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ESTUARINE
WETLAND RAPID ASSESSMENT PROCEDURE
FOR MITIGATION BANKS IN FLORIDA

Based on the Wetland Rapid Assessment Procedure (WRAP), South Florida Water Management District Technical Publication REG - 001, September 1997, by Raymond E. Miller Jr. and Boyd E. Gunsalus

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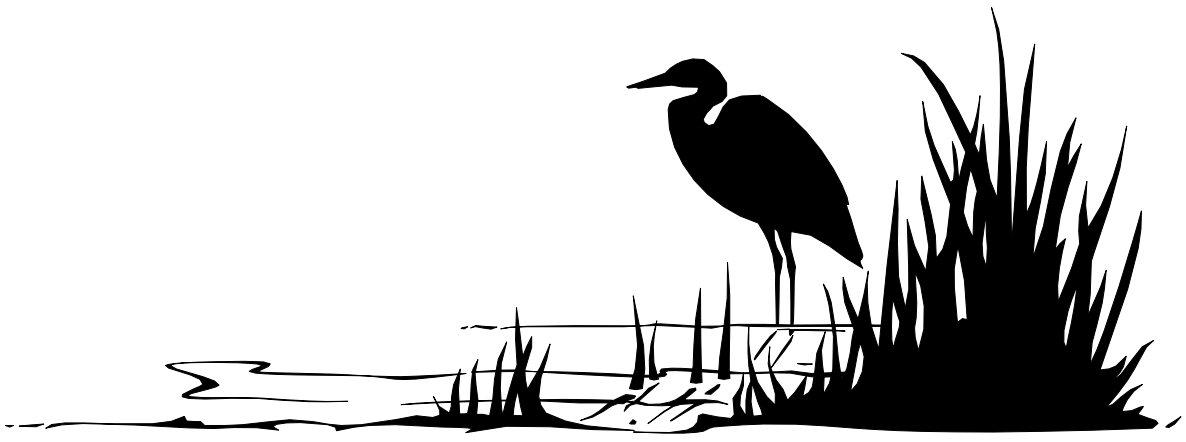

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TABLE OF CONTENTS

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1.0 INTRODUCTION

The Estuarine Wetland Rapid Assessment Procedure (E-WRAP) is a matrix that was developed by the Mitigation Bank Review team (MBRT) to assist in the regulatory evaluation of estuarine wetland mitigation bank sites that are created, enhanced, preserved, or restored in order to increase wetland functional lift to mitigate for future wetland losses authorized through the state and federal permit process in Florida. This standardized matrix is to be used in combination with professional judgment to provide an accurate and consistent evaluation of wetland sites and their landscape setting. The evaluator must have a good understanding of Florida ecosystems (functions and species identification) in order for the results to be valid.

E-WRAP was developed from the Modified Wetland Rapid Wetland procedure (M-WRAP), which assesses freshwater functions specifically for use on mitigation bank projects. The *Federal Guidance for the Establishment, Use and Operation of Mitigation Banks* (FR Vol. 60. No. 228, November 28, 1995) for mitigation banking endorse the use of a functional assessment for assessing the ecological value of mitigation bank proposals. Florida's statutes on mitigation banking require the use of a functional assessment for this purpose as well. Once Hydrogeomorphic Functional Assessment Models (HGM) are developed for Florida's ecosystems, it is likely that they will be used for this purpose. Until they are available for use E-WRAP should be the functional assessment methodology applied to estuarine mitigation banks in Florida. Use of another functional assessment method may be proposed, but will result in significant additional review and evaluation time.

The E-WRAP matrix establishes a numerical ranking for individual ecological and anthropogenic factors (variables) that can strongly influence the success of mitigation projects. The numerical output for the variables is then used to evaluate the current and expected wetland conditions. The matrix can be used to evaluate a wide range of wetland/upland systems (i.e. - mangrove forests, estuarine marshes, mosquito impoundments, etc.), but it is not intended to compare different wetland community types (i.e. - mangrove forests to estuarine marshes) to each other. **Each wetland type is rated according to its own attributes and characteristics.** Because an interactive association among variables does exist, variables within the matrix can be individually weighted based on a consensus of the evaluation team. Individual variables can be eliminated from the evaluation if the evaluator determines the specific parameter is not applicable.

Use of the E-WRAP matrix is intended to accomplish a number of objectives: to establish an accurate, consistent and timely regulatory tool; to track trends over time (mitigation success, land use vs. wetland type) and to offer guidance for mitigation bank plan development.

E-WRAP is not a substitution for applied research science. It is a tool that is to be used by the regulatory community to ensure consistency and accuracy when evaluating a site through the regulatory process of permitting and post permit compliance. E-WRAP can be used as a tool to document baseline information for a site prior to and after project activities. E-WRAP input data consists primarily of field observations and professional experience. Some variables, such as exotic and nuisance plant coverage, can be quantified through aerial interpretations or ocular estimations.

2.0 METHODOLOGY

E-WRAP incorporates concepts from the U.S. Fish and Wildlife Service's "Habitat Evaluation Procedures" (HEP) and the South Florida Water Management District's "Save Our Rivers Project Evaluation Matrix" (SOR).

Ecological communities (i.e. mangrove forests, salt marshes, salt barrens etc.) and their associated attributes provide food, cover and reproductive functions for a variety of flora and fauna. The holistic concept of HEP is used to evaluate entire systems; both upland and wetland, and their interactive associations. HEP assumes that the value of a habitat can be evaluated at the species level by using a set of measurable variables that are important for a particular species. The use of HEP is restricted by the number of species models that have been developed and those species chosen for evaluation.

The SOR matrix was developed as a method of evaluating habitats to prioritize the allocation of taxpayer dollars toward acquisition, restoration and management of sensitive lands. The matrix is used to evaluate sites using variables such as water management, water supply, site manageability, habitat and species diversity, connectiveness, rare and endangered species, site vulnerability and human use.

The U.S. Fish and Wildlife Services' "Habitat Suitability Index" was used to determine specific habitat requirements for the fauna of Florida. This has been included (Appendix A) as a resource for evaluating the wildlife utilization variable of E-WRAP. In addition, community profiles for sites to be evaluated using E-WRAP are described in Appendix B. Common freshwater fishes and aquatic insect taxa associated with the specific habitats are found in Appendices C and D.

E-WRAP variables are the following:

- **Fish and Wildlife Utilization**
- **Vegetative Community Cover: Overstory/Shrub**
- **Vegetative Community Cover: Ground Cover**
- **Adjacent Upland/Wetland Buffer**
- **Field Indicators of Wetland Hydrology**
- **Water Quality Inputs and Treatment Systems**

2.1 METHODOLOGY FOR USING E-WRAP FOR MITIGATION BANKS

2.1.1 OFFICE EVALUATION

The E-WRAP evaluator completes the following steps before leaving the office:

1. Identify the project site. Acquire an aerial map for field use and mark the project boundaries.

2. Identify land uses adjacent to the project site (see glossary for land use definitions).
    a. Identify developmental encroachment and type.
    b. Identify adjacent natural areas.
    c. Identify roads, canals and other features (i.e. - wellfields) potentially separating or impacting the site.
3. Identify wetland areas within the project site.
    a. Label wetland areas for future scoring with E-WRAP.
    b. Utilize soil maps to verify or identify depressional map units that may not be readily apparent from aerial maps.
    c. Identify wetland types (i.e. mangroves, grassbeds, salt marshes, etc.) if possible (may need to be done at the time of the site visit).
    d. Identify access points to wetland areas.
    e. Identify berms, canals and ditches adjacent to the wetland areas.
    f. Set up potential transects through wetland ecotypes. Transects would be warranted if a particular wetland exhibited a number of vegetative community types. The transects could then be used for future monitoring events.

In addition, the evaluator should review on-site hydrology, site management, rotational impoundment management, maintenance plans, seasonal variability, droughts, fire and excessive rainfall and any other pertinent information.

2.1.2 FIELD EVALUATION

In the field each wetland that will be enhanced or restored by the mitigation bank proposal (wetland polygon) is evaluated separately. The degree to which the adjacent uplands augment the functional value of the wetland is captured in the E-WRAP.

