Editor's Note: The SAB Staff Office received the text below on April 24, 2007. The lead author asks Committee members to review this text instead of the text provided in Part 2 Section 7 of the 4/22/07 draft for the May 1-2 C-VPESS Meeting

7. VALUATION IN REGIONAL PARTNERSHIPS

7.1. EPA Role in Regional-scale Analysis of the Value of Ecosystems and Services

Many important ecological processes take place at a landscape scale, making regional analysis an appropriate scale at which to analyze the value of ecosystems and services. For example, understanding habitat connectivity on landscapes, water and nutrient flows through watersheds, or patterns of exposure and deposition from air pollution in an airshed, require regional-scale analysis. There has been a vast increase in publicly available spatially-explicit data on environmental, economic and social variables. There has been a parallel expansion in the ability to display data visually in maps, and to analyze spatially-explicit data using a variety of analytical models and statistical methods. The increase in data and methods has opened up new frontiers for regional-scale analysis of ecosystem and services. There is an active EPA extra-mural research program under way for regional-scale analysis of ecosystems and services. For example, EPA has funded research on restoring water infiltration in urbanizing watersheds in Madison, Wisconsin, restoring multiple ecosystem functions for the Willamette River, Oregon, decision support tools to meet human and ecological needs in rivers in New England, and research examining multiple services from agricultural landscapes in the upper Midwest. Great potential exists, largely untapped to date, to use this type of analysis to aid regional decision-making.

Many important decisions affecting ecosystems and the provision of ecosystem services are taken at a regional scale by municipal, county, regional and state governments. Examples of important regional-scale decisions affecting ecosystems and ecosystem services include land-use planning and watershed management. Local and state governments rarely have the technical capacity, or the necessary resources, to

undertake regional-scale analyses of the value of ecosystems or services, or to incorporate the value of ecosystems or services into their decision-making processes.

Regional partnerships offer the potential for expanding local, state and EPA capacity to value ecosystems and services. EPA regional offices have many opportunities to partner at a regional scale with local and state governments, regional offices of other federal agencies, environmental non-governmental organizations and private industry. By partnering with local government, other federal agencies, and the private sector, EPA benefits by engaging important local stakeholders, gaining access to regional expertise, and gaining access to decision-making on important regional-scale environmental decisions. Local public and private partners benefit from access to EPA technical expertise and resources. Such partnerships can improve the knowledge-base for decision-making and improve the analysis of the value of ecosystems and services.

Unlike national rulemaking, where analysis is often constrained by specific mandates, there is great latitude available at the regional level to experiment with novel approaches to valuing ecosystems and services. Such experimentation may lead to improved methods and practices with potential benefits well beyond the region in which they are pioneered. The downside of not having legal or statutory requirements for EPA to engage in regional partnerships or to undertake valuation of ecosystems or services at the regional scale, is that EPA regional offices with limited resources and with a long list of mandated activities, may have little time or resources to undertake such activities with local partners. In addition, there may be limited expertise in regional offices for undertaking at least some of the crucial steps that the Committee recommends in carrying out valuation of ecosystems or services. For example, few regional offices have economists on staff that can work on valuation exercises. Many of the potential benefits of regional partnerships for valuing ecosystems or services at a regional level have not been realized to date.

In analyzing the opportunities for regional partnerships, a C-VPESS subcommittee found it useful to explore several case studies that illustrate some potential approaches to regional partnerships and regional-scale analysis of ecosystems and services, including cases from Chicago, Portland, Oregon, and the Southeast Region. The

subcommittee studied the example of Chicago Wilderness, a regional partnership involving EPA Region 5 and numerous local public and private partners, in greater depth. The subcommittee met at EPA Region 5 Headquarters in Chicago on April 28, 2006 with members of the partnership. The case studies included in this section are not meant to be a comprehensive summary of the many regional-scale analyses undertaken by regional office of EPA that relate to the value of ecosystems and services. Rather, they provide specific examples of approaches and issues likely to occur in doing regional-scale analysis. In what follows, details about the case studies are used to illustrate several general lessons about regional-scale analysis of the value of ecosystems and services and the potential benefits of regional partnerships.

7.2. Case Studies: Chicago Wilderness

Chicago Wilderness is an alliance of more than 180 public and private organizations. Chicago Wilderness represents a bottom-up organization that reflects the views of its member organizations. No single decision-maker or agency controls or guides Chicago Wilderness. Chicago Wilderness pursues objectives, as defined by its members, through consensus. .The member organizations Chicago Wilderness are brought together by a common interest in the environment of the Chicago metropolitan area. They have agreed to have as their common goal within Chicago Wilderness "to restore the region's natural communities to long term viability, enrich local residents' quality of life, and contribute to the preservation of global biodiversity." Chicago Wilderness is pursuing its goals by attempting to create "green infrastructure" that will support biodiversity, and maintain ecosystems and services linked to quality of life in the Chicago metropolitan area.

As a member of the Chicago Wilderness, EPA Region 5 provides technical and financial assistance, and facilitates the partnership. EPA expertise in Region 5, particularly in natural sciences, has contributed to quantifying ecosystem services and understanding how potential stresses affect ecosystems and the provision of services. The partnership has produced several reports, including its Biodiversity Recovery Plan and a green infrastructure map for the region. It has an active website for ongoing outreach activities (see Table 7 for references and full listing).

