeds the 30-year average. This criterion must be met during a minimum of three qualifying annual (or 12 month) cycles and the overall success rate averaged over all qualifying periods shall be at least 50% for the site to become eligible for release.

Wet Prairie

Wet prairies are herbaceous communities characterized by a dense and diverse herbaceous ground cover that is open and fire-maintained. These systems are nearly continuously saturated due to intersection of the land surface with the water table but seldom inundate. The vegetation community is typically dominated by wiregrass and sedges, and exhibits very high diversity. Flowering herbs and carnivorous plant species are also common. Canopy and subcanopy species are sparse to absent, with only a very few scattered pines and coppiced shrubs present. Wet prairie usually occurs on acidic, nutrient-deficient, saturated soils. Wet prairie occurs throughout the Florida with the exception of south Florida where limestone soils predominate (FNAI, 2010).

Natural fires enter wet prairies from surrounding pinelands and burn through when they are dry enough to carry fire. The historic fire interval in the surrounding sandhill, upland pine flatwoods, and mesic flatwoods communities are generally thought to be 1-3 years.

Synonyms/variants: moist pine barrens, grass-sedge savannah, grass-sedge seepage bog, FLUCCS 641-Wet Prairies, FLUCCS 310-Herbaceous

Groundcover

- Total ground cover shall be at least 95%;
- Relative ground cover by native grasses and sedges from the permit's target vegetation list shall be at least [50]%;
- At least [25] ground cover species from the permit's target vegetation list shall be present.
- Populations of at least [5] wet prairie specialist species from the permit's target vegetation list shall be present and self-sustaining.

Subcanopy

- Shrubs are reduced to coppice, averaging < 1.5m in height. Areas with shrubs averaging more than 1.5 meters in height and having a collective canopy coverage of more than 5 percent shall be limited to random spots of [X] acres or less where fire did not burn and shall represent an insignificant feature in this community type.

Canopy

- The wetland area shall support no more than 5 trees per acre that are greater than six feet tall. Canopy species present shall be limited to species from the permit's target vegetation list.

Fire/Site Management

- A minimum of two successful prescribed fires have been implemented. A successful prescribed fire shall be defined as a fire which carries over a minimum of 70% of the wetland and its buffer during the burn.
- A long-term management plan has been implemented which includes provisions for regular prescribed burning with a fire return interval of 3-5 years.
- A long-term management plan has been implemented which includes control of feral pigs (*Sus scrofa*).

Hydrology

- Soils across at least 80 percent of the wetland area shall exhibit saturation to within six inches of their surface for at least nine months during any calendar year (or 12-month period) in which rainfall meets or exceeds the 30-year average. This criterion must be met during a minimum of three qualifying annual (or 12 month) cycles and the overall success rate averaged over all qualifying periods shall be at least 50% for the site to become eligible for release.
- Inundation exceeding six inches above the soil surface shall be limited to sporadic events and shall not regularly (i.e. average events per year ≥ 1) exceed periods of 21 days.

Marl Prairie

Marl prairie is a sparsely vegetated (20-40% cover), graminoid-dominated community found on marl substrates, limited to South Florida. It is seasonally inundated (two to four months) to a shallow depth averaging about eight inches. It occupies large areas at intermediate elevations between marshes or dome and strand swamps with longer hydroperiod of six to twelve months, and pinelands or oak-palm hammocks that are seldom flooded.
These systems are open and fire-maintained and are situated within and ecologically integrated within a larger landscape of marl prairie, pine rockland, and glades marsh. The vegetation community exhibits extremely high diversity, but is typically dominated by only

two to three species in a given area. The canopy is absent and subcanopy species should be sparse to absent, with only a very few scattered patches of shrubs (typically *Salix* spp.) present. Soils are seasonally flooded marls or sandy marls, 2-24 inches deep, underlain by limestone. In the Big Cypress region, widely scattered, stunted pond cypress (*Taxodium ascendens*) is often present in these systems.

Marl prairie normally dries out during the winter and is subject to fires at the end of the dry season; the most acres naturally burn in May. The fire return interval for these systems is thought to be 1 to 6 years.

Synonyms/variants: cypress savanna, scrub cypress, rocky glades, muhly prairie, southern Everglades, FLUCCS 641-Freshwater Marshes

Groundcover

- Total ground cover shall be at least 15% and shall not exceed 80%;
- Relative ground cover by target dominants, as identified on the permit's target vegetation list, shall be at least 80%;
- At least 25 species from the permit's target ground cover vegetation list shall be present.
- Populations of at least 5 marl prairie species from the permit's target vegetation list shall be present and self-sustaining.

Subcanopy

- The wetland area shall support and average of no more than 1 shrub per acre. Shrub species present shall be limited to species from the permit's target vegetation list.

