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# Understanding Human Uses and Values in Watershed Analysis

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## Abstract

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Watershed analysis is used as a tool to understand the functioning of aquatic and terrestrial ecosystem processes at the landscape scale and to assess opportunities to restore or improve those processes and associated watershed conditions. Assessing those opportunities correctly requires an understanding of how humans have interacted with the watershed in the past and how they likely will interact with the watershed in the future. This paper provides a systematic approach to developing relevant information about human interaction with a watershed. The approach was originally developed as a technical supplement to the Federal process for watershed analysis. This document does not address American Indian traditional cultural and religious issues in depth; those are to be discussed in a separate technical supplement.

**Keywords:** Watershed analysis, planning, passive use, cultural use, commercial use, recreation, infrastructure, human dimensions.

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## Introduction

“The Federal Guide for Watershed Analysis” (Anonymous 1995), hereafter referred to as “the guide,” was developed by an interagency team of scientists, staff specialists, and managers working under the direction of the Regional Interagency Executive Committee and the Intergovernmental Advisory Committee. (Consult the “Acknowledgement” section of the guide for a list of agencies involved in developing the guide.) It provides an overview of the watershed analysis process and a detailed description of the six steps that make up the process: characterization, issues and key questions, current conditions, reference conditions, synthesis and interpretation, and recommendations. The guide lists seven topics that are to be addressed: erosion processes, hydrology, vegetation, stream channels, water quality, species and habitats, and human uses.

This paper was prepared by a subcommittee of the committee charged with developing the first draft of the guide. It follows the six-step process described in the guide and uses the terminology found in the guide and its glossary of terms. This paper was submitted to the interagency Regional Ecosystem Office in substantially its present form; however, it and other draft technical supplements were not published with the guide. It is currently being published in recognition that watershed analysis is now an ongoing process and that little guidance exists for dealing with the area of human uses and values in watershed analysis. We hope this paper will be a useful resource for those conducting watershed analysis until an officially sanctioned technical supplement is produced. This paper provides suggestions for doing a thorough analysis of the human-dimensions domain in watershed analysis. It covers more than can be done in a world of constrained budgets and limited personnel. It provides a checklist of areas from which analysts may selectively choose the most relevant and important for a particular watershed analysis. Those who are involved in watershed analysis but not mandated to use the guide also may find it useful.

Underlying this paper is the recognition that watersheds differ as do peoples’ interests and perceptions of them. It is therefore necessary to think carefully about what the important values and uses are and what information is relevant to decisions related to protecting or improving watershed biophysical processes and conditions.

When the material for this paper was drafted, it was envisioned that there would be a separate technical supplement dealing with the special status of Indian tribes and their interests in and uses of watersheds. Although this paper does not adequately address the special status of Indian tribes and their interests in watershed analysis, we observe that many of the interests of tribes in a watershed are similar to those of other social groups. Different cultural backgrounds and traditions, however, often mean ecosystem components and human activities have a different relative importance.

## Overview of Human-Dimensions Domain

### Purpose and Need

A watershed can be viewed as a patchwork of socioeconomic and biophysical processes. To understand a watershed, we need to understand the reciprocal relations between socioeconomic and biophysical processes, the reasons for and characteristics of these relations, and how these relations might change in the future. Evidence of these relations is found in both intentional and unintentional landscape alterations that result from developed uses, extraction of resources, specific efforts to preserve the watershed or specific elements of it, and other management activities.

### Scope

Human actions that affect a watershed originate in personal and societal values. These actions include past, present, and future land and resource alterations and uses. In addition to personal and societal values, actions derive from attitudes, beliefs, and attachment to particular places or “sense of place.”

Watershed analysis is a component of ecosystem management. The scope of human dimensions in ecosystem management was addressed by the Forest Service's National Human Dimensions of Ecosystem Management Task Force. Their understanding provides guidance for this domain (Human Dimensions Task Group 1993):

People are part of ecosystems and human conditions are shaped by, and in turn shape, ecosystems. People value and desire a broad spectrum of benefits (including survival) from ecosystems. In order to make effective ecosystem management decisions, the Forest Service must have a scientifically sound and integrated understanding of the physical, biological, and human dimensions of ecosystems. The human dimension of ecosystem management must include information about peoples' traditional and changing perceptions, beliefs, attitudes, behaviors, needs and values, and the past, present, and possible future influences of humans on ecosystems.

The human dimension includes human actions (behaviors); knowledge, skills, and machines (technology); artifacts of past actions and sentiments (cultural resources); current modifications to the ecosystem (uses and infrastructure); human organizations (communities and governments); and frequently most important, psychological-emotional and symbolic elements (such as perceptions, beliefs, values, attitudes, and a sense of place).

