White Paper

Economic Values of National Park System Resources Within the Colorado River Watershed

Final

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Executive Summary

For purposes of planning and participation in water resource allocation decisions, the National Park Service (NPS) needs to know the economic values of the resources it manages within park units along the Colorado River system (including major tributaries). **At present, the NPS does not have recent or comprehensive values to represent their current water-related activities within these Colorado River park units.**

This white paper summarizes how Colorado River water allocations are made, describes the types of economic values provided by Colorado River resources (natural, cultural, recreational) managed by the NPS, and discusses how alternative allocations of Colorado River water may affect those economic values. The economic values described here include welfare measures (market, non-market, use, and non-use values) and regional economic impacts. The last section of the paper presents a recommended approach to estimating the economic values of certain NPS resources along the Colorado River, as well as incorporating other available economic values associated with the river (i.e., values for hydropower, agricultural, and municipal and industrial uses).

This approach would estimate the following types of economic values associated with water allocations on the Colorado River:

- direct recreational use values for water-related activities in Colorado River park units
- nonuse values associated with the public's preferences for conservation of Colorado River resources managed by the NPS
- regional economic impacts resulting from water-related visitor use of Colorado River park units including output, jobs and income

This approach would also identify the most significant marginal use and nonuse values for a set of alternative management schemes and water allocations and flows in the basin. These marginal values would be integrated into existing hydrological models of the Colorado River system, including development of a user-friendly model for policy analysis. Users would be able to evaluate the impact of alternative water allocations on the use of National Park System resources and other significant uses along the Colorado River.

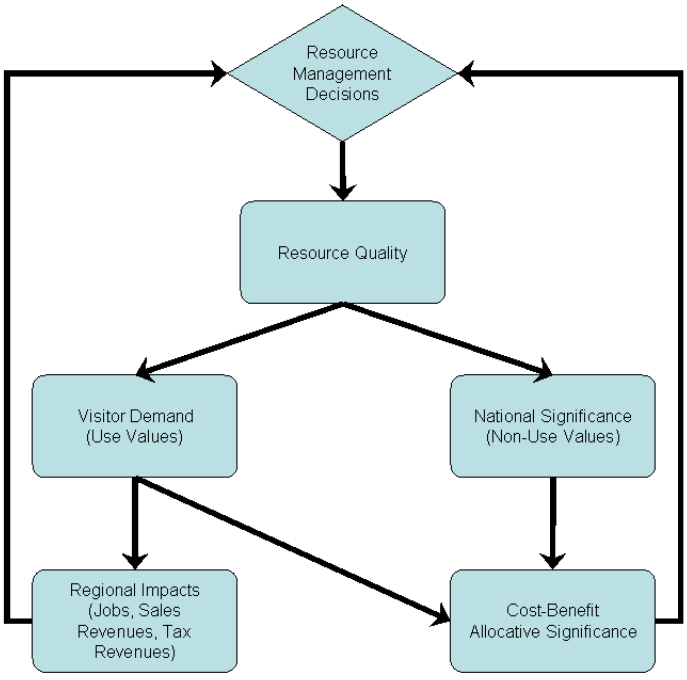
In evaluating these economic values, it's important to understand the linkage between the National Park System resources and the economy (Figure 1).

Use values demonstrate the linkage between resource quality and local economic activity. The economic demand for the direct recreational use of these resources is amenity-driven. People visit the Colorado River system and the NPS units found there because of quality amenities including scenic vistas, geologic features, and water, wildlife, archeological, cultural, and biological resources. This demand also generates

visitor spending in local communities, which yields jobs, sales revenue, and tax revenues. Those regional impacts, in turn, influence resource management decisions due to their salience with local communities. Accordingly, through the link to amenity-driven direct recreational use, the NPS mandate to preserve natural resources can significantly benefit regional economies. Therefore, estimates of use values and regional impacts are both indicators of the effectiveness of resource management.

Non-use values demonstrate the national significance of park resources. The conservation of river related resources in park units and their values relates to nonuse values, which are not associated with direct on-site resource use. Rather, those values obtain from the knowledge that resources exist in a viable state, or will be preserved in a given state for future generations (i.e., the motives of existence and bequest). For example, many individuals may want future generations to also be able to enjoy the rich heritage of our national parks. Non-use values also relate to the public enjoyment of park resources and values since the public includes both people who directly experience parks on-site and those who enjoy them from afar. These two basic linkages between quality amenities and the economy (amenities-visitation-regional economy and amenities-use and nonuse) also correspond to the two primary economic accounting systems appealed to in policy and management decisions: regional economic impacts (jobs and income) and welfare impacts (comparison of social benefits and costs).

Figure 1: Linkages between resource quality, economic values, and resource management.



These fundamental linkages between amenities and the economy also directly relate to the twin mandates that guide National Park System management from the NPS Organic Act (16 U.S.C. 1) and the Redwood Act (16 U.S.C. 1a-1). Those mandates establish the fundamental purpose of the National Park System as conserving park resources and values, and providing for their enjoyment by the public. The conservation of park resources and values directly relates to nonuse values through the motives of existence and bequest. Protecting amenity and resource values similarly drives visitor demand and enjoyment and beneficially impacts regional economies.

The Colorado River and its tributaries are the most significant sources of freshwater in the arid Southwestern United States, supplying approximately 15 million acre feet of highly valued western water and supporting the following beneficial uses:

- irrigated agriculture in some of the most productive growing areas in the U.S.
- municipal and industrial water to several of the West's largest cities
- hydroelectric developments at numerous dams, including Glen Canyon and Hoover Dams, and millions of dollars worth of electric energy annually
- river and reservoir related recreation for millions of visitors
- viability of important water-related ecosystems, biota, and cultural and archeological resources

The Colorado River corridors and reservoirs, particularly through Glen Canyon and the Grand Canyon, as well as upstream on the Green and Gunnison, are among the most highly valued natural resources of the United States for their recreational, cultural, aesthetic and ecological services (National Research Council, 1996).

While economic analysis of NPS-related values has been undertaken in the last twenty years for the Colorado River below Glen Canyon, these previous studies primarily focus on just the river corridor in Grand Canyon National Park. River regulation at Glen Canyon Dam also impacts water levels at Lake Powell (Glen Canyon National Recreation Area and Rainbow Bridge National Monument) and at Lake Mead (Lake Mead National Recreation Area), which also contain major recreational and natural resources. Additionally, other NPS units are also influenced by the operations of upstream and proximate dams and reservoirs. Recognizing this, the main National Park System units that would be included in the proposed research are the following:

- Grand Canyon National Park (river corridor focus)
- Glen Canyon National Recreation Area
- Rainbow Bridge National Monument
- Lake Mead National Recreation Area
- Black Canyon of the Gunnison National Park
- Canyonlands National Park
- Curecanti National Recreation Area
- Dinosaur National Monument.

Economic analysis of NPS values and the relationship to water allocation has, in general, been even more limited at the other units relative to the Grand Canyon river corridor.

The allocation of Colorado River water, as embodied in the "Law of the River," is an ongoing, dynamic process. That process responds to changing inflows in the short term, and, in the longer term, evolving societal values relating to natural resources, including endangered species and ecosystems, as well as accumulating knowledge on the actual physical and hydrological entity being managed. For example, understanding the influence of river flow levels and water quality (including temperature) on both sediment management and endangered fish in the Grand Canyon is still evolving. It appears that ongoing and future allocative issues related to hourly, monthly, seasonal, and annual time scales will affect NPS values in the Colorado River watershed. An understanding of those values and how they are impacted by river allocation decisions will improve the decisions that are made.

In the past, the primary issue on which NPS values were explicitly recognized and quantified was on flow management decisions (as embodied in the 1996 Record of Decision on the operation of Glen Canyon Dam). The focus of these decisions has been on the river corridor through the Grand Canyon National Park and Glen Canyon National Recreation Area. Some current policy and allocative issues require a larger spatial scale, at least including the two-reservoir and river corridor system (Lake Powell, the Glen Canyon and Grand Canyon river corridor, and Lake Mead). Additionally, there are some parallels to the system centered around Glen Canyon Dam elsewhere in the basin. For example, river flow regulation, recreation, and endangered fish, are ongoing issues of concern for the river corridors below Flaming Gorge and the Aspinall unit on the Green and Gunnison rivers, respectively.

There are very significant use and non-use values associated with NPS resources along the Colorado River including the following:

- Colorado River park units support about 20 million recreational visits per year
- values have been estimated for some specific visitor uses, such as whitewater boating in the Grand Canyon, at over $200 per trip
- from a regional economic impact perspective, park visitors in 2005 spent approximately $1.0 billion in the local area of these Colorado River park units
- this spending supports thousands of jobs.

These values are not only large in aggregate, but also in marginal terms across the range of policy-relevant changes in environmental parameters that have been closely examined in the past, including river flows (such as beach/habitat building flows), and visibility. For example, based on the 1995 Environmental Impact Statement that evaluated changes to operation of Glen Canyon Dam (Reclamation 1995), the nonuse values associated with river flows along the Colorado River corridor through the Grand Canyon and Glen Canyon were estimated to be on the order of $2.2 billion annually. The relative marginal values also appear to be potentially large for other resources including, for example, reservoir levels at Lake Powell and Lake Mead, and influences on endangered species.

The basic conclusion of the paper is that there is a need to estimate economic values associated National Park System resources along the Colorado River to help facilitate water allocation decisions. A recommended approach is described in the last section of

the paper. While this white paper (Phase I of the overall project) provides a cursory overview of the relevant economics literature, the logical approach to achieving the study goals is to proceed in three additional phases as follows:

- Phase II. Review existing literature and data
- Phase III. Conduct original research.
- Phase IV. Integrate and communicate.

Phase II- Review existing literature and data. This phase of the project involves collecting all existing and available data and studies that are relevant to the estimation of economic values for resources managed by the NPS (and other entities) along the Colorado River system. Much of the relevant economics literature has already been collected and summarized for the Phase I white paper. However, additional data on park visitation and dam and reservoir operations would be collected from the NPS, Bureau of Reclamation (and other entities as appropriate). That data would include management documents and technical reports. Additionally, relevant data and studies for resources and settings that are similar to those found along the Colorado River would be surveyed to identify possible value estimates for use in benefits transfer analyses.[1] This information would then be synthesized to present as complete a set of economic values as possible for relevant resources along the river. This analysis would also identify data gaps that must be filled using original research techniques. A written report will identify study findings in this phase.