Canopy

- The wetland area shall support and average of no more than 1 tree per acre. Canopy species present shall be limited to species from the permit's target vegetation list.

Fire/Site Management

- A minimum of two successful prescribed fires have been implemented. A successful prescribed fire shall be defined as a fire which carries over a minimum of 70% of the wetland and its buffer during the burn.
- A long-term management plan including a fire return interval of 2-7 years has been implemented.
- A long-term management plan has been implemented which includes measures to prevent/minimize impacts from off-road vehicles.

Hydrology

- A minimum of 80% of the wetland area shall inundate to a depth of at least six inches for a duration of at least two months during any calendar year in which rainfall meets or exceeds the 30-year average. This criterion must be met during a minimum of three qualifying annual cycles and the overall success rate averaged over all qualifying periods shall be at least 50% for the site to become eligible for release.
- A minimum of 80% of the wetland area shall become dry for a duration of at least seven months during any calendar year in which rainfall dos not exceed 125% of the 30-year average. This criterion must be met during a minimum of three qualifying

annual cycles and the overall success rate averaged over all qualifying periods shall be at least 50% for the site to become eligible for release.

Shrub Bog

Shrub bogs are dense stands of evergreen shrubs, vines, and short trees, with or without an overstory of scattered taller pine or bay trees, growing in mucky soil where water is usually less than one foot deep. The vegetation community is dominated by broadleaved evergreen shrub and is dense and nearly impenetrable. Characteristic shrub species include titi, black titi, fetterbush, large gallberry, wax myrtle, and sweet pepperbush). Shrub bog often forms the border between the mesic or wet flatwoods communities and dome swamp, basin swamp, or hydric hammock communities. In Florida, shrub bogs range throughout the state except for extreme southern Florida (FNAI, 2010).

Fires starting in the surrounding pinelands burn to the edges of shrub bogs, but burn through them only during drought periods, probably on the order of every 10-20 years. In the absence of appropriate fire, shrub bog may invade bordering wet prairies and wet flatwoods. Physical disturbance in the form of logging, ditching, and planting of pine plantations can favor the spread of shrub bogs at the expense of dome and basin swamps, as well as wet prairies (FNAI, 2010).

Synonyms/variants: titi swamp, scrub-shrub, shrub swamp, FLUCCS 614-Titi Swamps

Groundcover

- Relative ground cover by native species shall be at least [90]%;
- At least [3] ground cover species from the permit’s target vegetation list shall be present.

Subcanopy

- The wetland area shall support a minimum of 500 shrubs per acre that are greater than 4 feet tall. Shrub species present site-wide shall include at least five species from the permit’s target vegetation list.

Canopy

- *If restoration or enhancement:* The wetland area shall support no more than 100 trees per acre that are greater than 20 feet tall. Canopy species present shall be limited to species from the permit’s target vegetation list.
- *If creation:* The wetland area shall support no more than 100 trees per acre. Canopy species present shall be limited to species from the permit’s target vegetation list.

Fire/Site Management

- A long-term management plan has been implemented which includes provisions for regular prescribed burning with a fire return interval of 10-20 years.

Hydrology

- Soils across at least 80 percent of the wetland area shall exhibit saturation to within six inches of their surface for at least six months during any calendar year (or 12-month period) in which rainfall meets or exceeds the 30-year average. This criterion must be met during a minimum of three qualifying annual (or 12 month) cycles and the overall success rate averaged over all qualifying periods shall be at least 50% for the site to become eligible for release.

- Inundation exceeding 15 inches above the soil surface shall be limited to sporadic events and shall not regularly (i.e. average events per year ≥ 1) exceed periods of 21 days.

Freshwater Marshes

These are freshwater communities dominated by obligate and facultative wet herbaceous vegetation. Woody species have a minor presence or are absent. The soil may be peat, sand or marl.

Some types of marshes may be dominated by one or a few plant species while others will have a diversity of species. Marshes may have zones, each with a different collection of plant species and hydrology, such as a combination of open water, deep marsh, shallow marsh, and a transitional wetland fringe.

A defining characteristic of marshes is that woody species have a minor presence or are absent. Water levels and fire generally limit the presence of woody species. Fire frequency may be 3 to 5 years in deep marshes and more frequent in shallow marshes (Wade et al. 1980), and is related to the fire frequency of the adjacent community.

Synonym/variants: FNAI, 2010 include Depression Marsh, Basin Marsh, Floodplain Marsh, Slough Marsh, Glades Marsh and Freshwater Tidal Marsh variant; The Level III marsh types used in FLUCCS (1999), includes the Freshwater Marsh (641), Wet Prairie (643), Emergent Aquatic Vegetation (644), and Treeless Hydric Savanna (646). Synonyms based on the dominant vegetation include sawgrass marsh, flag marsh, and cattail marsh among others.

