Bureau of Land Management Socioeconomics Program Guidance

Economic Methods for Estimating Nonmarket Environmental Values

Purpose. This guidance describes when and how to use economic methods to estimate nonmarket environmental values when preparing National Environmental Policy Act (NEPA) analyses for the Bureau of Land Management's (BLM) resource management planning and other decision-making. These methods estimate the benefits individuals attribute to experiences of the environment, uses of natural resources, or the existence of particular ecological conditions that do not involve market transactions and therefore lack prices.

At least a *qualitative* description of the most relevant nonmarket values should be included for the affected environment and the impacts of alternatives in NEPA analyses involving environmental impact statements (EIS), for both resource management plans (RMP) and project-level decisions. Such description may also be appropriate for inclusion in environmental assessments (EA).

The use of *quantitative* valuation methods should contribute to the analysis of one or more issues to be addressed in the environmental analysis supporting planning or other decision-making. A quantitative analysis of nonmarket values in EIS-level NEPA analyses is strongly encouraged where one or more of the criteria provided below apply (see *Criteria for Nonmarket Valuation*).

This guidance is directed to several audiences. For non-specialists, it explains the basic concepts of nonmarket valuation and provides direction on when and how such methods can best be used (see *General Guidance*). For economists and other socioeconomic specialists, it provides additional notes on the use of these methods (see *Technical Guidance*).

The socioeconomics program is currently funding a series of field-based case studies on nonmarket economic valuation for resource management decisions. Those case studies and other comments from state and field office staff will be incorporated in revised guidance targeted for fiscal year 2015, emphasizing practical applications and lessons learned.

In addition to economic valuation methods, a number of sociocultural methods can be used to characterize the values attributed to places, landscapes, and other environmental features. Guidance on sociocultural methods for assessing environmental values, including ethnography, interviews, and surveys, is in preparation. See **Attachment 2** for a list of non-economic as well as economic methods of environmental valuation.

All new studies of nonmarket values require substantial knowledge of economics to design and interpret. Individuals preparing nonmarket studies or advising on their use should have demonstrated expertise in this topic. See information on professional support, section 6. This guidance is not a comprehensive manual for conducting nonmarket value studies. Rather, it is primarily intended to introduce non-specialists to the terminology, concepts, and appropriate application of nonmarket environmental valuation.

GENERAL GUIDANCE

(1) What are nonmarket values?

Nonmarket environmental values (or simply "nonmarket values") reflect the benefits individuals attribute to experiences of the environment, uses of natural resources, or the existence of particular ecological conditions that do not involve market transactions, and therefore lack prices. Examples include the perceived benefits from hiking in a wilderness, fishing for subsistence rather than commercial purposes, and appreciating the existence of the Grand Canyon without actually visiting it (an example of passive or non-use value).

Ecosystem goods and services include a range of human benefits resulting from appropriate ecosystem structure and function, such as flood control from intact wetlands and carbon sequestration from healthy forests. Some involve commodities sold in markets, for example, timber production. Others, such as wetlands protection and carbon sequestration, do not commonly involve markets, and thus reflect nonmarket values.

The scope of nonmarket values is not limited to the natural environment. Archaeological and historical sites, for example, may also hold such values.

Since the 1980s, nonmarket valuation has been used in a variety of Federal environmental protection contexts. Litigation concerning compensation for the 1989 *Exxon Valdez* oil spill in the Gulf of Alaska drew attention to nonmarket valuation as one basis for estimating the losses to the native subsistence fishery, and stimulated extensive academic research. Nonmarket valuation has a prominent place in the Department of the Interior's regulations for conducting Natural Resource Damage Assessments of events such as oil spills (see 43 CFR 11.83). The Office of Management and Budget's (OMB) Circular A-4 on regulatory analysis also provides guidance on the use of nonmarket valuation methods (see **Attachment 3**).

Here are some examples of the use of nonmarket values in the BLM's resource management documents.