Phase III- Conduct original research: This phase of the project involves filling the data gaps identified in Phase II. Initial research efforts for this phase will be focused on the major two-reservoir and river corridor system that includes Glen Canyon National Recreation Area, Grand Canyon National Park, and Lake Mead National Recreation Area. This study area is where much of the hydropower is produced along the Colorado River system, and where most of the water-related visitor use occurs. This study area is also significant in that it encompasses the location where the allocation of water between the upper and lower basin states occurs. Finally, this area contains resources of national and international significance which is relevant to non-use values.[2]

Phase III includes three survey efforts:

- a survey of recreational visitors to estimate use values and expenditures in the study area
- a survey of residential populations in the multi-state area surrounding the Colorado River to estimate nonuse values
- a survey of national households to estimate nonuse values

Direct recreational use values will be estimated using a random utility model. This approach would require surveying recreational visitors to Lake Powell, the river corridor in Glen and Grand Canyons, and Lake Mead as well as in other areas that are major

[1] Benefits transfer involves using economic values that have been previously estimated and reported in existing studies to address similar issues in other contexts.

[2] For example, Grand Canyon National Park was designated a World Heritage Site by the United Nations in 1979.

substitutes for these areas. These would likely include Black Canyon of the Gunnison National Park, Curecanti National Recreation Area, Dinosaur National Monument, Canyonlands National Park, Flaming Gorge National Recreation Area, Navajo Reservoir and popular floating sections on the Green, Upper Colorado, and San Juan rivers. Survey respondents would be recruited by a combination of on-site visitor contacts and random digit dialing. Surveys would be implemented by a combination of mail and phone methods.

The second and third survey efforts would be conducted to estimate non-use values along the Colorado River system corridor on a regional level, and on a national scale. The specific set of resources and attributes that would be valued in these surveys will be identified in this phase. The nonuse values study will focus on resource attributes impacted by water allocation decisions, potentially including endangered fish, beach/habitat enhancement, archeological and cultural features, and other ecosystem services and resources. Welsh et al. (1995) found significant differences between the non-use values held by people within the Glen Canyon Dam hydropower marketing area and those held by people nationally. Therefore, a similar stratification is recommended for this project. For each sampling area, a survey would be conducted to estimate non-use values for the study area using conjoint analysis. This approach is considered state of the art and is endorsed by the National Research Council (2005). These surveys would be implemented by phone or Internet-based methods, or a combination of the two approaches.

All three survey efforts would involve the use of focus groups in the development of survey instruments, and would rely on professional survey research firms. Peer review of survey instruments, sampling designs, and reports would be required. Additionally, the survey instruments and sampling plans would require information collection review and approval by the Office of Management and Budget (OMB).

The main research products from this phase will be:

- estimated economic values associated with direct recreational use
- estimated visitor expenditures and regional economic significance
- nonuse values for key system resources and attributes.

Phase IV. This phase provides integration of Phase II and III results with hydrological models of the Colorado River system. This will support estimates of marginal use and nonuse values and regional economic impacts associated with different river and reservoir management alternatives. The regional economic impact analysis will focus on the primary two-reservoir and river corridor study area including Glen Canyon National Recreation Area, Grand Canyon National Park, and Lake Mead National Recreation Area. This analysis will include changes in direct expenditures as well as the multiplier effects that ripple through the economy. The economic values provided by NPS resources along the Colorado River will be compared to other economic values associated with the Colorado River (e.g., hydropower, water storage, irrigation water uses, urban water uses).

This work will produce a user-friendly analysis tool that will enable NPS staff and other agencies to calculate the changes in the economic values of resources that result from

alternative operating scenarios and water levels. Users will input water allocation changes (flows and reservoir levels) and output will describe economic effects, based on both benefit-cost and regional economic accounting frameworks. This model will distinguish short term and long term effects. In the short run, there are no adjustments to National Park System facilities. In the long term, there would be adjustments to National Park System investments in facilities such as number and location of marinas and boat ramps, to best accommodate the economic opportunities available in a given flow regime. The main research products from this phase of the study are:

- a user friendly analysis tool that identifies marginal values and regional economic impacts of alternative management schemes
- a technical document that fully describes the background, methods, data, and results of this project
- a non-technical document that is understandable and relevant for the general public.

The time frame for this recommended approach is three years. The key assumption in this schedule is that the required Office of Management and Budget approval of sampling plans and survey instruments will be achieved in seven months. On the assumption that the work will be contracted through the Rocky Mountains Cooperative Ecosystems Unit (RM-CESU), a line-item budget has been developed based on current and projected salary, fringe, and other budget parameters at the University of Montana. The total budget for Phases II-IV of the recommended approach is $1,340,515.

I. Introduction

For purposes of planning and participation in water resource allocation decisions, the NPS has a need for the evaluation of the economic values of resources it manages along the Colorado River (and major tributaries). This white paper summarizes how water allocations are made within the Colorado River system, describes the types of economic values provided by the NPS along the river, and discusses how alternative allocations of Colorado River water may affect those economic values. The economic values described here include welfare measures (market, non-market, use, and non-use values) and regional economic impacts. The last section of the paper presents a recommended approach to estimating the economic values of resources within Colorado River park units. This paper was produced as Phase I of potentially a four phase project.

The study focus is on the major two-reservoir and river corridor system centered on Glen Canyon National Recreation Area (Lake Powell), the river corridor through Glen Canyon and Grand Canyon, and on Lake Mead National Recreation Area. The study will also include the other Colorado River or reservoir influenced units, including Black Canyon of the Gunnison National Park, Canyonlands National Park, Curecanti National Recreation Area, Dinosaur National Monument, and Rainbow Bridge National Monument. Additionally, the study will incorporate available economic values of other uses (e.g., hydropower, flood control, agriculture, etc.).

In evaluating these economic values, it's important to understand the linkage between the National Park System resources and the economy (Figure 1). The economic demand for the direct recreational use of these resources is amenity-driven. Visitors come to Colorado River park units because of quality amenities including scenic vistas, geologic features, and water, wildlife, archeological, cultural, and biological resources. This visitation demand leads to expenditures in the region and positive impacts on the regional economy. Accordingly, through the link to amenity-driven direct recreational use, the NPS mandate to preserve natural resources can significantly benefit regional economies. Similarly, the conservation of park resources and their values relates to nonuse values through the motives of existence and bequest. Nonuse values are the values associated with knowing that these resources are in a viable condition and with wanting future generations to also be able to enjoy this heritage.

These basic linkages between quality amenities and the economy (amenities-visitation-regional economy and amenities-use and nonuse) also correspond to the two primary economic accounting systems appealed to in policy and management decisions: regional economic impacts (jobs and income) and welfare impacts (comparison of social benefits and costs). As will be seen in examples described below of policy decisions concerning NPS resources both along the Colorado River and elsewhere in the nation, changes in amenity levels can lead to both significant regional economic impacts and have significant allocative implications in a benefit-cost setting.

The Colorado River and its tributaries are the most significant source of freshwater in the arid Southwestern United States. The benefits of this resource include the provision of approximately 15 million acre feet of highly valued western water, supplying, among other uses, a good share of the agricultural production of California's Imperial and

Cochella valleys and municipal and industrial water to several of the West's largest cities including Los Angeles, San Diego, Phoenix, and Las Vegas. Through the hydroelectric developments at numerous dams, including Glen Canyon and Hoover Dams, hundreds of millions of dollars worth of electric energy are provided annually. No less important, the river corridors and reservoirs, particularly through Glen Canyon and the Grand Canyon, as well as upstream on the Green and Gunnison, are among the most highly valued natural resources of the United States for their recreational, cultural, aesthetic and ecological services (NRC, 1996). The great value placed on these recreational experiences is, in part, indicated by the twelve-year wait, in recent years, for a private Grand Canyon float trip permit. The Colorado is also home to several endangered species, including the humpback chub.

Reflecting the national significance of the recreational, cultural and natural resources found along the Colorado River is the relatively high density of national park units (parks, monuments, and recreation areas) relative to most other areas of the United States. Ten NPS units encompass approximately 1,000 of 3,000 miles of the Colorado River system (Table 1).

These ten river or reservoir influenced units include Grand Canyon National Park, which has not only national, but international significance, as reflected in its designation (in 1979) as a World Heritage Site by the United Nation's Educational, Scientific and Cultural Organization. These NPS units are important recreational resources, supporting a total of nearly 20 million recreational visits in 2005 (Table 1). This visitation has a significant impact on the regional economy.

Table 1. Estimated 2005 Visitation: River or Reservoir Influenced National Park System Units Along the Colorado River

NPS Unit	2005 Total Recreational Visits
Arches NP	781,279
Black Canyon of the Gunnison NP	180,812
Canyonlands NP	393,381
Curecanti NRA	882,767
Dinosaur NM	391,559
Glen Canyon NRA	1,908,725
Grand Canyon NP	4,401,521
Lake Mead NRA	7,765,772
Rainbow Bridge NM	81,206
Rocky Mountain NP	2,798,368
Total	**19,585,390**

Not surprisingly, given the many demands on this river, an elaborate set of laws, institutions, and rules has developed over time. This "Law of the River" includes the Colorado River compact of 1922, but also all previous and subsequent statutes, judicial decisions, and treaties that affect water use (Ingram et al., 1991; Reclamation 2005a). Overall, the Law of the River allocates water between the upper and lower basin states and Mexico, but also provides general direction (through the Criteria for Coordinated Long Range Operation of Colorado River Reservoirs) for releasing water from the major dams on the system including Glen Canyon and Hoover on the Colorado, Fontenelle and Flaming Gorge on the Green, Blue Mesa, Morrow Point, and Crystal (Aspinall Unit) on

the Gunnison, Navajo on the San Juan, and lakes Mead, Mohave and Havasu on the lower river).