1. Walk a minimum of 50 % of the wetland perimeter.
2. Visually inspect 100 % wetland perimeter.
    a. Look for signs of wildlife utilization (tracks, scats etc.) and direct observations.
    b. Look for signs of fishery utilization (dipnetting, castnetting, etc.) and direct observations.
    b. Identify plant community composition (ocular estimate) using predetermined transect (if necessary).
        1. Conduct an ocular estimate of the plant species coverage and composition for the wetland and adjacent areas.
        2. Conduct an ocular estimate of the coverage of exotic and nuisance plant species in wetland and adjacent areas.
        3. Note any shifts in plant communities (i.e. encroachment of upland or transitional plant species into the wetland).
    c. Identify any hydrologic indicators present (see glossary for list).
3. Document field observations to establish baseline for future reference.
    a. Document observations on field data sheet (Section 3.0)

2.1.3 SCORE WETLAND

Generate E-WRAP score for each wetland type (polygon) on the project site using scoring methodology described in section 2.2.

2.2 SCORING METHODOLOGY

Each variable associated with the matrix is scored using a point scale ranging from zero (0) to three (3). Each point on the matrix is accompanied with a "calibration description" used to assist the evaluator in accurately scoring each habitat parameter.

When applying the matrix a score designation of three (3) is considered the best a system can function (reference wetland) and zero (0) is a system that is severely impacted, exhibiting negligible attributes (eg. The wetland has been filled). An evaluator also has the option to score each parameter in half (0.5) or quarter (0.25) increments. This gives the evaluator the flexibility to score a variable that is not accurately described or fitted by the "calibration description". Half and quarter increments are utilized on the point scale from 0.25 through 2.75. When evaluating the expected, or “With Bank”, scenario, the score should be based on the level of function that is reasonably likely to be attained. For example, some sites will be expected to score “3” for hydrology, while others will score “2” or “2.25” in the expected With Bank scenario.

When evaluating a particular system, that system is evaluated on its own attributes and is not to be compared to a different type of system (i.e., mangrove forest vs. salt marsh). If any variable does not apply to the habitat being rated, then the designation "NA" (not applicable) can be applied. When the designation "NA" is used for a specific variable it is omitted from the final calculations used to rate the habitat.

The amount of increase in ecological value (ecological lift) is obtained by scoring each wetland at the mitigation bank site as if the bank were successfully completed as compared to the bank’s baseline conditions. An essential factor in this scoring is the quality of the baseline condition. The baseline condition is defined as the condition of the wetland assuming a reasonably expected “without bank” condition.

Each applicable variable is scored, totaled and divided by the sum total of the maximum score for each variable. The vegetative variables (overstory and groundcover) are averaged (added together and divided by two) and the one variable is added to the other applicable variables and divided by the sumof the maxium for each varaible.

The final rating score for each wetland polygon's "Habitat Assessment Variables" will be expressed numerically with a number between zero (0) and one (1). The final rating score can be expressed mathematically as follows;

E-WRAP Score = Δ = Δ / V_{max}

(V_{max}) = Sum of maximum possible score for the rated variables.

where, V = (V**wildlife)** + **(Voverstory)** + **(Vgroundcover)** + **(Vbuffer)** + **(V hydrology)** + **(Vwater quality**).

Δ = (Vpredicted - Vbaseline), where Δ (delta) is the ecological lift assigned to a wetland polygon.

2.3 WEIGHTING THE VARIABLES

Prior to final E-WRAP scoring, the assessment team may evaluate the regional significance of the mitigation bank site for the following Weighting Factors: Threatened and Endangered Species; Strategic Habitat Conservation Areas (Florida Game and Freshwater Fish Commission *Closing the Gaps*); Established Watershed Plans; Adjacent Land Uses. Each wetland polygon will then be weighted, if appropriate, based on the degree of contribution the "with bank" scenario will provide for each Weighting Factor. If the assessment team finds that weighting is not appropriate, then each variable will be scored equally and weighting will be considered "not applicable".

The "importance" or "value" of a given wetland function is a very different concept than the "capacity" of the function. Wetland functional assessment methodologies such as HGM and E-WRAP are used to evaluate changes in the capacity of wetland functions. The relative importance of the measured changes is not addressed in HGM. In other words, the HGM approach stops short of valuing the capacity of the function being evaluated. Unfortunately, trading in individual functional capacities is not practical thus a single unit of trade is needed for mitigation crediting and debiting. In E-WRAP, the capacities of each function are averaged to produce a single output. Taking the average, however means that each of the factors is of equal importance. This approach can be refined. The MBRT has devised a method to incorporate public interest considerations into the relative weighting of the wetland functions included in a given assessment methodology, with respect to use in mitigation banking.

STANDARD WEIGHTING ASSIGNMENT GUIDANCE

This is a method through which relative weights can be assigned to wetland function. More complex evaluation methods could be developed in the future if need be. For now, the MBRT proposes a simple list of criteria to consider in a matrix form. As the MBRT considers the items on the list they can numerically score relative weights. This list is not inclusive and additional items could be added, as warranted. At a minimum, the following weighting criteria should be considered:

Established Watershed Issues
Benefits to Important Adjacent Areas
Threatened or Endangered Species
Scarce Habitats
Special Considerations

The MBRT should consider the following issues or questions to help rank the weight for a given function for a given polygon. Some of these criteria will apply to all polygons within a bank or impact site, while others may be specific to a particular polygon.

Established Watershed Issues: The project will result in identifiable ecological benefits/detriments to established watershed issues recognized to be critical to the watershed of the project. Such issues should be identified in publicly sanctioned plans. For example:

- SWIM plans
- The Reedy Creek/Lake Marion Creek Watershed Conservation Project
- National Estuary Program Comprehensive Conservation and Management Plans
- Strategic Habitat Conservation Area in the GAP analysis
- Aquifer Recharge Are (Note: This weighting factor is scored a zero when a watershed plan has not been developed for the particular area or when a perceived benefit is not critical to the established plan.)

BenefitsTo Important Adjacent Lands: The project will result in identifiable ecological benefits to adjacent lands or waters of regional importance such as a State/National Park, State/National Forest, SWIM water body, OFW, AP, refuges and lands managed for conservation.

Threatened and Endangered Species: The establishment of the mitigation bank improves the status of federal and/or state listed threatened or endangered species, or federally listed candidate species. Simply protecting or conserving a site which currently exhibits use by listed species, where the status of that species will not be identifiably improved, will be considered as maintaining the status-quo. For impact projects which affect a federally Threatened or Endangered species, this issue will be handled in accordance with Section 7 of the Endangered Species Act.

Scarce Habitats: The assessment area contains (or will contain) ecological features considered to be unusual, unique or rare in the region and which are of sufficient size. Expansion or restoration of habitats which have been extensively lost in a region will generally be given greater consideration for this parameter.

Special Considerations: This criteria is reserved for unforeseen circumstances which may be considered important in the weighting of E-WRAP variables.

Weighting Criteria Worksheet: On the next page is a self-explanatory worksheet designed to select which of the previously described weighting criteria will be used for scoring purposes. Except for threatened and endangered species, a simple yes or no question is asked. A yes is scored 3 and a no is scored 0. The scoring for threatened and endangered species is further refined into increments of 0, 1, 2 and 3 according to the relative benefit that the mitigation bank will provide.

WHEN WEIGHTING FACTORS ARE NOT APPLICABLE: After reviewing the Weighting Criteria, the MBRT may elect not to apply any weighting factors at the mitigation bank or impact site. In this case, the five E-WRAP scores will be the only basis in establishing credits and debits.

WEIGHTING CRITERIA WORKSHEET FOR MITIGATION BANKS IN FLORIDA

Established Watershed Issues — Score

Yes 3
No 0

Benefits to Important Adjacent Lands

Yes 3
No 0

Threatened and Endangered Species

Increases population of one or more listed species 3
Meets identified tasks within a recovery plan for listed species or increases the population of one or more candidate species.....2
Attracts listed species to the site 1
Maintains status quo 0

Scarce Habitat

Yes 3
No 0

(Special Consideration)

..... 3
..... 0

TOTAL

In order to determine the relative weighting numbers for the five E-WRAP variables, the following matrix example is presented:

WEIGHTING CRITERIA MATRIX

Weighting Criteria	WU	VC	AB	HY	WQ
Established Watershed Issues	3	3	0	3	3
Benefits to Important Adjacent Areas	0	0	0	0	0
Threatened or Endangered Species	1	3	1	2	0
Scarce Habitats	0	0	0	0	0
Special Considerations	0	0	0	0	0
Total:	4	6	1	5	3

Where: WU = Wildlife Utilization
VC = Vegetative Community
AB = Adjacent Buffer
HY = Hydrology
WQ = Water Quality

As presented in the hypothetical example Weighting Criteria Matrix above, the MBRT has determined that:

- Established Watershed Issues: Applies to Wildlife Utilization, Vegetative Community, Hydrology, and Water Quality variables.
- Benefits to Important Adjacent Areas: Does not apply (there are no important adjacent areas).
- Threatened and Endangered Species: Applies to Wildlife Utilization, Vegetative Community, Adjacent Upland/Wetland Buffer and Hydrology variables.
- Scarce Habitats: Does not apply (there are no scare habitats on the site).
- Special Considerations: No other Special Considerations apply.

