PROGRAMMATIC MEMORANDUM

TO: Reader of Mitigation Report *Enabling Progress*

FROM: American Wind Wildlife Institute

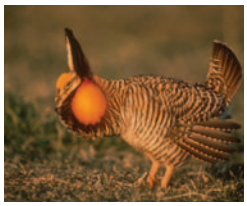
SUBJECT: Mitigation Report *Enabling Progress*

Dear Reader,

The American Wind and Wildlife Institute (AWWI) recognizes the tremendous value of wind energy as a clean energy source. Wind energy produces no carbon, no water or air pollution, requires no use of water, and comes from a renewable and abundant resource. However, we also know that as with all forms of land development, wind energy does have an impact on wildlife and the habitats it occupies. Recognizing this, one of AWWI's core initiatives is to be leaders in providing biologically effective and financially practical strategies for offsetting or mitigating unavoidable impacts to the natural environment.

To inform the discussion the American Wind Wildlife Institute (AWWI) commissioned , *Enabling Progress*, prepared by Solano Partners, Inc.. The report provides a review of current wildlife related mitigation practices employed in the United States and how those practices might relate to future wind energy development. The report also discusses where opportunities exist for developing a mitigation framework tailored to wind energy development.

By release of this report, AWWI and its members take no particular position with respect to the content of the report's information, findings or recommendations.



Enabling Progress

Compensatory Mitigation Scenarios for Wind Energy Projects in the U.S.

SEPTEMBER 17, 2009

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ACKNOWLEDGEMENTS

We would like to offer our sincere thanks to all of our interviewees and focus group participants, who are listed in the appendices. These representatives of leading wind energy companies, wildlife and conservation organizations, and government agencies gave their time and attention generously, and their insights fundamentally shaped the content of this report.

The Solano Partners team would also like to gratefully acknowledge the encouragement and leadership provided by Wayne Walker, a leading founder and Launch Director of the American Wind Wildlife Institute. He is an inspiration.

Finally, the authors have sought to include the most accurate and up-to-date information available. Any errors that remain are those of the authors alone.

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ACRONYMS

ACP – Adaptive Conservation Plan

AFWA – Association of Fish and Wildlife Agencies

AMF – Adaptive Management Framework

APHIS – U.S. Department of Agriculture Animal Plant Health Inspection Service

AWEA – American Wind Energy Association

AWWI – American Wind Wildlife Institute

BMP – Best Management Practice

CAA – Clean Air Act

CFR – Code of Federal Regulation

CM – Compensatory Mitigation

CMM – Compensatory Mitigation Model

CWA – Clean Water Act

DOI – U.S. Department of Interior

DSS – Decision Support System

EA – Environmental Assessment

EDF – Environmental Defense Fund

EFSC – Oregon Energy Facility Siting Council

EIS – Environmental Impact Statement

EPA – U.S. Environmental Protection Agency

ESA – Endangered Species Act

FACA – USFWS Federal Advisory Committee

FSC – Forest Stewardship Council

GW – Gigawatt

HCP – Habitat Conservation Plan

HUC – Hydrologic Unit Code

LEED – Leadership in Energy and Environmental Design

LEPC – Lesser Prairie Chicken

MBTA – Migratory Bird Treaty Act

MEA – Mitigated Environmental Assessment

MOA – Memorandum of Agreement

MSC – Marine Stewardship Council

MW – Megawatt

NCCP – Natural Communities Conservation Planning

NEPA – National Environmental Policy Act

NMFS – National Marine Fisheries Service

NRDC – Natural Resources Defense Council

NWCC – National Wind Coordination Collaborative

ODOE – Oregon Department of Energy

ODOT – Oregon Department of Transportation

ODFW – Oregon Department of Fish and Wildlife

ODWC – Oklahoma Department of Wildlife Conservation

REZ – Renewable Energy Zone

T&E – Threatened and Endangered Species

TNC – The Nature Conservancy

USACE – U.S. Army Corps of Engineers

USDOE – U.S. Department of Energy

USFWS – U.S. Fish and Wildlife Service

USGBC – U.S. Green Building Council

VEC – Valued Ecosystem Component

WDFW – Washington Department of Fish and Wildlife

WGA – Western Governors' Association

WWHG – Western Governors' Association Wildlife Habitat Council

SECTION 1: INTRODUCTION AND OVERVIEW

The opportunity of wind power in the U.S. is immense. Even taking transmission and integration costs into consideration, over 600 gigawatts (GW) of low-cost wind energy is available—over half of all U.S. electricity generation capacity today.[i] Siting new turbines, however, is a major challenge. In 2008, a record 8,358 megawatts (MW) of wind capacity was built in the U.S., which represents 42% of new generation in the country. Yet, wind is still just over 1% of total U.S. generation.

In order to fulfill it's potential to provide clean energy and address climate change, the pace of new construction will have to increase. In considering pathways forward for the wind power industry, a central question is: How will the challenge of siting be addressed to ensure that wind energy is developed while protecting wildlife and wildlife habitat?

Box 1: Compensatory Mitigation

"Compensatory mitigation refers to the restoration, establishment, enhancement, or in certain circumstances preservation of wetlands, streams or other aquatic resources for the purpose of offsetting unavoidable adverse impacts."

Excerpted from: U.S. EPA. "Wetlands Compensatory Mitigation" (http://www.epa.gov/owow/wetlands/pdf/CMitigation.pdf).

This report offers the results of research on potential pathways forward, with a focus on compensatory mitigation. Specifically, we suggest potential pathways forward to reduce time and cost for necessary permitting. This work is based on a series of focus groups and one-on-one interviews as well as extensive research on the current state of play in wind mitigation.

Our research has revealed broad-based agreement on a few core parameters that create boundaries around *whether*, *when*, and *how* mitigation should be considered:

First, **mitigation cannot work in every situation**. There are some rare and unique resources that simply cannot be replaced if they are harmed, and some types of impact that cannot be effectively mitigated through even the best restoration and conservation efforts. The decision as to exactly what types of resources and impacts are beyond the boundaries for effective mitigation, and therefore, which should not be developed under any circumstances, will need to be the focus of extensive and serious discussion.

Second, **compensatory mitigation is part of a continuum of actions which should focus first and foremost on avoidance and minimization of impacts.** The question of "how much avoidance is enough before mitigation responsibilities begin" is key, and we propose a set of options in this report to align avoidance and mitigation efforts. It is essential to underscore that the basis of this report is the view that a focus on avoidance is a natural consequence of a good mitigation strategy, as quality mitigation involves predictable costs that can be minimized through site selection, project design, and project operation.

Box 2: The Mitigation Hierarchy

Compensatory mitigation is actually the third step in a sequence of actions that must be followed to offset impacts to aquatic resources. The 1990 Memorandum of Agreement (MOA) between the Environmental Protection Agency (EPA) and the Department of Army establishes a three-part process, known as the mitigation sequence to help guide mitigation decisions and determine the type and level of mitigation required under Clean Water Act (CWA) Section 404 regulations.

Step 1. Avoid Adverse impacts to aquatic resources are to be avoided and no discharge shall be permitted if there is a practicable alternative with less adverse impact.

Step 2. Minimize If impacts cannot be avoided, appropriate and practicable steps to minimize adverse impacts must be taken.

Step 3. Compensate Appropriate and practicable ***compensatory mitigation*** is required for unavoidable adverse impacts which remain. The amount and quality of compensatory mitigation may not substitute for avoiding and minimizing impacts.

Excerpted from: U.S. EPA. "Wetlands Compensatory Mitigation" (http://www.epa.gov/owow/wetlands/pdf/CMitigation.pdf).

Even within these parameters, the siting of wind facilities presents some unique challenges that formed the basis for developing scenarios and assessing potential pathways forward as summarized in Table 1.

Table 1. Overarching Issues in Wind Project Siting

Wind Siting Issue Due to Varying Impacts	Explanation
Regulated *versus* Unregulated Impacts	Wind projects may impact: • Resources and species that are highly regulated (such as, federally listed threatened and endangered species), and/or • Resources and species that are of strategic concern to both industry and stakeholders but have no formal regulatory nexus. • An effective approach must be able to address both types of impacts.
Project Siting Impacts *versus* Indirect Effects and Cumulative Impacts	While our focus is on ways to provide successful compensatory mitigation from individual projects, we are aware that indirect effects and cumulative impacts to species and habitats will be increasingly a source of concern to stakeholders and regulators over time. Chapter 5 introduces an example process that illustrates objective basis for measuring *both* impacts and offsets in such a way that the method can be applied to direct and indirect effects of individual projects, but also to cumulative effects at a later stage.
Siting Impacts *versus* Ongoing Operational Impacts	While bird and bat strikes have been a predominant issue for the wind industry, the consensus of the participants in the focus groups and conversations were that habitat impacts, including fragmentation, are likely going to be a larger concern in the future. Therefore, an adaptive management approach based on project monitoring will be an essential part of a strategic solution. The question of whether or not bird and bat strikes can or should be addressed through compensatory mitigation—for example, which provides verifiable improvement to breeding and nesting habitat—remains an open and important question.

This report begins by describing the current state of play related to compensatory mitigation in the U.S. Details on leading cases of compensatory mitigation in the wind industry are then presented. A set of potential future scenarios for wind mitigation are also laid out, followed by details on project financial implications as they relate to the Compensatory Mitigation Model. The appendices offer details on case studies and research methodology, as well as lists of participants in focus groups and interviewees.

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i "AWEA/DOE/NREL 20% Wind Vision", presentation given by Jim Walker, President of the American Wind Energy Association Board of Directors, Manufacturing and Developing Wind Energy Systems in Michigan Conference, September 11, 2007.

SECTION 2: CURRENT "STATE OF PLAY" OF COMPENSATORY MITIGATION IN THE U.S.

Compensatory mitigation takes a range of forms and approaches within the U.S., as summarized in Table 2 and discussed in detail in this section. The main regulatory drivers of compensatory mitigation are Section 404 of the Clean Water Act (CWA), which requires compensatory mitigation as a means to achieve no net loss of wetlands and the Endangered Species Act (ESA). While there are other regulations that drive compensatory mitigation, they are often less direct.

Box 3: Regulations Related to Compensatory Mitigation

- Section 404 of the CWA
- ESA's Conservation Measures consultation process includes consideration of mitigation, but obligations are not clearly articulated in advance.
- National Environmental Policy Act (NEPA) required mitigation when a Mitigated Environmental Assessment (MEA) is prepared as a means to prevent the need for an Environmental Impact Statement (EIS).
- Mitigation performed for a non-mitigated Environmental Assessment (EA) is generally performed under a Consensus Agreement as a means to obtain project support from stakeholders.
- Clean Air Act (CAA) and Section 401 of the CWA, require offsets if permit compliance cannot be achieved, but these offsets can come in many forms and are generally not considered compensatory mitigation.

Each of these elements is described in detail below. It is also noteworthy that an avoidance and mitigation approach may also include a range of land use planning and management tools, such as Habitat Conservation Plans (HCPs), and Safe Harbor Agreements, which are described in Appendix 2.

Table 2. Approaches to Compensatory Mitigation in the U.S.

	Approaches	Details
Regulatory	Mitigation and Conservation Banking	A quantitative assessment of impact forms the basis of credit and debit accounting. Mitigation is completed in advance allowing purchase of credits from banks to result in a transfer of legal liability. These structured approaches have been developed and authorized by the U.S. Army Corps of Engineers (USACE) and U.S. Fish and Wildlife Service (USFWS) as a compliance alternative for specific types of impacts under the CWA and ESA, respectively.
Regulatory	In-Lieu Fees	In-lieu fees, as their name implies, provide for a mechanism for a project proponent to compensate for project impacts by paying a fee to a government entity or designated non-profit instead of conducting mitigation activities. The fee is then utilized to provide protection or restoration of resources adequate to compensate for impacts related to the project. Many early in-lieu fee programs suffered from the fact that fees charged to projects were inadequate to provide sufficient mitigation on the ground and from the temporal loss to the natural resource between when projects started and when a compensatory action was initiated. Newer in-lieu fee programs, such as the voluntary fund developed by the Oklahoma Department of Fish and Wildlife for the Lesser Prairie Chicken, have utilized more rigorous approaches for determining appropriate fees and methods for focusing funds on quality mitigation opportunities.
Voluntary	Certification	Certification approaches have been used by a variety of industry sectors, including forest products, fisheries, and construction/real estate, to address best management practices and related compensatory mitigation requirements. They have most often been used to address non-regulated impacts or a combination of regulated and non-regulated impacts.

MITIGATION BANKING

Mitigation banking provides both revenue and regulatory compliance through the sale of credits earned by creating conservation and restoration outcomes on private land that satisfy the goals of Section 404 of the CWA. Credits are purchased to offset unavoidable impacts from projects by outsourcing compliance obligations.

Under this system for addressing the impacts to wetlands and streams from various activities, landowners are required to avoid and minimize any impacts to wetlands and streams. When there are unavoidable impacts, however, they must mitigate the remaining impacts either on-site, off-site, by paying an in-lieu fee, or by purchasing credits from a mitigation bank almost always located in the same watershed.

On March 31, 2008, USACE and the U.S. Environmental Protection Agency (EPA) published a joint rule to cover compensatory mitigation legislated under 33 Code of Federal Regulation (CFR) 325 and 332 (USACE) and 40 CFR 230 (EPA). These new regulations make it more difficult to mitigate impacts on-site and in this way are intended to level the playing field for various mitigation options by requiring the same level of effort for so-called "permittee responsible" mitigation as has been required of mitigation banks. The new rules also mandate a watershed approach to compensatory mitigation and streamline the approval process for mitigation banks.

The area within which an aquatic resource bank may sell its credits, known as a service area, is defined by watershed considerations, and is typically limited to an 8- or 12-digit hydrologic unit code (HUC). The service area must be approved by USACE.

Box 4: U.S. Government Definition of Mitigation Banks

"Wetland restoration, creation, enhancement, and in exceptional circumstances, preservation undertaken expressly for the purpose of compensating for unavoidable wetland losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial. It typically involves the consolidation of small, fragmented wetland mitigation projects into one large contiguous site. Units of restored, created, enhanced or preserved wetlands are expressed as "credits" which may subsequently be withdrawn to offset "debits" incurred at a project development site."

Excerpted from the Federal Guidance for the Establishment, Use and Operation of Mitigation Banks Federal Register: November 28, 1995 (Volume 60, Number 228) Pages 58605-58614.

A bank owner must put the designated property into a permanent conservation easement with third party oversight, usually a non-profit or government agency. A "Mitigation Banking Agreement" must include a science-based management plan, an operation and maintenance plan, and provisions for remedial action. These activities must be fully funded by the bank's endowment fund.

Once plans are approved and ecological success criteria, which is defined by the government, has been achieved, then, the bank earns mitigation credits registered by the regulatory agencies for their efforts. The landowner can then sell these mitigation credits to others who must compensate for having impacted wetlands or other aquatic features in order to get their permit. The sale of the credits legally transfers the liability for mitigation from the permittee to the wetland banker.

For private lands with aquatic features, mitigation banking provides an incentive to invest in restoration, enhancement, creation, and protection of environmental features in cases where such investment can provide credits useful to those that must mitigate within the same watershed. While these may not be significant portions of the overall land in a given area, nonetheless the value of eligible lands is likely to be significantly higher as a wetlands bank than under other forms of appraisal. Examples of those needing mitigation are developers that have impacts they cannot avoid or minimize, or Department of Transportation projects.

CONSERVATION BANKING

Similar in approach and execution to aquatic resource mitigation banking, conservation banking allows formal transfer of liability for impact on the habitat of threatened and endangered (T&E) species. U.S. conservation banking is enabled by the legal requirements of the ESA. Specifically, Section 7 requires federal agencies to consult with the USFWS regarding potential impact to T&E species, and Section 10 requires "incidental take permits" and HCPs for those impacts. USFWS is the principal agency that administers the ESA with respect to terrestrial and freshwater species, while the National Marine Fisheries Service (NMFS) is the lead agency with respect to marine and anadromous species.

Recently, USFWS has been working on language that will allow for conservation banks to be established for both listed and non-listed species. So far, they have language for circumstances under which a bank covers both: (1) a non-listed but candidate species; and (2) de-listed species.[i]

In May 2003, USFWS released the official federal guidance for the establishment, use, and operation of conservation banks. This guidance was closely modeled after the State of California's guidance for conservation banks, which has been in place since 1995. This guidance established a unique process for establishing a conservation bank that was completely separated from the HCP mechanism and was intended to complement other habitat conservation efforts such as the Natural Communities Conservation Planning (NCCP) program that began in 1991 in Southern California.[ii] James Strock, Secretary for the California EPA, stated, "We are offering incentives to developers and local governments to bundle and direct mitigation work to those areas of highest regional conservation priority. We have found that this market-based approach provides greater environmental protection at a lower total cost."[iii]

The first conservation bank was the Bank of America-owned Carlsbad highlands bank in San Diego for coast sage scrub habitat.[iv] Today there are 114 approved conservation banks in 12 states covering 87 listed species. The highest densities are found in areas with the most development pressure on species and coinciding high demand for species credits.[v]

In conservation banking, the unit traded is most often an acre of habitat. Occasionally, due to specifics of an organism's ecology, the unit may be a breeding pair or combination of habitat and the actual species, or in the case of fish and aquatic species, the unit may be a linear foot of riparian habitat.

While an aquatic resource bank's service area is defined by watershed considerations, a conservation bank's service area is based on biological criteria of the species involved and often a recovery plan. The USFWS must approve service area determination.

As with an aquatic resource "Mitigation Banking Agreement," under a Conservation Banking Agreement a bank owner must put the designated property into a permanent conservation easement with third party oversight, usually a non-profit or government agency. A Conservation Banking Agreement must include a science-based management plan for species and habitats, an operational and maintenance plan, as well as provisions for remedial action. These activities must be fully funded by the bank's endowment fund.

Bank owners are required to provide adequate funding for the perpetual operation of the bank. To achieve this, financial assurance mechanisms are required such as a non-wasting endowment fund from the deposit of a fixed amount for every credit sold. In addition, the creation of a bank can require posting performance bonds for bank establishment and a maintenance period.

Endangered species benefit from banks because they usually create a critical mass of protected area that is more sustainable and manageable than "on site" mitigation in the long-term. Buyers of the credits benefit by transferring the long-term liability of managing endangered species habitat.

According to the federal guidance, conservation banking is primarily intended for those species that are listed as threatened or endangered under the ESA. However, recent USFWS policies have provided for banks established to serve candidate species as a means to prevent their listing. This is generally intended to cover candidate species that are the subject of Candidate Conservation Agreements with Assurances and species covered by those multi-species HCPs that include both listed and non-listed species. While many species not meeting these criteria will be protected as a by-product of establishing banks, the formal extension of conservation banking credit purchase opportunities to non-listed species remains a challenge. This is because, in most cases, there are no clear regulatory drivers and no agencies with clear jurisdiction over those species.

IN-LIEU FEES

An in-lieu fee program is an agreement between a regulatory agency (state, federal, or local) and a single sponsor, generally a public agency or non-profit organization. Under an in-lieu fee agreement, the mitigation sponsor collects funds from an individual or a number of individuals who are required to conduct compensatory mitigation under Section 404 of the CWA or another state or local wetland regulatory program. The sponsor may use the funds collected from multiple permittees to create one or a number of sites under the authority of the agreement to satisfy the permittees' required mitigation. In-lieu-fee mitigation is generally categorized as mitigation conducted after permitted impacts have occurred.

The March 2008 rulemaking by USACE and EPA limits the amount of fees that can be gathered by an in-lieu fee program to that equivalent to offsets for 30% of the future mitigation site's capacity for replacement values.

VOLUNTARY CERTIFICATION

In addition to formal compensatory mitigation for achieving compliance with environmental regulation, there are a host of efforts on the part of industry and its stakeholders to take into account and seek to lessen environmental impact. When compliance with a particular law or regulation is less the issue than a set of unavoidable impacts—to both regulated and *unregulated* resources—then various industries have invested in the development of certification standards that provide evidence of excellence in design and execution of projects with reduced environmental impact. These certification standards incorporate basic features that would be applicable to any analogous effort undertaken by the wind industry, such as:

- An open, transparent, consensus-based process of standard setting,
- Third party verification of claims,
- A qualification standard checked by third party verifiers, and
- An ongoing process of monitoring.

In some cases, certification has been used to address social and environmental issues that were beyond the scope of existing environmental law. In other cases, the voluntary criteria preceded and even shaped the direction of regulatory approaches.

Box 5: Examples of How Voluntary Initiatives Can Inform Future Regulation

The U.S. voluntary carbon markets have completed hundreds of millions of dollars worth of transactions resulting from reduction in CO_2 or other greenhouse gas emissions. Many of the object lessons and structural approaches included in the leading climate bill now moving through Congress (the 'Waxman Markey' bill) were developed through the experience of the voluntary markets.

In another instance, the Willamette Partnership in Oregon has developed clear ecological success criteria for 'credits' resulting from specific conservation and restoration actions for salmon, riparian buffer, water quality and other important environmental features. These credits are now in the process of being recognized by a range of federal and state regulatory agencies as a legitimate source of compliance with environmental laws.

The table below provides a brief overview of three leading certification efforts.

Table 3. Illustrative Certification Programs

Certifier	Description
Forest Stewardship Council (FSC)	FSC certification, along with the 'rival' voluntary certification schemes for forest management practices, like the Sustainable Forestry Initiative, was developed in response to consumer and advocate concerns about the effects of clear-cutting. While rotational clear cuts were a perfectly legal practice in 1993, when the FSC organization was formed, the perception that unacceptable impacts were occurring as a result caused major timber companies to engage with critics and stakeholders in a new way. FSC was formed with participation from environmental organizations and industry. It developed 10 principles and associated criteria that form the basis of a set of forest management standards that apply worldwide. In addition, there are more specific standards for regional contexts and/or specific forest types. FSC certification means that an independent and accredited third party has verified management practices of a forest products company on the ground. While it is a voluntary process, a company must meet rigorous standards under an audit-like inspection. A quick summary of the criteria that a company must meet for certification includes ensuring that: • Forest management is compliant with national legislation, local use rights and indigenous peoples' rights are respected, • The ecological functions of the forest and its biodiversity are maintained, and • Adequate management planning and monitoring of the operation are conducted. To maintain certification, a company must participate in an annual audit, and non-compliance Corrective Action Requests are issued if warranted. Companies must make required changes within specific timeframes to maintain certification. Once certification is in place, a company may use the FSC trademark logo, which is the most widely recognized standard for responsible forest management. The FSC certification now covers some 7,500 forestry operations in 80 countries, which operate on over 100 million acres. Source: Forest Stewardship Council website at http://www.fsc.org/facts-figures.html.
Marine Stewardship Council (MSC)	Modeled on the experience and success of FSC, MSC is a global certification and ecolabeling program for sustainable seafood. Like FSC, it was founded by a consortium of industry representatives and stakeholders. Standards were developed between 1997 and 1999, and require assessments to be carried out by independent, third-party certifiers. There are currently 48 certified fisheries in the MSC program.
US Green Building Council – Leadership in Energy and Environmental Design (LEED) certification	According to the U.S. Green Building Council (USGBC), buildings in the United States are responsible for 39% of CO_2 emissions, 40% of energy consumption, 13% water consumption and 15% of Gross Domestic Product per year.[vi] The organization was formed in 1993 following a major initiative by the Natural Resources Defense Council. The main focus has been the development and implementation of the LEED standards. LEED certification criteria, like both FSC and MSC, require that project developers to meet a detailed checklist of items providing information on environmental performance. Unlike those 'yes or no' systems, however, LEED provides ratings for differing levels of performance, including: • bronze, • silver, • gold, and • platinum. LEED rating systems are currently available for new construction, existing buildings, commercial interiors, core and shell, schools, retail and homes, and rating systems are in pilot or under development for neighborhood developments and health care. The LEED program is the largest single organized element of the green building movement in the U.S., which comprised 2% of non-residential construction starts in 2005 and 10-12% in 2008. Source: 2009 Green Outlook: Trends Driving Change, McGraw Hill Construction. Available at: http://construction.ecnext.com/coms2/summary_0249-294642_ITM_analytics.

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i Personal Communication, Deblyn Mead, National Conservation Banking Coordinator, USFWS, 06/26/09.

ii The Resources Agency of California. Press Release, "Market Created for Habitat Improvements; "Conservation Banks" Integrate Environmental, Economic Goals." April 7, 1995. http://ceres.ca.gov/topic/conservation /april_press_release.html.

iii The Resources Agency of California. Press Release, "Market Created for Habitat Improvements; "Conservation Banks" Integrate Environmental, Economic Goals." April 7, 1995. http://ceres.ca.gov/topic/conservation /april_press_release.html.

iv Department of Fish and Game, Catalogue of Conservation Banks in California. http://www.dfg.ca.gov/hcpb /conplan/mitbank/catalogue/catalogue.shtml.

v For a listing of all existing U.S. conservation banks, see http://ecosystemmarketplace.com/pages /marketwatch.overview.transaction.php?market_id=1.

vi USGBCl website: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=124.

SECTION 3: WIND ENERGY AND IMPACT AVOIDANCE, MINIMIZATION, AND MITIGATION

Although wind energy projects have dramatic water, air quality, and climate benefits, they still have environmental impacts. Since many of these impacts result from project construction and operation, careful siting and design are an essential part of environmental performance as the mitigation hierarchy indicates (see Box 2).

Overall, impact avoidance and minimization measures are key for wildlife and habitats and are at the heart of most major strategic initiatives aimed at facilitating the development of renewable energy. Specifically, impact avoidance in the preproject planning, design, permitting, construction, and operational phases of a project can drastically reduce the need for mitigation, which is beneficial both to the environment and the project developer. In addition, by successfully implementing avoidance measures, the regulatory, financial, and technical challenges associated with establishing, monitoring, and maintaining mitigation projects can be reduced. For more information on impact avoidance and minimization, please see Appendix 3, which describes two leading efforts including: the Western Renewable Energy Zone approach developed by the Western Governors' Association (WGA) and the US Department of Energy (USDOE), and the USFWS Federal Advisory Committee (FACA) guidelines that are in development for a set of recommendations to be made to the Secretary of the Interior.