Table 9: Status of Valuation Work for Chicago Wilderness and Chronology of Valuation Effort

Decision/document	Date	Source/URL
Biodiversity Recovery Plan	1999 (Award from APA in 2001 for best plan)	http://www.chicagowilderness.org/pubprod/brp/index.cfm Executive summary available at http://www.chicagowilderness.org/pubprod/brppdf/CWBRP_chapter1.pdf
Chicago Wilderness Green Infrastructure Vision	Final report, March 2004	http://www.nipc.org/environment/sustainable/biodiversity/greeninfrastructure/Green%20Infrastructure%20Vision%20Final%20Report.pdf
Green Infrastructure Mapping		http://www.greenmapping.org/
A Strategic Plan for the Chicago Wilderness Consortium (See attachment 1 for Introduction)	17 March 2005	http://yosemite.epa.gov/SAB/sabcvpess.nsf/06347c93513b181385256dbf00541478/72c1b26a9d2087568525713f005832e1!OpenDocument
Chicago Wilderness Regional Monitoring Workshop Final report, by Geoffrey Levin	February, 2005	http://yosemite.epa.gov/SAB/sabcvpess.nsf/06347c93513b181385256dbf00541478/8c33ee9115d706e68525713f005784e6!OpenDocument
Center for Neighborhood Technology (CNT) – green infrastructure valuation calculator	2006 (?)	http://greenvalues.cnt.org/calculator

The web page for the Chicago Wilderness (http://www.chicagowilderness.org/) contains a more complete chronology and links to many of these relevant documents, including the Biodiversity Recovery Plan.

Technical expertise and practical experience in valuing the protection of

ecological systems and services is limited among members of Chicago Wilderness. There is also limited capacity in Region 5 to undertake economic analysis of the value ecosystem services. There is no specific legal authority that mandates that certain analyses related to valuing ecosystems or services be undertaken as part of the work of Chicago Wilderness. Though not required, quantifying values associated with the conservation of greenspace and biodiversity could be helpful for Chicago Wilderness in meeting its own stated objectives and in communicating its analysis with other groups and the general public. Chicago Wilderness is interested in the valuation of ecosystems and services, but has only begun to explore the opportunities for carrying out and incorporating such valuation in its activities. Among the possible uses of additional valuation tools identified by Chicago Wilderness members, including EPA Region 5, are:

- To inform decisions on where to establish green infrastructure and establish priorities for acquisition of land, for example by forest preserve districts and soil conservation districts;
- To assess the value of preserving ground water and other ecosystem services related to clean water;
- To assess the relative value of investing in different research projects to establish priorities for funding decisions;
- To assess the relative value of conventional versus alternative development efforts and to demonstrate conditions where development decisions that have positive impacts on the environment might be in the financial interest of the developer;
- To effectively communicate with residents of the Chicago region the value of green infrastructure and biodiversity and how these are related to quality of life for area residents.

In sum, Chicago Wilderness, like many regional partnerships, would benefit from the ability to analyze the value of ecosystems and services, but is constrained by lack of expertise and resources in doing so.

1.2.1 An Example of How Valuation Could Support Regional Decision-Making: Open-

Space Preservation in the Chicago Metropolitan Area

Valuation of ecosystems and services is often most useful when done in the context of specific decisions contexts affecting the environment. The Subcommittee chose a specific decision context, county open space referenda in the Chicago Metropolitan area, to explore how the C-VPESS approach to valuation could be useful to support regional decisions.

Voters in four counties in northeastern Illinois passed referenda authorizing bonds for land purchase for open space preservation or watershed protection. In November 1997, voters in DuPage County passed an open space bond for $70 million. In November 1999, voters in Kane County and Will Counties passed bond issues of $70 million in each county for open space acquisition or improvement. The voters in McHenry County passed a $50 million bond for watershed protection. While these multi-million dollar bond proposals put a substantial amount of money into efforts to preserve open space and ecological processes in the region, they are insufficient to provide adequate protection for all worthwhile open space or watershed protection projects. Given this, input about what lands should be purchased, or what management actions should be undertaken to maintain or restore natural communities would help to ensure that these funds were invested wisely.

For purposes of this exercise, three types of values from protecting natural systems potentially relevant to the open-space and watershed protection will be examined: a) species and ecological systems conservation, b) water quality and quantity, and c) recreation and amenities. The water quality and quantity discussion will focus on McHenry County because the bond issue there was explicitly directed towards watershed protection. We follow the process outline in Part 1 of this report. The following sections describe: a) the process of stakeholder involvement and input into defining values of ecosystems and services of interest, b) predicting ecological impacts in terms of changes in ecosystem services, and c) using methods to assess and characterize the values of ecosystems and services.

1.2.2 Process of Stakeholder Involvement, Scientific and Technical Input, and Public Participation

Several of the themes from Part 1 of this report are reflected in the planning documents and activities of the Chicago Wilderness, including interdisciplinary collaboration, broad involvement. Chicago Wilderness consists of over 180 members, including local, state and regional governments. Partnership and participation are included as goals and operating principles. The Chicago Wilderness Biodiversity Recovery Plan (BRP) (see Table 7) discusses specific roles for private property owners, local, state and regional governments, intergovernmental agencies, and federal agencies. Actions of EPA that affect biodiversity and its role in Chicago Wilderness are also highlighted in this document. The inclusive planning process endorsed by Chicago Wilderness includes developing a common statement of purpose, setting up three working groups (steering, technical, and advisory committees), and working through nine planning steps, from visioning, development of inventories, assessment of alternative actions, to adopting a plan.