Thus, to understand ecosystems, we need to understand them in terms of both human (socioeconomic) and biophysical systems. We need to understand the reciprocal relations between the two systems—how the biophysical environment affects people as well as how people affect the biophysical environment.

Human influences on biophysical processes and conditions of ecosystems include past actions and choices, current actions and policies, and management to achieve future desires. Even the choice to prohibit or minimize human influence (as in a wilderness) results in human influence on the ecosystem.

Biophysical aspects of ecosystems affect humans by providing opportunities and imposing limits. Biophysical characteristics or features may impose costs that are too high for the benefits gained. Or, they may provide a setting and the resources for efficient use and enjoyment of natural resources. These influences should be described as part of the context of the watershed where they play a major role in the past, current, and future function of the ecosystem at the watershed scale.

This paper suggests focusing on two areas that will facilitate the analysis of a watershed: the ecological systems that comprise a watershed (and of which it is a part at a larger scale) and the values and benefits a watershed provides to people. Figure 1 provides a brief overview of important human-biophysical interactions within ecosystems. Arrows indicate the factors that influence the various actions and conditions that occur in each box. The box in the lower right corner represents all the biophysical interactions covered in the guide.

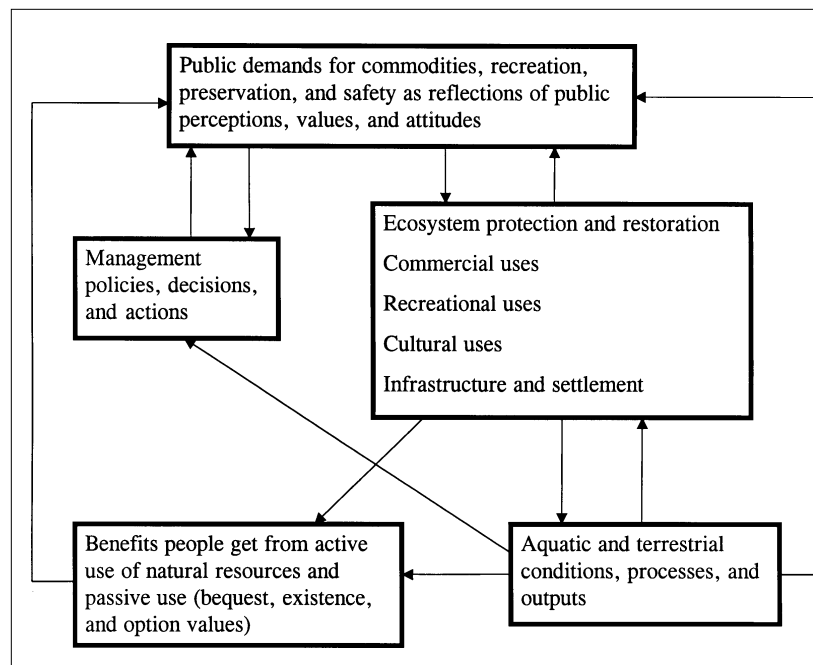


Figure 1—System diagram for an ecosystem with emphasis on human interactions.

## Assumptions

The human-dimensions domain as presented here consists of five modules: off-site passive uses, commercial uses, recreation, infrastructure and settlement, and culturally motivated uses (table 1). Each module and the assumptions specific to it will be discussed in more detail later in this document. There are some general assumptions that apply across modules and need to be recognized at the broader level of the human-dimensions domain.

**Systems**—Ecosystems are composed of both socioeconomic systems and biophysical systems. Socioeconomic systems, like biophysical systems, can be analyzed in terms of their structure, process, scale, diversity, trends, and condition. The socioeconomic influences on an ecosystem may be as complex as its biophysical parts and functions.

**Systems exist in a hierarchy of scales**—Socioeconomic systems, like biophysical systems, exist at a hierarchy of scales. Ecological processes, whether socioeconomic or biophysical, cannot be fully understood by examining a system at a single scale. This is particularly true for socioeconomic processes; the socioeconomic influences on the biophysical aspects of a forested watershed usually come from socioeconomic systems at (several) larger scales and result in influences that ripple out across several smaller scales.