- The King Range National Conservation Area's Resource Management Plan has a short discussion of nonmarket values of recreation to supplement market information in the socioeconomic portion of the Affected Environment chapter (**Ref. 10**).
- The California State Office assessed the social and environmental benefits associated with the BLM's Community Assistance and Hazardous Fuel Programs, considering "both the market-based and nonmarket values that are at risk from wildfire" (**Ref. 12**).
- In developing a plan to manage scattered tracts along the Little Snake River, the Wyoming State Office obtained nonmarket values "to quantify attitudes and economic values toward alternative ways of managing, selling or trading scattered tracts of BLM-administered lands." The management alternatives included increased recreation, enhanced wildlife habitat, and increased mining and grazing (**Ref. 11**).
- The Taos Field Office's Resource Management Plan describes nonmarket values qualitatively. "Nonmarket values are important to the welfare of visitors, area residents, and other communities inside and outside the planning area. . . . Specific natural amenities mentioned during the public involvement process include cultural resource protection, water quality, soil condition, habitat, landscape and riparian health" (**Ref. 21**).

(2) Why analyze nonmarket values?

In principle, economic analysis for resource management should consider all relevant values, not merely those that are easy to quantify. Utilizing nonmarket values provides a more complete picture of the consequences of a proposed activity than market data alone would allow.

Information on nonmarket values can support resource management decisions in several ways. These include clarifying the range of non-commodity values potentially affected by management decisions, revealing the magnitude of change in non-commodity values under action alternatives, and better differentiating stakeholder interests. For environmental analyses associated with individual projects, consideration of nonmarket values can clarify potential mitigation strategies. Finally, the analysis of nonmarket values can help offices and programs explain more effectively the objectives of the BLM's resource management.

Economic analyses in NEPA reviews associated with resource management plan adoption, revision and amendment, as well as with other kinds of BLM decision-making have primarily estimated the market impacts of commodity production and recreation. This level of analysis provides important information on the distributional effects of a management decision, asking who gains and who loses. Such information can help local governments anticipate demands on housing and public services. In contrast, assessing the value to society of different management decisions requires a consideration of both the costs and the benefits of each alternative. Both types of economic analysis should contribute to the BLM's decision-making.

- *Impact analysis* provides estimates of the direct, indirect, and cumulative economic activity that a given management decision is expected to create within a specified geographic area. This activity is typically expressed as projected changes in employment, personal income, or economic output. For example, developing a large oil and gas field might employ 9,000 workers and provide $500 million in wages per year, with a certain proportion of that economic impact remaining in the county or other local area. This type of analysis calculates the changes in activity for various economic sectors, typically measured as a difference from the "no-action alternative."
- *Benefit-cost analysis* in principle estimates the full range of economic benefits and costs to society of a proposed activity, both market and nonmarket, providing another picture of the proposed action. The spatial scale of benefit-cost analysis is usually large, for it attempts to capture benefits and costs to individuals regardless of where they reside. Such an analysis can provide a more holistic picture of each management scenario.

Example 1. To assess the impacts of a proposed oil and gas field, for example, the BLM routinely performs an impact analysis that estimates the jobs, income, and economic output that will occur over the life of the development. A benefit-cost analysis would estimate the overall economic value of the proposed field. From a market perspective, the economic value of the proposed oil and gas development and production would generally equal the price of oil and gas minus the cost of producing, processing, and transporting the minerals (**Ref. 2**).

Identifying and quantifying nonmarket values associated with this management decision is more challenging, but important. For example, the development of an oil and gas field could reduce the perceived amenity value of the area. This cost could be captured by considering changes to

property values. One study of the effects of siting oil and gas wells near urban development showed a mean loss of some $21,000 (Canadian) or 7 percent of property values for wells within 4 km of residential properties (**Ref. 18**).

Example 2. Visiting fishers, hunters, and climbers may spend money on motels and restaurants, but for the most part recreation on BLM-managed lands comes free or at a nominal charge. Numerous surveys document that individuals are often willing to pay more than their actual costs for a particular recreational experience. This is termed *consumer surplus* or *net willingness to pay* (WTP), the amount an individual would have been willing to pay for an environmental benefit minus the amount actually expended. Such surveys provide an important source of information for quantifying nonmarket values. One nonmarket study of mountain biking on the popular Slickrock Trail, located on the Moab, Utah Field Office, yielded an estimated consumer surplus of $197 to $205 per trip, and an aggregate annual value of $8.4 to $8.8 million (**Ref. 19**).

