Establishment of an Assessment Technique Examining the Quality and Quantity of Wetland Resources in Oklahoma

Oklahoma Conservation Commission Task #557

Deliverables

1. *Signed Agreement to Participate (Appendix B)*
2. *Report of Literature Review and Existing Wetlands Assessment Projects in Oklahoma*
3. *Wetland Assessment Discussion Notes (Appendix C)*

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INTRODUCTION

The goal of this project was to initiate a quantitative wetland assessment tool to evaluate the state's wetland resources that will enable Oklahoma's Wetlands Working Group to focus future wetland projects. The first step to accomplish this goal was to establish a consortium of local, tribal, state, and federal partners with a common interest in wetland resource based management. Next, assessment tools were examined that incorporated elements from existing functional and biological methods that would enable Oklahoma to address the various interests related to wetland conservation in a comprehensive fashion. Finally, a series of discussions were held to determine the path that needs to be taken for future development of wetland assessment methods for the state.

Representatives from various agencies, municipalities, and tribes were invited to participate in examination and discussion of wetland assessment methods that could be applied in Oklahoma. The state entities included were agencies that deal with wetlands the Oklahoma Conservation Commission (OCC), Oklahoma Water Resources Board (OWRB), Oklahoma Department of Environmental Quality (ODEQ), and Oklahoma Department of Wildlife Conservation (ODWC) and also the University of Oklahoma and Oklahoma State University. The federal agencies invited were the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (COE), USDA Natural Resources Conservation Service (NRCS), and U.S. Fish and Wildlife Service (FWS). Tribal representatives were invited including Cherokee Nation, Iowa Tribe of Oklahoma, and Otoe-Missouria Tribe of Oklahoma. The municipalities included were the City of Oklahoma City and the City of Tulsa.

Although not all of these groups participated in the process, a group of committed individuals willing to put time and effort into reviewing and discussing wetland assessment methodologies did contribute. The participants signed an agreement to participate in discussions to further the development of wetland assessment methods for use in Oklahoma (Appendix B). This agreement was enacted in lieu of a formal Memorandum of Understanding due to the vast amount of time it would take to complete the task and the limited amount of time available to complete the project. Through the efforts of the group, their time served to overmatch the federal dollars provided for this project.

A thorough review of existing wetland assessment methods, from rapid methods to intense functional assessments, was conducted prior to group discussions. After the literature review was completed, a series of facilitated discussions were held so the group could determine the best track for Oklahoma. The group used the EPA endorsed three-tiered framework to wetland monitoring to help guide the discussions. The group recognized the importance of gathering as much information about a wetland in the office before making a site visit, and they also recognized the need for intense wetland functional assessment in some instances. The group developed the following consensus statement.

Consensus statement ► Effective, scientifically defensible tools for wetlands assessment are needed in Oklahoma.

Although many needs exist for wetland assessment in Oklahoma, the focus of this round of discussions was on the Level 2 rapid assessment methods. The term "rapid" in this case means that one person can complete the assessment in a half day or less. The group used the EPA document "Review of Rapid Assessment Methods for Assessing Wetland Condition" as a tool to narrow the focus of discussion. The methods were studied and ranked based on their content and applicability to Oklahoma. The top three methods were then studied more in-depth for future discussion and development. The top three methods were Montana Wetland Assessment Method, Ohio Rapid Assessment Method for Wetlands, and Washington State Wetlands Rating System (Western Washington).

The methods were discussed and their components were debated creating a list of pros and cons for each method. A considerable amount of overlap existed among the three methods, but this is not surprising since all three methods were based on the Washington method. The methods are based on functional indicators, but they are not based upon intense field investigation of reference sites. The group would like to use one of the methods and calibrate it for use in Oklahoma. In addition, future efforts would focus on more intense wetland assessment methodologies, such as the Hydrogeomorphic Approach and the Index of Biotic Integrity, to corroborate the rapid assessments. These findings were then presented to Oklahoma's Wetlands Working Group and the following recommendations were made.

This group recommends that members of the Wetlands Working Group apply or find funding for two purposes:

1) **Continuing technical work with written procedures on how to use a Rapid Assessment Method (Level 2) to assess the level of function of wetlands and**
2) **Convening a public forum on the proposed methods for assessing the level of function of wetlands.**

OKLAHOMA AND WETLAND ASSESSMENT METHODS

Wetland assessment methods are becoming an increasingly important tool in wetland preservation and management. They can assist in regulatory decision-making as well as determining which wetlands deserve higher priority in restoration or preservation. In order to better manage this diminishing resource, the correct assessment tools must be used.

Functional assessment methods are used to represent the relationship between functional capacity and characteristics of wetlands. Wetland assessment approaches can help determine the role a wetland plays in its environment and whether it must be protected. These approaches also determine the compensation or mitigation required when wetlands have been damaged. A desire for improved wetland assessment methods has resulted in the development of many rapid assessment approaches in the United States and around the world since 1990 (World Wildlife Fund, 1992; Kusler, 1998; Magee, 1998; Bartoldus, 1999; Ainslie et al., 1999; Gernes and Helgen, 1999).

A trend has developed among the methods where specific functions are not evaluated and a smaller number of indicators are used to evaluate functions. However, none of these methods is used on a widespread basis. The validity of wetland assessment methods is limited by several factors, including complex processes that support wetland function; lack of information about these processes; large variability among wetlands; many components of wetland value that must be accounted; and diversity of assessment objectives (World Wildlife Fund, 1992). Assumptions and short-cuts made to simplify assessments have reduced accuracy accorded through these techniques. An additional problem with many methods is the lack of information on biota (including endangered species) to aid permitting agencies in determining the impacts of activities on species reproduction. Methods that mathematically combine factors expose the data to additional manipulation, which can inject a level of uncertainty on the accuracy of the factor's final representation (Kusler, 2003).

The Environmental Protection Agency (EPA) endorses a three-tiered framework to wetland monitoring. These include landscape assessments, rapid wetland assessments, and intensive site assessments. Level 1 methods are landscape assessments that essentially locate wetlands and characterize land uses. These can be used to target areas needing more intensive monitoring (Fennessy et al., 2004). Specific wetlands are assessed through rapid wetland assessments, which are Level 2 methods. The results of these assessments are used to target wetlands for restoration or preservation as well as making regulatory decisions (Fennessy et al., 2004). Both landscape assessments and rapid wetland assessments can be used to select sites for intensive site assessments, the Level 3 methods. The status of water quality physico-chemical and biological parameters at individual wetlands can be determined through intensive assessments. Alternatively, intensive site assessments can be used to validate landscape assessments and rapid assessment indicators (Fennessy et al., 2004).

Selecting one, all-encompassing wetland assessment method will be impossible. "Specific assessment models will still be needed to determine, for example, impact of a proposed activity on flood storage, erosion or stream stability" (Kusler, 2003). Certain methods not specifically generated for use with wetlands may yield applicable results for the project needs. These methods include GIS analyses, models assessing hydrologic parameters with models developed by the U. S. Army Corps of Engineer's Hydrologic Engineering Center (HEC), and assessing stream stability using Rosgen's applied river morphology techniques (Kusler, 2003).

The differing needs of regulatory groups and non-regulatory groups in wetland management decision-making currently make a sole rapid wetland assessment method impossible. Regulatory agencies working on a case-by-case basis do not need the wide-scale wetland inventories and comparisons of wetlands used by the non-regulatory agencies in wetland management decision-making (Kusler, 2003).

For the purposes of determining the quality of wetlands and for regulatory purposes in Oklahoma, the Environmental Protection Agency and the U. S. Army Corps of Engineers' regulatory definition of wetlands referred to in *Oklahoma's Comprehensive Wetlands Conservation Plan* is recommended, stated:

> *Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*

The U. S. Army Corps of Engineers' Waterways Experiment Station has recommended ten steps to select a function assessment procedure:

- Define assessment goals and select general objectives.
- Decide upon a preferred model (or if reliance on user judgment alone is desired) of the assessment (e.g. the model should be based on population data or on specific site conditions).
- Determine the appropriate geographic area.
- Choose the appropriate general habitat types
- Assess the available time, resources, and cost, and define the required level of detail and sensitivity. Set a maximum time allowed to assess each site.
- Determine if the habitat size should be reflected in the measure of function.
- Identify the required functions or social categories.
- Determine whether you need a unit of measure per function or if you need a unit combining all functions.
- Decide if a comparison of different habitat types is needed.
- Ascertain if the procedure will be able to meet the assessment's objectives.

This information can be found on the Waterways Experiment Station's website at http://www.wes.army.mil/el/emrrp/emris/emrishelp6/the_process_of_selecting_a_wetland_assessment_procedure_steps_and_considerations.htm.

Over forty rapid wetland assessment methods currently exist (Fennessy et al., 2004). Many of these have been proposed for specific states or ecoregions. Several are applicable to multiple wetland types and ecoregions. Those presented here are a few of the methods that can be used in assessing Oklahoma's wetlands. Appendix A contains a summarization of these methods compiled from Bartoldus (1999) and DuBois (2002).

Habitat Assessment Technique (HAT)

This assessment method was formulated to provide both regulators and non-regulators with a tool for decision-making. By using this technique, decisions could be made on the issue or denial of permits as well as whether land should be acquired for preservation purposes. Cable et al. (1989) compared this method to others and determined that it was easy to implement and cost efficient. With proper calibration, it can be applied to any region or habitat. HAT can also be used as a component in other wetland assessment methods if more information is needed.

Graber and Graber (1976) created a method for the state of Illinois to use birds and bird habitat to perform environmental evaluations. This technique provided a rapid habitat assessment that did not rely on measurements or calculations of multiple physical characteristics. The results of their method allowed multiple study areas to be easily compared (Cable et al., 1989).

The concept of HAT hinges on the ability to use a wetland's species diversity and uniqueness to assess its habitat quality (Cable et al., 1989). To do this, a faunal index is used to assess a wetland. This is derived from species points representing avian species diversity and uniqueness being divided by a factor representing the area of the wetland. Each obligate wetland avian species receives a base point rating determined by the state's breeding population. The higher the points are, the smaller the breeding population. For extremely rare species, presence alone "transcends any point value" (Cable et al., 1989). Literature and breeding bird atlases are reviewed to estimate breeding bird populations. Field surveys are conducted to determine species presence and numbers. The mean of base points for all species found at a site are calculated to arrive at a site's species index, which can then be used to compare sites of equal size (Cable et al., 1989). An assortment of maps and aerial photographs are used to determine the area of the wetland. An area factor is calculated by comparing the wetland's area to an "optimum size" that results from species-area equilibrium data; wetlands falling above or below this size are penalized (Cable et al., 1989). Dividing the species points by the area factor results in the faunal index. This index reflects habitat quality and allows wetland ranking (Cable et al., 1989).