Chicago Wilderness conducted workshops and meetings, to define implementation strategies and to prioritize among its long- and short-term goals, which focus on the restoration and conservation of biodiversity broadly construed. For priority-setting, several of the workshops included non-monetary valuation exercises with qualitative rankings of importance. The BRP also references other measures, for example the Nature Conservancy's global rarity index, and polls (e.g., "According to a 1996 poll, only two out of ten Americans had heard of the term "biological diversity." Yet, when the concept was explained, 87% indicated that "maintaining biodiversity was important to them" (Belden and Russonello1996)." BRP, p. 117). Chicago Wilderness also carried out eight workshops to assess the status and conservation needs with regard to natural communities in the area: four species addressing birds, mammals, reptiles and amphibians, and invertebrates, and four (consensus-building) workshops on natural communities addressing forest, savanna, prairie, and wetland. The natural communities workshops developed overall relative rankings based on the amount of area remaining, the amount protected, and the quality of remaining areas that incorporated fragmentation

and current management. The workshops also assessed relative biological importance" for community types, based on "species richness, numbers of endangered and threatened species, levels of species conservatism, and presence of important ecological functions (such as the role of wetlands in improving water quality in adjacent open waters)" (BRP Chapter 4, p. 41), and identified visions of what the areas should look like in 50 years. The workshop participants judged the data as insufficient to allow quantitative assessment of natural communities.

Two different groups of scientists and land managers identified a classification scheme for aquatic communities, based on physical characteristics. Streams were assigned recovery goals (protection, restoration, rehabilitation, and enhancement) or and lakes assigned priorities (exceptional, important, restorable, and other; based on Garrison 1994-95) in this effort. Streams were assessed using the index of biotic integrity (IBI), species or features of concern, the Macroinvertebrate Biotic Index (MBI), and abiotic indicators. The workshops also assessed threats and stressors to streams, lakes and near-shore waters of Lake Michigan.

Fostering public support through education and outreach is also an explicit goal of Chicago Wilderness. Working with schools (including universities) is emphasized, but Chicago Wilderness also identifies individuals, agencies and organizations as targets for outreach and involvement.

Chicago Wilderness provides an excellent example of an organization that has made extensive efforts to engage the local community in figuring out what are the most important features of ecosystems and services in the region, according to people who live there. Two of the great strengths of Chicago Wilderness are the broad range of groups included and the commitment to open processes that allow community input and involvement. This process allows the participants themselves to define the objectives, goals and priorities of the organization. As a result of the open and democratic process and the extensive efforts to include multiple views and voices, its goals and objectives are largely reflective of what people in the region view as important to conserve in their region. The strengths, however, also highlight some of the difficulties involved. Different individuals and different member groups define value differently. Some groups care more about restoring pre-settlement ecosystem conditions, others are primarily motivated by issues of open space and recreation, while the primary objective of others is

to maintain water quality or conserve the region's biodiversity. Because Chicago Wilderness is an organization based on consensus, they often cannot make choices involving tradeoffs between worthwhile objectives. It is easy to say that protecting biodiversity, protecting water quality, and providing open space and recreational opportunities are all good things. It is hard to say how to choose when doing more of conflicts with getting more of another goal. The inability to make tradeoffs among objectives limits their ability to make policy recommendations or have an influence on decision-making. In addition, the process of involvement and input is time consuming so that Chicago Wilderness is not well-placed to make rapid analyses or provide feedback on decisions that occur over a short time period.

1.2.3 Landscape Level Analysis of Ecosystems and Services

7.2.1 Species Conservation and Ecological Systems Conservation.

7.2.2 Methods developed by NatureServe for identification and prioritization of conservation actions through spatial representation and analysis of biodiversity and conservation values have been applied across multiple scales and geographies. The application of the method results in spatial representation of the uniqueness and irreplaceability of biological and ecological diversity in a regional context. The methods support planning efforts to sustain biodiversity, ecological integrity and ecological services to identify best opportunities to meet stakeholder goals. The approach is based on principles of conservation science, strives for complete transparency, and can provide solutions that reflect different stakeholder values.

The key steps in applying the method are as follows:

1. Involve stakeholder to identify the biological, ecological and ecosystem service targets of interest
2. Define standards that represent a viable occurrence for each target, and for valuing the relative quality of each of these occurrences.
3. Define standards for measuring the conservation status of each target.
4. Create a "conservation value layer" for each target that represents the conservation status of the element and the viability/service value of each

occurrence.

5. Create a "conservation value summary" that represents the composite values of all conservation targets.
6. Map current land uses, policies, threats, economic values, and compatibilities across the project landscape.
7. Analyze spatial solutions that address stakeholder goals and provide a clear delineation of priority actions.

Chicago Wilderness has generally followed the approach described above to identify biodiversity and conservation values. The conservation targets that the Chicago Wilderness has identified are described in detail in its Biodiversity Recovery Plan.

Water Quality and Quantity.

Water quality and quantity figure prominently in many ecological processes and in the provision of many ecosystem services. Text Box 8 describes possible ecological impacts and impacts on the provision of ecosystem services that are possible from the protection or restoration of watersheds. In some instances, Chicago Wilderness and its member organization have conducted prior studies making it possible to identify site-specific ecological characteristics important to considerations of ecosystems and services.