For wind projects, as with any land development, the reality is that not all impacts can be avoided. Even with full efforts at avoidance and minimization, impacts often remain including bird and bat mortality and habitat loss and fragmentation. For this reason, it is essential to understand and evaluate impacts as well as assess the need for offsets and compensatory mitigation.

One reason for the lack of clarity is that existing permitting processes do not often provide an objective measure for the desired level of resource protection and the maximum allowable level of impact. An exception that proves the rule is that a project developer seeking an Incidental Take Permit under the ESA is given clear limits on the amount of take that may occur and the type of conservation actions that are required to compensate for the impact. The terms of the Incidental Take Permits, including the required compensation for specific, indirect, and cumulative impacts, are negotiated up front. This approach provides both the agencies and the project proponents with clear boundaries by which to plan, monitor, and measure performance. It also allows the developer to take specific avoidance, minimization, and mitigation costs into consideration during project planning. Only when impacts are found to exceed the authorized level is the project proponent potentially required to implement additional best management practices (BMPs) and/or provide additional compensation. This additional obligation is determined in consultation with the agencies and is based on the additional level of effect.

The challenge for the wind industry is that no such impact thresholds or obligatory limits exist for many of the natural resources affected by wind energy projects. Therefore, the project proponent is placed in the position of having to avoid and minimize to unknown levels, *without* the benefit of:

- A pre-established limit on what impacts are allowable,
- A pre-established compensatory mitigation obligation, and/or
- The legal protection provided by compliance with a permit.

In an attempt to address the situation, many state, federal, international, and non-governmental organizations, often in collaboration with wind industry representatives, have produced guidance documents intended to help developers avoid and minimize impacts. A variety of BMPs are contained in

these documents. Some of this guidance has been developed for specific areas, based on the availability of baseline data and monitoring reports from existing projects in the region.

However, in many areas, there is a lack of sufficient resource data and, therefore, impact avoidance decisions are based on findings from other parts of the country.[i] The effectiveness of this approach to impact avoidance is currently unclear in many cases and therefore, few of the guidance documents specify appropriate types or amounts of compensatory mitigation.

Box 6: Case Study of Klickitat County, Washington's Response to Renewable Energy Siting Challenges

In recognition of the fact that renewable energy projects do have consequences, Klickitat County, Washington prepared the *Klickitat County Energy Overlay Environmental Impact Statement*, in order to ensure that wind energy development occurs in "optimal locations within the County."

The local government approach recommends multiple "mitigation actions" designed to "offset potential impacts due to development of energy facilities." It is intended to be a resource for both developers and County staff involved in site development for wind, gas-fired generation, biomass, and solar facilities. For each type of facility, the document provides a list of "potential mitigation actions."

Source: http://www.klickitatcounty.org/planning.

A challenge faced by wind developers is that the majority of mitigation requirements for wind projects are more accurately described as avoidance and minimization measures. In actuality, there are few resources available to help guide the true mitigation work that is done.

An example of this lack of guidance on wind power mitigation is the Bureau of Land Management Wind Energy Programmatic Environmental Impact Statement (EIS)[ii]. One of the main sections of this document is entitled "Potential Impacts of Wind Energy Development and Analysis of Mitigation Measures," but the entire section is devoted to discussion of design, avoidance, and minimization measures, and provides no guidance for appropriate compensatory mitigation measures for unavoidable impacts.

As a result, mitigation requirements are, by default, set on a case-by-case basis and there are no known instances where the mitigation resources of multiple projects have been pooled to create a regionally significant mitigation project. In the absence of a framework for developing regional goals and priorities, mitigation requirements are often unclear and mitigation projects are unable to realize their full ecological potential.

Further compounding these immediate complexities is the reality of cumulative effects. The need for Cumulative Effects Analyses is a common theme throughout the wind industry siting review and permitting process. However, the scope, scale, and methodology for performing such analyses have yet to be consistently established. This practice results in missed opportunities to perform strategic siting and project planning work.

Box 7: Case Study of the Virginia Department of Environmental Quality and the Highland New Wind Development Project

At one extreme, the Virginia Department of Environmental Quality recommended to the permitting agency for the 20 turbine Highland New Wind Development project that a cumulative impact analysis needed to be performed prior to project approval. The recommendation stated that "the cumulative impact of wind turbines proposed or planned at 34 facilities within the Allegheny Highlands of Virginia, West Virginia, Maryland, and Pennsylvania" needed to be considered. Therefore, in addition to the developer's own project, "88 currently operating wind turbines, 457 permitted wind turbines, and 480 utility-scale wind turbines proposed or planned at these 34 facilities" would need to be included in the evaluation.

Source: Wind Turbines and International Biodiversity-related Agreements: Emerging Trends and Recommendations, October 2006.

Overall, the expectations for project developers related to cumulative effects are often quite vague and varied in scope and scale (See Box 7 for one extreme case). Numerous projects have been proposed without consideration to cumulative effects. The intent of the recommendation from the Virginia Department of Environmental Quality is laudable, but the burden for a master-planning level of analysis is placed on one project developer, rather than on a

regional entity. This approach creates many problems in addition to project delivery and finance challenges. A particular concern is that multiple developers could potentially prepare their own cumulative effects analyses for the same general region—using conflicting data and different methodologies—which could lead to different results that then become a source of debate.

Box 8: Oil and Gas Industry and Sage Grouse Habitat

The oil and gas industry faces challenges similar to those faced by the wind industry in regard to mitigation. One of the primary concerns associated with oil and gas developments is the fact that many priority development areas are in the vicinity of sage grouse habitat.

Sage grouse rely on sagebrush habitats. This species is an indicator of the health of the habitats in which they live because development activities in their habitat can easily affect their survival. Since sage grouse are sensitive to change, they are considered an indicator species for sagebrush habitats. Negative effects to the sage grouse can imply risk to other species such as deer, antelope, and non-game species.

Due to the layout and infrastructure required for development of oil and gas facilities, sagebrush habitats can easily become fragmented. Similar to the wind industry, the oil and gas industry faces uncertain regulatory requirements and focuses on avoidance and minimization measures. Unless a direct federal nexus is triggered and threatened and endangered species of concern are present, little can be done to ensure mitigation when unavoidable impacts occur. The ambiguity associated with Migratory Bird Treaty Act compliance remains a liability.

The recently formed Western Governors Association's Wildlife Habitat Council (WWHC) has begun to address the needs of wildlife associated with oil and gas facilities. WWHC has recommended that "state fish and game agencies take the lead to develop criteria and guidance for on- and off-site compensatory mitigation, including when and where it should be applied or not applied." However, in the absence of this information, the industry is left to address mitigation issues as they arise, rather than proactively.

The June 11, 2009 USFWS Wind Turbine Guidelines Advisory Committee draft report calls for development of a regional-scale cumulative effects analysis. The report recommends "DOI improve it's capability to assess cumulative impacts by working with the USFWS regions to undertake, subject to available resources, a comprehensive look at the range of development stressors at an ecoregion level." The Committee further recommends that each USFWS region prepare a cumulative effects analysis that begins to estimate the overall impact associated with the potential for a "full build-out" wind development scenario. However, without an agreed upon framework for understanding how responsibility for cumulative effects is to be allocated back to individual projects, the utility of such analysis is likely to be limited.

The Committee also recommends that the Oregon Department of Fish and Wildlife's (ODFW) white paper on cumulative effects analysis be considered when guidance in this area is developed. The white paper is included in the *Oregon Columbia Ecoregion Wind Energy Siting and Permitting Guidelines* (September 29, 2008). The analysis was prepared in response to a request made by the Oregon Energy Facility Siting Council (EFSC) and was prompted by the EFSC's awareness of extensive wind energy projects proposed for development in the Columbia Ecoregion. The Oregon Department of Energy (ODOE), USFWS, and ODFW convened a taskforce that included multiple state agencies from Oregon and Washington, federal agencies, county staff, wind energy developers, environmental organizations, and consultants. The ODFW report begins by recognizing that, in regard to climate change impacts, responsible development of wind energy sites has the potential to benefit species and habitats and thus, cumulative effects analyses should take the positive effects of wind facilities into consideration. The taskforce concludes the following:

- The cumulative direct mortality from existing wind energy facilities in Oregon, where mortality monitoring studies have been undertaken in the Ecoregion, has not revealed population level impacts to bird or bat species.
- Past studies are not necessarily a good indicator of future cumulative impacts, given the rapid expansion of the industry in Oregon and increasing pressure to develop sites in high quality habitat.

- Concerns about impacts to sensitive species and habitats are real.
- The effects of even a single project could have a significant effect on future cumulative effects impact analyses.

In addition to the evaluation performed for the Ecoregion, the document identifies research that needs to be performed to address cumulative effects concerns related to wildlife and wildlife habitat. The following needs were identified:

- A regional cumulative effects analysis that is managed and funded collaboratively,
- An analysis approach that is focused, perhaps on a limited number of key species and habitats,
- Studies designed to fill information gaps about species and population dynamics so that "impact levels of concern" can be developed,
- Development of an action plan to address, in advance, impacts to key species and habitats that are in excess of the "impact levels of concern,"
- Development and maintenance of a data repository, and
- Expansion of the study to include areas in Oregon where clean energy development projects are likely to be implemented.

Similar recommendations can be found in a variety of guidance documents related to the industry, but all fall short of defining specifically how offsets for cumulative impacts will be performed.

The challenge for wind developers is further complicated by the fact that many important impacts have no federal nexus, and are thus regulated by state wildlife, natural resource, or environmental agencies under a variety of legislative mandates and by means of different methodologies.

Finally, of course, wind projects have far more than wildlife-related concerns to manage. Many local land-use requirements are focused on aesthetic or nuisance concerns arising from proximity to homes—requirements which can provide incentive for development in remote, windy locations far from people but much more likely to be of importance to wildlife.[iii]

Within this complex playing field for wind developers, there are, fortunately, building blocks which could serve as a starting point for thoughtful consideration of alternatives to the status quo, which include:

Table 4. Building Blocks for a Strategic Approach to Compensatory Mitigation for Wind

Strategic Elements	Significant Source
Guidance on avoidance and minimization in site design and operation	The USFWS FACA draft recommendations
Maps of sensitive habitat overlapped with wind resource potential sites	The WGA and USDOE "Renewable Energy Zones" initiative, as well as state-wide efforts in Oklahoma and Kansas
Clear direction on priority habitat types as well as mitigation ratios for impacts in each zone and incentives for development in already disturbed habitat	Washington and Oregon state guidance on wind energy
Summary of existing state regulations	The Association of Fish and Wildlife Agency's report entitled, "Wind Power Siting Regulations and Wildlife Guidelines in the United States"

Strategic Elements	Significant Source
Detailed mitigation approach for impacts to habitat of a particular species (Lesser Prairie Chicken)	Oklahoma's Department of Wildlife Conservation work in conjunction with the Oklahoma Ecological Services Field Office of the USFWS
Comprehensive project-based mitigation examples	Horizon Wind in Kansas Southern California Edison's Tehachapi transmission project, and Others discussed in the Case Studies section
A framework for biodiversity offsets from wind development	The Nature Conservancy (TNC)
The Mitigation Toolbox	The National Wind Coordinating Collaborative

In addition to these components, there are a series of examples of formal mitigation measures or frameworks proposed for wind facilities well worth understanding and deriving potential inspiration from in consideration of potential pathways forward:

- Washington Department of Fish and Wildlife (WDFW) guidelines
- Mitigation for Habitat Impacts in Oklahoma
- Mitigation for Habitat Impacts in Oregon
- Biodiversity Offsets for Natural Gas in Wyoming.

THE WASHINGTON DEPARTMENT OF FISH AND WILDLIFE GUIDELINES

The WDFW guidelines were originally issued in August 2003 and updated in April 2009. According to WDFW, the purpose of the guidelines is to, "provide consistent statewide guidance for the development of land-based wind energy projects that avoid, minimize, and mitigate impacts to fish and wildlife habitats in Washington State." The WDFW guidelines are intended to provide a clear approach for mitigating impacts to habitat losses to *all* species including but not limited to federal or state listed species. By providing formal requirements for mitigation, the guidelines explicitly intend to encourage better avoidance and minimization by imposing predictable costs for impacts on important habitat types and thereby directing projects toward already disturbed landscapes.

The approach is to divide Washington's land into four specific classifications each with a required approach to mitigation, is detailed in Table 5. Class I and Class II habitats are considered the highest priority for conservation. Low habitat value lands (Class IV) have *no* mitigation requirement, again with the explicit intention of motivating project developers to locate in previously disturbed areas.

Table 5. Washington State Classification for Compensatory Mitigation

CLASSIFICATION [1]	HABITAT TYPE [2,4]	MITIGATION	
		Temporary Impact	Permanent Impact
Class I West side	Westside Grasslands/ Herbaceous Balds, Westside Lowland Conifer-Hardwood (Mature) Forest, Westside Oak and Dry (Non-commercial) Douglas-fir Forest and Woodlands, Coastal Dunes	**CONSULTATION [3]**	**CONSULTATION**
Class I East side	Ponderosa Pine Forest and Woodlands (includes Eastside Oak Woodlands)		
Class II West side	Coastal Headlands and Islets, Subalpine Parkland	**0.5:1 MITIGATION/ RESTORATION[7]**	**2:1 ACQUISTION**
Class II East side	Eastside (Interior) Mixed Conifer Forest, Lodgepole Pine Forest and Woodlands, Montane Mixed Conifer Forest, Upland Aspen Forest, Shrub-steppe		
Class III West side	Alpine Grassland and Shrublands, Conservation Reserve Program (CRP) Lands	**0.1:1 MITIGATION/ RESTORATION**	**1:1 ACQUISTION**
Class III East side	Eastside (Interior) Grasslands, CRP Lands		
Class IV	Croplands [5], Pasture, Urban and Mixed Environs	**No Mitigation Required**	**No Mitigation Required**
FORESTRY	Conversion of Commercial Forest Lands [6]	**CONSULTATION**	**CONSULTATION**

While these guidelines allow for some flexibility in terms of consultation, the overall requirement that is set as a baseline includes the following elements:

- "Like kind" (i.e., grassland mitigation for impacts to grassland).
- Permanent protection through purchase of fee simple interest or easement at the mitigation site.
- Location of the mitigation site within a scientifically relevant distance from the impact site—within the same geographic region.
- The mitigation site chosen must be at some real risk of development or degradation in order to be considered to have provided legitimate net benefit for habitat in the state.

A distinction is made between temporary and permanent impacts, with temporary impacts (as defined) requiring significantly lower levels of compensatory mitigation.

A fundamental part of the mitigation structure developed in Washington is the inclusion of an in-lieu fee option for developers. It provides the developer the option of simply paying a fee to the State instead of finding or setting aside mitigation property. The specific fee required for any given project is negotiated with the WDFW, and is to be "based upon the estimated cost of probable habitat conservation properties identified by WDFW." In the case of the WDFW guidelines, the fee is to be paid on an annual basis for the life of the wind project, and is to be used primarily for stewardship activities as defined.

MITIGATION FOR HABITAT IMPACTS IN OKLAHOMA

In April of 2009, Oklahoma Gas and Electric announced a $3.75 million project with the Oklahoma Department of Wildlife Conservation (ODWC) to provide habitat for the Lesser Prairie Chicken (LEPC) as an offset or mitigation approach for its wind development in the state. This project is significant, because it represents a major effort to offset impacts to a species which is *not* listed as threatened or endangered under the ESA, but which is under a growing level of stress. The funds are to be used for acquisition of parcels in the mixed grass prairie region of Oklahoma, as identified in the Oklahoma Comprehensive Wildlife Conservation Strategy.

In addition, the strategy provides a mapping overlay of wind resources of category 3 and higher within the state, showing that between 13.7% and 15.6% of the state's 44 million acres contain both significant wind resources *and* no significant potential impact to the LEPC. This strategy, developed in conjunction with the Oklahoma Ecological Services Field Office of the USFWS, essentially divides the state into eight categories, with each rank reflecting the relative importance of the land for LEPC conservation. The rank of each mapping unit (in this case, each 30 square meter pixel) is determined by comparing it to a set of criteria that address habitat requirements and threats, as well as actual field observation of the species.

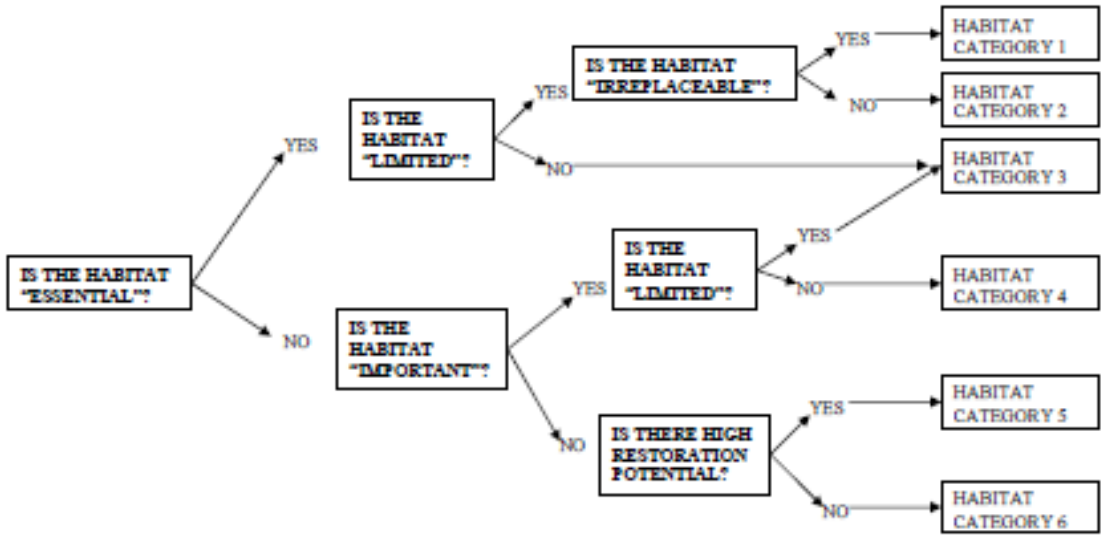
Finally, this strategy contains a comprehensive model for an in-lieu fee program, called the LEPC Habitat Conservation Fund. This voluntary mechanism calculates a fee required to offset impact to LEPC habitat based on the ranking of the location impacted. The financial calculation uses detailed information regarding the cost of land purchase, easement purchase, and cost of management from existing conservation efforts for the LEPC in Oklahoma. While this program is voluntary, it represents one thoughtful and practical alternative for mitigation to a specific species of major concern to the wind industry. Finally, it is important to note that while the program targets only LEPC habitat, the conservation and management of this type of habitat will provide benefits for a large number of other important species in the state.

MITIGATION FOR HABITAT IMPACTS IN OREGON

In late 2007, ODFW, ODOE, and USFWS convened a taskforce to evaluate facility siting and permitting practices in the Columbia Plateau Ecoregion. The goal of the taskforce was to develop voluntary guidelines that "ensure that wind project siting and permitting for all project sizes within the Ecoregion in Oregon, at all permitting jurisdictional levels (both county-level conditional use permitting and the EFSC site certification process) is protective of important biological resources." The taskforce, which included representatives from "the wind energy industry, counties, environmental organizations, consultants and state and federal resource agencies," developed the *Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines*. These guidelines currently cover the five Oregon counties where most wind energy facility development will occur. Ultimately, however, the taskforce would like to amend the guidelines so that they are regionally appropriate in other areas in the state.

The taskforce addressed macrositing, pre-project assessment, micrositing, construction, and operational monitoring activities. The guidelines lay out specific mitigation expectations that are based on the habitat categories defined in ODFW's Habitat Mitigation Policy (see Table 6). The goal of the ODFW Habitat Mitigation Policy, as summarized in Figure 1, is to steer project development activities, regardless of business sector, away from priority habitat areas and to incentivize development in degraded areas.

Figure 1. ODFW Habitat Mitigation Policy Flowchart



Source: www.dfw.state.or.us/lands/mitigation_policy.asp.

Table 6. ODFW Habitat Categories

ODFW Habitat Category	Policy Goal	Mitigation Required
Category 1 (Irreplaceable, essential, and limited habitat)	No loss of habitat quantity or quality	Avoidance
Category 2 (Essential and limited habitat)	No net loss of habitat quantity or quality and to provide a net benefit of habitat quantity or quality	In-kind, in-proximity mitigation
Category 3 (Essential habitat, or important and limited habitat)	No net loss of habitat quantity or quality	In-kind, in-proximity mitigation
Category 4 (Important habitat)	No net loss of habitat quantity or quality	In-kind or out-of-kind, in-proximity or off-proximity mitigation
Category 5 (Habitat having high potential to become either essential or important habitat)	Net benefit in habitat quantity or quality	Actions that improve habitat conditions
Category 6 (Habitat that has low potential to become essential or important habitat)	Minimize impacts	NA

Source: www.dfw.state.or.us/lands/mitigation_policy.asp.

In general, the guidelines recommend that: "mitigation should replace or provide comparable habitats." However, they also recognize that the proximity of mitigation activities to the impact site needs to be balanced with maximizing the efficacy of mitigation. In some instances, the best mitigation solution may occur by "aggregating mitigation responsibilities and activities from multiple dispersed wind projects into one larger, strategically placed mitigation activity." Highlights of the guidelines include:

- Developers should be responsible for mitigation of temporary and permanent impacts to habitat.
- Differing mitigation ratios should apply based on the habitat type and category that is impacted.
- Habitat types should be rated into ODFW Habitat Mitigation Policy categories.

Table 7. Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines

Type	Description
Priority Recommendations	Regionally specific guidelines should be created for other areas of Oregon, following the Columbia Plateau Ecoregion template. Sufficient funding must be provided to fund ODFW staff support for developers, local jurisdictions, and the EFSC. Funding could be in the form of "a legislative support package or via a cost-reimbursement agreement with wind developers." The Oregon EFSC's model wind energy siting ordinance for county governments should be revised to reflect the guidelines.
Other Recommendations	State legislators and agency directors should develop and fund programs designed to educate and work closely with county staff, wind project developers, agency staff and other stakeholders on application of the guidelines to wind energy project proposals. Statewide digital maps that show the intersection of wind energy potential and transmission lines with Oregon environmental and conservation priorities. Cumulative effects. Funding should be obtained for a designated management entity to design, establish, and manage a central data repository for wildlife mortality and habitat impact information. A cumulative impact analysis should be designed, funded, and implemented and it should include a comprehensive mitigation plan for impacts to key species above threshold-of-concern levels. Studies regarding direct wildlife impacts from temporary meteorological towers should be initiated, as should studies of wildlife displacement impacts from site development and operation. Siting and permitting guidelines should be developed for small-scale, community wind projects.

The guidelines recommend that mitigation funds from wind projects be directed toward conservation and enhancement of high quality habitat (ODFW Categories 1–4) and that land used for mitigation be:

- Protected in perpetuity when possible or at a minimum for the life of the wind project.
- At some risk of development or conversion.
- Protected from degradation to improve habitat function and value over time.
- Located in the same geographical ecoregion as the impact, unless an area outside of that geographical location is agreeable to the agencies and permitting entities.

The guidelines also address wildlife displacement and fatalities and state that displacement issues are best addressed at a site-specific level. In terms of fatalities, the guidance recognizes that a certain amount will occur and provides suggestions for how to address impacts that are higher than anticipated and if the impacts are determined to be unacceptable. Additional conservation actions that may be appropriate include "habitat restoration, raptor nest platforms, and donations to wildlife rehabilitation centers." It is

noteworthy that these guidelines are essentially compensatory mitigation and in-lieu fee measures, but the required level of such measures is not defined. In addition to site-level guidance, the guidelines also provide prioritized programmatic recommendations:

BIODIVERSITY OFFSETS FOR NATURAL GAS IN WYOMING

While the methods developed by the Wyoming Chapter of The Nature Conservancy (TNC) for biodiversity offsets were originally targeted to mitigation for natural gas development, their application to wind-related development seems evident. The strategy utilizes a tool called Marxan, which integrates landscape conservation criteria into the site selection process. TNC, in collaboration with BP, applied this tool to an approximately 50,000-acre natural gas field in the Upper Green River Valley. Specifically, the study compiled a list of nine representative species and one type of habitat, and then utilized the Marxan tool to identify maximum quality habitat that could serve as mitigation for impacts.

One critical element of this study was that it addressed the issues raised by having a mitigation site be located at a greater distance from the impact site. While it is intuitively better to have the mitigation site be located nearby, the TNC analysis sought to describe a, "choice of offset location that best balances proximity to the impact site with effectively achieving conservation benefits."[iv]

This analysis provides a number of significant object lessons and principles that can be used in any effort to select appropriate sites for biodiversity-related mitigation, including:

- Offsets must be truly additional to activity that would have taken place otherwise.
- A site selection tool like Marxan can be used in a complementary fashion with a valuation process like the functional assessment approach described in this report.
- Offsets must be in place over an appropriate time-period in order to fully compensate for impacts from construction *and* ongoing operation of facilities.

LESSONS LEARNED TO DATE

In the context of imperfect and evolving scientific knowledge about impacts from wind and other forms of development, regional ecological priorities are not always clear. Federal laws point in contradictory directions at times. For example, the ESA clearly allows for compensatory mitigation for unavoidable 'take' of listed species. However, the Migratory Bird Treaty Act (MBTA) unambiguously prohibits such compensatory mitigation. Distinctions between avoidance and mitigation, between direct and indirect impacts, and between immediate needs for mitigation in order to permit a project and longer term compensation under an adaptive management framework all make planning and risk management for projects difficult.

It would seem then, that there would be considerable support from both industry and wildlife organizations for a more organized structural solution. However, the deeper our project team looked and the more conversations we engaged in, the more we learned about fundamental concerns that cause even some committed advocates of wind power to be skeptical. These concerns fall into two main categories:

- **Scientific Issues:** On the science side, the fundamental question seems to be whether sufficient certainty about levels of impact and related levels of mitigation can be obtained at reasonable cost within reasonable timeframes. Given the enormous variation among the many ecosystems where wind projects are to be located, as well as the variation in the type of project impacts, there is real concern about any single methodology that attempts to measure and account for impacts and offsets.