Groundcover (for specific types of marshes)

- From 20 to 40 percent of the wetland area shall be flag marsh. Water depth shall be between 0.3 to 1 m at least 6 months of each year and below the ground surface during most dry seasons. At least 90 percent of the flag marsh groundcover shall be maidencane (*Panicum hemitomon*), pickerelweed (*Pontederia cordata*), fire flag (*Thalia geniculata*), bulltongue arrowhead (*Sagittaria lancifolia*), and sawgrass (*Cladium jamaicense*). No one species shall be greater than 20 percent of the area.

- From 20 to 40 percent of the wetland area shall be reed marsh. Water depth shall be above the surface 50 to 150 days each year. At least 90 percent of the marsh groundcover shall be maidencane (*Panicum hemitomon*), sand cordgrass (<u>*Spartina bakeri*</u>), beaksedge (*Rhynchospora tracyi*), white-topped sedge (*Dichromena colorata*) and sawgrass (*Cladium jamaicense*). No one species shall be greater than 20 percent of the area.

- From 20 to 40 percent of the wetland area shall be sawgrass marsh. Water depth shall be between 0.3 to 1 m at least 6 months of each year and below the ground surface during most dry seasons. At least 90 percent of the marsh groundcover shall be sawgrass (*Cladium jamaicense*).

Shrub/Subcanopy/Canopy

- No more than 5 percent of the cover shall be woody shrub or tree species within any acre.

Fire

- The wetland community type is maintained by prescribe fire, are required by this permit. Fire-adapted, native herbaceous species shall be of adequate density to carry a prescribed fire over an average of at least 80 percent of the vegetated area of shallow marsh and adjacent lands. Shrubs shall be reduced to coppice, averaging less than 1.5 meters in height.

Other

- Within the deepest region of the mitigation area, water depths shall be below the ground surface during most dry seasons.

- From 5 to 20 percent of the wetland area shall be open water. Water depth shall be greater than 1 m at least 9 months of each year and above the ground surface during most dry seasons. Up to 20 percent of the open water area shall be aquatic species including white water lily (*Nymphaea odorata*) and yellow lotus (*Nelumbo lutea*).

- The deep marsh zone shall have at least 6 inches of organic soil.

Cypress/Tupelo communities

Floodplain Swamp

Floodplain swamps are characterized as a closed canopy forest of flood tolerant species on frequently or permanently flooded soils adjacent to stream or river channels and in depressions and oxbows in floodplains. Bald cypress is dominant or codominant with one or more tupelo species. Trees are often buttressed and "knees" arising from the root systems are common. Water and ogeechee tupelo are limited to panhandle and North Florida. The understory and ground cover are sparse due to prolonged periods of inundation, leaving most of the ground surface open or matted with leaf litter. This community type often occurs within a complex mixture of communities like alluvial forest, bottomland forest and bayswamp where less flood tolerant species are found on hummocks or ridges within the swamp. They often immediately border the stream or river channel, but are also commonly isolated from the main channel by riverbank levees and are restricted to oxbows, overflow channels and backwaters where water is more stagnant. Topography is the result of alluvial process that build levees, point bars, scour channels and backswamps.

Floodplain swamp is generally replaced by strand swamp south of Lake Okeechobee. Pond cypress is more common in depressional swamps in peninsular river floodplains. Atlantic white cedar may be present with swamp tupelo and baygall species in the Panhandle and central peninsula. Freshwater tidal swamp is a variant seen as a river approaches the coast. Stresses from tidal driven inundation and occasional saltwater intrusion affect vegetation structure where cypress becomes less dominant and is replaced by stunted tupelo, pumpkin ash and sweetbay. Floodplain swamps are generally too wet to support fire.

Synonyms/variants: FLUCCS 613/Gum Swamp, 615/Stream and Lake Swamps, 621/Cypress, 624/Cypress – Pine – Cabbage Palm

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for Floodplain Swamp areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a floodplain swamp community shall be present and none shall comprise more than 30% relative cover of groundcover species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Saururus cernuus, Peltandra spp*, *Orontium* spp, *Osmunda* spp, *Thelypteris* spp, *Woodwardia* spp, *Blechnum* spp and other native ferns.

Shrub/subcanopy

- The shrub layer shall contain at least 75 shrubs per acre and shall include at least 3 FACW and/or OBL shrub species typical of a floodplain swamp community, not including *Salix*, *Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a floodplain swamp community, with no one species contributing more than 50% of the total shrub cover and not including *Salix*, *Myrica* or *Baccharis* spp.;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Floodplain Swamp areas shall have at least 33% canopy cover with *T. distichum* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) representing at least 50% of the canopy cover, and at least 7 additional FACW and/or OBL species typical of a floodplain swamp community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *T. distichum* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) and at least 7 additional FACW and/or OBL species typical of a floodplain swamp community shall be present with no one species comprising more than 20% of the remaining tree density.