The Secretary of the Interior is the water master for the lower Colorado River. Water allocation decisions are implemented by the Bureau of Reclamation primarily through its operation of Glen Canyon and Hoover dams.

Balancing of various beneficial uses of the river (including agriculture, municipal and industrial uses, and hydroelectric generation), against potential impacts to recreational, cultural and natural resources is an ongoing process. In particular, in the early 1980's there was increased concern over the environmental and recreational impacts of the daily and seasonal operation of Glen Canyon (which was essentially operated as a peaking or load-following facility). Among the environmental costs of the dam as historically operated were the suppression of native fishes, in part through significant changes in water temperature, erosion of beaches valued as campsites by rafters, and large daily changes in discharge volume and water level that impacted ecosystems and recreationists.

These concerns led, in 1982, to the Glen Canyon Environmental Studies (GCES) which were intended to document the effects of dam operations on resources other than hydroelectric power. This series of studies, and a related environmental impact statement process (Reclamation 1995), culminated in the Secretary of the Interior's Record of Decision (ROD) on October 8, 1996. One primary outcome of this process, which included evaluating nine different flow regimes, were significant changes to operating limits at the dam (constraining minimum and maximum releases and "ramp rates"). Another primary outcome was establishment of an Adaptive Management Program to monitor the environmental and recreational impacts of the new flow regime as well as experimental flows to investigate impacts on specific resources, such as beach/habitat building flows, and effects on endangered fisheries.

The Adaptive Management Program is ongoing, and is primarily implemented through an Adaptive Management Work Group and Technical Work Group. The Grand Canyon Monitoring and Research Center (GCMRC), created in November 1995, conducts monitoring and research to support Adaptive Management Program recommendations to the DOI Secretary.

From an economic viewpoint, several of the competing uses of Colorado River water have relatively ready measures in market transactions – the prices wholesalers and consumers pay for electricity, transactions in water rights for agriculture, municipal and industrial uses, and in the prices paid for residential water service. This is not the case, however, for many of the services for which the NPS is steward – including those included under the agency's dual mandate (from the NPS Organic Act of 1916) of recreation and preservation. Moreover, through the Redwood Act of March 27, 1978, Congress declared that when a conflict arises between conserving national park resources and values and providing for enjoyment of them, conservation is to be the primary concern.

As will be described below, the Glen Canyon studies resulted in the completion of two important economic studies, one in 1987 and the other in 1995, of recreation and

preservation uses, respectively. These studies, while having a narrower scope than the work proposed here, provide a good example of both use and nonuse studies of economic values along the Colorado River. However, these studies are now ten to twenty years old, and the Adaptive Management Program has not to date continued to monitor or measure the effects of alternative flow regimes and experiments on these important economic values (NAS 1999; Loomis, Douglas, and Harpman 2005).

While economic analysis of NPS-related values has been undertaken in the last twenty years for the Colorado River below Glen Canyon Dam, these previous studies primarily focus on just the river corridor in Grand Canyon National Park. River regulation at Glen Canyon Dam also impacts water levels at Lake Powell (Glen Canyon National Recreation Area and Rainbow Bridge National Monument) and at Lake Mead (Lake Mead National Recreation Area), which also incorporate major recreational and natural resources. Additionally, visitor use and natural resources at other NPS units, including Black Canyon of the Gunnison National Park, Canyonlands National Park, Curecanti National Recreation Area, Dinosaur National Monument, and Rainbow Bridge National Monument are also influenced by the Colorado River system dams. Economic analysis of NPS values and the relationship to water allocation has, in general, been even more limited at these other units relative to the Grand Canyon river corridor.

The remainder of this paper is organized as follows. The next section briefly summarizes how water allocations are made within the Colorado River system. This summary focuses on the legal framework embodied in the Law of the River and other institutional constraints that govern how Colorado River water is allocated and used. The next section describes the types and significance of economic values provided by National Park System resources within this watershed, and discusses how alternative allocations of Colorado River water may affect those economic values. The last section of the paper presents a recommended approach to estimate relevant economic values provided by Colorado River influenced National Park System resources. This approach will relate estimated economic values to existing hydrological models of the Colorado River system. This will provide an analysis tool for evaluating the impact of alternative water allocations on National Park System visitation and resources.

II. The Law of the River

Over time, a set of laws, institutions, and rules has developed to allocate Colorado River water. Unlike many Western rivers where the doctrine of prior appropriation primarily allocates water among users, on the Colorado River this is not fully the case. This may be in part because of the very high value of this scarce resource and because of the need to allocate water among states with competing interests. The Colorado River is managed and operated under numerous compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the “Law of the River.” (Reclamation 2005a). This collection of decisions and agreements apportion the water and regulates the use and management of the Colorado River among the seven basin states and Mexico.

The allocation of Colorado River water, as embodied in the Law of the River, is an ongoing, dynamic process. Elements of that process include responding to changing inflows in the short term, and, in the longer term, evolving societal values relating to natural resources, including endangered species and ecosystems, as well as accumulating knowledge on the actual physical and hydrological entity being managed. For example, the science concerning the influence of river flow levels and water quality (including temperature) on both sediment management and endangered fish in the Grand Canyon is still evolving. It appears that ongoing and future allocative issues related to hourly, monthly, seasonal, and annual time scales will affect NPS values along the Colorado River. Understanding those values and how they are impacted by river operation/allocation decisions will improve the decisions that are made.

In the past, the primary issue on which NPS values were explicitly recognized and quantified were on hourly-level flow management decisions (as embodied in the 1996 Record of Decision on the operation of Glen Canyon Dam). The focus of these decisions has been on the river corridor through the Grand Canyon. It appears that some current policy and allocative issues require a larger spatial scale, at least including the two-reservoir and river corridor system (Lake Powell, the Glen Canyon and Grand Canyon river corridor, and Lake Mead). Additionally, there are some parallels to the system centered around Glen Canyon Dam elsewhere in the basin. For example, river flow regulation, recreation, and endangered fish, are ongoing issues of concern for the river corridors below Flaming Gorge and the Aspinall unit on the Gunnison.

III. National Park Service Resource Values

This section describes the types of and general significance of economic values provided by the resources along the Colorado River (much of which is managed by the NPS). Additionally, this section describes how alternative Colorado River operations and allocations may affect those economic values. The economic values described in this task include welfare measures in a social benefit-cost framework (market, non-market, use, and non-use values) and regional economic impacts.

Types of Economic Values Provided by NPS Resources within Colorado River park units

There are many dimensions to the services provided by the resources along the Colorado River, many of which are managed by the NPS. These resources include, but are not limited to cultural, aesthetic, recreational, natural history, wildlife and bird life, and ecosystem services.

Market versus Non-Market Values. A primary dichotomy of economic values is the division of values into those that can be traded within existing economic markets, and those for which no developed market exists. Examples of resource services specific to the Colorado River system that are traded in markets are power generated from dams, water deliveries to farms or municipalities, or commercial river tours. While a number of services provided by the Colorado River System and the NPS units within the drainage can be classified as market services (with associated market-derived values), there are

many services provided by this river system and the NPS units along it that are classified as non-market services. These non-market resource services include noncommercial boating, fishing, swimming, birdwatching, flood control, protection of cultural sites, and aesthetic services.

Use v. Nonuse Values. A second dichotomy of resource services and associated values is that of use and nonuse services and values. The most obvious type, use services, relates to direct onsite uses. For public uses of natural resource services provided by national park units these include boating, fishing, or wildlife observation. The second type of resource services are so-called nonuse services. These services have values that derive from a given resource and are not dependent on direct on-site use. Several of the possible motives for nonuse values were first described by Weisbrod (1964) and Krutilla (1967), and include existence and bequest values. Existence values can derive from merely knowing that a given natural environment or population exists in a viable condition. For example, if there was a proposal to dam the Grand Canyon, many individuals could experience a real loss, even though they may have no expectation of ever personally visiting the river corridor through the Grand Canyon. Other individuals might similarly suffer a loss if the grizzly bear were to be made extinct in the Northern Rockies, even though those individuals may have no desire to directly encounter a grizzly. Bequest motives derive from ones' desire to provide for future benefit to children and others in future generations. There may be many possible motives for nonuse values, and these motives may or may not be mutually exclusive.

The methods used to estimate nonuse values are so-called stated preference methods (including contingent valuation and conjoint analysis (National Research Council 2005)). Individuals are asked in a survey to indicate directly the value they place on nonuse services or resources. These methods are generally accepted and applied in policy analysis, as evidenced by their endorsement as a recommended method in regulatory guidelines. These include the Department of the Interior regulations for implementing the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (or CERCLA, at 43 CFR part 11) and in the U.S. Environmental Protection Agency's *Guidelines for Preparing Economic Analysis* (2000).

These methods have now been widely applied and reported in the published economics literature. When contingent valuation as a recommended approach was challenged in court (Ohio v. United States Department of Interior, 880 F.2d 432, 474 (D.C. Cir. 1989), the court affirmed its usefulness for natural resource damage assessment. Additionally, in the context of the development of related regulations for implementation of the Oil Pollution Act of 1990 by the National Oceanic and Atmospheric Administration (NOAA), the use of contingent valuation was reviewed by a panel which included several Nobel laureates in economics. The panel endorsed the use of contingent valuation in a litigation setting, subject to the caveat that studies meet certain recommended guidelines (Arrow et al 1993).

As noted below, contingent valuation has been previously applied along the Colorado River both for use values (Bishop et al. 1987) and for passive use values (Randall and Stoll 1983; Welsh et al. 1995). Harpman, Welsh, and Bishop (1995) describe the

importance of nonuse economic values as a policy analysis tool, with specific reference to water-influenced resources in the Grand Canyon.

Nonuse values are particularly relevant to the management of National Park System resources given the mandates of the NPS Organic Act (16 U.S.C. 1) and the Redwood Act (16 U.S.C. 1a-1). Those mandates establish the fundamental purpose of the National Park System as conserving park resources and values, and providing for their enjoyment by the public. The conservation of park resources and values directly relates to nonuse values through the motives of existence and bequest. Nonuse values also relate to the public enjoyment of park resources and values since the public includes both people who directly experience parks and those who enjoy them from afar.