- **Institutional Issues**: Wind projects may impact both listed and unlisted species. In addition, projects must also address a wide range of non-wildlife related issues from legitimate aesthetic and noise concerns to entrenched 'NIMBY' positions. Due to this complexity, there is a fundamental question about how much even a formal structure for managing bird and habitat issues would help to move projects forward. A candid comment from one of our focus groups was essentially that, "We want to do the right thing about birds and habitat, but it remains less difficult to permit projects in remote and windy places where there aren't as many people living… the same places that are the best for birds and habitat."

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i Wind Power Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife, GAO Report to Congressional Requesters, September 2005. Available at: http://www.gao.gov /new.items/d05906.pdf.

ii Bureau of Land Management, Wind Energy Final Programmatic Environmental Impact Statement (EIS), http://windeis.anl.gov/documents/fpeis/index.cfm.

iii As one focus group participant put it, "There's a reason no one is living in extremely windy places that are now considered remote."

iv Kiesecker, et al., A Framework for Implementing Biodiversity Offsets: Selecting Sites and Determining Scale, BioScience 59 (1): 77-84.

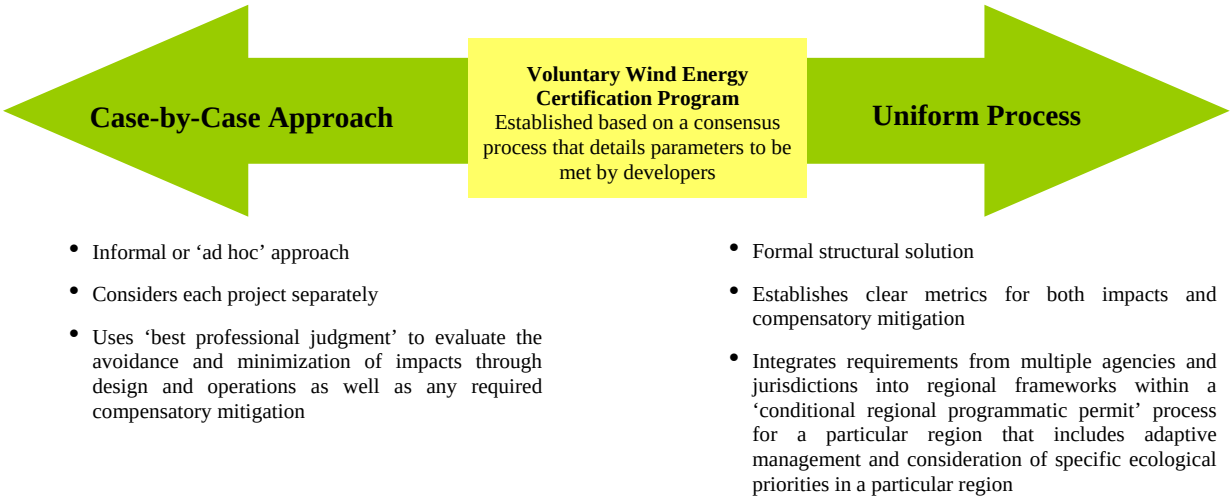
SECTION 4: ALTERNATIVE APPROACHES TO WIND ENERGY MITIGATION

The wind industry faces a challenging, but not unique, situation in regard to its need for regulatory certainty and improved environmental stewardship practices. The alternatives discussed in this section attempt to provide direction for overcoming the following challenges of:

- Lack of consistent site development regulations,
- Lack of consistent involvement by federal, state, and local regulatory entities, and
- Lack of consistent guidelines for use in regulated and unregulated project development contexts.

A frequent theme identified during the research for this project is the need for a single, primary organizing body charged with setting standards for environmental performance of wind projects. While the relationship between such standards and regulatory oversight will need to be developed further, the concept provides a structure around which it is possible to construct potential organizational frameworks.

Figure 2. Certification within the Spectrum of Structural Approaches to Wind Power Development Mitigation



In the absence of clear external regulatory processes and as a potential formalization of the model's use, the industry is presented with three alternative options if it seeks to develop a proactive management strategy.

Before these options are presented, however, it is important to note that the option of using this kind of model in a completely 'ad hoc' or informal way is always a possibility. In the absence of the kind of formal frameworks discussed below, this alternative may be worthy of serious consideration by individual wind projects. This ad hoc alternative is not presented as an option in this report because this kind of implementation would necessarily be limited in terms of its positive and useful implications for the industry as a whole, and therefore outside of the main focus of this report. In addition, the use of this kind of model on a case-by-case basis could well be subject to the same criticisms that apply to other forms of self-regulating behavior on the part of industry; that they are too subjective, that they suffer from

inconsistent application; and that they are too slow to gain acceptance from stakeholders or to produce meaningful results on the landscape at scale. Nonetheless, there is nothing in the model that makes it inherently inappropriate for use in design or mitigation considerations at the individual project level.

With this caveat in place, then, below are the three core alternative mitigation approaches presented for consideration.

Option 1: Seek consistent regulation through development of a standardized permitting process owned by a public agency with jurisdictional ties to the nature of the impacts.

If this path were chosen, then the most likely lead for a regulatory framework would be USFWS due to the fact that the agency has jurisdiction over many of the species potentially affected by wind projects. However, while 2009 FACA guidelines highlight the value that USFWS can provide in a coordination context (see Box 9), they stop short of recommending that USFWS assume ownership of a comprehensive program. Rather, federal agency coordination will likely be needed.

Box 9: Federal Wind Turbine Guidelines Advisory Committee

The June 11, 2009 Draft Recommended Guidelines from the Federal Wind Turbine Guidelines Advisory Committee recommend that USFWS serve as the convener for state and federal agencies engaged in the wind facility review and approval process. In addition, the guidelines specify that USFWS should manage BMPs that could be adopted by other federal and state agencies.

Current recommendations regarding federal agency coordination include:

- Establish an interagency working group to optimize federal coordination and use of the USFWS national guidelines to advance consistency and avoid duplication in the federal review and permitting process;
- USFWS should work with other federal agencies to provide incentives for their adoption and use of the USFWS national guidelines;
- USFWS should establish and maintain a data repository;
- USFWS should promote consistent data collection methodologies

Option 2: Develop a quasi-regulatory framework that is owned by a public entity without current clear jurisdictional ties to the impacts.

Working in concert with USFWS and other agencies at the federal and state levels, a quasi-regulatory body could be, with adequate funding, created to provide structure for development of a comprehensive program strategy. In this scenario, the lead organization could be tied to state government, but may lack any direct authority over specific regulations. Specific regulations would be addressed at the state level by organizations somewhat akin to current State Facility Siting Councils.

An example of a potential link to state government would be the WWHC, which was formed in 2008 in order to "identify key wildlife corridors and crucial wildlife habitats in the West and coordinate implementation of needed policy options and tools for preserving those landscapes." (For more details, please see Box 10.)

At a minimum, coordination with the WWHC would provide a means to ensure that mitigation efforts are compatible with, build on, and draw from, the ecological priorities identified for each state by the WWHC. Ideally, the WWHC (and its regional counterparts) would be able to play a leadership role and help coordinate the efforts of State Facility Siting Councils. Potential barriers to implementation of a quasi-governmental framework include the likely need for formation of new organizations at several levels and the need for program funding.

Box 10: Western Governors Association's Wildlife Habitat Council (WWHC)

The Governors identified the following priorities for the WWHC:

- "Coordinate and implement steps that foster establishment of a "Decision Support System" (DSS) within each state, including:
  - Further developing and refining definitions for "Key Wildlife Corridors" and "Crucial Wildlife Habitats."
  - Ensuring portability of definitions so that they extend beyond, and can be operationalized across, political boundaries as appropriate, while maintaining flexibility that recognizes localized needs and conditions.
  - Prioritization of the process for identifying wildlife corridors and crucial habitats.
  - Supporting research to understand climate change impacts on wildlife corridors and crucial habitat, and taking steps accordingly to support adaptation to climate change.
- Seek to establish policies that ensure information from state-led DSS is considered early in planning and decision-making processes, whether federal, tribal, state or local, in order to preserve these sensitive landscapes through avoidance, minimization, and mitigation.
- Make the WGA Western Renewable Energy Zone project (REZ) a model for applying the wildlife corridors recommendations. In particular, WGA, in coordination with the WWHC, should ensure that development of the renewable energy zones 1) includes identification of relevant wildlife corridors and crucial habitat from the relevant state DSS, and 2) considers appropriate policies and actions to avoid, minimize, or mitigate impacts in these sensitive areas.
- Seek funding from state and federal sources, and from private foundations to support the WWHC. Regarding federal funding, there are many recommendations in the report that point to Congressional authorizations and appropriations. WWHC should develop a Congressional strategy related to funding for wildlife corridor and crucial habitat issues, targeting such federal legislation as the Farm Bill, climate change bills, and the transportation bill."

Source: http://www.westgov.org. ,

Option 3: Self-manage through creation of a certification process and development of a mitigation marketplace.

The self-manage framework is similar to the quasi-regulatory framework in several ways. In terms of basic structure, it also includes a national organizing body, regional representation, and state level siting councils. Where this option differs most significantly, however, is that the lead organization could also spearhead a consensus-based process for developing specific certification criteria for project siting excellence, along with a monitoring and verification protocol to ensure adherence to standards. Such criteria could be developed for project planning, implementation, mitigation, and even for certification of debits and credits.

Potential barriers for formation of this framework are largely similar to those that affect the quasi-regulatory framework, most notably funding and organizational development at multiple levels.

Yet, certification could offer one approach to fostering the innovation and experimentation needed for defining all of the details required within a conditional regional programmatic permit process. Specifically, a voluntary certification process would launch the process of working towards an industry/stakeholder consensus on critical elements to consider in siting and operating wind power facilities.

A certification-based approach would provide a clear signal that an individual project has gone above and beyond existing legal parameters in order to meet rigorous criteria and is therefore 'excellent' in terms of its approach to avoiding, minimizing, and mitigating wildlife and habitat impacts. An 'excellent' designation would very likely be significant in the view of permitting agencies, if the process that developed and audited the standard is transparent and credible, and was developed with the participation of a full range of industry and stakeholder participants.

The establishment of a certification entity is time consuming, as it requires full engagement of all key stakeholders within an open process that is convened by a trusted neutral party. Within a multi-stakeholder process, details would have to be agreed upon around all key components of a certification scheme, including:

- Definition of performance standards
- Measurement of:
  - Direct impacts
  - Cumulative effects
  - Mitigation needs
- Creation of a:
  - Central information repository
  - Project conservation registry
- Establishment of a process and entities for conducting:
  - Monitoring
  - Verification

However, if certification were pursued, it could then provide a platform for standards and verification.

SECTION 5: POTENTIAL PATHWAY FORWARD

In order to develop a comprehensive mitigation program, it is necessary to have a common framework for understanding the types and amounts of impact that will need to be mitigated. There are opportunities to construct the facility impact analysis and approval processes so that they will be consistent with, and supportive of, the mitigation side of the equation. This section of the report addresses several key issues related to project development, and recommends the following steps in a broader analytical process:

Step 1: Articulate which resources are important

Step 2: Set limits on the amount of impact that is acceptable

Step 3: Develop a means to quantify impacts

Step 4: Construct an efficient project approval process

Step 5: Design and implement both a monitoring program and an adaptive management framework that ensures projects stay within acceptable impact limits

Step 1: Articulating What is Important – Regional Framework for Identifying Ecological Priorities

The development of regional ecological priorities would offer program level goals by which the industry could measure performance related to impact avoidance, minimization, and mitigation. It would also provide a foundation for mitigation site selection decisions, indirect and cumulative effects analyses, and adaptive management frameworks. Finally, this approach is consistent with the June 2009 USFWS Guidelines.

Box 11: State Wildlife Action Plans

In order to maintain eligibility for grant funding under the USFWS sponsored State Wildlife Grant program, all states completed Wildlife Action Plans by the end of 2005. These plans were driven by the desire to align USFWS conservation goals with those of state fish and wildlife agencies and they provide a "national blueprint" of actions needed to conserve species at risk.

- 40% of states produced spatial maps showing focal conservation areas
- 28% of states plans included specific and measurable goals
- 60% of states prioritized actions.

Source: http://www.wildlifeactionplans.org.

Many states have identified ecological priorities through natural resource management programs and land use planning processes. Additional starting points for development of regional ecological priorities include:

- Recovery plans prepared under the ESA,
- State Wildlife Action Plans,
- State fish and wildlife management plans, and
- Specific geographies and species of concern to environmental organizations.

Box 12: Project Benefits of Articulating Ecological Priorities in Advance

- **Early in the project planning stage, key impact avoidance priorities are known**
  - Developers can plan projects with an awareness of key sensitivities that may affect project delivery
  - Developers may be required to pay a premium (e.g. in the form of higher mitigation ratios) for impacts to priority resources and, similarly may be able to negotiate lower obligations for impacts to marginal resources
- **Strategic mitigation siting, restoration, and management decisions are encouraged**
  - Developers can be discouraged from using low-return, opportunistic mitigation solutions and can be encouraged to invest mitigation funds in areas with the greatest ecological value
  - Developers can negotiate mitigation ratios based on the contribution of their proposed offset to achieving regional goals
- **It becomes possible to develop a list of priority conservation projects into which developers can pay,** rather than forcing developers to perform in-kind mitigation that may be of either less ecological value or be less likely to succeed.

Due to the number of different sources where this type of information is generated, it may be useful to use a common terminology such as VECs to extract and define priorities. VECs can be identified and performance metrics can be established to track impact avoidance, minimization, and mitigation success by relying on:

- Available data sources,
- Existing planning documents, and
- Coordination with local resource agencies and other ecological experts.

Once VECs are selected and metrics are developed—ideally based on functions and indicators that are prerequisites for VEC sustainability—then a high-level regional baseline can be established and annual industry monitoring reports can be used to measure performance related to achieving regional goals. The benefits of this approach are articulated in Box 13.

Step 2: Setting Limits on Acceptable Impacts – BMPs and Performance Standards

There are currently a range of impact avoidance and minimization BMPs for facility siting, construction, operation, monitoring, decommissioning, and other aspects of wind power facility development and operations. The June 2009 USFWS Guidelines provide extensive information regarding overarching BMPs focused on impact avoidance and minimization (pg. 41-43).

These BMPs can be used independently or they can be incorporated into a comprehensive strategy similar to those involving Performance Standards and Programmatic Permits.

Box 13: Performance Standards vs. Best Management Practices

Performance Standards are outcome-based terms and conditions that set clear impact avoidance and minimization objectives. These standards can be used to set thresholds of allowable impact in the permitting and mitigation stages of a project.

Performance Standards differ from many BMPs in that, instead of prescriptive language that specifies how a developer must design, construct, or operate a site, they identify desired outcomes and define acceptable levels of impact that a project activity may cause. This approach provides project developers with flexibility regarding how to achieve compliance and encourages creativity and innovation in the facility siting, design, construction, and operation phases of the project.

When performance standards are used in a permitting context, they provide clarity and assurance for resource agencies and the project developers since compliance with the standards equates to meeting minimum permit compliance requirements.

Existing BMPs can be used in the development of Performance Standards, particularly if a given BMP is the result of previous, extensive debate and negotiation. In such cases, incorporation of the existing language may be preferable to reopening the debate unless there is cause to do so.

Box 14: Case Study: International Finance Corporation's (IFC) Performance Standards on Social and Environmental Sustainability

IFC applies Performance Standards to the projects it selects for financing and this approach offers one possible model for utilities to use when deciding where to purchase "green" wind power. Driven by IFC's Policy on Social and Environmental Sustainability, its Performance Standards provide a programmatic means for IFC to manage business risks related to social and environmental issues. Clients selected for financing by IFC must meet the Performance Standard requirements, in addition to complying with any relevant local, state, or national regulations in the area of their operations. There are specific Performance Standards that target issues such as Biodiversity Conservation and Sustainable Natural Resource Management, Community Health, Safety and Security, and Pollution Prevention and Abatement. In addition, the Social and Environmental Assessment and Management System Performance Standard exists to address the benefits of, and needs for:

- Integrated social and environmental impact, risk, and opportunities assessments,
- Community engagement and consultation; and
- Management of social and environmental performance during all stages of project development and operation.

The Biodiversity Conservation and Sustainable Natural Resource Management Performance Standard is of particular interest to this project as it is applied to projects in all habitats, regardless of level of pre-existing disturbance and regardless "*of whether or not they are legally protected*." IFC's decision to apply outcome based performance metrics to non-regulated resources provides an opportunity for the organization to standardize decision making processes, regardless of local regulatory variation. In addition to providing a consistent project selection framework, this approach levels the playing field for projects that may otherwise stand out in terms of the additional costs and processes associated with project development in a location with environmental compliance requirements as compared to projects with an equal, or greater, potential to result in environmental impact located in a region without existing protection measures.

IFC's Performance Standards approach to standardization and risk management is relevant to the wind industry in several ways, particularly if the industry were to utilize a certification approach. In the IFC situation:

- A minimum environmental stewardship threshold is established.
- Consistent stewardship objectives are applied across a variety of project types and locations.
- A project selection decision making framework is created where otherwise none exists.
- The playing field is leveled for competitors applying for financing.
- Project applicants know, in advance of submitting project funding applications, the standards that their projects must meet in order to be considered for selection.
- Power purchasers can evaluate competing independent power producers based on environmental performance.

Source: International Finance Corporation's Performance Standards on Social and Environmental Sustainability, April 2006.

Key criteria for development of performance standards include:

- **Performance Standards must be outcome-based.** In other words, ecosystem functions must not be impaired beyond the amount specified in the performance standard, but the Performance Standard does not identify the best way to achieve the required functional performance. Rather, the developer has the opportunity to develop creative solutions that allow the project to achieve compliance. The point of outcome-based Performance Standards is that they do not presume the best way to achieve the desired levels of resource protection.

- **The Performance Standard's desired outcome must be specifically defined**. Clear definitions stating what it means to "minimize to the extent practicable" must exist. These definitions should clarify whether or not financial constraints, timing limitations, technology requirements, and other issues are a part of the minimization equation or whether minimization criteria are strictly limited to ecological concerns. Regardless, the project developer must be able to measure impacts so that a determination of success or failure can be made. This drives the need for appropriate metrics.

- **Performance Standards should encourage and/or provide progressive compliance options**. For example, a Performance Standard may require the developer to avoid impairing a given function, such as a support function needed for nesting. It may then go on to state acceptable parameters that are appropriate for avoiding impairment of the function in question, such as a certain distance from a nest site within which a tower may be sited. However, if a particular project cannot meet the defined parameters, such as a tower needs to be sited within the defined buffer distance, then the project developer would be required to demonstrate that no functional impairment would occur before approvals could be obtained.

One reason Performance Standards are able to improve project delivery for both the developer and the authorizing agency is the fact that, if developed collaboratively, they can represent the requirements of all agencies and stakeholders involved in a project site, particularly in situations where projects may impact resources with different levels of regulatory protection. This approach means the developer receives one set of terms and conditions, rather than multiple, potentially conflicting sets from a variety of stakeholders.

Box 15: OTIA III State Bridge Delivery Program Environmental Performance Standards

Due to a time sensitive safety issue in 2003, the Oregon Department of Transportation (ODOT) faced an urgent need to repair or replace over 300 bridges throughout the Oregon at an accelerated pace. In order to accomplish the work in the required timeframe, ODOT recognized the need for a streamlined permitting process that would simultaneously protect the environmental aspects likely to be affected by the bridge projects and ensure timely project approvals. As a result, ODOT developed a comprehensive set of outcome-based environmental Performance Standards.

ODOT's Performance Standards were developed to ensure compliance with state and federal wetland and water quality regulations, as well as the ESA, Section 4(f) of the Federal Highway Act, the Governor's Executive Order on Sustainability, and state and federal waste and hazardous waste disposal requirements. The process involved collaboration between state and federal agencies, technical experts, engineers, and ODOT staff.

Where existing BMPs were appropriate, they were incorporated into the performance standards, but where none existed or they were inadequate, the coordination team worked collaboratively to develop new outcome-based guidelines designed to meet their collective goals. Projects designed within the thresholds of these standards are eligible to undergo the expedited permitting process because compliance requirements have been pre-negotiated and permit terms and conditions are clear.

The strength of using an outcome-based Performance Standard was demonstrated when the team addressed the issue of avoiding and minimizing bridge replacement impacts on salmonids. The traditional design approach had been to avoid placing piers in the water and to design abutments to sit just above the ordinary high water level so that in-water impacts requiring permitting could be avoided. However, the team realized that this particular avoidance technique caused the perverse result of constraining the channel, thus negatively affecting fish and wildlife habitat.

Rather than continuing to follow permitting requirements that drove that result, ODOT sought the opportunity to develop an innovative solution resulting in an outcome that avoids creating constrained floodplain conditions. The team agreed that the true goal of the existing regulations was to minimize impacts to fish and wildlife habitat, but that the traditional practice of avoiding regulated impacts actually caused greater harm.

The solution was development of Performance Standards that actually facilitate placement of piers in the water, if needed and appropriately designed, so that bridge spans can be elongated in order to place abutments outside the floodplain. ODOT's innovative approach to avoiding and minimizing impacts had several benefits beyond simply accelerating the permitting process. The new design approach resulted in decreased floodplain impacts, an improvement in fish habitat, and improved passage for wildlife previously unable to pass under bridges during periods of high water.

While the process of pre-negotiating all of the performance standards took approximately one year, the permitting process for individual projects was greatly accelerated and per project costs were significantly reduced.

If a similar framework were to be developed for wind energy projects, existing BMPs, such as those from the June 2009 USFWS Guidance, could be directly incorporated where appropriate so that resources could be focused on developing solutions to yet unresolved issues.

Source: OTIA III State Bridge Delivery Program Environmental Performance Standards, ODOT, November 2005.

Achieving this consensus requires upfront effort, but the benefits realized from investing in development of one set of Performance Standards and regional modifications as needed include:

- A risk management tool for the industry and for the agencies;
- Avoidance of delays and re-work caused by unanticipated regulatory requirements;
- Expedited project review and permitting processes; and
- Regulatory consistency for those operating within the terms of Performance Standards incorporated into regulatory processes.

Step 3: Developing a Means to Quantify Impacts – Assessment and Accounting Tools

While there are a wide range of ecological assessment tools available, existing tools vary greatly in their utility when applied within a mitigation context. Please see Appendix 5 for a comprehensive listing of these tools. Only a subset have been designed to measure both impacts and benefits using the same methods and quantification protocols—an important factor when seeking to understand the relationship between a given impact and the proposed mitigation. Even fewer provide an efficient means to perform alternatives analyses and to capture direct, indirect, and cumulative effects (both positive and negative) in a consistent language that can be adapted for use as a unit of trade in an offset context. Finally, only a small number allow for the measurement of total ecosystem function, an approach that is beneficial for complex project types like wind that affect a variety of resources.

In order to fully understand ecological effects for any project and therefore establish the correct level of needed offset, impacts need to be quantified for direct, indirect, and cumulative effects, and it is clearly beneficial to have a single method of analysis for all categories. A discussion of each category follows below.

Direct Impact Analysis

One way to quantify the direct impacts (positive or negative) of a project on the ecosystem is to measure changes in ecosystem functional performance. Using this approach, the value of a function performed on a site is based on a limited number of indicators (typically 3–7) and each of these parameters:

- Quality,
- Quantity,
- Distribution, and
- Concentration.

For example, indicators used to assess the ability of a site to provide cover and nesting support for songbirds (a likely VEC for many projects) include:

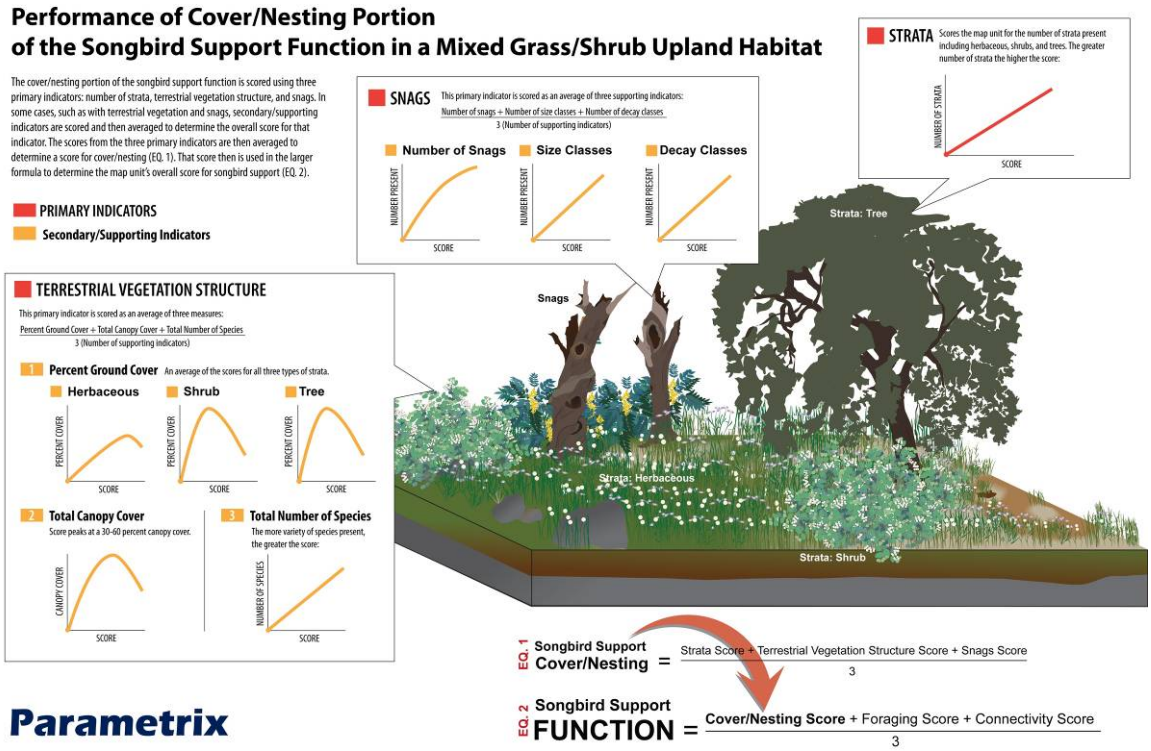
- Vegetation structure,
- The presence of snags, and
- The number of strata present.

Each indicator is represented by a curve that describes the relationship between optimal performance of a particular function and an increase (or decrease) of that indicator. The value of a function is calculated by averaging the performance of the indicators.

