A rapid functional assessment method for designed freshwater and brackish water filter marsh ecosystems used for water quality treatment (FMFAM)

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Charlotte Harbor National Estuary Program

The Charlotte Harbor National Estuary Program is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users working to improve the water quality and ecological integrity of the greater Charlotte Harbor watershed. A cooperative decision-making process is used within the program to address diverse resource management concerns in the 4,400 square mile study area. Many of these partners also financially support the Program, which, in turn, affords the Program opportunities to fund projects such as this. The entities that have financially supported the program include the following:

U.S. Environmental Protection Agency
Southwest Florida Water Management District
South Florida Water Management District
Florida Department of Environmental Protection
Peace River/Manasota Regional Water Supply Authority
Polk, Sarasota, Manatee, Lee, Charlotte, DeSoto, and Hardee Counties
Cities of Sanibel, Cape Coral, Fort Myers, Punta Gorda, North Port, Venice,
Fort Myers Beach, and Winter Haven
and the Southwest Florida Regional Planning Council.

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Partnerships

The water quality functional assessment methodology was developed in coordination with an interagency “A-Team”, and included representatives of the Florida Department of Environmental Protection, the South Florida and Southwest Florida Water Management Districts, local governments, and, if available, private sector water quality experts. Forty-five organizations from across the SWFRPC and CHNEP study areas have been invited to participate on the A-Team, in order to have a variety of perspectives. At the time of submission, 18 organizations are providing letters of support and 17 agencies have agreed to participate, including the Charlotte Harbor Environmental Center, the CHNEP, the City of Bonita Springs, the City of Cape Coral, the City of Ft. Myers, the City of Naples, the City of North Port, the City of Punta Gorda, the City of Sanibel, Collier County, FDEP, Florida Sea Grant, Greg Rawl, P.G., Lee County Division of Natural Resources, Manatee County, Sanibel-Captiva Conservation Foundation, Sarasota County, the Tampa Bay Estuary Program and USGS. These and other partners met regularly in the field and at office locations to develop and test the functional assessment methodologies. The partners will committed 18 days of work over the 2-year project period. Appendix A lists the members of the A-Team.

Internal first draft technical review is provided by the CHNEP TAC, CAC, and Management Committee and Policy Committee.

Information and technical assistance, and site access permission from the CHNEP, SWFRPC, FDEP, SFWMD, SWFWMD, the USFWS, the FWC, and the FMRI.

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Executive Summary

This project developed a functional assessment method to evaluate designed freshwater and brackish water ecosystems used for water quality treatment. This filter marsh functional assessment method (FMFAM) can be utilized for evaluating filter marshes and potentially crediting water quality improvements in Basin Management Action Plans (BMAPs) to address non-attainment of Total Maximum Daily Loads (TMDLs). The methodology has been developed in coordination with an interagency "A-Team", which included representatives of the Florida Department of Environmental Protection (FDEP), the South Florida and Southwest Florida Water Management Districts (SFWMD, SWFWMD), local governments, and private sector water quality experts. Team members developed an agreed-upon common baseline of knowledge about functional assessment methods. The new method was developed, focusing on biological and physical surrogates for water quality measurements, and then multiply tested. After calibration, the new method was retested to assure that the surrogates are applicable. EPA and state, local and private sector practitioners will be invited to test the new method. The new method has been presented for use and acceptance by state, federal and local governments as one tool in the BMAP arsenal.

Geographic Location:

The geographic location of this project includes the Southwest Florida Regional Planning Council and Charlotte Harbor National Estuary Program Study Areas; Sarasota Bay Program Study Area and the Big Cypress Watershed; Sarasota, Manatee, Charlotte, Desoto, Glades, Hendry, Collier, and Lee Counties; HUC: 03100103, Charlotte Harbor; 03090205, Caloosahatchee; 03100101, Peace; 03100102, Myakka; 03100201, Sarasota Bay including Lemon Bay and Dona & Roberts Bays; 03090204, Big Cypress Swamp including Estero Bay

Project Description

This project addresses the Core Element of Regulatory Activities. Applicable Actions and Activities include "Actively review proposed impacts to waters of the "state" – develop standard practices or general authorizations for like projects impacting similar aquatic resources"; "Determine and adopt comprehensive project review criteria – adapt and adopt 404(b)(1) guidelines or comparable review criteria for assessing and minimizing impacts"; "Require effective mitigation for authorized impacts – develop and establish minimum requirements and review criteria for mitigation proposals", "Track/Evaluate – development and adoption of state, tribal, or municipal rules to protect wetlands"; "Ensure impact assessments and mitigation crediting lead to replacement of aquatic resources with similar structural, functional or condition attributes – develop and adopt functional or condition assessment methodologies, develop and establish performance standards and success criteria for mitigation, develop methods to evaluate mitigation against reference and pre-impact sites regularly, develop and improve a process to coordinate regulatory programs with other entities conducting restoration to share best practices, mitigation/restoration priorities, and/or assessment methodologies.

The Federal Clean Water Act provides the statutory basis for state water quality standards programs. Section 303(d) of the CWA requires states to submit lists of surface waters that do not meet applicable water quality standards after implementation of technology-based effluent limitations, and to establish Total Maximum Daily Loads (TMDLs) for these waters on a prioritized schedule. TMDLs establish the maximum amount of a pollutant that a water body can assimilate without exceeding water quality standards. As such, development of TMDLs is an important step toward restoring wetlands and other surface waters to their designated uses. In order to achieve the water quality benefits intended by the CWA, it is critical that TMDLs, once developed, be implemented as soon as possible.

Chapter 99-223, Laws of Florida, sets forth the process by which the 303(d) list is refined through more detailed water quality assessments. Implementation of TMDLs refers to any combination of regulatory, non-regulatory, or incentive-based actions that attain the necessary reduction in pollutant loading. A Basin Management Action Plan (BMAP) is the "blueprint" for restoring impaired waters by reducing pollutant loadings to meet the allowable loadings established in a TMDL. It is a comprehensive set of strategies that includes an inventory of existing and future watershed restoration projects designed to implement the pollutant reductions established by the TMDL; a timeframe for implementation; and operational and maintenance plans that are required to meet the TMDLs. These broad-based plans are developed with local stakeholders and are adopted by Secretarial Order to be enforceable. This regulatory requirement impacts the capital improvement budgets of counties, cities, special drainage and water control districts, and has legal implications for failure to comply. Local government utilities and National Pollution Discharge Elimination System (NPDES) permits will be subject to stricter permit requirements in the near future.

Florida has experienced a general decline in the quality of its surface water over the last several decades due to development, agriculture and other human activities. The major pollutant of concern in Southwest Florida is nutrients. There are many sources of nutrients entering the watersheds: atmospheric deposition, contributions from plants and wildlife, development, automobile exhaust, septic tanks, fertilizer (both residential and agricultural) and domesticated animal waste. Nutrients are naturally occurring in Florida’s watersheds, however excessive nutrients, particularly ammonia, nitrates, and nitrites added to the landscape and water through human activity, constitute pollution. Natural phenomena such as tropical storms combined with a savanna climate of intense wet season storms further exacerbate this decline in water quality by increasing rapid flush storm water pollution loading to local water bodies. Man’s mismanagement of water quality and water quantities coupled with a changing climate is resulting in harmful algal blooms, negative impacts to human and wildlife health and the economy, and has limited the use of water resources. This can be attributed to the fact that local receiving waters have surpassed their natural capacity to assimilate nutrients due to over-enrichment from human activity.

Many southwest Florida watersheds are verified impaired for nutrients by FDEP and TMDLs have been established for them. Lee County is currently working with FDEP, SFWMD, the cities and non-governmental stakeholders to develop a BMAP or restoration plan to address water quality problems. Other local governments in the region have undertaken the start of BMAP planning for their watersheds as well. One of the important affirmative tools available to implement a BMAP is the restoration and/or creation of depressional or flats wetland treatment systems. These systems can reduce water quality pollution through the biological activity of vegetation and wetland metabolism. These processes reduce the pollution concentration and loading in the treatment wetland before discharge to the receiving waterbody.

It is important, in the development of water quality treatment areas, to gauge the attained or potential achievement of the BMAP goals. A field-based rapid assessment procedure that provides a functional assessment of water quality compatible with the State-adopted Uniform Mitigation Assessment Method (UMAM) and Federal Hydrogeomorphic (HGM) depressional and flats wetlands methods can be a vital tool to achieve these water quality improvement goals. This project will build upon the work completed by the applicant in the previous projects associated with wetland functional assessment methods and water quality issues in Florida: *A Watershed Analysis of Permitted Coastal Wetland Impacts and Mitigation Methods within the Charlotte Harbor National Estuary Program Study Area; Growth Management Regulation, Public Investment and Resource Implications for the Estero Bay Watershed*; and *Comprehensive Southwest Florida Charlotte Harbor Climate Change Vulnerability Assessment*.

Wetland assessment procedures began to be developed in the 1970s in an effort to demonstrate that wetlands provide benefits beyond narrowly defined commercial and recreational outcomes (Leonard et al. 1981, U.S. Environmental Protection Agency 1984). Overall, wetland assessment procedures that have attempted to link individual functions with services and values have done so in a very limited way, were not fully developed or field tested, and have not been widely used. They were also developed before it was possible to take advantage of advances in valuation theory and modern data storage and retrieval systems. The current trend in wetland assessment has been to improve procedures for evaluating functions (e.g., HGM Approach (Smith et al. 1995), Index of Biological Integrity (IBI) (Karr 1981, 1998), WEThings (Whitlock, Jarmon, and Larson 1994;Whitlock et al. 1994) and to leave the assessment of all related socioeconomic trade-offs to be worked out through the political process.

The FDEP basins included in the proposed study area include Everglades West Coast, Charlotte Harbor, Sarasota Bay/Peace River/Myakka River Basin, Caloosahatchee, and Fisheating Creek. Within these basins, 21 TMDLs are set in 20 water bodies, and 2 water bodies are considered priority areas with BMAP activities in progress.

Introduction and History of Functional Assessment Methods for Wetlands Up to the Current Project

A Short History of Functional Assessment Methods

Until 1960 the typical way to assign a functional value to a wetland was to assign it an economic market value as a development site. This was followed by occasional attempts to measure the economic value of recreational services wetlands supported, especially those associated with hunting and fishing (King *et al.* 2000).

Wetland assessment procedures began to be developed in the 1970s in an effort to demonstrate that wetlands provide benefits beyond narrowly defined commercial and recreational outcomes (Leonard et al. 1981, U.S. Environmental Protection Agency 1984). It was always the intent in these early efforts to find a suite of wetland values and functions that exceeded, perhaps by several orders of magnitude, the simple accounting of acre for acre values of wetland mitigation replacement. They were also developed before it was possible to take advantage of advances in valuation theory and modern data storage and retrieval systems.

Habitat Evaluation Procedure (HEP)

The Habitat Evaluation Procedure or HEP (developed by the U.S. Fish and Wildlife Service in 1980) is the most noteworthy of these procedures because it was one of the first and most comprehensive. It is still a widely used method for establishing nonmonetary currencies of habitat value (USFWS 1980b). The Habitat Suitability Index (HSI) and habitat units (HUs) developed using HEP provide a means to document professional judgments about the adequacy or equivalency of habitats for various fish and wildlife species. They can be used to evaluate some types of habitat trades and mitigation proposals.

Human Use and Economic Evaluation or HUEE

HEP focuses primarily on site characteristics that satisfy the needs and preferences of particular fish and wildlife species (e.g., breeding and feeding conditions), not on site and landscape characteristics that determine how improving habitats for those fish and wildlife is likely to satisfy the needs and preferences of people. A significant amount of conceptual work went into the development of a component of HEP called the Human Use and Economic Evaluation or HUEE (USFWS 1985), which did deal with those habitat values. However, indices related to wetland values were never fully developed or field tested and, unlike the rest of the HEP method, the HUEE module has not been widely used.

Standards for the Development of Habitat Suitability Index Models

The impetus for the development of the HSI series was the Habitat Evaluation Procedures, or HEP (USFWS 1980a), a planning and evaluation technique that focuses on the habitat requirements of fish and wildlife species. Methods in the HSI model series have been formatted according to Standards for the Development of Habitat Suitability Index Models (USFWS 1981). The HSI series models are similar to other sources of information that address, in general terms, the habitat requirements of fish and wildlife species. Several other efforts to compile species databases have been initiated in recent years (e.g., Mason et al. 1979; USFWS 1980b). These other databases are descriptive in content and contain an array of habitat and population information, while the HSI series is unique in that it is constrained to habitat information only, with an emphasis on quantitative relationships between key environmental variables and habitat suitability. In addition, HSI synthesizes habitat information into explicit habitat models useful in quantitative assessments. The HSI models reference numerous literature sources in an effort to consolidate scientific information on species-habitat relationships.

0.0 to 1.0 scale for Functional Assessment Methods

HSI models provide a numerical index of habitat suitability on a 0.0 to 1.0 scale, based on the assumption that there is a positive relationship between the index and habitat carrying capacity (USFWS 1981). This scale became the standard for all later Functional Assessment Methods. The models vary in generality and precision, due in part to the amount of available quantitative habitat information and the frequently qualitative nature of existing information. When possible, HSI models are derived from site-specific population and habitat data.

HSI Models

The HSI models are usually presented in three basic formats: (1) graphic; (2) word; and (3) mathematical. The graphic format is a representation of the structure of the model and displays the sequential aggregation of variables into an HSI. Following this, the model relationships are discussed and the assumed relationships between variables, components, and HSIs are documented. Finally, the model relationships are described in mathematical language, mimicking as closely and as simply as possible, the preceding word descriptions.

Numerous assessment procedures specific to wetlands have been developed since HEP. Some of them attempt to address wetland values by measuring functions and then identifying significant risks or exceptional values associated with each function using "red flags" or "noteworthiness" rankings Habitat Assessment Technique (Cable, Brack, and Holmes 1989), Evaluation for Planned Wetlands (EPW) (Bartoldus, Garbisch, and Kraus 1994), New England Freshwater Wetlands Invertebrate Biomonitoring Protocol (NEFWIBP) (Hicks 1997)).

These simple add-on approaches are based on the presence or absence of notable features, such as endangered species or designated historic or archeological areas. They do not attempt to make links between functions, services, and values.

A few procedures include simplified models or questions that are used to assign scores to wetlands based on social categories such as recreation, aesthetics, agricultural potential, and educational values:

1. New Hampshire Method (Ammann and Stone 1991)
2. Connecticut Method (Ammann, Frazen, and Johnson 1986)
3. Hollands-Magee Method (Hollands and Magee 1985)
4. Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNRAM) (Minnesota Board of Water and Soil Resources 1998)
5. Oregon Freshwater Wetland Assessment Methodology (OFWAM) (Roth et al. 1996)).

Some of them also weave concepts of function and value into a measure called "functional value" (e.g., Ammann, Frazen, and Johnson 1986; Ammann and Stone 1991). However, the criteria used in those methods to assign relative values to different wetlands or to distinguish between levels of function and associated values are not clearly defined.

The Wetland Evaluation Technique (WET) (Adamus *et al.* 1987) is exceptional in that it provides a basis for estimating separate ratings of social significance for most functions. However, in the WET approach, site evaluators are asked to "value" a function as low, medium, or high based on the *likelihood* of its being "socially significant," not on the *level* of social significance. Because these ratings relied on only a few easily recognized factors, the social significance component of the WET approach was used fairly often and yielded predictable and consistent results when applied by different wetland assessors. However, the advantage of having an approach that was easy to use and consistent came at a cost. WET indices did not address many important differences between wetlands that influence the links between wetland functions, services, and values and yielded empirical rankings that were difficult to interpret or defend. Because of these technical limitations, the valuation component of the WET method is rarely used today.

Overall, the earlier wetland assessment procedures that have attempted to link individual functions with services and values have done so in a very limited way, were not fully developed or field tested, and have not been widely used. They were also developed before it was possible to take advantage of advances in valuation theory and modern data storage and retrieval systems. The 1990's trend in wetland assessment has been to improve procedures for evaluating functions;

HGM Approach (Smith *et al.* 1995)
Index of Biological Integrity (IBI) (Karr 1981, 1998)
WEThings (Whitlock, Jarmon, and Larson 1994; Whitlock *et al.* 1994)

and to leave the assessment of all related socioeconomic trade-offs to be worked out through the political process. This limits the usefulness of wetland assessment procedures and makes it difficult for wetland managers and regulators to defend using the results. It also leaves them with very little technical justification for protecting "valuable" wetlands or preventing mitigation trades that result in the replacement of "valuable" wetlands with less "valuable" wetlands.

Rapid Assessment Procedure (RAP)

The original Rapid Procedure for Assessing Wetland Functional Capacity or Rapid Assessment Procedure (RAP) was developed to provide a procedure for assessing functional capacity of wetlands in the glaciated northeast and Midwest of the United States of America.

It also served as the original template and provided a step by step process for developing rapid assessment procedures for other regions of the continental United States, including Florida. The original RAP required a two person team of experienced wetland scientists, one with a soils/hydrology background and the other competent in plant identification and ecology. It was applicable to depressional, slope, lacustrine fringe, extensive peatland, flat and riverine wetlands.

The procedure template was designed to be applicable to all wetland types in the continental United States. Approximately eight wetland functions were evaluated

1. modification of ground water discharge
2. modification of ground water recharge
3. storm and flood water storage
4. modification of stream flow
5. modification of water quality
6. export of detritus; contribution to abundance
7. diversity of wetland vegetation
8. contribution to abundance and diversity of wetland fauna.

Functional Capacity Index (FCI) and Functional Capacity Units (FCUs)

To implement the method, the user(s) distinguished the wetland assessment areas (WAAs) based on hydrogeomorphic wetland class (Brinson 1993) and physical separation criteria.

The user then visited the wetland assessment area and completed the inventory sheet by selecting conditions that best described various landscape, hydrologic, soils, vegetation variables. Vegetation types/species and pre-emptive status were also identified. Information from the inventory sheet was applied to the models which (a) contain variables, (b) list conditions for each variable, (c) assign a weight (scale 0-3) to conditions for each variable, and (d) provide space for calculating the functional capacity index (FCI). Functional Capacity Units (FCUs) may also have been calculated. The output of RAP is a measure of functional capacity of a site relative to the range of possible scores for a given model.

Wetland Rapid Assessment Procedure (WRAP)

The Wetland Rapid Assessment Procedure (WRAP) was designed to provide a consistent, timely regulatory tool for evaluating freshwater wetlands that have been created, enhanced, preserved, or restored through the regulatory programs of the South Florida Water Management District and the Environmental Resource Permit process. M-WRAP is a modified version of WRAP designed for use in reviewing mitigation banks and to aid in determining the number of credits. E-WRAP is a modified version of WRAP designed for use in the assessing estuarine systems and contains different descriptors in the models for the estuarine environment and policy guidance for the assessment of sites in mosquito impoundments. Professional understanding of functions in Florida freshwater wetland ecosystems and familiarity with flora and fauna with respect to specific ecosystems are required to effectively utilize WRAP. Over 200 sites were visited during the development of WRAP.

The variable categories assessed include six variables:

1. wildlife utilization
2. overstory/shrub canopy of desirable species

3. wetland vegetative ground cover of desirable species
4. adjacent upland/wetland buffer
5. field indicators of wetland hydrology
6. water quality input and treatment.

The user(s) review(s) existing information (e.g., identify land uses adjacent to the site and on-site hydrology), visits the wetland area, and completes the data sheet. The data sheet (a) identifies the variables, (b) lists three or more calibration descriptors for each variable, and (c) assigns a score (range 0 to 3) to each description. Scores for each variable are summed and divided by the maximum possible score to derive a WRAP score (scale 0.0-1.0) for the wetland.

For this study we will use as our starting points the two current prevalent functional assessment methods utilized in Florida and the CHNEP study area: The State of Florida's Uniform Mitigation Assessment Method (UMAM) and the Federal Hydrogeomorphic Methodology (HGM).

Uniform Mitigation Assessment Method

In response to a request by the Florida state legislature in 1999 to "study mitigation options…implemented from 1994 to the present and…consider the effectiveness and costs of the current mitigation options in offsetting adverse effects to wetlands and wetland functions" (Section 373.414(18)(b), F.S., 1999), the Office of Program Policy Analysis and Governmental Accountability (OPPAGA) submitted a report in 2000 (Report No. 99-40) highlighting some of the shortcomings of the current mitigation process.

In particular, while the State could track the acreage of wetland loss and the acreage of mitigation, the report concluded that this information was not sufficient to ensure the replacement of wetland function resulting from wetland impacts. The recommendation of developing of a state wide wetland assessment method became law in 2000.

The Florida Department of Environmental Protection (FDEP) and the water management districts (SFWMD,SWFWMD,SJRWMD,SRWMD) worked closely to develop the Uniform Mitigation Assessment Method (UMAM) rule (Chapter 62-345, F.A.C.), which became effective in February 2004.

The UMAM is designed to assess any type of impact and mitigation, including the preservation, enhancement, restoration, and creation of wetlands, as well as the evaluation and use of mitigation banks, and it provides a framework for statewide standardized wetland assessment across community type and assessor.

The assessment area is evaluated based on two main parts, a qualitative description and a quantification of the assessment area. For the latter section, sites are evaluated in three categories, scored numerically on a scale from 0 to 10 (where 10 indicates a minimally impaired system).

The first category, Location and Landscape Support, examines the ecological context within which the system operates. The second examines the Water Environment, including rapid inference of hydrologic alteration and water quality impairment The third focuses on Community Structure and more specifically Vegetation and Structural Habitat, for areas with plant cover, and Benthic and Sessile Communities, for areas with a submerged benthic community.

Part 1, the Qualitative section provides a frame of reference for the type of community being assessed. It is completed (mostly) before visiting the site. This identifies the functions that will be evaluated. The fields to be filled out are self-explanatory (mostly)
The Florida Land Use and Cover Classification System *(FLUCCS)* code can be tricky. Defining the wetland community type that is being assessed is key. If the site is not a native community, like a borrow pit lake, the policy is to use a community type with most analogous functions as a reference If the site is a wetland altered anthropogenically, the historic community type at that location is used as reference. If any previous impacts to the site are temporary in nature, they can be ignored. The factors to consider include soils, remnant plant communities, aerial photos prior to alteration, and local knowledge. Generally, "if the area is currently a self-sustaining native community, the reviewer is directed to 'call it as you see it'". Further classification can use FNAI Natural Community Types. *Significant nearby features* refers to features that might affect the values of the functions provided by the wetland being assessed. *Uniqueness* refers to the relative rarity of the wetland type or any floral or faunal component in relation to the surrounding regional landscape. *Functions* includes: providing cover, substrate, and refuge; breeding, nesting, denning, and nursery areas; corridors for wildlife movement; food chain support; and natural water storage, natural flow attenuation, and water quality improvement. *Anticipated wildlife utilization* does not need to include all species that utilize the area, but must include all listed species and all species that are characteristic of the native community type considering the size and geographic location of the assessment area

Part 1, the Quantitative section : An impact or mitigation assessment area must be described with sufficient detail to provide a *frame of reference* for the type of community being evaluated and to identify the functions that will be evaluated. Part I is completed before scoring the assessment area in Part II, since this frame of reference will be used to determine the degree to which the assessment area provides those functions and the amount of function lost or gained by the project. Much of the information in Part I can be compiled in the office using ERAtools or ERAonline and aerial photographs, topographic and other maps, scientific literature, technical reports, and similar information. Other portions however, should be completed during the site visit, such as the "Assessment Area Description" and "Observed Evidence of Wildlife Utilization."

The *wetland field guides* contain detailed descriptions and reference information for wetlands classified by FLUCCS code.

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

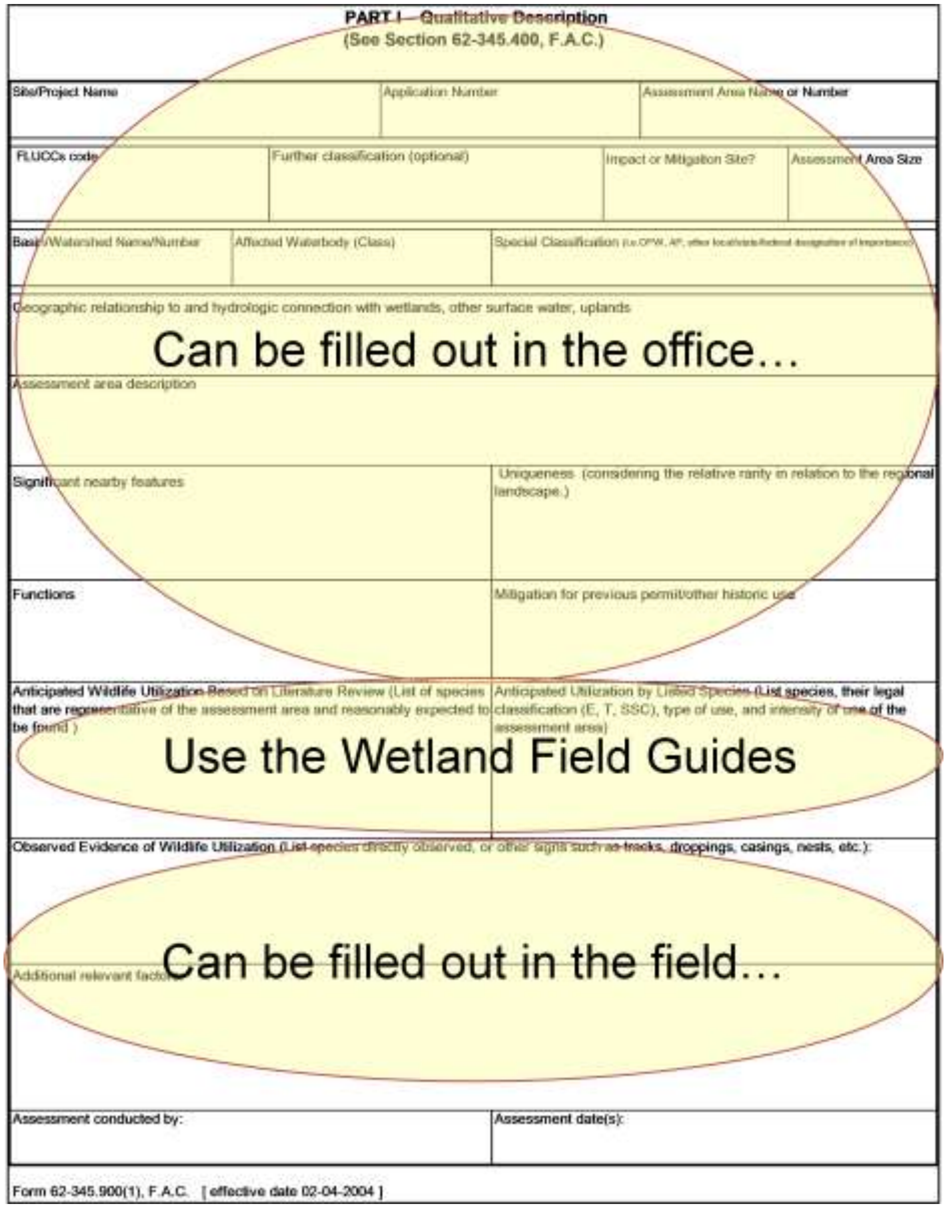
Site/Project Name	Application Number	Assessment Area Name or Number	
FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)	
Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands			
Assessment area description			
Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)		
Functions	Mitigation for previous permit/other historic use		
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)		
Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):			
Additional relevant factors:			
Assessment conducted by:	Assessment date(s):		

Form 62-345.900(1), F.A.C. [effective date 02-04-2004]

Figure 1: UMAM Page 1

Office work with the ERAtools or ERAonline http://publicfiles.dep.state.fl.us/DWRM/wetlands/eratools/ provides much of the information for the first part of the form. Using aerial photos, land use/land cover maps and other resources, the reviewer becomes as familiar with the site as possible noting uniqueness of the site and significant surrounding features. Provide a brief overview description of the assessment area. The wetland field guides http://www.dep.state.fl.us/water/wetlands/delineation/wetcomm/fieldguides.htm are helpful in filling out the anticipated wildlife utilization and utilization by listed species.

The last two sections of UMAM Part I are best filled out in the field during the field visit.



PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name | Application Number | Assessment Area Name or Number

FLUCCs code | Further classification (optional) | Impact or Mitigation Site? | Assessment Area Size

Basin/Watershed Name/Number | Affected Waterbody (Class) | Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Can be filled out in the office…

Assessment area description

Significant nearby features | Uniqueness (considering the relative rarity in relation to the regional landscape.)

Functions | Mitigation for previous permit/other historic use

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found) | Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)

Use the Wetland Field Guides

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Can be filled out in the field…

Additional relevant factors:

Assessment conducted by: | Assessment date(s):

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Figure 2: UMAM Page 1, breakdown of sections with location of completion.

Steps for completing Part 1.

1. Review permit application and identify the assessment areas (proposed wetland/surface water impact area(s) and proposed mitigation area(s).
2. Compile information for Part I - Qualitative Characterization, as follows:
   - Use the ERAtools to obtain the following information for the assessment area and surrounding areas :
     - FLUCCS code (level 3) for ecological communities and land cover

- Size of Assessment area
- Basin/watershed name/number
- Water bodies and their classification
- Maps and aerial photos of the assessment area and surrounding area
- Wetland field guides

▪ Print aerial maps (100 meter and 1 mile buffer) of assessment area and locate possible sampling sites based on surrounding landscape and land uses, vegetation signature within sampling area, and size of assessment area.