Text Box 1: Possible Ecological Impacts and Provision of Services from the Protection or Restoration of Watersheds Based on the Work of Chicago Wilderness

Surface water

- Availability—more water will be retained in the watershed because there is less runoff from impervious surfaces
- Periodicity of flows—changes in the hydrograph are mitigated because precipitation will be captured in the soil and vegetation, and subsequently released more slowly
- Maintenance of minimum flows—there is a greater chance of maintaining adequate minimum flows because of the dampening effects of intact

watersheds and continuation of subsurface flows.

- Flooding—flooding in reduced because of the retention capabilities of the intact watershed

Subsurface water

- Availability for domestic and industrial use—will be increased because percolation and subsurface recharge will be enhance by natural soil surface and vegetation
- Maintenance of wetlands—those habitats that depend on the water table or subsurface flow will be enhanced because natural percolation and recharge processes will be maintained

Biological systems that depend upon water quantity

- Special status species—increased persistence of those habitats that depend on increased quantities of water in the watershed and containing protected species
- Specific habitats—increased water quantity and more uniform stream flows will support regionally important ecological communities, e.g., in-stream communities, bottomland forests, wetlands and wet prairies

Effect on water quality

- Pollution dilution—increased flows will dilute concentrations of organic and inorganic pollutants
- Assimilation of biotic pollutants—increased stream flows will permit greater opportunity for the assimilation of biological materials

For purposes of the following discussion, suppose that both stakeholders and experts decided that the most important ecological services to be used in comparing watersheds within the county were: a) minimizing flooding, b) maintaining or increasing groundwater recharge, and c) maintaining or increasing wetland communities. In reality, the most important ecological services related to water would be determined by the stakeholder involvement and input process discussed above in section 1.2.2.

Minimize flooding: The GIS database collected by Chicago Wilderness includes

layers depicting rivers, streams, wetlands, forest lands, and floodplains. As a first approximation, historical records of flooding in McHenry County watersheds could be examined. Those watersheds with the greatest flooding could be identified. The analysis could then evaluate the potential for restoring floodplain forests and wetlands for mitigating flooding.

Maintain or increase groundwater recharge: The GIS database includes maps of aquifers and soils maps that described run-off and percolation rates for each soil type. Watersheds could be compared in terms of potential for aquifer recharge. The analysis could then consider the effects of alternative land use decisions on recharge (Arnold and Friedel, 2000).

Maintain or increase wetland communities: Using topographic maps and GIS data on rivers, streams, floodplains, forests, wetlands and land cover, watersheds within McHenry County could be ranked in terms of potential wetlands minus current wetlands. The areas within watersheds with the potential for expanding existing wetlands or restoring wetlands could be measured.

There are a number of GIS data files available from McHenry County that can assist understanding how protecting a given part of a watershed contributes to ecosystem processes and services What is often lacking, however, is a cause and effect relationship that can be used to predict how provision of an ecosystem services will change with changes in management or policy. It may be possible to transfer results from studies of ecological services from other regions. For example, Guo et al. (2000) measured the water flow regulation provided by various forest habitats in a Chinese watershed. If these relationships are transferable, then estimates of the effect of a policy of restoring forest habitat on water flow could be generated. Changes in water flow could then be used to predict impacts on aquatic organisms including game fish production, on wetland and their consequent production functions such as waterfowl, fisheries, wildlife viewing, etc. (Kremen, 2005).

Recreation and amenities.

The third set of values that we include in this example are recreational and

amenity values. Unlike biodiversity conservation and water quality and quantity issues, recreation and amenities do not have a large technical or natural science component to them. It is useful to map locations of recreational facilities and of features related to amenities. However, there is not a modeling component similar to what is necessary for biodiversity conservation or water quality/quantity. The most important steps for recreation and amenities come at the first stage, getting community input on what is important, and the next stage on attempts to measure values.

Summary.

Chicago Wilderness has done an admirable job of collecting spatially-explicit information relevant to land use, open space, recreation, biodiversity conservation, and water quality and quantity issues. However, for this information to be relevant to decisions that affect ecosystem, cause-and-effect relationships that can predict how policies choices would affect ecosystems and the provision of services are needed. Chicago Wilderness often has fallen short on this score. In other words, Chicago Wilderness does not have the kind of information at its disposal that would allow it to estimate ecological production functions. Chicago Wilderness can be quite effective in providing descriptive information, particularly in the form of maps, but will be limited in the ability to analyze alternative policies and make recommendations about which alternatives are preferable. For example, to invest the $50 million approved by voters for watershed protection in McHenry County in a way that will maximize the value of ecosystems and services, a decision-maker needs to know how taking particular actions affect ecosystems and the provision of services that people in the region have identified as important.

Gathering the necessary technical and scientific expertise to predict how policy choices will affect ecosystems and the provision of services is a difficult task and one that introduces another potential problem. The experts best placed to provide evidence may be tempted to substitute their values on what is important for those of the stakeholders and community that ideally set the objectives for the organization. For example, defining the levels at which targets can be considered as being met for conserving biodiversity

involves judgment. Different judgments used in models may give rise to different sets of recommendations. Making sure that the results of the analysis reflect the values of the community rather than the values of the expert requires honest communication as well as commitment on the part of experts to faithfully carry out the stated desires of the community.