To determine the site's current ability to perform functions, data are collected in the field and look-up tables are used to determine scores for each function, based on the quality and quantity of the indicators present. This provides a baseline from which to evaluate the extent of anticipated change to the site resulting from proposed activities, whether those activities are development or restoration related.

This type of functional assessment method can take into account not the physical conditions at the site, but the location of the site in the landscape and the nature of adjacent properties. Once the baseline values have been established, the same measurement process can then be used to estimate the site's ability to perform ecosystem functions *subsequent* to the proposed activity.

Figure 3. Functional Assessment Example



Indirect Effects Analysis

The incorporation of indirect effects into scientifically-based mitigation obligations is challenging because they are difficult to quantify. Yet, without quantification, it is very difficult to select equitable offsets. Therefore, consideration of these effects is essential.

The American Wind Energy Association (AWEA)'s Siting Handbook identifies several types of indirect species effects thought to result from wind energy projects. These effects include:

- Habitat loss and alteration;
- Habitat avoidance;
- Changes to migration and movement routes;
- Species displacement;

- Loss of forage species due to loss of native vegetation and introduction of invasive species;
- Increased fire risk due to loss of native vegetation and introduction of invasive species; and
- Population declines.

The key to developing a correlation between indirect effects and appropriate offsets is to find a unit of measurement that can be used for comparison purposes. One way to accomplish this task is to take a functions-based approach to measuring impacts. This is particularly helpful when one is attempting to measure the indirect effects on highly mobile species such as birds, bats, fish, and other wildlife.

It is clear that the potential indirect effects listed above focus primarily on changes in wildlife species behavior. An assumption made in association with wind energy projects is that if habitats or activities change within the areas upon which species depend, a change in species behavior is a logical potential outcome. If, rather than measuring the outcome, one measures the changes within the habitats that drive the outcome, it becomes possible to quantify anticipated impacts. In order for this to occur, one must accept that the way the landscape functions is critical to species survival and habitat use. These functions, referred to here collectively as species support functions, include the provision of cover/refugia, connected habitats, and habitat for foraging, nesting, breeding, and hibernation activities.

It is possible, using regionally adjusted indicators, to measure how the landscape's ability to perform these functions changes as the result of site development and operation. The following steps can be taken to quantify impacts and mitigation obligations:

- Identify and map study area;
- Identify and map activities associated with wind energy facility development and operation;
- Identify and map the VECs that are expected to experience indirect effects from wind energy projects;
- For those areas where sensitivities and activities overlap, establish buffer zones around activity locations;
    - *Note:* If data are available, then buffer zones should be based on studies that document species behavioral changes in response to specific types of activities—e.g., the threshold distance required for successful prairie chicken nesting in the vicinity of predator perch locations.
- Within the buffer zones, measure the baseline and anticipated future species support functions, based on anticipated changes to the indicators that dictate habitat suitability; and
- If functions anticipated to be lost in the buffer area are determined to be limiting functions for the species or are otherwise significant, focus mitigation activities on the provision of those functions in offsite areas.

Using this or a similar functions-based approach, it is possible to establish an initial relationship between activities and indirect impacts. This approach provides a quantifiable starting point that can be refined or changed as more monitoring data become available. In addition, a function-based approach that utilizes VECs and impact vectors for an indirect effects assessment provides foundational materials for a cumulative effects analysis that includes indirect effects.

Cumulative Effects Analysis

The existing literature and guidance documentation is clear about the need to evaluate cumulative effects associated with wind projects. It is clear that a well-designed cumulative effects analysis allows anticipated project effects to be understood in a broader context. In other words, knowing that a project

will have an impact is important, but the actual significance of the impact must be considered. A great example of this is the work done by TNC for the oil and gas sector in Wyoming, which provided a framework for understanding the total effect of oil and gas projects *and* related mitigation in the state.

For instance, a project may have a large impact on a resource, but if that resource is very resilient and has easily withstood such impacts in the past, there may not be value in expending significant time or money to avoid or off-set those impacts. On the other hand, if the resource is in serious decline and is likely to have additional future impacts, then even a small project impact may be worth investment in additional avoidance and minimization efforts. Considering potential impacts in a manner that is more sensitive to this broader context can provide the basis for improved programmatic approaches, pre-negotiated performance standards and streamlined permitting processes.

Perhaps the most efficient approach to developing the analysis is to start by developing an analysis *framework* at a pilot scale level. This approach seeks to develop agreement on the framework before an investment is made in the cumulative effects analysis. A secondary benefit to this approach is that as soon as there is consensus that the framework is a sufficient starting point, then, it can be implemented simultaneously in multiple regions. By providing a conceptual model that helps decision makers understand the environment in which wind energy projects occur, it could be adapted to meet federal, state, and local regulatory needs across various geographies. This approach would then allow project sponsors, stakeholders, and reviewers to consider a project's potential impacts and benefits by analyzing documented and anticipated environmental trends.

Box 16: Component Parts of a Cumulative Effects Framework

- Upfront definitions of significance and cumulative effect characteristics;
- Historic and current baseline condition information;
- A spatial catalogue of sensitivities (i.e., VECs or other receptors);
- A spatial catalogue of possible impact vectors generated by the wind industry sector and by other non-wind industry related vectors in the study area;
- A short list of significant cumulative impact vectors;
- An analysis of the distributional patterns of selected impacts, based on the relationship between VEC and impact vector locations, and
- An analysis of the temporal trends in significant impacts (long term cycles, climate change, seasonality, etc.)

When this information is spatially displayed using a grid analysis, it becomes possible for decision makers to evaluate "what-if" scenarios and develop a more comprehensive understanding of cumulative effects.

Development of such a framework would begin with defining the study area and the VECs of interest. By building on methods used for assessing indirect effects, it may be possible to have consistency between the indirect and cumulative effects analyses. This consistency is important because indirect effects are one of the considerations that go into a cumulative effects analysis. Since wind energy facility siting decisions are not based on ecology alone, consideration should be given to including economic and social effects in the framework.

Step 4: Constructing Efficient and Effective Permitting Processes – Programmatic Permits and Regulatory Timelines

As part of an overall structural solution, the incorporation of potential streamlining measures related to programmatic approvals into current regulatory processes would translate into time and cost savings. When existing formal permitting processes are triggered by a wind project, they have the opportunity to utilize the model as a means of evaluating impacts and mitigation alternatives. Illustrative approaches include:

Programmatic Permits

A programmatic General Permit is one that standardizes and clarifies the permitting process, defines acceptable levels of ecological impact, and clearly specifies the avoidance, minimization, and compensation required for authorized projects.

If access to the streamlined permitting process includes a requirement that project developers comply with pre-negotiated Performance Standards, it becomes possible to establish a baseline impact and avoidance minimization standard for projects that qualify for expedited delivery.

In order to further incentivize the use of general permits and Performance Standards, a compliance supplement can be constructed so that those who cannot attain 100% compliance with the *avoidance and minimization* Performance Standards can still take advantage of expedited permitting by complying with additional *offset* Performance Standards that set pre-negotiated mitigation requirements.

Incidental Take Permits

It is possible within the context of ESA compliance to construct programmatic Biological Assessments and obtain programmatic Biological Opinions from USFWS and NMFS. Obtaining programmatic authorizations from the Services would facilitate project delivery for the wind industry by limiting any time required for the consultation process. Since the challenging negotiation process would be handled up front, in advance of any given project, a project could undergo expedited processing and obtain an Incidental Take Permit if it is demonstrated that the project fits within the bounds of the programmatic authorization.

There is no equivalent type of Incidental Take Permit mechanism available for compliance with the MBTA, much less a programmatic compliance solution. Attempts to obtain authorization for impacts to migratory birds have been made in the form of exemptions. However, they are primarily related to Department of Defense activities, have been highly controversial, have failed to be particularly successful, and are unlikely to be relevant to wind industry activities.

There is broad recognition that the MBTA regulatory structure, as currently enforced, is insufficient for both protecting migratory birds and for facilitating the development of renewable energy derived from wind. The MBTA prohibits take of migratory birds, even though migratory bird takes are often unavoidable. This situation creates significant uncertainty for project proponents in the wind industry and elsewhere who are unable to obtain regulatory authorization and who, therefore, remain vulnerable to prosecution if USFWS chooses to do so.

The dilemma faced by the wind industry has triggered several reviews and analyses regarding the current regulatory framework and the need for reform (see Box 17). Efforts to develop Avian Protection Plans—voluntary agency-specific programs of BMPs designed to protect and conserve migratory birds endorsed by USFWS—may be a viable means for the wind industry to create the types of assurances and process improvements needed to facilitate responsible development in an uncertain regulatory environment. As noted above, the application of the proposed model could further assist in ameliorating this dilemma.

Box 17: Migratory Bird Treaty Act Reviews and Proposed Reforms

A recent analysis prepared by Meredith Blaydes Lilley and Jeremy Firestone outlines the history of the MBTA, analyzes current potential ramifications to the wind industry, and provides recommendations for moving forward. The authors discuss the fact that the definition of what activities may trigger prosecution varies from court to court, making it difficult for project proponents to address the issue proactively. The authors point out that the incentives for project proponents to avoid and minimize take may be hindered by the fact that even if they have invested heavily in the best available avoidance and minimization strategies, they fail to receive any type of regulatory certainty and may still be prosecuted for take:

> *"By criminalizing the take of migratory birds without a permit and simultaneously granting no permits whatsoever for incidental take, the MBTA creates a conundrum for entities engaged in an array of land uses that might result in, albeit unintentionally, migratory bird deaths. Indeed, to the wind power industry and to many others routinely involved in activities resulting in incidental take, the MBTA is a formidable statute. The opinion of what constitutes a prosecutable activity under the MBTA, however, varies from court to court. Due to its characterization as a fairly vague statute, coupled with the fact that it has been "highly controversial since its inception," the MBTA has lent itself to a considerable amount of judicial review."*

Lilley and Firestone call for reform of the MBTA and specifically identify the need for Incidental Take Permits, in addition to the need for provisions allowing public comment, civil sanctions, and citizen suit provisions. Additional calls for take authorization are made by John Arnold McKinsey, who argues that:

> *"An alternative solution involving the MBTA would be for Congress to statutorily authorize a take permit under the MBTA for wind energy facilities. Given the broad willingness of the USFWS to let the MBTA go un-enforced in the face of rapidly rising wind energy development, the USFWS should prove more than willing to support such a take permit for wind energy needs. Creation of a take permit under the MBTA may not require Congressional action. Section 704 of the MBTA authorizes the Secretary of the Interior to allow "taking" of migratory birds. By Congress establishing a statutory take permit, however, there would be no ambiguity about it legitimacy. Congress can probably accomplish this much faster than the regulatory process can be completed."*

ODOT, when faced with the challenges posed by the agency's inability to obtain a take permit under the MBTA, took the approach of developing a voluntary Avian Protection Plan. As the following excerpt from ODOT's Chris Maguire's abstract explains, the development of ODOT's program was a collaborative effort between USDA, USFWS, and ODOT:

> *"The Migratory Bird Treaty Act (MBTA), a federal law enforced by the U.S. Fish and Wildlife Service (USFWS), has no provision for incidental (i.e., unintentional) take of migratory birds during transportation projects. Because more than 400 species of migratory birds live in Oregon and more than 300 of them nest in highway right-of-ways and on bridges, Oregon Department of Transportation (ODOT) is at risk of non-compliance with the MBTA as the agency carries out its mission 'to provide a safe, efficient transportation system.' Although the MBTA is one of the oldest laws in the nation to protect species and natural resources (enacted in 1918), state DOTs have not been provided with guidance at the federal level on how to resolve transportation conflicts with migratory birds when they arise. In the absence of take permits for unintentional harm to migratory birds, ODOT has implemented a multi-faceted migratory bird strategy that not only increases migratory bird protection during transportation projects, but also minimizes the risk of prosecution should an ODOT MBTA violation inadvertently occur.*
>
> *Initially, ODOT developed a MBTA Highway Division Directive. The purpose of the Directive is to provide agency personnel involved in project delivery, construction, and maintenance with guidelines and strategies to ensure that appropriate and reasonable measures are taken to prevent injury to and death of migratory birds. The Directive emphasizes that all employees must practice due diligence to safeguard migratory birds while they carry out ODOT's transportation mission. Subsequently, ODOT signed inter-governmental agreements with USDA-APHIS-Wildlife Services (U.S. Department of Agriculture – Animal Plant Health Inspection Service). Wildlife Services is authorized by Congress to conduct animal control activities. When ODOT contracts with Wildlife Services for migratory bird management on projects, incidental take is covered under Wildlife Services' take permits.*
>
> *Currently, ODOT is developing an Avian Protection Plan (APP), a voluntary agency-specific program of best management practices designed to protect and conserve migratory birds that is endorsed by USFWS. USFWS Enforcement has MBTA prosecutorial discretion, and an agency operating under an APP is allowed to fulfill its mission without the need for formal USFWS concurrence on every action that has potential to impact migratory birds. ODOT will implement its APP following development of an agency-wide bird mortality tracking system."*

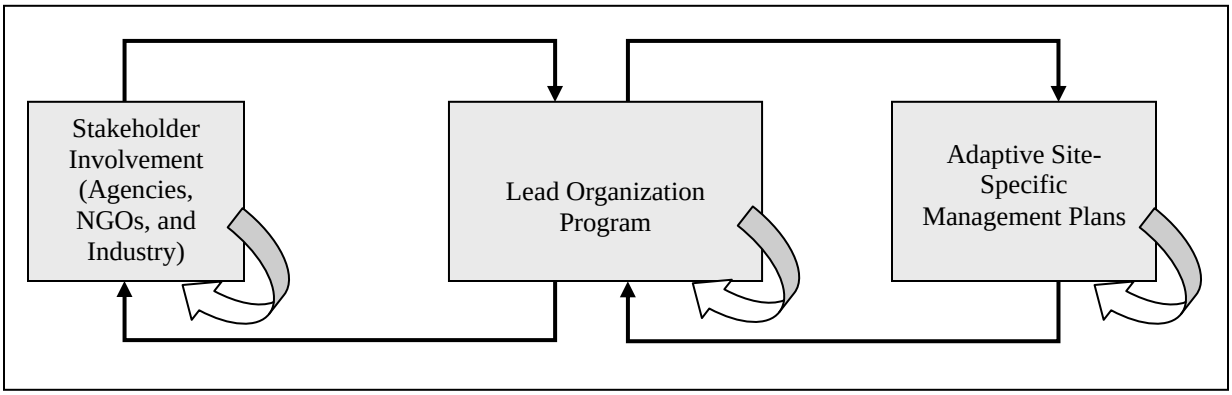
Sources: *Regulating Avian Impacts Under The Migratory Bird Treaty Act And Other Laws: The Wind Industry Collides With One Of Its Own, The Environmental Protection Movement*; John Arnold McKinsey; *Wind Power, Wildlife, And The Migratory Bird Treaty Act: A Way Forward* by Meredith Blaydes Lilley and Jeremy Firestone; Maguire, Chris. "Oregon Strategies for Transportation Compliance with the Migratory Bird Treaty Act". In proceedings of the 2007 International Conference on Ecology and Transportation. Raleigh, NC: Center for Transportation and the Environment, North Carolina State University, 2007.

Steps 5 and 6: Design and implement both a monitoring program and an adaptive management framework that ensures projects stay within acceptable impact limits

An Adaptive Management Framework (AMF), in which decisions are not irrevocable, can provide a level of confidence for project reviewers because it provides a mechanism for incorporating new knowledge. The AMF provides feedback loops, as illustrated in the figure below, and has three interacting elements:

- **Program level**—where basic rules for compliance or certification would be defined or set—in order to include new knowledge into a mitigation standard, whether that standard is utilized in a voluntary certification program, in a regulatory context, or to influence behaviors of those who want to improve performance, but do not want to engage in a formal program despite the business case for doing so.
- **Project level** to include new knowledge into individual site-specific management plans.
- **Process level** to include new knowledge into the stakeholder interaction process itself.

Figure 4. Adaptive Management Feedback Loops

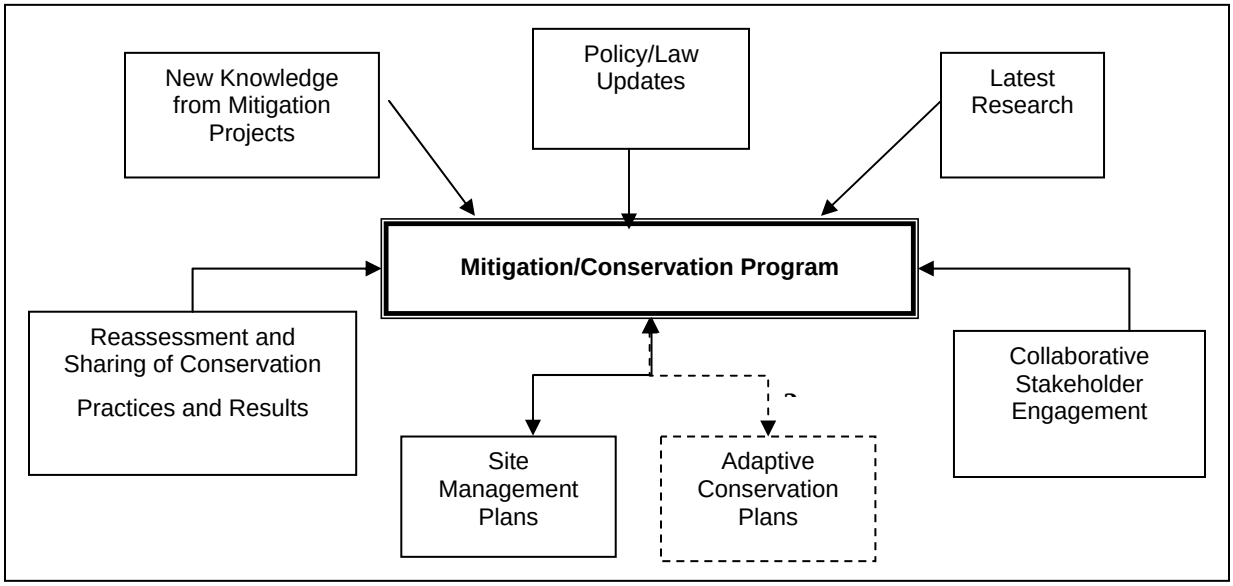


Adapted from the ODOT Statewide Banking Program Final Agreement, ODOT Misc. Contracts and Agreements No. 22141, April 2005.

Eventually, once the Program is sufficiently established and mitigation/bank sites have been developed, a process for the compilation and synthesis of information relevant to the conservation of specific ecosystems, habitats, or species could be implemented at the **project level**. One term that could be used for these project level methods for incorporating new knowledge is Adaptive Conservation Plans (ACPs).

ACPs are compilations of information relevant to the conservation of specific ecosystems, habitats, or species. Information can be derived from monitoring of individual projects, scientific literature, and expert opinion. Information within 'adaptive conservation plans' is synthesized to recommend activities for improved habitat conditions.

Figure 5. A Mitigation/Conservation Program Model



Adapted from the ODOT Statewide Banking Program Final Agreement, ODOT Misc. Contracts and Agreements No. 22141, April 2005.

Site-specific management plans can be developed and implemented in a manner that is responsive to changes in goals, conditions, and policies at either the program-level or the site-scale.

Key principles of adaptive management, as they relate to development and implementation of site-specific management plans include:

- Designing management plans that: (1) consider multiple options for mitigation/banking (including experimental "controls" for comparative purposes), (2) incorporate a monitoring program of sufficient scope, (3) define success criteria, and (4) describe triggers for adjusting management in response to new information or unforeseen events.
- Monitoring the implementation and effectiveness of mitigation/banking actions using a combination of success criteria, metrics of habitat value, and environmental/ecological parameters. Monitoring should be sufficiently robust to allow identification of factors responsible for the success or failure of mitigation conservation actions.
- Evaluating monitoring information to determine whether criteria developed during site design are being met, and to determine the causes of successes and failures.
- Adjusting the management plan when success criteria are not met or when policy and program guidance is updated.

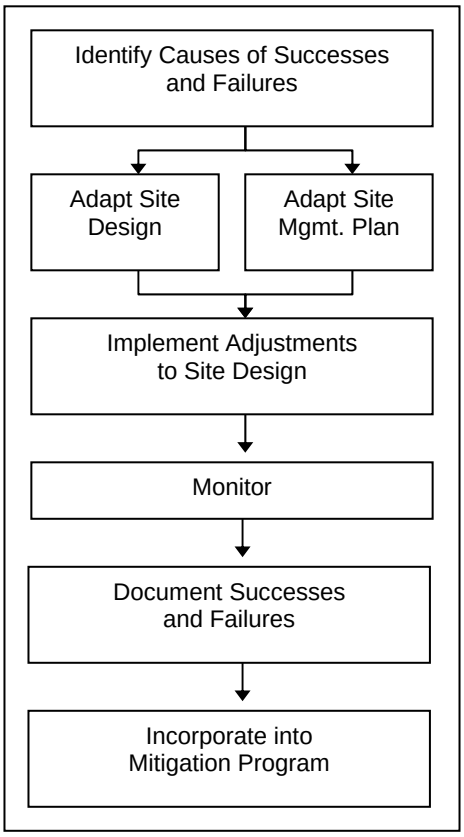
Finally, at the **process level**, a structured way of incorporating new knowledge from the stakeholder engagement process is suggested. Input from stakeholders provides policy and regulatory interpretation that can help guide implementation of the Program. The stakeholder process could encompass a wide range of natural resource issues. Principles of adaptive management can be applied here to ensure that new information is incorporated into the stakeholder process. Use of an AMF would provide regular opportunities for the stakeholders to provide guidance regarding policy and regulations, periodically

review assumptions used in credit accounting and site selection and design, assess mitigation/conservation successes and failures, and identify additional information needs.

Key principles of adaptive management, as they relate to the stakeholder process, include:

- Designing mechanisms to provide review of policy and process issues related to the mitigation program.
- Designing periodic reviews to assess stakeholder group function and review or incorporate new policy and new information.
- Evaluating the effectiveness, efficiency, and scope of the process on an informal continuous basis, as well as at annual meetings convened specifically to assess the function of the stakeholder group and to review the progress of the mitigation program in meeting regional ecological goals.
- Adjusting the process by working through issues in the stakeholder group.

Figure 6. Process for Adapting Site Management Plans



SECTION 6: WHAT ARE THE FINANCIAL IMPLICATIONS OF A STRATEGIC APPROACH TO MITIGATION?

Once a functional assessment process provides a numeric score that can be used to compare impact sites with mitigation sites, then a model can be used to evaluate the cost of compliance options, including:

- Conservation actions
- Restoration actions
- Purchase of management
- Payment of in-lieu fees.

The simple structure of this cost-estimation model will necessarily have to be refined to reflect the specific approach to compensatory mitigation endorsed by AWWI and adopted at the state or regional level. In addition, due to the tremendous variation in current approaches to compensatory mitigation in use by the wind industry and the wide range of impact types potentially requiring mitigation, a formal cost/benefit analysis comparing one approach is not possible at this juncture. Costs for monitoring, maintenance, and endowment costs for the various mitigation approaches in use, given the limited experience at this stage of industry development, simply do not provide the basis for any kind of 'apples to apples' comparison.

With this caveat, the intent of a performance standard approach coupled with a functional assessment method is to ensure that the factors that affect cost can be better anticipated and controlled. Overall, at this stage in the process, the goal is only to illustrate the way in which a quantitative approach to measuring both impacts and mitigation sites can provide the basis for cost estimation.

Box 18: Factors that Affect Cost

- **Lack of clarity around the issue of avoidance**. The question of 'how much avoidance is enough' must be answered in order to have a baseline from which to measure mitigation
- **Lack of clarity around both regulated and unregulated as well as strategically important impacts**
- **Lack of clarity regarding alternatives available for compensatory mitigation**. For example, explicit requirements regarding the distance from which mitigation actions may be performed from the impact site.
- **Lack of clarity regarding on-going liability related to facility operation**. These 'adaptive management' costs can represent open-ended liability if they are not structured in a manner that allows reasonable prediction of impact levels and associated costs.

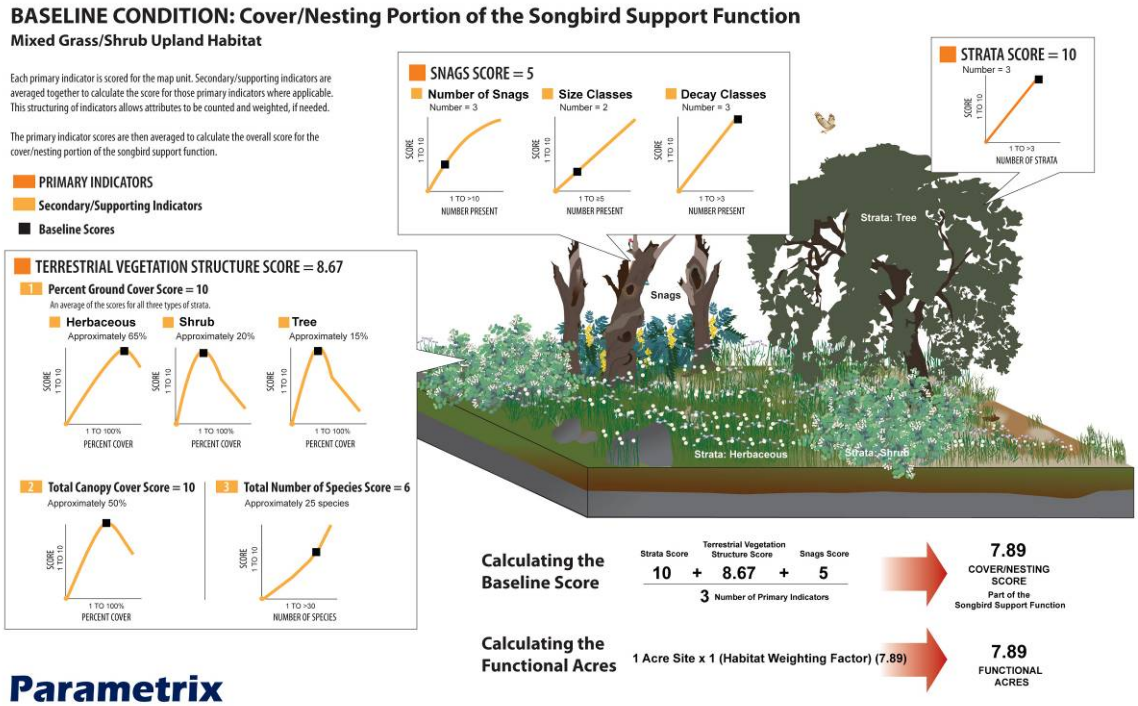
A COMPENSATORY MITIGATION MODEL

A Compensatory Mitigation Model (CMM) approach would offer a repeatable quantitative approach to measure the impacts to selected VECs. The CMM used in this discussion is a combination of a pre-existing functional methodology and a pro forma model. Figures 7 and 8, which represent the functional assessment methodology, and the screenshots provided below were used to illustrate the CMM to the focus groups. Specifically, these demonstration tools attempted to show an early iteration of an approach that:

- Integrates a functional assessment score for an impact site,
- Creates a process for using this score to provide a quantitative basis for a mitigation requirement, and
- Provides process for evaluating costs of specific mitigation project alternatives.