At least for the BLM's resource management decisions, it is seldom if ever feasible to assess all potential benefits and costs of an action. In practice the assessment of estimated economic consequences in NEPA analyses for both RMPs and other decisions should describe key economic activity and *selectively* consider benefits and costs of the proposed alternatives, notably nonmarket values. *Note that the results of impact analysis (in personal income or output) and benefit-cost analysis (in consumer surplus) cannot be directly compared.* For more on this point, see Technical Guidance.

(3) Total economic value – market and nonmarket

Whatever the scale of analysis, environments have multiple potential uses and provide many benefits. Some of these benefits are evident in market transactions, others are not. The term *total economic value* refers to all uses and benefits, both market and nonmarket, provided by a given environment. The components of total economic value represent a wide range of benefits. For example, a hypothetical landscape managed primarily for conservation and recreation rather than commodity production provides benefits related to:

- Direct use of the resource through recreation, education, and other activities on the landscape that might provide both market and nonmarket values. Some uses are linked to traditional community practices, such as the contribution of healthy caribou herds to Iñupiat villagers' subsistence way of life on the North Slope of Alaska.
- Indirect use of the resources, such as providing watershed protection for downstream communities, or protecting nearby scenic landscapes for residential property. These indirect uses typically reflect nonmarket values, though they might be related to market decisions.
- Passive use (sometimes called non-use) benefits, which might stem from a desire to preserve a resource as a social or public good (existence value), for future use (option value), or for enjoyment by future generations (bequest value). Passive use benefits reflect nonmarket values.

(4) How and when to consider nonmarket values

Describing nonmarket values

In framing information for management decisions, focus on the *difference in changes to nonmarket values* between action alternatives. Such information can highlight tradeoffs. For example, an alternative designating an additional thirty miles of trails for off-highway vehicles may *increase* the visitor days of use – therefore the total nonmarket benefits – from motorized recreation, but may *decrease* the benefits of subsistence hunting and watershed protection in this area. The *difference* between the changes to nonmarket values between this alternative and an alternative that, for example, only designates an additional ten miles of trails, can inform the choice among action alternatives.

Nonmarket studies provide estimates of both individual and aggregate benefits. In its simplest form, estimates of the aggregate benefit (consumer surplus) generated by an environmental use or experience is simply the product of the estimated individual benefit (often the arithmetic mean or median of responses) by the estimated population holding such values. (In the mountain biking example given above, these estimates were $8.4 to $8.8 million per year and $197 to $205 per trip, respectively.)

Nonmarket values can be described in several ways, which vary in specificity, validity, and level of effort. From least to most effort, these methods include:

- describing the values qualitatively,
- citing quantitative estimates of this type of benefit from other sites (*benefit transfer*), and
- conducting a new study for the site and activity in question.

First, nonmarket values can be described qualitatively.

- An assessment of actions to increase access to technical climbing sites might note: "Road and campground improvements under Alternative B will provide the greatest access to technically advanced rock climbing. More technically demanding climbing opportunities are perceived to offer greater benefits, as documented in 'willingness to pay' surveys of recreational climbing."
- In planning a timber sale, greater harvest setbacks from stream corridors can be linked to greater soil stabilization (an ecosystem service), resulting in cost savings from the reduced need for stream restoration.

Second, in benefit transfer, nonmarket values for a plan or project area may be characterized by citing representative estimates of comparable activities studied elsewhere. The most common approach (*point transfer*) directly applies value estimates from a study site or an average from multiple studies to the proposed site. For example, nonmarket value estimates for whitewater rafting on the Snake River in Idaho could be applied to rafting on the Rogue River in Oregon. The main weakness in point transfer is its inability to account systematically for differences between sites. Therefore, the uncertainty associated with the interpolated estimate may be high.

- A recent EIS for an oil and gas full field development plan characterized the nonmarket values of recreation by citing average benefit estimates from a 2001 meta-analysis,

adjusted for inflation (see **Ref. 20**). For example, the average benefit for camping is cited as $28 and for biking $69 per person per activity day.

While such figures may provide a reasonable estimate of the *magnitude* of the benefits to be found if a nonmarket value study were done for the new EIS, such average figures also mask wide variation. The estimated benefits reported in the 2001 review for camping vary from $1.69 to $187.11 per person per activity day; for biking these vary from $17.61 to $62.88 (**Ref. 6, Table 1**).