HAT can be used in both aquatic and terrestrial habitats anywhere. Another attractive characteristic of HAT is that it can be easily tweaked to apply to a targeted environment subset. It can also be used to bolster other habitat assessment methods. Because this method can be accomplished quickly and at a low cost, it lends itself towards application in projects that will assess and compare multiple areas. It can be used to select one site out of many, determining which of multiple sites should be preserved, and in making many site decisions on a continuous basis (Cable et al., 1989). In cases whether biological features and impacts require study, HAT is a good option (Kusler, 2003). A criticism of this method is that it treats obligate wetland species the same as those that can tolerate substitute habitats; however, it includes information on all species occurring in the wetland and evades the pitfall of biases introduced by indicator-species selection (World Wildlife Fund, 1992).

Species diversity, a strong indication of habitat value, is reflected in HAT's wetland values. Inclusion of population status in the base value of a species allows the importance of a species to an area to be considered. The size of the habitat patch is also reflected in the assessment allowing decision makers to consider the ramifications of selecting a small patch over a large patch (Cable et al., 1989).

Habitat Evaluation Procedures (HEP)

The U. S. Fish and Wildlife Service created the Habitat Evaluation Procedure to determine the impacts of projects on terrestrial and inland aquatic environments (USFWS, 1996). For a given species, the quality and quantity of available habitat can be determined. Additionally, comparisons can be made of the value of different areas at the same time as well as the value of the same areas in the future (USFWS, 1996). The potential impact of project activities on selected species can then be estimated. HEP is useful in determining baseline and future conditions for wildlife habitat, accomplishing trade-off analyses, and completing compensation analyses (USFWS, 1996). In cases where mitigation proposals arise in wetland regulation or a need to examine biological features exists, HEP can be a good choice (Kusler, 2003).

Time and money requirements can both be intensive for HEP. The size of the study area, the number of cover types and evaluation species, and the number and types of proposed actions may preclude the use of HEP (USFWS, 1996). HEP can be flexible, allowing a more extensive study to develop from a more general study design (USFWS, 1996). The more extensive the study becomes, however, the higher the time and cost requirements will be. This type of assessment can take anywhere from several days to several months to complete.

Costs begin accruing with the genesis of the project. Delineating the area using aerial photography that will allow for the classification of cover types costs about one person-day for 4000 acres (USFWS, 1996). Two person-days for species can be anticipated for developing species habitat models. Using models already developed decreases some of the costs associated with HEP (USFWS, 1996). The amount of time spent in the field is directly related to the number of indicator species and number of cover types designated for the study. For a good set of data, at least three samples are required for terrestrial studies, with 10 to 15 sample sites per cover type. Each cover type requires two to three days of sampling if 10 to 15 evaluation species are used in the study (USFWS, 1996). To analyze the data, 8-14 person days per proposed action should be allotted (USFWS, 1996).

As is true for many assessment methods, the limits of the study must be established first. This includes the boundary of the study area, the cover types, and the species used to evaluate the habitat (USFWS, 1996). The baseline conditions are then determined and translated into terms of Habitat Units (HUs). Depending on the goal of the project, the next step is to determine future HUs or to compare baseline areas. Proposed actions can then be compared, and compensation plans can be created if needed (USFWS, 1996).

A problem noted with HEP is that it assumes a linear relationship between acreage and function, resulting in the decision to increasing habitat units of many smaller wetlands to make up for losses in large wetlands. Unfortunately, many of the more rare wetland species rely exclusively on large wetlands. Enhancing smaller wetlands will not boost the regional diversity lost with the larger wetlands (World Wildlife Fund, 1992).

Hydrogeomorphic Approach (HGM)

The Hydrogeomorphic Approach is being developed by the U.S. Army Corps of Engineers under a National Action Plan to perform wetland functional assessments across the country. It is intended primarily for use in the context of the Clean Water Act Section 404 regulatory program, which is limited by time and resources (U.S. Army Corps of Engineers, 1996). This method focuses attention on the biological and chemical processes of wetlands instead of function and value. It is a helpful tool in situations requiring a high level of accuracy. Highway planning or planning for other utility corridors, wetland regulation, and non-regulatory wetland restoration may best be served using HGM. Situations requiring study of hydrologic features and impacts also benefit from analyses using HGM (Kusler, 2003).

HGM is a collection of concepts and methods used to develop functional indices that could be used to assess the capacity of a wetland to perform functions compared to other wetlands in the same regional class (Ainslie et al., 1999). HGM attempts to increase the accuracy of assessments, allow for reproducibility, and reduce the time required to perform an assessment. HGM is based on three factors that influence wetland function: position in the landscape, water source, and the dynamics of water once in the wetland. HGM differs from other assessments in that it classifies wetlands based on their different functions, it defines functions that each class performs, and it uses reference wetlands to develop a range of wetland functions (U.S. Army Corps of Engineers, 1996).

HGM classification is based on abiotic attributes of wetlands such as water chemistry characteristics, habitat maintenance, and water storage and transport rather than biotic features such as vegetation and faunal community structure. Specifically, HGM classification is based on three fundamental factors: geomorphic setting (position in landscape), hydrology (water source), and hydrodynamics (flow and fluctuation of the water once in the wetland). This classification groups wetlands with similar hydrogeomorphic classes together to better reveal their ecosystem functions (Brinson, 1993). This increases the accuracy of the assessment, allows for repeatability, and reduces the amount of time it takes to conduct an assessment.

Reference wetlands are used to establish a scale for comparison with other wetlands of the same type in the region to determine functional capacity. However, wetlands of different types or regions cannot be compared because the methods of assessment are specific for each regional wetland type. Reference wetlands are chosen to reflect the range of conditions in a particular geographic area, from relatively undisturbed to highly degraded (U.S. Army Corps of Engineers, 1996). Although HGM is meant to provide more accurate and repeatable data, it does not provide information regarding social significance or specific species, which may be important for regulations and management. HGM also requires a team of experts and much time during its development phase (Kusler, 1998).

The HGM assessment approach includes a development phase that is conducted by an interdisciplinary team of experts and an assessment phase conducted by a manager, regulator, or consultant. The basic layout of these phases can be seen below.

<u>Development Phase</u>

- Organize an interdisciplinary team of experts (A-team)
- Classify wetlands into regional subclasses
- Develop a functional profile that describes physical, chemical, and biological characteristics of the regional subclass
- Identify which functions are most likely to be performed
- Discuss different ecosystem and landscape attributes that influence each function
- Create a functional profile based on the experience and expertise of the A-team and information from reference wetlands
- Choose reference wetlands from a reference domain that represent sites that have a range of variation within a wetland type, including degraded and relatively undisturbed wetlands
- Develop and calibrate assessment models
- Assessment model results in a functional index 0-1 (capacity of the wetland to perform functions relative to the reference standards)

<u>Application Phase</u>

- Assess wetland functions for section 404 permit application, planning or management project
- Allows regulators to:
    - determine the level of environmental impacts of proposed projects rapidly and accurately
    - compare project alternatives
    - identify measures that would minimize environmental impacts
    - determine mitigation requirements
    - establish criteria for measuring mitigation success
- Results in providing greater certainty, reduced permit review times, and more rapid decision making

National guidebooks have been developed under HGM for each of the major classes of wetlands: riverine, depressional, slope, mineral soil flats, organic soil flats, lacustrine fringe, and tidal fringe. These national guidebooks serve as templates on which to develop the regional guidebooks for specific wetland subclasses (U.S. Army Corps of Engineers, 1996). In Oklahoma, a regional guidebook is under development for lacustrine fringe wetlands along the reservoirs of the state.

A criticism against HGM is that it does not consider all the relevant factors. It “contains sophisticated procedures for evaluating wetland processes, including relative condition. Use of these procedures, if fully tested, can provide an improved scientific basis for evaluating permits and establishing compensation needs. But, HGM then uses a simplified formula to calculate mitigation ratios, which omits many of the factors that wetland managers consider relevant” (Kusler, 2003). It also is time consuming, in both model development and validation and gives limited consideration to wetland characteristics that may be important to society such as aesthetics and archaeology (Kusler, 2003). These are issues that become important for regulatory agencies.

Indicator Value Assessment (IVA)

The Indicator Value Assessment method was created to provide the information required by regional wetland management plans in small watersheds or basins. It was meant to provide a standard process allowing for the creation of regional models and was developed with the intent to eventually be replaced by more quantitative methods (Hruby et al., 1995). The importance of the studied wetland to the region and the performance estimate of a socially important function are furnished through this assessment (Hruby et al., 1995).

To assess the wetland using the IVA, the functions of the wetland are first determined by agencies with permitting and management responsibilities over wetlands. Project and planning region values and goals shape the wetland functions assigned (Hruby et al., 1995). Indicators that will best predict the chosen functions are then selected. Often, an indicator will reflect more than one function (Hruby et al., 1995). These indicators are assigned scores depending on what type of impact they have on the function: additive, multiplicative, or fractional. For indicators increasing the function of a wetland, an additive score assignment is made. The indicator may have much more impact in a function’s efficiency that a multiplicative score will best reflect its importance. If the indicator negatively impacts the wetland function, it receives a fractional score (Hruby et al., 1995). These scores are then summed or multiplied (depending on assignment) to form a function’s performance score, and then normalized to the planning region’s highest score (Hruby et al., 1995). The social value of the functions is then determined by a group comprising those with an interest in the planning region’s wetland resources; this group should consist of non-scientists as well as scientists. These people rank the societal value of the functions depending on the ultimate importance of the function to the region (Hruby et al. 1995). To estimate the value of a wetland, the area of the wetland is multiplied by the function’s performance score, resulting in a value score (Hruby et al., 1995).

Hruby and others (1995) emphasized that "the scores or weighting factors used in the IVA usually reflect perceived importance and the best professional judgment of the author(s) rather than the results of rigorous experiments. This approach is necessitated by the lack of quantified relationships between environmental variables and functions that can be used at the scale of most wetland planning efforts. Unfortunately, conversion to numeric scores does not decrease the subjectivity of the original assumptions, but it does allow different users to arrive at the same scores."

By highlighting selected wetland scores, geographic information systems are helpful in determining the potential impacts of alternatives. This allows for an easier visualization of the results of wetland removal on a watershed's functions. Comparisons can be made to determine which wetlands are of higher value, requiring a higher level of protection. A wetland with less value can then be selected in its place, absorbing the impacts of necessary projects (Hruby et al., 1995).

In cases where unavoidable wetland impacts exist, compensation may be required to promote a regional wetland management plan. IVA results offer estimates that allow determination of the amount and type of necessary compensation. "Hectare-points" lost are used to determine impacts to function, which then are used in planning. Compensation occurs through regional planning when wetlands susceptible to degraded functions are targeted for restoration (Hruby et al., 1995).

Process for Assessing Proper Functioning Condition (PFC)

The Process for Assessing Proper Functioning Condition was developed by the Bureau of Land Management for use in managing wetlands under its responsibility for both multiple use and natural resource protection. The BLM wished to manage its wetlands to offer diversity in both vegetation and habitat while protecting the watershed (Prichard et al., 1993).

Through the formation of an interdisciplinary team, PFC assesses the vegetation, soils and hydrology of a wetland. Individuals with advanced knowledge in botany, soils, hydrology, and wildlife biology comprise the team (Prichard et al., 1993). This team will determine whether the wetland is functional, functional—at risk, or non-functional.