One specific example of a project impact was developed; a hypothetical wind project that affects songbird nesting habitat.

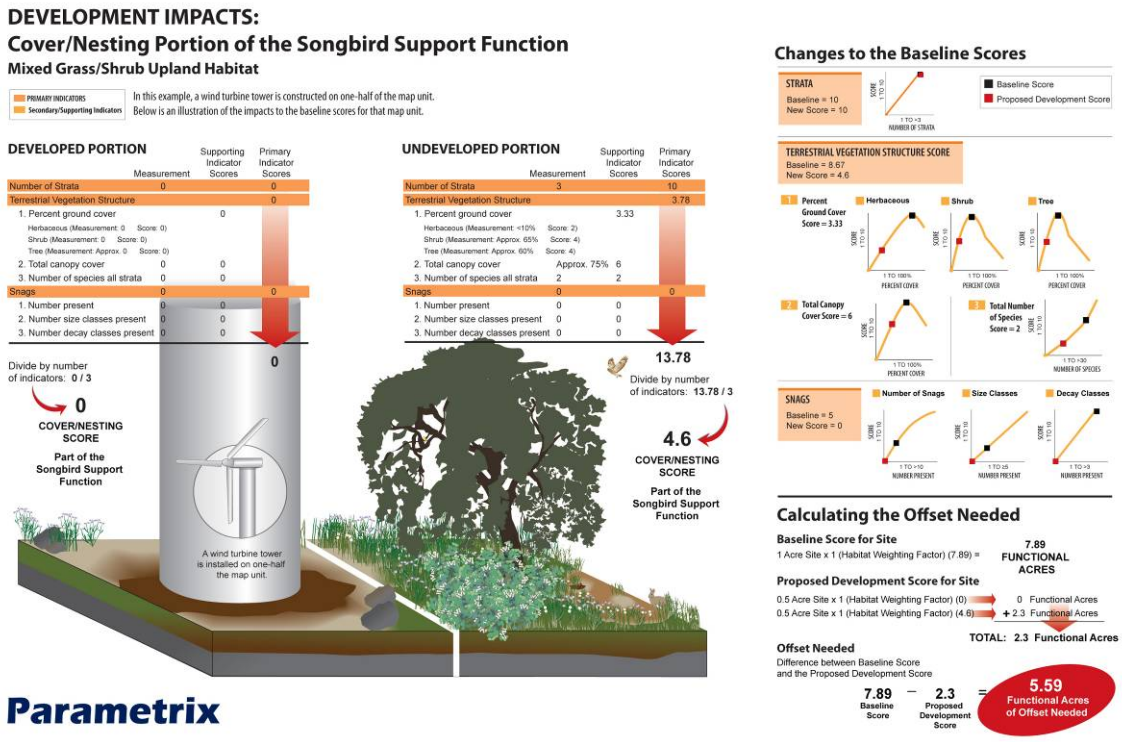
Figure 7. Illustration of Functional Assessment Baseline Calculation



In this example, the functional assessment measures terrestrial vegetation structure, snags and strata, and finds that the before condition of the site yields a score of 7.89 functional units based on its size and the presence of indicators that are relevant to songbirds.

In Figure 8, the site is shown after development. Because of the impacts from placement of a turbine, the score has dropped to 2.23 functional units, which then provides the basis for an objective decision about how much mitigation will be required. In this case, the mitigation requirement is the difference between the before score of 7.89 and the after score of 2.23, resulting in a requirement of 5.59 functional units of mitigation. Of course, the amount of mitigation actually required would be the result of such numeric score being subject to any weighting process or the imposition of mitigation ratios from a permit or certification process.

Figure 8. Illustration of Functional Assessment Impact Calculation



The scoring system used in the CMM accounts for impacts from ongoing operations (as opposed to construction impacts) by providing options for an "adaptive management" requirement. While the parameters of this project did not allow the full development of factors and considerations that would be included in such an adaptive management requirement, it was included in focus group discussions as an illustration of one approach to providing a basis for mitigating impacts from ongoing operations.

Model Development

The integration of the pro forma approach and the functional assessment method that together comprise the CMM was influenced by numerous existing model structures that provide quantitative outputs and focus group feedback. The CMM is tailored specifically to the wind industry in an effort to create the consistency needed across industry specific issues such as:

- **Model Structure** – Ideas for the model's structural framework were developed using, in part, approaches from other industries, such as wetland rapid assessment methods, Habitat Evaluation Procedures and associated Habitat Suitability Indices, and ecosystem services metrics under development in several states like Oregon and Washington.
- **Source of Valued Ecosystem Components** – VECs to be included in the template were drawn to a large extent from case studies of wind projects developed around the world over the past 10–15 years. Several of these are described in Appendix 1.

- **Model Refinement** – Refinements to the CMM were informed by input from focus groups that included a broad spectrum of industry, NGO, and agency representatives.
- **Model Elements** – The proposed model elements (like performance standard curves, species data, etc.) have been adapted from various sources, and represent the quantitative nature of the data to be included in the model.

The goal of developing this standardized approach, an endorsed protocol for calculating mitigation liabilities, was to capture potentially significant benefits that fall into two general areas:

Tangible Benefits, including quantifiable benefits such as:

- *Accurate determination of the number of units of mitigation required* (e.g., fewer units required when compensating for demonstrably lower quality habitat), to less quantifiable benefits such as reduced risk resulting from financial modeling (with a standardized and predictable method for calculating offsets, there is an increased confidence in pro forma outputs).
- *Increased Predictability* – A standardized approach to compensatory mitigation offers the ability to predict with high confidence, in the early stages of project planning, the off-sets required for various alternative project configurations. This can in turn improve project financial performance by presenting the least costly yet fully responsive mitigation alternative available.
- *Reduced Risk* – A significant consideration of any mitigation project pro forma is contingency, and a standardized approach to calculating and executing compensatory mitigation can dramatically reduce the risk and uncertainty for this part of an overall project pro forma.
- *Accuracy in Determining Obligations* – A quantifiable model which incorporates a functional assessment based debiting and crediting methodology could potentially reduce the amount of mitigation required—lower quality habitat being impacted may mean little or no mitigation rather than standard ratios. There are many examples of over-mitigating due to imperfect methods or inaccessible information, and just as many examples of insufficient mitigation (as revealed later in a project life through monitoring of resource degradation).
- *Adaptive Management* – A modifying factor for outputs from the model, the adaptive management tool will allow for reasonable compensatory mitigation considerations at the initiation of the project, but will provide a structured approach for dealing with exceedance of initial performance standards by providing for additional mitigation if and when necessary.

Intangible Benefits, including:

- *Time Efficiencies* – The value of time is apparent for both industry and regulators, and any process which reduces time investment and produces higher quality results has great value. A standardized protocol can greatly reduce the time needed to determine both impacts and offsets. As an example, establishment of wetland mitigation banks has historically taken 18–24 months, and often longer. A new, standardized approach for all elements and protocols in establishing such banks has resulted in a rule-mandated 295-day process from start to finish.
- *Facilitated Negotiations* – A standardized and broadly endorsed process results in smoother negotiations because there will be fewer areas of disagreement, and less need for disputable methods of calculating offsets.

Practical Use of a Compensatory Mitigation Model

The CMM is designed to allow the use of a functional assessment method like that used in the songbird example above to score a project for impacts to habitat or directly to a specific species.

Category 1: Habitats

The various habitats selected are likely to be affected by wind power facility siting. While the list in the CMM template is not complete, it is reasonably inclusive of those areas that are best represented in the literature as having some negative effects from wind resource development.

Objective Measures of Impact			Quantification of Impacts				Identify Mitigation	
			Direct Impacts		Indirect Impacts		Offset Menu	
Valued Ecosystem Components	Key Functions	Indicators Measured in Field and Scored Against Optimal Reference Site	Units	No. of Units	Units	No. of Units	Units	No. of Units
Habitats								
Short-grass Prairie	Species Support	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	2	Functional Acre	0	Functional Acre	4
	Pollination	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Natural Plant Succession	Total number of species, vegetation disturbance, percent native species	Functional Acre	0.5	Functional Acre	0	Functional Acre	3
	Erosion Management	Vegetation disturbance, soil composition, associated water regime, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Total			3.5		0		7
Wetlands	Species Support	Number of strata, percent ground cover, vegetation disturbance, down wood, etc.	Functional Acre	1	Functional Acre	0	Functional Acre	2
	Filtration	Percent ground cover, vegetation disturbance, soil composition, associated water regime, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	1
	Nitrogen Removal	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	0	Functional Acre	0	Functional Acre	0
	Groundwater Recharge	Soil composition, percent ground cover, associated water regime	Functional Acre	0	Functional Acre	0	Functional Acre	0
	Total			1.5		0		3
Mixed-grass Prairie	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Sagebrush Steppe	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Sandsage Prairie	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Wetlands	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Streams	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Riparian Areas	etc.	etc.	Functional Acre		Functional Acre		Functional Acre	
Habitat Total				5		0		10

Category 2: Species

Like habitats, the CMM list of species (both as groups and as individuals) is reasonably representative of those likely to be affected by wind facility siting, and includes species and groups of species well-described in the literature.

Objective Measures of Impact			Quantification of Impacts				Identify Mitigation	
			Direct Impacts		Indirect Impacts		Offset Menu	
Valued Ecosystem Components	Key Functions	Indicators Measured in Field and Scored Against Optimal Reference Site	Units	No. of Units	Units	No. of Units	Units	No. of Units
Species								
Raptors	Cover/Refugia	Number of strata, total canopy cover, snags, vegetation disturbance	Functional Acre	2	Functional Acre		Functional Acre	4
	Connectivity	Number of strata, total canopy cover, edge habitat	Functional Acre	0	Functional Acre	2	Functional Acre	4
	Foraging	Number of strata, percent ground cover, total canopy cover, downed wood	Functional Acre	1	Functional Acre		Functional Acre	2
	Nesting	Number of strata, total canopy cover, snags, vegetation disturbance	Functional Acre	1	Functional Acre		Functional Acre	4
	Total			4		2		14
Bats	Cover/Refugia	Number of strata, percent ground cover, total canopy cover, total number of species, snags, downed wood, vegetation disturbance	Functional Acre	0	Functional Acre		Functional Acre	
	Connectivity	Number of strata, total canopy cover, edge habitat	Functional Acre		Functional Acre	2	Functional Acre	4
	Foraging	Number of strata, percent ground cover, total number of species, vegetation disturbance, percent native species, etc.	Functional Acre	1	Functional Acre		Functional Acre	2
	Nesting	Number of strata, percent ground cover, total canopy cover, total number of species, snags, vegetation disturbance	Functional Acre	1	Functional Acre		Functional Acre	2
	Total			2		2		8
Small Mammals (Ferrets, Prairie Dogs, etc.)	Cover/Refugia	Number of strata, percent ground cover, total canopy cover, total number of species, downed wood, soil composition, associated water regime	Functional Acre	2	Functional Acre		Functional Acre	4
	Connectivity	Number of strata, total canopy cover, edge habitat	Functional Acre		Functional Acre	1	Functional Acre	2
	Foraging	Number of strata, percent ground cover, total canopy cover, total number of species, vegetation disturbance	Functional Acre	0.5	Functional Acre		Functional Acre	1
	Nesting	Percent ground cover, total canopy cover, soil composition, substrate disturbance	Functional Acre	0	Functional Acre		Functional Acre	
	Total			2.5		1		7

Additional VECs can be added along with associated metrics for life habits (various habitat elements, space requirements, etc.).

As described in the songbird example, objective measures of impact are used to determine a score for an impact site:

Objective Measures of Impact			Quantification of Impacts				Identify Mitigation	
			Direct Impacts		Indirect Impacts		Offset Menu	
Valued Ecosystem Components	Key Functions	Indicators Measured in Field and Scored Against Optimal Reference Site	Units	No. of Units	Units	No. of Units	Units	No. of Units
Habitats								
Short-grass Prairie	Species Support	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	2	Functional Acre	0	Functional Acre	4
	Pollination	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Natural Plant Succession	Total number of species, vegetation disturbance, percent native species	Functional Acre	0.5	Functional Acre	0	Functional Acre	3
	Erosion Management	Vegetation disturbance, soil composition, associated water regime, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Total			3.5		0		7

This score then becomes the basis for required mitigation:

Objective Measures of Impact			Quantification of Impacts				Identify Mitigation	
			Direct Impacts		Indirect Impacts		Offset Menu	
Valued Ecosystem Components	Key Functions	Indicators Measured in Field and Scored Against Optimal Reference Site	Units	No. of Units	Units	No. of Units	Units	No. of Units
Habitats								
Short-grass Prairie	Species Support	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	2	Functional Acre	0	Functional Acre	4
	Pollination	Number of strata, percent ground cover, vegetation disturbance, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Natural Plant Succession	Total number of species, vegetation disturbance, percent native species	Functional Acre	0.5	Functional Acre	0	Functional Acre	3
	Erosion Management	Vegetation disturbance, soil composition, associated water regime, etc.	Functional Acre	0.5	Functional Acre	0	Functional Acre	0
	Total			3.5		0		7

Finally, the CMM includes a traditional pro forma-type table, intended to illustrate how project developers could analyze alternative mitigation scenarios by allocating certain portions of the mitigation to any of four major types of compensatory mitigation: Habitat Restoration; Habitat Preservation/Management, Conservation Bank Credit purchase; and payment of a fee to an authorized recipient in-lieu of producing functional units of mitigation.

In some cases, a portion of the project offsets may be allocated to two or more mitigation strategies. For example, a project may have some on-site habitat restoration which produces 25% of the functional units, combined with purchase of credits from an approved conservation bank for another 25% of the functional units, and finally a payment of fees to an In-Lieu Fee program for the remainder of the functional units. The model allows the project proponent to examine multiple scenarios in an effort to identify the preferred means of providing the offsets.

Habitat Restoration

Habitat restoration, enhancement, and creation are forms of permittee-responsible mitigation wherein the project proponent retains all liabilities for producing the offsetting functional units which are specified in the "Identifying Mitigation" part of the model. The various elements of the approach include mitigation site identification and either fee simple purchase or protection in perpetuity through some other means of real estate as the site of the mitigation effort. This is followed by planning/design activities and then implementation (e.g., construction, planting, management activities like chemical applications, etc.) to produce the offsetting functional units. The model includes options for payments over time for certain costs, and calculations embedded in the model account for variables such as inflation of costs and return on the project endowment (which in turn provides revenue for operational items like monitoring and maintenance). A key element to this approach is that the project proponent retains all liability, obligation and associated risks for producing the offsets, with (typically) annual monitoring required to measure progress toward that end.

WIND ENERGY - REGIONAL MITIGATION COST ESTIMATION MODEL												
PROJECT: (Project Name)				INFORMATION AS OF:						CASE:	Base or other	
MITIGATION SUMMARY												
	Project Yearly Cycle:	Jan 1 - Dec 31										
	YEAR ENDING:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Habitat Restoration (Purchase or Easement)													
Planning (Design & Modeling)													0
Entitlements (Permits & Standards)													0
Real Estate													0
Implementation - Structural													0
Implementation - Ecological													0
Monitoring													0
Maintenance/Operation													0
Long-term Endowment													0
Contingency													0
Total, Habitat Restoration		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Habitat Preservation/Management

A commonly used method for mitigating project impacts, habitat preservation is typically accomplished through a real estate purchase, establishment of conservation easement and implementation of a habitat management plan in an effort to offset lost functional units at the project site. This type of mitigation is also a form of permittee-responsible mitigation the project proponent retains all liability, obligation and associated risks for producing the offsets, with (typically) annual monitoring required to measure progress toward that end.

WIND ENERGY - REGIONAL MITIGATION COST ESTIMATION MODEL												
PROJECT: (Project Name)				INFORMATION AS OF:						CASE:	Base or other	
MITIGATION SUMMARY												
	Project Yearly Cycle:	Jan 1 - Dec 31										
	YEAR ENDING:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Habitat Preservation/Management (Purchase or Easement)													
Planning													0
Entitlements													0
Real Estate													0
Monitoring													0
Maintenance/Operation													0
Long-term Endowment													0
Contingency													0
Total, Preservation/Management		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Conservation Bank Credits

Purchase of conservation bank credits is a form of third-party mitigation in which responsibility (all liability, obligation and associated risk) for producing the mitigation offset are transferred to the authorized conservation bank sponsor following payment for the needed credits (typically by species and/or habitat type). Third-party mitigation is an endorsed process (USACE under Section 404 of the CWA for aquatic sites; USFWS under the ESA and other authorities for species and habitats) with established federal guidance. Though relatively rare outside of California (at present there are only 114 conservation banks nationwide, 90 in California), the trend is toward an increase in establishment of species and habitat banks throughout the rest of the country.

WIND ENERGY - REGIONAL MITIGATION COST ESTIMATION MODEL												
PROJECT: (Project Name)				INFORMATION AS OF:						CASE:	Base or other	
MITIGATION SUMMARY												
	Project Yearly Cycle:	Jan 1 - Dec 31										
	YEAR ENDING:	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Conservation Bank Credits													
Planning (selecting bank)													0
Fee Payment													0
DEDUCT - Time value in NEPA	-15%												0
Total, Conservation Bank Credits		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Fees Paid In-Lieu of Mitigation

Finally, payment can be made to an authorized (typically by the USFWS and state wildlife agency) recipient for what is overtly characterized as funding for efforts which in one way or another produce the offsetting functional units needed to compensate for project impacts. This is generally considered a form of third-party mitigation when payment is made to an established In-Lieu Fee program and most if not all liability for producing the offsets transfers to the program. Some other forms of this approach, however, leave some liability with the project proponent, sometimes for indefinite periods (when expenditures of fees paid languish in the recipients accounts are not expended for the requisite habitat improvements).

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ABOUT THE AUTHORS

SOLANO PARTNERS, INC.

Solano Partners, Inc. is a consulting firm focused on environmental investment and the financial value of natural systems. Solano Partners convenes and manages teams of leading independent consultants that bring the best available knowledge and experience to client projects. The firm has assembled teams and delivered results across a range of projects that integrate sustainability principles into business strategy, solving problems related to environmental issues involving materials and energy efficiency and design, toxics and land management. Over the past ten years, the firm has had a particular focus on development of market mechanisms and incentives that allow landowners and land managers to benefit from conservation and restoration actions.

PARAMETRIX

The Ecosystem Services group at Parametrix specializes in developing programmatic solutions to streamline regulatory compliance processes, particularly in the NEPA, CWA, and ESA contexts. The Parametrix team includes recognized national leaders in the evolving field of Ecosystem Services-based planning, performance standard development, and functional performance measurement. The Parametrix team designs long-range planning and regulatory compliance strategies focused on project implementation; management and development of alternative natural resource mitigation and conservation approaches and associated accounting systems; development of habitat valuation currencies; and development of habitat assessment methodologies for terrestrial and aquatic habitats.

WIND POWER SOLUTIONS

Wind Power Solutions is a mission-driven environmental consulting firm owned and operated by Tom Weis. Tom has been active in the wind industry since early 2004 as a public outreach consultant to enXco, one of the nation's largest renewable energy companies. During this time, he helped permit 600 MW of wind energy projects (valued at over $1 billion) and built key strategic alliances between the wind industry and prominent environmental organizations as assistant to the president of the American Wind Energy Association (AWEA). Tom received AWEA's 2009 Special Achievement Award for his role in co-founding AWWI.

ECO-ASSET MANAGEMENT, LLC

Eco-Asset Management, LLC is an environmental consulting firm owned and operated by David Patrick. David has extensive experience in both community ecology and the use of financial incentive programs in support of conservation values. He has provided regulatory guidance and technical management for numerous public infrastructure projects throughout the U.S. as Senior Environmental Scientist for a global engineering design firm. Project experience included regulatory and environmental counsel for public infrastructure, environmental impact reports, land management plans, lake/reservoir studies and restoration programs, watershed planning and management, and the design, implementation and monitoring of large-scale habitat restoration efforts.

APPENDIX 1: METHODOLOGY

The SPI Team began the research process by establishing an online document sharing website and undertaking an extensive outreach process to ensure that the widest possible range of publically available information on the use of compensatory mitigation in the wind industry was organized and easily accessible. This 'internal project library' grew over the course of the project to include over 120 items, which are detailed in the bibliography included at the end of this report. Other background documents on subjects that are directly related to the project goals, for example on functional assessment methods and alternative compensatory mitigation structures were also collected.

Two primary efforts were undertaken on parallel courses utilizing this research material; one to develop the discussions providing background on compensatory mitigation and its use in the wind industry that form the basis for Sections 3 and 4, and the other to develop a working model for presentation to industry and non-governmental organization (NGO)/agency focus groups. The iterative process of developing this model based on the extensive feedback received from the focus groups provides the basis for Sections 5 and 6.

FOCUS GROUPS

The focus groups and related one-on-one conversations were instrumental in shaping the observations, techniques, and recommendations that form the core of this report.

An extensive outreach effort was undertaken to ensure that a representative cross-section of NGOs, wind industry, and government agency viewpoints were represented in this mitigation analysis. Between June 10 and 26, 32 individuals from 21 different institutions were queried about compensatory mitigation approaches in a series of structured "Focus Group" telephone conference calls (see details below). Nine of these individuals participated in a second focus group call. Seventeen other individuals, six from industry, eight from the NGO community, and three from government agencies, did not respond to repeated invitations to participate. In addition to the focus group calls, individual phone conversations were held with 13 individuals. Input on the mitigation analysis and functional assessment model was also received via e-mail from three individuals.

The focus group calls and related one-on-one conversations were instrumental in shaping the observations, techniques, and recommendations that form the core of this report. The groups discussed an enormously wide ranging set of topics, candidly providing appropriate critical comments and feedback, much of it based on first-hand experiences working in the wind/wildlife interface. The first round of calls was marked with a fair amount of skepticism and concern with regards to implementing effective mitigation frameworks. The second round of calls reflected much more positive and supportive feedback and comments, particularly with regards to the functional assessment approach. It is ultimately these supportive comments from practitioners in the industry, NGO community and government agencies that gives the authors of this report a shared sense of excitement and enthusiasm about the findings we present herein.

The Solano Partners team made the conscious decision to hold separate industry and NGO/agency focus group calls in order to facilitate the most open and candid conversations possible, realizing that each of these groups have concerns unique to their respective constituencies. We believe this was the correct approach at this early stage of this analysis, but that it would be highly beneficial for AWWI to organize a series of joint industry/NGO/agency focus group calls, or better yet, in-person meetings, if AWWI decides to pursue this mitigation analysis further.

Below are the individuals who participated in each call that took place, along with the participants:

June 10 NGO/Agency Focus Group Call Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

William Burnidge, The Nature Conservancy

Joe Kiesecker, The Nature Conservancy

Rob Manes, The Nature Conservancy

Brian Rutledge, Wyoming Audubon

Greg Hueckel, WDFW

Bill James, Utah Division of Wildlife Resources

June 10 Industry Focus Group Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

Kevin Halsey, Parametrix

Dave Cowan, First Wind

Joe Grennan, RES Americas

Bill James, Utah Division of Wildlife Resources

June 11 Industry Focus Group Call Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

Craig Cox, Interwest Energy Alliance

Dave Cowan, First Wind

Stu Webster, Clipper Windpower

Joe Grennan, RES Americas

Skelly Holmbeck, NextEra

Janine Bacquie, NextEra

Chris Taylor, Element Power

Rene Braud, Horizon Wind Energy

June 24 Industry Focus Group Call Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

Kenna Halsey, Parametrix

Brandy Gibson, BP Alternative Energy

Tom McFaul, Clipper Windpower

Skelly Holmbeck, NextEra

Brad Loveless, Westar Energy

Rick Greiner, Babcock & Brown

June 25 NGO/Agency Focus Group Call Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

Kenna Halsey, Parametrix

Pam Eaton, The Wilderness Society

Jennifer Boggs, The Wilderness Society

Sarah Tomsky, The Wilderness Society

Rob Manes, The Nature Conservancy

William Burnidge, The Nature Conservancy

Joe Kiesecker, The Nature Conservancy

Brian Rutledge, Wyoming Audubon

Daly Edmunds, Wyoming Audubon

Ed Arnett, Bat Conservation International

Greg Hueckel, WDFW

Bill James, Utah Division of Wildlife Resources

Bob Krska, USFWS, Division Chief, Ecological Services, Region 3

June 26 Industry Focus Group Call Participants

Adam Davis, Solano Partners

Tom Weis, Wind Power Solutions

Kenna Halsey, Parametrix

Rene Braud, Horizon Wind Energy

Danna Small, Horizon Wind Energy

Christina Calabrese, Horizon Wind Energy

Jerry Roppe, Iberdrola Renewables

Andy Linehan, Iberdrola Renewables

Kevin Martin, ACCIONA Energy

Stu Webster, Clipper Windpower

Susan Schumacher, WE Energies

Noel Cutright, WE Energies

Jim Walker, enXco

During the course of our research, separate calls were also made with the following individuals:

- Webex presentation by Joe Kiesecker, TNC, to Team (5/14)
- Tom W. call w/Wayne Walker, Oklahoma Gas & Electric (5/15)
- Team call w/Wayne Walker, OG&E (5/18)
- Tom W. call w/Abby Arnold, RESOLVE (6/1)
- Tom W. call w/Laurie Jodziewicz, AWEA (6/2)
- Team call w/Michael Bean, Environmental Defense Fund (6/3)
- Tom W. call w/Danna Small, Horizon Wind (6/10)
- Team call w/Bill James, Utah Division of Wildlife Resources (6/11)
- Team call w/Chris O'Meilia, Wildlife & Fire Consultation Biologist/GIS Coordinator, USFWS, Oklahoma Ecological Services Field Office (6/26)

In addition, David Patrick had one-on-one conversations with the following individuals:

- Lynn Sharp, Tetra Tech (6/18)
- Bob Thresher, NREL (6/19)
- John Audley, Deputy Director, Renewable Northwest Project (6/19)
- John Haufler, Ecosystem Management Research Institute (6/19)
- Deblyn Mead, National Conservation Banking Coordinator, USFWS (6/26)

Finally, detailed email correspondence was received from the following individuals:

- Brandy Gibson, BP Alternative Energy
- Stu Webster, Clipper Windpower
- Mike Azeka, AES Wind Generation

The groups discussed an enormously wide ranging set of topics, candidly providing appropriate critical comments and feedback, voicing skepticism and concerns, and finally providing extremely supportive comments on the final approach.