In contrast, *function transfer* uses regression analysis to account for differences in characteristics between the sites for which estimates are available and the new study site. A function transfer exercise for mountain biking trails might consider as independent variables such attributes as the trail difficulty rating and the trail's scenic quality. This is more accurate than point transfer, but correspondingly more complex. See Technical Guidance: Using Benefit Transfer.

Third, if properly conducted, primary (new) research provides the most valid estimates of nonmarket environmental values, with correspondingly lower uncertainty. The drawback is significantly greater time and expense.

A variety of nonmarket valuation methods can be used, depending on the problem (see Methods, below). All methods are technically demanding. Most methods use a survey to collect information on either preferences or behavior. When conducted by or on behalf of a Federal agency, such surveys require approval by OMB, which can add 9 to 12 months or more to the research schedule.

The added time and expense required for original nonmarket studies should not preclude their use by the BLM: many biophysical studies prepared for environmental analyses supporting RMPs or individual project approvals require as great or greater budgets and timeframes. The key is to have a clear rationale for why the improved data provided by a primary study justifies the additional time and expense, and to make this determination early in the planning or project assessment process.

Criteria for nonmarket valuation

It is not feasible to estimate *all* nonmarket values potentially associated with a site or landscape. The analysis should instead consider those nonmarket values most relevant to (a) describing the socioeconomic context (affected environment), (b) estimating impacts of the alternatives under consideration, or (c) identifying mitigation measures.

At least a *qualitative* description of the most relevant nonmarket values should be included for the affected environment and the impacts of alternatives in EIS-level NEPA analyses, for both RMPs and project-level decisions. Such description may also be appropriate for inclusion in environmental assessments (EA).

The use of *quantitative* valuation methods should contribute to the analysis of one or more issues to be addressed in the environmental analysis supporting planning or other decision-making (see the *BLM National Environmental Policy Act Handbook*, H-1790-1, Section 6.4). A quantitative analysis of nonmarket values in EIS-level NEPA analyses is strongly encouraged, either through systematic benefit transfer techniques or primary research, where one or more of the criteria provided below apply.

- A proposed action is likely to have a significant direct or indirect effect (as defined at 40 CFR 1508.8 and 1508.27), and the quality or magnitude of the effect can be clarified through the analysis of nonmarket values. For example, a proposed wind energy installation may affect the viewshed of a nearby community in ways that alter scenic values.
- The alternatives to be considered present a strong contrast between extractive and non-extractive uses of land and resources. For example, an RMP may include alternative resource allocations that vary between managing land primarily for oil and gas development or managing it for habitat conservation and recreation.
- The magnitude of the proposed change is large. An example could be the difference between a maximum allowable oil and gas development of 250 wells under the no-action alternative and 2,500 wells under the intensive use alternative.

(5) Nonmarket valuation methods

Select an approach to estimating environmental values that is appropriate for the decisions to be made, given the constraints of time, budget, available technical support, and the effort required to obtain and analyze the data.

Revealed preference methods

Revealed preference is used to estimate direct use values, deriving economic value from an individual's behavior. These include travel cost, hedonic pricing, and averting behavior.

- The *travel cost method* analyzes data on distance visitors travelled, time spent to reach a site, time spent on-site, other trip expenses, and number of visits to that site over a stated period of time – most commonly for recreation. From these data a demand curve is generated, which is used to estimate visitors' willingness to pay for a given experience beyond their actual expenditures.

- The *hedonic method* looks for price differences among otherwise similar goods that differ in a particular environmental attribute. For example, the difference in sale price for otherwise comparable homes in the same general location but with very different views (a parking lot versus an undeveloped mountain meadow) provides an indirect way to estimate the value placed on views of mountain meadows.

- The *averting (or defensive) behavior method* considers the cost of actions taken to avoid an environmental harm as a way to value the experience of some current environmental condition, absent that harm. For example, the expenditures a homeowner makes to reduce the risk of property damage from wildland fire, such as installing non-flammable roofing tiles or clearing vegetation, provides a lower bound estimate of the value placed on the current condition of the property and its setting. This approach has particular usefulness in assessing the health effects of pollution.

Stated preference methods

Stated preference can be used to estimate both use and passive use values. Stated preference methods use an individual's stated "willingness to pay" for an environmental use to calculate value. In some cases stated preference approaches can more precisely target the nonmarket values of interest than can revealed preference approaches. See **Attachment 3** for recommendations on designing effective stated preference surveys.