Overall (for Grandfathered activites)

- Species richness and dominance regimes in the canopy, sub canopy, and ground layer shall be within the range of values documented within reference wetlands of the target community type.

Hydrology

- Saturated soils or standing water shall be present between 100 and 300 days per year in a normal water year.

<u>Basin Swamp</u>

Basin swamps are generally isolated wetland communities found in large depressions like old lake beds, river basins, ancient coastal swales and lagoons, around lakes and often are headwaters for major rivers. They are characterized by trees and shrubs that can withstand an extended hydroperiod. Pond cypress and swamp tupelo generally dominate the canopy, but canopies of mixed species may also occur. The shrub and groundcover layers are variable based on hydrology and fire history. Shrubs may be common throughout or restricted to the edge. Diversity is often higher around the edge due to shorter hydroperiods and more aerobic soils. Epiphytes and orchids can be common especially in more mature swamps. Topographic microsites created by raised root mats and peat, hummocks, and trees stumps are important for tree, shrub and herbaceous species recruitment above the water surface.

If they are encircled by wet prairie, depression marsh, or other pyrogenic upland or wetland communities, fire may be carried into the swamp. If they are adjacent to hydric and mesic hammock, they will have a lower exposure to fire. Soils are usually acidic, nutrient poor peat over a clay lens or other impervious layer.

Synonyms/variants: FLUCCS 613/Gum Swamp, 616/Inland Ponds and Sloughs, 621/Cypress

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for Basin Swamp areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a basin swamp community shall be present and none shall comprise more than 30% relative cover of groundcover species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Saururus cernuus, Peltandra spp, Orontium* spp, *Osmunda* spp, *Thelypteris* spp, *Woodwardia* spp, *Blechnum* spp and other native ferns.

Shrub/subcanopy

- The shrub layer shall contain at least 75 shrubs per acre and shall include at least 3 FACW and/or OBL shrub species typical of a basin swamp community, not including *Salix*, *Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a basin swamp community, with no one species contributing more than 50% of the total shrub cover and not including *Salix*, *Myrica* or *Baccharis* spp.;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Basin Swamp areas shall have at least 33% canopy cover with *T. ascendans* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) representing at least 50% of the canopy cover, and at least 7 additional FACW and/or OBL species typical of a basin swamp community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *T. ascendans* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) and at least 7 additional FACW and/or OBL species typical of a basin swamp community shall be present with no one species comprising more than 20% of the remaining tree density.

Overall (for Grandfathered activities)

- Species richness and dominance regimes in the canopy, sub canopy, and ground layer shall be within the range of values documented within reference wetlands of the target community type.

Hydrology

- Saturated soils or standing water shall be present between 180 and 270 days per year in a normal water year.

Dome Swamp

Dome swamps are isolated, forested, depressional wetlands occurring within a pyrogenic community like mesic flatwoods, dry prairie, glades marsh, wet flatwoods and sandhill. Pond cypress often dominate, but swamp tupelo can also be dominant or codominant. The characteristic dome shape is created due to taller trees growing in deeper water and shorter trees growing in the shallower water of the edge due in part to fire burning into the edge more frequently. Shrub density is typically sparse to moderate and is usually determined by fire frequency. Tropical species like coco plum and pond apple are more common in South Florida, while Myrtle-leaved holly (Ilex cassine var. myrtifolia) may dominate shallow domes in North Florida. Herbaceous species cover can be dense to absent and includes a wide variety of species. The center can be deeper and have floating species like duckweeds, floatinghearts and water spangles and emergents like alligator flag and arrowhead. Epiphytes and orchids may be common, especially in South Florida. Topographic microsites created by raised root mats and peat, hummocks, and trees stumps are important for tree, shrub and herbaceous species recruitment above the water surface.

Soils are usually composed of a layer of peat that becomes thicker towards the center and is underlain with acidic sands or marl and then limestone or a clay lens. In South Florida, the peat directly overlays limestone.

These communities generally burn concurrent with adjacent pyrogenic upland or wetland communities. Fire frequency may range from 3 – 5 years at the edge to up to 100 – 150 years toward the center.

Synonyms/variants: FLUCCS 613/Gum Swamp, 616/Inland Ponds and Sloughs, 621/Cypress

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for dome swamp areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a dome swamp community shall be present and none shall comprise more than 30% relative cover of groundcover species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Saururus cernuus, Peltandra spp, Orontium* spp, *Osmunda* spp, *Thelypteris* spp, *Woodwardia* spp, *Blechnum* spp and other native ferns.