APPENDIX 2: CASE STUDIES

OG&E – Oklahoma

Windspeed Transmission and OU Spirit Wind Energy Projects

Brief Project Description:

The project includes the development in west-central Oklahoma of the Windspeed Transmission 345 kV double circuit line running 125 miles from Oklahoma City to Woodward, OK. Multiple land use types are traversed by the transmission line. The line distributes the 101 MW from the OU Spirit Wind Farm.

Turbines: 80?

Type: ?

Facility footprint:

29,000 acres for both wind farm and transmission facilities

Wildlife Mitigation Measures:

OG&E has a significant issue with potential impacts to a candidate species (Lesser Prairie Chicken) and associated habitats and species co-inhabitants. Major issues are:

- Lesser Prairie Chicken (*Tympanuchus pallidicinctus*)
- Short Grass Prairie ecosystem

Options for mitigation include:

- contributing to a regional ecosystem mitigation bank (i.e. buying credits), though this option doesn't yet exist and so time delays would be a problem;
- contribution to a state-wide mitigation fund under endorsed guidelines, though awaiting final guidance could be a time problem;
- self-design (off-site mitigation);
- self-design (on-site mitigation;
- other options or combinations of these four.

Costs:

Vary from research only at $1.5 million to mitigation under state guidance at $54.9 million. Reuters April 2009 reports $3.75 million paid to OK Dept of Wildlife Conservation for habitat development for Lesser Prairie Chicken.

Horizon Wind Energy – Kansas

Meridian Way Wind Farm

Brief Project Description:

The project includes development in north-central Kansas of a 201 MW facility in Cloud County, Kansas. Substantial avoidance and minimization efforts included abandoning 100,000 acre lease in high quality Tall Grass Prairie habitat (and associated high value wind resource) for modest wind resource with lower quality habitat. Turbine specification was modified from 1.8 MW to 3.0 MW,

reducing number of turbines and associated infrastructure from 117 to 67 and direct footprint acreage from 112 to just 55.

Turbines: 67?

Type: Vestas V90 (3MW)

Wildlife Mitigation Measures:

Horizon has issues with potential impacts to Tall Grass Prairie and associated species of concern, particularly the Greater Prairie Chicken and its co-inhabitants. Major issues are:

- Greater Prairie Chicken (*Tympanuchus cupido*)
- Tall Grass Prairie ecosystem

Mitigation strategy includes on-site and off-site efforts, along with funding for university study of the habitat and species. Off-site efforts include funding for 20,000 acres of grassland bird habitat restoration, including 13,000 acres under permanent conservation easement. Long-term habitat improvements include prescribed burning, tree and shrub removal, grazing modifications, fence removal and noxious weed control. Overall project includes 20-year monitoring and reporting on mitigation project success.

enXco – California

PdV Wind Energy Project

Brief Project Description:

A 300 MW wind farm near Tehachapi, CA, the PdV Wind Energy Project by Power Partners Southwest LLC, an entity affiliated with enXco is developing a project with 100 to 300 wind turbines on nearly 6,000 acres about 15 miles west of Rosamond, CA.

Turbines: 100 - 300

Facility Footprint: 6,000 acres

Wildlife Mitigation Measures:

For this project, enXco has a wide range of issues including both multiple species and multiple habitat types. The project calls for more than 30 prescribed wildlife/habitat mitigation requirements, including:

- Restore disturbed areas to natural condition;
- Mitigate impacts to stream/riparian habitat, desert scrub habitat, desert woodland habitat, and desert native grasslands habitat;
- Recover and relocate ground-dwelling special status species as encountered during construction;
- Trained staff on call at all times for Condor-specific response;
- Avoid at least 10 acres of suitable habitat for San Joaquin pocket mouse;
- Special attention to relocating and managing American badger;
- Ongoing surveys for, and relocations/mitigation of desert tortoise on 2,000 acres;
- Ongoing surveys for, and relocations/mitigation of Mohave ground squirrel on 1,300 acres;
- 500 foot buffers around raptor nest sites;

- Seasonal attention to several species during construction and operation, including burrowing owls, loggerhead shrike, Le Conte's thrasher, sage sparrow and Lawrence's goldfinch;
- Post-construction avian/bat mortality monitoring, with additional mitigation required after two years if impacts exceed established thresholds;
- Monitoring of sensitive bird species and their compatibility with the facility

enXco – California

Shiloh Wind Plant Project

Brief Project Description:

The Shiloh Wind Project, Phases I and II are each 150 MW in size, and are located in Solano County, CA. Mitigation is primarily for raptors (particularly Swainson's Hawk) and burrowing owl. was Raptor mitigation. Both were based on Rotor Swept area for project total number of sites (defined as the collision area). Shiloh 1 was for GE 1.5 MW with a 77 meter rotor. And Shiloh II was for a Repower 2.0 MW with a 92 meter rotor. up to 88 turbines with associated infrastructure

Turbines: 88

Type: 1.5 MW / 77 meter to 2.0 MW / 92 meter

Wildlife Mitigation Measures:

Wildlife mitigation measures address species and habitats (wetlands, streams, forested areas), including:

- 100 to 250 foot setbacks from wetland (including sensitive areas like vernal pools), streams, etc.;
- Exclusion from areas containing Carquinez goldenbush, Gairdner's yampah, pappose spikeweed, heartscale, San Joaquin spearscale, and bearded popcornflower;
- Avoid areas with habitat for California Tiger Salamander and Western Burrowing Owl;
- Post-construction monitoring of bird mortality and, depending on findings, additional mitigation may be required;
- On-site mitigation to include avoidance measures and a raptor mitigation plan;
- Off-site mitigation in the form of Conservation Bank credit purchases (Shiloh I at 120 credits $612,000 and Shiloh II at 146 credits for $803,000).

Highland New Wind – Virginia

Red Oak Knob/Tamarack Ridge Wind Facility

Brief Project Description:

Highland New Wind is developing a 38 MW facility on a 69 kV line on 200 acres of 4,400-foot ridgetop in western Virginia. Major mitigation issues include bird (especially raptors) and bat strikes, as well as specific concerns for impacts to Bald Eagle, Golden Eagle, Virginia Northern Flying Squirrel, Virginia Big-eared Bat and Indiana Bat, but were not found to be significant enough to warrant an HCP.

Turbines: 22

Type: 1.5 MW

Facility Footprint: 200 acres

Wildlife Mitigation Measures:

Mitigation measures are oriented toward avoidance, minimization and monitoring to determine what measures are needed to reduce impacts.

- Immediate shut-down if a listed species (federal or state ESA) is taken by the facility;
- Daily fatality searches under 10 turbines for three years, and subsequent additional monitoring and/or offsets if thresholds are exceeded (e.g. 2.1 bats and 6.9 bird species of concern per turbine per year);
- Adaptive mitigation requirements based on findings of monitoring, including:
    - changing operational procedures during peak migratory periods;
    - established replacement cost for each species killed, ranging from $1,000 per Northern Harrier to $500 for Eastern Screech Owl;
- On-site climatological data collected for correlation to passage/migration and fatality rates;
- Penalty payments for specific raptors killed at the facility;
- Monitoring cost capped at $150,000 per year for three years, then higher of $100,000 or 1.75% of prior year's total revenue for remainder of project life;
- Mitigation costs capped at $50,000 or 0.85% of prior year's total revenue for remainder of project life.

APPENDIX 3: AVOIDANCE AND MINIMIZATION MITIGATION FRAMEWORKS

U.S. ENDANGERED SPECIES ACT (ESA): HABITAT CONSERVATION PLANS AND 'SAFE HARBOR' PROVISIONS

Habitat Conservation Plans (HCPs) have become a major part of the effort to provide compliance options under the Endangered Species Act since Congress amended the ESA to enhance the permitting provisions of the act in 1982. Essentially, an HCP is an agreement between a permittee or local government agency and the USFWS or NOAA Fisheries that specifies anticipated impacts to listed species, steps taken to minimize or mitigate those impacts (known as 'incidental take'), an alternatives analysis and various other measures (Section 10(a) (2)(A).). This agreement with the USFWS or NOAA Fisheries, because of the detailed conservation planning measures required, then allows otherwise prohibited impacts to endangered or threatened species. An incidental take permit is only issued, however, if a determination is made that it will not "reduce the likelihood of the survival and recovery of the species in the wild."

In order to address private landowner reticence to engage with federal agencies with regards to endangered species, 'safe harbor' provisions were adopted by the USFWS, following a major effort to develop such provisions by Environmental Defense. This language recognizes actions by landowners that restore or enhance habitats for endangered species, and stipulates that they won't incur any new restrictions on the use of the land if their actions result in endangered species taking up residence.

The Endangered Species Act also empowers USFWS or NOAA Fisheries to include "terms and conditions" in the incidental take permits as necessary or appropriate. (Section 10(a) (2)(B)(v).) Among those terms and conditions are "no surprises assurances," issued in accordance with Federal regulations. 50 CFR Part 17. These regulations allow for assurances to be given to private landowners that if "unforeseen circumstances" arise, USFWS or NOAA Fisheries will not require the commitment of land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the levels otherwise agreed to in the conservation plan, without the consent of the permittee.

PROGRAMMATIC PERMITS

Programmatic permits are a viable tool for improving natural resource management efforts and streamlining project delivery. Programmatic permits are tools that set activity-based, project development impact thresholds and projects that fall within those thresholds are eligible to undergo a streamlined permitting process. This streamlining is possible because these permits are negotiated at a programmatic level and they encompass the range of impacts that may result from the covered project activities. Because the potential effects are identified in advance, the need to undergo the detailed negotiation process repeatedly on a project by project basis is greatly reduced, thus minimizing the demand placed on agency and developer resources. Regional General Permits (USACE), Nationwide Permits (USACE), Programmatic Biological Opinions (USFWS, NMFS), Programmatic Environmental Impact Statements (PEIS), and state General Authorizations, etc. are examples of programmatic "General Permits" designed to protect the environment while also facilitating implementation of projects that individually have minor effects on the environment. Programmatic permits are most commonly used in the transportation and infrastructure contexts.

An example of a programmatic solution designed to organize the needs of multiple agencies and geographic regions around a common activity type is provided by the *Programmatic Environmental Impact Statement Designation of Energy Corridors on Federal Lands in the 11 Western States* (DOE/EIS-0386), which was prepared in compliance with the Energy Policy Act of 2005 (EPAct). EPAct established a requirement that energy corridors ("Section 368 Corridors") be identified and designated as such, on federal lands in 11 western states. The intention of the act is to facilitate expedited permitting of oil, gas, hydrogen pipelines, and electricity transmission and distribution facilities.

Box 1: ODOT Case Study

"The Oregon Department of Transportation in collaboration with the Oregon Bridge Delivery Partners analyzed the cost/benefit differences between a traditional project permitting approach against the programmatic permitting process used on the OTIA III State Bridge Delivery Program. In summary, the analysis showed that the mean return on investment (ROI) for the programmatic permitting process was $3.19 for every $1 expended versus $.75 for every $1 expended on a traditional permitting approach. The results clearly show that a programmatic approach to permitting a large program has significant cost savings (measured in time and money) over a project by project permitting effort. The ROI exceeded benefits projected by the Department at the beginning of the Program. Initially, $54 million in savings was projected. Given the results of this analysis and the ~$23 million spent on the effort to date, the realized savings now exceed $73 million."

Excerpted from: OTIA III State Bridge Delivery Program Environmental Programmatic Permitting Benefit/Cost Analysis, October 2008.

EPA directs Agencies to develop procedures, including "uniform interagency operating procedures for reviewing applications for energy right-of-ways within designated Section 368 corridors," that will expedite permitting for energy projects located within the corridors. Project proponents interested in developing in the designated corridors benefit from existence of the PEIS because it provides a "one stop shopping" permitting opportunity in an area where many jurisdictional claims having the potential to complicate and delay the approval process. In the end, project proponents are able to seek project approvals for the entire length of a transmission project, rather than obtain separate permits for each segment of the project as it crosses jurisdictional boundaries.

Following the example established by the collaborative BLM, USFS, NPS, and USFWS "Service First" program, the Agencies participating in the streamlining project are directed to prepare guidance, based on information contained in the PEIS, related to the types of additional regulatory authorizations that will be required in order for projects to qualify for development in the Section 368 corridors. This guidance is to be made available to project reviewers and applicants alike so that a common understanding about compliance obligations exists. Program implementation highlights include:

- Project proposals undergo an initial completeness review and a determination is made regarding whether or not the project qualifies is acceptable and therefore, eligible to seek authorization using the program's single application process;
- While project approvals must be obtained from each agency, relevant agencies select the lead federal agency responsible for processing a given project's application and environmental review, in addition to dealing with construction activity, post-construction monitoring, and close out issues for the entire project;
- Project proponents are required to examine opportunities to coordinate with other energy transmission projects in order to maximize efficiencies within the corridor where possible;
- Project proponents are required to complete only one regulatory review process for each regulation triggered by the project and, where reviews need to occur on a state-by-state basis, all reviews will be coordinated by the lead federal agency;

- The agencies are tasked with developing one cost share agreement, which includes a project schedule agreed to by the applicant and agencies, one fee schedule, and one administrative record for the project; and
- All projects are required to maintain a project website, developed by the agencies, where all public information will be made accessible.

This clearly defined process is anticipated to be of great value to both project proponents and the resource agencies, which face expanding work loads and ever diminishing resources. By entering into a coordinated project approval program, the applicant is spared the inefficiencies associated redundant permitting processes that have the ability to generate conflicting terms and conditions, including those aimed at impact avoidance, minimization, and mitigation.[i]

ENDANGERED SPECIES ACT (ESA)

In addition to NEPA compliance, several streamlining tools are available for use in the ESA context and use of these tools can be advantageous when multiple, similar projects require approval. Programmatic consultations can occur at the plan-level or program-level, while project-level batching offers an alternative for processing multiple, individual projects:[ii]

- Plan-level consultations are performed for resource management plans and land use plans that include groups of programs with predictable impacts;
- Program-level consultations are prepared for specific types of activities, but not for specific projects; and
- Batched consultations are performed when a collection of specific projects, all with similar characteristics and anticipated impacts, are processed at one time, rather than individually.

Whether or not it is advantageous to pursue a programmatic Biological Opinion (BO), pursue batching, or engage in project-level consultation depends on several complexity factors, including:

- Amount and quality of information available upfront;
- Level of program predictability regarding issues such project scale, actions, location, timing, and level of likelihood of impact;
- Number of species and types of critical habitat affected;
- Behavior and life history of relevant species;
- Geographic scale; and
- Agency coordination needs.

Regional programmatic authorizations under the ESA have been developed for a variety of species and activities. Examples include:

The Oregon Department of Transportation's (ODOT) State Bridge Delivery Program collaborated with USFWS and NMFS to produce a joint programmatic BO to streamline ESA, Marine Mammal Act, Migratory Bird Treaty Act, and the Bald and Golden Eagle Act compliance for more than 300 bridge repair and replacement projects throughout Oregon. The BO, and the Performance Standards up on which it is based, were completed within less than one year from initiation (see Section 5, Performance Standards).

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i Source: Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States (DOE/EIS-0386), November 2008.

[ii] Assessment of Programmatic Consultations in Oregon, Washington, and Idaho; USFWS, NOAA, BLM, and USFS, July 9, 2004.

APPENDIX 4: CASE STUDIES ON AVOIDANCE AND MINIMIZATION

WESTERN RENEWABLE ENERGY ZONE APPROACH

Specifically, the WGA and the U.S. Department of Energy released a joint WREZ Phase 1 report on June 15, 2009 that takes the first steps toward identifying those areas in the Western Interconnection that have both the potential for large scale development of renewable resources and low environmental impacts. As a core element in the planning process to determine optimum siting for renewable energy generation and minimum environmental impact, a detailed set of avoidance criteria were developed and then mapped. The criteria used in this process result in what are termed Qualified Resource Areas.

In order to implement the goals of the project, working groups were set up for Zone Identification and Technical Analysis, Environment and Lands, and Generation and Transmission Modeling. The Environment and Lands (E&L) group was responsible for categorizing the resource potential of zones based on land use, wildlife and other environmental considerations.

The Zone Identification team identified discrete areas, quantified energy potential and created boundaries around a geographic region that could justify the construction of regional transmission. The results of this analysis were geographic areas with at least 1,500 MW of high quality renewable energy within a 100 mile radius.

> *"Next the E&L group identified those federal lands where renewable energy development is precluded legally by relying on the U.S. Forest Service, U.S. Fish and Wildlife Service and the Bureau of Land Management to provide guidance on the lands they manage. These lands generally include U.S. National Parks, U.S. National Monuments, federally designated Wilderness Areas, and U.S. Forest Service primitive areas. Additionally, E&L solicited information from state land management agencies on state-owned lands where renewable energy development is precluded by statute or regulation."*
>
> *"E&L also identified other categories of lands that should be excluded from analysis of potential renewable energy development due to the established purpose or policy direction for these lands. Among the lands included are BLM Areas of Critical Environmental Concern, state parks and state wildlife management areas. Finally, E&L identified a number of areas that are significant when considering renewable energy development, but which could not be mapped in this effort either because data is unavailable or because the concerns are more appropriately handled at the project level."*

Finally, ZITA elected to exclude the following types of lands from consideration based on incompatibility with resource development:

- Wetlands/water bodies
- Surface mines
- Urban areas
- Airports
- Military lands
- Excessively sloped areas

This process of elimination resulted in a subset of lands which were available for further consideration.

The next step in the process was to integrate information about important wildlife habitat, sensitive ecosystems and other sensitive lands. This was accomplished with the assistance of the Western

Governors' Wildlife Council, whose members represent state wildlife agencies.[i] The goal of integrating this information is to be able to categorize Qualified Resource Areas based on their level of biological sensitivity and the level of mitigation needed to accommodate large-scale renewable energy development.

> *"The Council requested wildlife data from agencies in 11 states and two Canadian provinces within the Western Interconnection.[ii] The agencies were asked to provide information for crucial habitats and wildlife corridors, as well as sensitive ecosystems. A request for data also was made to the environmental community, academic institutions and industry. A technical consultant developed a map showing the data layers and categorized them based on criteria developed by the Council[iii] with input from E&L.*
>
> *The criteria used to prioritize wildlife values within each state or province related to impacts from renewable energy generation. Some states and provinces applied the criteria themselves and that information was included in the overall map. Once the initial round of mapping was completed, wildlife agencies reviewed them for accuracy, before sending them to the governors or premiers' offices for approval. Many of the maps have been completed, but some await additional reviews by other agencies.[iv]"*
>
> *"The Council's maps identify the level of wildlife sensitivity within the Qualified Resource Areas. This effort was meant to provide a broad screening level assessment of development potential. The wildlife sensitivities were based on the best currently available data and the best professional judgment of the state wildlife agencies. Categorizations do not represent a binding action on development; the mapping effort by the Council was intended to indicate a prioritization of lands relative to wildlife in order to guide, from an overarching regional policy perspective, regional transmission investments to the areas with not only the best renewable resources, but also the least environmental conflicts."*
>
> *"In addition, WREZ stakeholders expect this type of wildlife information will encourage appropriate and corresponding levels of mitigation when eventual development in an identified zone is proposed."*

US FISH AND WILDLIFE SERVICE FEDERAL ADVISORY COMMITTEE GUIDELINES

Beyond the guidelines from Washington State, the June 11, 2009 USFWS Guidance begins to lay out compensatory mitigation measures and recommendations, in support of the USFWS Mitigation Policy. The document states that, wherever possible, mitigation requirements should be identified in advance of project approval, as should the type of mitigation that is to be performed. It also advises that project proponents consider the potential need for additional mitigation in the event that impacts are greater than expected and it encourages upfront identification and definition of feasible mitigation that may need to be performed in such instances.

In addition to stating that there should be a nexus between the level of impact and the type of mitigation performed, the document identifies mitigation options that may be appropriate:

- Offsite and on-site habitat restoration
- Offsite and on-site habitat creation
- Offsite and on-site habitat enhancement (and sometimes protection).

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i For information on the members, see the Western Governors' Wildlife Council website at www.westgov.org.

ii The data request is available on the Western Governors' Wildlife Council website at www.westgov.org.

iii The categorization criteria used by the Western Governors' Wildlife Council is available on their website at www.westgov.org.

iv Wildlife sensitivity maps, and a description of the datasets that were categorized, that have been approved by governors for use in the WREZ are available on the Western Governors' Wildlife Council website at www.westgov.org.

APPENDIX 5: EXISTING OR DEVELOPING ENVIRONMENTAL PERFORMANCE MEASUREMENT METHODOLOGIES

APPLIED RIVER MORPHOLOGY METHOD
Rosgen 1996

Provides a detailed explanation of the Rosgen stream classification system (Rosgen 1994) and "how it might be used to incorporate the observed processes of river mechanics into restoration designs." (Rosgen 1996). Presents probable channel evolution scenarios based on existing channel and valley features to suggest potential future stream conditions. Based on field data but may have GIS component. Descriptive and quantitative output.

Intended use: Nationwide rivers and streams

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

ARTIFICIAL INTELLIGENCE FOR ECOSYSTEM SERVICES (ARIES)
University of Vermont

A federally funded information science tool developed for web distribution that provides users a guided and intelligent way to assemble data, values and issues.

Intended use: To help organizations or jurisdictions identify issues and opportunities for understanding ecosystem services. A decision support system.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

BASINWIDE VISUAL ESTIMATION TECHNIQUE (BVET)
Dolloff et al. 1993

A sampling design for estimating total fish abundance and total fish habitat area within a watershed. Based on field data but may have GIS component. Quantitative output.

Intended use: Small streams. Not limited to any single geographic region, but was developed and has been most utilized in the western U.S.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

BENEFICIAL USE RECONNAISSANCE PROGRAM (BURP) FIELD MANUAL FOR STREAMS

Idaho Department of Environmental Quality, BURP TAC 2004

Initiated to help determine the existing uses and beneficial use support status of Idaho's water bodies. BURP monitoring emphasizes sampling, analysis, and assessment of biological assemblages and physical habitat structure of streams to ultimately support characterization of stream integrity and overall quality. This BURP Field Manual provides information needed for consistency and comparability of monitoring efforts among Idaho Department of Environmental Quality personnel as well as other entities interested in following these methods. A descriptive, ordinal scale with quantitative output.

Intended use: Idaho streams

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

BUSHBROKER

Victoria Department of Sustainability and Environment, Australia 2006

A trading scheme for registering and trading native vegetation offset credits. Native vegetation credits are listed on the *BushBroker* register and these can be bought by another party and subsequently used as an offset for the approved clearing of native vegetation.

Intended use: Auction-based tool for managing offset mitigation.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

BUSHTENDER PROGRAM

Victoria Department of Sustainability and Environment, Australia

This survey protocol develops habitat scores based on field site studies that can be conducted on large tracts of land. The resulting score has been used in trials for auction based conservation financing.

Intended use: Auction-based tools for restoration of native range and forest land.

Able to calculate multi-resource credit: Possible, currently creates a landscape level score for trading based on biodiversity.

Sensitivity: Coarse spatial scale, focused on a single ecosystem.

Capable of being integrated into multi-resource credit: Unknown

BUSINESS AND BIODIVERSITY OFFSET PROGRAM (BBOP)
Forest Trends

An international partnership between companies, governments and conservation experts to explore biodiversity offsets and develop the principles and methodologies required to support best practice in voluntary biodiversity offsets. BBOP has published a set of 10 principles on biodiversity supported unanimously by the 40 member organizations of the BBOP Advisory Committee, together with supporting material in the form of interim guidance on the design and implementation of offsets.

Intended use: To develop best practice on biodiversity offsets for the BBOP partners.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

CALIFORNIA CARBON PROJECT PROTOCOLS
California Climate Action Reserve

There are a number of protocols developed for different credit actions. Most relevant is December 2008 forest protocol applicable nationally. Quantifies only carbon sequestration.

Intended use: Carbon credit calculator

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

CALIFORNIA RAPID ASSESSMENT METHOD (CRAM)
Southern California Coastal Water Research Project

A wetland functional assessment that looks at conditions and stressors. Allows for differing level of detail based on use. First step is classifying the wetland, then assigning scores for Buffer and Landscape Context, Hydrology, Physical Structure, and Biotic Structure.

Intended use: Wetland assessment

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

CASCO BAY WATERSHED WETLANDS CHARACTERIZATION METHOD
Hertz and Sartoris 2001

To provide a watershed-based wetlands characterization method using GIS. Listed uses include: to inform and support wetlands conservation and protection programs at the state, local, and national levels; as an aid in municipal and regional planning, including open space, habitat and water quality planning; and to provide information on wetlands and affiliated upland systems for use in compensatory mitigation situations. Nominal scale output units.

Intended use: Maine freshwater and marine wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

CITY GREEN
American Forests

An ArcGIS package of models that calculates ecosystem services and economic value for stormwater, carbon storage and sequestration, air pollution removal, and water quality. Does analysis on user-defined land cover layer.