When there are tradeoffs among different services, habitat protection versus improvements in water quality for example, then information about the value of various aspects of ecosystems and services is necessary in order to inform decision-makers about what alternatives are more beneficial for the community. This requires information about relative values that goes beyond understanding the ecological impacts of management and policy alternatives.

1.2.4 Valuation of Changes in Ecosystems and Services in Monetary and Non-Monetary Terms

As noted in other parts of this report, there are many different ways to approach valuation of ecosystems and services. This section begins with a discussion of the potential contributions that valuation could make for Chicago Wilderness and is followed by brief reviews of possible valuation methods that could be applied. The discussion of possible valuation methods goes well beyond what Chicago Wilderness has actually done in the valuation realm. Chicago Wilderness has conducted very few valuation studies to date and largely lacks the resources and the expertise to do so.

The Role of Valuation.

The primary goal of Chicago Wilderness "is to protect the natural communities of the Chicago region and to restore them to long-term viability." As noted above, this goal was derived with active input from member organizations and represents a consensus view of their values. In some sense, the important valuation exercises for Chicago Wilderness were carried out at the first stage where Chicago Wilderness engaged the community and gathered feedback on what it felt was important. This process resulted in an important statement about the values held by the collection of organizations that

constitute Chicago Wilderness. Given this understanding and the clear statement of the main goal of the organization, it may be argued that formal valuation studies that try to quantify the monetary value of alternatives are of secondary importance. Of primary importance is to understand how various potential strategies contribute to the protection and restoration of natural communities, or to the provision of ecosystem services. The primary goal could be accomplished with methods developed by NatureServe for identification and prioritization of conservation actions through spatial representation and analysis of biodiversity and conservation values, as discussed above. Chicago Wilderness has, in fact, devoted most of its attention to stakeholder involvement and to assessing biophysical measures of the status of natural communities and much less attention to quantitative measures of value, monetary or otherwise.

With a clearly stated single objective, such as "to protect natural communities," economic analysis may be largely restricted to estimating the cost of various potential strategies to achieve that objective. Combining information about how various potential strategies contribute to the protection and restoration of natural communities along with information about the cost of these strategies is the main information necessary for cost-effectiveness analysis. Cost-effectiveness analysis addresses the issue of how best to pursue an objective given a budget constraint. In cost-effectiveness analysis, there is no need to estimate the value of protecting natural communities or of ecosystem services.

Of course, things are rarely so clear. Even with a single stated goal such as "to protect natural communities," there will are often multiple dimensions and tradeoffs among dimensions that require the analyst to go beyond cost-effectiveness analysis. For example, in protecting natural communities, there may be tradeoffs between protecting more of one type of natural community versus another. When there are multiple natural communities of interest, or multiple ecosystem services of interest, it becomes important to address questions of value. Is it more valuable to allocate more resources to restoring upland forest or wetlands? Is it more valuable to mitigate flood risk or improve water quality? Such questions can only be addressed by comparing the relative value attached of different natural communities or services.

Monetary valuation of the protection of natural communities may be important for

Chicago Wilderness, and more broadly to society at large, for several reasons. First, when there are multiple sources of value generated by protecting natural communities (e.g., species conservation, water quality, flood control, recreational opportunities, aesthetics, etc), monetary valuation provides a way to establish the relative importance of various sources of value. With "prices" or "values" attached to different ecosystem services, one can compare alternatives on the basis of the overall value generated. Second, some biological concepts such as "biodiversity" are multi-faceted. How one makes tradeoffs between different facets of biodiversity conservation, or among protection of different natural community types, is the ultimately the same question as how one makes tradeoffs among multiple objectives. Again, establishing prices on different components of biodiversity or on different natural communities allows for analysis of tradeoffs between components and an assessment of the overall value of alternatives. Finally, monetary valuation may facilitate communication about the importance of protecting and restoring natural communities in terms more readily understood by the general public.

Value may also be addressed using non-monetary valuation. If what is needed is to assess tradeoffs between protection of different natural communities or among different services, this may be done most directly by making such comparisons without the additional complication of trying to convert these values into monetary terms. In other words, it may be far easier for people to answer questions about whether they think it more important to provide additional protection of forests versus wetlands, as compared to asking about the monetary valuation of forest protection and the monetary valuation of wetland protection.

Valuation of Species Conservation and Ecological Systems Conservation.

Protecting natural communities may be done for reasons related to the provision of ecosystem services, or it may be done just because people value intact natural communities (e.g., existence value or intrinsic value). The only methods currently accepted by economists for estimating non-use values, such as the existence value of natural communities or biodiversity, are stated preference methods: contingent valuation

(CVM) and conjoint analysis. In trying to estimate of the value of protecting species and ecological systems, Chicago Wilderness could survey respondents in the Chicago area using CVM or conjoint analysis. Alternatively, Chicago Wilderness could attempt to use a benefits transfer approach by applying the results of relevant surveys done in other locations. The advantage of obtaining a monetary value for the conservation of species and ecological systems through CVM or conjoint analysis is that it would allow Chicago Wilderness to calculate a total economic value for alternative strategies. Without using CVM or conjoint analysis, Chicago Wilderness could not include non-use values and would be able to estimate a partial economic value for each strategy.