The MBRT believes that each of the five E-WRAP variables should have an equal minimum weight. In other words, each weighting factor will have two components. A fixed “minimum weight” component that is automatically given to each variable and an adjustable or “assigned weight” component which the MBRT determines. The Development Team proposes that the minimum weight be 10%. With 10% automatically assigned to each of the five E-WRAP variables, this leaves 50% of the available 100% for the assignment of weights (i.e., 100 –(5)(10)=50). The weighting formula is now:

$$Weight_{WU}+Weight_{VC}+Weight_{AB}+Weight_{HY}+Weight_{WQ}=0.5$$

Based on the total scores from the Weighting Criteria Matrix, the following equation is derived:

$$4x + 6x + 1x + 5x + 3x = 0.5$$

Solving for x: $19x = 0.5$, so $x = 0.0263$

Therefore, plugging 0.0263 back into the weighting formula for the five variables gives the following assigned weights:

Assigned Weight WU = 4 x 0.0263 = 0.1052
Assigned Weight VM = 6 x 0.0263 = 0.1578
Assigned Weight AB = 1 x 0.0263 = 0.0263
Assigned Weight HY = 5 x 0.0263 = 0.1315
Assigned Weight WQ = 3 x 0.0263 = 0.0789

(Remember, once the MBRT assigns the adjustable weights, 0.1 must be added to each of the assigned weights to bring the total weights to 100%)

Prior to integration of these assigned weights, the following must be done with the E-WRAP variable scores (for each bank polygon):

1) The E-WRAP individual variable scores, both "with" and "without bank" are each divided by the maximum score attainable (3.0).

2) The difference of these "averaged" scores is the unweighted E-WRAP "delta" (do for each of the five variables).

The assigned weights are then applied with the E-WRAP functional assessment as follows:

3) The "delta" for each E-WRAP variable is then multiplied by the sum of the assigned weight and the minimum weight of 0.1 to calculate the weighted E-WRAP "delta".

4) The five weighted E-WRAP variable deltas are multiplied by the acreage in each polygon to calculate total "credits" available in that polygon (Temporal Lag and Risk Factor multipliers have been left out here for simplicity).

5) Finally, the credits available in each polygon are summed to calculate the total credits available in the mitigation bank.

WHEN WEIGHTING FACTORS ARE NOT APPLICABLE: After reviewing the Weighting Criteria, the MBRT may elect not to apply any weighting factors at the mitigation bank or impact site. In this case, the five E-WRAP scores will be the only basis in establishing credits and debits.

2.4 METHODOLOGY FOR HABITAT ASSESSMENT VARIABLES

The matrix calibration descriptions for E-WRAP assessment variables follow. The functional attributes of each variable are qualitatively evaluated based on the calibration descriptions.

2.4.1.1 FISH AND WILDLIFE UTILIZATION

INTRODUCTION

Wetlands provide many species of wildlife with basic life sustaining needs such as water, food (i.e. macroinvertebrates and other wetland dependent species including plants) and nesting and roosting areas. While some animal species prefer uplands for nesting and rearing of young, their primary food sources are found within wetland systems. Water dependent species such as fish, some amphibians and birds have specific requirements in regard to length and magnitude of hydrologic inundation and access to appropriate habitat in order to complete their life cycles.

It is important for the evaluator to understand the basic habitat requirements of south Florida fauna to know which species or signs might be observed during site visits. Appendix A lists the habitat requirements for a number of fish and wildlife species found in coastal Florida. Included are food sources, protective cover, reproductive needs and habitat size. Appendices B (Habitat Community Profiles), C (Common Saltwater Fishes of Florida) and D (Common Aquatic Insect Taxa) list additional wildlife species. These appendices will be updated as more information is acquired for the areas of the state where E-WRAP is applied.

Though direct observation of fish and wildlife utilization is ideal, it is not always possible due to the time constraints of the regulatory review process and the secrecy, mobility, habits and seasonality of many species of fish and wildlife. The reviewer must rely on the presence of signs, including burrows, scat, tracks, rubs, and nests etc. In some instances a reviewer may have to assume that if habitat needs for a particular species are present then most likely this species does frequent the site. E-WRAP assessments will also be greatly affected by tidal cycles. Fishes and other motile orgamisms may be more readily observed during higher tides, while macroinvertebrates may be more readily observed during lower tidal cycles.

It is recommended that the reviewer use a D-frame dip net, cast net and/or seine to determine if fishes and macroinvertebrates are present. Several sweeps through the wetland vegetation and open water areas, in combination with direct observations, should provide the reviewer with an indication of the lower food trophic levels. It should be noted that the presence and diversity of macroinvertebrates are quite variable depending on a number of environmental factors such as temperature, pH, predation, and seasonality. During periods of low tide, the reviewer should look for available signs of epifauna (ie., oysters) and infauna (clams and marine worms).

Appendix F provides a list of guilds of wetland obligate and facultative species to assist in E-WRAP scoring. The more guilds of species that are present, the higher the E-WRAP score, since the wetland supports more trophic levels in the food chain. Conversely, the fewer guilds present indicates a lower E-WRAP score, since the wetland supports fewer trophic levels in the food chain. The exact number of guilds required to reach a given score is not provided, but is left up the the judgement of the assessment team.

2.4.1.2FISH AND WILDLIFE UTILIZATION MATRIX

Objective

The fish and wildlife utilization variable evaluates observations and noted signs (i.e. - scat, tracks etc.) of wildlife use, primarily wetland dependent species, and the use of the wetland by fishes and invertebrates. In addition, it also addresses potential fish and wildlife use through the noted presence or absence of food sources, nesting areas, roosting areas, den trees and protective cover.

EXISTING WETLAND EXHIBITS NO EVIDENCE OF FISH AND WILDLIFE UTILIZATION
0

The existing wetland is heavily impacted.
There is no evidence of fish and wildlife utilization.

EXISTING WETLAND EXHIBITS MINIMAL EVIDENCE OF FISH AND WILDLIFE UTILIZATION 1

There is minimal evidence of fish and wildlife utilization.
Wetland provides little habitat for macroinvertebrates, fish and wildlife (eg., clams, oysters, birds and small mammals).
Minimal representation of Species Guilds.
There are sparse or limited adjacent native habitats.
The site is not contiguous to naturally occurring vegetative communities (uplands, wetlands, or submerged aquatic vegetation).
Site may be located in residential, industrial or commercial developments with frequent human disturbances.

EXISTING WETLAND EXHIBITS MODERATE EVIDENCE OF FIAN AND WILDLIFE UTILIZATION 2

There is moderate evidence of fish and wildlife utilization.
There is evidence of wetland utilization by small or medium-sized mammals (observations, tracks, scat).
There is evidence of aquatic macroinvertebrates, amphibians and/or fishes.
Moderate representation of Species Guilds.
Adjacent upland native habitat is available.
There is minimal potential for human disturbance.
There is adequate protective cover for wildlife.
The site is contiguous and continuous on at least 50% of its perimeter to naturally occurring vegetative communities (uplands, wetlands, or submerged aquatic vegetation).

EXISTING WETLAND EXHIBITS STRONG EVIDENCE OF FISH AND WILDLIFE UTILIZATION 3

There is strong evidence of fish and wildlife utilization.
Wetland supports abundant aquatic macroinvertebrates, amphibians, fishes and/or wildlife.
Optimal representation of Species Guilds.
Abundant adjacent upland native habitat is available.
There is a high potential for fish and wildlife use.
The potential for human disturbance is negligible.