3. Complete the office portions of Part 1 - Qualitative Characterization for each type of assessment area identified.

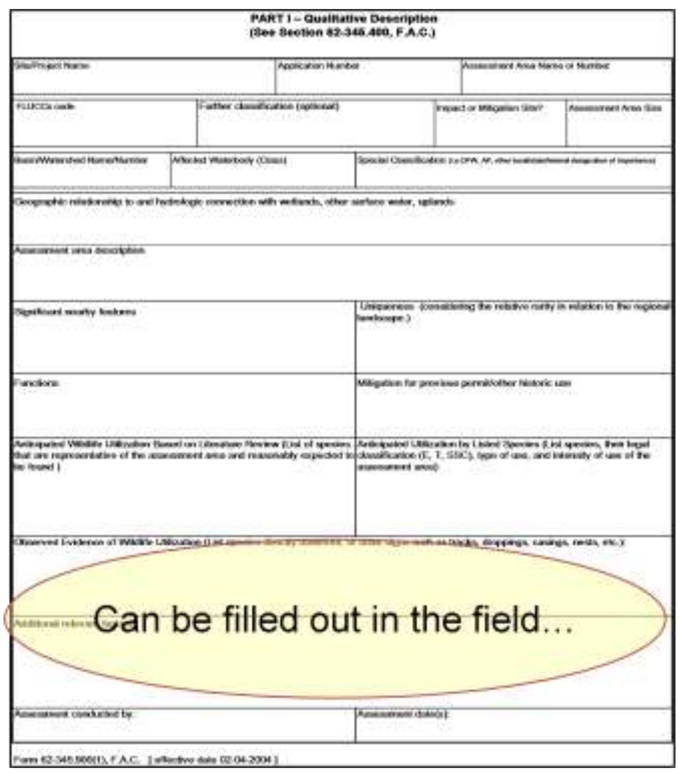
Prior to going to the field…

1. Obtain regionalized weather data

In the Field…

The last two sections of Part I, can be completed in the field:

Observed Evidence of Wildlife Utilization ~ List species directly observed or other signs such as tracks, droppings, casings, nests, burrows, etc.



PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e. OFW, AP, other local/state/federal designation of importance)

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Assessment area description

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
Functions	Mitigation for previous permit/other historic use
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Can be filled out in the field…

Assessment conducted by:	Assessment date(s):

Form 62-345.900(1), F.A.C. [effective date 02-04-2004]

Figure 3: UMAM Page 1, sections completed in the field

Additional Relevant Factors ~ Some additional factors may be identified in the office, for instance administrative actions by local governments that affect the site. Others may become evident upon a site visit, i.e., changes in surrounding land use since the most recent aerial photographs.

Upon reaching the Assessment Area…

1. Review UMAM Part I - Qualitative Characterization, and make any necessary adjustments to Geographic Relationships/Hydrologic Connections, Description, and Significant Nearby Features.
2. Consult maps and aerial photographs obtained in Part I - Qualitative Characterization to verify the correct Assessment Area.
3. Consult other information obtained in Part I, such as weather data, Field Guides etc. to become familiar with conditions, species, etc. that are likely to be encountered.
4. On aerial photographs, determine locations of wetland/water body edge and tentative locations of walking transects based on Standardized Field Protocol.
5. Conduct the Standardized Field Protocol
6. Score the three Functional Assessment Categories:
7. Location and Landscape Support
8. Water Environment
9. Community Structure
10. Calculate final overall score with adjustments.

Part 2. Scoring

Three main functions are evaluated

Location and Landscape Support

The ecological relationship between the assessment area and the surrounding landscape

Water Environment

The quantity of water including the timing, frequency, depth and duration of inundation or saturation, flow characteristics, and the quality of that water

Community Structure – may refer to the vegetative or the benthic community

The presence, abundance, health, condition, appropriateness, and distribution of plant communities (or, in marine or freshwater aquatic systems, benthic communities) in surface waters, wetlands

All functions are scored from 0 to 10 (whole numbers only) based on the level of function that benefits fish and wildlife:

10 = optimal, 7 = moderate, 4 = minimal, 0 = not present

Each function has characteristics that are to be taken into consideration when determining the score for that function.

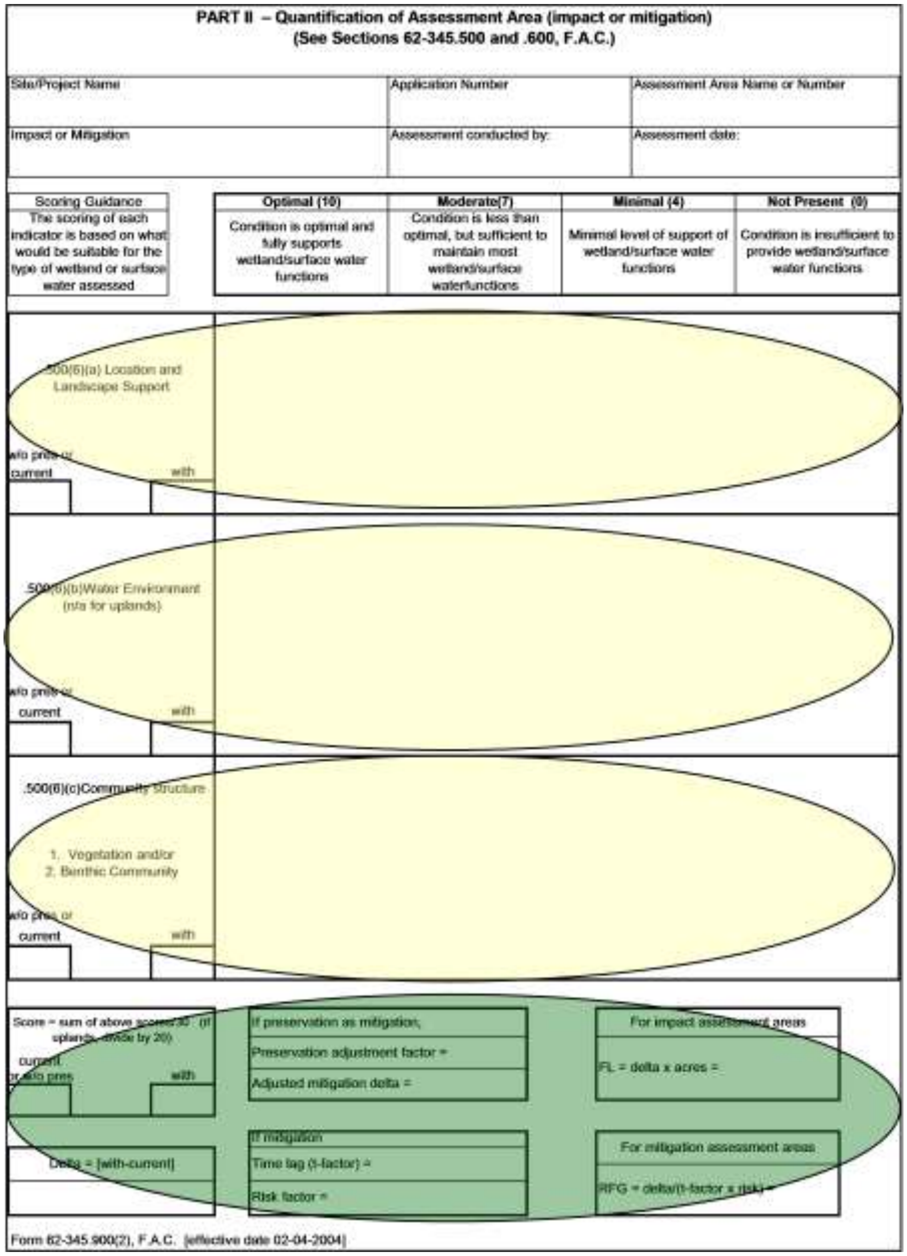
There is debate concerning whether or not these characteristics should be individually scored and then those scores averaged to determine a score for a particular function.

Part II- Quantification of Assessment Area

Scoring UMAM Part II…
There are three sections for scoring:

- Location and Landscape Support
- Water Environment
- Community Structure

…and a final section that is the overall score of the assessment area as well as adjustments to scoring based on preservation vs. mitigation, time lag, and risk factors.



PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Impact or Mitigation	Assessment conducted by:	Assessment date:

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support

w/o pres or current | with

.500(6)(b)Water Environment (n/a for uplands)

w/o pres or current | with

.500(6)(c)Community Structure

1. Vegetation and/or
2. Benthic Community

w/o pres or current | with

Score = sum of above scores/30 (if uplands, divide by 20)

current or w/o pres | with

Delta = [with-current]

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

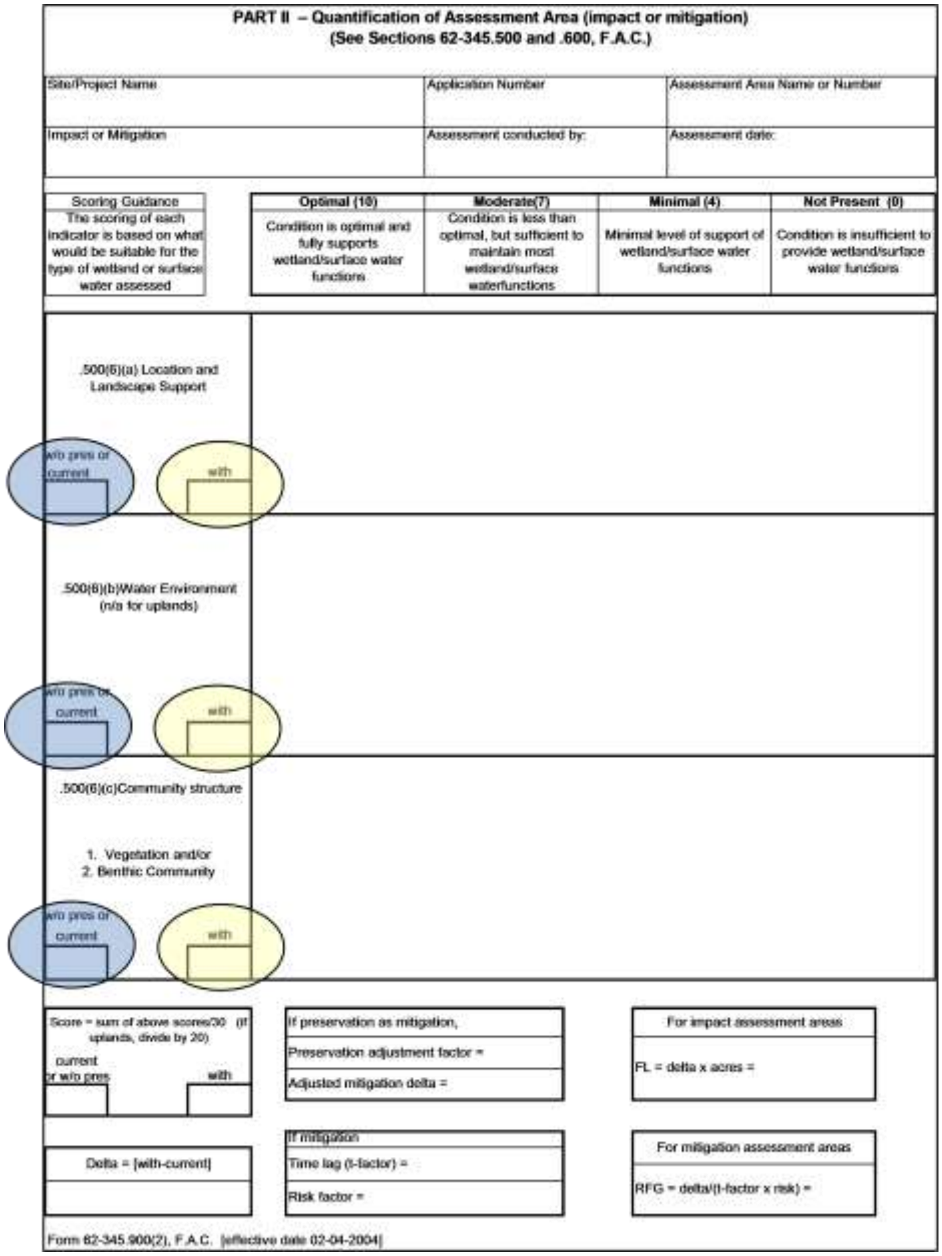
Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

Figure 4: UMAM Page 2, sections completed in the field

Each impact assessment and each mitigation assessment area must be evaluated under two conditions:

a. Current condition (or without preservation in the case of preservation mitigation)and

b. “With impact” or “With mitigation” – These assessments are based on the reasonably expected outcome, which may represent an increase, decrease, or no change in value relative to the current condition.



PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Impact or Mitigation	Assessment conducted by:	Assessment date:

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support

w/o pres or current | with

.500(6)(b)Water Environment (n/a for uplands)

w/o pres or current | with

.500(6)(c)Community structure

1. Vegetation and/or
2. Benthic Community

w/o pres or current | with

Score = sum of above scores/30 (if uplands, divide by 20)

current or w/o pres | with

Delta = [with-current]

If preservation as mitigation,

Preservation adjustment factor =

Adjusted mitigation delta =

If mitigation

Time lag (t-factor) =

Risk factor =

For impact assessment areas

FL = delta x acres =

For mitigation assessment areas

RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

Figure 5: UMAM Page 2, sections completed in the field current condition in blue and with impact and/or mitigation in yellow

Location and Landscape Support - 62-345.500(6) (a), FAC

Eight attributes are identified in the UMAM Rule to evaluate this category. To provide guidance, examples that depict variation in conditions for each of the attributes are included.

- Support to wildlife by outside habitats
- Invasive exotics or other invasive plant species in proximity of the assessment area
- Wildlife access to and from outside – distance and barriers

- Functions that benefit fish and wildlife downstream – distance or barriers
- Impacts of land uses outside assessment area to fish and wildlife
- Benefits to downstream or other hydrologically connected areas
- Benefits to downstream habitats from discharges
- Protection of wetland functions by upland mitigation assessment areas

Be aware that not all attributes are applicable to all assessment areas and in some cases, some attributes may be more relevant than others.

UMAM Scoring Worksheet ~ Location and Landscape Support

Guidance:. This worksheet is only a summary and is not intended to replace the rule. The rule should be used to resolve any question or dispute.

	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
Location and Landscape Support	full opportunity to perform beneficial functions at optimal level	opportunity to perform beneficial functions is limited to 70% of optimal ecological value	opportunity to perform beneficial functions is limited to 40% of optimal ecological value	provides no habitat support or opportunity to provide benefits to fish and wildlife
a. Support to wildlife by outside habitats	full range of habitats needed to support all wildlife species	optimal support for most, but not all wildlife species	fail to provide support for some, or minimal support for many wildlife species	no habitat support for wildlife
b. Invasive exotics or other invasive plant species in proximity of the assessment area	not present	present but cover is minimal and has minimal adverse effects	majority of plant cover consists of invasive exotics that adversely affect functions	predominance of plant cover consists of invasive exotics so that little or no function is provided
c. Wildlife access to and from outside – distance and barriers	not limited by distance or barriers	partially limited by distance or barriers	substantially limited by distance or barriers	precluded by distance or barriers
d. Functions that benefit fish & wildlife downstream – distance or barriers	not limited by distance or barriers	somewhat limited by distance or barriers that reduce opportunity to provide benefits	limited by distance or barriers that substantially reduce opportunity to provide benefits	functions not present
e. Impacts of land uses outside assessment area to fish and wildlife	no adverse impacts on wildlife	minimal adverse impacts on wildlife	significant adverse impacts on wildlife	severe adverse impacts on wildlife
f. Benefits to downstream or other hydrologically connected areas	opportunity is not limited by hydrologic impediments or flow restrictions	limited by hydrologic impediments or flow restrictions so that benefits are provided with lesser freq. or magnitude	limited by hydrologic impediments so that benefits are rarely provided or are provided at greatly reduced levels	no opportunity to provide benefits due to hydrologic impediments or flow restrictions
g. Benefits to downstream habitats from discharges	downstream habitats are critically or solely dependent on discharges	downstream habitats derive significant benefits from discharges	downstream habitats derive minimal benefits from discharges	downstream habitats derive negligible or no benefits from discharges
h. Protection of wetland functions by upland mitigation assessment areas	optimal protection of wetland functions	significant, but suboptimal, protection of wetland functions	minimal protection to wetland functions	no protection of wetland function

Figure 6: UMAM Scoring Worksheet - Location and Landscape Support

Twelve attributes are identified in the UMAM Rule to evaluate this category. To provide guidance, examples that depict variation in conditions for each of the attributes are included.

- Water levels and flows
- Water level indicators
- Soil moisture
- Soil erosion or deposition
- Evidence of fire history
- Vegetation - community zonation
- Vegetation – hydrologic stress
- Use by animal species with specific hydrological requirements
- Plant community composition – species tolerant of and associated with water quality degradation or flow alteration

- Direct observation of standing water
- Existing water quality data
- Water depth, wave energy, currents and light penetration

Be aware that not all attributes are applicable to all assessment areas and in some cases, some attributes may be more relevant than others.

UMAM Scoring Worksheet ~ Water Environment

	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
Water Environment	hydrology and water quality fully supports functions and provides benefits to fish and wildlife at optimal capacity	hydrology and water quality supports functions and provides benefits at 70% of optimal capacity	hydrology and water quality supports functions and provides benefits at 40% of optimal capacity	hydrology and water quality does not support functions and provides no benefits to fish and wildlife
a. Water levels and flows	appropriate	slightly higher or lower than appropriate	moderately higher or lower than appropriate	extreme degree of deviation
b. Water level indicators	distinct and consistent with expected	not as distinct or as consistent as expected	not distinct and not consistent with expected	not present or greatly inconsistent with expected hydrologic conditions
c. Soil moisture	appropriate with no evidence of soil desiccation, oxidation or subsidence	minimal soil oxidation or subsidence; soils are drier than expected	strong evidence of soil desiccation, oxidation or subsidence	strong evidence of substantial soil desiccation, oxidation or subsidence
d. Soil erosion or deposition	not atypical or indicative of altered flow rates	minor alteration in flow rates or points of discharge	atypical and indicative of alterations in flow rates or points of discharge	greatly atypical and indicative of greatly altered flow rates or points of discharge
e. Evidence of fire history	not atypical frequency or severity due to excessive dryness	fire frequency or severity may be more than expected	frequency or severity much more than expected, possibly due to dryness	great deviation from typical, due to extreme dryness
f. Vegetation - community zonation	appropriate in all strata	inappropriate in some strata	inappropriate in most strata	inappropriate in all strata
g. Vegetation – hydrologic stress	no signs of hydrologic stress such as excessive mortality, leaning or fallen trees, thinning canopy, insect damage or disease associated with hydrologic stress	slightly greater than normal mortality, leaning or fallen trees, thinning canopy, or signs of insect damage or disease associated with hydrologic stress	strong evidence of greater than normal mortality, leaning or fallen trees, thinning canopy, or signs of insect damage or disease associated with hydrologic stress	strong evidence of much greater than normal mortality, leaning or fallen trees, thinning of canopy, or signs of insect damage or disease associated with hydrologic stress
h. Use by animal species with specific hydrological requirements	consistent with expected hydrological conditions	less than expected	greatly reduced	lacking
i. Plant community composition – species tolerant of and associated with water quality degradation or flow alteration	Plant community composition is not characterized by species tolerant of and associated with water quality degradation or flow alteration	some species tolerant of and associated with water quality degradation or flow alteration	much of the community consists of species tolerant of and associated with water quality degradation or flow alteration	community consists predominantly of species tolerant of and associated with water quality degradation or flow alteration
j. Direct observation of standing water	no water quality degradation such as discoloration, turbidity, or oil sheen	slight water quality degradation such as discoloration, turbidity, or oil sheen	moderate water quality degradation such as discoloration, turbidity, or oil sheen	significant water quality degradation such as obvious discoloration, turbidity, or oil sheen
k. Existing water quality data	conditions are optimal for community type	slight deviation from normal, with minimal ecological effects	moderate deviation from normal, with expected ecological effects	large deviation from normal, with expected adverse ecological effects
l. Water depth, wave energy, currents and light penetration	optimal for community type	generally sufficient but expected to cause some changes in species, age classes and densities	not well suited for and expected to cause significant changes in species, age classes and densities	inappropriate for community type

Figure 7: UMAM Scoring Worksheet - Water Environment

1. Vegetation and Structural Habitat (continued)

Ten attributes are identified in the UMAM Rule to evaluate the "Vegetation and Structural Habitat" section of this category. To provide guidance, examples are given that depict variation in conditions for each of the attributes.

- Plant species in the canopy, shrub, or ground stratum
- Invasive exotics or other invasive plant species
- Regeneration & recruitment
- Age & size distribution
- Density and quality of coarse woody debris, snag, den, and cavity
- Plant condition
- Land management practices
- Topographic features such as refugia ponds, creek channels, flats or hummocks
- Siltation or algal growth in submerged aquatic plant communities
- Upland mitigation area - level of habitat and support for fish and wildlife in the associated wetlands or surface waters

Be aware that not all attributes are applicable to all assessment areas and in some cases, some attributes may be more relevant than others.

UMAM Scoring Worksheet ~ Community Structure: Terrestrial

Community Structure	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
1. Vegetation and Structural Habitat	vegetation community and physical structure provide conditions which support an optimal level of function to benefit fish and wildlife	vegetation community and physical structure limited to 70% of optimal level of function to benefit fish and wildlife in Part I	vegetation community and physical structure limited to 40% of optimal level of function to benefit fish and wildlife in Part I	vegetation community and physical structure do not provide function to benefit fish and wildlife in Part I
I. Plant species in the canopy, shrub, or ground stratum	all or nearly all appropriate and desirable	majority appropriate and desirable	majority inappropriate or undesirable	no appropriate or desirable species
II. Invasive exotics or other invasive plant species	not present	present, but cover is minimal	majority of plant cover	high presence and cover
III. Regeneration & recruitment	normal and natural	near-normal	minimal evidence	no evidence
IV. Age & size distribution	typical of type of system with no deviation from normal patterns of succession or mortality	no indication of permanent deviation, but may have had temporary deviations or impacts to age and size distribution	atypical and indicative of permanent deviation from normal successional pattern, with greater than expected mortality	high percentage of dead and dying vegetation, with no typical age and size distribution
V. Density and quality of coarse woody debris, snag, den, and cavity	optimal structural habitat	slightly lower or slightly greater than normal quantity	not present or greater than normal because vegetation is dead or dying	not present or exist only because native vegetation is dead or dying
VI. Plant condition	good condition, with very little to no evidence of chlorotic or spindly growth or insect damage	generally good, with little evidence of chlorotic or spindly growth or insect damage	generally poor, with evidence of chlorotic or spindly growth or insect damage	overall very poor, with strong evidence of chlorotic or spindly growth or insect damage
VII. Land management practices	optimal for long term viability of plant community	generally appropriate some possible fire suppression or water control features that have caused a shift in plant community	partial removal or alteration of natural structure, or introduction or artificial features, such as furrow or ditches	removal or alteration of natural structure, or introduction or artificial features, such as furrow or ditches
VIII. Topographic features such as refugia ponds, creek channels, flats or hummocks	present and normal	slightly less than optimal	reduction in extent of topographic features from what is normal	lack of topographic features that are normal for the area being assessed
IX. Siltation or algal growth in submerged aquatic plant communities	no evidence	minor degree of siltation or algal growth	moderate degree of siltation or algal growth	high degree of siltation or algal growth
X. Upland mitigation area - level of habitat and support for fish and wildlife in the associated wetlands or surface waters	optimal level of habitat and life history support	high, but less than optimal level of habitat and life history support	moderate level of habitat and life history support	little or no habitat and life history support

Figure 8: UMAM Scoring Worksheet - Community Structure: Terrestrial

2. Benthic and Sessile Communities (continued)

Seven attributes are identified in the UMAM Rule to evaluate the "Benthic and Sessile Communities" section of this category. To provide guidance, examples that depict variation in conditions for each of the attributes are included.

- Species number and diversity of benthic organisms
- Non-native or inappropriate species
- Regeneration, recruitment and age distribution
- Condition of appropriate species
- Structural features
- Topographic features such as relief, stability, and interstitial spaces (hardbottom and reef communities) or snags and coarse woody debris (riverine systems)
- Spawning or nesting habitats

Be aware that not all attributes are applicable to all assessment areas and in some cases, some attributes may be more relevant than others.

UMAM Scoring Worksheet ~ Community Structure: Benthic

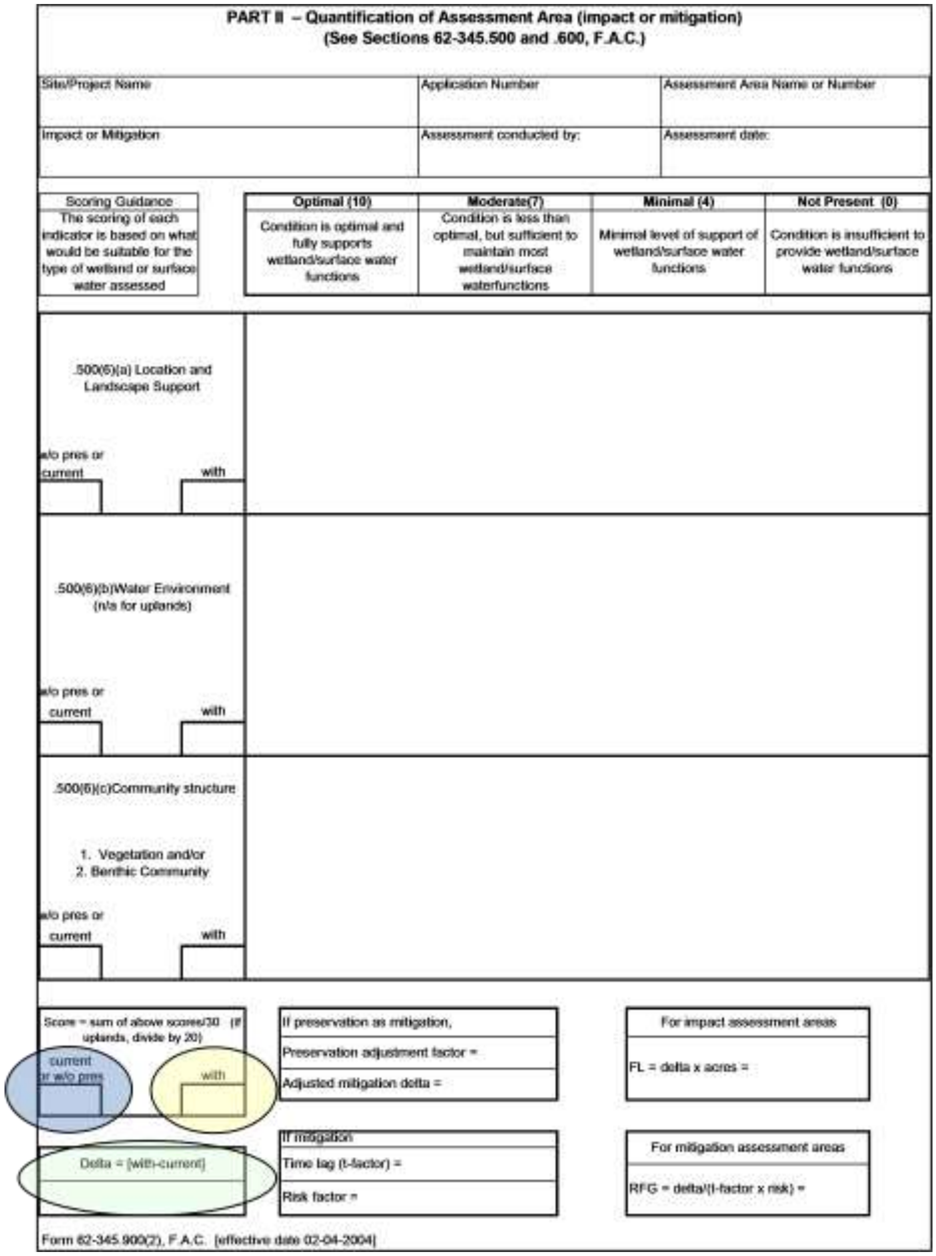
Community Structure	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
2. Benthic and Sessile Communities	benthic and sessile communities provide optimal support for all functions typical of the assessment area and provide optimal benefit to fish and wildlife	benthic and sessile communities provide functions at 70% of optimal level	benthic and sessile communities provide functions at 40% of optimal level	benthic and sessile communities do not support functions or provide benefits
I. Species number and diversity of benthic organisms	appropriate species number and diversity optimal for type of system	majority of species are appropriate with number and diversity slightly less than normal	appropriate species greatly decreased	lack of appropriate species, any appropriate species in poor condition
II. Non-native or inappropriate species	not present	represent a minority	majority	dominant
III. Regeneration, recruitment and age distribution	optimal	slightly less than expected	minimal	no indication
IV. Condition of appropriate species	good, with typical biomass	generally good	substantial number dying or in poor condition	not present
V. Structural features	typical with no evidence of past physical damage	typical, or with little evidence of past physical damage	atypical	structural integrity very low or non-existent, evidence or serious physical damage
VI. Topographic features such as relief, stability, and interstitial spaces (hardbottom and reef communities) or snags and coarse woody debris (riverine systems)	typical and optimal	slight deviation from expected	greatly reduced	lacking
VII. Spawning or nesting habitats	optimal	less than expected	few are available	none

Figure 9: UMAM Scoring Worksheet - Community Structure: Benthic

Part II Score - 62-345.500(7), FAC

The Part II score for an impact, wetland, or surface water mitigation assessment area is determined by summing the scores for each of the indicators and dividing that value by 30 to yield a number between 0 and 1. For upland mitigation assessment areas, the Part II score is determined by summing the scores for the location and community structure indicators and dividing that value by 20 to yield a number between 0 and 1.

The mathematical difference between the current condition and with-impact condition assessment, and between the current condition or without preservation and the with mitigation condition assessments is termed the "delta."



PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Impact or Mitigation	Assessment conducted by:	Assessment date:

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support
w/o pres or current | with

.500(6)(b)Water Environment (n/a for uplands)
w/o pres or current | with

.500(6)(c)Community structure
1. Vegetation and/or
2. Benthic Community
w/o pres or current | with

Score = sum of above scores/30 (if uplands, divide by 20)
current or w/o pres | with

Delta = [with-current]

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

Form 62-345.900(2), F.A.C. [effective date 02-04-2004]

Figure 10: Calculation of combined scores and the delta between the two.

