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

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Part 1 Introduction and History of Functional Assessment Methods
The Path Ahead

Introduction and History of Functional Assessment Methods for Wetlands up to Current Project
Manmade Treatment Wetlands in Charlotte, Collier, DeSoto, Glades, Hendry, Hillsborough, Lee, Manatee, Pinellas, Sarasota Counties

Study Goals

WQFAM: Water Quality Functional Assessment Method

- This project will 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.

- This method would 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 would be developed in coordination with an interagency “A-Team”. Team members will be brought to an agreed-upon common baseline of knowledge about functional assessment methods.

- The new method will be developed focusing on biological and physical surrogates for water quality measurements, and then be tested.

- After calibration, the new method will be 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 will then be presented for formal acceptance by the state as one tool in the BMAP toolbox.
Work began in October 2011 and will continue through Summer of 2013.
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).
The 1970s

- 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.
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.
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.
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.
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.
Presence or Absence Models

- 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.
Origin of “Functional Value”

- 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
  - New Hampshire Method (Ammann and Stone 1991)
  - Connecticut Method (Ammann, Frazen, and Johnson 1986)
  - Hollands-Magee Method (Hollands and Magee 1985)
  - Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNARAM) (Minnesota Board of Water and Soil Resources 1998)
  - 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.
1990’s Trend

- 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 current 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.
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:

- modification of ground water discharge
- modification of ground water recharge
- storm and flood water storage
- modification of stream flow
- modification of water quality
- export of detritus; contribution to abundance
- diversity of wetland vegetation
- contribution to abundance and diversity of wetland fauna.
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.
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 categories assessed include six variables:
- wildlife utilization
- overstory/shrub canopy of desirable species
- wetland vegetative ground cover of desirable species
- adjacent upland/wetland buffer
- field indicators of wetland hydrology
- 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)**
- The federal **Hydrogeomorphic Methodology (HGM)**
Uniform Mitigation Assessment Method

- 1999 - Florida Legislature requests a study of mitigation options implemented since 1994 to consider the effectiveness and costs of the current mitigation options in offsetting adverse effects to wetlands and wetland functions.

- 2000 – Office of Program Policy Analysis and Governmental Accountability submitted a report highlighting some of the shortcomings of the process in use at the time (ratios); found that the State could track the acreage of wetland loss and acreage of mitigation, but that this was not enough information to ensure the replacement of wetland function lost.

- UMAM was designed in response to this and became a part of Florida law in 2004.
QUESTIONS?

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End of Part 1