For example, looking at the socioeconomic system operating at the scale of an unpopulated, headwaters watershed common to much of the Pacific Northwest, we would see few human residents and few changes to the watershed overall caused by those residents. But, at a multicounty region scale, the socioeconomic system is active in the watershed with industries that use resources from its forests, lands, and waters, and with recreationists who desire certain qualities and experiences from their visits to the watershed. At a national scale, the socioeconomic system also influences the ecosystem of the watershed with a national market for wood, minerals, and energy; national

**Table 1—Human uses and influences**

On-site uses	Off-site uses
Commercial uses:	Bequest value
Hunter outfitter	Existence value
Fisher outfitter	Option value
Special forest products	
River raft guides	
Campground development	
Minerals development	
Hydropower development	
Ski area development	
Timber harvest	
Grazing	
Irrigation	
Energy development	
Recreation:	
Hunting	
Fishing	
Gathering	
River rafting	
Camping	
Mining	
Hiking	
Driving	
Photography	
Cultural uses: <sup>a</sup>	
Hunting	
Fishing	
Gathering	
Religious use	
Historical	
Contemplative use	
Infrastructure and settlement:	
Utility corridors	
Communication sites	
Water sites	
Residences	
Roads	
Communities	
Land uses	

<sup>a</sup> Because there are treaty rights and laws that apply to American Indians' use and access, applicable treaties and laws should be consulted to better understand cultural uses and to assure compliance.



sentiments about how it should look and be protected; and national laws, regulations, and policies about air and water quality, fish and wildlife habitat, and forest management.

**Watershed benefits and values**—To facilitate analysis of the human dimension in a watershed, we suggest examining how people value and use the watershed. The benefits and values of a watershed can be defined as those things (some) people regard as good or beneficial. Values motivate people to do things in a watershed (or to have things done). We see human values reflected in past, present, and proposed management policies and activities and public uses in a watershed.

Any specific value is not held equally by all; people often disagree over the relative goodness of or benefit to be derived from management activities, commodities, opportunities, and present and future uses. When describing watershed benefits and values, it is therefore important to indicate which people (which communities of interest and which communities of place) share particular values. Whether widely or narrowly shared, values motivate human actions (and human restraints) in watersheds. To understand how a watershed works from an ecosystem perspective, information on the human motivations that can be inferred from past, present, and possible future actions is essential.

**Analysis assumptions**—The analysis outlined here in the six-step process, and later in the human-dimensions modules, is both essential to understanding the ecosystem of a watershed and limited in what it attempts to do. Although the human-dimensions modules are not specifically written to different levels of detail, the analyst has latitude to tailor the level of detail to the needs of a particular analysis. The following assumptions will help in finding the balance between what is essential now and what can occur later.

The purpose of watershed analysis is not the development of a watershed plan but rather the development of an improved understanding of important elements of the ecological structures and processes of the watershed. The essence of watershed analysis is to gain an understanding of how ecosystem elements of the watershed (both biophysical and socioeconomic) interact; how the watershed got to its current condition (socioeconomic and biophysical conditions); and to describe activities that would improve, restore, or halt the decline of aquatic and terrestrial processes and conditions in the watershed.

The purpose and need for information about reciprocal relations within and across biophysical and socioeconomic processes derives from this basic purpose. To understand the causal relations among biophysical elements of the ecosystem of the watershed, we need to know about socioeconomic processes that have directly affected biophysical processes and conditions. We need to know how anticipated socioeconomic processes may affect future biophysical conditions. We also need to understand how the watershed affects people—the opportunities provided and the importance of the watershed for various human uses and values. This understanding will give us insight into potential conflict between stakeholder expectations and behavior, and agency desires to implement restoration and other management activities. Analysis of the benefits of management alternatives, the value of different (and competing) resource uses, and the social effects of different management choices is deferred to project and other planning processes, which may follow watershed analysis.

**Assumptions about terminology**—The most useless (and often unnecessarily contentious) arguments happen when people mean the same thing but use different terms to describe it, or think they are saying the same thing when they are actually using the same words quite differently. With that in mind, we will clarify our use of the terms ecology and ecosystems.

Whereas an ecosystem can be divided into those parts that are principally biophysical and those parts that are especially human, both are integral parts of the ecosystem. This reality often does not carry through in how people use terms like “ecosystem.” Sometimes “ecological” and “ecosystem” are used in ways that exclude people, especially in casual conversation. For the purposes of ecosystem management, a more current (and empirically valid) use of these terms includes people and their actions. In our discussion here, the human dimensions are an integral part of the ecosystem and its ecology.

## **The Six-Step Process**

### **Step 1: Characterization**

Using the guidance provided in the modules, describe the important socioeconomic processes affecting and affected by the watershed. What did people do in the watershed in the past? What do they do there now? What major impacts have people had on the watershed in the past? What impacts are they having currently? What makes the watershed important to people at different scales (locally, regionally, state-wide, and nationally)?

In what ways are these characteristics similar to or different from other watersheds in the basin? What are the ownership and land use patterns? What is the history of development and use in the watershed?

### **Step 2: Issues and Key Questions**

In general terms, identify socioeconomic issues and key questions that respond to two questions: What are people currently upset or happy about? and What is coming down the pike?

To expand on these two questions and help fit them into watershed analysis, we might ask several supplementary questions: What do people say they are upset or happy about, and what underlying values are being expressed? Are there conflicting values? Are there groupings of commonly held values? What are the foreseeable pressures on this watershed from people, many of who likely will live outside the watershed, some far away? In some cases, the issues may be best understood in the context of communities of interest.