Preservation Adjustment Factor - 62-345.500 (3), FAC

When assessing preservation, the gain in ecological value is determined by multiplying the delta by a preservation adjustment factor. The preservation adjustment factor is scored on a scale from 0 (no preservation value) to 1 (optimal preservation value), on one-tenth increments. The score is based on:

1. The extent the preserved area will promote natural ecological conditions such as fire patterns or the exclusion of invasive exotic species.

2. The ecological and hydrological relationship between wetlands, other surface waters, and uplands to be preserved.
3. The scarcity of the habitat provided by the proposed preservation area and the level of use by listed species.
4. The proximity of the preserved area to areas of national, state, or regional ecological significance, and whether the areas to be preserved include corridors between these habitats.
5. The extent and likelihood of potential adverse impacts if the assessment area were not preserved.

Mitigation Determination Formulas - 62-345.600 (3), FAC
After calculating the FL and RFL, you can use the Mitigation Determination Formulas on the left to determine:

1. Total Potential credits for a mitigation bank
2. Mitigation needed to offset impacts when using a bank
3. Mitigation needed to offset impacts, when not using a bank

UMAM Uniform Mitigation Assessment Method TRAINING MANUAL
Web-based training manual for Chapter 62-345, FAC for Wetlands Permitting
Eliana Bardi, Mark T. Brown, Kelly C. Reiss, Matthew J. Cohen

This manual was developed to assist in the implementation of Chapter 62-345, Florida Administrative Code, Uniform Mitigation Assessment Method (UMAM).
Since 1998, The University of Florida Howard T. Odum Center for Wetlands (UF-CFW), through funding from the Florida Department of Environmental Protection (FDEP) under contract #WM-683, has collected a variety of data, such as data on the community composition of the algal, macrophyte, macroinvertebrate assemblages, as well as water and soil parameters, from over 200 herbaceous and forested wetlands (n=75 and n=142, respectively) throughout Florida. The sample wetlands were exposed to a variety of impacts and embedded in an array of land uses, ranging from reference to silviculture, agriculture, and urban (the latter for forested wetlands only). Using data collected during the past six years, the UF-CFW has developed a number of tools that can assist permitting personnel and consultants in the implementation of the UMAM.

This manual is designed to be used as a guide in completing Parts I and II of the UMAM by providing step-by-step instructions for gathering and compiling the information for Parts I and II, and providing examples of attributes identified in the UMAM rule.

Hydrogeomorphic (HGM) Approach

The Hydrogeomorphic (HGM) Approach is a method for developing functional indices and the protocols used to apply these indices to the assessment of wetland functions at a site-specific scale. The HGM Approach was initially designed to be used in the context of the Clean Water Act Section 404Regulatory Program permit review to analyze project alternatives, minimize impacts, assess unavoidable impacts, determine mitigation requirements, and monitor the success of compensatory mitigation. However, a variety of other potential uses have been identified, including the determination of minimal effects under the Food Security Act, design of wetland restoration projects, and management of wetlands.

This report uses the HGM Approach to develop a Regional Guidebook to

(a) characterize the Depressional Wetlands in Peninsular Florida,
(b) provide the rationale used to select functions for the herbaceous and cypress dome subclasses,
(c) provide the rationale used to select model variables and metrics,
(d) provide the rationale used to develop assessment models,
(e) provide data from reference wetlands and document its use in calibrating model variables and assessment models, and
(f) outline the necessary protocols for applying the functional indices to the assessment of wetland functions.

A Short History of HGM

The Hydrogeomorphic (HGM) Approach is a collection of concepts and methods for developing functional indices and subsequently using them to assess the capacity of a wetland to perform functions relative to similar wetlands in a region. The approach was initially designed to be used in the context of the Clean Water Act Section 404 Regulatory Program permit review sequence to consider alternatives, minimize impacts, assess unavoidable project impacts, determine mitigation requirements, and monitor the success of mitigation projects. However, a variety of other potential applications for the approach have been identified, including determining minimal effects under the Food Security Act, designing mitigation project impacts, and managing wetlands.

On 16 August 1996 a National Action Plan to Implement the Hydrogeomorphic Approach (NAP) was published (*Federal Register 1997). The NAP was developed* cooperatively by a National Interagency Implementation Team consisting of the U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (USEPA), National Resources Conservation Service (NRCS), Federal Highways Administration (FHWA), and U.S. Fish and Wildlife Service (USFWS). Publication of the NAP was designed to outline a strategy and promote the development of Regional Guidebooks for assessing the functions of regional wetland subclasses using the HGM Approach; to solicit the cooperation and participation of Federal, State, and local agencies, academia, and the private sector in this effort; and to update the status of Regional Guidebook development.

The sequence of tasks necessary to develop a Wetland Functions of Depressional Wetlands in Peninsular Florida Regional Guidebook outlined in the NAP was used to develop this Regional Guidebook (see the section, "Development Phase”). An initial workshop was held in Miami, FL, on 8-11 May 1995. The workshop was attended by hydrologists, biogeochemists, soil scientists, wildlife biologists, and plant ecologists from the public, private, and academic sectors with extensive knowledge of the depressional wetland ecosystem. Based on the results of the workshop, two regional wetland subclasses were defined and characterized, a reference domain was defined, wetland functions were selected, model variables were identified, and conceptual assessment models were developed. Subsequently, fieldwork was conducted to collect data from reference wetlands. These data were used to revise and calibrate the conceptual assessment models. A draft version of this Regional Guidebook was then subjected to several rounds of peer review and revised into the present guidebook.

The HGM Approach is a collection of concepts and methods for developing functional indices and subsequently using them to assess the capacity of a wetland to perform functions relative to similar wetlands in a region.
The HGM Approach includes four integral components:

(a) the HGM classification,
(b) reference wetlands,
(c) assessment models/functional indices, and
(d) assessment protocols.

During the development phase of the HGM approach, these four components are integrated in a Regional Guidebook for assessing the functions of a regional wetland subclass. Subsequently, during the application phase, end users, following the assessment protocols outlined in the Regional Guidebook, assess the functional capacity of selected wetlands. Extensive discussions of the components of the HGM Approach and the development and application phases can be found in Brinson (1993; 1995a, b); Brinson et al. (1995, 1996, 1998); Hauer and Smith (1998); Smith (2001); Smith and Wakeley (2001); Smith et al. (1995); and Wakeley and Smith (2001).

The HGM Classification was developed specifically to achieve an appropriate level of resolution within the available time frame is to reduce the level of variability exhibited by the wetlands being considered (Brinson 1993, Smith et al.1995). It identifies groups of wetlands that function similarly using three criteria that fundamentally influence how wetlands function:

a. Geomorphic setting
b. Water source, and
c. Hydrodynamics.

Geomorphic setting refers to the landform and position of the wetland in the landscape.

Water source refers to the primary water source in the wetland such as precipitation, overbank floodwater, or ground water.

Hydrodynamics refers to the level of energy and the direction that water moves in the wetland.

Based on these three classification criteria, any number of “functional” wetland groups can be identified at different spatial or temporal scales. At a continental scale, Brinson (1993) identified five hydrogeomorphic wetland classes. These were later expanded to the seven classes described in Smith et al. (1995).

1) Depression
2) Tidal Fringe
3) Lacustrine Fringe

4) Slope
5) Mineral Soil Flats
6) Organic Soil Flats
7) Riverine

Reference wetlands are wetland sites selected to represent the range of variability that occurs in a regional wetland subclass as a result of natural processes and disturbance (e.g., succession, channel migration, fire, erosion, and sedimentation) as well as cultural alteration. The reference domain is the geographic area occupied by the reference wetlands (Smith et al. 1995). Ideally, the geographic extent of the reference domain will mirror the geographic area encompassed by the regional wetland subclass; however, this is not always possible due to time and resource constraints.
Reference wetlands serve several purposes.

First, they establish a basis for defining what constitutes a characteristic and sustainable level of function across the suite of functions selected for a regional wetland subclass.

Second, they establish the range and variability of conditions exhibited by model variables and provide the data necessary for calibrating model variables and assessment models.

Finally, they provide a concrete physical representation of wetland ecosystems that can be observed and measured.

Reference standard wetlands are the subset of reference wetlands that perform the suite of functions selected for the regional subclass at a level that is characteristic in the least altered wetland sites in the least altered landscapes.

In the HGM Approach, an assessment model is a simple representation of a function performed by a wetland ecosystem. It defines the relationship between one or more characteristics or processes of the wetland ecosystem. Functional capacity is simply the ability of a wetland to perform a function compared to the level of performance in reference standard wetlands. Model variables represent the characteristics of the wetland ecosystem and surrounding landscape that influence the capacity of a wetland ecosystem to perform a function. Model variables are ecological quantities that consist of five components (Schneider 1994):

1. a name,
2. a symbol,
3. a measure of the variable and procedural statements for quantifying or qualifying the measure directly or calculating it from other measures,
4. a set of variables (i.e., numbers, categories, or numerical estimates (Leibowitz and Hyman 1997)) that are generated by applying the procedural statement, and
5. units on the appropriate measurement scale.

Model variables occur in a variety of states or conditions in reference wetlands. The state or condition of the variable is denoted by the value of the measure of the variable. For example, percent herbaceous groundcover, the measure of the percent cover of herbaceous vegetation, could be large or small. Based on its condition (i.e., value of the metric), model variables are assigned a variable subindex. When the condition of a variable is within the range of conditions exhibited by reference standard wetlands, a variable subindex of 1.0 is assigned. As the condition deflects from the reference standard condition (i.e., the range of conditions within which the variable occurs in reference standard wetlands), the variable subindex is assigned based on the defined relationship between model variable condition and functional capacity. As the condition of a variable deviates from the conditions exhibited in reference standard wetlands, it receives a progressively lower subindex reflecting its decreasing contribution to functional capacity. In some cases, the variable subindex drops to zero. For example, when the percent cover of herbaceous groundcover is 40 percent or greater, the subindex for percent herbaceous groundcover is one. As the percent cover falls below 40 percent, the variable subindex score decreases on a linear scale to zero.

Model variables are combined in an assessment model to produce a Functional Capacity Index (FCI) that ranges from 0.0 to 1.0. The FCI is a measure of the functional capacity of a wetland relative to reference standard wetlands in the reference domain. Wetlands with an FCI of 1.0 perform the function at a level characteristic of reference standard wetlands. As the FCI decreases, it indicates that the capacity of the wetland to perform the function is less than that characteristic of reference standard wetlands.

Depression wetlands occur in topographic depressions (i.e., closed elevation contours) that allow the accumulation of surface water. Depression wetlands may have any combination of inlets and outlets or lack them completely. Potential water sources are precipitation, overland flow, streams, or groundwater/interflow from adjacent uplands. The predominant direction of flow is from the higher elevations toward the center of the depression. The predominant hydrodynamics are vertical fluctuations that range from diurnal to seasonal. Depression wetlands may lose water through evapotranspiration, intermittent or perennial outlets, or recharge to groundwater. Prairie potholes, playa lakes, vernal pools, and cypress domes are common examples of depressional wetlands.

Mineral soil flats wetlands are most common on interfluves, extensive relic lake bottoms, or large floodplain terraces where the main source of water is precipitation. They receive virtually no groundwater discharge, which distinguishes them from depressions and slopes. Dominant hydrodynamics are vertical fluctuations. Mineral soil flats lose water by evapotranspiration, overland flow, and seepage to underlying groundwater. They are distinguished from flat upland areas by their poor vertical drainage due to impermeable layers (e.g., hardpans), slow lateral drainage, and low hydraulic gradients. Mineral soil flats that accumulate peat can eventually become organic soil flats. They typically occur in relatively humid climates. Hydric Pine Flatwoods with hydric soils are an example of mineral soil flat wetlands.

Organic soil flats wetlands, or extensive peatlands, differ from mineral soil flats in part because their elevation and topography are controlled by vertical accretion of organic matter. They occur commonly on flat interfluves, but may also be located where depressions have become filled with peat to form a relatively large flat surface. Water source is dominated by precipitation, while water loss is by overland flow and seepage to underlying groundwater. They occur in relatively humid climates. Portions of the Everglades are examples of organic soil flat wetlands.

The Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Depressional Wetlands in Peninsular Florida was developed to assess the functions of two subclasses of freshwater depressions in peninsular Florida: Cypress Domes and Herbaceous Marsh Depressional Wetlands. The reference domain for this guidebook is peninsular Florida from the Everglades north to the boundary of Land Resource Region U (USDA 1981). The model variables are calibrated based on reference wetland sites located in Charlotte, Collier, Flagler, Hernando, Highlands, Osceola, Hillsborough, Indian River, Martin, Palm Beach, Pasco, Pinellas, Polk, Putnam, St. Johns, St. Lucie, and Volusia counties.

The following functions performed by Cypress Domes and Herbaceous Depressional Wetlands in Peninsular Florida are addressed in this HGM Method:

a. Surface Water Storage.
b. Subsurface Water Storage.
c. Biogeochemical Processes.
d. Characteristic Plant Community.
e. Wildlife Habitat.

The following functions performed by flats wetlands in the Everglades are addressed in the HGM Method:

a. Surface and Subsurface Water Storage
b. Biogeochemical Processes
c. Characteristic Plant Communities
d. Wildlife Habitat

Each Function is described in the HGM method in the following sequence:

i. *Definition: defines the function and identifies an independent* quantitative measure that can be used to validate the functional index.
ii. *Rationale for selecting the function: provides the rationale for why a* function was selected and discusses onsite and offsite effects that may occur as a result of lost functional capacity.
iii. *Characteristics and processes that influence the function: describes the* characteristics and processes of the wetland and the surrounding landscape that influence the function and lay the groundwork for the description of model variables.
iv. *Description of model variables: defines and discusses model variables* and describes how each model variable is measured.
v. *Functional Capacity Index: describes the assessment model from which* the FCI is derived and discusses how model variables interact to influence functional capacity.

The tasks required to complete an assessment of depressional wetlands:

a. Define assessment objectives.
b. Characterize the project site.
c. Screen for red flags.
d. Define the Wetland Assessment Area.
e. Collect field data.
f. Analyze field data.

g. Apply assessment results.

Herbaceous Field Data Sheet

Assessment Team:____

Project Name:____

Location:____

Date:____**Subclass: herbaceous depression**

Sample variables 1-3 using aerial photography, topographic maps, National Wetland Inventory maps, soils survey maps, etc.

1.	V_{CATCH}	Percent change in the size of the catchment (if no impact to catchment, variable subindex = 1.0)……… Size of original catchment _______ha; Size of current catchment _______ ha	_____	%
2.	V_{UPUSE}	Percent cover of upland landuse (if native landscape in good condition, variable subindex = 1.0)……… Cover type_______ Curve #______ %____Cover type________ Curve #______ % Cover type_______ Curve #______ %____Cover type________ Curve #______ % Cover type_______ Curve #______ %____Cover type________ Curve #______ % Cover type_______ Curve #______ %____Cover type________ Curve #______ % Cover type_______ Curve #______ %____Cover type________ Curve #______ %	_____	%
3.	$V_{WETPROX}$	Distance from wetlands edge to nearest depressional wetland within 500 m……… Sector 1 ______ m Sector 2 ______ m Sector 3 _______ m Sector 4 _______ m Sector 5 ______ m Sector 6 ______ m Sector 7 _______ m Sector 8 _______ m	_____	m

Sample variables 4-7 during on site field reconnaissance

4.	V_{WETVOL}	Change in the volume of the wetland (if no fill or excavation variable subindex = 1.0)……… Diameter of wetland north-south ____m; Diameter of wetland north-south ____m Depth of the wetland__________m Length of fill material ____m; Width of fill material ____ m; Average thickness of fill material____m	_____	% m
5.	V_{SUROUT}	Percent of wetland effected by lateral effect of ditches to surface water storage…… Difference in elevation of bottom of ditch and bottom of wetland ____m; Lateral effect of ditch _____ m; Distance of ditch to wetland _____ m	_____	%
6.	V_{SUBOUT}	Percent of wetland effected by lateral effect of ditches to subsurface water storage Difference in elevation of bottom of ditch and bottom of wetland + 6 in _____m; Lateral effect of ditch _____ m; Distance of ditch to wetland _____ m	_____	%
7.	V_{ZONES}	Change in the number of wetland zones (if no change in the number of zones variable subindex = 1.0)………		#

Sample variables 8-10 along 4 or more transects that cross each wetlands zone

8.	V_{MAC}	Percent cover of emergent macrophytic vegetation………		%
10.	V_{SURTEX}	Average soil texture of surface horizon or layer of the WAA or PWAA……… Subindex score of sample point: Transect 1 zone1_____; zone2_____; zone3_____; zone 4_____ Transect 2 zone1_____; zone2_____; zone3_____; zone 4_____ Transect 3 zone1_____; zone2_____; zone3_____; zone 4_____ Transect 4 zone1_____; zone2_____; zone3_____; zone 4_____	_____	
13.	V_{HCOMP}	Average percent concurrence of dominant species from all wetland zones present.. Wet meadow zone __________ % Shallow marsh zone _________ % Deep marsh zone ___________ %	_____	%

Figure 58. Data Form 1, sample field data sheet for herbaceous depressional wetlands

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Figure 11: Field Data Sheet for the Herbaceous Depression HGM.

- ☐ *The cycle nutrients function is defined as the characteristic biotic and abiotic* processes of the Everglades wetlands that alter concentrations of imported nutrients and compounds in the water leaving the wetland in comparison with water entering the wetland.
- ☐ These processes include conversion of nutrients and other elements and compounds from one form into another by assimilation into plant biomass, remineralization of those materials when the plant materials decompose, long-term storage of nutrients and compounds in mineral and organic soil fractions, and oxygen production.
- ☐ The function can be validated using correlation of the function FCI with the differences in amounts of dissolved nutrients and compounds (tons/ha/year) in inflowing and outflowing water to and from the assessed wetland.

Methods and Project Tasks

The primary focus of this project is to develop a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment. The project tasks include:

1. Development of the multiagency, multidisciplinary A-team; Beginning on October 1, 2011 invitations were sent to 50 water quality, wetland creation, and regulatory experts. 30 responded (see Appendix 1)
2. Team development of baseline background knowledge in functional assessment methodology generally, and UMAM and HGM models appropriate to herbaceous depressional and flats wetlands;
3. Agreement on the functions to be evaluated with the new methodology, the formal ways these functions are currently evaluated, and surrogates for these functions;
4. Evaluations of model development sites using existing functional assessment methods;
5. Individual or agency sub-team site evaluations testing developed methodology;
6. Team evaluation of results and model adjustment;
7. Testing of updated model with EPA staff and outside practitioners;
8. Visits to other restored/constructed systems in the study area to test methodology;
9. Presentation of the new methodology to agencies and formal request for acceptance of the methodology as one tool in the BMAP arsenal;
10. Assembly of the Draft Report from outputs of the completed Tasks and development of illustrations, tables, and graphs for inclusion in the Draft Report;
11. Presentation of the Draft Report for peer review to the CHNEP Management Conference and posting for public comment on the CHNEP and SWFRPC websites;
12. Compilation, review and consideration of peer-review and public comments;
13. Completion of the Final Report and approval through the CHNEP conference; and
14. Inclusion of narrative text within EPA Quarterly Report, providing information about project progress, issues encountered, proposed resolution, and anticipated work in the next. Information about financial status will be included in the appropriate section of the Quarterly Report.

This project developed a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment. This method can be utilized for evaluating and crediting water quality improvements in Basin Management Action Plans (BMAPs) to address non-attainment of Total Maximum Daily Loads (TMDLs).

The methodology was developed in coordination with an interagency “A-Team”. Team members agreed-upon common baseline of knowledge about functional assessment methods.

The new method focuses on biological and physical surrogates for water quality measurements, and then be tested. After calibration, the new method was retested to assure that the surrogates are applicable. EPA and state, local and private sector practitioners will be invited to test the new method. The new method was then be presented for formal acceptance by the state as one tool in the BMAP toolbox.

The A-Team meetings

A-Team Meeting 1:

On November 28, 2011 the Water Quality Functional Assessment Method (WQFAM) Team met at the 1st Floor conference from of the Southwest Florida Regional Planning Council for the first time from 1:00 p.m. – 4:00 p.m. Welcome and Introductions were made of team members in the meeting room and participating by teleconference. The team membership list is included in this report as Appendix 1.

Ms. Whitney Gray gave the first presentation on the background of the project and an outline of the tasks ahead of the team, with a general timeline. The Key Points of the presentation are:

- This project will develop a *functional assessment method*
- The method will be used to evaluate the *water quality benefits* of restored and constructed treatment wetlands
- The method will be *used for evaluating and crediting water quality improvements* in BMAPs to address TMDLs
- A cross-jurisdictional, cross-functional *team* will create the method
- The method will focus on *biological and physical surrogates* for water quality measurements
- The method will be *tested and calibrated* in the field
- The method will be proposed to be *accepted by the state*

A generalized timeline was presented for the 36 months of the project.

The agenda for the meeting was altered due to the time constraints of Dr. Lisa Beever, so the next presentation was her background information on Total Maximum Daily Loads (TMDLs). Dr. Beever defined applicable terms, and briefly discussed the processes by which water bodies are deemed impaired. She then presented maps and lists of impairments within the study area and gave examples of the presentation of TMDL components from Florida Department of Environmental Protection (FDEP) documentation. Dr. Beever presented a map of BMAPs adopted and in progress within the state of Florida. She then reviewed the newly published CHNEP "Charlotte Harbor Seven-County Watershed Report", pointing out the parts of the report applicable to the project, including findings on the sources of surface water pollution and the loadings. She briefly discussed trends for loadings of nitrogen, phosphorus and total suspended solids.

Ms. Whitney Gray, filling in for Jim Beever who was not able to attend due to illness, gave the next presentation, "History of an Introduction to Wetland Functional Assessment", which traced the progress of wetland functional assessment from its beginnings meaning only what development potential was represented, to a method for assigning mitigation ratios based on area of wetland lost, to a method for assigning mitigation based on wetland function lost.

Ms. Gray then presented background on the Uniform Mitigation Assessment Method and an overview of the use of the method to determine wetland function.

The final presentation was on the Hydrogeomorphic Methodology (HGM) for determining wetland function in digressional and flats wetlands of Florida. Ms. Gray gave some background, then a brief overview of the use of this method.

The next item was a discussion on which water quality parameters the team recommended that the WQFAM would be assessing. The goal of the project is to devise a rapid assessment of how well a treatment wetland is doing its job, not to get a precise measurement of any parameter.

Several issues emerged from the team discussion as being important:

- Seasonal differences
- Flashiness of systems due to rain events
- Dissolved oxygen: necessary/unnecessary/ considered linked as a causative pollutant to other pollutants
- Nitrogen – which forms?
- The possible use of the 50^{th} percentile distributions

Although an extensive list was mentioned, much of the discussion centered around the ability to empirically test for parameters using probes or sensors, and the need to have data to tie observed conditions to.

Another issue was the role of incoming water quality, and how to know what that is as well as what the nature is of the contributing watershed. The group did not eliminate any parameters from consideration that compose what was referred to as the "typical suite":
organic and inorganic nitrogen and phosphorus, ammonia nitrogen, TKN, orthophosphate, total phosphate, nitrate, nitrite, total nitrogen, total suspended solids, fecal coliforms, cadmium, chromium, and copper.

It was suggested that, with additional funding, work could be done comparing water sampling test kits to probe results to lab analysis results.

Indicators of good treatment wetland performance were discussed. The first indicator mentioned was biodiversity, but there were some concerns with that: natives vs. exotics; and survival of what was planted vs. recruitment of other plants. Water clarity and depth, presence of wildlife, vegetative cover, presence or absence of hydrogen sulfide smell in sediments, colors indicating organics in soils/sediments, residence time, and lack of siltation were all mentioned as possible indicators of good treatment performance.

The final agenda item was to list locations of treatment wetlands in the study area known to the participants the generated list included:

10-Mile Canal, Lee County
Gordon River Water Quality Park, Collier County
Riverside Circle City Park, Naples, Collier County
Billy's Creek Filter Marsh, Fort Myers, Lee County
Seminole Campus of St. Petersburg College, Pinellas County

Campus of FGCU, Lee County
Conservancy of Southwest Florida, Collier County

Suggested contacts who may know of more on these locations include:
Johnson Engineering, Church Roberts
FDOT
Scheda Environmental, Tom Reiss
Wilson Miller, Craig Schmittler

The next meeting date was not set, but a Doodle poll was be sent out with the appropriate time frame by the end of the week.

A-Team Meeting 2:

Meeting 2 of the WQFAM Team was on January 25, 2012 at the 1st Floor conference from of the Southwest Florida Regional Planning Council from 1:00 p.m. – 3:45 p.m. Welcome and Introductions were made of team members in the meeting room and participating by teleconference. –

Attending In Person:

James Evans
Betty Staugler
Mike Kirby
Steve Adams
Karen Bickford
Lisa Beever
Rick Bartleson
Judy Ott
Melanie Grigsby
Jim Beever
Whitney Gray
Via WebEx:
Harry Phillips
Kim Haag
Michael Jones
Rhonda Evans
Charles Kovach
Mac Hatcher
Lindsay Cross
Mike Bauer
Katie Laakkonen

After introductions, Jim Beever gave background of the WQFAM project and presented the goals for the meeting: selection of the water quality (WQ) parameters to be assessed, starting the list of candidate visual indicators of water quality for the selected WQ parameters, and review and adding to the list of locations of existing and proposed treatment wetlands.

Several clarifications of the project were brought out. Ms. Ott mentioned that the need for a method like WQFAM was brought up at another meeting she recently attended. Mr. Kirby asked if the method would be applicable to storm water detention ponds and rain gardens. Mr. Beever replied that, no, it would not. Mr. Beever clarified that the method would concentrate on filter marshes, and could include floating vegetation mats created for water quality treatment, and wetland restoration projects if water quality treatment was a stated goal of the restoration. Steve asked if the method could be applicable to Everglades STAs. Jim replied that it could, but that currently those were outside of the geographic study area.

Mr. Beever proceeded with an interactive activity for selecting water quality parameters to be assessed by the WQFAM method. Large posters were provided that contained a table of water quality parameters gathered from the Florida Department of Environmental Protection list of water quality impairments and additional suggested parameters. Each meeting participant present in person was given five green dot stickers and five red dot stickers. The participants were instructed to use their green dots to indicate the five water quality parameters they felt were the most important to assess using WQFAM. Red dots could be used to indicate parameters that should not be assessed using WQFAM. WebEx participants used the WebEx chat function to send their choices to Ms. Gray, who transferred those choices to the posters with dots. (See Figures 1 and 2)

Green dots counted as a +1 and red dots counted as a -1, yielding the results in Figure 13 below.

Figure 12 Parameter Ranking

Figure 13: Sum score of candidate parameter scores

Biochemical Oxygen Demand	**+5**
Chloride	**-1**
Chlorophyll-a	**+12**
Conductance	**+4**
Copper	**-5**
Dissolved Oxygen	**+7**
Dissolved Solids	**-1**
Fecal Coliform	**+2**
Iron	**-2**
Lead	**-8**
Mercury in Fish Tissue	**-7**
Nutrients (Combined)	**+9**
Total Coliform	**-7**
Total Dissolved Solids	**-2**
Total Nitrogen	**+9**
Total Phosphorous	**+10**
Trophic State Index	**+4**
Turbidity	**+2**
Un-Ionized Ammonia	**-4**

From this input, the top five water quality parameters to be assessed by WQFAM were: chlorophyll-a, total phosphorus, total nitrogen, nutrients (combined), and dissolved oxygen.

Discussion ensued. Mr. Beever pointed out that oxygen redox potential may be a good surrogate. Several participants commented on conductance, and Dr. Beever offered that it can determine limiting nutrients, and, since the other parameters chosen are indicative of nutrients, including conductance would be beneficial since it is not generally considered to be nutrient-related, and also provides information about hydrology. Mr. Kovach suggested that conductance is easily measured using an instrument; but it was also mentioned that, if conductance is altered in a wetland for long enough, changes to the vegetation community occur, making those changes a visual indicator of conductance changes. Mr. Adams asked what would be "good" conductance as contrasted with "bad" conductance, and it was explained that that would be relative to the site. Mr. Evans asked if speciation of nitrogen should be considered and Mr. Beever explained that, when nitrogen measurements in TMDLs are evaluated, nitrogen speciation is generally limited to ammonia, and that the group could discuss this topic more fully at a future meeting. The result of this discussion was a consensus to include conductance as a sixth parameter to be assessed with WQFAM.

Ms. Gray then presented "Shopping for Variables," a look at two HGM models and UMAM for potential visual indicators that could be used in WQFAM. The group added several potential visual indicators, resulting in Table 2.

The group then did an "Envelopes" exercise in which each participant was to suggest visual indicators for each of the six water quality parameters chosen earlier in the meeting. Six large manila envelopes were presented, one for each water quality parameter. Participants were given pieces of paper and were instructed to write down potential visual indicators specific to the water quality parameters and put them in the appropriate envelopes. One indicator was to be written on each piece of paper. Any number of indicators could be submitted for each water quality parameter. WebEx participants were asked to email their submissions to Ms. Gray. Results were to be compiled after the close of the meeting and would be reported on at the next meeting.

Finally, Mr. Beever presented the results of a search for treatment wetlands and filter marshes completed, under construction, or being planned across the study area. Maps were provided. The group was asked for additional locations that they know of. Some additions were provided. This list was still being compiled and additions are welcome at any time.

A Doodle poll was sent out to find the next meeting date for February. A procedure for submitting travel expenses was briefly outlined by Ms. Gray. The meeting ended at 3:45.

A-Team Meeting 3:

Meeting 3 of the WQFAM Team was on February 27, 2011 at the 1st Floor conference from of the Southwest Florida Regional Planning Council from 1:00 p.m. – 3:45 p.m. Welcome and Introductions were made of team members in the meeting room and participating by teleconference.