While use services may or may not have associated developed markets for them, nonuse services are exclusively non-market services.

Total Valuation and Ecosystem Services. When nonuse and use values are estimated together, the estimate is referred to as total economic valuation (TEV). This concept was first introduced by Randall and Stoll (1983) and has been further developed by Hoehn and Randall (1989).

Figure 2 places the use and nonuse values described above within an overall structure relating ecosystem services to human values (National Research Council 2005). The figure illustrates the feedback loop wherein human actions and policy directly impact ecosystem functions and structure and resulting ecosystem goods and services. This figure details two types of use under the category "use values." These are consumptive resource use (such as hunting, fishing, or final water use in agriculture) and nonconsumptive use. Nonconsumptive use of resources is further divided into direct and indirect use. Direct nonconsumptive use includes such activities as boating, swimming, and aesthetic viewing. Indirect nonconsumptive use includes resource services such as flood control or habitat support.

The types of resources and values provided by NPS units along the Colorado River include examples from all categories of values shown in Figure 2. Most significantly, these values include both use and nonuse values. Any reliable estimate of total value associated with services provided by these resources must therefore be estimated within a total value framework (as described above), including both estimates of use values and non-use values.

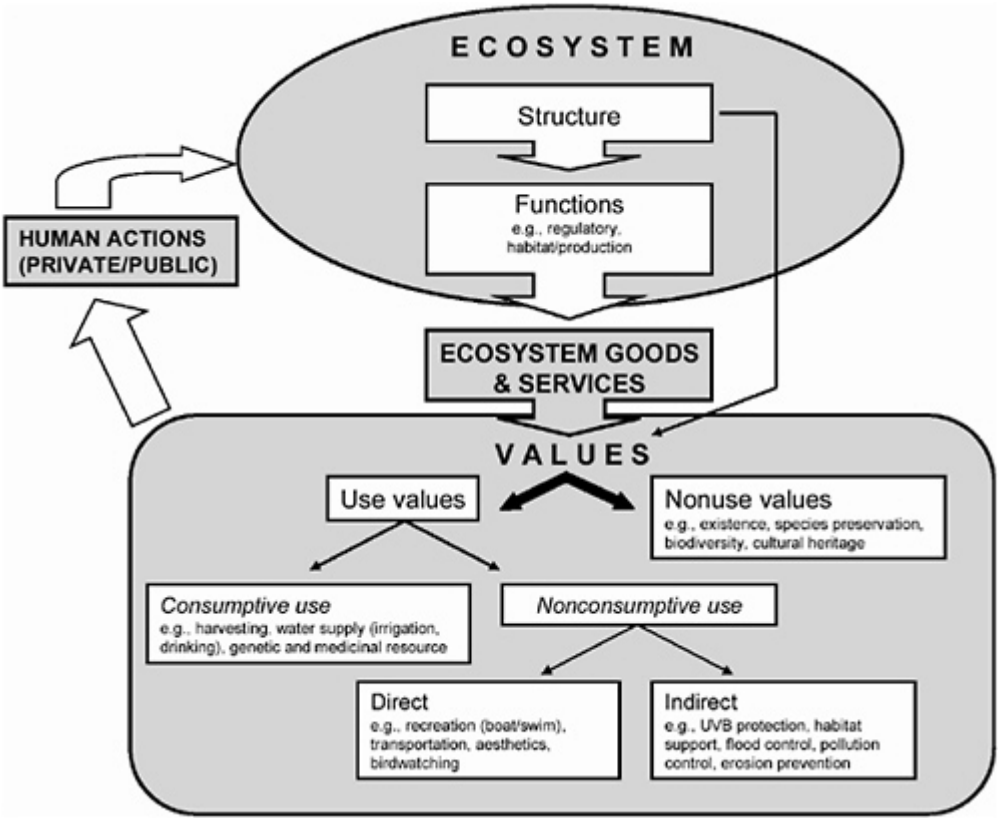


Figure 2: Connections between ecosystem structure and function, services, policies and values (source, NAS 2005)

The National Research Council (2005, at p. 6) offers the specific guidance that: "Economic valuation of changes in ecosystem services should be based on the comprehensive definition embodied in the TEV framework; both use and non-use values should be estimated."

Significance. The total valuation framework developed above, including both use and nonuse values, can be used (along with some readily available previous studies) to address the economic significance of the NPS-related resources in the Colorado River Watershed. As shown conceptually in Figure 2, one might want to investigate both use values (for example, including recreational uses of all kinds) for National Park System resources in the basin, as well as nonuse values for key resources of interest. In addition to the breakout of use and nonuse by unit, it is useful to distinguish total values of current use levels or states, as opposed to marginal values associated with a change in some environmental parameter (such as river or reservoir levels, presence/absence of given species, etc.).

These are two quite different kinds of problems, with the latter being the more formidable. Only some of these different categories of values for NPS resources along the Colorado River system have been previously estimated. The following discussion draws on some of this economic literature by way of discussing the significance of NPS resources in this basin. The existing literature indicates the general significance of these resources in economic terms.

To date the number of published estimates of the value of recreational visits to National Park System units is somewhat limited. Kaval and Loomis (2003) identified eleven studies that provided 49 activity-specific net economic value per activity day estimates. The activities included sightseeing, boating, picnicking, hiking and wildlife viewing. Updating the Kaval and Loomis (2003) average estimates from 1996 dollars to 2005 dollars indicates an average value per day across all 49 observations of $53.88. The updated average that Kaval and Loomis report for the Southwest Region national parks is $28.16. As noted earlier, studies of whitewater boating in Glen Canyon and Grand Canyon indicate net economic values on the order of several hundred dollars per trip and higher. A recent study, using a travel cost model, also provides estimates of values for a subset of seven National Parks along the Colorado River (Markowski et al. 2004). The results of this study, which are still preliminary, indicate that net economic benefits per trip may be higher than indicated by earlier work.

Economic Studies of NPS Resources in the Colorado River. To date there have been two major economic studies related to NPS-related uses in the Colorado River corridor, both in the context of the Glen Canyon studies. These studies, while having a fairly narrow geographic scope (just the river corridor through Glen Canyon and Grand Canyon), are discussed here as a good example of the type of proposed economic analysis outlined in section IV below. Both of these earlier studies focused on identifying marginal values, in the sense of measuring the change in value associated with moving from the base case or no action alternative in the EIS planning process for Glen Canyon Dam to some specific alternative. By having these marginal values, it was possible in the EIS process to compare the tradeoffs of alternative uses, including recreation and power generation values.

The economic context here is that generally the monthly allocation of flow releases at Glen Canyon is based on maximizing the value of power, subject to the constraints imposed by other purposes. In the early years of operation, the main constraints were providing sufficient available storage for flood control and river regulation. Typically this has meant that releases are higher in the months when power is most valuable, during the winter heating season and the summer cooling season. For example, given the markets for power in the Southwest in the mid-1990's, releases were about 20 percent greater in a typical water year during the months of December, January and February and June, July and August, compared to the spring and fall months (Harpman 1999a).

Historically, hourly releases at Glen Canyon Dam have also been driven largely by hydropower economics. Prior to 1991, Glen Canyon was operated as a more or less unconstrained load following (or peaking) plant, with higher releases during the day and early evening when power demands (and values) were highest and lower releases during the night. This could mean a change from releases as high as 31,500 cfs (plant capacity prior to the late 1980's) during the day to as low as 1,000 to 3000 cfs (the historical minimum release in winter and summer, respectively). There were no constraints on how quickly these flow changes occurred (e.g., no constraint on ramp rates or allowable daily fluctuations). For the first several decades of Glen Canyon's operations, this led to flow level fluctuations below the dam on many days on the order of 7 to 12 feet.

The first Glen Canyon economic study focused on recreational use and was undertaken by Bishop et al. (1987). This study was conducted as part of the Glen Canyon Environmental Studies program during 1984 and 1985. The overall goal of the Bishop study was to evaluate the impacts of alternative flow release patterns from Glen Canyon Dam on white-water boating, day-use rafting, and fishing on the Colorado River below the dam. The 1987 study authors conducted a several phase investigation in order to address their goal. First, user surveys were conducted to identify the attributes of fishing and floating trips that provided value to users. A second, more comprehensive contingent valuation survey of river users addressed potential changes in resource values associated alternative flow release patterns. While Bishop et al. found no statistically significant relationship between flow levels and values associated with day-use floating below Glen Canyon Dam, they found a strong link between flows and both fishing and whitewater boating values. The study found that for whitewater rafters relatively constant flows between 20,000 and 25,000 cfs yielded the highest satisfaction and associated values. For anglers, a similarly constant flow regime in the 10,000 cfs range yielded improved recreational trip values over current flow regimes (Bishop et al. 1987, pp. 170-178). As an example of the range in values, the net economic value per trip (willingness to pay over and above trip costs) for commercial whitewater boaters was estimated at $127 per trip ($236 in 2005 dollars) at a 5,000 cfs flow level and rose to a maximum value of $888 per trip ($1,653 in 2005 dollars) at higher flows.

The Bishop et al. (1987) economic study is one of a number of such studies reported in the economics literature that relate changes in streamflow levels to use or nonuse values. These usually include recreation, but also may include other environmental services such as endangered species. For example, Brown (1991) lists nine studies of the value of instream flow for recreational activities including fishing, boating, and general shoreline activities. Duffield et al. (1992) estimated marginal WTP per acre foot for a range of flows at two sites, the Bitterroot River in Western Montana, and the Big Hole River in the headwaters of the Missouri River system. A related study in cooperation with the U.S.D.A. Rocky Mountain Experiment Station in Fort Collins estimated nonuse values for these same resources based on a random sample of regional households (Brown and Duffield, 1995).

As noted previously, the second Colorado River study examined nonuse values. Contingent valuation methods were applied to estimate willingness to pay to improve native vegetation, native fishes, game fish (such as trout), river recreation, and cultural sites in Glen Canyon NRA downstream of Glen Canyon Dam and in Grand Canyon NP (Welsh et al. 1995). This study utilized a population survey of two groups, Western U.S. households within the marketing area for Glen Canyon power, and households in the entire U.S. Respondents were asked questions of their willingness to pay either increased electric power rates (Western U.S. sample) or higher taxes (national sample) to reduce flow fluctuations from Glen Canyon Dam to protect wildlife, beaches, and cultural sites. The study results (Table 2) show that the “steady flow” scenario that was presented as being most beneficial to resource protection also had the highest associated values.