Any effort to place a monetary value on non-use values through stated preference methods raises the questions of whether monetary values are commensurate with the types of values that Chicago residents attach to protecting natural communities. In discussing the importance of protecting biodiversity, Chicago Wilderness emphasizes that a survey of public attitudes regarding biodiversity involving Chicago focus groups found that "responsibility to future generations and a belief that nature is God's creation were the two most common reasons people cited for caring about conservation of biodiversity." (Biodiversity Recovery Plan, p. 14.) CVM valuation of the bequest value of biodiversity might be consistent with measuring "responsibility to future generations," although the respondents in the focus group were presumably thinking in moral rather than monetary terms. Strong differences of opinion exist on whether it is appropriate to try to capture such notions as "stewardship" or "moral values" in monetary terms using stated preference methods.

Deliberative valuation exercises using citizen juries or other small focal groups might be a particularly useful means of evaluating tradeoffs among potential strategies to protect natural communities in the Chicago Wilderness context. Under deliberative valuation, experts would work with a small group of selected individuals in the Chicago area to determine comparative values for parcels of land through a guided process of reasoned discourse. Deliberative valuation might enable participants to develop more thoughtful and informed valuations, to better tradeoff among multiple factors, and to engage in a more public-based consideration of values. Experts could use deliberative

valuation either to try to come up with monetary comparisons of the values of the alternative properties or with weights that could be used to aggregate multiple layers of data.

Monetary values derived through deliberative valuations may differ considerably from traditional private values, both because of the consent-based choice rules that deliberative valuation employs and the explicitly public-regarded nature of the valuation exercise. Recent analysis suggests that deliberative valuations may aggregate individual values in a manner that systematically departs from the additive aggregation procedures of standard cost-benefit analysis (Howarth & Wilson, 2006).

Valuation of Water Quality and Quantity.

Changes in water quantity can be valued either because there is too much (flood control) or too little water (water scarcity).

Flood control: one approach to measuring the value of flood control is to measure avoided damages with reduction in probabilities of flooding. Several studies of the value of preserving wetlands for flood control have been undertaken in Illinois including studies of the Salt Creek Greenway (Illinois Department of Conservation, 1993; USACE, 1978) and the value of regional floodwater storage from forest preserves in Cook County (Forest Preserve District of Cook County Illinois, 1988). The later study found estimated flood control benefits of $52,340 per acre from forest preserves (Forest Preserve District of Cook County Illinois, 1988).

Water availability: another important ecosystem service in many metropolitan areas is the provision of clean drinking water. Protection of ecosystems may help reducing the fluctuation of water availability by storing water during wet periods and gradually releasing it during dry periods. Ecosystems protection may also be beneficial is providing relatively clean water for municipal supply. There is also value of surface recharge of aquifers (NRC 1997).

Valuation of Recreation and Amenities.

A large literature in environmental economics exists on estimating the values of

various forms of recreational opportunities and amenities created by the natural environment. Typical methods used by economists to estimate the monetary value of recreation and amenities include hedonic property price analysis, travel cost, and stated preference. In addition, there is a smaller literature that uses evidence from referenda voting to infer values for open space and other environmental amenities.

Applications of the hedonic property price model are a common method for estimating the value of environmental amenities, especially in urban areas because of the availability of large data sets on the value of residential property values. The hedonic property price model has been applied to estimate the value of air quality improvements (e.g., Ridker and Smith 1967, Smith and Huang 1995) living close to urban parks (e.g., Kitchen and Hendon 1967, Weicher and Zeibst 1973, Hammer et al. 1974), urban wetlands (Doss and Taff 1996, Mahan et al. 2000), water resources (e.g., Leggett and Bockstael 2000), urban forests (e.g., Tyrvainen and Miettinen 2000), and general environmental amenities (e.g., Smith 1978, Palmquist 1992). Given the large number of residential property sales in the Chicago area and existing spatially-explicit data bases on many environmental attributes, there is great potential for Chicago Wilderness to utilize such studies to estimate values of various environmental amenities. This method has not been used by Chicago Wilderness to date.

A large literature also exists on the value of recreation sites using the travel cost method. With the large number of visitors to Lake Michigan beaches, forest preserves, and parks in the Chicago metropolitan area, there is great potential for Chicago Wilderness to apply travel cost to estimate the value of recreational activities. To date, these methods have not been applied by Chicago Wilderness. {Provide references on appropriate travel cost studies in an urban setting}

Stated preference methods can also be used to estimate the value of recreational opportunities and environmental amenities. One such study has been done for Chicago Wilderness. Kosobud (1998) estimated the willingness-to-pay for "wilderness recovery and extension activities" in Chicago region. {Provide short summary of results}

Finally, there is a small but growing literature that analyzes the results of voting behavior in referenda involving environmental issues to estimate values. In particular,

studies have analyzed the value of open space using results of voting on open space referenda (Kline and Wichelns 1994, Romero and Lissero 2002, Vossler et al. 2003, Vossler and Kerkvliet 2003, Schläpfer and Hanley 2003, Schläpfer et al. 2004, Howell-Moroney 2004a, 2004b, Solecki et al. 2004, Kotchen and Powers 2006, Nelson et al. 2007). As noted above, several counties in the Chicago metropolitan area have passed referenda authorizing bonds to purchase open space or for watershed protection. Though the number of referenda is relatively small, making it difficult to generalize or make comprehensive statements about values, analysis of the results of these referenda could provide insights into the values of different segments of the public for various environmental amenities.

Summary.