Attending

In Person:	Via WebEx:
James Evans	Rhonda Evans
Mike Kirby	Mac Hatcher
Steve Adams	Lindsay Cross
Karen Bickford	Mike Bauer
Betsie Hiatt	Katie Laakkonen
Jim Beever	Jason Green
Whitney Gray	Diana Bandlow
	Greg Blanchard

After introductions, Jim Beever presented a review of the water quality parameters that were selected at the last meeting for inclusion in the assessment method. He clarified that the goal of the development of the process is to identify visual indicators, not lab tests, for the water quality parameters chosen. During the method development, we will be testing those parameters so that those results can be compared to the visual indicators observed for calibration.

Whitney Gray then presented a summary of the candidate visual indicators collected at the last meeting. Several graphs were presented showing analyses of the polling results. A total of 168 visual indicators had been suggested by the A-Team. These indicators had fallen into several natural groupings. The analysis can be found in the presentation for agenda item 3, found on the project portal page.

For chlorophyll-a, the visual indicators chosen by the A-Team were grouped as follows: algae, animal species, clarity, inappropriate levels, plant condition, and plant species. For total nitrogen the grouped indicators were: algae, animal species, clarity, inappropriate levels, land management, plant species, and water chemistry. For total phosphorus, the groups were: algae, animal species, clarity, inappropriate levels, land management, and plant species. For combined nutrients the groups were: algae, animal species, clarity, hydrology, inappropriate levels, land management, odor, plant condition, plant species and substrate. For dissolved oxygen the groups were: algae, animal condition, animal species, inappropriate levels, physical attributes, plant species, and substrate. For conductance the groups were: animal species, hydrology, inappropriate levels, odor, plant condition, plant species, and substrate. Whitney clarified that the group "inappropriate levels" included comments about meter measurements.

Jim Beever then led the group through the process to select visual indicators for chlorophyll-a. The process was to discuss each of the visual indicators suggested for assessing chlorophyll-a: algae, animal species, clarity, inappropriate levels, plant condition, and plant species. Jim Beever mentioned that chlorophyll-a is often measured similar to turbidity, so that a Secchi disk could be used if water depths were great enough (as in Celery Fields and some portions of 10 Mile Canal) or a transparency tube if depths were as little as 1 ½ inches.

The first indicator discussed was clarity. Jim Beever presented typical Secchi depths for Florida lakes, then discussed use of the disk and the relationship (from the data) between total chlorophyll and Secchi depth. Another device discussed for measuring chlorophyll-a in the field was the transparency tube, and the data regarding that instrument was presented. A potential scaling system for clarity was discussed.

Next, algae as a visual indicator of chlorophyll-a was discussed. Bioassessment to determine numbers and species of microalgae, blue green algae and diatoms is not rapid, but has been used well in the past (Palmer 1969). Many states are in the process of determining how bioassessment of their water bodies relates to water quality. An existing Pollution Index (Palmer 1969) identified genera of microalgae and assigned each an index value between one and five.

The third visual indicator of chlorophyll-a was plant species. A-Team members had brought up several potential attributes of plant community composition, positive and negative. While cattail (*Typha* sp.) was mentioned as a negative attribute, it was acknowledged that other species may also be considered negative. Zonation in the plant community will be important.

The fourth visual indicator of chlorophyll-a was plant condition. Jim proposed basing scores for this indicator on signs of hydrologic stress in the plants in the wetland.

The fifth indicator was animal species, expressed in terms of a well-balanced community of benthic invertebrates. Several sources for bioassessment protocols and standards were presented. Of particular interest is the Florida Wetland Condition Index (FWCI) proposed by Brown (2005). While this index is not fully developed, it does contain surrogates that may be useful in our process, especially the Floristic Quality Assessment Index (FQAI), which relates the plant community present to the animals likely to be present.

The final visual indicator of chlorophyll-a discussed was inappropriate levels. Jim asked the group to write down on provided paper what devices they would recommend for field measurement or assessment of chlorophyll-a levels in the water column. Group members were also asked to indicate their preference of federal or state water quality standards. Results were as follows:

Device	Number of mentions
Transparency tube	4
Secchi disk	4
YSI	2
HydroLab	2
Stereoscope	1
Dry/wet biomass	1

Standard	Votes
Federal	6
State	2

Figure 14: A-Team devices recommended for field measurement or assessment of chlorophyll-a levels in the water column and preference of federal or state water quality standards.

Next on the agenda was a discussion on scaling the visual indicators for chlorophyll-a. The first indicator discussed was clarity. Jim Beever suggested two scaling schemes found in the presentation for agenda item 5, slides 4 and 5.

The scores would be proportionate; that is if the Secchi depth was 25% of the max, the score would be between zero and four, but this would vary depending on where in the system it was measured. By measuring at the infall, in the wetland, and at the outfall, the lift from treatment could be determined. It was discussed that a series of tables would be necessary to account for systems that were naturally eutrophic, since a perfect score for a mesotrophic wetland is different than a perfect score for an oligotrophic wetland.

Scaling a measurement for algae was presented next (slide 9). The group discussed what kinds of algae were appropriate to be used for this visual indicator. If phytoplankton, there are probes that can be purchased that measure this via chlorophyll-a. A distinction was made between algae, as nonvascular plants, and vascular macrophytes that may be floating, encrusting or rooted. This indicator is intended to reflect the presence of filamentous and microalgae, although it was noted that these types of algae are to be expected within a treatment system. Again, measuring at the top and bottom of a treatment system would yield a meaningful differential. The subject of management of treatment wetland systems was brought up and will be discussed in more detail at a future meeting. It was also decided that the column headings “Improved” and “Declining” in the table need to be changed.

Scaling the plant species indicator was discussed next (slides 10 and 11). This indicator would focus on vascular plants, submerged, emergent, and floating. A list or series of lists of appropriate plant species would need to be developed. Community composition could also account for changes in salinity in the system. It was pointed out that less qualitative terms need to be used in the tables; the term “improved” needs to be changed to “moderate.” As homework, Jim asked that the team members suggest plant species, such as cattail, that may not be beneficial as a monoculture.

Plant condition was discussed. This indicator would be based on vegetation being in trouble, however, the group noted that the use of herbicides and/or poor water quality could also cause poor plant condition. Other characteristics of poor plant condition would include presence of mold on leaves and chlorotic leaves. There was discussion about the appropriateness of this as an indicator of the presence of chlorophyll-a in the water column, especially since the indicator focused on emergent macrophytes. The group agreed to further discuss changing this indicator to a focus on the condition of submerged aquatic vegetation, which, it was agreed, would suffer under conditions of high chlorophyll-a in the water column.

Animal species was the next indicator to be discussed. It was mentioned that the timing of any assessment would greatly influence which taxa were present. Hydrology and the seasonality of predators were mentioned as other factors that would affect the makeup of the faunal community at any given time. Lists or tables of preferred species would need to be produced. The team agreed that it may be difficult to find benthic invertebrates during a rapid assessment.

The selection of visual indicators for other water quality parameters was reviewed briefly. This will be covered in more detail in a future meeting.

Locations of existing and proposed treatment wetlands were reviewed and some corrections were made to the table in the presentation for agenda item 7.

- Lely Main is a spreader waterway which should be pulled from the list. It is not a treatment wetland.
- There may be a wetland mitigation bank with a stated water treatment function in Oldsmar.
- A Lee County project of 3 to 5 acres was required as a condition of the widening of Alico Road.
- A 15-acre project in Lee County is in design.

Jim Beever asked Karen Bickford about water sampling points on 10 Mile Canal. Karen offered to track down the data from those stations.

Mike Kirby asked about submitting for BMAP credits with a stormwater treatment wetland that Bonita Springs is considering. Karen Bickford responded that there is guidance on design that could be used so that the project would qualify for credits.

A Doodle poll will be sent out to determine the date of the next meeting, which will likely be a full day with field work in the morning and an office session in the afternoon. Lunch will be provided.

A-Team Meeting 4: WQFAM Version 1

WQFAM Version 1 was completed on March 22, 2012. Based on the input of the A-Team the survey included a pre-field sheet with from 22 to 30 variables (Figure 15), a section on water clarity with 7 variables (Figure 16),, an algae page with 5 variables(Figure 17), a vascular plant section with 9 variables (Figure 18), an animal speceis section with 15 variables (Figure 19), water temperature, odor and soil textures section with 3 variables (Figure 20). for a total of 61 to 69 variables depending on the surrounding land use diversity. The first field test was scheduled for Meeting 4 of the A-Team.

Meeting 4 of the WQFAM Team was on March 26, 2012 at the parking lot of the Southwest Florida Regional Planning Council at 8:30 a.m. for carpooling to the John Yarbrough Linear Park Trail near the corner of Daniels Parkway (CR 876) and Metro Parkway. It is on the east-bound side of Daniels, west of Metro.

Attending

In Person:	Via WebEx:
Steve Adams	Rhonda Evans
Judy Ashton	
Rick Bartleson	
Jim Beever	
Lisa Beever	
Karen Bickford	
Dan Cobb	
James Evans	
Whitney Gray	
Mac Hatcher	
Charles Kovach	
Mike Kirby	
Jennifer Nelson	
Judy Ott	

Part 1 of the meeting was held at the Ten Mile Canal Filter Marsh. The A-Team met at the trailhead for Jon Yarborough Linear Park, near the intersection of Daniels Parkway and Metro Parkway. Karen Bickford of Lee County Natural Resources gave an overview of the filter marsh project. Karen provided information on the history, the size and capacity, and the maintenance protocols of the marsh.

Jim Beever then introduced the draft data forms for the assessment method. The Team then went through an assessment on Cell 1 of the filter marsh.

The team then undertook to access the first Cell of the 10-Mile Canal Filter Marsh utilizing the Version 1.0 of the draft WQFAM forms.

Part 1 of the form is designed to fill in prior to going into the field. The top has an entry for the Sit Project Name, the site project ID number, who conducted the assessment and the date of the assessment. The next entry id for the Assessment Area Size. This is calculated form aerial photography and permit documents if they specify it. The next entry is a narrative description of the general location and description of the assessment area that is obtained from the aerial photography and supplemented in the field with observation of on-the-ground site conditions. A note is also provided as to if the site is used for mitigation.

The land uses surrounding the filter marsh and forming the watershed that contributed to the filter marsh is then listed in a table. This information is obtained from the aerial photography and from the site visit.

Part 1 Pre-Field

Site/Project Name	Site/Project ID	Conducted by Date
Assessment Area Size (Calculated from aerial photographs or permit documents)		
Assessment Area General Location and Description (From aerial photographs and site visit) Is this a mitigation site?		

Surrounding Land Uses (From aerial photographs and site visit)

Land Use	Score x	% Area within 300m =	Subtotal

Total = _______

<u>Scores for Land Use Categories</u>

3.0 - natural undeveloped areas
2.5 - unimproved pasture/rangeland
2.0 - citrus grove
2.0 - sugarcane
2.0 - low density residential
2.0 - low intensity commercial
2.0 - low volume highway
2.0 - institutional
1.5 - single family residential
1.5 - recreational
1.5 - moderately intensive commercial
1.5 - golf course
1.0 - high volume highway
1.0 - improved pasture
1.0 - row crop
1.0 - multifamily residential
1.0 - industrial
1.0 - mining
0.5 - high intensity commercial
0.0 - dairy and feedlot

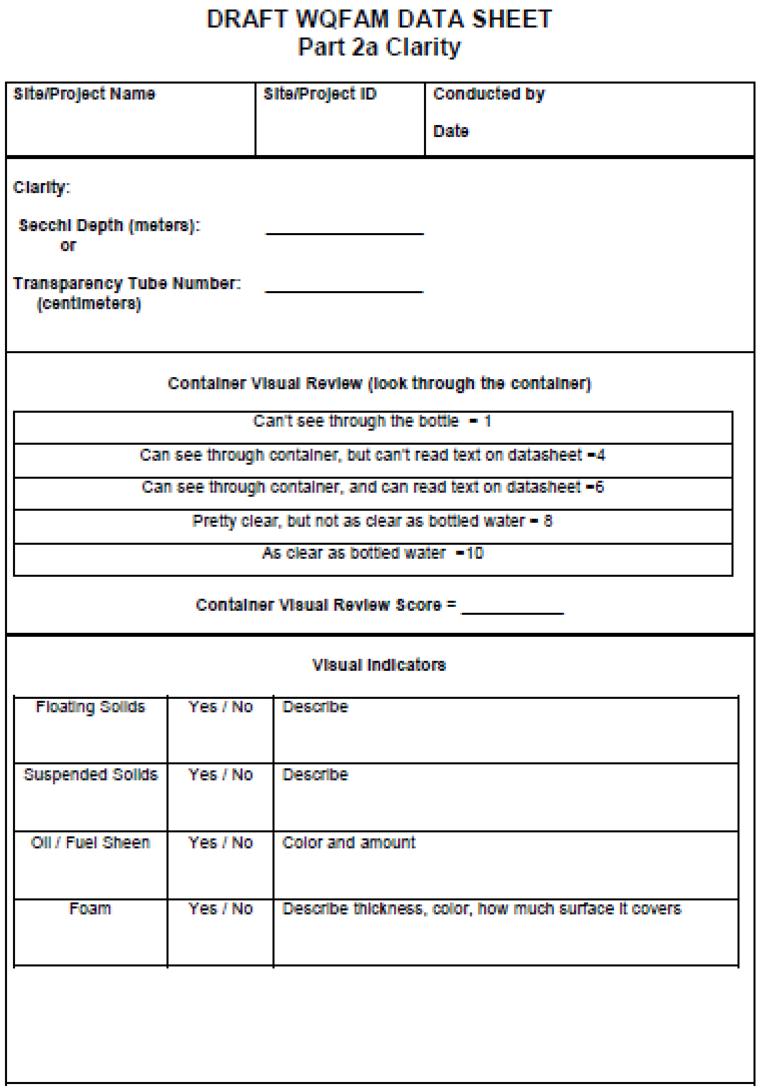
Hydrologic Connections (From aerial photographs and site visit)
Input from:

Outflow to:

Water Quality Data

Parameter	Upstream	At Site	Downstream
Chlorophyll-a			
Conductance			
Dissolved Oxygen			
Nutrients (combined)			
Total Nitrogen			
Total Phosphorus			

Figure 15: WQFAM Version 1 Part 1 Pre-Field Data Sheet


DRAFT WQFAM DATA SHEET
Part 2a Clarity

Site/Project Name	Site/Project ID	Conducted by Date

Clarity:

Secchi Depth (meters): ______________
or
Transparency Tube Number: ______________
(centimeters)

Container Visual Review (look through the container)

Can't see through the bottle = 1
Can see through container, but can't read text on datasheet =4
Can see through container, and can read text on datasheet =6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water =10

Container Visual Review Score = __________

Visual Indicators

Floating Solids	Yes / No	Describe
Suspended Solids	Yes / No	Describe
Oil / Fuel Sheen	Yes / No	Color and amount
Foam	Yes / No	Describe thickness, color, how much surface it covers

Figure 16: WQFAM Version 1 Part 2a page 1 Clarity Data Sheet

Water Clarity UMAM

A score of (10) means that water quality fully supports the functions and provides benefits at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Light penetration (Clarity) is optimal for the type of community being evaluated.

A score of (7) means that water quality supports the functions and provides benefits at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Light penetration (Clarity) is generally sufficient for the type of community being evaluated but are expected to cause some changes in species, age classes and densities.

A score of (4) means that water quality supports the functions and provides benefits at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Light penetration (Clarity) is not well suited for the type of community being evaluated and are expected to cause significant changes in species, age classes and densities.

A score of (0) means that the water quality does not support the functions and provides no benefits. The score is based on reasonable scientific judgment and characterized by: Light penetration (Clarity) is inappropriate for the type of community (species, age classes and densities) being evaluated.

Score (1-10) = _______________

Notes:

Figure 17: WQFAM Version 1 Part 2a page 2 Water Clarity UMAM Data Sheet

DRAFT WQFAM DATA SHEET
Part 2b Algae

Site/Project Name	Site/Project ID	Conducted by Date

Algal Community - Circle score or check box

	Score
Algal community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The algal community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Algal community composition =

Algal Biomass

Algal biomass low	10
	7
Algal biomass moderate	5
	3
Algal biomass excessive	0

Algal biomass score =

Blue-Green Algae

No blue-green or filamentous green algae	10
Approximately 30% blue-green or filamentous green algae	7
Approximately 50% blue-green or filamentous green algae	5
Approximately 70% blue-green or filamentous green algae	3
Blue-green or filamentous green algae monoculture	0

Blue-green Algae score =

Algal Cover

Algal cover characteristic for that wetland type	10
Most of the algal cover characteristic for that wetland type	7
Half of the algal cover characteristic for that wetland type	5
Some of the algal cover characteristic for that wetland type	3
Algal cover completely uncharacteristic for that wetland type	0

Algal cover score =

Figure 18: WQFAM Version 1 Part 2b Algae Data Sheet

DRAFT WQFAM DATA SHEET
Part 2c Plant Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Examples of Undesirable Species

Genus	Species	Common Name
Alternantera	*philoxeroides*	alligator weed
Ardisia	*elliptica*	shoebutton ardisia
Brachiaria	*mutica*	para grass
Casuarina	*equisetifolia*	Australian pine
Colocasia	*esculenta*	taro
Cupaniopsis	*esculenta*	carrotwood
Dioscorea	*bulbiflora*	air potato
Eichornia	*crassipes*	water hyacinth
Hydrilla	*verticillata*	hydrilla
Hymenachne	*amplexicaulis*	West Indian marsh grass
Ludwigia	*octovalvis*	water primrose
Ludwigia	*peruviana*	primrose willow
Lygodium	*japonicum*	Japanese climbing fern
Lygodium	*microphyllum*	old world climbing fern
Mikania	*scandens*	climbing hempweed
Melaeuca	*quinquenervia*	melaleuca
Panicum	*repens*	torpedo grass
Paspalum	*notatum*	bahia grass
Pistia	*stratiotes*	water lettuce
Psidium	*guajava*	guava
Rhodomyrtus	*tomentosqa*	downy rose myrtle
Sapium	*secunotatum*	Chinese tallow
Schinus	*terebinthifolius*	Brazilian pepper
Senna	*pendula*	climbing cassia
Syzygium	*cumini*	Java plum
Tespesia	*populnea*	seaside mahoe
Typha	spp.	cattail
Urena	*lobata*	Caesar weed
Wedelia	*trilobata*	wedelia

Plants Observed

Plant Community

	Score
Plant community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The plant community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Plant community composition =

Figure 19: WQFAM Version 1 Part 2c Page 1 Plant Species and Condition Data Sheet

Plant Community Zonation

Zonation of vegetation appropriate	10
	7
	5
	3
Zonation of vegetation inappropriate	0

Plant Community Zonation score =

Cattails

No cattails	10
Approximately 30% of plant coverage is cattails	7
Approximately 50% of plant coverage is cattails	5
Approximately 70% of plant coverage is cattails	3
Cattail monoculture	0

Cattail score =

Plant Cover

Plant cover characteristic for that wetland type	10
Most of the plant cover characteristic for that wetland type	7
Half of the plant cover characteristic for that wetland type	5
Some of the plant cover characteristic for that wetland type	3
Plant cover completely uncharacteristic for that wetland type	0

Algal cover score =

Plant Community UMAM

A score of (10) means that water quality fully supports the functions and provides benefits at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Plant community is optimal for the type of wetland being evaluated.

A score of (7) means that water quality supports the functions and provides benefits at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Plant community is generally sufficient for the type of wetland being evaluated but exhibit some changes in species, age classes and densities due to decreased water quality.

A score of (4) means that water quality supports the functions and provides benefits at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Plant community is not well suited for the type of wetland being evaluated and exhibits significant changes in species, age classes and densities due to decreased water quality.

A score of (0) means that the water quality does not support the functions and provides no benefits. The score is based on reasonable scientific judgment and characterized by: Plant community is inappropriate for the type of wetland (species, age classes and densities) being evaluated.

Score =

Figure 20: WQFAM Version 1 Part 2c Page 2 Plant Species and Condition Data Sheet and Plant Community UMAM

Plant Condition

	Score
Vegetation shows no signs of stress such as excessive mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with stress.	10
Vegetation has slightly greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with some stress.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Vegetation has strong evidence of greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease associated with stress.	3
Vegetation has strong evidence of much greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with stress.	0

Vegetation stress UMAM

A score of (10) means that water quality fully supports the functions and provides benefits at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized the following: Vegetation shows no signs of hydrologic stress such as excessive mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.

A score of (7) means that water quality supports the functions and provides benefits at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following Vegetation has slightly greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with some hydrologic stress.

A score of (4) means that water quality supports the functions and provides benefits at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by the following Vegetation has strong evidence of greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease associated with hydrologic stress.

A score of (0) means that the water quality does not support the functions and provides no benefits. The score is based on reasonable scientific judgment and characterized the following: Vegetation has strong evidence of much greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.

Score =

Notes

Figure 21: WQFAM Version 1 Part 2c Page 3 Plant Species and Condition Data Sheet and Vegetation Stress UMAM

DRAFT WQFAM DATA SHEET
Part 2d Animals Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Animal Species

	Score
Animal species indicative of good water quality.	10
Animal species indicative of a mesoligotrophic system.	7
Animal species indicative of a mesotrophic system.	5
Animal species indicative of a eutrophic system.	3
Animal species indicative of a hypereutrophic system.	0

Animal Species – check appropriate score

Species Characteristic	Optimal (10)	Moderate (7)	Minimal (4)	Not present (0)
Number and diversity of benthic macroinvertebrates				
Number and diversity of fish community				
Regeneration/recruitment of appropriate species				
Invasive/inappropriate species				
Habitat structure				
Presence of fish or wildlife adapted to poor water quality				
Overall wildlife utilization				

Species observed:

Figure 22: WQFAM Version 1 Part 2d Page 1 Animal Species and Condition Data Sheet

Animal Condition – check appropriate score

Condition Characteristic	Optimal (10)	Moderate (7)	Minimal (4)	Not present (0)
Presence of dead fish				
Wildlife behavior indicative of poor water quality				
Age/size distribution of benthic species and/or fish				
Condition of appropriate species				
Changes in diversity and/or number of benthic species or fish				
Animal density				

Notes:

Animal Community UMAM

A score of (10) means that water quality fully supports the functions and provides benefits at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Presence or evidence of use by animal species with specific hydrologic requirements is consistent with expected hydrologic conditions for the system being evaluated.

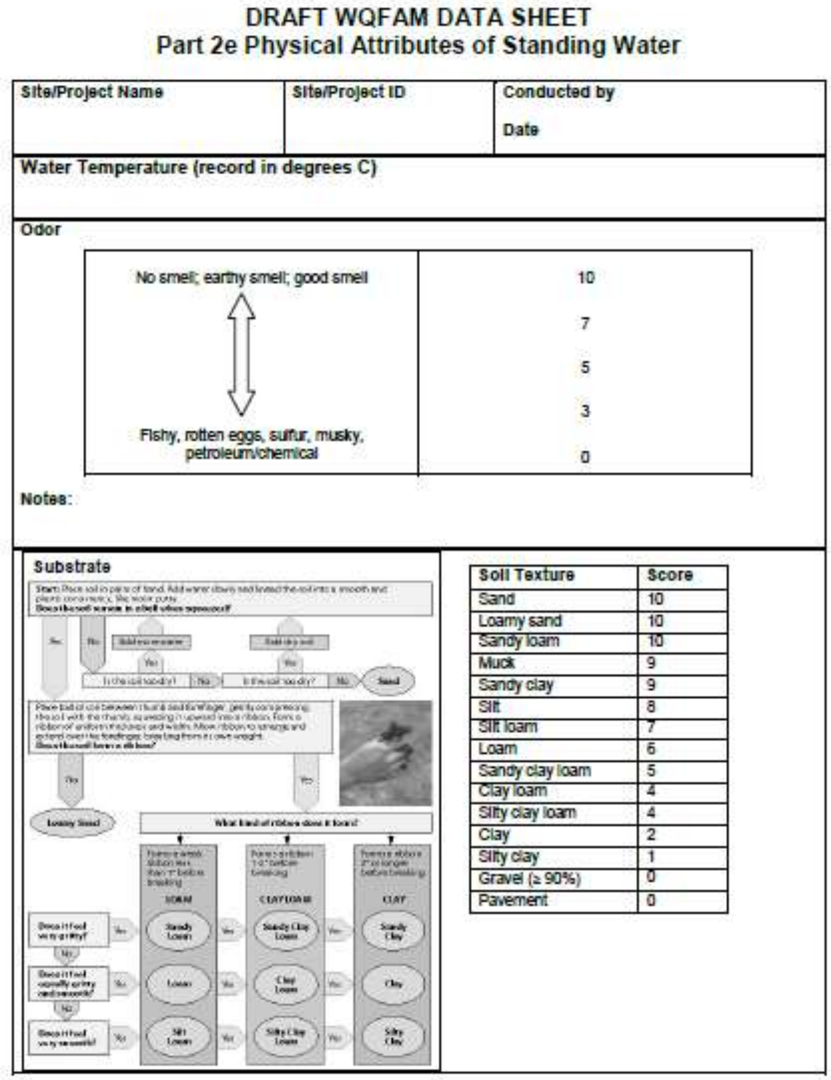
A score of (7) means that water quality supports the functions and provides benefits at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Presence or evidence of use by animal species with specific hydrologic requirements is less than expected or species present have more generalized hydrologic requirements.

A score of (4) means that water quality supports the functions and provides benefits at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by: Presence or evidence of use by animal species with specific hydrologic requirements is greatly reduced from what is expected or species present have more generalized hydrologic requirements.

A score of (0) means that the water quality does not support the functions and provides no benefits. The score is based on reasonable scientific judgment and characterized by: Presence or evidence of use by animal species with specific hydrologic requirements is lacking and species present have more generalized hydrologic requirements.

Score =

Figure 23: WQFAM Version 1 Part 2d Page 2 Animal Species and Condition Data Sheet and Animal Community UMAM



DRAFT WQFAM DATA SHEET
Part 2e Physical Attributes of Standing Water

Site/Project Name	Site/Project ID	Conducted by Date

Water Temperature (record in degrees C)

Odor

No smell; earthy smell; good smell	10
	7
	5
	3
Fishy, rotten eggs, sulfur, musky, petroleum/chemical	0

Notes:

Substrate

Soil Texture	Score
Sand	10
Loamy sand	10
Sandy loam	10
Muck	9
Sandy clay	9
Silt	8
Silt loam	7
Loam	6
Sandy clay loam	5
Clay loam	4
Silty clay loam	4
Clay	2
Silty clay	1
Gravel (≥ 90%)	0
Pavement	0

Figure 24: WQFAM Version 1 Part 2e Physical Attributes Data Sheet

3. 1:30 p.m. – 4:30 p.m.

Part II – Debriefing/Discussion at SWFRPC Office

WQFAM version 1 was field tested at the 20 filter marshes and floating island sites listed in Figure 38 in a period from April to September 2012. Water quality information was collected at sixteen sites with a YSI meter. for temperature, conductivity, specific conductance, salinity, % saturation of dissolved oxygen, dissolved oxygen concentration, and pH. The mean results for YSI water quality sampling is on figure 25.

Figure 25: Water Quality Parameters from YSI Sampling of Filter Marshes Used in Calibration.

Site	mean Temperature (F)	mean Temperature (C)	mean Conductivity (uS/cm)	mean Specific Conductance (uS/cm)	mean Salinity ppt	mean DO %	mean DO ppm	mean pH
BILLY'S CREEK	82.22	27.90	616.00	583.00	0.28	6.60	0.52	6.81
NORTH COLONIAL	83.30	28.50	749.00	703.00	0.34	13.36	1.04	7.24
TEN MILE CANAL CELL 1B	83.26	28.48	849.00	796.80	0.39	31.26	2.42	7.30
MANUALS BRANCH	79.34	26.30	737.20	719.00	0.35	54.24	4.36	7.41
LAKES PARK	81.18	27.32	588.20	563.40	0.27	69.22	5.48	7.72
THE BROOKS	84.56	29.20	759.60	703.60	0.34	58.90	4.51	7.55
HARNS MARSH	83.84	28.80	529.80	494.00	0.24	50.70	3.91	7.77
FORD CANAL	81.32	27.40	530.80	507.60	0.24	34.06	2.69	7.46
KINGS HWY	80.78	27.10	449.52	432.30	0.21	16.74	1.33	7.31
FREEDOM PARK	80.96	27.20	579.20	555.40	0.27	14.24	1.13	7.22
RIVERSIDE	80.96	27.20	1224.20	1174.40	0.58	14.46	1.15	7.19
17th AVENUE SOUTH	82.51	28.06	643.20	608.20	0.29	39.46	3.08	7.91
EAST LAKE DR	84.26	29.03	595.33	553.00	0.26	34.10	2.62	7.61
CELERY FIELDS	79.88	26.6	551.8	535.2	0.26	26.2	1.69	7.278
OLEAN & KING	83.84	28.8	397.32	535.2	0.18	39.08	3.07	7.206
POWELL CREEK	80.10	26.10	529.70	502.50	0.38	80.10	8.21	7.94
Total Means	82.02	27.75	653.34	622.91	0.30	36.42	2.95	7.43

The results were analyzed for comparison to concurrent UMAM scores and variables that did not provide information that correlated with wetland functions as measured by UMAM were discarded.

WQFAM version 2

WQFAM version 2 was completed on October 15, 2012. It differs from Version 1 in not including the section involving landscapes. The landscape variables were found to have no correlation with UMAM scores and with the other variables indicative of water clarity, algae, vegetation, and wildlife which all had a closer correlation with each other.

WQFAM version 2 was field tested at the 20 filter marshes and floating island sites listed in Figure 38 in a period from October to December 2012. The results were analyzed for comparison to concurrent UMAM scores and variables that did not provide information that correlated with wetland functions as measured by UMAM were discarded. This lead to the removal of the wildlife, water temperature, odor, and substrate variables.

A-Team Meeting 5: WQFAM Version 3

WQFAM version 3.5 was completed on January 1, 2012.