The team reviews existing documents that offer a foundation in PFC, allowing for the selection of the best procedures for describing and assessing the wetland (Prichard et al., 1993). Identification of wetland benefits pertinent to the study area follows the document review. This is accomplished through use of the BLM's definition of PFC, which describes the agency's six attributes qualifying a wetland to be properly functioning and determining if the wetland in question has the ability to meet the criteria (Prichard et al., 1993). This leads to the selection of attributes specific for the site to be studied. By looking for less disturbed areas, studying historic records, and recording and comparing the current species and vegetation with historical records, wetland functionality can be assessed. At this time, capability of the wetland to meet a certain function should be considered. In areas where human disturbances (e.g. dams) have impacted certain functions, the potential of the area might be able to eventually meet the function, but the capability of the area, in regards of human need, may preclude the possibility (Prichard et al., 1993).

Site visits are conducted to rate the functionality of the area. A checklist allows documentation covering all aspects of the assessment. Determining whether a wetland is functioning or not functioning is often not difficult. Wetlands in transition, however, are more difficult to classify, and in some cases, may require more intensive inventorying (Prichard et al., 1993).

This process fits into management planning with ease. The existing condition of the wetland is assessed. Using historical information and current settings, the potential condition is predicted. Distilling this information leads to the minimum requirements of the area to attain proper functionality. Resource values are then considered to discover the plant communities that will support them. Management goals are established and actions are planned so that specific goals will be set to achieve the desired condition. Monitoring will then be implemented to determine if the management goals are being achieved (Prichard et al., 1993). This technique can also be helpful in situations requiring impacts to stream stability (Kusler, 2003).

Regulatory Assessment Method (RA)

The Regulatory Assessment Method was developed specifically for agencies that must make decisions affecting wetlands within a regulatory time frame (Kusler, 1998). It is intended to systematically provide necessary information to regulatory decision-makers who must meet requirements of Section 404 of the Clean Water Act as well as state and local regulatory permitting programs (Kusler, 1998). It is used to determine the impacts of proposed activities on wetlands. Often, a more intensive wetland assessment technique will be needed to make a regulatory determination. RA helps coordinate the decision making process. Agencies using RA adapt the method to meet the goals of their specific program.

The agency applying RA to a decision must first ensure that both the wetland and activity under consideration are both regulated, that the activity is with the boundaries of a regulated area, and whether the site is publicly or privately owned (Kusler, 1998). Once these issues are addressed, the agency can begin a preliminary environmental evaluation. This portion of the technique reviews the proposed project’s impact on the area and the public. It also considers the impact’s severity. Alternatives available to the landowner and the impact of a denial on the landowner are also considered at this time. The result of these considerations is to find “red flags” that merit project denial, “yellow flags” indicating a need for more information, or if the project should be allowed (Kusler, 1998). Some criticism may be levied against this technique at this stage because of its reliance on professional judgment, injecting a level of unpredictability into the process; however, RA makes information gathering more systematic and easier for others to comprehend how the agency arrived at its decision (Kusler, 1998).

If "yellow flags" arose, a more intensive evaluation is necessary. Any potential problems will be explored and ultimately allow the agency to make a decision. Landowners are often relied upon for providing information required to make a decision. Often the "yellow flags" will be addressed using a more intensive assessment method that yields more detailed analyses (Kusler, 1998).

The next stage applies the findings of the assessment to the regulatory guidelines to determine whether the permit should be issued, denied, or conditionally approved. The final step in the RA process is to monitor the area to both ensure permit compliance and to enforce regulations (Kusler, 1998).

RA was specifically engineered to help agencies meet requirements imposed on them by statute. It uses regulatory procedures already in place to help acquire information needed in decision-making exercises. One of the main goals of the RA is to help the agency meet its legal requirements and support its findings in court (Kusler, 1998). The technique creates an organized way to methodically proceed in making decisions and is accompanied with corresponding documentation that can be used to defend findings.

Rapid Procedure for Assessing Wetland Functional Capacity (RAP)

RAP was developed on the principles of HGM classification and the concept of functional capacity. Therefore, geomorphology and hydrology were the primary factors used to determine the physical, chemical, and biological characteristics of wetlands for this method. Thirty-three landscape, hydrologic, soil, and vegetation variables are assessed to determine the functional capacity of eight different wetland functions. However, unlike HGM, RAP does not require the use of reference wetlands and quantitative measurements in order to develop a model for assessment. HGM requires more time and money to establish reference wetlands for each wetland subclass; therefore, the RAP was developed for rapid functional assessment when time and cost factors prohibit establishing reference wetlands (Magee, 1998).

RAP was originally developed under contract with the U.S. Army Corps of Engineers Waterways Experiment Station (WES) during 1993-95. It was intended to be an HGM procedure for wetland assessment in the glaciated northeast and midwest. While under development, it became evident that developing reference wetlands was not practical or affordable in all cases, so efforts were shifted to create a more time and cost effective procedure still based on the principles of HGM classification and the concept of functional capacity. Geomorphology and hydrology were the primary factors used to determine the physical, chemical, and biological characteristics of wetlands for this method (Magee, 1998).

There are two primary applications for this procedure. First, it can be used to assess wetland functional capacity in the glaciated northeast and midwest for eight functions of depressional, slope, lacustrine fringe, extensive peatland, flat, and riverine wetlands. Second, the procedure can be used as a template to develop assessment procedures for different regions of the country (Magee, 1998).

In addition to being based on the principles of HGM classification, RAP is based upon the Hollands-Magee wetlands assessment method, which uses qualitative, rule-based modeling to determine the capacity of each function. This modeling procedure can cope with a lack of information by using rules instead of equations and quantitative data. For example, a model variable such as wetland size can be characterized as large, medium, or small without knowing the exact quantitative measurement of its area. This variable can then be assigned a value that can be used in the models to determine functional performance. An index can be generated for each model to determine the functional capacity of each wetland function. As the functional indices are generated for a regional wetland class over time, a data set may be formed to provide a basis for comparison (Magee, 1998).

RAP assesses eight wetland functions listed below.

Wetland Functions Assessed by RAP

- Modification of groundwater discharge
- Modification of groundwater recharge
- Storm and floodwater storage
- Modification of stream flow
- Modification of water quality
- Export of detritus
- Contribution to abundance and diversity of wetland vegetation
- Contribution to abundance and diversity of wetland fauna

Functional capacity is the degree to which a wetland performs a specific function, not the summed capacity of the wetland to perform multiple functions. Therefore, wetlands will have separate functional capacities for each different function they perform. Functional capacity can be measured quantitatively as a ratio or interval, or qualitatively on a nominal or ordinal scale. The characteristics of the hydrologic regime, plant species composition, and soil type of the wetland ecosystem and the landscape surrounding it determine the functional capacity of the wetland (Smith et al., 1995). Since these characteristics are variable among wetlands, it is possible to have high functional capacity for some functions and low functional capacity for other functions depending on how these characteristics interact.

Each wetland was assessed by measuring variables that predict functional capacity. First, a wetland is examined for special/pre-emptive variables, listed below, to determine if it needs special consideration or exemption from further assessment. If the assessment is to continue, there are five landscape variables, fifteen hydrologic variables, one soil variable, and twelve vegetation variables that are measured to establish functional capacity. These variables are determined by using aerial photographs, maps, and any other available resources, and by field observations.

Different ranges or choices exist, defined by the developers of the RAP, that best describe each of the variables for a wetland. After all of the variables have been described, a weighted scoring sheet (Magee, 1998) is used to assign values between 0 and 3 to the variables that affect each of the eight functions. The values for the variables are then added up and divided by the total possible to give the Functional Capacity Index (FCI) score for that particular function. For example, if a function received a value of 11 for the variables associated with it and the total possible was 12, then the FCI would be 0.92.

$$\text{FCI} = \frac{\text{variable score}}{\text{total possible}} = \frac{11}{12} = 0.92$$

The FCIs range from 0 to 1.0, with 0 showing dysfunction and 1.0 demonstrating that the wetland should be performing the function adequately. Each of the eight functions receives a score between 0 and 1.0 to show its functional capacity.

Synoptic Approach

The Wetlands Research Program of the EPA developed the synoptic approach to allow wetlands to be assessed at a local scale, an intraregional scale, and an interregional scale. The smallest scale assesses the function of an individual wetland. Comparisons can be made between wetlands sharing a watershed using the intraregional scale, and relative comparisons made between wetlands in different watersheds using the interregional scale (Leibowitz et al., 1992). This technique cannot assess either the cumulative nature of stressors on a specific area but can be used to study the relative rating of cumulative impacts between areas (Leibowitz et al., 1992). Many assessment techniques study how one specific activity will affect a wetland or watershed but do not consider the potential problems that may arise from multiple impacts. Several methods study a wetland in terms of a project's proposed disturbance, while cumulative impact methods study a wetland in terms of valued wetland functions (Leibowitz et al., 1992).

Using a five-step process, this method gives groups a tool for wetland management. Development of project goals and criteria is the initial task of this technique. This includes defining the objectives and intended use, determining the level of accuracy required and the constraints of the assessment. The next step is to define synoptic indices. Defining the synoptic indices identifies wetland types, describes the wetland setting and landscape boundary (including the entire drainage area of the study) and establishes wetland functions and values. Significant impacts are determined and landscape subunits are selected. In cases where factors will be combined to represent an index, rules shaping the way the data are combined should be addressed. Selection of landscape indicators is the third step. A survey of data and existing methods is part of this task. Data adequacy should be assessed and costs of improved data should be evaluated. Comparison and selections of indicators leads to assumptions of the indicators being described. Subunit selection is finalized and a pre-analyses review is conducted. The assessment is then conducted. This includes defining quality assurance and quality control, performing map measurements, and analyzing data. Maps can then be produced and checked for accuracy. A post-analysis review helps ensure more accurate results. The final step is production of a synoptic report (Leibowitz et al., 1992).

Synoptic indices reflect the functions and values of the study area, and the landscape indicators are the parameters that form the indices. The goals and limitations of the assessment and the study area shape the indices and indicators selected. The assessment team is important in this process as it should be comprised of people that know the needs and constraints and who can apply best professional judgment to address the issues. The team members will need different backgrounds and will fulfill the tasks of defining the overall goal of the assessment, defining the ecological relationships pertinent to the project goals, and data collection. This technique does not offer pre-fabricated lists of potential indicators for indices. Each application of this method requires different sources of data and produces different results for each project (Leibowitz et al., 1992). This technique differs from many in considering landscape units instead of ranking individual wetlands (World Wildlife Fund, 1992).

To assess the impacts of multiple stressors, function, value, functional loss, and replacement potential are general synoptic indices. Functions include habitat, water quality, and hydrological. The goals of cumulative impact assessments are valued ecological functions, with values determined by the instigator of the assessment. The resulting effects of cumulative stressors on a wetland are reflected in functional loss. This can be from wetland conversion or degradation. Replacement potential through human effort reflects the ability of the wetland's functions to be replaced. In areas where function replacement will be difficult, the need for protection increases (Leibowitz et al., 1992).