Shrub/subcanopy

- The shrub layer shall contain at least 75 shrubs per acre and shall include at least 3 FACW and/or OBL shrub species typical of a dome swamp community, not including *Salix, Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a dome swamp community, with no one species contributing more than 50% of the total shrub cover and not including Salix, Myrica or Baccharis spp;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Dome Swamp areas shall have at least 33% canopy cover with *T. ascendans* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) representing at least 50% of the canopy cover, and at least 5 additional FACW and/or OBL species typical of a dome swamp community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *T. ascendans* and/or *N. aquatica, N. sylvatica* var *biflora, N. ogeche* (depending on region) and at least 5 additional FACW and/or OBL species typical of a dome swamp community shall be present with no one species comprising more than 20% of the remaining tree density.

Overall (for Grandfathered activities)

- Species richness and dominance regimes in the canopy, sub canopy, and ground layer shall be within the range of values documented within reference wetlands of the target community type.

Hydrology

- Saturated soils or standing water shall be present between 180 and 270 days per year in a normal water year.

Fire

- Fire-adapted, native herbaceous species are of adequate density to carry a prescribed fire over an average of at least 25% of the dome swamp.

Strand Swamp

A strand swamp is a shallow, forested, elongated depression or channel in a trough within a flat, limestone plain. They are restricted to South Florida where they replace floodplain swamps and basin swamps. Strand swamps are dominated primarily by bald cypress, but smaller strand swamps and shallow edges may instead contain pond cypress. The understory contains a mix of tropical and temperate species. The warm, humid climate supports a diversity of epiphytes and bromeliads.

Soils are generally peat over limestone. Fire is rare in strand swamps, but fires from adjacent pine-dominated communities can frequently burn into the outer edges and help maintain a cypress dominated community.

Synonyms/variants: FLUCCS 621/Cypress

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for strand swamp areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a strand swamp community shall be present and none shall comprise more than 30% relative cover of groundcover species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Saururus cernuus, Peltandra spp, Orontium* spp, *Osmunda* spp, *Thelypteris* spp, *Woodwardia* spp, *Blechnum* spp, *Acrostichum danaeifolium*, and other native ferns.

Shrub/subcanopy

- The shrub layer shall contain at least 75 shrubs per acre and shall include at least 3 FACW and/or OBL shrub species typical of a strand swamp community, not including *Salix, Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a strand swamp community, with no one species contributing more than 50% of the total shrub cover and not including *Salix, Myrica* or *Baccharis* spp;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Strand swamp areas shall have at least 50% canopy cover with *T. ascendans* and at least 5 additional FACW and/or OBL species typical of a strand swamp community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *T. ascendans* and at least 5 additional FACW and/or OBL species typical of a strand swamp community shall be present with no one species comprising more than 20% of the remaining tree density.

Overall (for Grandfathered activities)

- Species richness and dominance regimes in the canopy, sub canopy, and ground layer shall be within the range of values documented within reference wetlands of the target community type.

Hydrology

- Saturated soils or standing water shall be present between 180 and 270 days per year in a normal water year.

Fire

- Fire-adapted, native herbaceous species are of adequate density to carry a prescribed fire over an average of at least 25% of the strand swamp.

Hardwood wetland communities

Baygall

The Guide to the Natural Communities of Florida (2010) describes Baygall as an evergreen forested wetland of bay species situated at the base of a slope or in a depression. Dependent upon seepage flow and a high water table, they should seldom completely dry out. Soils are generally composed of peat or mucky peat.

Synonyms/Variants: The Level III Baygall type used in FLUCCS (1999) is Bay Swamp (611) and synonyms include Bayhead, Bay Swamp, Seepage Swamp, and Sandhill Bog. Community variations of Baygalls include but are not limited to North Florida Bayheads with titi and doghobble, Panhandle Bayheads with white-cedar, Bay Swamp ie. large basins such as Pinhook Swamp, and South Florida Bayhead as Tree Islands in the Everglades on elevated sites of Gandy Peat.

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for baygall areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a baygall community shall be present and none shall comprise more than 30% relative cover of groundcover and vine species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Osmunda cinnamomea*, *Woodwardia areolata*, *W. virginica*, *Sphagnum* spp., *Smilax laurifolia*, *S. walteri*, and *Vitis rotundifolia*.

Shrub/subcanopy

- The shrub layer shall contain at least 75 shrubs per acre and shall include at least 3 FACW and/or OBL shrub species typical of a baygall community, not including *Salix*, *Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a baygall community, with no one species contributing more than 50% of the total shrub cover and not including Salix, Myrica or Baccharis spp;

Canopy

- The canopy and subcanopy layer should contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Baygall areas shall have at least 33% canopy cover with *Gordonia lasianthus* and/or *Magnolia virginiana, Persea palustris* representing at least 50% of the canopy cover. Additional FACW and/or OBL species typical of a baygall community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *Gordonia lasianthus* and/or *Magnolia virginiana, Persea palustris*. Additional FACW and/or OBL species typical of a baygall community shall be present with no one species comprising more than 20% of the remaining tree density.