Many questions about the management of forest watersheds cannot be appropriately answered in watershed analysis. These include questions (and issues) about the economic efficiency of management practices, the management of individual sites, the changes to management prescriptions, and the tradeoffs involved in decisions that alter human uses. Although watershed analysis may generate some data and information relevant to these issues, many of these questions are too specific for watershed analysis and need the more site-specific environmental analysis done for proposed projects (National Environmental Policy Analysis). Important questions and issues identified, but not dealt with in watershed analysis, should be documented for subsequent analysis under “Step 6: Recommendations.”

**Step 3: Current Conditions**

The human-dimensions modules provide guidance in reporting key aspects of reciprocal relations between socioeconomic and biophysical processes.

**Step 4: Reference Conditions**

Information on prehistorical and early historical human use can improve our understanding of both the effects early humans had on biophysical systems and their cultural use of watersheds. It is primarily the relatively recent history of human use that is relevant to understanding reciprocal influences. Reference conditions as used in the guide are a biophysical concept. The concept of reference conditions is based on an assumption that the conditions that prevailed before “significant” human intervention were the result of processes unimpaired by human intervention. Because the ecosystem evolved under those conditions, it is assumed that these conditions represent a sustainable, healthy process. The assumption is further made that deviations from an identified historical range represent warning signs. From a socioeconomic perspective, for most of society, it is deemed desirable to move from prehistorical conditions; that is, away from subsistence lifestyles to higher levels of income, wealth, and creature comforts. For this reason, reference conditions as used in the guide have no counterpart in human dimensions. It is important when describing biophysical reference conditions to include the level and degree of human interaction with the biophysical elements during the reference period.

**Step 5: Interpretation**

Once you have described the important past and current human interactions with the watershed in steps 1, 3, and 4; developed information on anticipated trends affecting human pressures on the watershed; and accurately portrayed the issues in step 2, you are ready for step 5.

Working with other members of the watershed analysis team, develop a narrative that describes the conditions, causes, and mechanisms that have led to the current biophysical and socioeconomic conditions in the watershed. Make sure that human influences and interactions are accurately incorporated into this understanding of the watershed.

**Step 6: Recommendations**

Working with other members of the watershed analysis team, strengthen the development and presentation of management actions that will improve (or halt the decline of) aquatic and terrestrial processes and conditions in the watershed while limiting conflicts with existing uses to the extent feasible. The most important contribution to the recommendations will be to note (1) if these management actions will be consistent or will conflict with the current values various communities of interest and communities of place have for the watershed, (2) if these management actions are politically feasible (or more urgently needed) in light of the foreseeable human pressures on the watershed, and (3) what issues need further analysis.

Note that these contributions, although essential in making the watershed analysis a useful tool for management, are not finely drawn analytical conclusions. If these observations cannot be made with confidence from scientifically known relations and the data that are available, the uncertainty should be noted. It is just as important for managers and the public to know that some signs are inconclusive as it is to know that others are definite. These uncertain indications will be essential to look at in subsequent analyses, along with the issues and questions that are not analyzed but carried forward from step 2.

## Additional Considerations

Additional, more general aims of the human-dimensions components of watershed analysis include the following:

**Trends**—The most important information in a watershed analysis may well be information on trends. Data from one period are of little value without other data or discussion that enables us to see a trend in the past and to project one into the future.

**Reciprocal relations**—More specifically, describe the trends of the more important past and present human actions on the biophysical structure and functioning of the watershed. Identify the biophysical contributions and constraints to the human actions. Consider human systems, most specifically communities, at multiple scales. This contributes to “telling the story of the watershed” and provides an understandable context for the issues identified in step 2.

**Current and future trends**—In addition to past trends, describe the more important current and projected future trends relative to human actions that affect biophysical processes and conditions of the watershed and the foreseeable demands for watershed resources and attributes. Identify the biophysical contributions and constraints to these future human uses. Consider human systems (communities) at multiple scales. This helps describe “the future of the watershed” (or more accurately, “the futures of the watershed”). What will be the important socioeconomic pressures on the watershed in the future? How will these pressures affect the watershed? How can management respond to these pressures? How will the public respond to these pressures and the resulting changes?

**Benefits and value of the watershed to humans**—Analyze and interpret the benefits of the watershed to humans, particularly as it relates to specific issues and opportunities identified in step 2, and in the presentation of possible management actions in step 6. Identify, as appropriate, the significance of the resources, uses, and conditions of the watershed to stakeholders. Identify the impact of potential changes in the watershed to those stakeholders (including communities near and far and American Indians).