Intended use: Analysis tool for decision makers.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

COMBINED HABITAT ASSESSMENT PROCEDURE/HABITAT EVALUATION PROCEDURES
Bonneville Power Administration/NW Habitat Institute

Used to quantify the impact of hydroelectric projects and benefits of mitigation in the Pacific Northwest. CHAP is an evolution that allows for crediting out-of-kind habitats. Based on species-habitat associations.

Intended use: Integrated ecosystem services accounting

Able to calculate multi-resource credit: Yes

Sensitivity: The system is sensitive to direct impacts from projects, but can only measure change based on presence/absence of habitat elements. Function-based accounting, but the functions are limited to those provided by species. Has more potential benefit as an assessment.

Capable of being integrated into multi-resource credit: Yes

CONNECTICUT METHOD
Ammann et al. 1986

To provide a method of wetland evaluation for use by public officials and others who have some familiarity with wetlands; to be used for wetland policy formation and analysis. Ordinal scale output.

Intended use: Connecticut inland wetlands and watercourses.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

DELAWARE RAPID ASSESSMENT
Jacobs 2005

To assess the current condition of the wetland site and identify stressors that are present that are lowering the condition of the site. Ordinal scale output.

Intended use: Non-tidal wetlands of Outer Coastal Plain regions of Maryland and Delaware.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

DESCRIPTIVE APPROACH (HIGHWAY METHODOLOGY)
USACE New England Regulatory Program 1999

To identify and display wetland functions and values acceptable for the Corps New England District Regulatory Program. This method can be used for any project where the characterization of wetland resources is necessary for Section 404 permit requirements.

Intended use: New England wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

DEVELOPING RAPID METHODS FOR ANALYZING UPLAND RIPARIAN FUNCTIONS AND VALUES
Hruby T., 2009

A rapid assessment method for non-wetland riparian habitat in Washington State. Indicators are used to identify the potential of a site to provide a function, the potential of the landscape to support the function, and the value the function provides to society.

Intended use: To implement upland riparian laws in Washington.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

DEVELOPMENT OF A FLORISTIC QUALITY ASSESSMENT METHODOLOGY FOR WISCONSIN
Wisconsin Department of Natural Resources, 2003

Developed to provide an intensive measure of wetland biological integrity based on the condition of the plant community.

Intended use: For use with the Wisconsin wetland monitoring program.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

EASTERN KENTUCKY STREAM ASSESSMENT PROTOCOL (EKY)
USACE 2002

The eKY Protocol was developed to address the need for a headwater stream assessment procedure to assess potential impacts of projects proposed in the Eastern Kentucky Coalfield Region by applicants seeking authorization from the U.S. Army Corps of Engineers pursuant to Section 404 of the CWA. In addition, the assessment protocol also had to suggest requisite levels of compensatory mitigation efforts to offset the adverse impacts and identify applicable monitoring variables and success criteria to evaluate the success of mitigation efforts. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Eastern KY Coalfield physiographic region; 1st to 3rd order streams.

Able to calculate multi-resource credit: Yes

Sensitivity: At the stream reach (minimum 100m in length), plus a macroinvertebrate bioassessment index for headwater streams of the Eastern Coalfield Region.

Capable of being integrated into multi-resource credit: Unknown

ECOLOGICAL SITE INVENTORY
Bureau of Land Management

A descriptive tool used by NRCS to describe the baseline ecological conditions as part of natural resources planning. There are not quantitative elements, so an extensive review was not conducted.

Intended use: Qualitative tool.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

ECOMETRIX
Parametrix

An integrated function based ecosystem services accounting methodology that integrates resources and methodologies allowing for decision making analysis, crediting and trading, and environmental performance measurement monitoring.

Intended use: Integrated ecosystem services accounting

Able to calculate multi-resource credit: Yes

Sensitivity: The methodology is very sensitive to direct impacts from projects – both restoration and development related, but can be used at landscape-scale. Function based accounting based on

ecosystem services identified by the Millennium Assessment. Can be tailored to meet geography, habitat, and policy requirements.

Capable of being integrated into multi-resource credit: Yes

ECOSYSTEM DIAGNOSIS AND TREATMENT MODEL
Mobrand Biometrics, Inc. / ICF Jones and Stokes

Ecosystem Diagnosis and Treatment (EDT) is a system for rating the quality, quantity, and diversity of habitat along a stream, relative to the needs of a focal species such as coho or Chinook salmon.

Intended use: The methodology includes a conceptual framework for decision making and a set of modeling tools that organize environmental information and rate the habitat elements in regard to the focal species. In effect, it describes how the fish would rate conditions in a stream based on our scientific understanding of their needs.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

ECOSYSTEM VALUATION METHODS
Virginia Department of Forestry

A package of models on a website that allows landowners to calculate potential ecosystem credits from their lands. Best available models are approved by agencies for use but are still early in development.

Intended use: Water quality

Able to calculate multi-resource credit: Not likely due to “still in development” nature of models

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

ENVIRONMENTAL MONITORING AND ASSESSMENT PROTOCOLS (EMAP)
Environmental Protection Agency

A series of assessment methods and guidance for monitoring ecological conditions and risks.

Intended use: Broad set of assessment tools for various resources.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

ENVISION
Oregon State University

Envision is a GIS-based tool (beta version) for developing alternative-futures analysis used to model the landscape impacts of various policy scenarios on land use change and accompanying biophysical impacts. Strongest applications are mapping the cumulative effects of multiple actions at multiple sites as it tracks impacts over time. Has the ability to plug in evaluative models (e.g., credit calculators).

Intended use: Created to conduct research about the nature and properties of coupled human and natural environmental systems in the context of climate change.

Able to calculate multi-resource credit: Unknown, but has connections to other credit calculators.

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

EPA OREGON STREAM METHODOLOGY
EPA

Identifies perennial and ephemeral streams in Oregon. Uses field indicators that identify evidence of flow.

Intended use: Water quality assessment

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: No

EPA REGION 10 IN-STREAM BIOLOGICAL MONITORING HANDBOOK
EPA/Hayslip 1993

To supplement the rapid bioassessment protocols (Plafkin et al. 1989; rev. Barbour et al. 1999) by illustrating how Region 10 States have adapted the RBPs for the northwestern U.S.; to define the minimum components necessary to conduct stream bioassessment; and to encourage consistency of sampling methods to facilitate data sharing. Ordinal scale, nominal scale, and quantitative output.

Intended use: Wadeable streams and rivers in Region 10 (WA, OR, and ID)

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

EVALUATION FOR PLANNED WETLANDS (EPW)
Bartoldus et al. 1994

To determine whether a planned wetland has been adequately designed to achieve defined wetland function goals. This method has also been used to assess conditions of existing wetlands. Ordinal scale output.

Intended use: US wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

FAIRFAX COUNTY STREAM PHYSICAL ASSESSMENT PROTOCOLS
Fairfax County Stormwater Management Branch 2001

Fairfax County developed a Stream Protection Strategy as part of on-going progress towards a watershed management program. The Strategy includes methods that build upon and incorporate extant bioassessment programs and will allow the Stormwater Management Branch to better anticipate, prevent, prioritize, and correct adverse impacts to the County's stream resources. The Strategy incorporates biological sampling (e.g. benthic macroinvertebrates and fish) and rapid physical habitat and geomorphology assessments. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Fairfax County small streams

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

FIELD MANUAL FOR OHIO'S HEADWATER HABITAT STREAMS
Davic 2002

The Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams is intended to promote standardized assessment of actual and expected biological conditions in primary headwater habitat (PHWH) streams in Ohio. The principal regulatory and/or administrative impetus for development of the protocols was pursuant to water quality standards (designated uses, water quality criteria, antidegradation) for the NPDES program. The methods outlined in the Manual are designed to statistically differentiate among three quality classes (designated uses) of PHWH streams in Ohio: Class III PHWH Stream (cool-cold water adapted native fauna); Class II PHWH Stream (warm water adapted native fauna); Class I PHWH Stream (ephemeral stream, normally dry channel). Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Ohio; however, this method can be applied to other areas that have cold-cool spring fed adapted biological communities of headwater salamander and benthic macroinvertebrate communities.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

FIRE REGIME CONDITION CLASS
FRCC 2005

To provide tools for fire, vegetation, and fuels assessment and management at both the landscape and stand levels. Methods are used to describe general landscape fire regime and vegetation-fuel characteristics. Descriptive, ordinal scale, and nominal scale output.

Intended use: Forests nationwide

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

FLORIDA WETLAND QUALITY INDEX
Lodge, T.E., H.O. Hillestad, S.W. Carney, and R.B. Darling., 1995

A method for determining compensatory mitigation requirements for impacted wetlands within the Everglades.

Intended use: To evaluate mitigation site compliance with regulatory requirements.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

FLORIDA WETLAND RAPID ASSESSMENT PROCEDURE
South Florida Water Management District, 1999

A rapid assessment procedure designed to assess mitigation projects with a habitat emphasis. It yields a single score that may be interpreted as condition.

Intended use: Assessing mitigation projects

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

FLORISTIC QUALITY ASSESSMENT INDEX (FQAI)
Swink and Wilhelm 1979

To provide an objective standard (Floristic quality assessment index) for describing the quality of plant communities. Used to make relative comparisons in environmental and natural resources management. Ordinal scale output.

Intended use: Any vegetation community. Initially for Chicago Illinois, but subsequently has been modified for use in a few additional states.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

FRESHWATER WETLAND MITIGATION QUALITY ASSESSMENT PROCEDURE
New Jersey Department of Environmental Quality, 2001

A wetland functional assessment that evaluates the relative probability that a constructed freshwater wetland will develop to approximate the functioning of natural wetlands over time.

Intended use: An informatory tool only.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

GRAVEL BED INSTREAM FLOWS
Schmidt and Potyondy 2004

To provide a methodology for estimating essential water flow regimes needed for the self maintenance of gravel-bed stream channels. Quantitative output.

Intended use: Intermountain west. Perennial, unregulated, snowmelt-dominated, gravel-bed streams with alluvial reaches. This method is unlikely to work in arid environments with ephemeral channels where hydrographs are flashy.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

GUIDANCE FOR RATING THE VALUES OF WETLANDS IN NORTH CAROLINA
North Carolina Department of Environmental and Natural Resources, 1995

A wetland functional assessment that assesses six wetland functions only for their effect on wetland values (societal benefit).

Intended use: Tool for making 401 Water Quality decisions on impacts and mitigation.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

GUIDEBOOK FOR HYDROGEOMORPHIC (HGM)-BASED ASSESSMENT OF OREGON WETLAND AND RIPARIAN SITES – WILLAMETTE VALLEY RIVERINE IMPOUNDING AND SLOPES/FLATS SUBCLASSES
Adamus and Field, 2001

An HGM reference-based assessment restricted to Willamette Valley ecoregion riverine impounding and slopes/flats wetlands. Addresses both functions and values for these subclasses.

Intended use: Wetland assessment

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

GUIDELINES FOR EVALUATING FISH HABITAT IN WISCONSIN
Simonson et al. 1993

To establish a standardized general protocol "that can be used when conducting any stream habitat survey, evaluation, monitoring program, appraisal, or special project.when precise, defensible methods are needed to substantiate management objectives, priorities, or effectiveness [of management treatments]" (Simonson et al. 1994). Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Wisconsin and adjacent states. Permanent, wadeable streams.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

HABITAT ASSESSMENT MODEL
Wockner et al. 2005

To aid managers in discerning the relationships between wildlife populations (for elk and mule deer) and habitat sustainability. The model produces a range of population values with related management implications (e.g., grazing, burning) that can be used in the planning process. Developed to resolve fence and forage conflicts on private and public lands. Quantitative output.

Intended use: CO terrestrial habitat.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

HABITAT EQUIVALENCY ANALYSIS (HEA)
NOAA

Developed to calculate the credits needed to identify impacts for Natural Resource Damage Assessments under a series of statutory authorities including CERCLA (Superfund) Assigns a habitat functional score to each habitat unit in a site and multiplies that by the area. Time to being fully functional is also

accounted for using a standard discount rate. The assessments allow for out of kind and off site assessments, but it is used only in response to natural resource damages not in anticipation.

Intended use: Integrated ecosystem services accounting

Able to calculate multi-resource credit: Allows for measurement for mitigation but not necessarily credits per se.

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

HABITAT EVALUATION PROCEDURE (HEP)
USFWS 1980

Assess the quality and quantity of available habitat for selected wildlife species, by comparing the same area at different points in time, or different areas at one point in time. Ordinal scale output.

Intended use: All regions regularly inhabited by species for which HIS models are available.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

HAWAII STREAM BIOASSESSMENT
Kido 2002

To provide the tools and informational framework required to conduct meaningful water quality assessments aimed at restoring and/or maintaining the "biological integrity" of Hawaii's streams. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Hawaii streams

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

HEAT SOURCE MODEL
Oregon Department of Environmental Quality

Currently the Shade-a-Lator tool within the Heat Source model is being used to calculate temperature credits in the Willamette. Requires data from GIS and field collection.

Intended use: Water quality assessment

Able to calculate multi-resource credit: Yes

Sensitivity: Focuses on a single component of water quality.

Capable of being integrated into multi-resource credit: Unknown

HYDROGEOMORPHIC METHOD (HGM)
U.S. Army Corps of Engineers/EPA/FHWA

National methodology for wetland impacts and mitigation.

Intended use: Wetland assessment

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

IDAHO SMALL STREAM ASSESSMENT
Grafe 2002

To assess aquatic life use support for small streams using biological indicators, habitat data, and numeric water quality criteria. The document provides detailed technical information concerning the development and integration of the Stream Macroinvertebrate Index (SMI), Stream Fish Index (SFI), and Stream Habitat Index (SHI) used in the aquatic life use support determination. Ordinal scale, nominal scale, and quantitative output.

Intended use: ID medium and large rivers in mountainous settings.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

INDEX OF BIOLOGICAL INTEGRITY (IBI) – BIRDS, FISH, INVERTEBRATES, AND PLANTS
Karr 1981

To assess biological integrity of a habitat utilizing one of the four (birds, fish, invertebrates, and plants) as indicators of relative condition of a selected habitat. Ordinal scale and quantitative.

Intended use: Nationwide in most habitat types.

Able to calculate multi-resource credit: Yes

Sensitivity: Sensitive for the four specific biotic groups (birds, fish, invertebrates, plants) in relation to habitat.

Capable of being integrated into multi-resource credit: Unknown

INDEX OF MARSH BIRD COMMUNITY INTEGRITY
DeLuca et al. 2004

To evaluate the biological integrity of marsh bird communities and assess estuarine wetland condition. Ordinal scale output.

Intended use: Chesapeake Bay (Maryland, Virginia, and Delaware) tidal wetlands.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

INSTREAM FLOW INCREMENTAL METHODOLOGY (IFIM)
Bovee 2004

IFIM is a tool to assess in-stream flow problems, ranging from simple diversions to complex storage and release schemes. It provides resources managers with a decision support system for determining the benefits or consequences of different water management alternatives. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: National

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

INTERIM GUIDELINES TO AVOID AND MINIMIZE WILDLIFE IMPACTS FROM WIND TURBINES – POTENTIAL IMPACT INDEX (PII)

USFWS 2003

PII is a protocol allows the user to evaluate potential development sites using checklists and rank them against a reference site. Objectives are to: (1) assist developers in deciding whether to proceed with development; (2) provide a procedure to determine pre-construction study needs to verify use of potential sites by wildlife; and (3) provide recommendations for monitoring potential sites postconstruction to identify, quantify, or verify actual impacts (or lack thereof).

Intended use: To assist the wind energy industry in avoiding or minimizing impacts to wildlife and their habitats.

Able to calculate multi-resource credit: The Physical Attributes, Species Occurrence and Status, and Ecological Attractiveness groupings in this protocol should serve as a model framework; the terrain features, species, and conditions used in these groupings will be dictated by local conditions and should be developed by wildlife biologists familiar with the region in which this protocol is being used.

Sensitivity: Acknowledges that each proposed development site is unique due to local differences in wildlife concentration and movement patterns, and requires detailed, individual evaluation.

Capable of being integrated into multi-resource credit: Unknown

INVEST

Natural Capital Project

A package of models in an ArcGIS extension that calculates ecosystem services based on land use/land cover and packaged assumptions about service provision by land cover type.

Intended use: Integrated ecosystem services accounting

Able to calculate multi-resource credit: Yes

Sensitivity: Scoring is based on landscape scale data inputs. Not sensitive to direct impacts caused by implementing projects.

Capable of being integrated into multi-resource credit: Unknown

KING COUNTY FUNCTIONAL EQUIVALENCY EVALUATION SYSTEM (KC-FEES)

King County Department of Natural Resources and Parks and Department of Development and Environmental Resources, 2008

Description: A methodology to provide a standardized procedure for assessing the functions provided by wetlands and aquatic areas, the amount those functions are reduced by impacts and the amount of mitigation required to offset the loss.

Intended use: Establishes a system for determining the amount of mitigation needed to offset adverse impacts to wetlands and aquatic areas. The system also is designed to award and deduct credits through the King County Mitigation Reserves Program.

Able to calculate multi-resource credit: Yes

Sensitivity: A standardized procedure at the site level for assessing wetland and aquatic function.

Capable of being integrated into multi-resource credit: Yes

MARYLAND GREEN INFRASTRUCTURE ASSESSMENT
Weber 2003

To help identify and prioritize those areas of greatest statewide ecological importance, as well as those at greatest risk of loss to development. Nominal scale output.

Intended use: Maryland

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MDT MONTANA WETLAND ASSESSMENT METHOD
Berglund 1999

To evaluate wetland function and values. Designed to address highway and other linear projects, but can be applied to other types of projects including mitigation. Nominal and ordinal scale output.

Intended use: Montana wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

METHODS FOR ASSESSING WETLAND FUNCTIONS. VOLUME I: RIVERINE AND DEPRESSIONAL WETLANDS IN THE LOWLANDS OF WESTERN WASHINGTON
Washington State Department of Ecology, 1999

An HGM reference-based assessment restricted to depressional and riverine class wetlands located in Washington's western lowlands.

Intended use: Wetland assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

METHODS FOR ASSESSING WETLAND FUNCTIONS. VOLUME II: DEPRESSIONAL WETLANDS IN THE COLUMBIA BASIN OF EASTERN WASHINGTON
Washington State Department of Ecology, 2000

An HGM reference-based assessment restricted to depressional class wetlands located in Washington's Columbia Basin.

Intended use: Wetland assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

METHODS FOR CHARACTERIZING STREAM HABITAT (NAWQA)
Fitzpatrick et al. 1998

To assess status and trends in water quality nationwide and to develop an understanding of the major factors influencing observed conditions and trends. Descriptive and quantitative output.

Intended use: Nationwide streams

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

METHODS FOR EVALUATING STREAM CONDITIONS
Platts et al. 1983

Platts et al. (1983) presents standard techniques for measuring aquatic, riparian, and biotic attributes and stresses the precision and accuracy of each measurement. In this way, the authors aim to provide the field practitioner with tools and information to build on and evaluate for assessing particular aquatic habitat and biological features. Platts et al. (1987) expands upon Platts et al. (1983) with a "comprehensive set of the latest methods for … use in managing, evaluating, and monitoring riparian conditions…." Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Nationwide

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

METHODS FOR STREAM HABITAT SURVEYS AQUATIC INVENTORIES PROJECT
Oregon Department of Natural Resources

Developed to monitor habitat conditions for Oregon streams

Intended use: Streams and rivers.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

MICHIGAN VALLEY SEGMENT ECOLOGICAL CLASSIFICATION - INVENTORY
Seelbach et al. 1997

Identify and describe naturally occurring, ecologically distinct, spatial units in river. Uses include inventory, research (sampling designs based on stratification of river valley segment types), and basis for resource management. Descriptive output.

Intended use: Lower Michigan. Currently being revised for application for entire states of Michigan, Illinois, and Wisconsin.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MINNESOTA HABITAT AND WATER CHEMISTRY PROTOCOL
Minnesota Pollution Control Agency (MPCA) 2002

To support assessment of water quality and development of biological criteria for Minnesota streams. These procedures are also applicable for USEPA Environmental Monitoring and Assessment Program (EMAP) stations and sites suspected of being impacted by a source of pollution. Descriptive and ordinal scale output.

Intended use: MN wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MINNESOTA ROUTINE ASSESSMENT METHOD (MNRAM)
Minnesota Board of Water and Soil Resources

Wetland functional assessment. Starts with assessment of vegetation then asks 72 questions to develop functional indices.

Intended use: Wetland assessment

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MINNESOTA ROUTINE ASSESSMENT METHOD (MNRAM) (UPDATED VERSION)
Minnesota Board of Water and Soil Resources 2007

The original 1992 version of MnRAM was developed to provide a practical assessment tool that would help local authorities make sound wetland management decisions as they assumed responsibility for regulating wetland impacts. The current version represents a more refined procedure that provides numeric, rather than the original descriptive, ratings. It may be applied to existing wetlands or potential restoration sites. Descriptive and ordinal scale output.

Intended use: Northern Great Plains Prairie Pothole Region wetlands within watershed context including open water bodies and streams

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MONTANA STREAM MITIGATION PROCESS
U.S. Army Corps of Engineers – Omaha

Uses indicators of riparian functions to assign a broader range of trading ratios.

Intended use: Water quality assessment

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

MONTANA WETLAND RAPID ASSESSMENT METHOD
Montana Department of Environmental Quality, 2005

A wetland rapid assessment that looks at ecological integrity (condition) of a wetland.

Intended use: Field-based screening level assessment tool used to help identify and prioritize wetlands within a watershed or region for protection and restoration.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

MULTI-SCALE ASSESSMENT OF WATERSHED INTEGRITY (MAWI)
Smith 2003

To provide a baseline (current condition) assessment of riparian ecosystem integrity at the watershed scale. Once completed the assessment can be used to evaluate potential impacts of future development on riparian areas within a watershed or to help prioritize areas for riparian restoration. Ordinal scale output.

Intended use: Watersheds of California (i.e. watersheds that drain to the Pacific Ocean); Riparian ecosystems and streams, including adjacent upland areas.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

NEW HAMPSHIRE METHOD
Ammann and Stone 1991

To provide a method of wetland evaluation for use by public officials and others who have some familiarity with wetlands, but who are not necessarily wetland specialists. Used for planning, education, and wetland inventory. Ordinal scale output.

Intended use: NH Nontidal wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

NEW JERSEY WATERSHED METHOD
Zampella et al. 1994

GIS-based method for assessing watershed and wetland integrity and the potential impact to this integrity. Created to enable a comparative assessment of all watersheds and wetlands in NJ pinelands. Ordinal scale output.

Intended use: NJ Pinelands; could apply to other riverine wetland types

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

NORTH CAROLINA COASTAL REGION EVALUATION OF WETLAND SIGNIFICANCE (NC CREWS)
Sutter et al. 1999

Designed to predict the relative ecological significance and to assess the level of water quality, wildlife habitat, and hydrologic functions of individual wetlands using a watershed-based model in GIS software. Nominal scale output.

Intended use: NC coastal region wetlands.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

NUMERICAL METHOD FOR EVALUATION OF MAINE PEATLANDS
Davis and Anderson 1999

A quantitative method of evaluation of the natural features of peatlands, providing the fundamental tool for establishing peatland protection priorities. Nominal and ordinal scale output.

Intended use: Maine peatlands

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

NUTRIENT TRADING TOOL (NTT) (POWERED BY THE APEX MODEL)
USDA – Natural Resource Conservation Service

Developed by NRCS to calculate Nitrogen credits. Has expanded to include phosphorous, and can also calculate sediments. It is powered by the APEX model, which is a run-off based model. No field-level data is required. Farmer can input crop types, fertilizer use, irrigation patterns, and BMPs. Future add-ons will include water quantity and carbon calculations.

Intended use: Water quality assessment

Able to calculate multi-resource credit: Yes

Sensitivity: Site-level sensitivity that incorporates condition and management practice.

Capable of being integrated into multi-resource credit: Yes

NUTRIENTNET (POWERED BY EPIC)
World Resources Institute

NutrientNet is a web-based platform customized for each watershed to support nutrient trading. It has a credit calculator, registry, and exchange function. Very similar to Nutrient Trading Tool, but maybe not as powerful.

Intended use: Water quality assessment

Able to calculate multi-resource credit: Yes

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

OHIO RAPID ASSESSMENT METHOD FOR WETLANDS, VERSION 5.0
Ohio EPA, Division of Surface Water, 2001

The Ohio Rapid Assessment Method is designed to aid in the determination of wetland categories as defined in Ohio's Wetland Antidegradation Rule. The use of the Ohio Rapid Assessment Method should not be considered as a substitute, and is not intended to be a substitute, for detailed studies of the functions and biology of a wetland.

Intended use: The method is designed to identify the appropriate level of regulatory protection a particular wetland should receive. It is not designed or intended to be used to determine a particular wetland's ecologic or human value.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

OREGON RAPID WETLANDS ASSESSMENT PROTOCOL (ORWAP)
Adamus (in development)

Being developed as a rapid functional assessment combining visual assessments and collection of spatial data. Considers both wetland functions and conditions.

Intended use: Wetland assessment for regulatory compliance

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes. Currently being integrated into the EcoMetrix method library.

OREGON VERNAL POOL METHOD
Adamus et al. 2007

To provide a technique that (1) assesses 4 major functions and 7 values of vernal pool wetlands, (2) is standardized and rapid (in the sense that the procedure can be completed in one day or less), (3) is well-documented with scientific literature, mainly from Oregon, and (4) can be used to prioritize vernal pool complexes and compare them before and after restoration or impact. Ordinal scale output.

Intended use: OR Individual vernal pools and vernal pool complexes in non-forested lowlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

PFANKUCH CHANNEL STABILITY
Pfankuch 1975

To provide information about the resistance of a channel to erosive forces acting upon its bed and banks and to suggest the capacity of streams to recover from changes in flow or increases in sediment. Nominal and ordinal scale output.

Intended use: U.S. Forest Service Northern Region

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

PHYSICAL HABITAT SIMULATION SYSTEM (PHABSIM)
U.S. Geological Survey

The purpose of (PHABSIM) is to simulate a relationship between streamflow and physical habitat for various life stages of a species of fish or a recreational activity. The basic objective of physical habitat simulation is to obtain a representation of the physical stream so that the stream may be linked, through biological considerations, to the social, political, and economic world.