Meeting 5 of the WQFAM Team was January 9, 2012
8:30 a.m. – 4:30 p.m.

Meeting Location Information:
• If carpooling from SWFRPC, meet in back parking lot at 1926 Victoria Ave, Ft. Myers no later than 8:30 a.m.

• If meeting at the site, please arrive by 9:00 a.m. Access the Billy Bowlegs parking lot for near the corner of Michigan Avenue and Marsh Avenue. Google Maps link:

US 41: http://goo.gl/maps/Gehny
I-75: http://goo.gl/maps/VclqL
• If joining the meeting after lunch, go directly to the SWFRPC office at 1926 Victoria Avenue in Ft. Myers. We will begin the second part of the meeting at 1:30. Google Maps link: http://goo.gl/maps/W8vO0

****MAP IS ALSO INCLUDED ON PAGE 2 ****

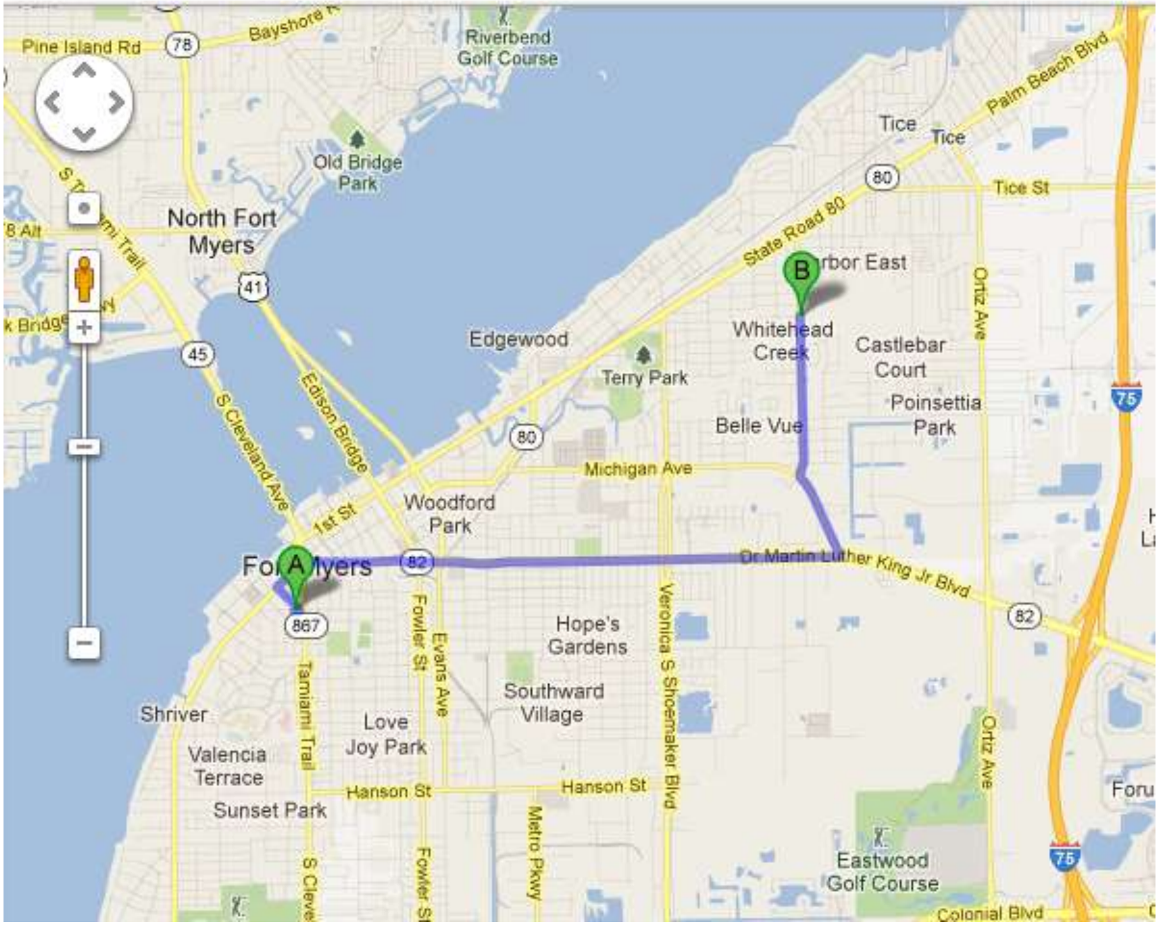


Figure 25: Directions to and from the Billy's Creek Filter Marsh site

1. 9:00 a.m. – 12:00 p.m.

   Part I – Field Work at Billy's Creek Filter Marsh in Ft. Myers

   a. Overview of the project – Jim Beever
   b. Site assessment using draft WQFAM Version 3 forms – Group

Figure 26: Aerial View of the Billy's Creek Filter Marsh site

Located within the City of Fort Myers, this property is located on the north bank of Billy's Creek canal directly west of Billy Bow Legs Park. The filter marsh is possible through a three-way partnership of government agencies. Lee County is bought the land; the South Florida Water Management District helped pay for the construction of the filter marsh with an $839,000 grant; and the City of Fort Myers paid the remainder of the construction costs, did the construction work and maintains the filter marsh. The property's two native plant communities, cypress slough and oak hammock, remained untouched by the filter marsh.

This project enhances the water quality of Billy's Creek and the Caloosahatchee River through a system of weirs, and includes an 8-acre lake and 13.4 acres of filter marshes. The park surrounding the filter marsh provides hiking and cycling trails, picnic areas and kayak and canoe launches The site will eventually be listed on the Great Calusa Blue Way Trail.

Visual Container review: Huge difference in sample depending on location sample is taken. Sample technique suggested by Karen – purchase a Nalgene to be used on a reach pole or string depending on location.

Judy also mentioned that one water sample was probably not effective, but too many would not be rapid.

In order to test whether or not it is even valuable to use the test I would like to revisit a site and compare scores. However, this sediment in the way of testing was not an issue at sites with board walk access.

UMAM Language: expansive difference in language used regarding what is "good" or "bad" with algae coverage. Also there was debate on which algae to count for coverage (submerged? Etc) Possible analysis on data reversing the positive to a negative scores and see if the correlation changes for previous sites. Clarity in new language for version four.

Creating Materials for training: Even with experience there was still a need to use a field guide of sorts, suggestions were made to create a new field guide specific to this study which indicates good plants and undesirable ones.

Plant opinion variation: Should cattails be considered undesirable? They are removing nutrients as planned. Is an invasive species a nuisance or actually non-native.

Dead fish: the removal of the fauna sheets also removed scores which would be considered incredibly negative, such as presence of dead fish, should this be included in the weighting if present?

Could burning be possible in the future?

Where to sample: Suggestions that the water that should be sampled would be end point, or there should be a correlation between receiving waterbody quality and our scores.

1. 1:30 p.m. – 4:30 p.m.

   Part II – Debriefing/Discussion at SWFRPC Office

   a. Part 1 WQFAM History
   b. Part 2Water Quality Functional Assessment Method: Sites and YSI data
   c. Part 3 Flora and Fauna of the Filter Marshes
   d. Part 4 WQFAM Results

DRAFT WQFAM DATA SHEET
Part 1 Clarity

Site/Project Name	Site/Project ID	Conducted by Date

Clarity:

Secchi Depth (meters): ______________
or

Transparency Tube Number: ______________
(centimeters)

Container Visual Review (look through the container)

Can't see through the bottle = 1
Can see through container, but can't read text on datasheet =4
Can see through container, and can read text on datasheet =6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water =10

Container Visual Review Score = __________

Visual Indicators

Floating Solids	Yes / No	Describe
Suspended Solids	Yes / No	Describe
Oil / Fuel Sheen	Yes / No	Color and amount
Foam	Yes / No	Describe thickness, color, how much surface it covers

Figure 27: WQFAM Version 3 Water Clarity Data Sheet

DRAFT WQFAM DATA SHEET
Part 2 Algae

Site/Project Name	Site/Project ID	Conducted by
		Date

Algal Community - Circle score or check box

	Score
Algal community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The algal community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Algal community composition =

Algal Biomass

Algal biomass low	10
	7
Algal biomass moderate	5
	3
Algal biomass excessive	0

Algal biomass score =

Blue-Green Algae

No blue-green or filamentous green algae	10
Approximately 30% blue-green or filamentous green algae	7
Approximately 50% blue-green or filamentous green algae	5
Approximately 70% blue-green or filamentous green algae	3
Blue-green or filamentous green algae monoculture	0

Blue-green Algae score =

Algal Cover

Algal cover characteristic for that wetland type	10
Most of the algal cover characteristic for that wetland type	7
Half of the algal cover characteristic for that wetland type	5
Some of the algal cover characteristic for that wetland type	3
Algal cover completely uncharacteristic for that wetland type	0

Algal cover score =

Figure 28: WQFAM Version 3 Algae Data Sheet

DRAFT WQFAM DATA SHEET
Part 3 Plant Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Examples of Undesirable Species

Genus	Species	Common Name
Alternantera	*philoxeroides*	alligator weed
Ardisia	*elliptica*	shoebutton ardisia
Brachiaria	*mutica*	para grass
Casuarina	*equisetifolia*	Australian pine
Colocasia	*esculenta*	taro
Cupaniopsis	*esculenta*	carrotwood
Dioscorea	*bulbiflora*	air potato
Eichornia	*crassipes*	water hyacinth
Hydrilla	*verticillata*	hydrilla
Hymenachne	*amplexicaulis*	West Indian marsh grass
Ludwigia	*octovalvis*	water primrose
Ludwigia	*peruviana*	primrose willow
Lygodium	*japonicum*	Japanese climbing fern
Lygodium	*microphyllum*	old world climbing fern
Mikania	*scandens*	climbing hempweed
Melaeuca	*quinquenervia*	melaleuca
Panicum	*repens*	torpedo grass
Paspalum	*notatum*	bahia grass
Pistia	*stratiotes*	water lettuce
Psidium	*guajava*	guava
Rhodomyrtus	*tomentosqa*	downy rose myrtle
Sapium	*secunotatum*	Chinese tallow
Schinus	*terebinthifolius*	Brazilian pepper
Senna	*pendula*	climbing cassia
Syzygium	*cumini*	Java plum
Tespesia	*populnea*	seaside mahoe
Typha	spp.	cattail
Urena	*lobata*	Caesar weed
Wedelia	*trilobata*	wedelia

Plants Observed

Plant Community

	Score
Plant community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The plant community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Plant community composition =

Figure 29: WQFAM Version 3 Page 1 Plant Species and Condition Data Sheet

Plant Community Zonation

Zonation of vegetation appropriate	10
	7
	5
	3
Zonation of vegetation inappropriate	0

Plant Community Zonation score =

Cattails

No cattails	10
Approximately 30% of plant coverage is cattails	7
Approximately 50% of plant coverage is cattails	5
Approximately 70% of plant coverage is cattails	3
Cattail monoculture	0

Cattail score =

Plant Cover

Plant cover characteristic for that wetland type	10
Most of the plant cover characteristic for that wetland type	7
Half of the plant cover characteristic for that wetland type	5
Some of the plant cover characteristic for that wetland type	3
Plant cover completely uncharacteristic for that wetland type	0

Plant cover score =

Notes:

Figure 30: WQFAM Version 3 Page 2 Plant Species and Condition Data Sheet

WQFAM version 3 was then field tested in the 20 sample filter marshes and floating island systems sites listed in Figure 38 in a period from January to August 2013. The results were analyzed for comparison to concurrent UMAM scores and variables that did not provide information that correlated with wetland functions as measured by UMAM were discarded.

A-Team Meeting 6: WQFAM Version 4.5

WQFAM Version 4.5 was completed August 22, 2013.

8:30 a.m. – 4:30 p.m. at the parking lot of the Southwest Florida Regional Planning Council at 8:30 a.m. for carpooling Meeting 6 August 29, 2013
8:30 a.m. – 11:30 noon
Meeting Location Information:
• *If carpooling from SWFRPC, meet in back parking lot at 1926 Victoria Ave, Ft. Myers no later than 8:30 a.m.*
• *If meeting at the site, please arrive by 9:00 a.m. Access the Powell Creek Preserve filter marsh site at 15601 Hart Rd, North Fort Myers (on west side of Hart Rd., about ¼ mile north of Bayshore Rd.)*
• *Google Maps link:*

US 41: http://goo.gl/maps/Uo15Q
I-75: http://goo.gl/maps/LIvM5
• *If joining the meeting after lunch, go directly to the SWFRPC office at 1926 Victoria Avenue in Ft. Myers. We will begin the second part of the meeting at 1:30. Google Maps link: http://goo.gl/maps/W8vO0*

**MAP IS ALSO INCLUDED ON PAGE 2 **
1. 9:00 a.m. – 11:30 p.m.

Part I – Field Work at Powell Creek Preserve Filter Marsh in North Fort Myers. This 18-acre filter marsh was recently constructed on the 77-acre Powell Creek Preserve. Once at the site, we will field test the current version of the method, WQFAM 3.5.

WQFAM 4.5 DATA SHEET
Part 1 Clarity

Site/Project Name	Site/Project ID	Conducted by Date

Container Visual Review (look through the container)

Can't see through the bottle = 1
Can see through container, but can't read text on datasheet =4
Can see through container, and can read text on datasheet =6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water =10

Container Visual Review Score = ___________

Visual Indicators

Floating Solids	Yes / No	Describe
Suspended Solids	Yes / No	Describe
Oil / Fuel Sheen	Yes / No	Color and amount
Foam	Yes / No	Describe thickness, color, how much surface it covers
Dead Aquatic Life	Yes / No	Describe

Figure 31: WQFAM Version 4.5 Water Quality Data Sheet

WQFAM 4.5 DATA SHEET
Part 2 Algae

Site/Project Name	Site/Project ID	Conducted by Date

Algal Community - Circle score or check box

	Score
Algal community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The algal community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Algal community composition =

Algal Biomass

Algal biomass low 0%	10
	7
Algal biomass moderate 50%	5
	3
Algal biomass excessive 100%	0

Algal biomass score =

Blue-Green Algae

No blue-green or filamentous green algae	10
Approximately 30% blue-green or filamentous green algae	7
Approximately 50% blue-green or filamentous green algae	5
Approximately 70% blue-green or filamentous green algae	3
Blue-green or filamentous green algae monoculture	0

Blue-green Algae score =

Algal Cover

Algal cover characteristic for that wetland type	10
Most of the algal cover characteristic for that wetland type	7
Half of the algal cover characteristic for that wetland type	5
Some of the algal cover characteristic for that wetland type	3
Algal cover completely uncharacteristic for that wetland type	0

Algal cover score =

Figure 32: WQFAM Version 4.5 Algae Data Sheet

WQFAM 4.5 DATA SHEET
Part 3 Vascular Plant Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Examples of Undesirable Species (circle)

Genus	*Species*	Common Name
Alternantera	*philoxeroides*	alligator weed
Ardisia	*elliptica*	shoebutton ardisia
Brachiaria	*mutica*	para grass
Casuarina	*equisetifolia*	Australian pine
Colocasia	*esculenta*	taro
Cupaniopsis	*esculenta*	carrotwood
Dioscorea	*bulbiflora*	air potato
Eichornia	*crassipes*	water hyacinth
Hydrilla	*verticillata*	hydrilla
Hymenachne	*amplexicaulis*	West Indian marsh grass
Ludwigia	*octovalvis*	water primrose
Ludwigia	*peruviana*	primrose willow
Lygodium	*japonicum*	Japanese climbing fern
Lygodium	*microphyllum*	old world climbing fern
Mikania	*scandens*	climbing hempweed
Melaeuca	*quinquenervia*	melaleuca
Panicum	*repens*	torpedo grass
Paspalum	*notatum*	bahia grass
Pistia	*stratiotes*	water lettuce
Psidium	*guajava*	guava
Rhodomyrtus	*tomentosa*	downy rose myrtle
Sapium	*secunotatum*	Chinese tallow
Schinus	*terebinthifolius*	Brazilian pepper
Senna	*pendula*	climbing cassia
Syzygium	*cumini*	Java plum
Tespesia	*populnea*	seaside mahoe
Typha	spp.	cattail
Urena	*lobata*	Caesar weed
Wedelia	*trilobata*	wedelia

Vascular Plants Observed

Vascular Plant Community

	Score
Plant community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The plant community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Plant community composition =

Figure 33: WQFAM Version 4.5 Page 1 Plant Species and Condition Data Sheet

Vascular Plant Community Zonation

Zonation of vegetation appropriate	10
⇕	7
	5
	3
Zonation of vegetation inappropriate	0

Plant Community Zonation score =

Vascular Plant Cover

Plant cover characteristic for that wetland type	10
Most of the plant cover characteristic for that wetland type	7
Half of the plant cover characteristic for that wetland type	5
Some of the plant cover characteristic for that wetland type	3
Plant cover completely uncharacteristic for that wetland type	0

Plant cover score =

Notes:

WQFAM 4.5 DATA SHEET

Figure 34: WQFAM Version 4.5 Page 2 Plant Species and Condition Data Sheet

WQFAM version 4.5 was then field tested in the 20 sample filter marshes and floating island systems sites listed in Figure 38 in a period from August 2013 to July 2015 in order to calibrate against two seasonal UMAM scores at sites . The results were analyzed for comparison to concurrent UMAM scores and variables that did not provide information that correlated with wetland functions as measured by UMAM were discarded.

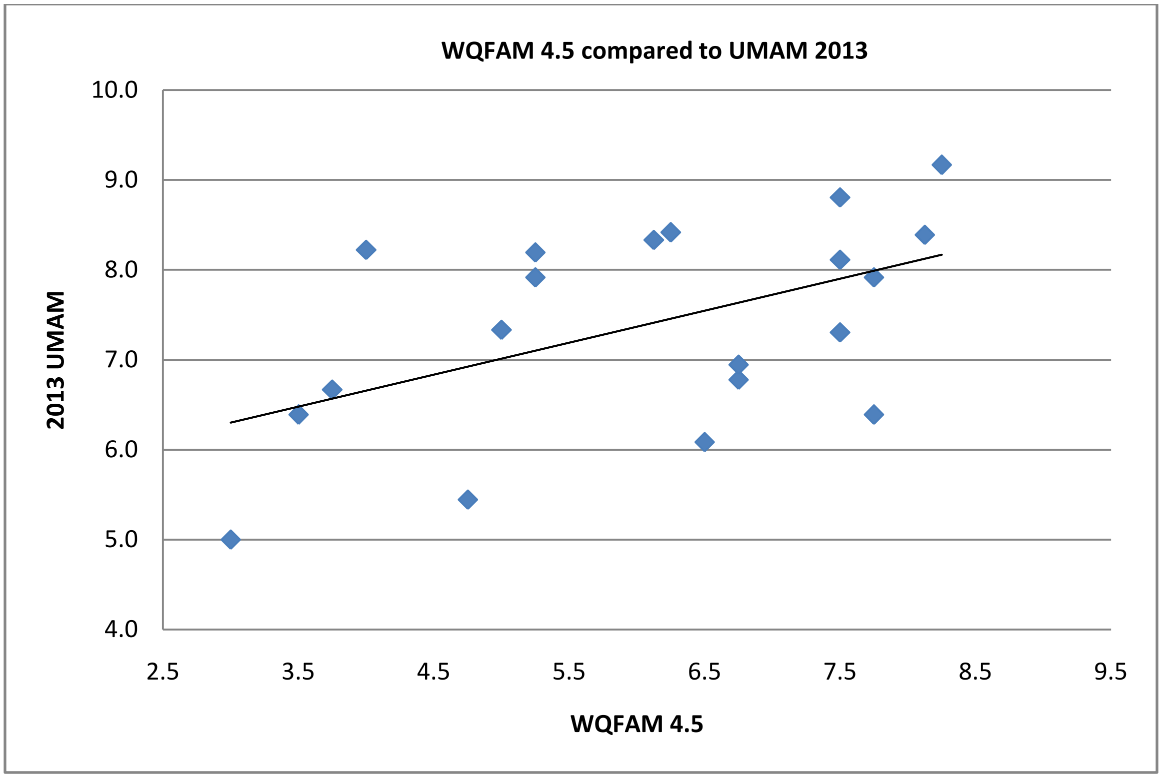


Figure 35: Comparison of WQFAM 4.5 Score to the 2013 UMAM score of the Sampled Filter Marshes

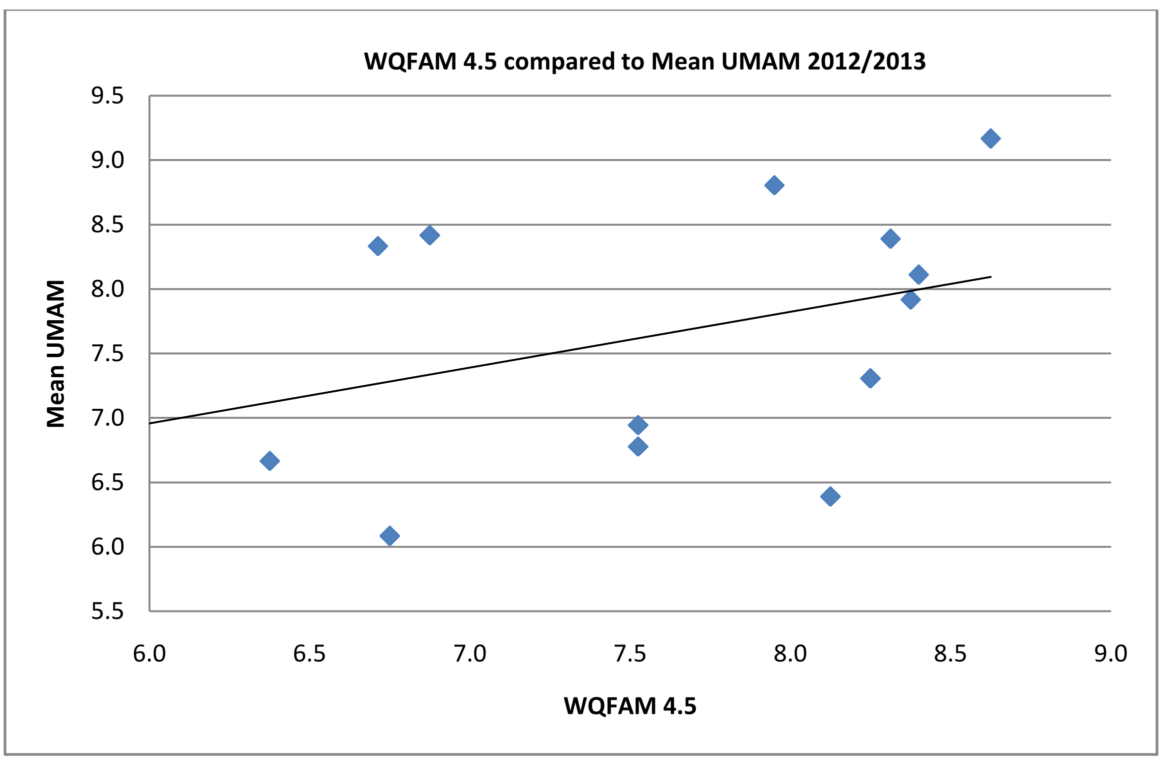


Figure 36: Comparison of WQFAM 4.5 Score to the Mean UMAM scores of the Sampled Filter Marshes

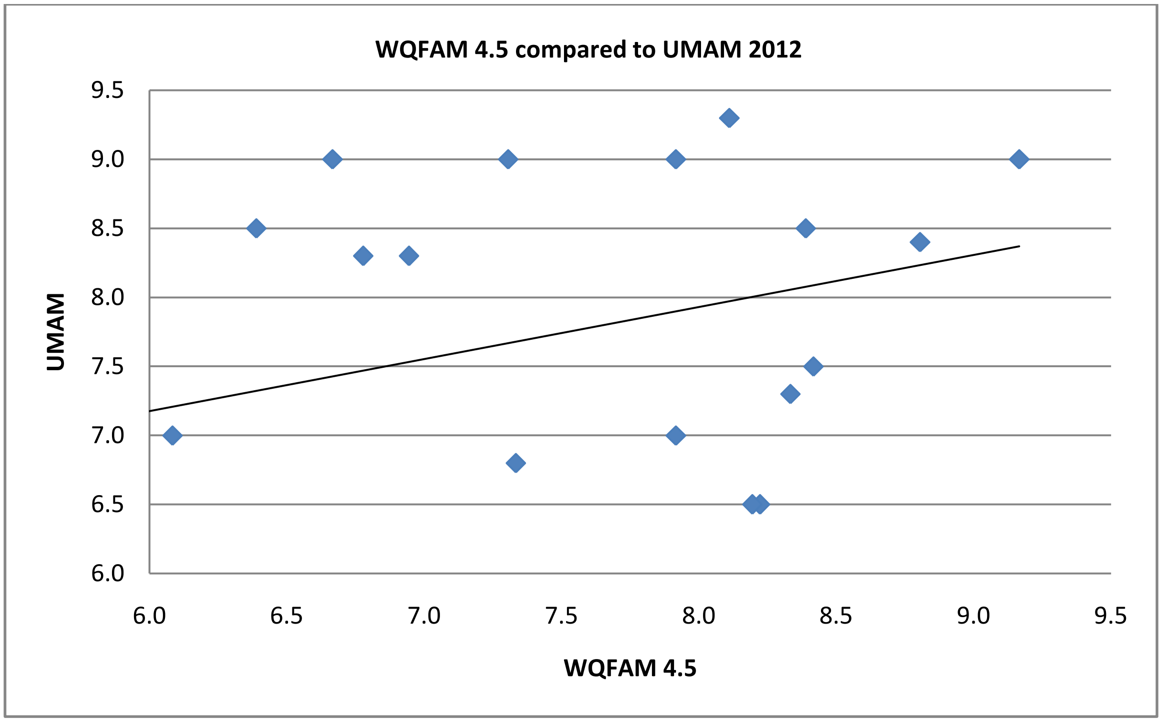


Figure 37: Comparison of WQFAM 4.5 Score to the 2012 UMAM score of the Sampled Filter Marshes

WQFAM Version 5

WQFAM Version 5 was completed July 7, 2015. It includes the following three areas:

- Visual Clarity of the Water
- Algae
- Plant Species and Condition without Extent of Cattails Variable
- With a total of 8 quantitative and 6 qualitative variables.

During field reviews by the A-Team and Bet-Testing with independent private sector consultants input recommended the creation of a wetland plant field guide to assist in answering the questions in the vascular plant section of the method. This was developed with field photos taken during field review and with photography donated by members of the CHNEP conference. The guide was prepared by James Beever III, Principal Planner IV, Southwest Florida Regional Planning Council, Lisa Van Houdt, Florida Department of Environmental Protection, **Lisa.VanHoudt@dep.state.fl.us**, Dr. Lisa Beever, Charlotte Harbor National Estuary Program, **lbeever@chnep.org;** Whitney Gray, Florida Fish and Wildlife Conservation Commission **whitney.gray@myfwc.com;** and Tim Walker, GIS Analyst, SWFRPC with assistance and/or photo contributions from Jan Allyn, Barbara Ann Comer, Brian Holst, Dr. Steven Richardson, Elizabeth Wong, Ernesto Lasso De La Vega, J. Envoy, Kara Tyler-Julian, Mike Kirby, Priscilla McDaniel, Sanford L. Cooper, Sharon Franz, Betty Staugler, and Stephen H. Brown

On June 1, 2012, the 2012 National Wetland Plant List replaced the 1988 U.S. Fish and Wildlife Service's *National list of plant species that occur in wetlands* (U.S. Fish & Wildlife Service Biological Report 88 (24)) for all wetland determinations and delineations performed for Section 404 of the Clean Water Act, the Swampbuster provisions of the Food Security Act, and the National Wetland Inventory. See *www.***plants.usda***.gov/core/***wetlandSearch.** These were used for the Federal Wetland Status in the plant guide. We used the 2012 source to update scientific names

.

WQFAM 5 is positively statistically correlated with Water Clarity, the 2014 Uniform Mitigation assessment Method (UMAM) and the Average of the Seasonal UMAM.

			Wclar	Uwcla	UMAM3	UMAM4	UMAMav	WQFAM4
Kendall's tau_b	Wclar	Correlation Coefficient	1.000	.454(**)	.080	.189	.139	.179
		Sig. (2-tailed)	.	.005	.610	.224	.366	.247
		N	22	22	22	22	22	22
	Uwcla	Correlation Coefficient	.454(**)	1.000	.510(**)	.735(**)	.636(**)	.376(*)
		Sig. (2-tailed)	.005	.	.002	.000	.000	.019
		N	22	22	22	22	22	22
	UMAM3	Correlation Coefficient	.080	.510(**)	1.000	.679(**)	.836(**)	.285
		Sig. (2-tailed)	.610	.002	.	.000	.000	.069
		N	22	22	22	22	22	22
	UMAM4	Correlation Coefficient	.189	.735(**)	.679(**)	1.000	.848(**)	.419(**)
		Sig. (2-tailed)	.224	.000	.000	.	.000	.007
		N	22	22	22	22	22	22
	UMAM av	Correlation Coefficient	.139	.636(**)	.836(**)	.848(**)	1.000	.375(*)

		Sig. (2-tailed)	.366	.000	.000	.000	.	.015
		N	22	22	22	22	22	22
	WQFAM4	Correlation Coefficient	.179	.376(*)	.285	.419(**)	.375(*)	1.000
		Sig. (2-tailed)	.247	.019	.069	.007	.015	.
		N	22	22	22	22	22	22

Figure 38: Correlations of WQFAM 5.0 with Water Clarity and UMAM taken during different seasons.