The value of the watershed to humans is expressed in terms of benefits and uses. Benefits to people are those aspects and components of the watershed that people find desirable. When people receive or capture a benefit from the watershed, we say that they have made use of it. Uses, in the way we are using the term here, include all the ways that people interact with and within the watershed, no matter what the motivation. In the modules in table 1, we include commercial uses in which people hope to earn a profit, as well as recreational and cultural uses that are satisfying in themselves. We also include off-site passive uses in which people receive benefits not through actively exploiting or visiting a watershed, but through the satisfaction in knowing that it exists or that it remains for future generations or uses. All these uses and benefits motivate people in their interactions with the watershed and in their preferences for how it is managed. These benefits and uses are crucial information for managers to know about a watershed to understand what “makes it tick” and to visualize a general management approach to the watershed.

## Map and Data Needs

Although much social and economic data are available, watershed analysis is not an invitation to compile them all and then attempt to rigorously analyze them. Often much of the data that are available are not at the appropriate scale to answer key questions. Data compilation and mapping should be commensurate with the need for information to answer the key questions and address the important issues identified in step 2, and it should be at the appropriate scale.

An efficient way to start compiling information on relevant human dimensions is to see what is available from Forest or District planning efforts. Additional information is sometimes available from state, county, and city planning offices. More specific guidance is provided in the human-dimensions modules on data collection, compilation, and interpretation.

As with data collection, more information can be mapped than is needed to achieve the purposes of watershed analysis. Mapping of human-dimension components (other than infrastructure and settlements and management areas), however, has not been widely done in forest management analyses. Watershed analysis teams are encouraged to consider mapping other human-dimension elements at the scale that aquatic and terrestrial information is recorded. Mapping sites that are special to people, important scenic vistas and viewpoints, and unique features can aid in understanding how people interact with the watershed.

Significant human effects on the watershed come from socioeconomic processes that extend beyond the watershed. Smaller scale maps can be used to record and display this information. Information such as population densities, highway travel densities, and county land use zones can provide useful information for analyzing trends and influences. Where this information is currently available on maps, it is not necessary to transfer it onto maps of a different scale unless it would serve a particular purpose.

## Relevant Modules

Table 1 provides a way to group types of human actions based on the human motivation for those actions. One implication of this approach is that some activities are displayed more than once because people with different motivations may engage in the same activity. Hunting, for example, may be both a recreational activity and a cultural activity. Although this may be inconvenient with respect to the way data are commonly available, the characteristics that are important to people and the impact the activities have on biophysical processes and conditions may differ significantly depending on the motivation for the activity. The five modules that result from grouping activities in this way are off-site passive uses, commercial uses, recreation, infrastructure and settlement, and culturally motivated uses (table 1).

Hunting and gathering to augment household resources do not fall neatly within our categories. These activities can be a significant component of household resources. They may be engaged in for various recreational, cultural, and commercial motivations. Hunting and gathering can be significant uses of a watershed and should be documented.

## Definitions

**Off-site passive uses**—The enjoyment, appreciation, or contemplation of a site, resource, or ecosystem that a person experiences without actually being physically at the place or in direct contact with it are off-site passive uses. These uses can include such activities as thinking about a resource or place and feeling good that it exists; knowing that the heritage of one's people, culture, or country is being preserved; looking at pictures, reading books, or watching movies or videos about a resource or place for enjoyment or education; and incorporating the known existence of a resource or place into one's cultural or religious ceremonies and traditions, even when not actually at the site.

**Off-site passive use values**—These values are based on economic, psychological, or spiritual benefits. Off-site passive uses are generally categorized as follows:

- Existence value—The worth one places on the fact that a resource or place exists, without having to be there physically to experience or enjoy it, now or in the future.
- Option value—One’s willingness to pay to ensure the option of potential future active use; that is, to assure that one may actually be able to visit or otherwise actively use a resource or place in the future (similar to an insurance premium).
- Bequest value—The worth one places on the assurance that a resource or place will continue to exist to be enjoyed in the future by children or grandchildren (future generations).

**Commercial uses**—Commercial uses are those that are engaged in by someone to provide goods or services to others with the expectation of earning income from the activity. These are distinguished from cultural and recreational use, which generally provide goods or services to the user.

## Off-Site Passive Uses Module

### Purpose

1. Identify and characterize the off-site passive uses and values associated with the watershed, watershed features, cultural or heritage sites and properties, or extractive products from the watershed.
2. Describe how individuals or groups (communities of interest or communities of place) holding off-site passive use values may affect potential management actions designed to improve or halt the decline of watershed processes and conditions.