There is significant cover for wildlife within the wetland and adjacent upland.
The site is contiguous and continuous on at least 80% of its perimeter to naturally occurring vegetative communities (uplands, wetlands, or submerged aquatic vegetation).

2.4.2.1 VEGETATIVE COMMUNITY COMPOSITION: OVERSTORY AND SHRUB

INTRODUCTION

The Wetland Overstory/Shrub Canopy of Desirable Species variable evaluates the presence, health and appropriateness of the wetland overstory and shrub canopy at the bank site.

Canopy is defined as the plant stratum composed of woody plants and palms with a trunk that is four inches or greater in diameter at breast height (4.5'), except vines (DER. 1994). Subcanopy (which includes shrubs) is that plant stratum composed of all woody plants and palms, exclusive of canopy, with a trunk or main stem diameter at breast height (4.5') between one and four inches, except vines (DER, 1994).

Most of the estuarine wetland species have adapted to a restricted range of hydrologic regimes, slainity and temperature (South Florida Water Management District, 1995). Wetland overstory/shrub canopy provides many benefits to wildlife species such as cover, food, nesting and roosting areas. Wetlands can vary dramatically in the composition and density of overstory/shrub canopy species (Appendix B). This variable should be used when there is significant overstory/shrub canopy (i.e. the coverage of canopy/shrub species should exceed twenty (20) percent of the overall wetland acreage). The variable can also be used when there is potential (i.e. immature) canopy present or a mangrove wetland that has been cleared or otherwise disturbed.

E-WRAP categorizes the native wetland community composition into few, moderate and abundant trees present. Using these categories the reviewer evaluates the aereal coverage and density of the overstory/shrub canopy for a particular wetland.

Certain estuarine wetland types characterized as salt marsh, mudflats and salt barrens systems exhibit limited or no canopy or shrub species (Myers, 1990), (SCS, 1987), In these type of situations the variable would be designated "NA" (not applicable) and omitted from the final calculations.

The overall condition of a native estuarine wetland forest and shrub community composition can be evaluated by observing indicators such as presence of a large percentage of dead or dying trees or shrubs, soil subsidence, little or no seedling regeneration and the presence of an inappropriate understory plant species. Although short-term environmental factors such as flooding, extended drought and fire (Beever, unpublished) can temporarily impact the health of the canopy. The health and abundance of wetland groundcover can be significantly affected by extremes in wetland hydrology. Deepwater conditions through improper wetland control elevations or natural variability can drown wetland plant species (e.g., mosquito impoundments). Conversely, restricting tidal innundation to estuarine wetlands and natural variability can reduce the presence of many wetland species and allow for the encroachment of more upland/transitional species. The health of the vegetation can also be evaluated in terms of plant robustness. If the plants are

chlorotic or spindly (provided they weren't just planted), it may be a sign of nutrient deficiency, improper soils or hydroperiod response.

Human activities such as flooding (i.e. - stacking water in retention systems) or draining systems via conveyance canals irreparably damage these systems. Human impacts (including the hydrological influences noted above) can promote significant changes in wetland ground cover. Mowing of herbaceous wetlands for aesthetics can interfere with seed production of certain plants. Grazing by cattle can influence the species composition of some wetlands due to the introduction of nuisance species of plants. Off-road vehicle traffic in wetlands creates soil disturbance and compaction as well the destruction of vegetation.

Exotic and nuisance plant species have become a serious problem in Florida, outcompeting and replacing native plant communities in many places. Wetlands containing E&N plant species are impacted in various ways depending on the type of wetland and the degree to which it is infested. There are approximately 200 species of exotic plants currently listed by the Florida's Exotic Pest Council's 1995 List of Florida's Most Invasive Species. Many of the listed species can be found invading Florida estuarine wetlands.

Nuisance plants are native species that under certain conditions can dominate a wetland. These plants are usually found dominating wetlands with disturbed soils, or where there have been alterations in hydrology or nutrient inputs from adjacent land uses (i.e. - cow manure, lawn fertilizer, etc.).

2.4.2.2 VEGETATIVE COMMUNITY COMPOSITION: OVERSTORY AND SHRUB MATRIX

Objective

The vegetative community composition: overstory and shrub variable evaluates the presence, health and appropriateness of the wetland's shrub and overstory canopy, where applicable. The functional assessment of the canopy strata is objectively evaluated based on food, cover, nesting potential, and appropriateness of the vegetative community. The canopy strata is evaluated based on the habitat type. This variable may not be applicable to estuarine habitats where overstory/shrub canopy are typically not present. The exotic and nuisance plant species factors evaluate the extent of nuisance plant infestation within the wetland and adjacent upland.

NO DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY PRESENT 0

No desirable wetland trees or shrub species present.
If present, trees are newly planted seedlings providing little habitat support (i.e. - roosting, nesting and foraging).
Site may also have been subject to recent clear cutting with little evidence of canopy plant regeneration.
Wetland and adjacent areas are heavily infested (> 75%) with undesirable plant species, including exotic and nuisance species.

FEW DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY PRESENT 1

Site may exhibit large amounts of undesirable or inappropriate tree or shrub species.
Desirable trees may be immature, but provide some potential for habitat support.
There are minimal signs of natural recruitment of canopy and shrub seedlings.
Live canopy trees exhibit stress.
Wetland and adjacent areas are infested 25% to 50% with undesirable plant species, including exotic and nuisance species.

MODERATE AMOUNT OF DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY PRESENT 2

Few undesirable or inappropriate canopy trees/shrubs may be present (<25%).
Wetland overstory/shrub canopy is providing habitat support.
There is some evidence of natural recruitment of canopy/shrub seedlings.
Live canopy trees are healthy with minimal evidence of stress.
Areas adjacent may contain some exotic and nuisance plant species providing a seed source for future re-establishment.

ABUNDANT AMOUNT OF DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY PRESENT 3

No nuisance or inappropriate canopy/shrub species present.
Desirable trees are providing good habitat support.
There is strong evidence of natural recruitment of canopy and shrub seedlings.
Live canopy trees are healthy with no evidence of stress.
Area contains no exotic plant species.
If present, negligible nuisance plants.
Adjacent area is mostly native plants species.
Site is void of nuisance vegetation and inappropriate vegetative species are minimal.

2.4.3.1 VEGETATIVE COMMUNITY COMPOSITION: GROUND COVER

INTRODUCTION

The vegetative community composition: ground cover variable evaluates the presence, health and appropriateness of the wetland ground cover and herbaceous wetland communities at the mitigation bank site.

Groundcover will be defined as the plant stratum composed of all plants not found in the canopy or subcanopy. Ground cover vegetation can provide a refuge for macroinvertebrates, fish, reptiles, amphibians, small mammals and also provide a food source for small mammals and waterfowl.

Ground cover vegetation can be classified into herbaceous, graminoid, and woody type species and can also be characterized by its growth form such as emergent, floating-leaved, submersed, free-floating surface and subsurface. Most of these wetland species have adapted to a restricted range of hydrologic regimes (South Florida Water Management District, 1995). Species composition of groundcover varies between ecosystems although many species overlap (Appendix B).

The health and abundance of wetland groundcover can be significantly affected by extremes in wetland hydrology. Deepwater conditions through improper wetland control elevations or natural variability can drown wetland plant species (e.g., mosquito impoundments). Conversely, restricting tidal innundation to estuarine wetlands and natural variability can reduce the presence of many wetland species and allow for the encroachment of more upland/transitional species. The health of the vegetation can also be evaluated in terms of plant robustness. If the plants are chlorotic or spindly (provided they weren't just planted), it may be a sign of nutrient deficiency, improper soils or hydroperiod response.

Human activities such as flooding (i.e. - stacking water in retention systems) or draining via conveyance canals irreparably damage these systems. Human impacts (including the hydrological influences noted above) can promote significant changes in wetland ground cover. Mowing of herbaceous and graminoid wetlands for aesthetics can interfere with seed production of certain plants. Grazing by cattle can influence the species composition of some wetlands due to the introduction of nuisance species of plants. Off-road vehicle traffic in wetlands creates soil disturbance and compaction as well the destruction of vegetation.

Exotic and nuisance plant species have become a serious problem in Florida, outcompeting and replacing native plant communities in many places. Wetlands containing E&N plant species are impacted in various ways depending on the type of wetland and the degree to which it is infested. There are approximately 200 species of exotic plants currently listed by the Florida's Exotic Pest Council's 1995 List of Florida's Most Invasive Species. Many of the listed species can be found invading Florida estuarine wetlands.