The results of the synoptic approach can be organized in a map or tables of the region or state, illuminating areas of interest and allowing for easier site comparison. As data is collected from a region or state all at the same time, both time and money are saved (Leibowitz et al., 1992).

Wetland Evaluation Technique (WET)

One of the first methods to consider the range of wetland functions that could be assessed quickly, accurately, and consistently was Wetland Evaluation Technique. WET is a broad-based wetland assessment approach that is designed to gather information rapidly regarding wetland functions (Adamus et al., 1991). It can be used in cases where a low accuracy level is acceptable (Kusler, 2003). Nine functions and two values are addressed and evaluated according to social significance, functional capacity, or habitat suitability

(Bartoldus, 1999). The functions and values are evaluated by characterizing the wetland with predictors. These predictors are variables that correlate with the physical, chemical, and biological characteristics of the wetland and its surroundings. WET consists of numerous questions about these predictors, and the responses are analyzed with interpretation keys that assign qualitative probability ratings of high, moderate, or low to each function and value based on social significance, effectiveness, and opportunity (Adamus et al., 1987). The data obtained using WET can be used for comparative analysis of all wetlands in a region (Novitzki, 1995). WET is also useful in corridor planning, non-regulatory wetland restoration, and in situations requiring a regional assessment (Kusler, 2003).

WET was originally developed under the Federal Highway Administration (FHWA) as the Method for Wetland Functional Assessment (Version 1.0) in 1983. It was designed to meet the needs of the FHWA to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Some users found Version 1.0 to be complex, cumbersome, time consuming, and confusing. In an attempt to simplify and clarify Version 1.0, the U.S. Fish and Wildlife Service (USFWS) initiated a workshop sponsored by 17 Federal agencies to review the method. The group representing these federal agencies was the Interagency Wetland Values Assessment Coordinating Group (IAWVACG) and was instrumental in the development of WET. WET is a joint product of the Wetlands Research Program (WRP) of the Environmental Laboratory (EL), U.S. Army Corps of Engineers Waterways Experiment Station (WES), and the U.S. Environmental Protection Agency (USEPA) Environmental Research Laboratory (ERNL) (Adamus et al., 1991).

WET was designed for use in the contiguous United States. This method can be found in *Wetland Evaluation Technique Volume II: Methodology* (Adamus et al., 1987). WET evaluates nine functions and two values listed below. These functions and values are assessed in terms of social significance, effectiveness, and opportunity.

Wetland Functions and Values Assessed by WET

Functions
- Groundwater Recharge
- Groundwater Discharge
- Flood Flow Alteration
- Sediment Stabilization
- Sediment/Toxicant Retention
- Nutrient Removal/Transformation
- Production Export
- Wildlife Diversity/Abundance
- Aquatic Diversity/Abundance

Values
- Recreation
- Uniqueness/Heritage

Social significance assesses the wetland according to societal values. Effectiveness assesses the capability of the wetland to perform a function due to its physical, chemical, or biological characteristics. Opportunity assesses the wetland according to its opportunity to perform a function to its level of capability. With WET, there are different types of evaluations that can be performed. Social significance, effectiveness, and opportunity Level 1 can be done with maps, aerial photographs, and other information about the site. The Level 2 social significance evaluation refines the uniqueness/heritage value from the Level 1 evaluation and can be done using an NWI map. The effectiveness and opportunity Level 2 requires a field visit. Effectiveness and opportunity Level 3 requires more long term monitoring. In addition, a habitat suitability evaluation can be conducted for birds, fish, and invertebrates.

The evaluations for WET consist of series of yes or no didactic questions that pertain to predictors that directly or indirectly measure the physical, chemical, and biological processes or attributes of a wetland area. By using topographic maps, NWI maps, aerial photographs, county soil surveys, and field observations, the questions are answered about the wetland and its surroundings. The responses to the questions are then analyzed with a series of interpretation keys for each of the functions. Practice is required to perform skilled WET assessments (World Wildlife Fund, 1992). A rating is assigned based on the results for a function of low, moderate, or high for social significance, effectiveness, and opportunity.

Index of Biotic Integrity

A biological assessment or bioassessment is the use of organisms to detect environmental health and integrity (Rosenberg and Resh, 1993). Plants and vertebrate animals have been used since the early twentieth century as indicators of soil and water conditions (Odum, 1971). The use of a bioassessment may be desirable because the biological component of ecosystems should be more responsive to environmental stress than functional attributes (Howarth, 1991). In addition, practices such as chemical sampling may provide valuable information regarding ecosystem health, but they are not adequate without correlated biological data (Hart, 1994). Much of the work that has been done for bioassessments has involved streams, but recent efforts have shown that these methods can be applied to other habitats, such as lakes, reservoirs, and wetlands (Karr, 1994).

Wetland biological assessments measure the health of biological communities in wetland habitats by taking quantitative measurements of assemblages of plants, invertebrates, fish, or wildlife. Biological assessments can possibly be used with functional assessments to more accurately characterize wetland conditions and predict changes that may result from human activities (Danielson, 1998).

Some examples of taxonomic assemblages that are used for wetland bioassessments include macroinvertebrates, plants, amphibians, algae, and birds (Danielson, 1998). The types of organisms that are used for a bioassessment depend upon the objectives of the study. Depending on the stressors that may be present, different organisms will react differently to disturbances in their environments (Rader, 2001). Scientists can use the information obtained from these assessments to determine if a wetland has been degraded by chemical, physical, or biological stressors. The bioassessment may also enable the scientist to identify the stressor that is causing the damage (Danielson, 1998). The complexity of biological systems, such as wetlands, requires the use of a broadly based, multimetric approach to detect the effects of degradation on the systems (Kerans and Karr, 1994). These multimetric approaches utilize multiple indicator groups, which enable the method to assess a wetland thoroughly. This provides a better understanding of what disturbances may or may not be affecting the wetland.

Comprehensive multimetric indices were first developed for fishes to evaluate stream biotic integrity, called an index of biotic integrity (IBI) (Karr, 1981). An IBI is a combination of several biological indicators, or metrics, in a summary index. The IBI can detect damage to a wetland caused by chemical, physical, or biological stressors. More recently multimetric indices have been developed for invertebrates to evaluate the biotic integrity of streams (Kerans and Karr, 1994). Species composition and richness and ecological factors are biological attributes that are combined into indices that are then used to evaluate the health of an ecosystem (Karr, 1981). The approach for assessing the condition of wetlands was modified from IBIs for fish and invertebrates used on streams (Gernes and Helgen, 1999).

Indexes of Biotic Integrity (IBI) for Wetlands: Vegetation and Invertebrate IBIs was developed by the Minnesota Pollution Control Agency (MPCA) on depressional wetlands in the North Central Hardwood Forest ecoregion of Minnesota (Gernes and Helgen, 1999). This method uses two separate sets of metrics to yield information about wetland vegetation and invertebrates to determine the health and integrity of depressional wetlands. Since there are many ecological differences among the diverse wetland types, IBIs need to be developed for similar wetland types in a common ecogeographic region (Gernes and Helgen, 1999).

The vegetation IBI developed by MPCA uses aquatic plants as the basis of the multimetric biological criteria to evaluate wetland quality. The metrics are biological attributes that have a consistent and predictable response to human disturbances. This IBI consists of ten metrics. Four of the metrics concentrate on life-form guilds and two each focus on taxa richness, sensitive and tolerant taxa, and community structure. It is advantageous to use plants as indicators of wetland quality because both vascular and nonvascular plants are common and diverse enough to provide clear signals of human disturbance. Plants are also relatively easy to work with and are known to be acutely sensitive to disturbances such as heavy metal contaminants (Gernes and Helgen, 1999).

The wetland invertebrate IBI developed by MPCA uses aquatic invertebrates to determine the condition of wetlands since they are sensitive to a variety of environmental stresses. Invertebrates exhibit acute and chronic effects in response to disturbances such as metals, pesticides, acidification, siltation, and eutrophication. The types of invertebrates that are used to assess depressional wetlands include insect and non-insect taxa. Data on species richness and composition is more important than biomass or abundance information because it shows a strong correlation to human disturbances. This data may then be used to develop the metrics to calculate the IBI (Gernes and Helgen, 1999).

Amphibian Monitoring

Many places have incorporated biological monitoring to determine the health of wetlands. In Minnesota, a Wetland Index of Biological Integrity using wetland macroinvertebrates can indicate wetlands affected by runoff of stormwater and agricultural sources. These indices of biological integrity comprise metrics that assess human impact. Chemical changes, physical changes, and biological changes are all analyzed through different metrics, which allow researchers to determine which stressor is affecting the life of a habitat. This can assist managers in more efficiently managing and maintaining a wetland resource (Danielson, 1998).

Monitoring amphibian populations can often indicate the quality of a habitat. Many generalist species of amphibians have wide ranges, making them good candidates for spotting regional or global environmental changes, while local changes can be detected from specialists. As amphibians possess both physiological and ecological traits that link them inextricably to their habitat, they make a particularly useful indicator to the health of that habitat (Heyer et. al, 1994). These traits include a moist, highly permeable skin, jellied, unshelled eggs, and biphasic life histories (US EPA, 2002). Many researchers are concerned as worldwide amphibian populations appear to be declining, with the additional concern that increased rates of anuran deformation indicates that ecosystem health may be worsening (Knutson, et al., 2002). In wetlands located near agricultural areas, the land practices, including chemical application, can degrade the health of the wetland. Anuran species' health can be compromised by stressors in their habitat that put them at risk to pathogens in their environment (Knutson et al., 2000).

Many study design elements must be considered when developing amphibian monitoring programs. Upland habitats adjoining wetlands must be incorporated as many amphibians spend large quantities of time on land. Due to annual variation, short-term monitoring should be avoided. Additionally, simple presence or absence data is not the best option for studies assessing overall wetland health. Multiple visits should be planned, with monitoring occurring at least two times during breeding season to address regional differences in breeding times of various species. Use of more than one sampling technique to address multiple life stages should be considered, as well. The optimal study looks at many wetlands in an area or occurs over multiple years. Applying findings on a regional rather than global basis will assist in developing pertinent amphibian metrics (US EPA, 2002).

Studies comparing the results using different monitoring methods can help ascertain which technique is best for a given situation or even a given species. A study by Funk et al. (2003) monitoring *Eleutherodactylus* frog species in Ecuador compared methods of direct and indirect population density. The team found that the capture-recapture method was both precise and less biased than distance sampling or visual encounter surveys when monitoring the population of these neotropical frog species.

Knutson et al. (1999) assessed the impact of landscape composition and fragmentation on anuran populations in both Iowa and Wisconsin. Associations of abundance and species richness were made using call data and land-cover maps of the areas. High species richness was linked to high forest cover. Negative associations between species richness and agriculture were discovered in Iowa. This may be accounted for by agricultural practices being more intense in Iowa than Wisconsin and some crops and practices disturbing anuran species less than others may. In areas experiencing intensive row-crop agriculture, anurans are more dependent on nearby environments less impacted by the practices. Both Wisconsin and Iowan anurans were negatively impacted by urban environments, with road density causing much disturbance.