### Assumptions

1. People value certain landscapes and ecosystems (or associated components) and the existence of cultural and heritage sites from afar, without being on-site.
2. Existence values are held even though a person is not on-site and may not see or visit the place, feature, or component valued.
3. Passive use values may be closely associated with other traditional culturally motivated values, such as those held by American Indians.
4. Passive use values have an important influence on resource and ecosystem management legislation and policy. Thus it is important for decisionmakers and managers to be aware of these values and their source (for example, biodiversity, spotted owls [*Strix occidentalis*], old-growth forests, wilderness, salmon, and unusual or unique landscapes and features, such as Mount Rainier or Old Faithful).

### Data Needs

1. Evidence of off-site passive use values from media articles and reports, formal surveys, personal interviews, public input to decision processes, or other anecdotal information.
2. Estimates of the relative magnitude and intensity of off-site values, and those communities of interest who hold them (quantification is not needed unless it is easily obtainable from existing studies).
3. Any survey or anecdotal evidence that indicates whether off-site passive use values will increase, decrease, or remain relatively constant in magnitude and intensity over the next 10 to 20 years.

### Products

1. A discussion of the off-site use values likely to be most relevant to the watershed, and their relative importance.
2. Identification of individuals, groups, or other communities of interest who hold these values.

	<p>3. A discussion of the anticipated social changes likely to make certain off-site uses of the watershed substantially more important or substantially less important in the future.</p>
<b>Procedures</b>	<ol style="list-style-type: none"> <li>1. Review existing reports and public input to agency decisionmaking processes.</li> <li>2. Review media sources.</li> <li>3. Conduct informal interviews.</li> <li>4. Review formal surveys, if pertinent.</li> <li>5. Summarize and integrate information.</li> </ol>
<b>Commercial Uses Module</b>	<ol style="list-style-type: none"> <li>1. Describe the important past and current commercial uses of the watershed and the role of the watershed in providing for those uses.</li> </ol>
<b>Purpose</b>	<ol style="list-style-type: none"> <li>2. Identify the areas in the watershed where those uses have taken place, are currently taking place, may be permitted to take place in the future, or where they are currently permitted but may be restricted in the future.</li> <li>3. For each use, identify the places where use may be permitted by categories that indicate the commercial value of that use relative to its commercial value in other locations; that is, is this a highly valuable or a barely commercial activity.</li> </ol>
<b>Assumptions</b>	<ol style="list-style-type: none"> <li>1. Commercial uses have affected biophysical processes and conditions in many watersheds.</li> <li>2. Information on the extent of commercial use will be useful in trying to understand the reciprocal relations between biophysical and sociocultural changes.</li> <li>3. The relative economic value of commercial use depends on the difference between the value of resources and the cost of development, both of which may differ widely among different areas of the watershed.</li> </ol>
<b>Data Needs</b>	<ol style="list-style-type: none"> <li>1. For commodity production activities such as timber harvest, (1) the locations where commercial activities occurred, or are currently occurring, summarized by activity and decade or other more relevant period; and (2) measures of quantity and type of harvest relevant to describing socioeconomic benefits and impacts on biophysical elements of the watershed.</li> <li>2. For other commercial activities such as river raft guiding, similar data in whatever units are most relevant to understanding the benefits to people and the effects of those activities on biophysical elements of the watershed.</li> <li>3. Where practicable, data on the relative commercial value of resources in those areas where commercial development may be permitted.</li> <li>4. Where practicable, data on the relative cost of development of commercial uses in those areas where commercial development may be permitted.</li> <li>5. Data on trends in markets for commercial uses that are likely to affect the watershed. The more important ones include those commercial uses that are or could be significant uses in the watershed. Pay particular attention to commercial uses that will be serving social groups that, because of proximity or demographic changes, are likely to exert increased pressure on the watershed. Commercial recreational services in the rural-urban interface and demand for permits for commercial harvest of special forest products are possible examples.</li> </ol>

**Products**

1. Discussion of historical commercial uses by activity, location, and period, including supporting graphs, tables, and maps.
2. Description of anticipated trends in commercial uses.
3. Maps showing general or specific locations for potential commercial use over the next 10 to 20 years.
4. Maps showing the relative value (may be only high, medium, or low) of resources in those areas where commercial development may be permitted.
5. Maps showing the relative cost (may be only high, medium, or low) of future development of commercial uses in those areas where commercial development may be permitted.

**Procedures**

1. Historical data for commercial uses on Federal lands will come primarily from agency records. Disaggregation of data that do not correspond with watershed boundaries will be a common problem. Commercial use data for non-Federal lands in the watershed may be available through other government agencies or may be difficult or impossible to obtain.
2. Value and cost information will come primarily from agency resource specialists and agency resource data. Economic values should be based on the potential quality and quantity of the commodity, good, or use produced. Cost should include extraction, agency permitting and administrating, mitigation, and effects on other values in the watershed. Only areas that could reasonably be considered economically viable by potential commercial users should be mapped and rated.
3. Information on trends will come from various places including the public media; scientific literature; state, city, and county planning documents; and informal interviews with knowledgeable experts.
4. There may be insufficient data to assess the relative economic value and development costs for some potential commercial uses. For example, the development costs of a proposed hydroelectric site, and the expected revenues to be generated from that site, may not be possible to assess until a more site-specific analysis is done as part of a license application or National Environmental Protection Act analysis.