Hydric Hammock

Hydric hammock is an evergreen hardwood and/or palm forest with a variable understory that occur on low, flat, wet sites with limestone near the surface. Since soil disturbance and canopy openings facilitate the spread of exotic invasive plants, the control of feral hogs (*Sus scrofa*) is important to minimize soil disturbance which decreases diversity of native ground cover within hydric hammock. Soils are variable and Hydric Hammocks are inundated for short periods after rains (seldom inundates more than 60 days per year).

Synonyms/Variants: Wetland Hardwood Hammock, Wet Hammock, Gulf Hammock and the Level III Hydric Hammock type used in FLUCCS (1999) is Mixed Wetland Hardwoods (617).

Groundcover

- Total groundcover by non-nuisance, non-exotic FAC, FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for hydric hammock areas shall be at least 50%.

- Herb cover, when present should include mostly graminoids and ferns. Five or more native wetland (FACW or OBL) species typical of a hydric hammock community shall be present 20% percent of the relative cover shall include the following shade adapted species: *Carex* spp., *Chasmanthium spp., Elephantopus nudatus, Elytraria caroliniensis, Oplismenus setaria, Thelypteris* spp., *Osmunda cinnamomea, Osmunda regalis* var. *spectabilis*, *Blechnum serrulatum, Woodwardia areolata,* and *W. virginica.*

Shrub/subcanopy

- In addition to saplings of canopy species, the shrub layer shall include at least 3 FACW and/or OBL shrub species and/or saplings of canopy species typical of a hydric hammock community, not including *Salix*, *Myrica* or *Baccharis* spp., with no one species contributing to more than 50% of the total shrub density.

or

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species and saplings of canopy species typical of a hydric hammock community, with no one species contributing more than 50% of the total shrub cover and not including Salix, Myrica or Baccharis spp;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Hydric Hammock areas shall have at least 33% canopy cover with *Quercus laurifolia* and/or *Q. virginiana, Sabal palmetto,* and *Juniperus virginiana* representing at least 50% of the canopy cover. Other species typical of a hydric hammock community shall be present with no one species comprising more than 20% of the remaining tree density.

or

- At least 50% of the trees in the canopy stratum shall consist of *Quercus laurifolia* and/or *Q. virginiana, Sabal palmetto,* and *Juniperus virginiana.* Other species typical of a hydric hammock community shall be present with no one species comprising more than 20% of the remaining tree density.

Bottomland Forest

According to the Guide to the Natural Communities of Florida (2010) Bottomland forest is a deciduous, or mixed deciduous/evergreen, closed-canopy forest of hydrophytic and mesophytic trees on terraces, levees, and oxbows within riverine floodplains and in shallow depressions between deeper swamps and uplands. In some cases, there will be pronounced micro-topography that will support xeric conditions within the floodplain. Inundation occurs only during higher floods, regardless of the stream type. Differences in hydrologic conditions across bottomland forests (high vs. low water table, deep vs. shallow flood depths) lead to highly variable mixtures of species that fluctuate across different floodplains as well as within the same system. Those Bottomland Forests flanking blackwater and seepage streams in western panhandle typically consist of White Cedar, Tuliptrees, and Bays.

Synonyms/Variants: The Level III Bottomland Forest type used FLUCCS (1999) are Stream and Lake Swamps (Bottomland) (615), Mixed Wetland Hardwoods (617), Atlantic White Cedar (623), or Wetland Forested Mixed (630).

Groundcover

- Total groundcover by non-nuisance, non-exotic FACW and/or OBL species listed in rule 62-340.450, F.A.C., and appropriate for bottomland forest areas shall be at least 50%. Groundcover trends over at least three years show increasing cover.

- 10 or more native wetland (FACW or OBL) species typical of a bottomland forest community shall be present and none shall comprise more than 30% relative cover of groundcover and species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Dichanthelium* spp., *Chasmanthium laxum, Carex* spp.

Understory/Subcanopy

- The understory is either dense shrubs with little ground cover, or open, with few shrubs and a groundcover of ferns, herbs, and grasses. Ground cover is also variable in composition and abundance, often with species overlap between herbs suited to either mesic or hydric conditions.

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a bottomland forest community, with no one species contributing more than 50% of the total shrub cover and not including Salix, Myrica or Baccharis spp;

Canopy

- Characteristic set of species include water oak, sweetgum, swamp laurel oak, red maple, loblolly pine, spruce pine.