In further studying the associations of species with habitat, Knutson et al. (2000) were able to suggest specific species as potential bioindicators for specific habitats, especially in the midwest. They found that the wood frog, eastern gray treefrog, spring peeper, and cricket frog were associated with forests. Grassland species included the chorus frog, Cope's gray treefrog, leopard frog, and the American toad. While the bullfrog, green frog, pickerel frog, and mink frog associated with lotic and lentic environments, a lack of clear preference precluded their use as bioindicators for these environments; however, the pickerel frog was a good potential bioindicator for cold-water wetlands.

A project that focused on habitat associations of three salamander species in an Appalachian watershed yielded relationships between species type and habitat (Bruce, 2003). One species was discovered in only one habitat; *Pseudotriton montanus* was found in a bottomland swamp. Two other species were commonly associated with springs (*Gyrinophilus porphyriticus* and *P. ruber*). The results of projects such as this could potentially be used to determine the health of a wetland.

The effects of habitat fragmentation have also been studied on anuran populations. In the floodplain of the Middle Parana River, Argentina, eight ponds were monitored for various parameters including air temperature, humidity, vegetation richness, and turbidity, noise level, and disturbance. An anuran survey was completed at these sites and indicated that five families were represented by 20 different frog species. Species richness increased with air temperature, humidity, and vegetation richness. It decreased with turbidity, noise levels, and disturbance. The results indicated that species richness decreased with modification of habitat. To maintain diversity in this area, the remnants of habitat need to be preserved and disturbance needs to be reduced (Peltzer et al., 2003).

Avian Monitoring

Birds can be extremely useful in monitoring the environment. Much is known about their ecology, many museum collections exist, and bird watching is a popular pastime, allowing for a large number of people to voluntarily track populations (Peakall and Boyd, 1987). The health of an ecosystem can be inferred from the types of birds utilizing the area. In the Mid-Atlantic highlands located in Pennsylvania, Maryland, West Virginia, and Virginia, EPA and Penn State Cooperative Wetlands Center studied the songbird populations. They found that ecological condition could be inferred from the type of species using the area. Birds living in areas in excellent condition were insectivorous neo-tropical migrants that produce one brood each year. These areas were forest areas of mature hardwood or mixed hardwood. Areas in poor condition were characterized by non-native, generalist species that produce multiple broods. Many of these are nest parasites. These areas fell into two classes of rural and urban. These findings can be used in managing the natural resources of the area (US EPA, 2000).

A bird integrity index has been developed for use in assessing the health of stream sites in the Willamette Valley of Oregon. Thirteen metrics comprise this index, which assesses taxonomic richness, human disturbance tolerance, diet, and foraging and nesting traits. The team concluded that this index, used in conjunction with other stream assessments, offers a more holistic view of stream health (Bryce et al., 2002).

Wading birds can be especially useful in assessing the health of an ecosystem. They are easily identifiable, occurring in large numbers making them easy to survey, and are dependent on areas with sufficient water to provide for their needs (Crozier and Gawlik, 2003). A wide range facilitates comparisons between populations. Dwindling populations, which can be determined through nesting patterns, can indicate wetlands at risk (Crozier and Gawlik, 2003).

An index of biotic integrity using birds has also been recommended. They are influenced by vegetation, water quality, levels and seasonality, and human disturbance. Two scales can be involved with bird IBIs. For areas with small, wetland-dependent species that do not wander far from their habitat, the IBI values will indicate the health of that specific site. Assessing a site inhabited by large birds more prone to wander can reflect the condition of a broader area (US EPA, 2002).

Other studies have focused on changes in bird populations. Increasing populations of Great Crested Grebes are found on waterbodies experiencing increasing eutrophication (Rutschke, 1987). An obvious decrease in numbers of dunlins, redshanks, and lapwings in the Clyde Estuary in Scotland was noted by researchers. After eliminating a variety of possibilities for the decline, the birds' diet was targeted as the likely cause. While not explaining the mechanism of the decline, the long-term data collected on these wading birds exhibited the dramatic change that can occur to bird populations in response to their ecological environment (Furness, 1993). Monitoring bird populations can also yield information about the population changes in other types of animals, as well. Recommendations have been made to use seabird population monitoring to determine population and distribution changes in pelagic fish that are difficult monitor otherwise (Montevecchi, 1993).

Dippers in the United Kingdom and Ireland were studied as potential indicators of habitat health. They were chosen as an indicator species as they are strongly tied to a local environment. In a similar manner, their diet consists of fish and aquatic invertebrates that are also tied to the immediate area. This diet can expose the birds to metal and organochlorine contamination. Additionally, dippers can indicate stream acidification. In areas with higher levels of stream acidity and aluminum concentrations, dipper pairs require larger territories to gain the resources they need (Ormerod and Tyler, 1993). In Ontario, Black Ducks and Common Goldeneye can be used as biomonitors as they are affected by the combined impacts of acidification and fish predation on invertebrate prey species, while Common Loon breeding success can provide an early indication of the impact of acidification on fish populations at pHs greater than 5.5 (McNicol et al., 1987). Collected eggs and chicks of Snowy Egrets, Great Egrets, and Black-crowned Night Herons in the United States yielded accumulations of DDE and PCBs. Through this type of biomonitoring, the degree of estuary contamination can be evaluated (Custer et al., 1990).

To more appropriately management wetland areas, studies have been made of wetland use by a variety of species. In the North Bay of the San Francisco Bay, waterbirds were found to stay in one estuary subregion instead of moving between areas, indicating the proper unit for management is the subregion. If habitat is lost in one subregion, mitigating in a different subregion will not replace the habitat (Takekawa et al., 2002). A study of avocets in South Carolina indicated that human-altered wetlands, while used by the birds, did not make up for wetland loss (Boettcher and Haig, 1995). Moorhens in Guam associated most with small wetlands with emergent cover of transitory vegetation, with wetlands used based solely upon availability (Ritter and Savidge, 1999).

Many variables affect wetland bird use. A study of avian numbers using wetlands in San Joaquin Valley in California indicated that large, shallow wetlands with variable topographically supported more species at greater densities than smaller, deeper, less variable wetlands (Colwell and Taft, 2000). The timing of drawdowns in Delaware Bay was found to impact the numbers of waterfowl making use of a wetland. Migratory ducks preferred impounds with high levels in the spring (Parsons et al., 2002).

Waterfowl have an increased need for nutrients for energy requirements during breeding season, often more than other bird species. Because of this, the fertility of a wetland is important to many duck species. A study in British Columbia indicated that in wetlands selected for use by Green-winged Teal, phosphorus and Chlorophyll-*a* concentrations were greater than in unused wetlands. The chosen wetlands were shallower, as deeper wetlands are less productive (Paquette and Ankney, 1996). In a similar manner, wetlands used by Mallards and Black Ducks in Ontario are more fertile than unused wetlands, and breeding densities increase with increased wetland fertility. Fertile wetlands produce more nutrients needed by breeding ducks (Merendino and Ankney, 1994).

In the prairies of North America, the size, longevity, amount of shoreline, conductivity, salinity, abundance of chironomids, and vegetation characteristics all impact the likelihood of use of a wetland by breeding waterfowl (Fast et al., 2004). The size of a wetland is especially important to Lesser Scaup in Canada. The wetlands selected were larger than 0.01 ha despite the presence of smaller wetlands. These wetlands were deeper and supported more invertebrates and more cover for the offspring (Fast et al., 2004).

DeLeon and Smith (1999) found that wetlands in the Prairie Pothole Region in the Great Plains are important to a variety of migrating shorebirds. These wetlands provide a much needed source of energy to the birds in both spring and fall movements. As these wetlands are ephemeral, deLeon and Smith recommended that large areas of this region should be targeted for conservation. Niemuth and Solburg (2003) found that the density and distribution of five species of wetland birds was positively correlated with the number of wetlands available and that water availability affects the distribution of these species.

Changes in land type and land use are reflected in changes in the bird communities making use of an area. In the Colorado River Delta in Mexico, topography, water depth and salinity, vegetation variables and agricultural use all affected the avian community. The studies of these variables yielded insight on how to manage the area for waterbirds. Releasing freshwater into the environment to maintain areas with aquatic vegetation yields improved habitat for waterbirds in this area (Hinojosa-Huerta et al., 2004). In Australia, rice fields offer a good foraging area to the Cattle Egret; however, these areas do not function as a substitute for natural wetlands for the Intermediate Egret and Great Egret, both native species (Richardson and Taylor, 2003).

The Western Hemisphere Shorebird Reserve Network (WHSRN) studies shorebird usage of areas in the United States to determine important stopover sites for migrating birds. These areas can then be targeted for preservation (Farmer and Parent, 1997). Additionally, the information produced by the WHSRN has been used to typify which areas of the United States are utilized by specific species (Page et al., 1999).

Oklahoma Wetland Projects Utilizing Assessment Methodology

Development of Hydrogeomorphic (HGM) Regional Guidebook for Lacustrine Fringe Wetlands in Oklahoma

In Oklahoma, a Regional Guidebook is under development for lacustrine fringe wetlands along the reservoirs of the state through the Tulsa District U. S. Army Corps of Engineers, Waterways Experiment Station, and the Model Assessment Team. The reservoir hydrodynamics, soil, and vegetation of a region are some of the parameters studied and characterized to derive a regional subclass classification. Currently in draft format, this guidebook encompasses the following subclass functions: shoreline stabilization, nutrient cycling, elements and compounds removal and sequestration, characteristic plant communities maintenance, wildlife habitat provision, and fish habitat provision.

Development of Indices of Biological Integrity for Depressional Wetlands in Central Oklahoma

Indices of biological integrity (IBI) have been proposed for use in evaluating the quality of wetland habitats. The IBI is the sum of multiple metric scores, and is established by evaluating an assemblage of organisms from sites that occur across a gradient of human disturbances. A study conducted by Dena Hartzell, Dr. Joseph Bidwell, and Dr. Craig Davis through Oklahoma State University is working to develop an IBI for depressional wetlands in central Oklahoma. A working group of 12 wetlands has been selected by site reconnaissance, soil surveys, aerial photos, and topographic maps. These wetlands exhibit different degrees of disturbances, such as cattle grazing, mowing, levees, and road runoff. Macroinvertebrate, plant, and bird assemblages will be monitored and evaluated seasonally for the next two years. Sixteen potential metrics for each assemblage will be evaluated for their response to human disturbance. A final group of eight metrics that respond to human disturbance will be used to evaluate each site. Within a site, each metric will be assigned a numerical value of 5, 3, or 1 to represent a healthy, a moderately disturbed, or a poor quality system, respectively. The score of the final metrics will be summed to determine the overall IBI score for the wetland.

Oklahoma Biological Survey of Ecologically Significant Wetland Communities

The Oklahoma Biological Survey (OBS) is creating a manual that enumerates wetland plants specific to Oklahoma. A corresponding website and distribution maps will also be established to assist state wetland managers.