Nuisance plants are native species that under certain conditions can dominate a wetland. These plants are usually found dominating wetlands with disturbed soils, or where there have been alterations in hydrology or nutrient inputs from adjacent land uses (i.e. - cow manure, lawn fertilizer, etc.).

2.4.3.2 VEGETATIVE COMMUNITY COMPOSITION: GROUND COVER MATRIX

Objective
The vegetative ground cover variable evaluates the presence, health and appropriateness of the wetland's shrub and overstory canopy, where applicable, and the ground cover vegetation**.** The functional assessment of the canopy strata is objectively evaluated based on food, cover, nesting potential, and appropriateness of the vegetative community. The canopy strata is evaluated based on the habitat type. This variable may not be applicable to estuarine habitats where overstory/shrub canopy are typically not present. The vegetative ground cover variable evaluates the presence, abundance, appropriateness and condition of vegetative ground cover within the wetland. Salt barrens and mud flats exhibit limited or no canopy or shrub species; thus, the sub-variables addressing tree and shrub species would be designated "NA" (not applicable). The exotic and nuisance plant species variable evaluates the extent of nuisance plant infestation within the wetland and adjacent upland.

GROUND COVER IS SEVERELY IMPACTED OR NON-EXISTENT 0

Ground cover may be dominated (>75%) by inappropriate or undesireable plant species, including exotic and nuisance vegetation.
Ground cover may be extensively impacted.
Site may exhibit no evidence of seed germination or natural recruitment.
Adjacent areas are heavily infested (> 75%) with inappropriate or undesireable plant species, including exotic and nuisance vegetation.

GROUND COVER IS EXTENSIVELY IMPACTED OR DOMINATED BY LARGE AMOUNTS OF INAPPROPRIATE PLANT SPECIES 1

Ground cover may consist primarily (25%-75%) of inappropriate or undesireable plant species, including exotic and nuisance vegetation.
Ground cover may be moderately impacted.
Site may exhibit some evidence of seed germination or natural recruitment.
Adjacent areas are moderately infested (25%-75%) with inappropriate or undesireable plant species,
including exotic and nusiance vegetation.

GROUND COVER IS SLIGHTLY IMPACTED AND PROVIDES SOME FUNCTIONAL HABITAT 2

Ground cover is primarily (>75%) appropriate native vegetation.
Ground cover may be slightly impacted.
Site may exhibit extensive evidence of seed germination or natural recruitment.
Adjacent areas may contain some (10%-25%) inappropriate or undesireable plant species, including exotic and nusiance vegetation with potential for infestation to spread.

GROUND COVER IS EXTENSIVE WITH MINIMAL OR NO DISTURBANCES 3

There are minimal or no impacts to ground cover.
Area contains no exotic or nuisance vegetation.
If present, inappropriate plants are negligable.
Adjacent area is mostly (>90%) native plants species.

2.4.4.1 ADJACENT UPLAND/WETLAND BUFFER

Introduction

The adjacent upland/wetland buffer variable is a measure of the adjacent habitat support for the subject wetland. This variable is evaluated based on the adjacent buffer size and the ecological attributes (i.e., sediment removal, nutrient uptake, cover, food source, and roosting areas) the buffer area is providing for the wetland system that is being assessed.

Wetland systems are subjected to disturbances that originate in adjacent upland areas. These disturbances can impact biological, chemical and physical attributes of wetlands (Castelle, et al, 1994). Buffers are vegetated areas located between the jurisdictional wetland line and adjacent areas subject to human disturbance. Adjacent wetlands also serve as wetland buffers. Buffers may consist of areas that are undisturbed native vegetation, areas wholly or partially cleared and revegetated, or areas with varying degrees of exotic and nuisance vegetation.

The criteria for determining adequate buffer sizes should be partly based on the quality of the wetland and the intensity of the adjacent land use (Castelle, et al, 1992). Smaller buffers are more acceptable when the adjacent land use is low intensity. Larger buffers are necessary when the adjacent land use intensity is high and the quality of the buffer is low. Buffers provide benefits to wetlands through sediment control (Shisler, et al, 1987), removal of excess nutrients and metals from runoff by both physical filtration and plant uptake (Madison, et al, 1992), and maintenance of habitat diversity for animal species that require the adjacent upland buffer to meet specific habitat needs (Naiman, et al, 1988).

Buffers also form a transitional zone between the wetland and the adjacent development. The edge effect theory proposes that the numbers of plant and animal species increase at the edge, due to overlap of adjacent habitats and the creation of unique edge-habitat niches (Castelle, et al, 1994). Finally, buffers can act to reduce direct human impact by reducing access to the wetland and blocking noise and light pollution.

Castelle, et al, (1994) state that buffers less than 15-30 feet provide little protection for aquatic resources. Buffers should be a minimum of 45-90 feet under most conditions. The lower range (45 feet) is necessary for maintenance of physical and chemical protection, while the upper range (90 feet) is a minimum for the

protection of biological components. Habitat Suitability Index models have demonstrated the need for buffers between 10 and 350 feet depending on the resource needs of the particular species.

Buffer quality is also very important. A good buffer might contain a mixture of native tree, shrub and ground cover plant species. This would provide a visual and sound barrier for the wetland as well as a food source, cover and nesting habitat for wildlife species. In addition, the ground cover plant species would act as a filtration system for incoming surface water. An example of a low quality buffer would be a ring of dense Brazilian pepper around the wetland. The dense growth of the pepper allows little wildlife utilization. In addition, little or no ground cover can grow in the dense shade.

Large buffers (greater than 300 feet) consisting primarily of pasture grasses may provide spatial protection and some sediment control for wetlands. However, these types of buffers provide less benefit as cover, food source and roosting areas than a good quality buffer.

This procedure considers high volume traffic roads or highways as a severance to existing buffers. Low volume traffic roads (i.e., dirt maintenance or fire break roads) are considered as a continuation to the existing buffer.

2.4.4.2 ADJACENT UPLAND /WETLAND BUFFER MATRIX

Objective

The adjacent upland /wetland buffer variable is a measure of the area adjacent to the subject wetland and the landscape setting of the wetland. This variable is evaluated based on the adjacent buffer size and the ecological attributes (i.e. cover, food source and roosting areas for wildlife) that this area is providing in association with the wetland that is being assessed.

NO ADJACENT UPLAND/WETLAND BUFFER
0

Buffer non-existent.

ADJACENT UPLAND/WETLAND BUFFER AVERAGES 30 FEET OR LESS, CONTAINING DESIRABLE PLANT SPECIES 1

Less than 30 feet average width.
Mostly desirable plant species which provide cover, food source, and roosting areas for wildlife
Not connected to wildlife corridors.

ADJACENT UPLAND/WETLAND BUFFER GREATER THAN 30 FEET BUT LESS THAN 300 FEET, CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES

2

Greater than 30 feet but less than 300 feet average width.
Contains desirable plant species which provide cover, food, and roosting areas for wildlife
Portions connected with contiguous offsite wetland systems, wildlife corridors.
Greater than 300 feet but dominated (greater than 75%) by undesirable noninvasive plant species (e.g., pasture grasses).

ADJACENT UPLAND/WETLAND BUFFER AVERAGES GREATER THAN 300 FEET, CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES 3

Greater than 300 feet wide average width, or of exceptional ecological significance.
Contains predominantly desirable plant species (less than 10% nuisance, and no exotic species) for cover, food, and roosting areas for wildlife.
Connected to wildlife corridor or contiguous with offsite wetland
system or areas that are large enough to support habitat for large mammals or reptiles.

2.4.5.1 FIELD INDICATORS OF WETLAND HYDROLOGY

INTRODUCTION

Wetland hydrology can be a difficult variable to evaluate given the limited time frames associated with the regulatory process. Several field indicators of wetland hydrology exist that enable an evaluator to make inferences with regard to wetland hydrology. The duration and magnitude of tidal inundation within a wetland system can be estimated based on plant physiological responses, plant community structure and soil morphology.