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Transects shall have an average of ≥10 native, canopy species appropriate to bottomland forest communities as identified in literature such as the Florida Plant Atlas (USF), Guide to the Vascular Plants of Florida (Wunderlin 2003), and Guide to the Natural Communities of Florida, 2010 edition (Florida Natural Areas Inventory).

Alluvial Forest

Alluvial Forests are mostly found in panhandle along the Apalachicola River; they are restricted to oxbows and riverbanks between the Suwannee River and Lake Okeechobee. Soils are variable mixtures of sand and alluvial sediments that have been deposited by the current drainage system and are often distinctly layered. Although flooding may be extensive (one to four months of the year), alluvial forest usually does not contain standing water during the dry season. The vegetation is similar to Bottomland forests with variations such as Overcup/WaterHickory/River Birch and Peninsular Alluvial Forest without Overcup Oak or River Birch

Synonyms/Variants: The Level III Bottomland Forest type used in FLUCCS (1999) are Stream and Lake Swamps (Bottomland) (615), Mixed Wetland Hardwoods (617), or Wetland Forested Mixed (630).

Groundcover

- 10 or more native wetland (FACW or OBL) species typical of a alluvial forest community shall be present and none shall comprise more than 30% relative cover of groundcover and species in the wetland. 20% percent of the relative cover shall include the following shade adapted species: *Packera glabellus, Woodwardia areolata, Panicum rigidulum, and Axonopus furcatus.*

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a alluvial forest community, with no one species contributing more than 50% of the total shrub cover and not including Myrica or Baccharis spp.

Subcanopy/Shrub

- The understory is either dense shrubs with little ground cover, or open, with few shrubs and a groundcover of ferns, herbs, and grasses. Ground cover is also variable in composition and abundance, often with species overlap between herbs suited to either mesic or hydric conditions.

- Representative data shall demonstrate at least 20% shrub cover by at least 3 FACW and/or OBL species typical of a bottomland forest community, with no one species contributing more than 50% of the total shrub cover and not including Salix, Myrica or Baccharis spp;

Canopy

- The canopy and subcanopy layer shall contain at least 400 trees per acre that appear healthy and have attained an average height ≥12 feet. No area greater than one acre in size shall have less than 200 live trees per acre.

- Alluvial forest areas shall have at least 33% canopy cover with *Quercus lyrata* and/or or *Fraxinus pennsylvanica*, and *Carya aquatica* representing at least 50% of the canopy cover, and at least 7 additional FACW and/or OBL species typical of an alluvial forest community shall be present with no one species comprising more than 20% of the remaining canopy cover.

or

- At least 50% of the trees in the canopy stratum shall consist of *Quercus lyrata* and/or *Fraxinus pennsylvanica, Carya aquatica* and at least 7 additional FACW and/or OBL species typical of an alluvial forest community shall be present with no one species comprising more than 20% of the remaining tree density.

Stream and Riverine Communities

These communities include streams that fall under the alluvial, blackwater and seepage stream categories and can include small headwater streams all the way up in size to major river systems. Additional classification systems are available to help further define the stream type. The example criteria below apply to most stream types but may need to be modified depending on the type. For example, criteria for fish, macroinvertebrates, large woody debris and bed form diversity may not be applicable to or may need to be modified for the smallest headwater streams.

Hydrology

- Bankfull stage and discharge volumes compared to drainage area shall fall within the 95% confidence interval of the appropriate regional curve

- Bankfull stage and discharge volumes shall be comparable to the values identified in the design/in the modeling/ or reference streams.

- Bankfull stage shall occur at the frequency predicted in the modeling or at a frequency consistent with the reference streams.

- Wet season flows produce bankfull discharge and velocities within the range of values of the reference streams/ or predicted by the modeling.

Channel Stability

- The bankfull depths, widths and cross sectional area shall be comparable to those in the design plans/ or fall within the range of values for the reference streams.

- Stream banks shall be stable, but normal erosion and deposition zones shall be present as evidenced in part by stream morphology that falls within the approved Rosgen stream class (C or E). The landscape, cross section, profile, and plan form characteristics of each reclaimed reach shall be similar to the details specified in the design plan.

Floodplain Connectivity

- Bank height ratio shall not exceed 1.2 at any measured riffle cross section.

- Entrenchment ratio shall not be less than 2.2 at any measured riffle cross section.

Large Woody Debris

- Tree roots, log jams, snags and other in-stream structure are present at intervals along the stream consistent with the specifications provided in the design plan or shall fall within the intervals documented in the reference streams.

- The Large Woody Debris Index of the project equals the Large Woody Debris Index of the reference streams.