**Recreation Module****Purpose**

1. Identify and describe the historical, current, and expected future recreational uses of the watershed.
2. Identify and describe access and travel routes and associated facilities for recreational uses of the watershed.
3. Describe the role the watershed plays in providing recreation opportunities for the local and regional populace.
4. Identify and describe the impacts on watershed biophysical processes and conditions that recreation use and associated roads, trails, and other facilities have had, are having, or may have in the future.

**Assumptions**

1. Data on recreation use are available through the Recreation Resource Information System or similar use reporting systems.
2. If quantitative data are unavailable, quantitative and qualitative estimates are available from local field personnel, area recreationists, and other sources.



3. Access and travel routes and associated facilities are known and mapped (see also human dimensions-infrastructure and settlement module).
4. Types of recreation use and places people recreate in the watershed are known.
5. Recreation use trend estimates are available from State Comprehensive Outdoor Recreation Plans or other sources.

**Data Needs**

1. Historical and current recreation use data by recreation type and recreation experience level.
2. Information on types of recreation activities in which people engage, where they occur, and what components of the landscape or ecosystem they affect.
3. Mapped location and description of special land allocations (wilderness, developed ski areas, wild and scenic rivers, etc.), recreation experience opportunity types (Recreation Opportunity Spectrum) (Clark and Stankey 1979), roads (by maintenance-service level), trails (by use type), and developed and dispersed recreation sites.
4. Location and description of unique or special areas or features for recreation opportunities and experiences that draw people to the watershed or may do so in the future.
5. Local-regional population and demographic data and trends.
6. Expected trends in future recreation types and participation rates related to existing or possible recreation use of the watershed.

**Products**

1. A narrative summary of recreation use in the watershed; contribution of the watershed to supply of recreation opportunities for the locale and region; expected future recreation demand for the watershed or river basin; access and travel infrastructure and use patterns; potential implications of future recreation use in the watershed on management actions designed to improve or halt the decline of watershed biophysical processes and conditions; and potential implications on recreation use of management actions such as road closures that may be suggested as a means to improve the condition of the watershed.
2. Maps, graphics, and tables that support, clarify, and help explain the narrative discussion.

**Procedures**

1. Collect as much of the above data as possible that are relevant for exploration and discussion of the issues identified in step 2.
2. Using these data, answer the key questions for recreational use and associated access and travel routes and facilities in the watershed.
3. Identify historical, current, and expected future recreation patterns and trends.
4. Assess the implications of future recreation demand and use in the watershed for management actions designed to improve or halt the decline of watershed biophysical processes and conditions.
5. Assess the implications of management actions designed to improve or halt the decline of watershed biophysical processes or conditions for recreation opportunities. Estimate socioeconomic costs of management actions on recreation.

## **Culturally Motivated Uses Module**

### **Purpose**

1. Identify and describe the prehistorical, historical, current, and expected future culturally motivated uses of the watershed. Differentiate recreational and commercial development activities and include these under separate modules where possible.
2. Identify and describe institutional structures including laws and policies that define, protect, regulate, or otherwise address culturally motivated uses. Include treaties and laws that relate specifically to American Indian cultural interests.
3. Identify and describe access and travel corridors and associated support facilities and activities related to the culturally motivated uses of the watershed.
4. Describe the role the watershed plays in providing culturally motivated opportunities for the local and regional population, particularly American Indians, and note any concerns or opportunities of national or international significance. Identify specific sites or general areas, and associated types of use—gathering of medicinal plants, for example.
5. Identify and map particularly sensitive or special sites. Are there sites that provide opportunities for culturally motivated uses such that either the sites or the opportunities are rare or threatened and such that this could be a factor in the political acceptability of any restoration activity proposed?
6. Identify and map visual land classifications, as these may be a factor in the kind of restoration or other activities that could occur.

### **Assumptions**

1. Development and settlement activities and recreation, although having a cultural component, can be separated out from other culturally motivated activities, and are covered in other modules. Some activities may be both recreationally and culturally motivated.
2. Agencies may have reports on culturally motivated uses, especially uses by American Indians.
3. Anecdotal information about culturally motivated uses can be collected by interviewing agency employees and other key contacts.
4. Future trends can be estimated by looking at demographic trends and past use to identify changes in the number and composition of people who use the watershed for cultural activities.