Application of valuation methods would generate quantitative estimates of the value of the protection of ecosystems and the provision of various ecosystem services. This information could be of great use to decision-makers in evaluating alternative strategies to protect natural communities. Valuation studies could also be quite useful in communicating consequences of various alternatives to the general public. A number of valuation methods could be usefully applied by Chicago Wilderness for these purposes.

To date, however, Chicago Wilderness has initiated very little valuation research There have been some attempts to collect information about the value of protecting natural communities and ecosystem services (e.g., Kosobud 1998), but this effort has not been comprehensive or systematic. This contrasts with the major efforts undertaken to garner stakeholder involvement and input into setting the goals for the organization, and the large-scale effort collecting technical and scientific knowledge to characterize current status of ecosystems and species. In part, the lack of valuation activity is the result of the mix of expertise of the individuals involved in Chicago Wilderness. In part, the lack of valuation activity is the result of the choice made by the organization about the set of activities most important to it (which is a different sort of revealed preference). Interest exists within Chicago Wilderness to include economic and other social science approaches to study the value of protecting natural communities, but there has not been

the right mix of available expertise and circumstances to make this a reality.

1.3 Other Case Studies: Portland, OR and the Southeast Region

7.2.3 1.3.1 Portland, Oregon Assessment of the Value of Improved Watershed Management

The city of Portland, Oregon, facing potentially major expenses from meeting its obligations under the Clean Water Act, Superfund, and Endangered Species Act, decided to invest in an analysis of ecosystem impacts and the value ecosystem services that would result from improved watershed management. By taking a systems approach and considering the multiple benefits of actions, Portland officials hoped to find more effective watershed management that would both save the city money and improve the welfare of its citizens. Of primary interest were impacts on flood abatement, water quality, aquatic species (salmon in particular), human health, air quality, and recreation. The City of Portland's Watershed Management Program requested David Evans & Associates and ECONorthwest to undertake the study, which was completed in June 2004 (David Evans & Associates and ECONorthwest, 2004). The C-VPESS received a briefing on the project on September 13, 2005. Though the project was not an example of a regional partnership with EPA, the Committee was impressed with the analysis and results of the project. The project provides one of the best current examples of the kind of landscape-scale analysis of the value of ecosystems and services and exemplifies many of the recommendations of the Committee.

Portland city officials realized that they only understood a portion of the benefits of improved watershed management. To be able to make intelligent decisions about watershed management, these officials wished to have a more complete accounting, which required applying methods that could quantify a range of normally un-quantified ecosystem benefits. The project aimed to expand the range of ecological changes that are valued, focusing on those changes in ecosystems and their services that are likely to be of greatest concern to people. From the beginning, the effort attempted to solicit input from the public and important stakeholder groups about important ecological impacts. In

addition to the value of direct flood-abatement impacts, the study monetized the benefits of air quality, amenity, and recreational improvements.

In order to carry out the project, both biophysical and economics analyses were commissioned. The biophysical analyses included studies of hydrology and flooding potential, water quality, water temperature, habitat analysis for salmon and other aquatic species, habitat analysis for birds and other terrestrial species along riparian buffers, and air quality impacts (ozone, sulfur dioxide, carbon monoxide, carbon, particulates). The economic analyses included studies of the impact of ecosystem changes on property values, including public infrastructure, residential and commercial property, the value of flood risk reduction, the value of amenity and recreation, and the value of impact on changes on human health.

The project used a "system dynamics" approach that most closely resembles what the Committee refers to as production function analysis. The approach linked management changes, such as flood project alternatives, to a range of ecological changes. These ecological changes were analyzed for the effect on various ecosystem services. Finally, the economic analysis attempted to value the changes in various ecosystem services. The ecological and economic analyses were largely conducted by separate teams. However, the project was designed to provide a close linkage between ecological results and economic valuation.

Of particular note in this study was the emphasis on focusing the analysis to estimate the change in values that would occur under various management alternatives. Rather than simply a static description of current conditions, which is the predominant form of information collected by Chicago Wilderness, the approach taken here tried to estimate cause-and-effect relationships that would allow the systematic appraisal of the set of consequences of alternative policy or management decisions. This focus, along with a systems approach capable of incorporating multiple benefits, makes this an effective vehicle to study the net benefits of alternative management options.

This case provides a good example of potential benefits of integrated regional level analysis. The project undertook an integrated approach capable of analyzing the impact of alternative management actions on ecological systems and the consequent

changes in the value of ecosystem services. Attempts were made to solicit input from the public in the design of the project so that it captured the impacts about which the public had the greatest interest. Results of the project were presented with a graphical interface that allowed stakeholders to run scenarios and see the resulting impacts based on underlying biophysical and economic models. The analysis effectively deployed existing methods and estimates but it did not attempt to develop or test new approaches or methods.

The project also aptly illustrates some of the potential problems and limitations in undertaking detailed quantitative landscape-scale analysis. Inevitably in this type of analysis there are data gaps and gaps in understanding. Gaps in understanding include how ecological systems will be affected by changes in management actions, how this will affect the provision of ecosystem services, and the consequent value of those services. For example, how will songbird populations change in response to changes in the amount and degree of fragmentation of habitat? What is the value to residents of Portland of changes in songbird populations? The study often had to use benefits transfer methods from cases quite different from the Portland context to generate estimate of values.