Plant Physiological Responses - Several wetland plant species have developed physiological adaptations that enables them to survive extended periods of inundation. Many wetland tree and shrub species develop adventitious roots as a response to the duration of inundation (e.g. mangrove prop roots). Extended periods of inundation promote the development of these secondary roots along the basal stem of the plant. Adventitious roots are formed when the primary root stock is inundated to the extent that anaerobic conditions severely reduce root oxygen and nutrient transport. In addition, recent cypress tree knee growth is an indication of extended inundation. The bark on the apex of the knee will be spread exposing light brown or tan new growth tissue.

Other indicators include small plant species that colonize on the trunks of trees at the interface of the seasonal high water mark. These hydrologic indicators can be used to assist in the determination of the magnitude of inundation, (Hale, 1984). Lichen lines colonize down to the seasonal high water mark. Conversely, moss collars predominantly colonize up to the seasonal high water mark.

Plant Community Structure - The plant community structure evaluates the plant community associated with the ground cover and the overstory/shrub canopy. The plant community structure (PCS) can be used to make inferences to hydrologic impacts resulting in an increased or reduced hydroperiod. The primary focus of the PCS is to evaluate the plant species for a specific habitat. The plant community profiles associated with specific wetland habitats has been documented for use with this procedure in Appendix B. Although this list is not inclusive, it lists plant species typically associated with a specific wetland system.

Transitional plant species such as wax myrtle, saltbush etc., encroaching into the wetland can be cautiously used to assess the existing hydroperiod of a wetland system (Rochow, 1994 and Mortellaro et. al., 1995). Evaluation of these transitional tree and shrub species allows an observer to make some inference to the wetland hydroperiod over the last 1 - 3 years. When evaluating the groundcover plant community it is important to remember that transitional changes within this plant community can occur within one (1) year (Thibodeau and Nickerson, 1985).

Plant Community Structure - Conversely, some wetland systems can be impacted by an increased hydroperiod.
Before accurate inferences can be made to a reduced hydroperiod, it is necessary to first determine the extent of tidal innundation. Having knowledge of what the average tidal range will assist an evaluator with regard to this variable.

Soil Morphology - Soil morphology evaluates soil development and characteristics. A reduced hydroperiod has a direct impact on organic soil development and can result in soil subsidence due to oxidation (Synder and Davidson, 1994). When significant oxidation occurs the PCS for the overstory may show signs of tree falls, excessive tree leaning and exposed roots. In addition, if forested wetland systems are maintaining a proper hydroperiod then seedling regeneration will be occurring either in openings within the canopy or on the periphery of the system.

2.4.5.2 FIELD INDICATORS OF WETLAND HYDROLOGY MATRIX

Objective

This variable evaluates the hydrologic regime based on observed field indicators for the subject wetland. The evaluation considers hydroperiod duration and magnitude It is generally interpreted by using vegetative indictors and other signs of altered hydrology such as the encroachment of upland and transitional plant species into the wetland. In addition, hydrologic indicators such as wrack lines, algal communities, adventitious roots, basal water marks and attached epifauna are used.

HYDROLOGIC REGIME HAS BECOME SEVERELY ALTERED WITH STRONG EVIDENCE OF SUCCESSION TO TRANSITIONAL/UPLAND OR OPEN WATER PLANT COMMUNITY 0

The wetland hydrology has been severely altered.
There is an inadequate hydroperiod to support wetland plant species for the particular community type.
There is strong evidence that upland plants are encroaching into the historical wetland area.
Water levels are too high or too low, resulting in a die-off of wetland plant species.
There are no indicators of a hydrologic regime that would be typical for the subject community type.
In sites with an organic soil substrate, there is evidence of substantial soil subsidence.
In sites that have mineral soils and no natural organic surface horizons, the uppermost 6 inches of the soils at or below the target water surface elevation exhibit substantial changes in color value as measured by a Munsell Soil Color Chart (MSCC), as compared to the site's unaltered natural or its reference condition.

HYDROLOGIC REGIME INADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM 1

The site does not exhibit an adequate hydroperiod to maintain a system that is being created, enhanced or preserved.
Succession of wetland plant species into transitional/upland plant species. Appropriate vegetation is stressed or dying from too much or too little water.
There are few, if any, indicators of a hydrologic regime that would be typical for the subject community type.
In sites with an organic soil substrate, there is evidence of unnatural soil subsidence or accretion.
In sites that have mineral soils and no natural organic surface horizons, the uppermost 6 inches of the soils
at or below the target water surface elevation exhibit readily observable changes in color value as measured by a Munsell Soil Color Chart (MSCC), as compared to the site's unaltered condition.

HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM. EXTERNAL FEATURES MAY AFFECT WETLAND HYDROLOGY 2

Wetland appears to exhibit adequate hydroperiod, although site conditions may exist that interfere or influence the natural hydroperiod of site (i.e. canals, ditches, swales, berms, culverts, pumps, control elevation and wellfields).
Plants appear healthy and exhibit no stress from too little water or too much water.
There are some indicators of a hydrologic regime that would be typical for the subject community type.
In sites with an organic soil substrate, there is evidence of little or no unnatural soil subsidence or accretion.
In sites that have mineral soils and no natural organic surface horizons, the uppermost 6 inches of the soils at or below the target water surface elevation shall exhibit only minor changes in color value as measured by a Munsell Soil Color Chart (MSCC), as compared to the site's reference condition.

HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM 3

Plants are healthy with no stress resulting from an improper hydroperiod.
System exhibits a natural wetland hydroperiod.
If wetland is adjacent to canals, ditches, swales, berms or wellfields, there are no direct observable negative impacts to the wetland within the landscape setting.
There are a few to several indicators of a hydrologic regime that would be typical for the subject community type.
In sites with an organic soil substrate, there is no evidence of unnatural soil subsidence or accretion.
In sites that have mineral soils and no natural organic surface horizons, the uppermost 6 inches of

the soils at or below the target water surface elevation exhibits no change in color value, as measured by a Munsell Soil Color Chart (MSCC), as compared to the site's unaltered natural or its reference condition.

2.4.6.1 WATER QUALITY INPUTS AND TREATMENT

INTRODUCTION

Evaluating water quality within the limited timeframes of the regulatory process is a very difficult task. Without the collection of long term water quality data it is virtually impossible to make any inferences to water quality within a wetland system. However, during the literature review, it became apparent that relatively comprehensive information is available for several water quality constituents including; total nitrogen, total phosphorus, ortho-phosphorus, BOD, TSS, total lead and total zinc (Harvey, 1990). It can be stated that for these selected constituents, runoff water quality varies with land use (Whalen and Cullum, 1988). The E-WRAP for MB'S procedure utilizes nine (9) land use categories to evaluate stormwater quality runoff and its associated impacts. The nine land use categories where taken from Stormwater Loading Rate Parameters for Central and South Florida (Harvey, 1990). The land use categories used in E-WRAP for MB'S include the following; low-density residential, single-family residential, multi-family residential, low-intensity commercial, high-intensity commercial, industrial, highways, agriculture and recreation/open space. Each of these land use categories are further defined within the glossary for this procedure. It is important to use these land use designations when applying this procedure in the field.

For initial mitigation bank establishment, selected water quality sampling is necessary to document baseline, site-specific water quality functions and to monitor future anticipated water quality improvement over the life of the mitigation bank. The Water Quality Indicators described below are separated into General Field Parameters, which will be measured at all mitigation bank sites, and Potential Parameters for Specific Sites based on the land use categories adjacent to a specific mitigation bank. The final selection of water quality criteria and the frequency, location and duration of water quality sampling are designed to be flexible, and will be tailored to each mitigation bank based on discussions with the Mitigation Bank Review Team, water quality experts, and the prospective mitigation banker.

Water quality sampling at a proposed mitigation bank site should begin early in the planning process and is designed to supplement the E-WRAP scoring described below. Initial water quality analyses should be submitted for review by the MBRT in the Mitigation Bank Prospestus, or soon thereafter, but prior to on-site inspection by the MBRT. In addition to documenting baseline conditions at a specific mitigation bank site, water quality data may document unique water quality issues needing resolution prior to bank approval, and will be utilized to quantifiably document improvement, or lack thereof, in water quality conditions over the life of the mitigation bank. As such, water quality criteria will be utilized during the establishment of credit release schedules and the ultimate release of credits based on documented water quality improvement.