- *Contingent valuation* uses surveys to identify the dollar value individuals hypothetically would be willing to pay to preserve an environmental benefit. Alternatively, such surveys can be used to estimate the amount individuals would be willing to accept in compensation for some environmental loss.

- *Choice experiments* also use surveys to elicit willingness to pay, but here the choices are made among sets of multiple attributes. For example, a questionnaire on forest management might describe alternative management prescriptions with different options for the spacing of roads, treatment of dead and dying trees, and techniques of riparian protection, as well as the hypothetical payment the respondent would make to value each alternative. This method elicits economic values for sets of choices that more closely resemble land management decisions than do the simpler questions used in contingent valuation, but such surveys are correspondingly more complex to design and interpret.

Passive uses concern values attributed to a place, landscape, or ecological condition without direct use or experience. Many Americans will attribute value to the existence of the Arctic National Wildlife Refuge (ANWR) as a wilderness without having been there. By and large, stated preference methods are the only feasible way to estimate passive use values. Ignoring passive uses can result in substantially underestimating total economic value. Nonetheless, using stated preference methods to develop defensible estimates of passive use values can be quite challenging. See the discussion of estimating passive use values in the Technical Guidance.

Cost-based methods

Valuation based on cost can be useful and in some cases may be simpler to use. Assume a proposed project will degrade a wetland. One way to value the benefits of conserving the wetland would be to calculate its *replacement cost*; for example, the cost of restoring a wetland elsewhere in the region to provide comparable ecological functions (**Ref. 7**, p. 114).

(6) Other recommendations

(a) Get professional support. Nonmarket valuation studies require appropriate economic expertise. If a BLM economist with experience in nonmarket valuation is not available to assist, there are several alternatives:

- The BLM's National Operations Center (NOC), Division of Resource Services has established a Blanket Purchase Agreement with several consulting firms to provide socioeconomic analyses, including nonmarket valuation.

- The NOC has also established interagency agreements with the Forest Service (USFS) and the U.S. Geological Survey (USGS) to provide social and economic assistance to state and field offices.
- The Cooperative Ecological Studies Units (CESU) system, regional networks of federal agencies and universities, provide access to many faculty members with expertise in environmental or ecological economics. Information is available at: http://www.cesu.psu.edu/.

See Contacts (below) for assistance.

(b) Use appropriate assumptions and well established methods. When in doubt, it is better to risk understating rather than risk overstating nonmarket values. Disclose all relevant assumptions and limitations.

(c) Take a collaborative approach in designing an analysis of nonmarket values. Seek buy-in from cooperating agencies and other key stakeholders (consistent with Federal Advisory Committee Act requirements) on the objectives and methods of any nonmarket valuation study. This may forestall a challenge by commodity users or others who may be skeptical about the fairness and validity of nonmarket analyses.

(d) Allow adequate lead times when planning to use nonmarket value surveys. Identical questions administered to 10 or more members of the public require approval by the OMB. In estimating project schedules that require surveys, assume 9 to 12 months for OMB clearance, in addition to the time needed to develop the questionnaire, administer it, and analyze the results. In some cases, it may be feasible to utilize the results of nonmarket value studies commissioned by other organizations, such as a stakeholder group, without a requirement for survey clearance by OMB. Socioeconomic staff at the Washington Office and the National Operations Center can advise. See Contacts.

(e) Estimate the benefiting population as carefully as is practical. There is little point in calculating nonmarket values carefully if the estimated number of benefiting individuals is very imprecise. The nonmarket values of recreation uses are often the most practical to estimate, because many recreation sites have reliable data on annual visitor days.

(7) For further information

At an introductory level, *Ecosystem Valuation* (http://www.ecosystemvaluation.org/) is a website offering extensive information and case studies on nonmarket valuation techniques, sponsored by the Natural Resources Conservation Service and the National Oceanographic and Atmospheric Administration **(Ref. 1).**

For a more rigorous introduction to the use of nonmarket environmental values in resource management, see Cindy S. Swanson and John B. Loomis, *Role of Nonmarket Economic Values in Benefit-Cost Analysis of Public Forest Management* **(Ref. 2).**

For a technically thorough guide to nonmarket valuation, see Patricia A. Champ, Kevin J. Boyle, and Thomas C. Brown, eds., *A Primer on Nonmarket Valuation* **(Ref. 3).** For information on the methods mentioned in this guidance, see the following chapters:

- averting behavior (11),

- benefit transfer (12),
- choice experiments (6),
- contingent valuation (5),
- hedonic method (10), and
- travel cost (9).