The OBS developed a definition of ecologically significant wetland communities which allowed a ranking of “A” being the highest and “D” being the lowest, with “A” and “B” indicating wetlands of conservation interest. OBS then inventoried 60 wetlands in fifteen counties in northeastern Oklahoma. Those wetlands meeting the established definition were added to the Oklahoma Natural Heritage Inventory Element Occurrence (OHNI) database, which is frequently updated and available to any group or individual desiring the information. Of the 60 wetlands assessed, 11 received an “A” rating, 43 a “B”, and 6 a “C”.

The current wetland vegetation of 21 sites in 10 counties in southwest Oklahoma has been inventoried and the biological diversity assessed using the data once it was added to the OHNI database. The OBS also located and assessed 105 ecologically significant wetland communities in 27 counties of north central, northwestern, and panhandle of Oklahoma. The resulting 207 species and other site data were added to and further analyzed with the OHNI database.

Wetland Health Assessment Monitoring (WHAM) Volunteer Monitoring Program

The Oklahoma Water Resources Board (OWRB) developed a volunteer wetland health assessment monitoring pilot program (WHAM) and studied the feasibility of maintaining such a project. With limited funding and less manpower, reliance upon volunteer assistance has grown. To educate the public and collect baseline data on Oklahoma's wetlands, WHAM comprised methods from programs with goals and situations similar to those of Oklahoma.

The program was developed in conjunction with a citizen advisory group and the Oklahoma Wetlands Working Group. Nine parameters were selected to study the health of Oklahoma's wetlands. Weather was assessed using temperature, wind direction, and cloud cover. Human impacts, degradation, and a sketch of the wetland were indicators of the surrounding land use. Evidence of wildlife and wildlife seen or heard comprised the wildlife category. Amphibians were studied in two parameters: bullfrogs seen or heard and the presence or absence of other species. Water quality parameters included temperature, pH, dissolved oxygen, ammonia, nitrate, phosphate, and chlorophyll a. To document ecosystem change, photopoints were taken by setting up three sites and taking a panoramic photo sequence. Vegetation is assessed through counts of thirteen indicator species and helps give an estimation of diversity. Standing water depth, the presence or absence of sulfide odor and mottles, relative color, and the depth to the ground water allow wetland boundaries to be delineated. Hydrology is studied through calculating groundwater depth and making notes on the crest height.

Volunteers increased their knowledge about wetlands, as exhibited in a comparison of a pre-test with a post-test. The program can be tailored to specific wetland classes or to specific needs. The OWRB came to two conclusions on how to improve WHAM. First, to best meet the needs of the program, funding should be sought to furnish volunteers with all the monitoring equipment they will need. Lastly, OWRB volunteers indicated that three hours per month was the amount of time they felt comfortable volunteering for the Water Watch program. In some cases, the parameters monitored in WHAM could take much more time. For volunteer retention, OWRB felt that the parameters monitored and the techniques used in WHAM would need adjustment so less time would be required of the volunteers.

Wetland Prioritization, Enhancement, and Protection

Through the University of Oklahoma, the Oklahoma Conservation Commission compared different wetland assessment techniques. The goal was to assist in the characterization of Oklahoma's wetland resources. To meet this goal, three objectives were established. The first was to determine which functional assessment techniques would be appropriate for Oklahoma wetlands. A functional assessment approach database was created to accomplish this objective. Secondly, a comparison of different techniques applicable for Oklahoma was conducted using selected Oklahoma wetlands. This objective was met through the application of functional assessment tools to the Deep Fork River wetlands in Lincoln County and the development of additional functional assessment models. The final objective, to evaluate the potential of wetland bioassessment techniques, was effected through the appraisal of pilot biological assessments.

Out of twelve techniques applicable to Oklahoma wetlands, three rapid assessment methods were selected for further study. These were the Hydrogeomorphic Approach, the Rapid Procedure for Assessing Wetland Functional Capacity, and the Wetland Evaluation Technique. Additionally, the Index of Biological Integrity for Wetlands was selected as a biological wetland assessment method.

Based on the results of this study, the Hydrogeomorphic Approach, while thorough, consumed much time and effort. The results applied only to a single regional wetland type. For application of this technique to the diverse bottomland hardwood forests of Oklahoma, reference sites, dominant plant lists for each vegetation strata, and regionalized methods must be developed. The Rapid Assessment Procedure relies on semi-quantitative variables and can be quickly and readily applied to different wetland types, making it a potential candidate for application to the diverse wetlands of Oklahoma. The Wetland Evaluation Technique can also be applied to different wetland types, but produces qualitative results for which the interpretation can be problematic. Biological assessments were found to indirectly indicate wetland condition with regard to disturbance. They cannot replace functional assessments, but should be used in conjunction with them. For application in Oklahoma, lists of tolerant and sensitive species and widespread evaluation are needed. Overall, a combination of regionalized and well-referenced functional and biological assessment techniques appears to provide the best comprehensive evaluation of Oklahoma wetland ecosystem health and integrity.

The assessment methods were tested in Lincoln County to help manage land on a watershed scale. Currently, an assessment method has not been selected to be used in Lincoln County. The adoption of an accepted assessment method by the state may be necessary before one is used on a widespread basis.

Wetland Water Quality Standards for the State of Oklahoma.

The Oklahoma Water Resources Board (OWRB) has prepared a draft of wetland water quality standards for the state and submitted them to the Environmental Protection Agency (EPA) for comment. The EPA wanted modification of the proposed standards across a variety of topics. Instead of supporting numeric criteria, the EPA recommends the use of a functional assessment methodology to place Oklahoma wetlands into subclasses. EPA indicated that numerical standards are used in lakes and streams as opposed to wetlands. Another suggestion was to include the EPA and other federal agencies (e.g. U. S. Fish and Wildlife Service) in the planning process to improve the standards.

Some of the issues with creation of wetland water quality standards come with the definition of wetlands as "waters of the state" and received a default beneficial use. The wetland water quality standards sent to the EPA needed a beneficial use designation; the standards Oklahoma submitted only referred to marshes, a wetland class not dominant in the state. EPA wanted to be sure that other wetland types would be included as well. Currently, due to the intense controversy, Oklahoma is waiting for the federal government and the courts to further hone the definition of "waters of the state."

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Appendix A: Summarized Methods

Habitat Assessment Technique

Required Expertise

- Ornithologist (or specialist of species for which method is adapted)

Applicable Habitat or Wetland Types

- All wetlands and aquatic or terrestrial habitat

Data Requirements

- Obtain breeding bird population estimates
- Conduct field survey to assess avifauna composition
- Produce aerial photographs, maps, or field measurements of the wetland area

Pros

- Need only one person for assessment
- Applicable to wide range of wetland habitats
- Can be adapted for other species
- Low data requirements
- Less than 1 hour required per site
- Can directly compare habitats within geographic ranges of evaluation species
- Breeding bird estimates available from the Oklahoma Biological Survey
- Aerial photographs available from the Oklahoma Geological Survey
- Describes habitat quality
- Is useful in site selection—a high index near a proposed site means good habitat potential while a low index could indicate a potential restoration site

Cons

- Cannot be used for design since it does not provide information on habitat structure or other design elements

Habitat Evaluation Procedure (HEP)

Required Expertise

- HEP-Certified team with voting members from the review agencies (e.g. USFWS, USACE, USEPA, state agencies, applicant/action agency)

Applicable Habitat or Wetland Types

- Most terrestrial, wetland, and aquatic habitats in the United States

Data Requirements

- Use aerial photographs in conjunction with gauging station records to:
    - Delineate cover types
    - Choose 10-15 evaluation species for each cover type
    - Categorize species into guilds
    - Choose a species from each guild

- Calculate total area of available habitat by summing areas of cover types likely to be used by evaluation species
- Calculate Habitat Suitability Index (HSI)
  - Establish HSI model requirements
  - Acquire HSI model
  - Determine HSI for available habitat
- Determine Habitat Units (HUs)

Pros
- Can directly compare habitats within geographic ranges of evaluation species
- Aerial photographs available from the Oklahoma Geological Survey
- Gauging station information available from USGS
- Flexible for different habitat/wetland types
- Used extensively, including Oklahoma
- Can be used for design as it provides design criteria with explicit measurements

Cons
- Requires multiple individuals to conduct assessment
- Team members need HEP certification

Hydrogeomorphic Approach (HGM)

Required Expertise
- For development, an interdisciplinary team of experts is needed

Applicable Habitat or Wetland Types
- All wetland types, but not all assessment models are developed

Data Requirements
- Development
  - Obtain regional wetland classifications and other information for region
  - Define regional subclass
  - Develop functional profile to characterize regional subclass
  - Define reference domain
  - Identify reference wetlands
  - Use national or regional guidebooks to develop assessment models
  - Use reference wetlands to estimate reference standards and calibrate models
- Application
  - Define assessment objectives
  - Describe project area with narrative, maps and figures
  - Prepare base map of area with USGS 7.5 minute topographic map
  - Use models to determine functional capacity

Pros
- Application of model require 1-2 hours per site

- Can compare wetlands from same regional subclass
- Some models have been developed that could be used in Oklahoma
- Can be used for restoration purposes
- Can be used for design as it provides design criteria with explicit measurements

Cons
- Requires interdisciplinary team of experts
- Development phase can take months
- Cannot compare wetlands from different subclasses
- Model development would be required for Oklahoma
- Does not address values

Index of Biologic Integrity (IBI)

Required Expertise
- Biologist trained for the biota assessed

Applicable Habitat or Wetland Types
- All wetland habitats

Data Requirements
- Define region, classify system type
- Define how humans influence the ecosystem
- Select an assemblage to be indicators of human influence
- Identify metrics which are attributes showing an empirical and predictable change in value along a gradient of human disturbance
- Combine at least 7 metrics (assigning scores 1, 3, 5) to form IBI
- Field sample for assemblage to test the IBI

Pros
- Can compare similar habitats in the same geographic region
- Assessment can be completed rapidly: half day in field and half day in lab per site
- Helpful in guiding site selection

Cons
- Cannot directly compare different habitats or same habitats in different regions
- Much preparation required before site can be assessed
- Only accounts for biotic environment
- Not useful as a guide to design

Indicator Value Assessment (IVA)

Required Expertise
- Group of experts knowledgeable of the wetlands in the planning watershed

Applicable Habitat or Wetland Types
- All U.S. wetland types, but not all assessment models are developed

Data Requirements
- Identify wetland functions
- Identify indicators for each function
- Assign scores to indicators
- Estimate performance score for each function (0-100)
- Establish the relative social importance of functions
- Estimate value of wetlands

Pros
- 1-4 hours required after development, using 2-3 people
- Can directly compare wetlands (regardless of type) in same geographic area
- Variables useful to assess impacts for different development options, for compensation need identification, and for selecting wetlands for enhancement

Cons
- Multiple experts required
- Method is very subjective
- Development requires 3-5 days for each planning region or watershed
- Not useful in design

Process for Assessing Proper Functioning Condition (PFC)