Pollutant loading rates from recreation/open space are much lower than any other category. Loading rates for residential land uses increase steadily for each pollutant category from low-density to single-family to multi-family. Low intensity commercial mass loading is much less than high-intensity uses for all pollutant categories with industrial uses falling in between the two. Finally, contribution of nutrients from agricultural uses are much greater than loading rates for wetlands and open water, and appear to be similar to single-family pollutant loadings (Harvey, 1990). These land use categories and their associated loading rates have been used within this procedure to calibrate the water quality variable. It is important to recognize that the previously mentioned land use designations represent the vast majority of land uses within central and south Florida.

In addition to land use types, the efficiencies associated with different water management systems to

remove pollutants shall be considered. Treatment for the pollution generated by stormwater runoff is required in the state of Florida through the regulatory process. There are several treatment methods that are suggested. Wet detention is the most commonly used mechanism, with approximately 70 percent of the water management systems permitted in south Florida being wet detention systems. Dry retention, and/or retention and some form of infiltration /filtration are the other types of treatment mechanisms that are commonly used (Whalen and Cullum, 1988).

Retention systems which include grass swales, achieve upwards of 90 percent reduction for nutrients and solids. Wet detention basins provide good to excellent pollutant removal efficiencies. The standing water column provides for several physicochemical processes to achieve pollutant removal (Whalen and Cullum, 1988).

Treatment of stormwater by use of dry retention basins is generally considered to be inferior to that achieved by wet detention. The reason for the low removal of pollutants is most likely due to the absence of a standing water column, which provides a mean for more extensive biological treatment (Whalen and Cullum, 1988).

The water quality component of E-WRAP evaluates the land use type (LU) adjacent to the subject wetland and the type of surface water management pretreatment (PT) associated with the subject land use. Both LU and PT will be independently assessed and then summed. The summed total is then divided by two (2) to calculate the water quality input and treatment (WQIT) score for E-WRAP. Many times on-site conditions exist that are either not accurately described or a combination of land uses exist adjacent to the subject wetland. In these instances the evaluator must evaluate each of the surrounding land use(s), and the surface water management system associated with each land use. This is mathematically expressed as follows;

(%surrounding x LU1) + (%surrounding x LU2) + (%surrounding x LU3) = LU total

and,

(%surrounding x PT1) + (%surrounding x PT2) + (%surrounding x PT3) = PT total

hence,

WQIT = (LU total + PT total)/2

The conclusions of the PT systems are given with the assumption that the guidelines for proper construction of these systems are followed and that operation and maintenance procedures for the systems are followed during post construction.

MITIGATION BANKS: SELECTION OF WATER QUALITY INDICATORS

1. Objectives: Quantifiable water quality criteria, which meet Florida's Class III standards and detection limits, must be used to assess anticipated water quality improvements attained at proposed mitigation banks. These criteria must be site-specific, and incorporate potential water quality impacts from adjacent and nearby lands. Sampling and analyses of water quality parameters must be performed by HRS approved laboratories using FDEP approved methods.

2. General Field Parameters: The following should be measured within ALL potential mitigation sites:

Specific conductance, pH, Dissolved oxygen, Turbidity, Hydrogen sulfide, Biological oxygen demand (BOD), Total hardness, Total dissolved solids, Total organic carbon, Chemical oxygen demand (COD), Unionized ammonia, Total nitrogen, Total phosphorus. Historic mosquito control treatment history, if applicable, may identify additional specific water quality criteria which need to be measured.

3. Potential Parameters for Specific Sites: The selection of water quality criteria will based on the following land use categories adjacent to a given mitigation bank on a case-by-case basis:

A. Agricultural lands/Golf courses: Pesticides (Chlordane, Endosulfan, Endrin, Heptachlor, Malathion, 2,4,5-TP, 2,4,-D, Aldrin, DDT).

B. Range/Pasture/Dairy and Feedlots: Total Coliform, Fecal coliform, Pesticides.

C. Residential/Commercial: Oils and greases, Pesticides, Aluminum, Chlorides, Total coliform, Fecal coliform, Chromium, Lead, Orthophosphate, Selenium, Semivolatile compounds, Volatile compounds, Zinc.

D. Industrial: Oils and greases, Pesticides, Aluminum, Chlorides, Chromium, Lead, Orthophosphate, Selenium, Semivolatile compounds, Volatile compounds, Zinc, Polynuclear aromatic hydrocarbons, Total Phenols, Polycyclic aromatic hydrocarbons, Phthalate esters, Polychlorinated biphenyls, Radioactive substances, Cyanides.

E. Highway: Oils and grease, Semivolatile compounds, Volatile compounds.

2.4.6.2 WATER QUALITY INPUT AND TREATMENT MATRIX

Objective

The water quality variable of the matrix is a measure of the quality of the surface water flowing into the subject wetland from adjacent land uses (LU). The percent and type of surrounding land uses as well as any on-site pretreatment (PT) of surface waters prior to the discharge into wetlands is considered.

The scores for land use types are as follows:

LAND USE CATEGORY (LU)	SCORE
open space / natural undeveloped areas	3
unimproved pasture / rangeland	2.5
low density residential	2
low intensity commercial	2
institutional	2
single-family residential	1.5

recreational	1.5
golf course	1.5
moderately intensive commercial	1.5
highways	1
industrial	1
mining	1
citrus grove	1
sugarcane	1
multi-family residential	1
improved pasture	1
row crop	1
high intensity commercial	0.5
dairy and feedlot	0

*see Glossary for definitions

The scoring increments for treatment systems are as follows:

PRE-TREATMENT CATEGORY (PT)	**SCORE**
natural undeveloped area	3
berms which prevent runoff from entering wetland	2.5
wet detention with swales	2.5
wet detention with dry retention	2.5
combination grass swales with dry retention	2
turbidity during construction	1.5
wetland system is part of treatment	1.5
grass swales only	1
dry retention only	1
no treatment	0

The scores for the PT systems are given with the assumption that the systems are built, operated and maintained in accordance with all applicable regulations and guidelines.

FORMULA FOR WATER QUALITY INPUT AND TREATMENT VARIABLE (WQIT)

Example: (%surrounding x LU1) +(%surrounding x LU2) + (%surrounding x LU3)= LU total

WQIT =(LU total + PT total) /2

APPENDIX F

FLORIDA WILDLIFE GUILDS

WETLAND OBLIGATE AND FACULTATIVE SPECIES

	Common Name	Scientific Name
MAMMALS		
Wetland Herbivores	Round-tailed muskrat	*Neofiber alleni*
	White-tailed deer	*Odocoileus virginianus*
	Marsh rabbit	*Sylvilagus palustris*
	Rice rat	*Oryzomys palustis*
	Beaver	*Castor canadensis*
Wetland Carnivores	River otter	*Lutra canadensis*
	Mink	*Mustela vison*
	Bobcat	*Lynx rufus*
	Florida panther	*Felis concolor coryi*
	Raccoon	*Procyon lotor*
	Black bear	*Ursus americanus*
	Virginia opossum	*Didelphis virginiana*
BIRDS		
Wading Birds	Wood stork	*Mycteria americana*
	Great blue heron	*Ardea herodias*
	Great egret	*Casmerodius albus*
	Green-backed heron	*Butorides striatus*
	Little blue heron	*Egretta caerulea*
	Reddish egret	*Egretta rufescens*
	Snowy egret	*Egretta thula*
	Tricolored heron	*Egretta tricolor*
	Roseate spoonbill	*Ajaia ajaja*
	White ibis	*Eudocimus albus*
	Glossy ibis	*Plegadis falcinellus*
	Black-crowned night heron	*Nycticorax nycticorax*
	American bittern	*Botaurus lentiginosus*
	Least bittern	*Ixobrychus exilis*
Fish-Eating Birds	Terns	*Sterna spp.*
	Black skimmer	*Rynchops niger*
	Belted kingfisher	*Ceryle alcyon*
	Brown pelican	*Pelicanus occidentalis*
	Common loon	*Gavia immer*
	Grebes	*Podiceps, Podilymbus*
	Mergansers	*Mergus spp.*
	Anhinga	*Anhinga anhinga*
	Double-crested Cormorant	*Phalacrocorax auritus*
Aquatic Invertebrate-Eating Birds	Plovers	*Charadrius spp.*
	Black-necked stilt	*Himantopus mexicanus*
	American avocet	*Recurvirostra americana*
	Sandpipers and phalaropes	*Colopacidae*
	American oystercatcher	*Haematopus palliatus*
	Snail kite	*Rostrhamus sociabilis*
	Limpkin	*Aramus guarauna*
Raptors	Bald eagle	*Haliaeetus leucocephalus*