The BLM's course *Socio-Economic Aspects of Planning* is available in a webcast version, and includes a section on the use of nonmarket values **(Ref. 4).**

A report by the Environmental Protection Agency's Science Advisory Board, *Valuing the Protection of Ecological Systems and Services*, provides an excellent review of the methods and challenges of environmental valuation **(Ref. 5).**

For a thoughtful discussion of environmental values and the limits of economics in characterizing them, see Mark Sagoff, *Price, Principle, and the Environment* **(Ref. 14).**

For an overview of ecosystem services and their valuation see Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: A Framework for Assessment* **(Ref. 17)**.

(8) Contacts

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TECHNICAL GUIDANCE

This section provides additional technical notes that should be considered by specialists incorporating nonmarket values into the BLM's RMPs and EISs.

(9) Comparisons using benefit-cost analysis

As noted above, economic information can be used in resource management in two main ways.

- *Impact analysis* provides estimates of the direct and indirect economic activity that a given management decision is expected to create within a specified geographic area. This activity is typically expressed as projected changes in employment, personal income, or economic output.
- *Benefit-cost analysis* in principle estimates the full range of economic benefits and costs to society of a proposed activity, both market and nonmarket, providing another picture of the proposed action. The spatial scale of benefit-cost analysis is usually large, for it attempts to capture benefits and costs to individuals regardless of where they reside.

To use nonmarket values in benefit-cost comparisons, they must be compared to like values, expressed as consumer surplus. For example, if the recreational alternatives under consideration involve different ways of balancing motorized and non-motorized recreation, an appropriate comparison would involve the estimated change in consumer surplus for the various recreational uses, for each alternative. This involves multiplying the change in net WTP for that use by the estimated number of users.

Nonmarket values reflecting the benefits of recreation or other non-extractive uses can also be compared with the benefits from extractive uses. In this case the consumer surplus generated by a non-extractive use is compared with the *producer surplus* created by an extractive use. Producer surplus is the difference between the price a producer of a good or service receives and the minimum price that producer would be willing to accept. More technically, producer surplus reflects gross revenues minus the variable costs of production, not including the input from public resources made available by the land management decision (**Ref. 2**, pp. 6-12).

In the case of a proposed timber sale, a logging company's producer surplus would be the sale price of the logs delivered to the mill (gross revenues) less the cost of production, including felling the timber, bucking and yarding the logs, and hauling them to the mill. This is equivalent to the stumpage price, the price paid in the timber sale. If the timber sale reduces the attractiveness of that forest for recreational uses, then a benefit-cost analysis of the timber sale could include comparing the producer surplus resulting from the timber sale with the change in consumer surplus for recreational uses, which might reflect both a lower number of users and a lower willingness to pay for the recreational experience.

Do not compare the consumer surplus estimated for a non-extractive use with the economic impact, as measured by personal income or the value of output, for an extractive use. The personal income generated by expenditures for a non-extractive use such as mountain biking (e.g., employment at a bike rental shop) *can* be compared with the income generated by an extractive use such as logging.

(10) Using benefit transfer

In benefit transfer, nonmarket values for a plan or project area may be characterized by citing representative estimates of comparable activities studied elsewhere. Unfortunately, the uncertainties involved in nonmarket valuation studies are compounded in applying the results of an existing study to a proposed plan or project in a new environmental and social setting. As noted above, there are several techniques for benefit transfer.

Point transfer directly applies value estimates from a study site or an average from multiple studies to the proposed site. The main weakness in point transfer is its inability to account systematically for differences between sites. The simplicity of this method is attractive in situations with limited staff expertise and quick deadlines. However, for this method to be technically defensible there should be a high degree of correspondence between the study site and the proposed site.

Function transfer assumes that nonmarket environmental values are a function of numerous attributes, including biophysical attributes and the socioeconomic context of the environmental use or experience. For example, a function transfer to estimate the value of improved lake conditions for recreation may relate the willingness to pay for improved water quality (the

dependent variable) to multiple factors, including existing water quality, the amount and types of recreational use, population within a half-day drive to the recreation site, the number of substitute sites within a specified distance, and per capita income of the user group (the independent variables). The functional relationship at the study site between the value users attribute to improved water quality and these independent variables will be applied to equivalent data from the new site to provide an estimate of willingness to pay for the proposed improvement.