Table 2. Welsh et al. (1995) Estimates of Nonuse Values for Three Glen Canyon Flow Scenarios. (2005 dollars)				
	National Sample		Western US Sample	
Flow Scenario	Per Household	Annual Value (millions)	Per Household	Annual Value (millions)
Moderate Fluctuations	$17.74	2,791	$29.05	79
Low Fluctuations	$26.19	4,386	$28.25	80
Steady Flow	$26.91	4,474	$38.02	107

While the nonuse study for the Colorado River corridor in Grand Canyon NP (Welsh et al. 1995) was completed too late to be fully utilized in the 1995 EIS (Reclamation 1995), the study findings did have an influence on the EIS outcome. The National Research Council panel that reviewed the Glen Canyon Environmental Studies commented favorably on this study. Their report stated: "The GCES nonuse value studies are one of the most comprehensive efforts to date to measure nonuse values and apply the results to policy decisions. … While not completed in time to be reported in the final EIS, the nonuse value results are an important contribution of GCES and deserve full attention as decisions are made regarding dam operations." (National Research Council, 1996, at p. 135)

The National Research Council panel also compared annual values associated with three of the EIS alternatives for power, direct use values (recreation), and nonuse values (Table 3). Their report showed that for the seasonally adjusted steady flows alternative, the foregone power revenues are somewhat larger than the combined recreational and nonuse values in the marketing area (western U.S.) As the panel noted (National Research Council 1996, pp. 133-134), the national nonuse values, however, are about 30 times larger than the foregone power revenues for seasonally adjusted steady flows.

Table 3. Annual Values Associated with Alternative Dam Operations ($ millions)				
			Nonuse Values	
Flow Scenario	Power	Recreation	National	Marketing Area
Moderate Fluctuating Flows	-36.7 to -54.0	+0.4	+2,286.4	+52.2
Low Fluctuating Flows	-15.1 to -44.2	+3.7	+3,375.2	+50.5
Seasonally Adjusted Steady Flow	-88.3 to -123.5	+4.8	+3,442.2	+81.4

Source: National Research Council, 1996, Table 7.3, p. 134.

With respect to the significance of recreation use values in the Glen Canyon operations context, the influence of flows on recreational values is primarily through the effect on the quality of the trip. There is excess demand for river recreation below Glen Canyon Dam (use is basically always at the permitted capacity in the main season). This limits the potential magnitude of changes in use values in response to changing flow regimes. By contrast, the nonuse value effects are quite large relative to the foregone power revenues for the alternatives examined, and have allocative significance.

In more recent work on the impacts of changed flow regimes on power generation values, Harpman (1999a) provides an estimate of $6.1 million for a representative water year, using an hourly simulation of Glen Canyon operations and actual spot market prices and

loads for 1996. Harpman and Jalbert (1997) and Harpman (1999b) estimated the impact of the eight day beach/habitat building flow of 1996 on hydropower and recreation. Short term recreational impacts were found to be negligible, but power costs were estimated to be on the order of $2.5 million. Because the high flow of 45,000 cfs was in excess of power plant capacity, about 15,000 cfs were spilled daily for eight days that would normally have been used to generate power. Additionally, to implement the spill, it was necessary to reallocate water releases primarily from the months of January, February, July, and August to March and April. Accordingly, water that was used to generate power was reallocated from a time when flows were more valuable to a time when it was less valuable.

In the context of the general linkages between resources/amenities and the economy shown in Figure 1, the Bishop (1987) and Welsh et al. (1995) studies focus on the social benefit-cost implications. Regional economic impacts were not as significant for this case given that visitor use was constrained at permitted-capacity levels and there was considerable excess demand. The bottom line is that varying resource attributes including flow levels, stability of flows, beach size, and the status of endangered fisheries and riparian ecosystems had allocative implications through the linkage to both direct use and nonuse. In this case the social benefit-cost was dominated by nonuse values, and the findings strongly supported the EIS preferred alternative's changes to the daily flow regime.

The estimates of the Welsh (1995) contingent valuation study are conservative in that Welsh chose in his methodology to count only those "yes" respondents that also indicated they would "definitely yes" pay the stated amount. The use of only "definitely yes" responses has been shown in other CV validity studies to provide a valid estimate of actual willingness to pay. Champ et al. (1997) also found this result in assessing the nonuser social value of a program at Grand Canyon NP to remove compacted dirt roads on the North Rim of the Canyon. A more recent study by Champ and her colleagues that is focused on riparian ecosystems (Duffield, Neher, Patterson, and Champ 2005) also found that CV responses with a self-rated high certainty of actual contribution corresponded well with actual levels of cash donations. The application in this case was to purchases of instream flow rights on dewatered Montana streams, primarily to benefit riparian ecosystems, fishery species of special concern, and other wild fish.

Parenthetically, it is interesting to note that Grand Canyon National Park was also the setting for a much earlier nonuse valuation studies, focused on the national values associated with improved visibility. This included the Randall and Stoll (1983) study mentioned earlier that was the first to use a total valuation framework and Schultz et al. (1983). This and other studies eventually led the U.S. Environmental Protection Agency on October 3, 1991, to issue a regulation requiring the Navajo Generating Station coal-fired power plant to reduce sulfur emissions. In a 1990 study, the annual benefits of achieving 90% emission control was estimated to be between $130 and $150 million annually, compared to the estimated costs of this control of $89.6 million (1990 dollars). Deck (1997) describes both the benefit and cost studies that were the basis of this decision.

Another good example of the importance of nonuse valuation estimates for National Park System management policy is the reintroduction of wolves into Yellowstone National Park. In the early 1990's wolf recovery in Yellowstone National Park and Central Idaho was the nation's preeminent wildlife debate, and more than 160,000 people commented on the Draft Environmental Impact Statement. The economic evaluation of the wolf reintroduction alternative rested largely on the nonuse values associated with restoring wolves to this ecosystem (Duffield and Neher 1996).

Amenity Linkages to the Regional Economy. The economic impact of National Park System visitor spending on local economies has been previously investigated in a number of contexts. An example for the Colorado River is Douglas and Harpman (1995) who estimated the total expenditure by day use rafters, anglers, and commercial and private boaters in the Glen Canyon and Grand Canyon river corridor. In addition to expenditures on commercial guides and outfitters, recreational visitors spend money on lodging, food, gasoline and other consumer items. These expenditures support retail and wholesale businesses and create induced spending throughout the regional economy. Douglas and Harpman defined their economic region as Coconino and Mohave Counties, and used an IMPLAN (Minnesota Implan Group 2005) regional economic model to compute job creation. Loomis, Douglas, and Harpman (2005), updated the Douglas and Harpman 1995 estimates to 2004 dollars, and identified a total of $22 million in nonresident visitor expenditure in these two counties tied to Glen Canyon and Grand Canyon recreation. The estimated total number of jobs supported by this expenditure (based on the original study) is 586. This is consistent with more recent estimates by Douglas (2005) of 438 total jobs created by whitewater boating in the Grand Canyon.

Other studies of the regional economic impact of National Park System visitation include Neher and Duffield's (2000) study of the economic impacts of flooding in Yosemite National Park, the economic impacts of the 1995-96 federal government shutdown on park visitation (Duffield et al. 1996), and the regional economic impacts of changing winter use management (for example, banning snowmobile use) in Yellowstone and Grand Teton National Parks (Duffield and Neher 2000).

While the Glen Canyon studies focused on the river corridor below Glen Canyon, river regulation also affects reservoir levels on Lake Powell and Lake Mead. Unlike river running in the Grand Canyon, visitation at Lake Powell is not constrained at some level of permitted capacity. Accordingly, the changes in use levels at issue in consideration of reservoir level impacts are potentially quite large. For example, the total 2005 recreational visitation to Glen Canyon NRA was reported by the NPS as 1.9 million visits, and to Lake Mead NRA at 7.8 million (Table 2). This is a much larger visitor base that is in part water-level dependent, compared to the potential impact of Glen Canyon Dam operations on Grand Canyon permitted river runners (who totaled less than 22,000 in 2003).

Just as there is an economic literature on instream flow values, there is a related literature on the effect of reservoir levels on recreation. Huszar et al. (1999) developed and estimated a joint model of fish catch and recreation demand, both of which depend on water levels, to assess the losses and gains from water level changes tied to events in the

Humboldt River Basin of Northern Nevada. Additionally, Eiswerth and Englin, et al. (2000) estimated recreation values for preventing a decline in water levels at, and even the total loss of, a large western lake that is drying up.

IV. Recommended Approach

This section describes a recommended approach to estimate Colorado River and reservoir influenced economic values for NPS resources within Colorado River park units, as well as incorporate other available economic values associated with the river (i.e., values for hydropower, agriculture, municipal and industrial uses, etc.).

The motivation for this proposed research is that the NPS does not have recent or comprehensive economic values to represent their current water-related activities along the Colorado River. Nor can NPS place the value of the services its resources provide within the context of the overall value of these resources.

The geographical focus is on the two-reservoir and river corridor system including Lake Powell, the Grand Canyon, and Lake Mead, and the other river and reservoir influenced National Park System units in this watershed. The specific study area units include:

- Grand Canyon National Park (river corridor focus)
- Glen Canyon National Recreation Area
- Rainbow Bridge National Monument
- Lake Mead National Recreation Area
- Black Canyon of the Gunnison National Park
- Canyonlands National Park
- Curecanti National Recreation Area
- Dinosaur National Monument.

This approach addresses how to relate estimated economic values to existing hydrologic models of the Colorado River system in order to evaluate the impact of alternative operating scenarios and water levels on National Park System resources. This section also provides a budget for the approach described.