Required Expertise
- Interdisciplinary team consisting of a biologist and specialists in vegetation, soils and hydrology

Applicable Habitat or Wetland Types
- U.S. riparian wetlands

Data Requirements
- Review existing documents providing a basis for assessing PFC for that wetland
- Analyze PFC definition to identify benefits applicable to the study area
- Assess functionality through:
  - Attributes and processes appropriate for study area
  - Capability and potential
  - Properly functioning condition
- Complete checklist that:
  - Identifies 17-20 items regarding vegetation, hydrology, landform/soils
  - Provides columns for checking yes, no, or NA
  - Has blank spaces for remarks for “no” response
  - Summarizes functional rating, trend for functional at-risk, factors contributing to unacceptable conditions outside BLM’s control/management

Pros

- Requires half an hour to assess
- Can directly compare wetlands of same or different class or region
- Parameters include the three wetland attributes
- Useful in developing management strategies

Cons

- Interdisciplinary team required
- Team must visit each site to determine condition
- Designed to inventory wetland riparian areas, not specific project sites
- Not intended as a design tool
- Only applicable to riparian wetlands

Regulatory Assessment Method (RA)

Required Expertise

- Regulatory program wetland professional

Applicable Habitat or Wetland Types

- All U.S. wetland types

Data Requirements

- Make jurisdictional determinations
- Conduct preliminary environmental evaluation using best professional judgment:
  - Focus upon project characteristics and interactions with wetland
  - Identify resource related red and yellow flags
  - Evaluate how the wetland works
  - Determine the magnitude of the functions, values, and impacts
  - Determine the adequacy of impact reduction and compensation measures
- Use more detailed analyses and assessment methods if yellow flags are identified
- Apply results to regulatory criteria
- Monitor to determine compliance

Pros

- Assessment requires only one person
- Applicable to a wide range of wetland habitats

Cons

- Comparison between wetland types must be determined by the evaluator during the preliminary environmental evaluation
- Lacks structure for repeatability
- Not useful in design

Rapid Procedure for Assessing Wetland Functional Capacity (Rapid Assessment Procedure)

Required Expertise
- Two experienced wetland scientists representing backgrounds in soils/hydrology and plant ID/ecology

Applicable Habitat or Wetland Types
- Depressional, slope, lacustrine fringe, extensive peatland, flat and riverine HGM class wetlands

Data Requirements
- Development entails:
    - Describing the region
    - Developing a general profile for each HGM class
    - Developing a list of functions
    - Developing a functional profile for each HGM class
    - Listing the relevant and appropriate variables for each function
    - Describing each of the variables
    - Preparing rationale for model development
    - Developing an inventory sheet
    - Developing a model for each function
- Application entails:
    - Defining the wetland assessment area
    - Completing the wetland inventory data sheet
    - Applying the models
    - Calculating functional capacity

Pros
- Application of model requires 1-3 hours per site
- Can compare wetlands from same regional class
- Useful as a guide to design models for different regions

Cons
- Cannot compare wetlands from different classes
- Models require modification for use in Oklahoma

Synoptic Approach for Wetlands Cumulative Effects Analysis (Synoptic Approach)

Required Expertise
- Team including a resource manager, resource specialist/permit reviewer, and technical analyst

Applicable Habitat or Wetland Types
- All U.S. wetland types

Data Requirements

- Define goals and criteria, including level of accuracy required
- Define synoptic indices
- Select landscape indices
- Conduct assessment using NWI maps, county soul surveys, USGS topographic maps, USGS land use/land cover maps
- Prepare synoptic reports

Pros

- Could enable direct comparison of landscape subunits within a geographic area
- Could be used for restoration
- Can guide in site selection

Cons

- Requires multiple team members
- Preparation can take six months to two years
- Not appropriate for small projects
- Cannot directly compare individual wetland areas
- Not useful as guide to design

Wetland Evaluation Technique (WET)

Required Expertise

- An individual with an undergraduate degree in biology, wildlife management, or environmental science

Applicable Habitat or Wetland Types

- All wetland types in contiguous U.S.

Data Requirements

- Obtain maps including USGS topographic maps, county soil surveys, aerial photographs, NWI maps, and any additional maps, surveys, or inventories
- Delineate assessment areas
- Answer series of yes/no questions
- Analyze answers with interpretation keys

Pros

- Requires only one person
- Once maps are acquired, only requires two hours
- Can directly compare all wetland types in U.S.
- Can evaluate habitat suitability for multiple species groups

Cons

- Output is only a rating of probability that a function will occur
- Not useful as guide to design

Appendix B: Agreement to Participate

Appendix C: Meeting Notes

Wetlands Assessment Meeting Notes

July 27, 2004
9:00 a.m. until 2:45 p.m.
Oklahoma City Metro Tech, Springlake Campus

Opening remarks/introductions:

Chris DuBois, Oklahoma Conservation Commission

Chris outlined the scope and purpose of today's meeting, generally describing the opportunity for this working group to compile and contrast general information pertaining to wetlands assessment, and other relevant, technical data and information. This project is funded by an EPA grant. Facilitation services within the grant project are provided by the Institute for Issue Management and Alternative Dispute Resolution, OSU. The facilitation team is Weldon Schieffer and Terrie Altman.

The agenda for discussion in today's meeting (and future discussion sessions) is:

Where are we?
Where do we want to be?
Why do we want to be there?
How are we going to get there?

Future meeting dates have been set for August 11th and 26th, and September 9th , at this same meeting location, with the September 9th meeting to be convened with the invited attendance of others from Oklahoma's Wetlands Working Group.

Handouts distributed by Chris included:

- Element of Wetland Monitoring & Assessment Program Checklist
- Agreement to Participate (a sign-up form requested by EPA as a function of the facilitated dialogue intended to occur within this funded project)

PowerPoint Presentation by Chris DuBois – (See attached presentation: "Wetlands Assessment Discussion Group")

Facilitated group discussion:

Discussion Question: *Where are we?*

- A wide spectrum of ideas, methods, and expectations exists
  - some non-existent within regulatory perspectives
  - within a wide diversity of wetlands that exists across Oklahoma
- A parallel spectrum of wetlands exists within private land ownership
- There are many, varied natural aspects of wetlands to consider

- Social perceptions (value, function, purpose) of wetlands also vary widely
- The spectrum existing within technical communities is also varied, including within other states that have previously assessed techniques for their use
- An educational component would be of value and would add several layers of benefit

Discussion Question: *Where do we want to be?*

A lot of discussion takes place within agencies, both State and Federal, but these activities are often impacted by current administrative policies, in addition to technical aspects.

Consensus statement ► Effective, scientifically defensible tools for wetlands assessment are needed in Oklahoma.

What is the controversy on assessment techniques from existing regulatory perspectives?

- Such techniques impact costs, and these costs may well increase risks, e.g., mitigation.
- Mitigation may be triggered by the "no-net-loss of wetlands" concept, in contrast to the assessment of wetlands on a "case-by-case" basis.
- Wetlands may be determined by function, or a loss of function basis via acreage. Functional use is a very important element of assessment.
- Creating and comparing a list of functions, and then prioritizing those functions, may be an option in formulating a template, utilized to add structure within determinations.
- Assessments should use scientific methods; logistics and how to make assessments are often part of the challenge.
- Various assessment models provide a numerical index for determinations. Beneficial use is often dependent on utilizations, purpose, and other subjective values.

Determinations of what is good and what is bad can be troublesome, particularly when evaluating data. Other states have struggled with these same issues. Models exist that would help move beyond these hurdles. The acceptance of assessment techniques may need to be tested prior to any acceptance of specific methods.

Who are stakeholders?

Consensus list (not comprehensive) ►

- Municipalities
- Council of Governments (INCOG, ACOG, etc)
- Universities/Academia
- State agencies:
  Oklahoma Water Resources Board
  Oklahoma Department of Environmental Quality

Oklahoma Conservation Commission
Oklahoma Department of Wildlife Conservation
Oklahoma Department of Transportation
Oklahoma Transportation Authority
Oklahoma Department of Agriculture?
Oklahoma Corporation Commission (Oil & Gas Division)

- Federal agencies:
  USDA (both the Natural Resources and Conservation Service and Farm Service Agency)
  U.S. Fish & Wildlife (Biological Survey Unit)
  Environmental Protection Agency
  U.S. Corps of Engineers
  U.S. Forest Service
  U.S. Federal Highway Administration
  U.S. Geological Survey
  Military?
- Native American Indian Tribes
- Organizations (Federation of Farm Bureau, Oklahoma Farmers Union, the Nature Conservancy, Ducks Unlimited, etc.)
- Recipients from assessment methodology

What are their needs? (e.g., reasons for their interests):

- Flood control
- Water quality
- Quality of habitat
- Measurable status of a wetlands' function(s)
- Comparison of functional value(s)
- General Compliance

Discussion question: *Why do we want to be there?*

- To meet agency goals and/or objectives
- To make more informed decisions, both presently and in the future
- To gain knowledge for future activities
- To better focus research and inquiries in order to address issues
- To protect natural resources

Discussion question: *How are we going to get there?*

- Determining what information we need to create in order to meet the objectives for assessments.
- Determining what question(s) to ask, and then gathering sufficient, appropriate information in order to provide answers.

- Looking at options and tools for assessment, and identifying relevant applications and the scenarios in which to use them.
- Develop decision criteria for the level of intensity needed to assess the wetlands.

Facilitator's note: This was the majority of discussion regarding the discussion questions for this project. The Institute announced that it would forward these notes to working group attendees for suggested edits and other commentary. All suggested changes/edits from working group attendees are to be forwarded to the Institute for further compilation and editing. The Institute will forward all suggested changes and edits back to attendees and also to Chris.

The Institute's contact person and address for this activity is **taltman@okstate.edu**.

Discussion regarding Chris' power point slides: *Identifying Wetland types; Regional differences*

- There likely is good value in utilizing knowledge from other states, including their identification of stakeholders, the choice of assessment tools used, and practical knowledge gained from their efforts.
- Natural vs. created or human derived wetlands; there is a question of functionality, with other related interests associated with "values. For example, will assessments be made on all sites or only the "naturally occurring" sites? Discussion at this meeting seemed to lean toward assessing all sites.
- What changes should/could be made in methodology for the benefit of application?
- There may be the need to find additional reference sites in order to test applied methods.

The next meeting is scheduled August 11, 2004, at MetroTech, Springlake Campus, in the Blue Room, from 9:00am until 2pm. The meeting will also include a power point presentation by Chris on various assessment methods.

A question pertaining to the objective for the September 9th meeting was asked, with the general response being refining statements and prioritized lists regarding:

- Proposed recommendations for consideration and action,
- A list of preferred/suggested methods as examples,
- Geographic areas where different assessment levels/methods might apply.

Wetlands Assessment Meeting Notes

August 11, 2004
9:00 a.m. until 2:45 p.m.
Oklahoma City Metro Tech, Springlake Campus

Discussion Questions:
What are important aspects of design:

1) What data are important for Level 1 Assessments? (In-office assessments used to identify wetland location, their surrounding land uses, used for forecasting possible functions and assumption regarding condition.)