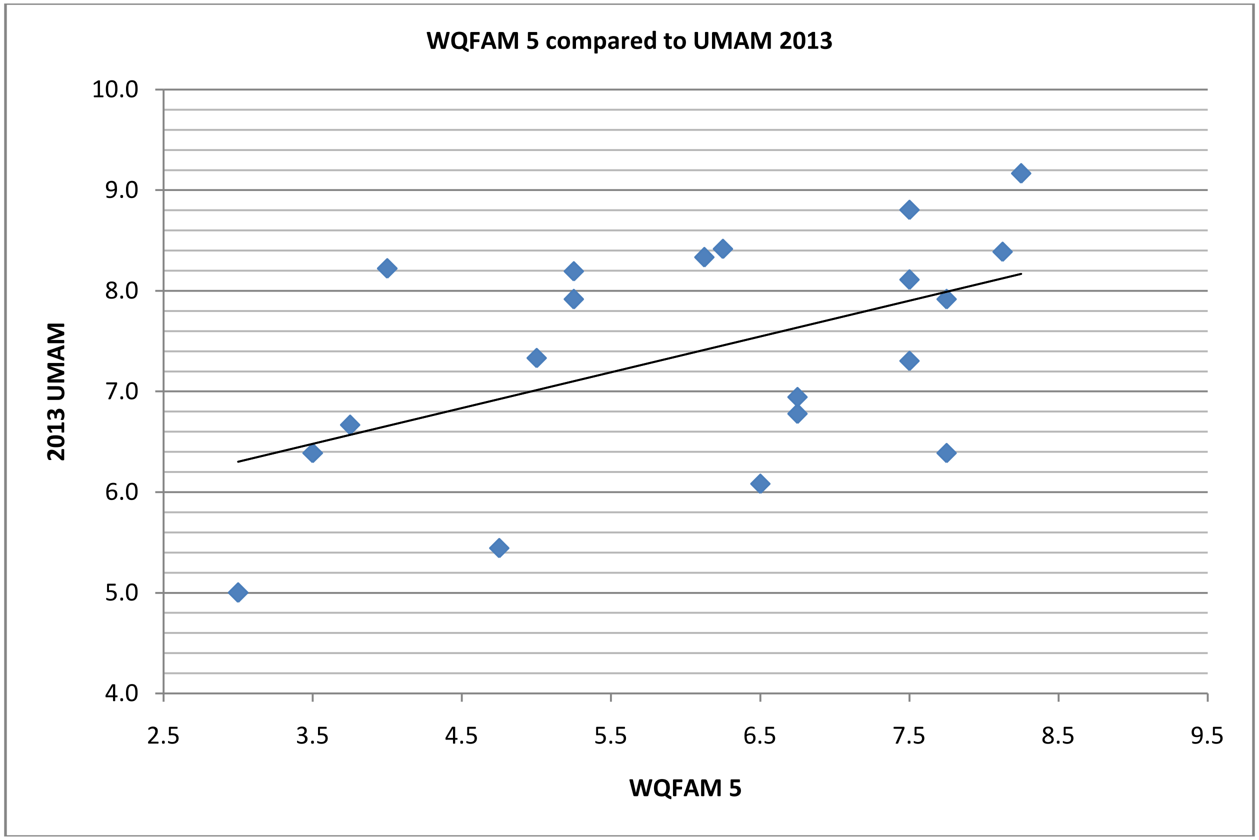


Figure 39: Comparison of WQFAM Version 5 scores to UMAM (2013) scores for the same site at the same time in sample filter marshes.

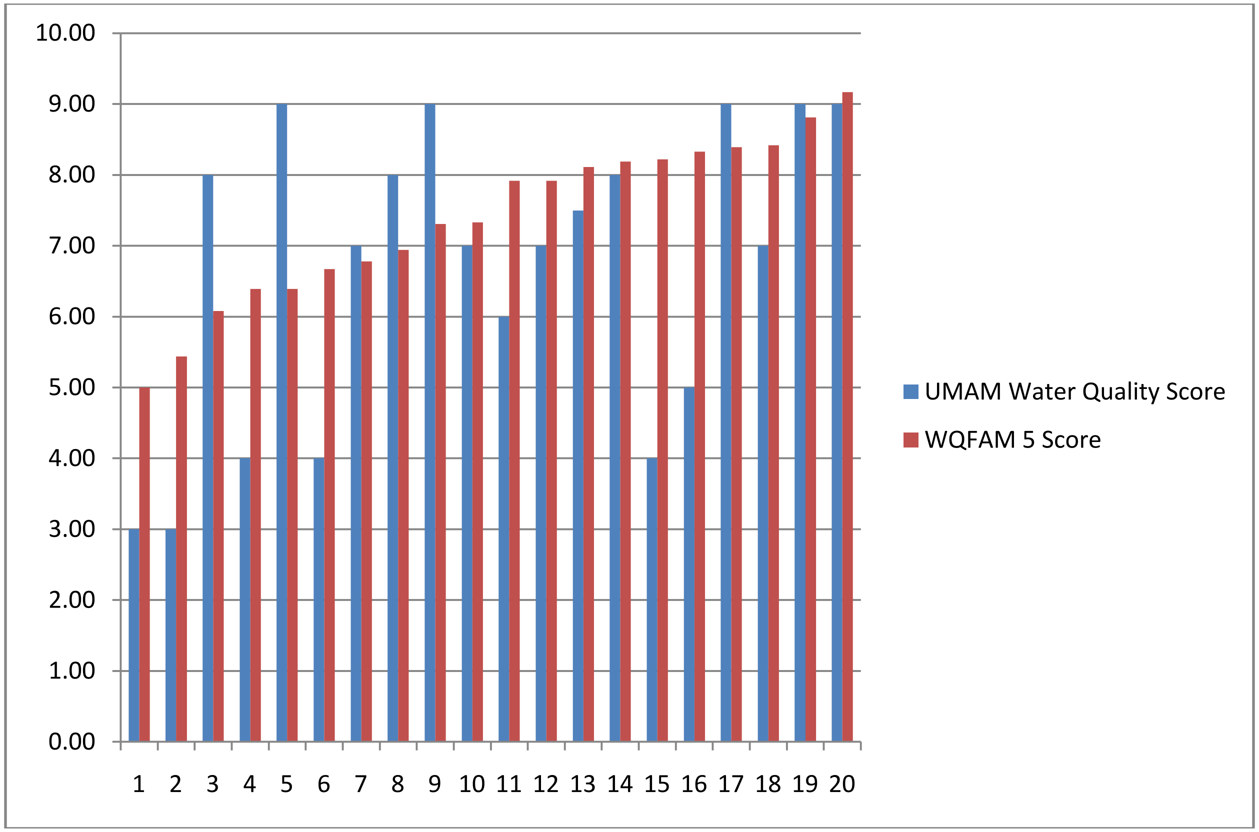


Figure 40: Comparison by filter marsh of UMAM and WQFAM 5 scores taken at the same location at the same time on the same date.

This is the version presented to the CHNEP and the Interagency Project Review Committee for acceptance in a series of five meetings. Input was taken from reviewers and several changes were made. The list of nuisance plant species was alphabetized. The calculation fo the score was described explicitly at the end of the form. Errors in the plant identification field guide were identified and a sticker with errata was created and placed in the field guides. At the request of the reviewers a written protocol to accompany the use of the method in sequence was generated to match with the assessment forms. It was recommended during these reviews that the title of the functional assessment method be changes to Filter Marsh Functional Assessment Method (FMFAM) rather than WQFAM since the method is actually assessing the total filter marsh and not just the water quality of the filter marsh. As a result the method is now designated Filter Marsh Functional Assessment Method (FMFAM) Version 5.1

Filter Marshes Used for Field Testing of WQFAM

For field testing of WQFAM All versions of WQFAM three floating island site in the City of Naples, and seventeen filter marshes of various ages and designs in Charlotte, Collier, Lee, and Sarasota Counties were utilized. All but the Briarcliff site were publically accessible from public roads and sometimes a short walk in a public park. The sites are listed in 38 below.

Filter Marsh Sites	City	County	Number for Graphs
17th Avenue Floating Island	Naples	Collier	1
6th Avenue N	Naples	Collier	2
7th Avenue N	Naples	Collier	3
Billy's Creek	Fort Myers	Lee	4
Briarcliff Canal	Fort Myers	Lee	5
Celery Fields	Unincorporated	Sarasota	6
Conservancy	Unincorporated	Collier	7
East Lake Floating Island	Naples	Collier	8
Elmira and Kings Highway	Unincorporated	Charlotte	9
Ford Canal	Fort Myers	Lee	10
Freedom Park	Unincorporated	Collier	11
Harn's Marsh	Unincorporated	Lee	12
Lake's Park	Fort Myers	Lee	13
Manuel's Branch	Fort Myers	Lee	14
North Colonial Waterway	Fort Myers	Lee	15
Olean and Kings Highway	Unincorporated	Charlotte	16
Powell Creek	Unincorporated	Lee	17
Riverside	Naples	Collier	18
Ten-Mile Canal Cell1B	Fort Myers	Lee	19
The Brooks	Unincorporated	Lee	20

Figure 41: List of the Location of the Filter Marsh and Floating Island Sites Used in WQFAM Testing and Calibration 2012-2015

Figure 42: Location of the Filter Marsh and Floating Island Sites Used in WQFAM Testing and Calibration 2012-2015

The Floating Islands of the City of Naples

Naples Bay is considered impaired for copper by both the federal and state governments, and the Natural Resources Division has worked hard to eliminate this deadly metal's introduction into the bay through the city's stormwater system. Copper sulfate is a commonly used poison that kills algae in stormwater retention ponds (lakes). This chemical dissolves in stormwater and then flows downhill from the ponds into Naples Bay. Once in the bay, copper kills aquatic life. A very small amount is capable of causing harmful effects. To combat this problem, the Division mailed brochures to all residents in the City living on lakes that described a new policy whereby if all of the residents along the shoreline of a lake will agree not to add copper sulfate to their lake, the City will place floating islands and aerators in the water. One group of residents took advantage of this program. The lake between 16th and 17th Avenues South was covered with a thick mat of algae. The City placed floating islands and aerators in it, and within a few short weeks, the lake completely cleared of algae. Another success occurred at North Lake on 7th Avenue North. A few years ago, algae covered the entire surface of the lake. With the addition of floating islands and aerators, the algae disappeared.

The patented floating plant mat consists of puzzle cut mats held together by nylon connectors. These mats may be assembled in any size or shape. After the mats are connected, plants are inserted into pre-cut holes. The plants may be any species of emergent aquatics. The mats can be attached to anchors or shoreline stakes.
As plants grow, the excess nutrients in the water are taken up and stored in their tissues. Periodic harvesting of the mature plants prevents the stored nutrients from re-entering when the plants die and decompose. The floating wetland system provides an easy way to remove the entire plant and replant the mats to increase nutrient removal. This takes care of fluctuating water levels, produces oxygen, takes nutrients and pesticides out of the water, and provides habitat for wildlife utilization.

Most of the treatment of nutrient rich water within a wetland occurs in the thin aerobic layer at the surface of the soils within plant communities. This aerobic biofilm is a result of oxygen leakage from the plant roots at the soil-water interface. In an effort to more efficiently utilize the natural ability of macrophytes to extract and store nutrients from surface water, the designed floating mat system suspends native emergent plants and grasses. Expanding the root zone that is in contact with the water column increases the thickness of the aerobic layer, resulting in increased nitrification and accelerating the process in which nitrogen is cycled from the aquatic environment to the atmosphere. The greatly expanded root mass also facilitates increased uptake and storage of inorganic phosphorus in the plant tissues by creating more surface area for beneficial bacterial colonization. The periodic removal of mature macrophytes from the floating plant mat, prevents the accumulated nutrients from re-entering the aquatic ecosystem at senescence. Those plants are then composted at an upland location, allowing bacterial decomposition to release some of the organic phosphorus so it can be recycled and used as a fertilizer ingredient for growing soil mixtures. The foam and nylon parts of the floating plant mats are re-used to start a new cycle of plant growth and nutrient uptake.

Dr. Mike Bauer, the Director of the storm water program has been instrumental in establishing a very successful, natural, nutrient pollution treatment program, and the islands are appearing in ponds all over the city.

Figure 43: Residential lake BEFORE floating islands and aerators

Figure 44: Residential lake AFTER floating islands and aerators

Figure 45: 6th Avenue North Floating Island

Figure 46: 7th Avenue North Floating Island

Figure 47: 7th Avenue North Floating Island

Figure 48: 17th Avenue Floating Island

East Lake Floating Island

Figure 49: East Lake Floating Island

Billy's Creek Park Filter Marsh

Billy's Creek Filter Marsh is located within the City of Fort Myers on the north bank of Billy's Creek canal directly east of Billy Bow Legs Park at 4320 Woodside Avenue.

The land was acquired through $2,500,000 funding from the Lee County Conservation 20/20 program. The South Florida Water Management District provided $808,000 in grant funding towards the construction of a filter marsh to improve water quality downstream and $308,000 for exotic plant removal for the Billy Creek Filter Marsh, and the City of Fort Myers provided the remainder of the funding and now oversees the daily operations of the facility. The funding and participation partnership also includes:

- Friends of Billy's Creek
- City of Ft Myers Public Works/Stormwater & Parks, Mayor/Council Offices and Planning Department
- Florida Department of Environmental Protection
- Lee County Natural Resources, Parks and Recreation, Visitor Convention Bureau and Public Resources
- Charlotte Harbor National Estuary Program
- Dean Park Historic Neighborhood
- Lee County Schools
- Fould's Foundation
- Edison State College
- American Rivers
- Caroline Comings, Artist
- and other Corporate Sponsors

The 50.69-acre site was acquired Friday, June 27, 2008. Groundbreaking for the filter marsh was September 8, 2008. The filter marsh includes an 8-acre lake and 13.4 acres of filter marshes. the filter marsh construction was completed and planted in December 2009. The park opened to the public on June 2, 2010.

A canoe/kayak launch and 1.5 miles of paved multi-use trails and were added to the site as part of the construction project. A walk-through entrance is located on Woodside Drive. Parking is provided at the City of Fort Myers Billy Bow Legs Park on Marsh Avenue. Recreation opportunities include Bike Trails, Bird Watching, Canoe/Kayak Launch, Fishing, Hiking (Marked Trails), Jogging, Nature Study/Photography, On-leash Pet Walking, Picnic Area.

On July 6, 2010 the Florida Stormwater Association (FSA) awarded the Billy's Creek Filter Marsh with a 2010 Stormwater Project Award for Outstanding Achievement. The FSA Awards recognize stormwater projects that demonstrate creativity in cooperating with other jurisdictions and show an outstanding commitment to best stormwater management practices that benefit the environment and local communities.

Figure 50: Billy's Creek Park Filter Marsh

Photo credit: Wright Construction Group

Figure 51: Billy's Creek Park Filter Marsh

Briarcliff Canal Filter Marsh

The Briarcliff Canal Filter Marsh Project is a 15-acre filter marsh designed to provide wetlands that will filter water from the Briarcliff Canal, thereby improving the water quality. Water will enter the filter marsh by two control structures. A steel sheet-pile weir was installed to aid in the dry season water conservation. There will be no public access to date.

Figure 52: Briarcliff Canal Filter Marsh

Celery Fields Filter Marsh

This 360+ acre site is owned by Sarasota County and is the County's primary flood mitigation park. It is managed by the division of Storm Water and Sarasota County Parks & Recreation. The Sarasota County Department of Transportation is also involved in its management and maintenance.

Mainly consisting of open marshlands, deep ponds, shallow pools, and canals, the Celery Fields are edged by oaks, willows, and pines on the eastern and southern boundaries. The Fields are roughly divided into three segments: the North Cells receive water from the Fruitville Road entry canal and have the deepest ponds. From there, the water is channeled into the Central Cells which cover the area that you see when looking west from the hill. The water then flows under Palmer Boulevard into the South Cells, and then southward into Phillippi Creek.

Historically the area was a sawgrass marsh and evidence of early native settlement has been found. The site is also rich in paleontological artifacts. From about 1920, the Palmer interests (also known as the Sarasota-Venice Company, originally started by Mrs. Potter Palmer who died in 1918) extended the vegetable growing area from Gulf Gate to the location of the present Celery Fields. Prior to that time, the site was a rich muckland known as Big Camp Saw Grass and Tatum Saw Grass. The muck (peat) occupied the lowest 2,000 acres, and was surrounded by a higher dark loam area and an even higher sandy area. The depth of the muck varied from a few inches to 8 feet, and was composed of from 66 to 73% organic material. Below the muck layer was sand, which varied inversely with the depth of the muck. A clay or marl layer lay about four feet deeper still. The Palmer interests engaged Arcadia engineer J .A. Kimmel to make topographical maps and a drainage plan for the entire 8,000-acre area. The site was organized as the Sarasota Fruitville Drainage District in 1921. The firm of Cravens and Kimmel prepared excellent 1-foot contour maps for drainage, which made development in the Phillippi Creek watershed possible. Construction of the Celery Fields began in 1923. The main canals were finished by 1926. An experimental farm of 2,000 acres was set up under the direction of E.L. Ayres, then County Agent. Although different vegetables were tried, by 1927, it was decided to grow predominantly celery. Roads were built across the area. Since the muck was constituted in great part by acid, lime was added: 1.5 to 2 tons of ground limestone and 1 to 1.5 tons of hydrated lime per acre. Unit ditches served 10-acre tracts. Artesian wells served two 10-acre tracts from each 6-inch well. At first, just a spring crop was harvested. Later both spring and fall crops were grown. The farms, which were sold off as private units, continued to produce celery until the property was acquired by Sarasota County in 1995.

Sarasota County in cooperation with the Southwest Florida Water Management District began construction fo the regional stormwater treatment project in the later part of the 1990s. Kimley-Horn served as consultant for the Celery Fields Regional Stormwater Facility (CFRSF), and analyzed, planned, and developed the Celery Fields Integrated Water Resources Plan. The firm conducted flood protection enhancement alternative development, hydrologic/hydraulic modeling, analysis design and permitting; investigated and evaluated stormwater reuse opportunities for alternative water supply and water quality benefits; and conducted planning and preliminary design of alternative recreational facilities associated with and located at the CFRSF. Celery Fields also serves as a passive recreational park for the local community. Kimley-Horn provided design, planning and community involvement services related to the park project. This project won a 2005 Award of Honor from the Florida ASLA.

Wetlands restoration of 100 acres is complete at the Celery Fields. More than 200,000 aquatic plants and trees have been planted, and two boardwalks have been installed, one off Palmer Blvd and the other off Raymond Road which borders the southeastern cell.

Sarasota County, recognizing the importance of the Celery Fields as a food and habitat source to a wide variety of birds and other wildlife, worked with Sarasota Audubon to restore 100+ acres in the Southern Cells into a more traditional wetland. Wetlands restoration of 100 acres is now complete at the Celery Fields. More than 200,000 aquatic plants and trees have been planted. The County also constructed two boardwalks: one on Palmer Blvd and the other on Raymond Rd. Both boardwalks provide excellent opportunities for wildlife watching.

In early 2001, Sarasota Audubon began conducting bird surveys at the Fields. To date, 217 species have been recorded. Wintertime offers particularly good birding, hosting sparrows, Marsh and Sedge Wrens, and several species of rails, including Sora and Virginia. The Fields also host breeding birds, including Black-necked Stilts, King Rail, Least Bittern, Limpkin, Purple Gallinule, Eastern Towhee, Barn Owl and Eastern Meadowlark. Least Terns breed on nearby buildings and use the ponds as a primary food source. Rarities show up from time to time, including Upland and White-rumped Sandpipers, Short-eared Owl and Nelson's Sharp-tailed Sparrow.

The Celery Fields Filter Marsh has dedicated public parking and an extensive recreational boardwalk as well as paths for biking, and other activities. On our site visit there were quite a few people utilizing the filter marsh for recreation.

Figure 53: The Celery Fields Filter Marsh Sightseeing Boardwalk

Figure 54: The Celery Fields Filter Marsh Sightseeing Boardwalk

Figure 55: The Celery Fields Filter Marsh

Figure 56: The Celery Fields Filter Marsh

Conservancy of Southwest Florida Filter Marsh

The Shotwell Wavering Family Filter Marsh is a natural filtration system located at the Conservancy of Southwest Florida Nature Center. Within the Gordon River South sub-basin, in Naples, Florida, an existing drainage ditch allowed stormwater runoff to flow from the Coastland Center Mall parking lot, Goodlette-Frank Road, and adjacent residential areas with minimal or no treatment. The ditch bisects the Conservancy property before it discharges into the Gordon River. The purpose of the Conservancy Filtration Marsh Project was to reduce urban runoff pollution, while enhancing the wildlife and education values of the site. The runoff would pick up pollutants and debris, run into the ditch and flow directly into the Gordon River, eventually emptying into Naples Bay. This runoff severely impacted the water quality in the Bay. This filter marsh project was designed by Hole-Montes engineers to intercept the stormwater flow in the drainage ditch and divert it into a wet detention pond, draining through a filter marsh before discharging into the river. The littoral shelf comprises a minimum of 30 percent of the surface area of the basin and is planted with native wetland vegetation. The shelf while reducing erosion, enhances the biological uptake of pollutants by plants, prevents re-suspension of sediments, and increases the habitat and aesthetic values of the filter marsh. A new, large box culvert improved ditch flow characteristics and replaced an existing ineffective drainage culvert. The drainage ditch was analyzed with HEC-RAS to see the effects the improvements would have on the existing condition during the permitting phase of the project. The results of the analysis showed that upstream head conditions was reduced dramatically by removing the existing triple ERCP ditch culvert and replacing it with a smaller box culvert. These types of BMP improvements will reduce erosion of the ditch side slopes during high flow events, decrease the risk of upstream flooding, provide a littoral zone for further improved wildlife habitat/foraging, and provide additional treatment of the stormwater runoff.

The filter marsh uses plants and settling ponds to clean the water, rather than water treatment plants and chemicals. It ensures that our site's drainage is clean before it leaves the Nature Center rather than polluting the Gordon River and Naples Bay, greatly reducing the Nature Center's impact on municipal systems. Now, the filter marsh and all remaining green space on campus are protected from further development by conservation easements and LEED Sustainable Site commitment. Within six months of the end of construction, the filter marsh and sedimentation basins have proven to be a valuable habitat to small fish and wading birds. Wood storks, roseate spoonbills, great blue herons, egrets and river otters have utilized the filter marsh.

Figure 57: Conservancy of Southwest Florida Filter Marsh Flow way

Figure 58: Conservancy of Southwest Florida Filter Marsh

Figure 59: River otters in the Conservancy of Southwest Florida Filter Marsh (Jennifer Hecker, Conservancy of Southwest Florida 4/20/2015)

Elmira/Olean and Kings Highway Filter Marsh

The filter marshes flanking both sides of King's Highway were constructed to address stormwater associated with the King's Highway widening to a divided boulevard. This novel design is an alternative to the typical borrow pit postage stamp type ponds located along roadways for storm water treatment. The multiple cell system treats water from the highway and adjacent residential and commercial areas eventually discharging to the Charlotte canals drainage system.

Figure 60: Elmira and Kings Highway Filter Marsh

Figure 61: Olean and Kings Highway Filter Marsh

Ford Canal Filter Marsh

This project proposes to provide a BMP for this watershed by intercepting all seasonal runoff from the canal and diverting it to a constructed wetland system that shall consist of: control structure across Ford Street canal, settling pond and two planted wetland treatment cells prior to discharging through an overflow weir to Billy's Creek. This BMP is expected to reduce the following pollutants discharging to Billy Creek: Biochemical oxygen demand (40-60%), Chemical Oxygen Demand (40-60%), Total Nitrogen (20-40%), Total Suspended Solids (60-

80%), and Total Phosphorus (20-60%). The system shall also have passive park amenities to educate the public on storm water pollution to minimize their effect on the environment.
The project also includes 1.63 acres of the passive recreational facility to improve accessibility and provide additional amenities along Billy's Creek. The improvements consist of constructing a paved walking trail from the existing handicap parking spaces within the park to the existing boardwalk, expanding the available parking at the boardwalk, renovating the existing wooden boardwalk, removing the existing canoe/kayak launch, and constructing 1,299 linear feet of new boardwalk over the herbaceous freshwater marsh, a picnic pavilion, and bike rack. An 18 linear foot extension of 14-inch by 23-inch elliptical reinforced concrete culvert is proposed associated with the paved walkway.

Figure 62: Ford Canal Filter Marsh

Freedom Park Filter Marsh

Collier County built this water quality treatment park as part of the "Save the Naples Bay" Plan to address harmful pollutants and alleviate flooding problems in surrounding areas. The park also provide a number of passive recreational and educational uses. The site is situated on a 50 (+/-) acres parcel of County owned property located on the northeast corner of Goodlette-Frank Road and Golden Gate Parkway. The stormwater run-off within this watershed discharges directly into the Gordon River, proceeds to Naples Bay and ultimately makes its way to the Gulf of Mexico.

Formerly known as the Gordon River Filter Marsh the Freedom Park Filter Marsh is Based on the application of an interconnected system of multi-depth ponds, polishing marshes and

wetlands, the man-made park functions as a natural filtration system in an urban setting using Everglades-type passive storm water treatment technologies.
The restored wetlands comprise the eastern third of the property. Amenities include a 5-acre lake with approximately 3500 feet of boardwalk constructed throughout the park. Existing onsite wetlands have been restored via removal of exotic vegetation and planting of native species. Other amenities include a 2500 square-foot educational facility with restrooms, six lookout pavilions, water fountains, and walking trails. Educational and informational signage is in the process of being developed and should be installed soon. The design of this facility will allow the County the future option of an Aquifer Storage and Recovery System (ASR) within the park which will help store treated stormwater run-off for future landscape irrigation use.

The land purchase price for the site was $19,214,818. More than 70 percent of the funding for the project is from grants. The $10 million project was constructed by Kraft Construction Company. Florida Communities Trust provided $6 million and $1.5 million was granted by South Florida Water Management District. The remainder of the funding was allocated from ad valorem taxes.

Figure 63: Plan design of the Freedom Park by CH2MHill

Figure 64: Aerial of the Freedom Park Wetlands, Naples FL

Figure 65: Freedom Park Filter Marsh

Figure 66: Freedom Park Filter Marsh

Figure 67: Freedom Park Filter Marsh

Figure 68: Freedom Park Filter Marsh

Harn's Marsh Filter Marsh

Harns Marsh is located in the eastern portion of Lee County located off of Sunshine Blvd in Lehigh Acres. The South Florida Water Control District built the marsh on land formerly owned by a farmer named Harns. Harns Marsh is owned by the East County Water Control District. It is a 578-acre man-made marsh used to filter the stormwater runoff and reduce flooding from the Lehigh Acres Area Before it enters the Orange River. Planning for this Marsh Started back in 1981 and the lake/marsh system was completed in 1985. In 2007, some 182 acres along the north marsh were dredged and cleared of invasive plants, which improved water quality and wildlife viewing. An expansion section (West Side) was purchased in December 2008 via the Conservation 20/20 Program and it is planned to make in public access friendly. The manmade marsh is now a lush habitat for snail kites, limpkin and more than 164 other species of animals. Hiking and bicycling, but no motorized vehicles, are allowed on the four-mile sandy impoundment road encircling the marsh. There is a Harns Marsh Wings over Water Festival most recently held on February 27 & 28, 2015. There is a Friends of Harns Marsh Association and a middle school named after Harns Marsh.

Figure 69: Harns Marsh Filter Marsh

Figure 70: Harns Marsh Filter Marsh

Figure 71: Harns Marsh Filter Marsh

Lake's Park Filter Marsh

The Lakes Park project entails construction of 40 acres of filter marsh connecting the east lake to the west lake, resulting in a flow way that reduces nutrients, improves oxygen content and enhances conditions for native wildlife. As a result of this restoration work, cleaner water will be discharged from the lake to improve water quality in Hendry Creek and Estero Bay, Florida's first Aquatic Preserve. It is part of the Comprehensive Everglades Restoration Plan (CERP). Lee County finished the project that's designed to clean up area water in February 2013. The $2.3-million water quality project was funded by the DEP, the South Florida Water Management District and Lee County's general fund. What was once a rock quarry has been transformed into a filter marsh designed to reduce pollution in the waterway - a requirement by the state. The county could have faced potential fines if they didn't correct the problem. That often causes algae blooms and fish kills. Hendry Creek is impaired for nutrients and the project is designed to take the pollutants out of the water stream that comes from the water shed above it, sources. It's also expected to bring in more people adding to the half-million who already pass through gates of Lakes Park each year. Kayaking and canoeing are proposed as part of the recreational use.

Figure 72: Lakes Park Filter Marsh Before and After

Manuel's Branch Filter Marsh

Manuel's Branch is the name of a narrow, wooded creek that meanders westward along the southern boundary of Fort Myers High School and Edison Park before it empties into the Caloosahatchee River. Where Cortez Boulevard crosses the stream, the roadway is supported by the Manuel's Branch Filter Marsh located behind the Fort Myers High School just downstream of the Manuel's Branch Bridge.. The SFWMD provided $240,000 for a flood control project at Manuel's Branch that included the small filter marsh and $15,000 for silt reduction in Manuel's Branch.

Manuel's Branch Bridge was selected in 2000 as the site for a memorial honoring Manuel A. Gonzalez, Fort Myers' first permanent settler. The memorial consists of bridgeworks cast by local sculptor D.J. Wilkins, who was hired for the project by the Fort Myers Beautification Advisory Board, which had commissioned more than 20 other public artworks from the "official sculptor of Fort Myers." Wilkins skirted the bridge with 450 feet of ornate balustrade that contains end pilasters that feature raised reliefs of Manuel A. Gonzalez in cast marble and spacer pilasters that depict hummingbirds, butterflies, palmetto fronds and sea oats. Each was made from brands cut out of copper, hammered into shape and heated to burn the pattern into blue foam panels. The panels, in turn, were inserted into the moulds before the concrete was poured into them. When the moulds were stripped, the pattern was left in relief. For moulds he made for the balusters, base and upper railings, Wilkins borrowed the pattern used by the WPA in the 1930s for the railings adjoining the Fort Myers Yacht Basin. He poured the balusters using 4,000 psi concrete for strength and durability. Each 12-foot section of rail weighs a staggering 1.5 tons. "The railing system has no steel running between the individual parts," Wilkins points out, "and is designed to 'break away' when hit by a car." The design not only reduces the risk of injury to the vehicle's occupants, but decreases the costs of repair. "[The rails have] been hit seven times since being installed in 2000," notes Wilkins, who hastens to add that there have been no injuries and that the total cost of all seven repairs has been just $4,500.