Three specific goals of this proposed research are:

- estimate values for NPS river and reservoir related uses along the Colorado River system, and compile other available economic values associated with the river (i.e., values for hydropower, agriculture, municipal and industrial uses, etc.).
- identify the most significant marginal use and nonuse values for alternative management schemes for water allocation and flows in the basin
- integrate these marginal values into existing hydrological models of the basin, including the development of a user-friendly model for policy analysis

This section is organized as follows. First, an overview is provided on the recommended approach for organizing the study into distinct, logically-related, phases with identifiable

products or milestones at each phase. Secondly, taking account of the direction of the most recent economics literature in this field with regard to methods, and what is known to date about NPS values in the region, several high priority focuses for measuring use and nonuse values are identified. Lastly, a specific research program to implement these studies is summarized, along with schedule, tasks, deliverables, personnel allocation, and budgets specific to each phase of the project and each fiscal year.

Organization and Scope of Work.

This is a proposal to estimate the following types of economic values associated with water allocations on the Colorado River:

- direct recreational use values for water-related activities in river park units
- nonuse values associated with the public's preferences for conservation of resources within NPS units along the Colorado River
- regional economic impacts resulting from water-related visitor use along the Colorado River system including output, jobs and income

This approach would also identify the most significant marginal use and nonuse values for a set of alternative management schemes, water allocations, and dam operations in the Colorado River system. These marginal values would be integrated into existing hydrological models of the Colorado River system, including development of a user-friendly model for policy analysis. Users would be able to evaluate the impact of alternative river operations and water allocations on the use of NPS resources. As currently conceived, this approach would also compile other available economic values (i.e., hydropower, agriculture, municipal and industrial uses, etc.) in order to place the NPS values in the overall context of water management on the river.

While this white paper (Phase I of the overall project) has provided a cursory overview of the relevant economics literature, the logical approach to achieving the study goals is to proceed in three additional phases:

- Phase II. Review existing literature and data
- Phase III. Conduct original research.
- Phase IV. Integrate and communicate.

Phase II-Review existing literature and data. Conduct a careful and thorough review of the literature surrounding uses and values associated with Colorado River parks, and other potentially comparable recreational venues and activities. This review of existing studies and methods will be used to answer as many questions as possible surrounding use and values of Colorado River park visitation and other water uses along the river. This process will also provide information on where significant gaps exist in the available information on park-related values.

Phase III-Conduct original research. Address the information gaps for park-related values identified in Phase II. The focus is on Lake Powell, the river corridor through Glen Canyon and Grand Canyon, and Lake Mead, as well as major substitute water-based

recreational sites for the primary study area. This research will include visitor and population surveys of use and nonuse values. While not included in this initial proposal, these original research efforts could be expanded to include non-park-related values in partnership with other managing agencies.

Phase IV- Integrate and communicate. Integrate Phase II and III results, and use of benefits transfer of values from original research and the literature to estimate direct use values for the other Colorado River park units as appropriate. All relevant economic values will be estimated, including welfare measures (market, non-market, use, and non-use values) and regional economic impacts. This integration will relate estimated economic values to existing hydrologic models of the Colorado River system in order to evaluate the impact of alternative water allocations on the use of NPS resources. The economic values provided by NPS resources within Colorado River parks will be compared to other economic values associated with the Colorado River (e.g., hydropower, water storage, irrigation water uses, urban water uses). The research products will include:

- a user-friendly analysis tool to estimate marginal values from alternative management schemes
- a technical document that fully describes the background, methods, data, and results of this project
- a non-technical document that communicates study findings to the general public.

Methods.

This section provides an overview of the methods to be applied in each phase of the recommended approach.

Phase II. Review of existing literature and data. NPS and Bureau of Reclamation records (plus the records of other managing entities as appropriate) provide a large body of data on visitation, and dam and reservoir operations. It is anticipated that a review of this data, as well as the economics literature, will provide estimates of economic values for most beneficial uses of the Colorado River, including agriculture, hydropower, and municipal and industrial water uses. Much of the relevant economics literature has been summarized above. Additionally, NPS management documents and associated technical reports provide park specific data on visitation, site characteristics, etc. Gathering this data and body of documents will form the first level of the literature search. Additionally, relevant resource studies from similar resources and settings to those found in Colorado River park units will be surveyed in order to identify possible value estimates for use in a benefits transfer analysis to preliminarily address the first objective of this study of developing comprehensive estimates of values.

In addition to collection of existing studies and data, this project would entail some additional analysis of existing data as appropriate.

Research products from Phase II:

- written report on findings

- peer review

Phase III. Conduct Original Research. It is anticipated that there will be a need to collect original data in three different surveys. The major work elements in this phase will be in the design, implementation (data collection), analysis, and report writing related to these three surveys:

- **a survey of recreational visitors to estimate use values and expenditures in the study area**
- **a survey of residential populations in the multi-state area encompassing the Colorado River to estimate nonuse values**
- **a survey of national households to estimate nonuse values**

While not included in this initial proposal, these original research efforts could be expanded to include non-park-related values in partnership with other managing agencies. Such efforts could include estimating the values for hydropower, agriculture, municipal and industrial uses, and other relevant water values.

Based on the literature review summarized previously, there appear to be several significant data gaps. Preliminarily, there is a need to expand the direct use/regional economic analysis to a broader set of sites than the original (now 20 years old) work by Bishop et al. (1987). The latter focused on the Colorado River below Glen Canyon Dam. It appears that a current need is to expand the core set of sites to include Lake Powell (Glen Canyon NRA) and Lake Mead, as well as to replicate and extend the original work by Bishop et al. The direct use study will utilize a random utility maximization (RUM) travel cost modeling framework, but will also include a replication and extension of the contingent valuation questions used by Bishop et al (1987) for boaters in the Grand Canyon. The RUM travel cost model is the most widely used multiple-site model for examining recreational demand. Kling and Herriges (1999) and Parsons (2003) provide recent overviews of the related economic literature.

The focus of this direct recreational use model will likely be on the major two-reservoir and river corridor system centered on Glen Canyon Dam. This is where most of the hydropower is produced in the Colorado River system, and also where the most significant water-related visitor use occurs. Additionally, this is where the allocation of water between the upper and lower basin states occurs. To correctly model use at these core sites, the model will need to include major substitute sites in the Colorado River area. This will likely include other NPS units including Black Canyon of the Gunnison, Dinosaur Monument, and Canyonlands, but possibly also Flaming Gorge, and popular floating sections on the Green, Upper Colorado, and the San Juan. Determining the appropriate set of sites for this model of water-based recreation along the Colorado River will be a study task. Preliminarily, a sample of 3000 potential respondents will be contacted. Recruitment will likely be a combination of on-site visitor contacts at key access points as well as random digit dialing to obtain a probability sample of Colorado River users. A panel data set will be created with up to four contacts per respondent (combination mail/phone methods) to create a record of recreational use that minimizes recall bias and sample attrition.

A second need is for nonuse studies that utilize state of the art methods and that address scenarios and attributes that are relevant to current policy and water allocation decisions. Identifying the most important study area resources and attributes from a nonuse standpoint will be a specific task in this phase. As early as 1999, the National Academy of Sciences (NAS) concluded that while the nonuse study by Welsh (1995) was high quality, the methods were no longer state of the art, and, in particular, the scenarios examined, were no longer as policy relevant. A new NAS publication (2004) is explicitly focused on nonuse values for ecosystem services. The recommendation of this study, and the direction of the recent economics literature, is to use the more flexible methods of conjoint analysis, which emphasizes resource attributes as opposed to examining just one scenario (as in contingent valuation), which can later turn out to be an irrelevant one. Additionally, conjoint analysis does not run the risk of insignificant "scope effects" (response one expects from economic theory to quantitative changes in the environmental parameters of interest, such as the number of birds saved by a given restoration program, etc). Holmes and Adamowicz (2003) and NAS (2004) provide a survey of the relevant literature on conjoint analysis and related attribute-based choice models. In addition to its endorsement by the NAS (2004) panel for nonuse value estimation, conjoint analysis is also the method of choice in a current major nonuse study sponsored by the National Oceanic and Atmospheric Administration. The focus of this latter work is on assessing alternative conservation strategies for coral reefs.

The sampling frame for the nonuse study will include two strata: Colorado River residents and national residents. Preliminarily, the targeted number of completed surveys is 2000. The contact method will likely be either phone or web-based, or a combination of these two approaches.

It is anticipated that this phase of research will include the following key components:

- Individual interviews with policy makers to identify relevant policy issues and questions
- Use of focus groups to aid in development of understandable, efficient, and reliable survey instruments
- Use of professional survey research firms, either phone or web-based as appropriate.
- Peer review of draft survey instruments, draft sampling plans and draft reports will be an integral part of this study component with a minimum of two independent peer reviewers at each stage.

Research products from Phase III:

- Focus group reports
- Draft survey instruments, sample design, survey methods
- peer review of instruments, design, and methods
- package of survey related materials submitted for OMB approval
- three final data bases corresponding to the three survey efforts
- draft technical report describing methods and findings
- peer review of draft technical report

- final technical report

Phase IV. Integration and Communication. This phase will include:

- integration of existing studies and original research to develop a comprehensive set of economic values for Colorado River park units

- benefits transfer to estimate NPS values to all Colorado River park units, as appropriate

- integration of estimated values with existing hydrological models of the Colorado River system to evaluate water allocation alternatives

- user friendly analysis tool to calculate changes in economic values

- documents to communicate findings to technical and non-technical audiences

The economic value estimates developed in Phases II and III can be stated in terms of dollars per unit of water resource (e.g. dollars per change in foot reservoir elevation or per cfs for flows). These economic parameters will be tied to hydrological models so that the economic effect of changes in water allocation can be measured. There are a number of existing hydrological models of the Colorado River Watershed; these include several maintained by Reclamation. One of these is an hourly model focused on power generation and values, another is the model used for planning at the monthly and annual level for purposes of the Annual Operating Plan. However, a number of different models exist that have been used.

The identification of the appropriate hydrological model or models will be a project task. The primary constraint of this task is that marginal values need to be estimated in a way that is compatible with the time step/environmental parameter provided by the model. In fact, the given marginal values are likely to be compatible with any number of specific models of a given genre.