Existing resources:

Aerial photographs
Land use maps (NRCS, INCOG, FEMA flood plain maps, various sources)
USGS quadrangles (7.5 minute)
National Wetland Inventory Maps (US Fish & Wildlife)
County Soil Surveys (NRCS publication)
USGS Gauge Data
Individual Reports associated with specific locations
NRCS Wetland Inventory Maps
MesoNet Data (Precipitation)

2) What aspects of Level 2 assessments are important? (On-site assessment)

Rapid (1-3 hours on site, 1-2 hours in office) and easy (can be accomplished by 1 person, relatively straightforward, repeatable by other trained individuals, typically uses a standardized series of questions, etc.)

Consistency (i.e. output is standardized score or scores which allows comparison between sites)

Assesses both Condition and Capacity (function)

To build sufficient amount of scientific methods into Level 2 assessments to generate defensible results

Indicators that would be Considered in Level 2 assessments:

Hydrology
Vegetation
Surrounding land use
Existence of buffer zones
Soil type and characteristics
Water quality
Size
Use by wildlife

Use by endangered or threatened wildlife
Presence of endangered or threatened plant species
Flood attenuation
Proximity to other wetlands
Location within watershed
Human use or disturbance
Aquatic and semiaquatic organisms
Groundwater recharge/discharge
Stressors

3) How can level 3 assessment verify level 2? (Level 3 assessment is more intense requiring more time, personnel, identification, resources, etc.)

May require use of Level 2 assessment to establish IBI
Level 3 is more in depth (measurements, samples, study) than Level 2
Two most commonly used methods are HGM and IBI
Assumptions built into Level 2 may be validated or disproved by Level 3 activities
Range of reference sites could be utilized as comparables
Scientific methods (Level 3) are more in depth and would be related to the indicators in Level 2 assessments.
A more data rich approach

4) Is a wetland classification scheme important for Oklahoma? A wetland classification scheme may or may not be helpful in relation to who is asking the question and their purpose for its use.

Is a wetland classification scheme necessary for Level 2 assessments?

May not be necessary, may be built into the assessment method
Classification could change questions asked in Level 2
It would not be necessary for mitigation

Is a wetland classification scheme necessary for Level 3 assessments?

Can a wetland classification scheme be sufficiently built into the assessment method?

Does Oklahoma already have one? Possibly the Oklahoma Wetlands Reference Guide (OWRG). Does this constitute a wetlands classification scheme for Oklahoma? The OWRG does not contain a flowchart or key. The Wonders of Wetlands (WOW) Program contains a flowchart for the types of wetlands.

Which wetlands classification scheme is best for Oklahoma?

FOR NEXT MEETING:

The "Review of Rapid Methods for Assessing Wetland Condition" will be distributed to all workgroup members by IIMADR for the workgroup members' review prior to the next meeting, scheduled for September 9, 2004. The members are to provide feedback to The Institute in which they rank the seven (7) state rapid assessment methods (identified in Table A-1, A-2, and A-3 and further described in Appendix C), due to the Institute by August 26th. The meeting previously scheduled for August 26th has been moved to September 9th to allow time for members to receive the information and make their rankings. The next meeting will be held on September 9th at the MetroTech Spring Lake Campus, 9:00am to 2:30pm. Room TBD.

Discussed options for stakeholders comparing various assessment methods from other states

Each stakeholder ranking each method
Identifying priorities for this region

Considerations for realistic goals when developing assessment methods

Wetlands Assessment Meeting Notes

September 9, 2004
Oklahoma City Metro Tech, Springlake Campus

Recap of previous meetings and how these three methods became the top 3 chosen by the group.

<u>Montana Method</u>

Easy to follow
Easy to implement (may need to be broken down more for data gathering for producers, contractors or developers)
Assignment of scores (could be a plus or a minus)
Included values
Wetland took up a large portion
Used a classification scheme – combined HGM and Cowardin classification method

May need a consultant or professionally trained person to perform assessments.
Expense of a consultant or professionally trained person (PE) would increase cost of assessments.

Orientation and training still needs to be provided regardless of the level of users to any methodology.

No software is available at this time that would provide an assessment based on the data entered about the wetlands similar to those used by USDA.

1987 Corps Wetland Delineation Manual and Supplemental Guidance is somewhat considered the Standard Manual in Oklahoma

Delineation and Assessment could be done at the same time, but Montana requires additional information than the Corps requires at this time – this may save money.

Montana Method is easy to use and information can be obtained through various resources: OU Biological Survey has technical data for all of Oklahoma, flood plain information via flood plain insurance, etc.

Actual point score for each area that would be calculated and the wetland would be assigned to category based on total score.

If NRCS accepts an Oklahoma Model then NRCS could be applying the model when assessing wetlands in the fields. Would decrease costs since NRCS would be following 87 Delineation Manual utilized by the Corps, but an Oklahoma Model would utilize a few extra steps that could be performed at the same time as the delineation and assessment with little extra time, resources and effort.

Washington Method

Not as cleanly put together –
Has office data form with series of questions which provides ability to breakdown site within categories
Field data form human disturbances, irreplaceable functions, special wetland types
Category 4 – lowest quality types
Scoring is on the significant habitat value which determines if the wetlands is a category lack of scoring didn't allow you to compare numerically and
Only 2nd and 3rd provided scores, 1st and 4th did not
Reproducibility and subjectivity would be possible arguments against methods. Montana and Ohio Methods are based from the Washington Method.

Endangered species seem to be automatically flagged in a category 1 versus category 2 or category 3 – how does that factor in to the process Oklahoma chooses – something to consider in future. There will be regional differences that would both produce high quality wetlands for that particular area/region.

An ecoregion point system may need to designed/developed to help identify regional differences.

Montana method addresses different wetland functions in which the Washington Method lacked. Both Montana and Washington addresses buffers but by utilizing different questions

Montana is thinner and has different questions. Was the easiest to go through out of the top three methods.

Ohio Method (also based on the Washington)

The narrative rating mirrors Washington, habitat endangered/threatened species, wetland types. Yes or No questions
Most recent (2001) also the thickest of the three.
Quantitative rating – similar aspects as the other two. More like Montana in that there is more scoring of different parameters. Rating scale is reversed compared to that of Montana

Has hydrology section includes a section rating modifications through natural hydrology. Ohio scores are based on a total of 100 points, but the size of the wetlands is scored within the point system. Montana was based on percentage points but was multiplied by the size of the wetland so there is a possibility of having more than 100 total points. Area is not as important in Ohio method. The Montana method provides more evaluative benefit overall based on size of wetlands. Montana may be geared toward larger wetlands.

Size and uniqueness of wetland also have values.

What to present to the Wetland Working Group?

The needs the value of going through, the populations that can/will benefit (public, farmers and ranchers, agencies),

Present that the group looked at seven methods and came up with their top three rankings for Oklahoma which are the Montana, Ohio and Washington methods. Oklahoma's method would be a combination of these three models.

Benefit financially more than it is going to cost
Ability

Chris will present to the Wetland Working Group September 24th MetroTech, Economic Development Center. Should focus on the benefits of having a standardized method for assessing wetlands in Oklahoma. Scientific tool for various regulatory and public purposes.

Possibility of having a power point presentation
Spectrum of approaches, user friendly, easily applied, scientific tool easily, outcome, understandable, interface with existing regulatory procedures.

Series of three meetings – members from various perspectives. OSU, OU, City of Tulsa, Conservation Commission, Corps of Engineers, DEQ, OWRB

September 24th at 10:00am to 12:00 noon, Metro Tech Economic Development Center.

Wetlands Assessment Meeting Notes

September 24, 2004
Oklahoma City Metro Tech, Springlake Campus

Wetlands Assessment Meeting
Notes from September 24, 2004

Introductions
Overview of the Institute for Issue Management & Alternative Dispute Resolution – History of OAMP and the Institute created by HB2068 –now 70 O.S.§3430 - authorizes IIMADR to provide services for any agriculture, rural living, environment or government issues.

Chris DuBois discussed the EPA grant identifying the need for a standard wetlands assessment and then presented a PowerPoint presentation involving the activities of the discussion groups.

Final grant report with recommendations for focus and direction will be due within a month.

Will send a list of documents available for Working Group in one central location via email.

Future meetings are recommended with other stakeholders not previously involved in previous meetings.

If used in a regulatory basis, what have other states done? EPA Region 6 is involved in other states that are involved in Wetlands Assessment Methods.

What is considered a "Wetland" has been under discussion statewide. Regulatory authority, definitions, etc. are still undecided. Wetland Assessment Methods may be not be needed until these decisions are made. However, it may be that using a wetland assessment method my help define if the area is in fact a wetland area or not from a scientific perspective. Concerns were voiced over identifying or defining "wetlands" as opposed to categorizing the types of acreages in Oklahoma from a data perspective.

Is there money available for next phase of project, further refining methods? Ongoing need exists for finding wetlands assessment method?

There is a need to scientifically determine what a wetland is, however there are political concerns since other stakeholders are affected/involved (oil and gas, landowners, real estate developers, etc.) Methods may be a way to help everyone define what a wetland really is.

Is testing of these methods warranted at this time?

A meeting with all stakeholders might be an avenue to discuss concerns with defining wetlands via wetland method assessment models and the need for Oklahoma to adopt an assessment model. Various groups might be interested in attending, such as Oklahoma's Homebuilders Association

Should the next phase be a group to look at assessment methods or bring others in to discuss methods already identified?

Do we continue to develop methodologies?

There is currently a federal definition of "wetlands" utilized by the Corps of Engineers and NRCS – both have appeal programs for adverse decisions. State level may have questions, since there are no state programs with regulatory authority to determine the issue. The qualities and functions of wetlands and applying the science to various wetlands are more beneficial at this point than definitions. There was discussion of federal versus state definitions and authorities concerning identifying wetlands, quality levels of wetlands, and use of land (oil and gas restoration activities and historical uses). On a federal level, applicants for wetland projects have tools to assess their land to federal standards that benefit landowners and project proponents, state agencies, as well as the Corps of Engineers.

Public input, possibly a public meeting, containing all stakeholders is needed to discuss:
Assessment of individual wetlands?
How do you assess or inventory land across the state?

Also send notes from previous meetings to Wetland Working Group.

Concerns were voiced regarding funding for activities associated with refining assessment methods. Possibilities of how to organize a public meeting to discuss the Wetlands issues in Oklahoma were discussed.

Should technical aspects be refined before public meeting is held with additional stakeholders, or simultaneously? Maybe simultaneously since time is needed to plan public meeting.

Methodology, quality assurance plan, and field-testing would be needed to refine assessments. The group discussed possibilities of EPA funding proposals in the future for additional phases of the project.

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This group recommends that members of the Wetlands Working Group apply or find funding for two purposes:

1) **Continuing technical work with written procedures on how to use a Rapid Assessment Method (Level 2) to assess the level of function of wetlands and**

2) Convening a public forum on the proposed methods for assessing the level of function of wetlands.

The meeting adjourned at 12:26pm