Lateral Erosion/Bank Stability

- Individual bank pin measurements (i.e, length of pin exposed due to lateral movement of the bank) shall not exceed10% of as-built bankfull width during any given monitoring interval (e.g., no more than 10% between years 1 and 2, 2 and 3, 3 and 5, 5 and 7, or 7 and 10), and individual bank pin measurements shall not exceed 20% of the as-built bankfull width over the duration of monitoring.

- The Lateral Erosion Rate based on cross sections shall be between 1.0 and 1.3 (W/D*project*/W/D*design or reference*)

Bed Form Diversity

- The riffle-pool percentages shall fall within the range of values documented in the reference streams/or shall be comparable to the percentages specified in the design.

- The pool-to-pool spacing ratio is between 4 and 5 or falls within the range of values documented in the reference streams/or shall be comparable to the spacing specified in the design.

- Depth variability (Pool Max Depth Ratio) is greater than 1.2.

Riparian Buffer

- Native riparian buffers for restored upland confined, wetland confined, and wetland underfit channels shall be at least 95, 60, and 25 feet wide, respectively, and shall be composed of native canopy, shrub, and groundcover species, as appropriate for the community type shown on the design plans. Relative cover by nuisance and exotic species within the riparian buffers shall be less than 10%.

- Average buffer width for C and E stream types is greater than 150 feet from each bank and shall be composed of native canopy, shrub, and groundcover species, as appropriate for the community type shown on the design plans.

- For C and E streams, the buffer includes a meander belt width that is at least 3.5 times the bankfull width plus at least 60 additional feet from the outside of the meander bend and shall be composed of native canopy, shrub, and groundcover species, as appropriate for the community type shown on the design plans.

Biota

- Species richness of the macroinvertebrate community shall meet or exceed the range of values documented in the non-perennial reference streams or based on literature values for similar stream systems in peninsular Florida. The monitoring data shall also document a sustained presence (at least two consecutive sampling periods) of individuals from lotic and lentic macroinvertebrate species and a sustained presence of all functional feeding guilds of macroinvertebrate species. The proportion of lotic species shall meet or exceed the range of values documented in non-perennial reference streams or based on literature values for similar stream systems in peninsular Florida. Determination of lotic versus lentic species and functional feeding guilds shall be assigned based on Merritt and Cummins, An Introduction to the Aquatic Insects of North America, or similar published literature. In instances when a genus or species is assigned as both lotic and lentic, each individual sampled of that genus/species shall be considered as one half of an individual for each designation.

- Fish sampling shall show that a viable fishery resource has established in the restored stream segments. Species richness of the native fish community shall be within the range of values documented in the non-perennial reference streams or based on literature values for similar streams in peninsular Florida. If sampling efforts reveal that, although there is sufficient flow in the channel, fish are not reaching a particular restored reach because of habitat deficiency or the presence of other barriers to the passage of fish within the restored channel, then remedial measures shall be undertaken to enhance channel habitat and/or remove the barriers to fish passage.

Saltwater marshes

These are communities in the coastal zone affected by tides and seawater, protected from strong waves, characterized by herbaceous halophytic vegetation. Myers and Ewel (1991) notes that the types of salt marsh plants vary considerably around that state due to a combination of latitude and geographic differences. Soils may range from deep mucks to fine sands. The slope of the shore and tidal range controls the width of the salt marsh.

Salt Marshes may have vegetation zones, with Smooth cordgrass (*Spartina alterniflora*) dominating waterward of the mean high water level, and needle rush (*Juncus roemerianus*) landward of the mean high water level, along with tidal creeks without rooted vegetation. Salt Flats may occur high in the marsh, where it is flooded only by storms or extreme high tides. The Salt Flat is very saline and desiccated, with much bare soil and sparse cover by species that can tolerate very high salinities. Woody species have a minor presence along the high marsh zone or are absent.

Synonyms/variants: Salt Marsh, Salt Flat. The Level III marsh type used FLUCCS (1999) is the Salt Marsh (642). Synonyms based on dominant vegetation include the Cordgrass (Spartina) Marsh and Needlerush (Juncus) Marsh.

Groundcover

- From 20 to 40 percent of the mitigation area shall be cordgrass marsh. Water depth shall be from the average low water level to the mean high water level. No less than 80 percent of the vegetated area shall be smooth cordgrass (*Spartina alterniflora*).

- From 20 to 40 percent of the mitigation area shall be needlerush marsh. Water depth shall be above the mean high water level. No less than 80 percent of the vegetated area shall be smooth cordgrass (*Juncus roemerianus*).

- No more than 10 percent of the mitigation area shall be unvegetaed drainageways.

Shrub/Subcanopy/Canopy

- No more than 5 percent of the cover shall be woody shrub or tree species within any acre.

- Within the high marsh, the relative cover by woody species native to this community shall be less than 30 percent.