Intended use: Discharge and habitat assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

PROPER FUNCTIONING CONDITION
Bureau of Land Management

Uses the Ecological Site Inventory results to calculate conditions for riparian areas. There didn't appear to be quantitative, objective, or clear measures attached to this. It is more of a framework. No detail review was conducted.

Intended use: Riparian assessment tool*:*

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

QUALITATIVE HABITAT EVALUATION INDEX (QHEI)
Midwest Biodiversity Institute for Ohio Environmental Protection Agency

To provide a rapid, reproducible measure of stream habitat generally corresponding to the physical stream factors that affect fish communities and other aquatic life. Results in an index (scale 0 to 100), representing an evaluation of a stream's macrohabitat characteristics that are important to fish communities relative to streams within a given watershed or region.

Intended use: Habitat assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

RAPID ASSESSMENT METHOD FOR OREGON TIDAL FRINGE WETLANDS (RAM)
Adamus 2006

To provide a technique that (1) assesses 13 recognized wetland functions and values of tidal marshes, (2) is standardized and rapid (in the sense that the procedure can be completed in one day or less), (3) is well-documented with scientific literature, and (4) can be used to compare tidal wetlands before and after restoration or impact. Ordinal scale output.

Intended use: OR tidal wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

RAPID BIOASSESSMENT PROTOCOLS FOR USE IN STREAMS AND WADEABLE RIVERS: PERIPHYTON, BENTHIC MACROINVERTEBRATES, AND FISH. SECOND EDITION.
U. S. Environmental Protection Agency

Developed to provide "a practical technical reference for conducting cost-effective biological assessments of lotic systems."

Intended use: Rapid assessments of streams and rivers.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

RAPID STREAM ASSESSMENT TECHNIQUE FIELD METHODS (RSAT)
Galli 1996

To provide a simple, rapid reconnaissance-level assessment of stream quality conditions on a watershed scale. Descriptive and ordinal scale output.

Intended use: MD Piedmont non-limestone Piedmont streams with a watershed of approximately 100-150 square miles

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

REMOTE FUNCTIONAL WETLAND ASSESSMENT MODEL (RFWAM)
Stallman et al. 2005

Assess wetlands in the project area in order to categorize them as suitable for conservation, enhancement, or restoration. Nominal and ordinal scale output.

Intended use: Alabama Gulf Shore depressional, riverine, and flat wetlands

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

REMOTELY SENSED INDICATORS FOR MONITORING CONDITION OF NATURAL HABITAT IN WATERSHEDS
Tiner 2004

To characterize and assess trends in the general ecological condition of watersheds using a set of remotely sensed indicators of "natural habitat integrity." Ordinal scale output.

Intended use: Nationwide; all habitats within a watershed

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

RIPARIAN COMMUNITY TYPE CLASSIFICATION OF UTAH AND SOUTHEASTERN IDAHO - INVENTORY
Padgett et al. 1989

Provides a riparian community type classification system for use in the inventory of lands administered by the USDA Forest Service in Utah and southern Idaho. Descriptive output.

Intended use: Utah and SE Idaho riparian communities

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

ROUGE RIVER PROJECT RAPID ASSESSMENT METHOD
Tilton et al. 1997

Provide a regional evaluation of the condition of wetland (river and lake) resources in order to aid in development of a watershed management plan. Nominal scale output.

Intended use: Michigan Rouge River watershed

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

SAVANNAH'S STANDARD OPERATING PROCEDURE: MITIGATION
U.S. Corps of Engineers – Savannah

Uses indicators of wetland functions and stream functions to assign a broader range of trading ratios.

Intended use: Wetlands and surface water assessment

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

SOIL MANAGEMENT ASSESSMENT FRAMEWORK
Andrews et al. 2004

To enhance and extend current soil assessment efforts by presenting a framework for assessing the impact of soil management practices on soil function. Ordinal scale output.

Intended use: Agricultural lands; intended as a national framework, to be modified as necessary for more local use

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

SOUTH AUSTRALIAN BIODIVERSITY ASSESSMENT TOOL (SABAT)
Government of South Australia, Dept. of Water, Land and Biodiversity Conservation

The Biodiversity Significance Index factors three components in to its assessment of biodiversity values: Conservation Significance (CS), Landscape Context (LC), and Habitat Condition (HC). The value of SABAT: Standardized/Objective Indexing Framework, Vegetation Association Benchmarks, Compares Apples with Oranges –in Standardized 'Fruit Units', Provides for Regional/State/larger BSI, Makes Complex Evaluations Simple, Spatial Database – In-Field Operations, Provides 'Condition' Benchmark for Ongoing Monitoring, Allows Roll-up for Regional M&E Framework,

Intended use: Southern Australia: multiple habitat types

Able to calculate multi-resource credit: Yes

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

SOUTHERN CALIFORNIA RIPARIAN ECOSYSTEM ASSESSMENT (SCREAM)
Stein et al. 2004

To assess hydrology, sediment processes, habitat support, and biogeochemistry components of riparian habitat using a watershed-based model in GIS software. Ordinal scale output.

Intended use: Southern CA riparian areas

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

SPATIAL WETLAND ASSESSMENT FOR MANAGEMENT AND PLANNING (SWAMP)
Sutter 2001

To assess the level of water quality, wildlife habitat, and hydrologic functions of individual wetlands using a watershed-based model in GIS software. Nominal scale output.

Intended use: Ashepoo-Combahee-Edisto River Basin, South Carolina tidal and riverine wetlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

STREAM AND RIPARIAN HABITATS RAPID ASSESSMENT PROTOCOL
Starr and McCandless 2001

Provides a comprehensive stream and riparian corridor assessment and inventory protocol for use by trained practitioners to rapidly identify, assess, and prioritize physical stream corridor conditions. Ordinal scale, nominal scale, and quantitative output.

Intended use: Chesapeake Bay stream and riparian habitats

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

STREAM ASSESSMENT IN THE VIRGINIA COASTAL ZONE: DEVELOPMENT OF A SIGNIFICANT NEW DATABASE AND INTERACTIVE ASSESSMENT APPLICATION
Virginia Commonwealth University, 2004

Development of a multivariate model of reference stream conditions for the Virginia Coastal Zone using biological, ecological, and geomorphological variables.

Intended use: Virginia Coastal zone stream assessment

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

STREAM CHANNEL REFERENCE SITES
Harrelson et al. 1994

Provides techniques from numerous published sources for collecting a minimum set of high quality data necessary to quantify the physical character of streams for monitoring, impact assessment, inventory, response to management actions, etc. Descriptive and quantitative output.

Intended use: Nationwide wadeable streams

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

STREAM CORRIDOR ASSESSMENT SURVEY PROTOCOLS (SCA)
Yetman 2001

To rapidly assess the general physical condition of a stream system and identify the location of a variety of common environmental problems within the stream's corridor. Not intended to be a detailed scientific survey, it provides a rapid method of examining an entire drainage network to target future monitoring, management or conservation efforts. One of the main goals is a prioritized list of problems to be corrected throughout an entire watershed. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: MD wadeable streams and rivers

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

STREAM IMPACT ASSESSMENT MANUAL FOR THE NORTHERN VIRGINIA STREAM BANK
Wetland Studies and Solutions, Inc. 2006

The purpose of the Manual is to describe a system whereby the user can rapidly assess the condition of a stream, in a repeatable manner, without specialized equipment or significant training.

Intended use: Intended for use by regulatory agencies and the regulated public utilizing CWA and Virginia Water Protection permits that utilize compensation in the Northern Virginia Stream Bank.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

SUBJECTIVE EVALUATION OF AQUATIC HABITATS
Kansas Dept. of Wildlife and Parks 2004

To provide a rapid holistic evaluation based on subjective assessments of physical, biological, and chemical parameters of the aquatic system. Descriptive, ordinal scale, and nominal scale output.

Intended use: KS Ephemeral, intermittent, or perennial streams and small impoundments or large lakes

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

TECHNIQUE FOR THE FUNCTIONAL ASSESSMENT OF NON-TIDAL WETLANDS IN THE COASTAL PLAIN OF VIRGINIA

Virginia Institute of Marine Science, 1991

A wetland functional assessment based on WET that assesses functions of non-tidal wetlands in the coastal plain of Virginia. Output is a rating system of high, medium, and low relative probability that a wetland has the opportunity to perform and/or be effective at performing a function.

Intended use: To evaluate the relationships among vegetation structure, function, and landscape position. Has been largely phased-out by HGM models.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

TEMPERATURE TRADING PLATFORM

Oregon State University

Tool that allows landowners to draw a reach for riparian shade and estimate the temperature credits created. The tool is powered by a derivative of the Heat Source model rather than the shade-a-lator. Wetted width and some data still needs to be collected in the field, but most runs on spatial GIS layers.

Intended use: Temperature credit calculator

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

UNIFORM MITIGATION ASSESSMENT METHOD (UMAM)

Florida Department of Environmental Protection

A functional assessment for wetlands and surface waters, but also applicable to several terrestrial habitat types. Quantifies gains and losses by developing a multiplier applied to area. Considers landscape support, water environment, and community structure. Also applies factors for time lag for recovery and risk of project failure.

Intended use: Wetland mitigation credit calculations.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

UNIFIED STREAM ASSESSMENT – URBAN SUBWATERSHED RESTORATION MANUAL NO 10

Center for Watershed Protection (Maryland), 2005

The Unified Stream Assessment is a rapid technique to locate and evaluate problems and restoration opportunities within an urban stream corridor in Maryland.

Intended use: Maryland subwatershed restoration planning

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: No

VARIABLES FOR ASSESSING REASONABLE MITIGATION IN NEW TRANSPORTATION (VARMINT)

Vermont Agency of Natural Resources 2004

To provide a framework to lessen and mitigate impacts to terrestrial environments. Nominal and ordinal scale output.

Intended use: Pennsylvania: Habitat not stated but implied that the framework is applicable to most habitats within a project area including, but not limited to shrubland, forest, prairie, wetlands, riparian areas, etc.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

VERMONT STREAM GEOMORPHIC ASSESSMENT PROTOCOL HANDBOOKS

Vermont Agency of Natural Resources, 2003

The Handbooks have a focus on those watershed processes and features critical to its riparian corridor management objectives.

Intended use: The purpose of the assessment protocols is to provide a phased method for gathering information that can be used for watershed planning and detailed characterization of riparian and instream habitat, stream-related erosion, and flood hazards. The information will be used for basin planning; river and riparian corridor protection, management, and restoration projects; aquatic and riparian habitat assessment; and hazard assessment to reduce property loss and damage from riverine erosion during floods.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

VISUAL STREAM ASSESSMENT PROTOCOL

Natural Resources Conservation Service (NRCS)

NRCS has a number of protocols used by field staff to identify baseline farm conditions and to design conservation plans. Most are visual assessments that provide general scores of conditions.

Intended use: Water quality assessment

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WADEABLE STREAM ASSESSMENT FIELD OPS
EPA 2004

Contains the field operations and bioassessment methods for evaluating the health and biological integrity of wadeable freshwater streams throughout the US. These methods can be used to determine stream condition assessment and/or to monitor the effects of impacts on aquatic organisms, particularly benthic macroinvertebrates. Descriptive, ordinal scale, nominal scale, and quantitative output.

Intended use: Nationwide; Wadeable streams (generally stream orders 1-3, or higher orders in arid to semi-arid regions of the U.S.). Intermittent or ephemeral streams can be sampled using the WSA Field Ops protocols, but only when water is present in the channel.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WASHINGTON AQUATIC HABITAT DESIGN GUIDELINES
Saldi-Caromile et al. 2004

To characterize the present (and/or historic) state of habitat and the processes that create and maintain it so that problems and appropriate restoration options and obstacles can be identified and prioritized. No output units?

Intended use: WA; Primarily aquatic habitat in streams, riparian areas, and standing water bodies

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WASHINGTON STATE WETLAND FUNCTION ASSESSMENT PROGRAM (WFAP)
Washington State Department of Ecology

The Wetlands Function Assessment Project was a statewide effort to develop relatively rapid, scientifically acceptable methods of assessing how well wetlands perform functions such as improving water quality, reducing floods, and providing wildlife habitat. The methods were developed for different wetland types in Washington State.

Intended use: Wetland assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

WASHINGTON STATE WETLAND RATING SYSTEM (WESTERN AND EASTERN VERSIONS)
Washington State Department of Ecology, 1993; 2002

Washington's wetland rating system evaluates functions and special characteristics weighted heavily on the opportunity of a wetland to perform a particular function. Also evaluates sensitivity to disturbance, rarity, and inability to replace.

Intended use: Wetland assessment.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

WATERSHED VULNERABILITY ANALYSIS
Zielinski 2002

To identify and classify subwatersheds that are vulnerable to changes in land use based on estimates of current and future impervious cover; and to identify subwatersheds that warrant restoration actions. Descriptive output.

Intended use: Streams within subwatersheds. The model was based on research in the Pacific Northwest and Mid-Atlantic regions. However, supporting data exists for the Northeast, Upper Midwest, and Southeast.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WATERSHED-BASED PRELIMINARY ASSESSMENT OF WETLAND FUNCTIONS (W-PAWF)
Tiner 2003

To provide a preliminary assessment of wetland functions based on enhanced National Wetlands Inventory digital data. The assessment uses a combination of wetland classifications, specifically the U.S. Fish & Wildlife Service's official system (Cowardin et al. 1979) and the classification system to enhance the NWI by adding LLWW descriptors for landscape position, landform, water flow path, and waterbody type (Tiner 2003a). Descriptive and nominal scale output.

Intended use: Wetlands and deepwater habitats of the United States, but the emphasis for functional assessment is on wetlands including shallow open waterbodies such as ponds. Developed for all regions of the United States; however, the correlations focus on the Northeastern U.S.

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WETLAND EVALUATION TECHNIQUE (WET)
Adamus et al. 1987

WET is an initial, rapid assessment of wetland functions, designed to assess the qualitative probability that a wetland function will occur. WET has been superseded by more rigorous reference-based, regionally specific methods recently developed.

Intended use: Wetland consultants.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

WETLAND VALUE ASSESSMENT METHODOLOGY (WVA)
Environmental Work Group 2002

Estimates wetland benefits of proposed wetland restoration projects submitted for funding under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The application in the plan formulation process is described in USGS (2006). Ordinal scale output.

Intended use: Louisiana coast marshlands

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WILDLIFE HABITAT APPRAISAL PROCEDURE (WHAP)
Frye 1995

To allow a qualitative holistic evaluation of wildlife habitat for particular tracts of land statewide (Texas) without imposing significant time requirements. WHAP is intended to be used for (a) evaluating impacts upon wildlife populations from development project alternatives, (b) establishing baseline conditions, (c) comparing tracts of land which are candidates for land acquisition or mitigation, and (d) evaluating general habitat quality and wildlife management potential for tracts of land over large geographical areas. Ordinal scale output.

Intended use: Texas; based on list of habitat classes; seems to represent all upland and wetland habitat in Texas (e.g., swamp, cultivated wetlands, water including ponds, and water treatment facilities, urban areas, dunes, beach).

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

WISCONSIN RAPID ASSESSMENT METHODOLOGY FOR EVALUATING WETLAND FUNCTIONAL VALUES
Wisconsin Department of Natural Resources, 1992

A wetland functional assessment to evaluate and provide a measure of wetland function.

Intended use: For use with making routine Section 404 permit applications decisions.

Able to calculate multi-resource credit: No

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Yes

WISCONSIN WETLAND ASSESSMENT METHODOLOGY (WIRAM)
Wisconsin Department of Natural Resources 2001

To provide a standardized process for the professional to evaluate the extent to which a specific wetland performs a given function. Descriptive output.

Intended use: WI wetlands

Able to calculate multi-resource credit: Unknown

Sensitivity: Unknown

Capable of being integrated into multi-resource credit: Unknown

Summary Overview

Method	Intended Use	Multi-Resource Credit	Integrate into Multi-Resource
Applied River Morphology Method	River classification	No	Unknown
Artificial Intelligence for Ecosystem Services (AIRES)	Decision support system	Unknown	Unknown
Basinwide Visual Estimation Technique (BVET)	Fish abundance and habitat estimation	No	Unknown
Beneficial Use Reconnaissance Program (BURP) Field Manual for Streams	Stream assessment	Unknown	Unknown
BushBroker	Native vegetation offset credit trading	No	Unknown
BushTender Program	Native vegetation credit trading	Possible	Unknown
Business and Biodiversity Offset Program (BBOP)	Development of offset BMPs	No	Unknown
California Carbon Project Protocols	Carbon credit calculator	Unknown	Unknown
California Rapid Assessment Method (CRAM)	Wetland assessment	No	Yes
Casco Bay Watershed Wetlands Characterization Method	Wetland assessment	No	Unknown
City Green	Integrated ecosystem services assessment	Unknown	Unknown
Combined Habitat Assessment Procedure (CHAP)	Integrated ecosystem services accounting	Yes	Yes
Connecticut Method	Wetland assessment	No	Unknown
Delaware Rapid Assessment	Wetland assessment	No	Unknown
Descriptive Approach (Highway Methodology)	Wetland assessment	No	Unknown
Developing Rapid Methods for Analyzing Upland Riparian Functions and Values	Riparian (upland) assessment	No	Yes
Development of a Floristic Quality Assessment Methodology for Wisconsin	Floristic quality assessment	No	Yes
Eastern Kentucky Stream Assessment Protocol (eKY)	Stream assessment	Yes	Unknown
Ecological Site Inventory	Qualitative tool	No	Unknown
EcoMetrix	Integrated ecosystem services accounting	Yes	Yes
Ecosystem Diagnosis and Treatment Model	Stream assessment	No	Yes
Ecosystem Valuation Methods	Integrated ecosystem services accounting	Unlikely	Unknown
Environmental Monitoring and Assessment Protocols (EMAP)	Assessment tools	Unknown	Unknown
Envision	Water quality assessment	Unknown	Unknown
EPA Oregon Stream Methodology	Water quality assessment	No	No
EPA Region 10 In-Stream Biological Monitoring Handbook	Stream assessment	Unknown	Unknown
Evaluation for Planned Wetlands (EPW)	Wetland assessment	No	Unknown

Method	Intended Use	Multi-Resource Credit	Integrate into Multi-Resource
Fairfax County Stream Physical Assessment Protocols	Stream assessment	No	Unknown
Field Manual for Ohio's Headwater Habitat Streams	Water quality assessment	No	Unknown
Fire Regime Condition Class	Vegetation assessment	No	Unknown
Florida Wetland Quality Index	Wetland assessment	No	Yes
Florida Wetland Rapid Assessment Procedure	Wetland assessment	No	Yes
Floristic Quality Assessment Index (FQAI)	Vegetation assessment	No	Unknown
Freshwater Wetland Mitigation Quality Assessment Procedure	Wetland assessment	No	Yes
Gravel Bed Instream Flows	Stream assessment	No	Unknown
Guidance for Rating the Values of Wetlands in North Carolina	Wetland assessment	No	Yes
Guidebook for Hydrogeomorphic (HGM)-based Assessment of Oregon Wetland and Riparian Sites – Willamette Valley Riverine Impounding and Slopes/Flats Subclasses	Wetland assessment	No	Yes
Guidelines for Evaluating Fish Habitat in Wisconsin	Stream habitat assessment	No	Unknown
Habitat Assessment Model	Terrestrial habitat assessment	No	Unknown
Habitat Equivalency Analysis (HEA)	Integrated ecosystem services accounting	No credits	Unknown
Habitat Evaluation Procedure (HEP)	Habitat assessment	No	Unknown
Hawaii Stream Bioassessment	Stream assessment	No	Unknown
Heat Source Model	Water quality assessment	Yes	Unknown
Hydrogeomorphic Method (HGM)	Wetland assessment	No	Yes
Idaho Small Stream Assessment	Stream assessment	No	Unknown
Index of Biological Integrity (IBI) – Birds, Fish, Invertebrates, and Plants	Habitat assessment	Yes	Unknown
Index of Marsh Bird Community Integrity	Habitat and wetland assessment	No	Unknown
Instream Flow Incremental Methodology (IFIM)	Stream assessment	No	Unknown
Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines – Potential Impact Index (PII)	Site evaluation	Yes	Unknown
InVEST	Integrated ecosystem services accounting	Yes	Unknown
King County Functional Equivalency Assessment System (KC-FEES)	Wetland and aquatic assessment and credit calculator	Yes	Yes
Maryland Green Infrastructure Assessment	Habitat assessment	No	Unknown
MDT Montana Wetland Assessment Method	Wetland assessment	No	Unknown
Methods for Assessing Wetland Functions. Volume I: Riverine and Depressional Wetlands in the Lowlands of Western Washington	Wetland assessment	No	Yes

Method	Intended Use	Multi-Resource Credit	Integrate into Multi-Resource
Methods for Assessing Wetland Functions. Volume II: Depressional Wetlands in the Columbia Basin of Eastern Washington	Wetland assessment	No	Yes
Methods for Characterizing Stream Habitat (NAWQA)	Stream assessment	No	Unknown
Methods for Evaluating Stream Conditions	Stream assessment	No	Unknown
Methods for Stream Habitat Surveys, Aquatic Inventories Project, ODFW	Stream assessment	No	Yes
Michigan Valley Segment Ecological Classification – Inventory	Stream assessment	No	Unknown
Minnesota Habitat and Water Chemistry Protocol	Water quality assessment	No	Unknown
Minnesota Routine Assessment Method (MnRAM)	Wetland assessment	Unknown	Unknown
Montana Stream Mitigation Process	Water quality assessment	Unknown	Unknown
Montana Wetland Rapid Assessment Method	Wetland assessment	No	Yes
Multi-Scale Assessment of Watershed Integrity (MAWI)	Ecosystem integrity	No	Unknown
New Hampshire Method	Wetland assessment	No	Unknown
New Jersey Watershed Method	Wetland assessment	Unknown	Unknown
North Carolina Coastal Region Evaluation of Wetland Significance (NC CREWS)	Wetland assessment	Unknown	Unknown
Numerical Method for Evaluation of Maine Peatlands	Peatland assessment	Unknown	Unknown
Nutrient Trading Tool (NTT)	Water quality assessment	Yes	Yes
NutrientNet	Water quality assessment	Yes	Unknown
Ohio Rapid Assessment Method for Wetlands, Version 5.0	Wetland assessment	No	Yes
Oregon Rapid Wetlands Assessment Protocol (ORWAP)	Wetland assessment	No	Yes
Oregon Vernal Pool Method	Wetland assessment	No	Unknown
Pfankuch Channel Stability	Stream assessment	No	Unknown
Physical Habitat Simulation System (PHABSIM)	Discharge and habitat assessment	No	Yes
Proper Functioning Condition	Riparian assessment	No	Unknown
Qualitative Habitat Evaluation Index (QHEI)	Habitat assessment	No	Yes
Rapid Assessment Method for Oregon Tidal Fringe Wetlands (RAM)	Wetland assessment	No	Yes
Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish.	Stream and river Assessment	No	Yes
Rapid Stream Assessment Technique Field Methods (RSAT)	Stream assessment	No	Unknown
Remote Functional Wetland Assessment Model (RFWAM)	Wetland assessment	Unknown	Unknown

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Remotely Sensed Indicators for Monitoring Condition of Natural Habitat in Watersheds	Habitat assessment	No	Unknown
Riparian Community Type Classification of Utah and Southeastern Idaho – Inventory	Riparian community classification	No	Unknown
Rouge River Project Rapid Assessment Method	Wetland assessment	No	Unknown
Savannah's Standard Operating Procedure – Mitigation	Wetlands and water assessment	Unknown	Unknown
Soil Management Assessment Framework	Soil assessment	No	Unknown
South Australian Biodiversity Assessment Tool (SABAT)	Habitat assessment	Yes	Unknown
Southern California Riparian Ecosystem Assessment (SCREAM)	Riparian habitat assessment	Unknown	Unknown
Spatial Wetland Assessment for Management and Planning (SWAMP)	Water quality, habitat, and hydrologic function assessment	No	Unknown
Stream and Riparian Habitats Rapid Assessment Protocol	Stream and riparian habitat assessment	No	Unknown
Stream Assessment in the Virginia Coastal Zone: Development of a Significant New Database and Interactive Assessment Application	Stream assessment	No	Yes
Stream Channel Reference Sites	Stream assessment	No	Unknown
Stream Corridor Assessment Survey Protocols (SCA)	Stream assessment	Unknown	Unknown
Stream Impact Assessment Manual for the Northern Virginia Stream Bank	Stream assessment	No	Yes
Subjective Evaluation of Aquatic Habitats	Aquatic habitat assessment	No	Unknown
Technique for the Functional Assessment of Non-Tidal Wetlands in the Coastal Plain of Virginia	Wetland assessment	No	Yes
Temperature Trading Platform	Temperature credit calculator	No	Unknown
Unified Stream Assessment – Urban Subwatershed Restoration Manual No. 10	Subwatershed restoration planning	Unknown	Unknown
Uniform Mitigation Assessment Method (UMAM)	Wetland and surface water assessment	No	No
Variables for Assessing Reasonable Mitigation in New Transportation (VARMINT)	Habitat assessment	No	Unknown
Vermont Stream Geomorphic Assessment Protocol Handbooks	Stream assessment	No	Yes
Visual Stream Assessment Protocol	Water quality assessment	Unknown	Unknown
Wadeable Stream Assessment Field Ops	Stream assessment	No	Unknown
Washington Aquatic Habitat Design Guidelines	Aquatic habitat assessment	No	Unknown
Washington State Methods for Assessing Wetland Functions (WFAP)	Wetland assessment	No	Yes
Washington State Wetland Rating System (Western and Eastern versions)	Wetland assessment	No	Yes

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Watershed Vulnerability Analysis	Stream assessment	No	Unknown
Watershed-Based Preliminary Assessment of Wetland Functions (W-PAWF)	Wetland assessment	Unknown	Unknown
Wetland Evaluation Technique (WET)	Wetland assessment	No	Yes
Wetland Value Assessment Methodology (WVA)	Wetland assessment	No	Unknown
Wildlife Habitat Appraisal Procedure (WHAP)	Upland and wetland habitat assessment	No	Unknown
Wisconsin Rapid Assessment Methodology for Evaluating Wetland Functional Values	Wetland assessment	No	Yes
Wisconsin Wetland Assessment Methodology (WIRAM)	Wetland assessment	Unknown	Unknown