{Possibly draw from material provided by City of Portland regarding how the results of the study have been used – or not used }

{Note: graphic from presentation on how the analysis works is quite similar to the process the committee has recommended as a model. It would be worthwhile including this graphic and discussing it further}

7.2.4 1.3.2 Southeast Ecological Framework Project (EPA Region 4)

The Southeast Ecological Framework (SEF) project represents a unique regional approach for the identification of important ecological resources to conserve across the southeastern United States. This region is one of the fastest growing regions in the US. Despite this, it still harbors a significant amount of globally important biodiversity and other natural resources. The SEF is designed to meet EPA's goals of gathering and disseminating information pertinent to the ecological condition of a region. The ultimate SEF project goal is for the project results to enhance regional planning across political jurisdictions and to help focus federal resources to support state and local protection of

ecologically important lands. The work was completed by the Planning and Analysis Branch of EPA Region 4 and the University of Florida in December of 2001.

The SEF applied a regional landscape analysis approach that represents conservation priorities and threats across the region in order to sustain critical ecological and biological values in the region, This approach builds from existing conservation areas and adds additional conservation areas and connecting corridors in order to secure and sustain the protection of critical native biodiversity and landscape functions. The conservation significance is determined from variables that characterize habitat type, protected areas and presence of rare species. The methodology is designed to meet standards of transparency and repeatability, and can be updated with new data. The GIS decision support approach provides a means to integrate complex data at a landscape scale to aid decision-making.

This framework has been developed for the eight southeastern states in EPA Region 4 (FL, GA, SC, NC, AL, MS, TN, and KY). This project has created a new regional map of priority natural areas and connecting corridors, along with geographic information system (GIS) tools and spatial datasets. The framework identified 43% of the land that should be protected and managed for specific societal benefits. Two additional applications of the SEF were developed to demonstrate its utility for conservation planning at the sub-regional and local scales. This approach is now being evaluated for utility in other regions and nationally.

The SEF differs from the prior two case studies (Chicago Wilderness and City of Portland) because it focuses on a broad regional analysis, eight states, rather than a single metropolitan area or watersheds within a metropolitan area. The SEF also differs in that it focuses almost exclusively on habitat conservation rather than a broad suite of ecosystem services. The SEF did not undertake an extensive stakeholder involvement process to set its objective, rather it started with the focus on habitat conservation. It also does not attempt to combine economic analysis with ecological analysis to value the protection of ecosystems or services in monetary terms. Discussion of values focuses on "conservation value," which is the ability to sustain species and ecological processes. In this regard, the SEF is a good tool to carry out regional analysis of ecological

components, particularly habitat conservation. Because of its focus, the level of scientific knowledge underpinning the SEF is in general far higher than in the other case studies. However, it was not designed to include extensive input from stakeholders on which ecological consequences are of greatest importance, as was particularly true in the case of Chicago Wilderness, or to integrate ecological analysis with economic or other social science approaches to discern effects on changes in value, as was particularly true in the Portland example. An important challenge facing regional analysis is how to figure ways to incorporate a rigorous ecological approach capable of showing the range of ecological impacts from alternative policy and management decisions, with stakeholder involvement and input on what consequences are of greatest importance to them, with rigorous evaluation of changes in value under alternative decisions, at a broad regional scale like the eight-state Southeast region.

1.4 Summary and Lessons Learned

Regional-scale analysis has great potential to inform decision-makers and the general public about the value of protecting ecosystems and services. Regional-scale partnerships between EPA Regional Offices, local and state governments, regional offices of other federal agencies, environmental non-governmental organizations and private industry could aid both EPA and regional partners. Such partnerships offer great potential for improving science and management for protecting ecosystems and enhancing the provision of ecosystem services. At present, however, this potential is largely unrealized. To take advantage of this potential, EPA would need to increase the capacity of regional offices in both economic and ecological analysis. EPA would also need to devote resources to make the study of the value of protecting ecosystems and services a high priority. Making this a high priority is hampered by the lack of specific legal mandates or authority to study these values. Given tight agency budgets, the valuation of ecosystems and services at present appears to be more of an unaffordable luxury rather than a necessity.

A review of several regional analyses of ecosystems and services yields the following general lessons:

- Important ecological processes take place at a regional scale, making it an appropriate scale at which to analyze the value of ecosystems and services.
- Recent increases in publicly available spatially-explicit data and a parallel expansion in the ability to display and analyze such data make it feasible to undertake comprehensive regional-scale studies of the value of protecting ecosystems and services.
- Many important decisions affecting ecosystems and the provision of ecosystem services are taken at a regional scale by municipal, county, regional and state governments, but local and state governments rarely have the technical capacity, or the necessary resources, to undertake regional-scale analyses of the value of ecosystems or services. Local and state governments often do not incorporate the value of protecting ecosystems or services into their decision-making processes.
- Several regional-scale analyses have included extensive stakeholder involvement and input to establish the set of ecological consequences of greatest importance to the community at large. Gathering such input is easier at a more local scale such as in the Chicago and Portland examples, than at broader regional scales such as in the Southeast Region example.
- Many regional-scale analyses to date have shown greater ability to characterize the current extent and condition of natural habitat types but have much more limited ability to analyze likely consequences of changes in policy or management.
- Even when information on ecological production functions exists, at least for some range of important ecological functions or services, there is often very limited ability to integrate ecological impacts with valuation methods to arrive at the value of protecting ecosystems or services.
- In addition, there is a great need to increase the ability of natural scientists to collaborate with economists and other social scientists in doing integrated research at a regional scale.