Development of a user-friendly analysis tool will enable NPS staff to calculate the changes in the economic values of National Park System resources that are associated with alternative operating scenarios and water levels:

- the user will be able to input a change in water allocation
- the model will output the change in economic values associated with the given allocation
- The model will distinguish short-term and long-term effects of a given water allocation

In the short term, capital investment in NPS recreation-related facilities, such as the location and number of boat ramps or marinas, is taken as fixed. The short-term economic effects are limited to water level fluctuations, given existing capital investments. In a long-term analysis, investments in facilities can change and be adjusted

to best utilize the opportunities associated with a given flow regime or range of reservoir levels.

The development of this analysis tool will be done using an Excel spreadsheet format. This program has been utilized in several similar NPS-sponsored modeling efforts including creation of a model of socioeconomic impacts of Yellowstone NP winter use level management options (Duffield and Neher, 2001). This model had a number of applications during rulemaking on the winter use plan for Yellowstone and Grand Teton National Parks, for example NPS (2004). This software platform was also used in the development of the MGM2 "Money Generation Model" (Stynes and Propst 2001) for modeling impacts of visitation to NP units on local area economies.

Research products from Phase IV:

comprehensive set of values for study area sites

- draft technical report
- user friendly analysis tool
- peer review report
- final technical report
- final nontechnical report

Schedule, Tasks, and Budget

This section provides a narrative description of the timeline, tasks, milestones, and budget for the recommended approach. Detailed budget tables are provided in Appendix A.

Timeline. Table 5 provides a timeline for Phases II through IV of this recommended approach. The study is projected to be completed in three years. It is anticipated that:

- Phase II will require five months to complete
- Phase III will require 21 months (including 7 months survey review)
- Phase IV will require 10 months.

A wild card in development of a schedule is the need for review by the U.S. Office of Management and Budget (OMB) of sample plans and survey instruments. This formal review includes publication of notices in the Federal Register. It is possible that OMB approval will be granted in as little as several months. A more likely estimate is seven months, which is the time period for OMB review included in the three year timeline. However, it is possible that approval could take as long as 12 to 18 months, which could add another year to the project.

The schedule shown in Table 4 assumes OMB approval will be completed in seven months. It is possible that the use study will be approved sooner, and the nonuse study later. These two original studies can progress independently. Because of the possible delay in OMB approval, a fourth year is shown on the schedule in Table 4 that would accommodate an additional seven month delay in OMB approval for at least one study (a

total of 14 months review). In any case, the budgets described below are based on current cost rates, and will need to be updated if the project is delayed.

Table 4. NPS Colorado River Drainage Project Timetable

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Phase II (5 months)					Phase III						
2	Phase III cont. (21 months)											
3	Phase III cont.		Phase IV (10 months)									
4	Potential OMB delay of up to 7 months											

Tasks and Milestones. Table 6 provides a list of research tasks and milestones and research products for each study phase. The primary research products for Phase II are a draft and final report. As in all phases, there is peer review of the study at key design points as well as for major products. In Phase II there is peer review of the draft report. As in other phases, there is also a presentation scheduled of key findings in this phase for the study Steering Committee.

In Phase III, tasks are somewhat different between the direct use and the nonuse studies, accordingly tasks for each of these studies are listed separately. The direct use study includes:

- preliminary site assessment
- identification of site characteristics
- geographic extent of the market
- survey agents contact a probability sample of visitors

Development of the sample frame of visitors in Phase III will entail considerable travel. By contrast, the sample frame for the nonuse studies will be based on random samples of resident populations from listed samples such as phone listings or from web-based sample frames.

The nonuse study will also include use of focus groups to identify the attributes of amenities and resources that are most significant to potential respondents.

Peer review for both the use and nonuse studies is at the stage of sampling plan and survey design, as well as for the draft report.

This phase will include development of a package (survey, sampling plan, justification) for submission to OMB. The Principle Investigator (PI) is familiar with this process, having successfully obtained OMB approval for surveys in the past. A total of four trips

to Washington, DC for meetings with OMB during this process are scheduled in this phase for the PI.

Separate presentations for the Steering Committee are scheduled for the direct use study and the nonuse study.

In Phase IV, the major research products include:

- a report on comprehensive values
- summary of direct use regional economic impacts
- user-friendly analysis model
- draft and final technical and non-technical documents
- Peer review on the draft technical report.

Two presentations to the Steering Committee are scheduled: after completion of the user-friendly analysis model, and after completion of the technical and non-technical documents.

Table 5. Tasks and Milestones, by Project Phase		
Phase	**Task**	**Milestone**
Phase II		
	Task 1. Synthesize existing literature relevant to the Colorado River	
	Task 2. Additional analysis of existing datasets	
	Task 3. Preliminary comprehensive estimate of Colorado River NPS resource values from existing literature and benefits transfer	
	Task 4. Identify data gaps important for Phase III work plan	
	Task 5. Phase II Draft Report	1) Draft Report
	Task 6. Phase II peer review / revisions / Final Report	2) Final Report
	Task 7. Presentation to Steering Committee	3) PowerPoint presentation
Phase	**Task**	**Milestone**
Phase III	**(A) Direct Use**	
	Task 1. Preliminary Site Assessments	
	Task 2. Establish Geographic scope of market	
	Task 3. Study site characteristics	
	Task 4. Sample plan and draft survey instrument	1) Sample plan and draft survey instrument
	Task 5. Peer review and revisions	2) Final sampling plan and survey instrument
	Task 6. Pretest and revisions	
	Task 7. OMB submission and approval	3) OMB package
	Task 8. Conduct survey(s)	4) Report on sample size and response rates
	Task 9. Estimate valuation models and analysis	
	Task 10. Write Draft Report	5) Draft report
	Task 11. Peer Review and Revisions	6) Final Report
	Task 12. Presentation to Steering Committee	7) Direct Use PowerPoint Presentation
Phase	**Task**	**Milestone**
Phase III	**(B) Nonuse**	
	Task 13. identify nonuse related attributes through focus groups and interviews	8) Qualitative research report
	Task 14. Draft Sample plan and survey instrument	9) Draft sample plan and survey instrument
	Task 15. Peer review and revisions	10) Final sample plan and survey instrument
	Task 16. Pre-test and revisions	
	Task 17. OMB submission	11) OMB Package

	Task 18. Conduct nonuse survey	12) Report sample sizes and response rates
	Task 19. Estimate model and analysis	
	Task 20. Draft Report	13) Draft Report
	Task 21. Peer review and revisions	14) Final report
	Task 22. Presentation to steering committee	15) Nonuse PowerPoint presentation
Phase	**Task**	**Milestone**
Phase IV	Task 1. Integrate information from Phases II & III to a comprehensive estimate of the value provided by NPS resources along the Colorado River.	1) Report on comprehensive value
	Task 2. Select/construct hydrological models to interface with economic value parameters	
	Task 3. Conduct regional economic modeling at the multi-county and basin-wide scale	
	Task 4. Integrate change in water-related amenity attitudes, changes in visitor use, and model of regional economic impacts	2) summary of direct use impacts on the regional economy
	Task 5. Integrate change in water-related amenity values to changes in welfare measures for both for Direct use and nonuse values	
	Task 6. Compute economic values provided by NPS resources along the Colorado River with other economic values associated with the Colorado river (e.g. hydropower, water storage)	
	Task 7. Integrate amenity-direct use-regional economies model with Hydrological models in a user friendly analysis tool for NPS staff use	3) User-friendly integrated analysis model
	Task 8. Presentation of Analysis Model to Steering Committee	4) PowerPoint presentation
	Task 9. Draft technical document summary of project background, models, datasets, and results	5) Draft Technical document
	Task 10. Peer review and revisions	6) Final technical document
	Task 11. Nontechnical document describing project and results	7) Nontechnical document
	Task 12. Presentation to Steering Committee	8) PowerPoint presentation
		9) Submit 2 papers to a peer-reviewed journal

Budget. The recommended approach is assumed to be contracted through the Rocky Mountains Cooperative Ecosystems Studies Unit, located at the University of Montana. This implies a relatively low (17.5%) overhead rate. All rates reported here are based on actual and projected University of Montana rates for the key personnel. The budget presented here presumes an efficient research structure with a single Principle Investigator and all key team members at the University of Montana. If a different structure is implemented that includes multiple collaborators, costs would be somewhat higher.

Key personnel include:

- Dr. John W. Duffield (Ph.D. Economics, Yale, 1974),
- Dr. David A Patterson (Ph.D. Statistics, University of Iowa, 1983),
- Mr. Chris J. Neher (MA Economics, University of Montana, 1989).

Other study participants will include peer reviewers, and Research Assistants. The RA's will conduct data entry, site contacts, and other supervised tasks.

Allocation of personnel time across study phases is shown in Table 6, by project phase for each of the three remaining phases of the project.

Table 6. Personnel Allocation by Phase and Budget Period (months)

	Personnel			
	Duffield	**Patterson**	**Neher**	**Research Assistant II**
A) Time Allocation by Phase				
Phase II	4	0	4	0
Phase III	16	6	16	22
Phase IV	8	2	8	0
Totals	**28**	**8**	**28**	**22**

It is anticipated that there will be a total of four peer reviewers. Two reviewers will participate in all phases of the review. It is anticipated that one of these reviewers will fund his/her own participation. Two other reviewers will focus on the direct use, and nonuse studies, respectively, as well as the final technical document. The review of the Phase II report will require two reviewers and three days each. The Phase III review of each study plan/survey instrument will require three reviewers five days each, for both the nonuse and use study plans. The draft reports in this phase will require three reviewers each and three days each reviewer. The final technical report will require four reviewers three days each.

Future academic salary rates at the University of Montana are projected to increase at 4% on October 1, 2006, and 3.75% in each of the following years. Fringe rates are assumed stable. Health insurance rates increase $50 each year on June 1. The total personnel

budget (excluding peer review and subcontracted services) is $798,252 (allocation of personnel effort by project phase is detailed in appendix Tables A4-A6).

Travel budgets are shown in Appendix Tables A1 – A3. The on-site visitor survey agent travel budget totals $39,032. Trips by the PI to the Denver area for meetings with the Steering Committee are budgeted at $720 each. Trips to Washington DC by the PI are budgeted at $1,200 each. Per Diem rates are State of Montana, out-of-state travel rates. Lodging is federal lodging allowance. Airfare and car rentals are based on a recent web search.