Figure 73: Manuel's Branch Bridge

Figure 74: Manuel's Branch Bridge

Figure 75: Manuel's Branch Filter Marsh

Figure 76: Manuel's Branch Filter Marsh

North Colonial Waterway Filter Marsh

The project site is located in central Lee County, adjacent to Ten Mile Canal between Daniels Road and Six Mile Cypress Parkway. The north colonial filter marsh also has a linear bike path, and on our visit there were plenty of people utilizing this public land. It is one of the oldest filter marshes and utilizes old borrow pit excavations as cells of the filter marsh. Traveling parallel to the North Colonial Waterway from Metro Parkway to Ortiz Avenue, the 2.7 mile North Colonial Linear Park pathway is available to bicycles & pedestrians

Figure 77: North Colonial Waterway Filter Marsh

Powell Creek Filter Marsh

The Powell Creek Preserve was formerly part of Hart's Dairy in the 1950's. Lee County purchased the 77.2 site for $618,000.00 on August 1, 2003.It is located west of Hart Road in North Fort Myers, and contains the northern most reaches of the natural channel of Powell Creek.

The South Florida Water Management District partnered with Lee County to design, construct and operate an 18-acre filter marsh on the 77-acre Powell Creek Preserve, a Conservation 2020 preserve acquired in 2003 for $618,000. The main purpose of this project is to improve the water quality of Powell Creek and reduce existing impairments within the Creek before it enters the Caloosahatchee River. The project diverts water from both Powell Creek and Powell Creek

Canal into the filter marsh utilizing a pump. The water discharges into a deeper area of the marsh to allow sediment to settle out. Water then flows through a series of shallow and deep wetland areas for treatment. allowing sediment to settle out and for nutrients to be absorbed by wetland plants before flowing back into Powell Creek. via a control structure. The filter marsh has been designed with sinuous edges to lessen the impact to the gopher tortoises that inhabit portions of the site and to provide a more natural appearance. The existing wetland located in the southeast corner of the Powell Creek Preserve property was incorporated into the proposed filter marsh to improve its hydrology. Filter marshes act as a natural filter cleaning nutrients generated in upstream urban and agricultural areas. The filter marsh improves the natural function of Powell Creek by restoring and creating adjacent wetlands and reduce existing water quality impairments. Construction began in October 20111 and was completed September 2012, on a portion of the Conservation 2020 Powell Creek Preserve land. Included with this project are pedestrian trails adjacent to the wetlands for hiking, bird watching, and nature photography opportunities.

The project is a part of the Caloosahatchee River Watershed Protection Plan. Developed by a variety of public and private interests, the watershed protection plan involves the evaluation of various alternatives using best available tools and scientific information to identify science-based and technologically feasible options for improving ecosystem health in the Caloosahatchee River.

Figure 78: Powell Creek Filter Marsh

Figure 79: Powell Creek Filter Marsh

Figure 80: Powell Creek Filter Marsh during construction and before planting

Riverside Filter Marsh

Located to the east of Goodlette-Frank Road behind the public works facility along the shoreline of the Gordon River, the Riverside Filter Marsh was built to lower amounts of pollutants entering Naples Bay. Prior to construction of this 1.4 acre project, the city drained stormwater from a 226 acre urbanized area directly into the Gordon River without treatment. This runoff carried phosphates and nitrates from fertilizer, bacteria, and other pollutants into the upper reaches of Naples Bay. The filter marsh now intercepts the stormwater and naturally treats it prior to discharge into the river. By running stormwater through a constructed wetland marsh, plus changing the flow from a point flow to a sheet flow, amounts of pollutants flowing off the City and into Naples Bay have been reduced. Further, the marsh provides habitat for wetland plants and animals. Otter, wood storks, egrets, and herons are already using the site.

Figure 81: Riverside Filter Marsh looking south

Figure 82: Riverside Filter Marsh boardwalk at outflow connection to Naples Bay

Ten-Mile Canal Filter Marsh

The Ten Mile Canal was constructed in the 1920's to drain agricultural lands in South Fort Myers. It cut through the Six-Mule Cypress Strand disconnecting it form the headwaters of Hendry Creek. In the 1970's the Canal was deepened and widened, and control structures were installed to maintain the water table and to protect saltwater intrusion. The Ten Mile canal watershed covers an area of 13 square miles and flows into Mullock Creek, an outstanding Florida Water which is designated as impaired, and subsequently into Estero Bay, Florida's first aquatic preserve. The existing predominant land use includes commercial and industrial. The watershed is affected by heavy urban development, cropland, and some pastureland along the banks.

Construction of an approximately 6,000-foot long filter marsh was completed in December 2005. The filter marsh is located approximately at the half-way point along the canal length between Daniels Boulevard and Six-Mile Cypress Parkway. The construction involved excavating approximately 400,000 cubic yards of material from a 6,000-foot by 100-foot area adjacent to the canal and routing the canal water into the filter marsh through two (2) 30-inch diameter pipes. A maintenance road and a recreation bike path have been constructed to separate the canal from the filter marsh. The inlet with a controllable screw type sluice gate system is installed upstream of a weir. Water flow into the filter marsh system is regulated through the gate system. The filter marsh system is divided into four (4) different cells connected through three (3) 30-inch diameter pipes.

Water depths in cells vary from 18 inches to 5 feet. The first cell acts as a settling basin with limited wetland vegetation. The second cell is shallow and planted with wetland vegetation. The third cell is deeper than any other cell and has wetland vegetation suitable for deeper water. The last cell is shallow and also has a lot of shallow water wetland vegetation. Each cell is outfitted with an outflow riser regulated by flash boards. This structure allows excess water flow back into the canal. Further, this structure is being used to lower the water level in the cells during maintenance events.

The long term goal is to implement dynamic, effective water quality enhancement for Lee County's designated impaired water bodies. Nutrient reduction is the primary focus of this project. In order to monitor the effectiveness of the system, Lee County Environmental Lab is collecting water quality samples on a monthly basis at stations established within the filter marsh in addition to established sampling stations in the canal proper. Flow and stage data within the marsh is collected to coincide with the water quality sample collection. Water quality data collected show some improvements from inflow to outflow conditions. The maintenance of the filter marsh includes harvesting wetland vegetation on a regular basis. The construction cost of the filter marsh was approximately 1.6 million dollars. Florida Department of Environmental Protection provided $507,000 in grant funding. The filter marsh was constructed along with a contiguous linear park to the east of the filter marsh. Both the filter marsh and the linear park were included in a single construction project.

Figure 83: Ten Mile Canal Filter Marsh

Figure 84: Ten Mile Canal Filter Marsh

The Brooks Filter Marsh

The developer of The Brooks worked in conjunction with Lee County and the SFWMD on the flow way design that provides the dual purpose of area-wide flood control and re-establishment of hydro-period of the existing wetland systems on site. Hole Montes was the Engineer of Record for a project originally known as the Sweetwater Ranch which was later developed as The Brooks at Bonita Springs and Coconut Point. The project is made up of approximately 5 sections of land in Estero, Florida. The project started in the late 1980's when the land was utilized for farming. Topographic surveying and the setting and monitoring of shallow groundwater wells for the determination of seasonal water level trends were completed. Permitting through the SFWMD and USACOE for the project incorporated the design of a wetland flow-way system, re-establishing a hydraulic connection of on-site wetlands to the existing Halfway Creek watershed, designed to mimic the pre-existing natural conditions and incorporated the existing conditions monitoring data. In addition, the flow-way was extended through the project to the east and connected to culverts passing through the I-75 right-of-way for a hydraulic connection to land east of I-75 to redirect floodwaters from the Imperial River basin after the early 1990's flooding. The developer worked in conjunction with Lee County and the SFWMD on the flow-way design that provides the dual purpose of area-wide flood control and re-establishment of hydro-period of the existing wetland systems on site. The flow-way consisted of lakes and swales excavated through cap rock adjacent to the wetland areas and was designed as an outfall for most of the drainage basins within The Brooks and Coconut Point. Control structures consisting of broad-crested weirs were designed within the flow-way to maintain the water levels at the historic water table elevations. The weirs and several culvert crossings were modeled and designed using HEC-RAS river routing software. The project is currently home to several thousand residents and includes over a million square feet of retail commercial development.

Figure 85: The Brooks Filter Marsh

Figure 86: The Brooks Filter Marsh

Species Observed.

During the field review we observed 42 plant species and 65 animal species; including 10 mammals, 28 birds, 12 reptiles, 4 amphibians, and 11 fish species in the filter marshes sampled.

Figure 87: Plant Species Observed During Field Work		
Common Name (s)	*Genus*	*Species*
Giant leather fern	*Acrostichum*	*danaeifolium*
alligator weed	*Alternanthera*	*philoxerdides*
broomsedge	*Andropogon*	*sp.*
salt bush	*Atriplex*	*polycarpa*
Bacopa	*Bacopa*	*monnieri*
Spanish needles	*Bidens*	*alba*
American beauty berry	*Callicarpa*	*americana*
yellow Canna	*Canna*	*flaccida*
sea grape	*Coccoloba*	*uvifera*
elephant ear	*Colocasia*	*sp.*
papayrus	*Cyperus*	*papyrus*
spike rush	*Eleocharis*	*cellulosa*
smooth Rush	*Equisetum*	*laevigatum*
Hydrilla	*Hydrilla*	*verticillata*
soft stem Juncus	*Juncus*	*effusus*
white mangroves	*Lanuncularia*	*racemosa*
southern cutgrass	*Leersia*	*hexandra*
duckweed	*Lemnoideae*	*spirodela*
white lily	*Lilium*	*candidum*
primrose willow	*Ludwigia*	*octovalvis*
primrose willow	*Ludwigia*	*peruviana*
melaleuca	*Melaleuca*	*quinquenervia*
water lily (yellow)	*Nuphar*	*lutea*
maiden cane	*Panicum*	*hemitomon*
torpedo grass	*Panicum*	*repens*
bahia grass	*Paspalum*	*notatum*
lawn grass	*Paspalum*	*sp.*
water lettuce	*Pistia*	*stratiotes*
pickerelweed	*Pontederia*	*cordata*
cabbage palm	*Sabal*	*palmetto*
duck potato	*Sagittaria*	*latifolia*
bulltongue arrowhead	*Sagittaria*	*lancifolia*
lance-leaf Sagittaria	*Sagittaria*	*spathea*
Broadleaf arrow head	*Sagittaria*	*latifolia*
coastal willow	*Salix*	*hookeriana*
Brazilian pepper	*Schinus*	*terebinthifolius*
coastal little bluestem	*Schizachyrium*	*littorale*
bulrush	*Scirpus*	*sp*
golden rod	*Solidago*	*sempervirens*
Bakers cordgrass	*Spartina*	*bakerii*
Cypress	*Taxodium*	*distichum*
Fire Flag	*Thalia*	*geniculata*
cattail	*Typha*	*Latifolia*

Figure 88: Mammal Species observed visually or by sign during field testing		
Common Name	**Genus**	**Species**
Big Cypress fox squirrel	*Sciurus*	*niger avicennia*
bobcat	*Felis*	*rufus*
domestic dog	*Canis*	*familiaris*
feral hog	*Sus*	*scrofa*
hispid cotton rat	*Sigmodon*	*hispidus*
marsh rabbit	*Sylvilagus*	*palustris*
raccoon	*Procyon*	*lotor*
river otter	*Lontra*	*canadensis*
Virginia opossum	*Didelphis*	*virginiana*
white-tailed deer	*Odocoileus*	*virginianus*

Figure 89: Bird Species observed during field testing		
Common Name	**Genus**	**Species**
anhinga	*Anhinga*	*anhinga*
bald eagle	*Haliaeetus*	*leucocephalus*
bank swallow	*Riparia*	*riparia*
belted kingfisher	*Ceryle*	*alcyon*
blue-winged teal	*Anas*	*discors*
common egret	*Ardea*	*albus*
cattle egret	*Bubulcus*	*ibis*
Common Moorhen	*Gallinula*	*chloropus*
common nighthawk	*Chordeiles*	*minor*
double-crested cormorant	*Phalacrocorax*	*auritus*
Florida Ducks	Fulvigula	fulvigula
great blue heron	*Ardea*	*herodias*
great egret	*Ardea*	*alba*
green-backed heron	*Butorides*	*virescens*
little blue heron	*Egretta*	*caerulea*
loggerhead shrike	*Lanius*	*ludovicianus*
Louisiana Heron	*Egretta*	*tricolor*
Louisiana water thrush	Parkesia	*motacilla*
mallard duck	*Anas*	*platyrhynchos*
mockingbird	*Mimus*	*polyglottis*
Muscovy Duck	*Cairina*	*moschata*

osprey	*Pandion*	*haliaetus*
roseate spoonbill	*Platalea*	*ajaja*
solitary sandpiper	*Tringa*	*solitaria*
swallowtail kite	*Elanoides*	*fortificatus*
tricolor heron	*Egretta*	*tricolor*
turkey vulture	*Cathartes*	*aura*
white ibis	*Eudocimus*	*albus*

Figure 90: Reptile Species observed during field testing		
Common Name	***Genus***	***Species***
green anole	*Anolis*	*caroliniana*
alligator	*Alligator*	*mississippiensis*
banded water snake	*Nerodia*	*fasciata*
black racer	*Coluber*	*constrictor priapus*
brown anole	*Anolis*	*sagrei*
corn snake	*Elaphe*	*guttata elapsoides*
Florida banded water snake	*Nerodia*	*fasciata cyclas*
Florida box turtle	*Terrapene*	*carolina bauri*
mangrove salt marsh snake	*Nerodia*	*clarkii compressicaida*
peninsular cooter	*Pseudemys*	*peninsularis*
soft shell turtle	*Apalone*	*ferox*
yellow-bellied slider	*Trachemys*	*scripta scripta*

Figure 91: Amphibians Species observed during field testing		
Common Name	***Genus***	***Species***
Cuban tree frog	*Osteopilus*	*septentrionalis*
green tree frog	*Hyla*	*cinerea*
Pig Frog & tadpoles	*Rana*	*grylio*
Southern leopard frog	*Rana*	*sphenocephala*

Figure 92: Fish Species observed during field testing		
Common Name	***Genus***	***Species***
blue tilapia	*Oreochromis*	*aureus*
bluegill	*Lepomis*	*macrochirus*
Brown bullhead catfish	*Ameiurus*	*nebulosus*
Eastern mosquitofish	*Gambusia*	*holbrooki*
Florida gar	*Lepisosteus*	*platyrhincus*
hogchoker	*Trinectes*	*maculatus*
long-nosed killifish	*Fundulus*	*similis*
mullet	*Mugil*	*sp.*
sailfin molly	*Poecilia*	*latipinna*
sheepshead minnow	*Cyprinidon*	*variegatus*
snook	*Centropomus*	*undecimalis*

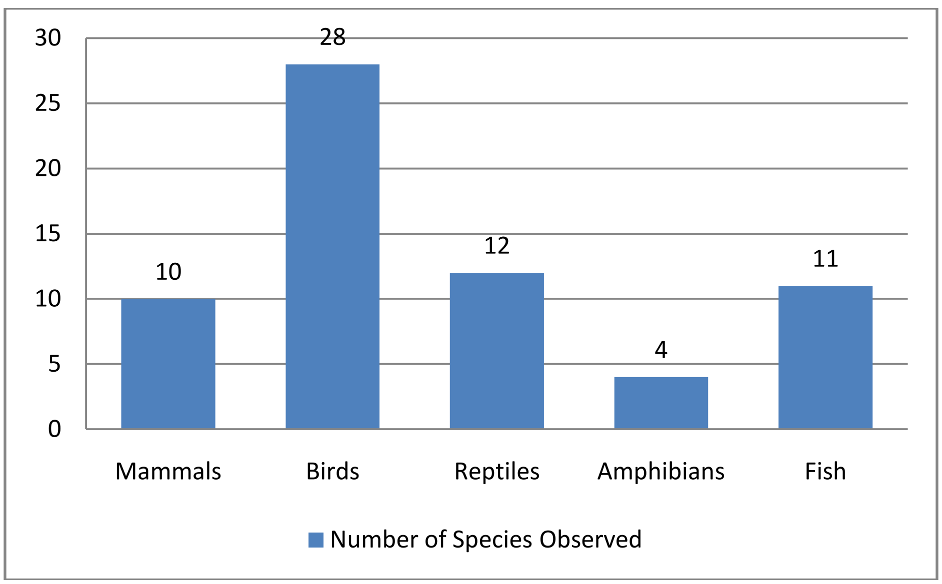


Figure 93: Number of animal species by group observed during field testing

FMFAM Version 5.1: The Final Version

FMFAM 5.1 DATA SHEET
Part 1 Water Clarity

Site/Project Name	Site/Project ID	Conducted by Date

Container Visual Review (look through the container)

Can't see through the container = 1
Can see through container, but can't read text on datasheet = 4
Can see through container, and can read text on datasheet = 6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water = 10

Container visual review score = ___________

Visual Indicators

Floating Solids	Yes / No	Describe
Suspended Solids	Yes / No	Describe
Oil / Fuel Sheen	Yes / No	Color and amount
Foam	Yes / No	Describe thickness, color, how much surface it covers
Dead Aquatic Life	Yes / No	Describe

1

Figure 94: FMFAM Version 5.1 Water Quality Data Sheet

FMFAM 5.1 DATA SHEET
Part 2 Algae

Site/Project Name	Site/Project ID	Conducted by Date

Algal Community - Circle score or check box

	Score
Algal community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The algal community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Algal community composition score=

Algal Biomass

Algal biomass low 0%	10
	7
Algal biomass moderate 50%	5
	3
Algal biomass excessive 100%	0

Algal biomass score =

Blue-Green Algae

No blue-green or filamentous green algae	10
Approximately 30% blue-green or filamentous green algae	7
Approximately 50% blue-green or filamentous green algae	5
Approximately 70% blue-green or filamentous green algae	3
Blue-green or filamentous green algae monoculture	0

Blue-green algae score =

Algal Cover

Algal cover characteristic for that wetland type	10
Most of the algal cover characteristic for that wetland type	7
Half of the algal cover characteristic for that wetland type	5
Some of the algal cover characteristic for that wetland type	3
Algal cover completely uncharacteristic for that wetland type	0

Algal cover score =

2

Figure 95: WQFAM Version 5.1 Algae Data Sheet

FMFAM 5.1 DATA SHEET
Part 3 Vascular Plant Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Examples of Undesirable Species (circle)

Common Name	Genus	Species
air potato	*Dioscorea*	*bulbifora*
alligator weed	*Alternantera*	*philoxeroides*
Australian pine	*Casuarina*	*equisetifolia*
bahia grass	*Paspalum*	*notatum*
Brazilian pepper	*Schinus*	*terebinthifolius*
Caesar weed	*Urena*	*lobata*
carrotwood	*Cupaniopsis*	*esculenta*
cattail	*Typha*	spp.
Chinese tallow	*Sapium*	*secunotatum*
climbing cassia	*Senna*	*pendula*
climbing hempweed	*Mikania*	*scandens*
downy rose myrtle	*Rhodomyrtus*	*tomentosa*
guava	*Psidium*	*guajava*
hydrilla	*Hydrilla*	*verticillata*
Japanese climbing fern	*Lygodium*	*japonicum*
Java plum	*Syzygium*	*cumini*
melaleuca	*Melaeuca*	*quinquenervia*
old world climbing fern	*Lygodium*	*microphyllum*
para grass	*Brachiaria*	*mutica*
primrose willow	*Ludwigia*	*peruviana*
seaside mahoe	*Tespesia*	*populnea*
shoebutton ardisia	*Ardisia*	*elliptica*
taro	*Colocasia*	*esculenta*
torpedo grass	*Panicum*	*repens*
water hyacinth	*Eichornia*	*crassipes*
water lettuce	*Pistia*	*stratiotes*
water primrose	*Ludwigia*	*octovalvis*
wedelia	*Wedelia*	*trilobata*
West Indian marsh grass	*Hymenachne*	*amplexicaulis*

Vascular Plants Observed

Vascular Plant Community

	Score
Plant community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The plant community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Plant community composition =

3

Figure 96: FMFAM Version 5.1 Page 1 Plant Species and Condition Data Sheet

Vascular Plant Community Zonation

Zonation of vegetation appropriate	10
⇕	7
	5
	3
Zonation of vegetation inappropriate	0

Plant community zonation score =

Vascular Plant Cover

Plant cover characteristic for that wetland type	10
Most of the plant cover characteristic for that wetland type	7
Half of the plant cover characteristic for that wetland type	5
Some of the plant cover characteristic for that wetland type	3
Plant cover completely uncharacteristic for that wetland type	0

Plant cover score =

Notes:

FMFAM Score is

Container visual review score = Water Clarity score = ______

(Algal community composition score +Algal biomass score + Blue-green Algae score +Algal cover score)/3 = Algae score= ______

(Plant community composition score + Plant Community Zonation score + Plant cover score)/3 = Plant Score= ______

WQFAM score = (Water Clarity score +Algae score + Plant score)/ 3 = ______

4

Figure 97: FMFAM Version 5.1 Page 2 Plant Species and Condition Data Sheet

Nutrient Removal Efficiency of Filter Marshes.

There are a limited number of studies where the nutrient removal efficiencies of filter marshes have been measure directly with certified methods. Seven of the calibration filter marshes for this project have sufficient data. One of these Powell Creek was young and not yet at full nutrient removal efficiency at the time of measurement.

Southwest Florida Filter Marshes

Billy Creek Filter Marsh (Fort Myers)

Nitrogen removal = 20-40% and Phosphorus removal = 20-60%

Ford Canal Filter Marsh (Fort Myers)

Nitrogen removal = 30% and Phosphorus removal = 40%

Freedom Park Filter Marsh (Naples):

Nitrogen removal = 37-75% and Phosphorus removal = 47-84%

Lakes Park Filter Marsh (South Lee County):

Projected Nitrogen removal = 62.2% and Phosphorus removal = 78%

Popash Creek Filter Marsh (North Fort Myers, Lee Co):

Projected Nitrogen removal = 26% and Phosphorus removal = 43%

Powell Creek Filter Marsh at 1 year (North Fort Myers, Lee Co):

Nitrogen removal = 23.3% and Phosphorus removal = 31%

Ten Mile Canal Filter Marsh (South Lee County):

Nitrogen removal = 68% and Phosphorus removal = 82%

Mean for all documented Southwest Florida Filter marshes

Mean TN =51.7% TP = 55.7%

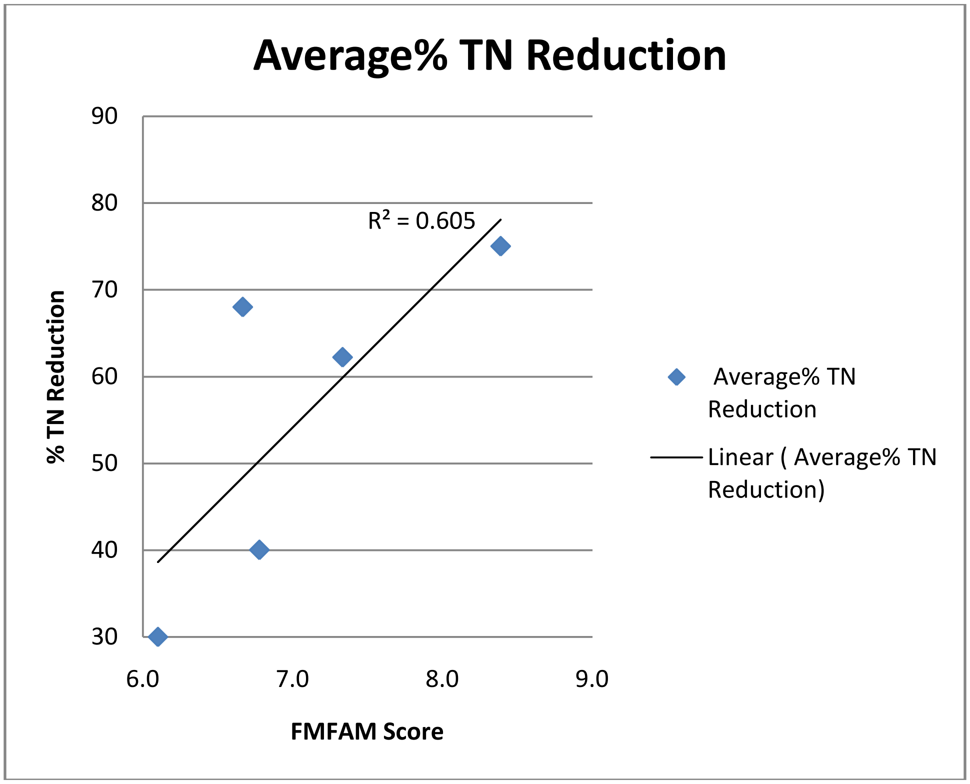


Figure 98: Relationship between FMFAM 5.1 score and % nitrogen reduction from mature filter marshes with measured nitrogen

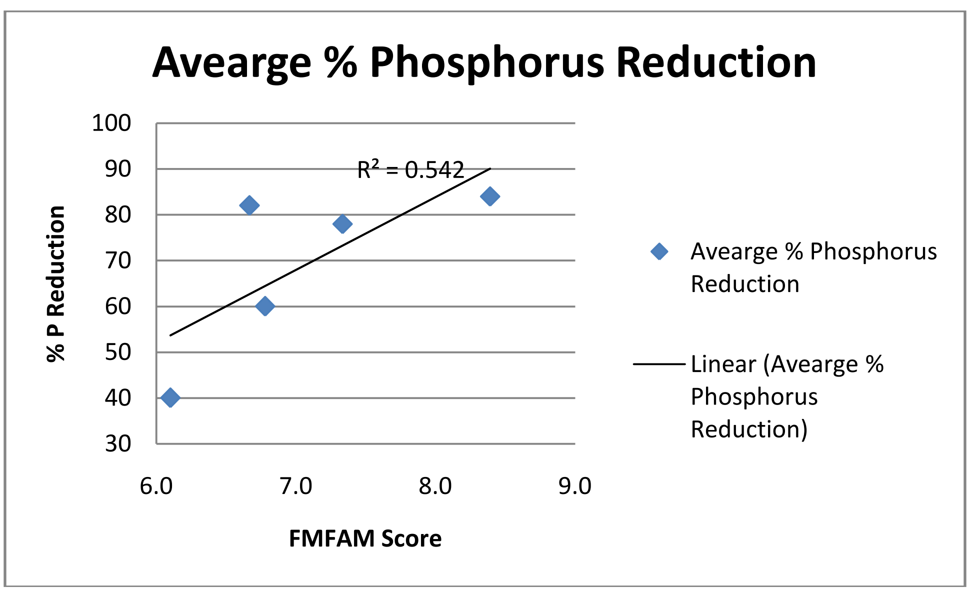


Figure 99: Relationship between FMFAM 5.1 score and % phosphorus reduction from mature filter marshes with measured phosphorus

Because of the small number of filter marshes that have nutrient reduction data collected the level of statistical significance of the relationship of the FMFAM score to nitrogen and phosphorus reduction cannot be properly determined either parametrically or non-parametrically at this time.

Other Florida Filter Marshes

Lake Apopka Filter Marsh

removal efficiencies are 89–99%TSS, 30–67 % TP, and 30–52% TN.

West Palm Beach

70-82% TN

Pasco County Floating Islands

32% TN

Everglades Nutrient Removal (ENR) STA:

TP load removal ranged from 66% to 91% and averaged 82% while TN load removal ranged from 11% to 76% and averaged 55%.

Northern United States of America Filter Marshes

Ohio Average: Nitrogen 40% and Phosphorus 60%

Maryland, Illinois, and Iowa Average : Nitrogen 68% and Phosphorus 43%

California: Ammonia 24-51%

Texas: Ammonia 83%

Oregon: Ammonia 64-69%

Pennsylvania: Ammonia 57%

Kentucky: Ammonia 76%

Ontario: Ammonia 30%

The warmer the temperature the better the nutrient removal. Winter slows nutrient removal down. This is because of the faster metabolism of the plants in warmer conditions..

Beta-Test with Independent Consultants.

Multiple private consultants in wetland science and permitting were invited to field beta-test the functional assessment method. Seven volunteered their time to do this. At each test the tester utilized the method to assess a filter marsh site independently at the same time that the principle author evaluated the same site at the same time. The scores were then compared to each other.

Figure 100 listed the results and the small difference that occurred between the scores.

Figure 100: Comparison of Beta-test Scores to Experienced Reviewer Scores			
Event	Reviewer Score	Experienced Score	Difference
1	9.25	9.125	0.13
2	9.5	8.75	0.75
3	9	9.125	-0.13
4	9	8.5	0.50
5	7.625	7.75	-0.13
6	8.5	8.75	-0.25
7	8.125	8.75	-0.63
Mean	8.714286	8.678571	0.04
Standard Deviation	0.66	0.47	

Figure 101 shows this graphically.