Function transfer is inherently more accurate than point transfer, but is correspondingly more complex (**Refs. 6, 8,** and **9**).

(11) Considerations in estimating passive uses

As noted, a wide range of nonmarket environmental values can be associated with a site or landscape, involving both direct uses (such as the value of a mountain bike trip) and passive uses (such as the value attributed to the existence of the Grand Canyon). Ignoring passive uses can result in substantially underestimating total economic value. Nonetheless, using stated preference methods to develop technically defensible estimates of passive use values can be more challenging than estimating direct use values. Here are some factors to consider.

(1) Surveys should be carefully designed to maximize validity and minimize bias. Survey respondents commonly are more generous when responding to hypothetical questions regarding their willingness to pay for an environmental good than when solicited for actual donations to support the same cause (**Ref. 15**, p. 166). This is termed *hypothetical bias* or *warm glow*, a factor that is particularly relevant to estimating passive use values. Considerable research has been devoted to improving survey techniques to minimize hypothetical bias (**Ref. 16**). In estimating passive use values, the proposed survey and the protocol for administering it should be developed by an experienced researcher, and carefully pretested to minimize hypothetical bias and other distorting factors. (See **Attachment 3**.)

(2) Selecting the appropriate geographic scale is particularly important in surveying passive use values. Total nonmarket benefits resulting from an environmental change are typically determined by multiplying the mean survey value by the estimated population "willing to pay" for the environmental benefit. In estimating passive use benefits, where by definition there is no clearly identifiable group of users, there is no generally accepted principle for determining what geographic area should be included.

The decision on geographic scale has a large effect on the results. A 2009 study of passive use values associated with National Park units affected by operations of the Glen Canyon Dam surveyed at two scales: the dam's hydropower marketing area and nationwide. Across three options considered, the aggregate passive use values for the marketing area ranged from $51 to $81 million, while national estimates ranged from $2.3 to $3.4 billion (**Ref. 13**, Table 1). Similarly, the issue of whether to open the Arctic National Wildlife Refuge (ANWR) for oil and gas development has attracted attention world-wide. It is not clear whether the total passive use value of preserving ANWR as wilderness should be estimated for the population of the North Slope, the state of Alaska, the United States, or the world.

The decision over what geographic area to estimate passive use values is more a matter of management judgment than economic expertise. The choice of scale should be reasonable, considering the nature of the proposed change. In passive use estimates, "the good being valued may have little meaning to respondents, and respondents may be forming their valuations for the first time in response to the questions posed" (**Attachment 3**). It may be appropriate to estimate on a nationwide basis passive use values associated with the Grand Canyon or other nationally recognized environmental goods. But for environmental values associated with most BLM land use plans or projects, a smaller geographic scale is generally appropriate.

References

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Acknowledgements

Two drafts of this guidance have been extensively revised based on responses from reviewers. Thanks are due to the following colleagues for their thoughtful comments and suggestions:

Bureau of Land Management: Roy Allen, Stewart Allen, Aimee Betts, Meagan Conry, Michael Hildner, Michael Johnson, Vicki Josupait, Joel Larson, Paul McNutt, Liz Meyers-Shields, Rebecca Moore, Matt Preston, Kim Prill, Brent Ralston, Josh Sidon, Bill Stevens, John Thompson, Joan Trent, and Travis Young.

External reviewers: Ken Bagstad (USGS), David Brookshire (University of New Mexico), Steve Crookshank (American Petroleum Institute), Christian Crowley (DOI Office of Policy Analysis), Billy Gascoigne (USGS), Lynne Koontz (USGS), John Loomis (Colorado State University), Pete Morton and colleagues (The Wilderness Society), Bruce Peacock (National Park Service), Leslie Richardson (USGS), and Ben Simon (DOI Office of Policy Analysis). Acknowledgement of these external reviewers does not imply endorsement of this guidance by these individuals or their organizations.

Thanks also to Delilah Jaworski (USFS) for her review of benefit transfer techniques, from which the section on benefit transfer was adapted.