### **Data Needs**

1. Historical and current culturally motivated use data by type of activity.
2. Mapped locations of areas frequently used for culturally motivated activities.
3. Location and description of special areas important for culturally motivated uses.
4. Local-regional demographic data to help identify changes in the number and composition of users.
5. Visual resource maps.

### **Products**

1. A narrative summary of culturally motivated use in the watershed; impacts to biophysical resources of the watershed from culturally motivated opportunities; expected future demand for various culturally motivated activities; access and travel routes and use patterns and what this means for levels of impact; potential implications of future culturally motivated use in the watershed on management actions designed to improve or halt the decline of watershed biophysical processes and conditions and the potential implications of management actions designed to improve or halt the decline of watershed biophysical processes and conditions on future culturally motivated use.

	<ol style="list-style-type: none"> <li>2. Supporting maps, graphics, etc.</li> </ol>
<b>Procedures</b>	<ol style="list-style-type: none"> <li>1. Collect data by searching for and gathering existing documentation.</li> <li>2. Interview employees of stakeholder agencies, tribal members, and other key contacts familiar with culturally motivated uses and users.</li> <li>3. Relate the information to the key questions.</li> <li>4. Identify historical, current, and expected future patterns and trends.</li> </ol>
<b>Infrastructure and Settlement Module Purpose</b>	<ol style="list-style-type: none"> <li>1. Identify areas of recent and current human habitation.</li> <li>2. Identify broad categories of land uses in the watershed.</li> <li>3. Identify and describe infrastructure located in the watershed.</li> <li>4. Describe the importance of the infrastructure to people within and outside the watershed.</li> <li>5. Describe trends in residential and infrastructure use of the watershed.</li> </ol>
<b>Assumptions</b>	<ol style="list-style-type: none"> <li>1. Other watershed modules that involve discussion of settlement and infrastructure will be coordinated with this module.</li> <li>2. Settlement and land use practices are fundamental to most ecosystem problems considered for watershed restoration activities.</li> <li>3. Proximity is an important criterion for determining relevance of information. The closer the information source is to the watershed, the higher the probability of its relevance to the watershed analysis.</li> <li>4. Because the subject of this module is, in part, the relation to people outside the watershed, data must be considered for people and events beyond the watershed boundaries.</li> </ol>
<b>Data Needs</b>	<ol style="list-style-type: none"> <li>1. Existing Federal land use plans.</li> <li>2. County and local land use plans.</li> <li>3. United States Geologic Survey maps, cartographic feature files, aerial photos, highway maps, local histories, and other sources showing current and past settlement or land use.</li> <li>4. State, county, and local transportation development plans.</li> </ol>
<b>Products</b>	<ol style="list-style-type: none"> <li>1. Map of historical and current human habitation.</li> <li>2. Map of land uses in the watershed such as tilled agriculture, pasture land, industrial timberland, residential land, wildland, etc.</li> <li>3. Map showing infrastructure types and locations.</li> <li>4. Narrative discussing trends relative to past and current conditions of settlement, land use, and infrastructure in the watershed.</li> <li>5. Narrative discussing the importance (if any) of infrastructure to people, industries, and institutions outside the watershed.</li> </ol>

## Procedures

1. Review existing materials prepared from other modules for their content pertaining to infrastructure and settlement.
2. Review existing county plans, local histories, United States Geologic Survey quad maps, highway maps, recreation guides, plans for nearby privately owned land, and land management agency documents.
3. Map areas that contain residences. Isolated residences may be indicated as points. It may be useful to distinguish among permanent and seasonal and current and historical residences.
4. Map locations of infrastructure features such as municipal watersheds; roads and related levels of use; communications sites and related access routes; electric power generation and transmission sites and routes; pipelines; private, municipal, common carrier, and commercial telephone lines, particularly trunk lines; and railroad lines and corridors.
5. Identify historical, current, and expected future patterns and trends in settlement, and trends relating to use of the lands in the watershed. Be alert for the effects of forces outside the watershed such as population growth, highway changes, new visitor destination attractions, introduction and decline of large employment sources, and changes in communication technology.

## Conclusions

Ecosystem management is an attempt to provide humans goods and services within the limits of the natural processes of the ecosystem. Watershed analysis is a component of ecosystem management. Thus, we must understand relations and consequences of relations if we are to achieve management that is economically feasible, ecologically appropriate, and socially acceptable. As described here, the goal of watershed analysis is improved understanding of the biophysical and socioeconomic structures, processes, and reciprocal relations of the watershed. This understanding must be based on knowledge of how conditions and uses have changed over time; activities that would improve, restore, or halt the decline of biophysical processes and conditions and the corresponding socioeconomic costs and benefits of these activities.

We hope that the modules offered here will provide a framework that will be useful to those conducting watershed analysis.

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