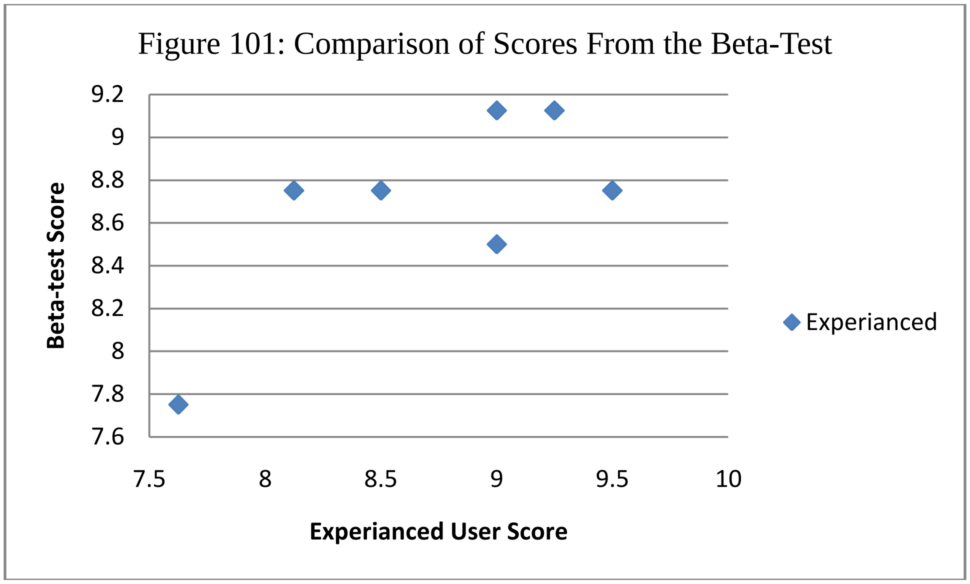


Figure 101: Comparison of Scores From the Beta-Test

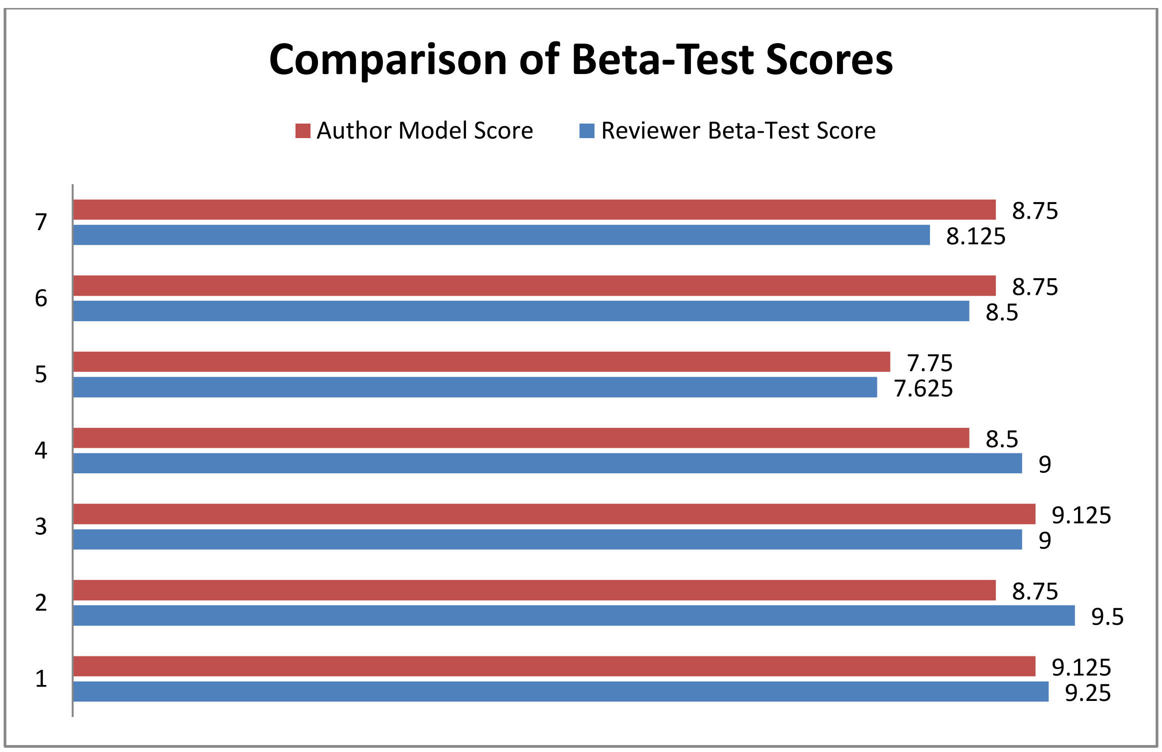


Figure 102: The cumulative comparison of the private consultant WQFAM 5 scores to the experienced agency WQFAM 5 scores at the same time and location at sample filter marshes. The Wilcoxon Rank Sum Correlation Coefficient = 0.7125

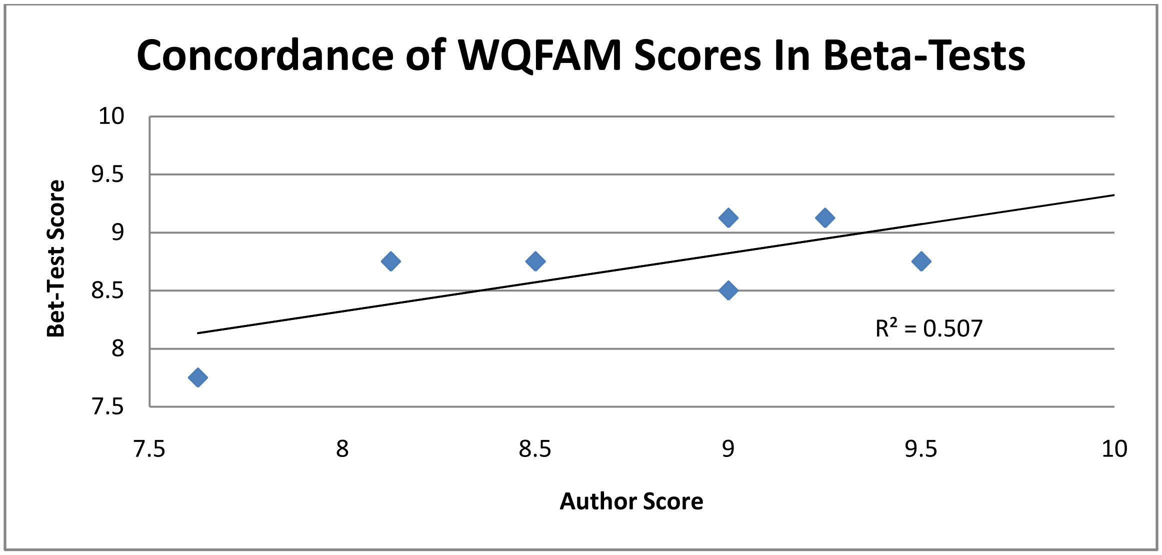


Figure 103: Comparison of WQFAM 5 Beta-Test Reviewer Scores to the WQFAM 5 2012 Author Scores of the Sampled Filter Marshes

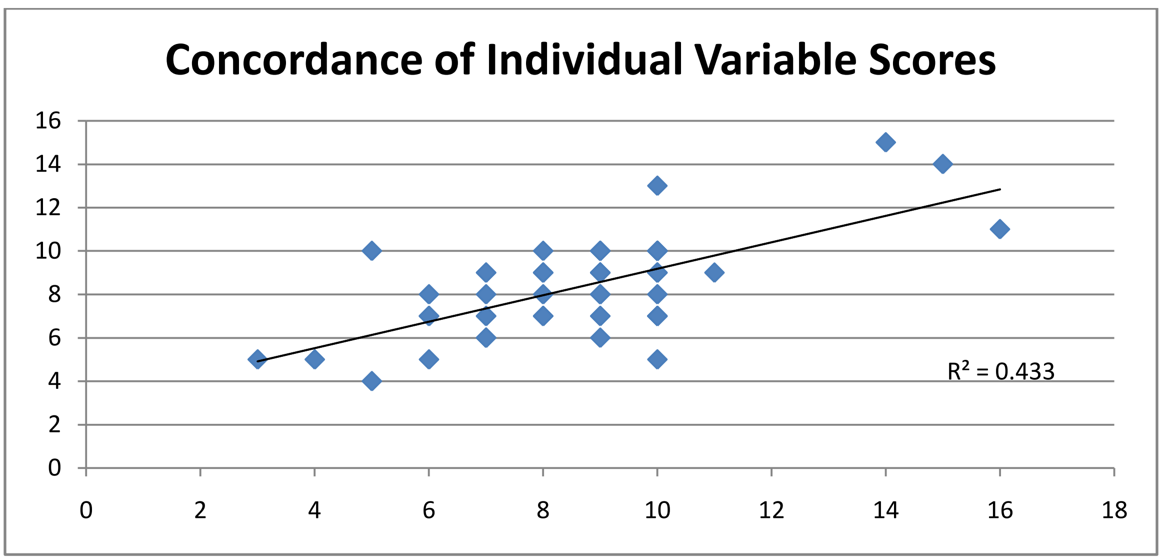


Figure 104: Comparison of WQFAM 5 Beta-Test Reviwer Individual Variable Scores to the WQFAM 5 Individual Variable Author Scores of the Sampled Filter Marshes

Results

This projects has completed a rapid functional assessment method (FMFAM Version 5.1) with a protocol guidance and associated plant identification guide (Appendixes II, III, and IV) for evaluating the functions of designed freshwater and brackish water filter marsh ecosystems used for water quality treatment, compatible with and an extension of the Uniform Mitigation Assessment Method (UMAM) for Florida.

The project has improved the understanding of the water quality wetland functional assessment methodology in a wide audience of agency, private sector and public in Florida.. The method is a system with decreased time and equipment needed for a rapid water quality assessment in constructed treatment wetlands that are documented to increase water quality in receiving water bodies.

This project directly supports EPA Strategic Plan, Goal 2 “Protecting America’s Waters”, which supports research that implements programs to prevent or reduce nonpoint source pollution. In addition, this project assists in achieving the EPA objective to continue efforts to restore waterbodies that do not meet water quality standards, to preserve and protect high quality aquatic resources, and to protect, restore, and improve wetland acreage and quality. The project provides improved innovative tools that enhance water quality improvement efforts and cross-agency collaboration to protect and prevent water quality impairment in healthy watersheds.

Transfer of Results

The CHNEP and the SWFRPC are partnership programs. The stakeholders for this project included local governments, Florida Department of Environmental Protection, the South Florida Water Management District and Southwest Florida Water Management District, which are active partners in the CHNEP Management Conference and the SWFRPC. CHNEP partners were updated on project progress at Management Conference meetings. The project protocol and results were shared with other NEP programs, NERR and Aquatic Preserve Programs through direct presentations and technical assistance contacts. Project products will be posted to the CHNEP website and made available to both partners and the general public. SWFRPC partners, including the Estero Bay Agency on Bay Management were updated on project progress at their monthly meetings. Project products will be posted to the SWFRPC website and made available to partners and the public. The results of the study will be reported in a refereed scientific journal such as the *Journal of the Florida Academy of Sciences*

FAFAM with associated protocol instructions and the plant field guide has been provided to more than 100 wetland professional in federal, state, regional, local government wetland agencies and members of the public and government interested in wetland water quality and restoration.

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Appendix II: Final FMFAM 5.1 DATA SHEET

FMFAM 5.1 DATA SHEET
Part 1 Water Clarity

Site/Project Name	Site/Project ID	Conducted by Date

Container Visual Review (look through the container)

Can't see through the container = 1
Can see through container, but can't read text on datasheet = 4
Can see through container, and can read text on datasheet = 6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water = 10

Container visual review score = ___________

Visual Indicators

Floating Solids	Yes / No	Describe
Suspended Solids	Yes / No	Describe
Oil / Fuel Sheen	Yes / No	Color and amount
Foam	Yes / No	Describe thickness, color, how much surface it covers
Dead Aquatic Life	Yes / No	Describe

1

FMFAM 5.1 DATA SHEET
Part 2 Algae

Site/Project Name	Site/Project ID	Conducted by Date

Algal Community - Circle score or check box

	Score
Algal community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the algal community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The algal community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Algal community composition score=

Algal Biomass

Algal biomass low 0%	10
	7
Algal biomass moderate 50%	5
	3
Algal biomass excessive 100%	0

Algal biomass score =

Blue-Green Algae

No blue-green or filamentous green algae	10
Approximately 30% blue-green or filamentous green algae	7
Approximately 50% blue-green or filamentous green algae	5
Approximately 70% blue-green or filamentous green algae	3
Blue-green or filamentous green algae monoculture	0

Blue-green algae score =

Algal Cover

Algal cover characteristic for that wetland type	10
Most of the algal cover characteristic for that wetland type	7
Half of the algal cover characteristic for that wetland type	5
Some of the algal cover characteristic for that wetland type	3
Algal cover completely uncharacteristic for that wetland type	0

Algal cover score =

2

FMFAM 5.1 DATA SHEET
Part 3 Vascular Plant Species and Condition

Site/Project Name	Site/Project ID	Conducted by Date

Examples of Undesirable Species (circle)

Common Name	Genus	Species
air potato	*Dioscorea*	*bulbifera*
alligator weed	*Alternantera*	*philoxeroides*
Australian pine	*Casuarina*	*equisetifolia*
bahia grass	*Paspalum*	*notatum*
Brazilian pepper	*Schinus*	*terebinthifolius*
Caesar weed	*Urena*	*lobata*
carrotwood	*Cupaniopsis*	*esculenta*
cattail	*Typha*	spp.
Chinese tallow	*Sapium*	*securiotatum*
climbing cassia	*Senna*	*pendula*
climbing hempweed	*Mikania*	*scandens*
downy rose myrtle	*Rhodomyrtus*	*tomentosa*
guava	*Psidium*	*guajava*
hydrilla	*Hydrilla*	*verticillata*
Japanese climbing fern	*Lygodium*	*japonicum*
Java plum	*Syzygium*	*cumini*
melaleuca	*Melaeuca*	*quinquenervia*
old world climbing fern	*Lygodium*	*microphyllum*
para grass	*Brachiaria*	*mutica*
primrose willow	*Ludwigia*	*peruviana*
seaside mahoe	*Tespesia*	*populnea*
shoebutton ardisia	*Ardisia*	*elliptica*
taro	*Colocasia*	*esculenta*
torpedo grass	*Panicum*	*repens*
water hyacinth	*Eichornia*	*crassipes*
water lettuce	*Pistia*	*stratiotes*
water primrose	*Ludwigia*	*octovalvis*
wedelia	*Wedelia*	*trilobata*
West Indian marsh grass	*Hymenachne*	*amplexicaulis*

Vascular Plants Observed

Vascular Plant Community

	Score
Plant community composition is not characterized by species tolerant of and associated with water quality degradation.	10
Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	7
Half of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	5
Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation.	3
The plant community composition consists predominantly of species tolerant of and associated with highly degraded water	0

Plant community composition =

3

Vascular Plant Community Zonation

Zonation of vegetation appropriate	10
⇕	7
	5
	3
Zonation of vegetation inappropriate	0

Plant community zonation score =

Vascular Plant Cover

Plant cover characteristic for that wetland type	10
Most of the plant cover characteristic for that wetland type	7
Half of the plant cover characteristic for that wetland type	5
Some of the plant cover characteristic for that wetland type	3
Plant cover completely uncharacteristic for that wetland type	0

Plant cover score =

Notes:

FMFAM Score is

Container visual review score = Water Clarity score = ______

(Algal community composition score +Algal biomass score + Blue-green Algae score +Algal cover score)/3 = Algae score= ______

(Plant community composition score + Plant Community Zonation score + Plant cover score)/3 = Plant Score= ______

WQFAM score = (Water Clarity score +Algae score + Plant score)/ 3 = ______

Appendix III: Final Protocol to use the FMFAM Version 5.1 Data Sheet

Protocol to use the FMFAM Version 5.1 Data Sheet

The needed equipment for the use of the FMFAM data sheets is

1) a clean bucket or Nalgene bottle on a reach pole or cord depending on the filter marsh location.
2) a clear plastic or glass container of 5 to 6.3 cm (2 to 2.5 inch) diameter, preferable with a screw-on top.
3) the *Water Quality Functional Assessment Method for Filter Marshes Plant Identification Guide* may be used to answer several of the plant questions.

Step 1: Select a site in the filter marsh that is a treatment cell with marsh vegetation. Do not locate the assessment site at or near an in-fall, or any out-fall location. Do not select a deep water settling cell, canal or channel. Collect water with bucket or Nalgren bottle and put water into clear container.

Protocol Figure 1: A-Team member gathering a water sample for step 2 at Ten Mile Canal filter marsh.

Step 2: Look through container at data sheet. Score the Container Visual Review by looking through the container at the printed side of the data sheet).

Can't see through the container = 1
Can see through container, but can't read text on datasheet = 4
Can see through container, and can read text on datasheet = 6
Pretty clear, but not as clear as bottled water = 8
As clear as bottled water = 10

Write number on line **Container visual review score = __________**

It is acceptable to select other integer numbers for conditions between the stated written line conditions.

Protocol Figure 2: Scientist-Intern performing Step 2 at 10-Mile Canal Filter Marsh South End.

Step 3:Looking through the container with water observe for the visual indicators Floating Solids, Suspended Solids, Oil / Fuel Sheen, Foam and Dead Aquatic Life. Mark if present of not present and describe the issue if it is present.

Protocol Figure 3: Author looking for visual indicators in Step 3.

Step 4: Looking at all the algae present determine by visual inspection to what extent the algal community composition is not characterized by species tolerant of and associated with water quality degradation. Species of algae tolerant of and associated with water quality degradation are typically filamentous green algae, blue-green algae, and blooming algal phytoplankton.

Below are some visual examples:

Protocol Figure 4: Filamentous Green Algae.

Protocol Figure 5: Filamentous Green Algae.

Protocol Figure 6: Blue-Green Algae.

Protocol Figure 7: Blue-Green Algae.

Protocol Figure 8 : Blue-Green Algae.

So if the Algal community is not filamentous green algae, blue green algae and/or phytoplankton blooms than it would score high (10). If the algal community is all or only filamentous green algae, blue green algae and/or phytoplankton blooms than it would score low (0).

Step 5: **Algal Biomass**: Looking at all the algae present determine by visual inspection how much algal biomass there is in the assessment area. This includes all submerged benthic, water column, and surface floating algae of all species.

If there is no visible algae then the score is 10. If the only visible plant biomass is algae then this is excessive at 100% and the score is 0. Below is a guide for visual estimation of algal biomass form a visual inspection

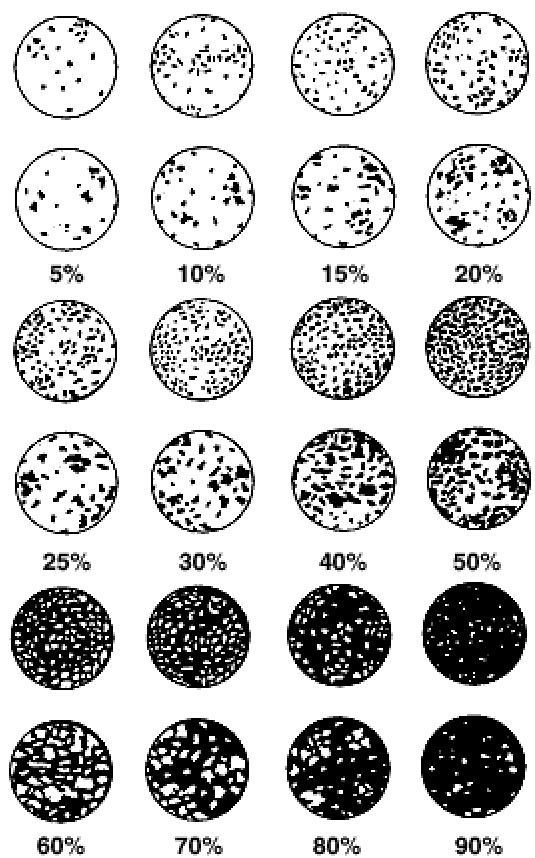

Figure 9: % Biomass Visual Estimator.

Step 6: Blue-Green Algae and Filamentous Green Algae

Looking at all the algae present determine by visual inspection in the assessment area how much of the algal is blue-green algae and/or filamentous green algae. Examples of these species are shown above.

Step 7: Algal Cover

Looking at all the algae present determine by visual inspection determine if the algal cover is characteristic in the assessment area for that wetland type. The wetland type of filter marshes is herbaceous freshwater or brackish water wetland unless the filter is a floating island in which case it is lake littoral. The characteristic algaes of freshwater marshes include periphyton, diatoms, green algaes, golden algaes. Below is a guide for visual estimation of algal cover from a visual inspection based on estimation of cover associated with oil spills.

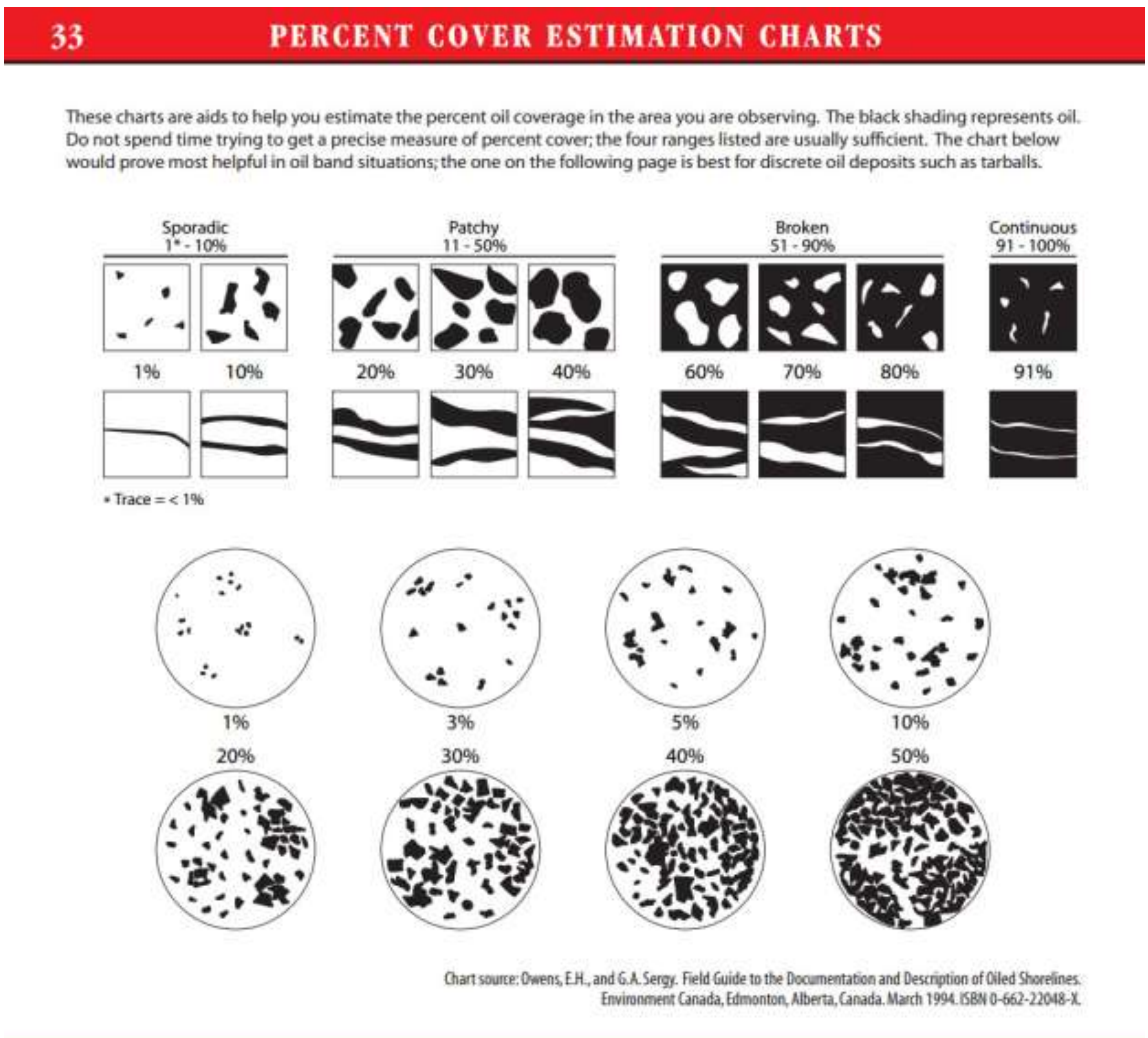

Figure 10: % visual cover estimation charts

Step 8: Undesirable Species

Looking at all the vascular plants present determine by visual inspection in the assessment area what undesirable vascular plant speceis are present. The list is on the data sheet and all these species can be found in the *Water Quality Functional Assessment Method for Filter Marshes Plant Identification Guide.*

Step 9: Vascular Plants Observed

Looking at all the vascular plants present determine by visual inspection in the assessment area what other vascular plant speceis are present. All the species encountered in the course of the project in filter marshes of southwest Florida can be found in the Water Quality Functional Assessment Method for Filter Marshes Plant Identification Guide. Write the names of the species in the blank space provided. The names can be the common name, the scientific name or both.

Protocol Figure 11: A-Team members perform a visual inspection of vascular plant species at Ten Mile canal for Step 9.

Step 10: Vascular Plant Community

Looking at all the vascular plants present determine by visual inspection in the assessment area determine if the plant community is characterized by plant species tolerant of and associated with water quality degradation. These species include several of the undesirable species including cattails, Peruvian primrose willow, water hyacinth, water lettuce, duckweed, and West Indian marsh grass. Do not consider the algae here. That was done in a prior observation. If plant species tolerant of and associated with water quality degradation are not present or in a small amount then this will score a 10. If the vascular plant community is dominated by these species than the score will be zero (0).

Protocol Figure12 : An example of a filter marsh plant community composition that is not characterized by species tolerant of and associated with water quality degradation scoring a 10.

Protocol Figure 13 : An example of a filter marsh plant community composition consists predominantly of species tolerant of and associated with highly degraded water scoring a 0.

Step 11: Vascular Plant Community Zonation

Looking at all the vascular plants present determine by visual inspection in the assessment area if the zonation of vegetation is appropriate in a normal condition. In a linear filter marsh a series of parallel bands of vegetation with decreasing tolerance of inundation as the vegetation extends landward and upgrade. In circular or irregular filter marsh vegetated cells the bands will circle the perimeter with decreasing tolerance of inundation landward and up slope. Open water settlement cells will not be expected to display zonation but these settling cells should not be an assessment site for WQFAM. If zonation is absent of out of order in a filter marsh vegetation cell then there is likely grading problems or a unusual monoculture, likely of a nuisance species. Cells with algae blooms will also lack appropriate zonation.

Protocol Figure 14: A-Team visually examining zonation at 10-mil Canal filter marsh.

Protocol Figure 15: Example of a filter marsh showing a score of 10 in plant zonation.

Protocol Figure16 : Example of a filter marsh showing a core of 7 in plant zonation.

Protocol Figure 17 : Example of a filter marsh showing a score of 0 in plant zonation.

Step 10: Vascular Plant Cover

Looking at all the vascular plants present determine by visual inspection in the assessment area if the plant cover is characteristic for that wetland type. The wetland type for filter marshes is either depressional herbaceous for a bermed cell with a water control outflow or riverine herbaceous for linear free-flowing systems. The vascular plants characteristic fo filter marsh should be native, obligate and facultative wetland grasses, sedges, rushes, reeds, and herbaceous monocots and dicots. Exotic invasive species, upland native plants, and (unless they were part of project design) trees and shrubs are not characteristic plant species for successful filter marshes.

Protocol Figure 18: A-Team estimating the vascular plant cover.

Step 11: Calculate Scores for Categories

Container visual review score = Water Clarity score = ______

(Algal community composition score +Algal biomass score + Blue-green/ Filamentous Green Algae score +Algal cover score)/3 = Algae score= ______

(Plant community composition score + Plant Community Zonation score + Plant cover score)/3 = Plant Score= ______

For example on a site visit to Powell Creek Filter Marsh the Container visual review score was 8; the Algal community composition score was 7, the Algal biomass score was 5, the Blue-green/ Filamentous Green Algae score was 10, and the Algal cover score was 6, the Plant community composition score was 10, the Plant Community Zonation score was 8, and the Plant cover score was 10.

Container visual review score = Water Clarity score = 8

(Algal community composition score +Algal biomass score + Blue-green/ Filamentous Green Algae score +Algal cover score)/3 = Algae score= 7

(Plant community composition score + Plant Community Zonation score + Plant cover score)/3 = Plant Score= 9.3

Step 12: Final FMFAM Score

FMFAM score = (Water Clarity score +Algae score + Plant score)/ 3 = _____

From the example on a site visit to Powell Creek Filter Marsh

FMFAM score = (Water Clarity score +Algae score + Plant score)/ 3 = 8.1

Appendix IV: Water Quality Functional Assessment Method for Filter Marshes Plant Identification Guide (This exists as a separate file due to different formatting to fit into pockets in the field)

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On June 1, 2012, the 2012 National Wetland Plant List replaced the 1988 U.S. Fish and Wildlife Service's *National list of plant species that occur in wetlands* (U.S. Fish & Wildlife Service Biological Report 88 (24)) for all wetland determinations and delineations performed for Section 404 of the Clean Water Act, the Swampbuster provisions of the Food Security Act, and the National Wetland Inventory. See *www.***plants***.***usda***.gov/core/***wetlandSearch**. These were used for the Federal Wetland Status. We used the 2012 source to update scientific names.

Appendix V: Presentations on the project to date

1. FDEP Webinar September 9, 2015. FUNCTIONAL ASSESSMENT METHOD FOR FILTER MARSHES: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment, Florida Water Resources Monitoring Council focused on the theme of "Water Quality and Resources Restoration Efforts"
2. Charlotte Harbor National Estuary Program Policy Committee, August 13, 2015, Water Quality Improvements by Using Filter Marshes: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment
3. Charlotte Harbor National Estuary Program Citizens Advisory Committee, August 12, 2015, Water Quality Improvements by Using Filter Marshes: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.
4. Interagency Project Review Committee, August 11, 2015, Water Quality Improvements by Using Filter Marshes: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.
5. Charlotte Harbor National Estuary Program Management Committee, July 31, 2015, Water Quality Improvements by Using Filter Marshes: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.
6. Charlotte Harbor National Estuary Program Technical Advisory Committee, July 16, 2015, Water Quality Improvements by Using Filter Marshes: Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.
7. CHNEP Management Committee February 21, 2014. Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.
8. CHNEP Technical Advisory Committee February 13, 2014. Development of a functional assessment method to evaluate the water quality benefits of wetland restoration and designed freshwater and brackish water ecosystems used for water quality treatment.