	Osprey	*Pandion haliaetus*
	Northern harrier	*Circus cyaneus*
	Peregrine falcon	*Falco peregrinus*
	Merlin	*Falco columbarius*
REPTILES		
Crocodylians	Alligator	*Alligator mississippiensis*
	American crocodile	*Crocodylus acutus*
Aquatic Turtles	Florida snapping turtle	*Chelydra serpentina*
	Peninsula cooter	*Chrysemys floridana*
	Florida redbelly turtle	*Chrysemys nelsoni*
	Yellowbelly slider	*Chrysemys scripta*
	Florida chicken turtle	*Deirochelys reticularia*
	Striped mud turtle	*Kinosternon bauri*
	Florida mud turtle	*Kinosternon subrubrum*
	Stinkpot	*Sternotherus odoratus*
	Florida softshell	*Trionyx ferox*
Aquatic Snakes	Water snakes	*Nerodia spp.*
	Striped crayfish snake	*Regina alleni*
	Florida swamp snake	*Seminatrix pygaea*
	Florida cottonmouth	*Agkistrodon piscivorus*
AMPHIBIANS		
	Treefrogs	*Hyla spp.*
	Cricket frogs	*Acris spp.*
	Chorus frogs	*Pseudacris spp.*
	Eastern narrowmouth toad	*Astrophryne carolinensis*
	Eastern spadefoot	*Scaphiopus hobrooki*
	True frogs	*Rana spp.*
	Two-toed amphiuma	*Amphiuma means*
	Dwarf salamander	*Eurycea quadridigitata*
	Peninsula newt	*Notophthalmus viridescens*
	Dwarf siren	*Pseudobranchus striatus*
	Eastern lesser siren	*Siren intermedia*
	Greater siren	*Siren lacertina*
F**ISH**		
Predatory Fishes	Largemouth bass	*Micropterus salmoides*
	Gar	*Lepisosteus spp.*
Forage Fishes	Sunfish	*Centrarchidae*
	Killifishes	Cyprinodontidae
	Livebearers	Poeciliidae

MACROINVERTEBRATES

Crayfish	Procambarus spp
Apple snail	*Pomacea paludosus*
Ram's horn snail	*Planorbella spp*.
Prawns	*Penaeus spp*.
Grass shrimp	*Paloaemonetes paludosus*
Dragonflies	Anisoptera

Mayflies	Ephemeroptera
Aquatic beetles	Dytiscidae/Gyrinidae/Hydrophilidae
Fishing spiders	*Dolomedes spp*.
Water striders	Gerridae
Aquatic bugs	Hemiptera
Leeches	Hirudinea
Water mites	Hydracarina
Aquatic moths	Lepidoptera

GLOSSARY

Agriculture - activities include cattle grazing, row crop, citrus and related activities

Appropriate plant species - plant species which are appropriate for a given community type (i.e. - *Rhyncosphora tracyii* in a wet prairie, *Nymphaea odorata* in a deepwater marsh)**.**

Baseline condition - the condition of the wetland assuming a reasonably expected “without bank” condition.

Canopy - the plant stratum composed of all woody plants and palms with a trunk four inches or greater in diameter at breast height (4.5'), except vines.

Decreased hydroperiod - a decrease in the annual period of inundation, resulting in a change in the plant community composition and structure. The effect is an increase of transitional and upland plant species.

Desirable plant species - native plant species that are appropriate in a regional biological sense and provide benefits to wildlife in the form food, cover, and nesting potential.

Direct impacts - a physical act such as dredging or filling of wetlands.

Dry detention - impoundments in which stormwater is temporarily stored. They are designed so that no standing water remains in the basin after the bleed down period.

Exotic plant species - plants species that are non-native, purposefully or accidentally introduced to a geographic area, invasive in nature and disrupt native plant communities.

Extensively maintained - mowed, disked or impacted on more than a semi-annual basis.

Freshly mulched created mitigation area - the spreading of hydric soils (with viable native seed bank present) across a graded, newly constructed mitigation area.

Grass swales - a grassed swale is a linear depression, that is usually designed to capture, store, and convey stormwater runoff.

Ground cover - the plant stratum composed of all plants not found in the canopy or subcanopy.

Heavily impacted - impacted in such a degree as to significantly reduce the functionality of a system.
High intensity commercial - land use consisting of commercial with high levels of traffic volume with traffic constantly moving of the area; these include downtown areas, commercial office sites and regional malls.

High intensity land use - includes intensive agricultural operations such as dairy farming (including feedlots) and high-intensity commercial projects. These surrounding land uses are significantly disruptive to wetland systems through indirect and indirect impacts.
Highway - includes major road systems such as interstate highways, major arteries and thoroughfares.

Hydroperiod - the annual period of continuous inundation, but without regard to depth.

Hydrological indicators - indicators that may be used as evidence of inundation or saturation when evaluated with meteorological information, surrounding topography, and reliable hydrological data. Indicators include algal mats, aquatic mosses, aquatic plants, aufwachs, drift lines, elevated lichen lines, evidence of aquatic fauna, morphological plant adaptations, secondary flow channels, sediment deposition, vegetated tussocks and water marks.

Hydrology - water depth, flow patterns, and duration and frequency of inundation as influenced by precipitation, surface runoff and groundwater inputs and outputs.

Impervious surface - surfaces which do not allow for the percolation of water (i.e. - asphalt parking lots and roads, rooftops of buildings).

Inappropriate plant species - plant species which are not usually considered nuisance species, however may be indicative of other problems (i.e. - improper hydrology) and may dominate a particular stratum (e.g. *Rubus* sp. in a cypress forested wetland). These plant species are not considered appropriate for a

particular habitat.

Increased hydroperiod - an increase in the annual period of inundation, resulting in a change in the plant community composition and structure. Can include an increase in the duration and magnitude of inundation.

Indirect impacts - impacts to wetlands such as increased nutrient loading, altered hydrology, impacts to wetland buffer, development of adjacent areas or disturbances by sound, air, light or noise pollution.

Industrial - includes manufacturing, shipping and transportation operations, sewage treatment plant facilities, water supply plants and solid waste disposal.

Infiltration trench - impoundments in which incoming runoff is temporarily stored until it gradually leaves the basin by infiltrating into the soils.

Institutional - includes schools, churches, libraries etc. Similar runoff concentrations to low-intensity commercial.

Landscape setting - the type of land use that surrounds a wetland (i.e. - agriculture, residential, commercial/industrial, undeveloped).

Low density residential - a rural area with lot sizes greater than 1 acre or less than one dwelling unit per acre.

Low-intensity commercial - areas that receive a moderate amount of traffic volume and are parked for only a portion of the day; these areas include universities, schools, churches, professional office sites and small shopping centers.

Low intensity land use - land uses such as low density residential, citrus and low intensity commercial.

Low plant biomass density - little accumulation of plant biomass due to numerous factors including mowing, grazing, recent vegetation installation, inappropriateness of planted species, improper hydrology (including drought) and other human perturbations such as disturbances by off-road vehicles.

Moderately intensive land use - includes single-family residential, multi-family residential, golf courses and golf course residential communities, industrial projects, highways and agricultural activities such as pasture and row crops.

Multi-Family residential - residential land use consisting primarily of apartments, condominiums and cluster homes.

Pretreatment or MSSW system - constructed systems designed to pretreat water (i.e. - removal of suspended solids and degrees of nutrient removal) prior to discharge. Systems can range in simplicity from grass swales, dry retention to secondary treatment and polishing ponds.

Routinely maintained - mowed or impacted on less than an annual basis.

Secondary productivity - macroinvertebrates, fishes and wildlife.

Single-Family residential - typical detached homes with lot sizes less than 1 acre and dwelling densities greater than 1 dwelling per acre; duplexes constructed on one-third to one-half acre also included.

Subcanopy - means the plant stratum composed of all woody plants and palms, exclusive of the canopy, with a trunk or main stem with a diameter breast height (4.5') between one and four inches, except vines.

Undesirable plant species - exotic, nuisance or inappropriate plant species for a given habitat.

Wet detention - impoundments in which stormwater runoff is temporarily stored until it gradually leaves the basin through an outflow control structure. They are designed so that a pool of standing water remains in the basin after the bleed-down period.

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