Subcontracts include peer review (a total of 44 days at $1500/day or $66,000), data collection for the nonuse study (2000 at $35 per complete or $70,000), and contracted data collection for the use study (recruit RDD visitor sample 1000 at $30 or $30,000, panel data collection by phone/mail at 1500 times three contacts at $25,000 per contact or $75,000, and web-administered survey at $5,000).

Appendix Tables A4 to A6 show budgets for all items by project phase**.** These totals are $113,189 for Phase II, $950,647 for Phase III, and $276,679 for Phase IV.

Table 7 shows a summary budget. Budget elements include:

- salaries $798,252 (including 36 months at the Ph.D. level in economics and statistics, 28 months at the MA level (economics) and 22 months for research assistant support)
- travel $53,612 (including survey agent travel, and PI travel to meet with OMB and the study Steering Committee)
- subcontracts $246,000 (including peer review at key study design and draft report stages, and data collection)
- other operations ($43,000 (primarily mail survey costs)
- total direct cost of $1,140,864
- indirect costs are $199,651, based on the RM-CESU overhead rate of 17.5 percent

The total budget for Phases II-IV of the recommended approach is $1,340,515. This proposed work and budget has been approved by the University of Montana administration, and is ready to be implemented.

Table 7. Summary Total Project Budget, by Phase				
	Phase II	**Phase III**	**Phase IV**	**Total Budget**
Total Personnel Costs	$ 91,111	$ 486,610	$ 220,532	$ 798,252
Total Travel	$ 720	$ 51,452	$ 1,440	$ 53,612
Total Subcontracts	$ 4,500	$ 228,000	$ 13,500	$ 246,000
Total Operations	$ -	$ 43,000	$ -	$ 43,000
Total Direct	**$ 96,331**	**$ 809,062**	**$ 235,472**	**$ 1,140,864**
Total Indirect	$ 16,858	$ 141,586	$ 41,208	**$ 199,651**
Total Budget	**$ 113,189**	**$ 950,647**	**$ 276,679**	**$ 1,340,515**

To conclude this section, the recommended approach is to organize the study into three sequential phases:

- Phase II-literature review and synthesis
- Phase III-original research
- Phase IV-integration and communication.

The major work elements are in phases III and IV. In Phase III it is recommended that both a direct recreational use and a nonuse values study be undertaken. The focus of the direct recreational use study will be on the river and reservoir system centered around Glen Canyon Dam and including Lake Powell and Lake Mead. The nonuse values study will focus on resource attributes impacted by water allocation decisions, potentially including endangered fish, beach /habitat enhancement, archeological and cultural features, and other ecosystem services and resources. The recommended approach is projected to take three years at a cost of $1,340,515.

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Appendix A: Detailed Budget Tables

Table A1. Estimated Travel Budget - NPS Colorado River Unit Visitor Survey: On-site Visitor survey

	Unit cost	Number	Total cost	Category subtotal
Airfare Details				
RT Flight - Missoula/Flagstaff	$800	2	$ 1,600	
RT Flight - Missoula/Denver	350	2	$ 700	
				$ 2,300
Per Diem				
225 person days	28	225	$ 6,300	
				$ 6,300
Lodging				
Grand Canyon/Flagstaff	68	112	$ 7,616	
Colorado	93	112	$ 10,416	
				$ 18,032
Car Rental				
Denver monthly rental	1,100	4	$ 4,400	
Flagstaff monthly rental	1,000	4	$ 4,000	
				$ 8,400
Gas, tolls, parking, misc.	1,000	4	$ 4,000	
				$ 4,000
Total travel budget				**$ 39,032**

Above budget assumes 4 people surveying for 8 weeks apiece.
A total of 32 weeks (224 days). Also assumes each person will rent
a compact car. Per diem rates are State of Montana, out-of-state travel rates.
Lodging is Federal lodging allowance. Airfare and Rental car rates are based on
10/13/05 Search of Travelocity.com rates for a 2 month period in the summer of 2006.

Table A2. Estimated Travel Budget - NPS Colorado River Unit Visitor Survey: PI Denver Trip

	Unit cost	Number	Total cost	Category subtotal
Airfare Details				
RT Flight - Missoula/Denver	350	1	$ 350	
				$ 350
Per Diem				
3 days per trip	28	3	$ 84	
				$ 84
Lodging				
Colorado	93	2	$ 186	
				$ 186
Car Rental				
Denver 3 day rental	100	1	$ 100	
				$ 100
Total travel budget				**$ 720**

Assumes each person will rent a compact car. Per diem rates are State of Montana, out-of-state travel rates. Lodging is Federal lodging allowance. Airfare and Rental car rates are based on 10/13/05 Search of Travelocity.com rates

Table A3. Estimated Travel Budget - NPS Colorado River Unit Visitor Survey: PI Washington DC Trip			
Airfare Details			
RT Flight - Missoula/Dulles	700	1	$ 700
			$ 700
Per Diem			
2 days per trip	28	2	$ 56
			$ 56
Lodging			
DC	166	2	$ 332
			$ 332
Taxi etc parking			$ 112
Total travel budget			**$ 1,200**
Per diem rates are State of Montana, out-of-state travel rates.			
Lodging is Federal lodging allowance. Airfare and Rental car rates are based on			
10/13/05 Search of Travelocity.com rates			

Table A4. NPS Colorado River Basin Project: Phase II					
1) Personnel Budget		**Days**	**Unit price**	**Line Total**	**Totals**
	Salaries				
	Duffield	86	620.45	$ 53,359	
	Patterson	0	338.6	$ -	
	Neher	86	192.15	$ 16,525	
	RA II	0	0	$ -	$ 69,884
	Fringe				
	Duffield		22.75%	12,139	
	Patterson		18.00%	-	
	Neher		30.50%	5,040	
	RA II		10.00%	-	17,179
	Health				
	Duffield	4 months	506	$ 2,024	
	Patterson	0	506	$ -	
	Neher	4 months	506	$ 2,024	
	RA II	0	506	$ -	$ 4,048
2) Travel					
	PI to Denver 1 time		720	$ 720	$ 720
3) Subcontracts					
	3 peer review days (phase II)		1500	$ 4,500	$ 4,500
Total Direct					**$ 96,331**
4) Indirect					
	17.5% of total direct				$ 16,858
Total Budget - Budget Phase II					**$113,189**
Note : Phase II health estimated at 506					
Patterson compensation: Treated as extra compensation in Phase II: 18% fringe rate and no Health					

Table A5. NPS Colorado River Basin Project Phase III					
1) Personnel Budget		**Days**	**Unit price**	**Line Total**	**Totals**
	Salaries				
	Duffield	344	636.29	$ 218,882	
	Patterson	128	347.62	$ 44,495	
	Neher	344	196.96	$ 67,754	
	RA II	473	83.22	$ 39,363	**$370,495**
	Fringe				
	Duffield		22.75%	$ 49,796	
	Patterson		22.22%	$ 9,887	
	Neher		30.50%	$ 20,665	
	RA II		10.00%	$ 3,936	**$ 84,284**
	Health				
	Duffield	20 months	566.00	$ 11,320	
	Patterson		566.00	$ 1,169	
	Neher	20 months	566.00	$ 11,320	
	RA II	14 months	573.00	$ 8,022	**$ 31,831**
2) Travel					
	PI to Denver 2 times		720	$ 1,440	
	PI to DC 4 times		1200	$ 4,800	
	Travel to Flagstaff -site assessment (10 days)			2160	
	Travel for focus groups -2 people, 3 2-day trips (Denver cost basis)		1340	$ 4,020	
	Direct use on-site survey (32 person weeks)			$ 39,032	**$ 51,452**
3) Subcontracts					
	32 peer review days (phase III)		1500	$ 48,000	
	Nonuse survey data collection		2,000 @ 35	$ 70,000	
	Recruit RDD Visitor sample		1000 @ $30	$ 30,000	
	Survey 1500 3x @ 25,000 per wave			$ 75,000	
	Implement Web-based survey			$ 5,000	**$228,000**
4) Operations					
	Mail contact direct use sample (3000 @$10)			$ 30,000	
	nonresponse mail survey 1,200 @ $8			$ 9,600	
	Miscel. Phone/FedEx/Printing			$ 1,000	
	Focus groups (4 groups of 8 at $50 plus 4*$200 for room rental			$ 2,400	**$ 43,000**
Total Direct					**$809,062**
4) Indirect					
	17.5% of total direct				**$141,586**
Total Budget - Budget Phase III					**$950,647**
Patterson Compensation Year 2: 4 months treated as extra compensation (18% fringe) and 2 months as Buyout of Classes (30.5% fringe, health @ FTE*12*monthly health rate)					

Table A6. NPS Colorado River Basin Project Phase IV					
1) Personnel Budget		**Days**	**Unit price**	**Line Total**	**Totals**
	Salaries				
	Duffield	172	672.61	$ 115,689	
	Patterson	43	365.35	$ 15,710	
	Neher	172	208.3	$ 35,828	
	RA II	0	0	$ -	**$167,227**
	Fringe				
	Duffield		22.75%	$ 26,319	
	Patterson		30.50%	$ 4,792	
	Neher		30.50%	$ 10,927	
	RA II		10.00%	$ -	**$ 42,038**
	Health				
	Duffield	8 months	625	$ 4,998	
	Patterson		625	$ 1,271	
	Neher	8 months	625	$ 4,998	
	RA II		625	$ -	**$ 11,267**
2) Travel	PI to Denver 2 times		720	$ 1,440	**$ 1,440**
3) Subcontracts					
	9 peer review days (phase IV)		1500	$ 13,500	**$ 13,500**
Total Direct					**$235,472**
4) Indirect					
	17.5% of total direct				**$ 41,208**
Total Budget - Budget Phase IV					**$276,679**
Note : Phase IV health estimated at (5 months * 606 + 3 months *656) / 12 = 624.75					
Patterson Compensation Phase IV: 2 months as Buyout of Classes (30.5% fringe, health @ FTE*12*monthly health rate)					