An Estimation of the Non-Market Economic Value of Wetland Habitats and Recreation Sites in the Spring Valley, NV, Basin Using Secondary Data Sources

Prepared by

Klaus Moeltner, PhD

for

Great Basin Water Network
Reno, NV
Western Environmental Law Center
Taos, NM
Long Now Foundation
San Francisco, CA

November 2, 2006

Contact address:
Klaus Moeltner
Department of Resource Economics / MS 204
University of Nevada, Reno
Reno, NV 89557-0105
phone: (775) 784-4803
fax: (775) 784-1342
e-mail: moeltner@cabnr.unr.edu

Note: This research was performed by Dr. Moeltner through a private consulting agreement with the above listed organizations. It is *not* to be interpreted or cited as an official study conducted by the University of Nevada, Reno (UNR).

Contents:

Tables:

Definition of Non-Market Valuation:

"The measurement and translation, into dollars, of the economic values society derives from environmental amenities and natural resources other than those that can be directly sold and bought in existing markets".

Executive Summary:

There are two components to this report. The first part, reflecting the primary objective of this study, assesses the non-market economic value of the Swamp Cedar and Shoshone Ponds Natural Areas in Spring Valley, NV. Given the lack of primary research results for these wetlands, our analysis builds on secondary information reported in existing wetland valuation studies. These secondary data are analyzed using a Meta-Regression Model. The results of this model are then combined with basic information on Spring Valley wetlands and regional demographics to generate an estimate of the *annual* value these lands provide through habitat services and recreational opportunities to the local and state-wide population. We estimate these values at approximately $2 million per year for the combined population of Nevada and Utah households.

Using recently submitted scientific information on the potential impact of the proposed groundwater transfer from Spring Valley to the Las Vegas area on these wetlands, we also derive estimates of the *total economic losses over time* to various underlying population segments. Depending on the projected impact scenario, the discounted present value of total economic losses to Nevada and Utah households associated with the disappearance of these wetlands are estimated to lie between $42 million and $70 million for a 70-year time horizon.

The second section of the report uses an existing meta-study on outdoor recreation to derive approximate estimates of economic values to visitors of the Cleve Creek Campground in Spring Valley, and the Sacramento Pass Recreation Area between Spring Valley and Snake Valley. A conservative use of the lower half of the confidence interval flowing from this analysis estimates the per-person and activity day benefits to lie in the $6-$42 range for either site. This implies that Cleve Creek probably generates an estimated $35,000 - $254,000 per year in economic benefits to its total population of visitors. For Sacramento Pass, the corresponding figure is expected to lie between $71,000 and $508,000 per year. Extrapolating these annual benefit estimates to a 70-year horizon produces discounted present values of between $1.3 million and $9.5 million for Cleve Creek, and between $2.7 million and $19 million for Sacramento Pass.

Both of these analyses build on secondary data. While we are confident that our results provide a reasonable first estimate of the potential economic losses through diminished habitat services and recreational opportunities that could occur in the Spring Valley Basin as a result of the proposed groundwater transfers, our secondary approach cannot fully substitute for thorough primary data collection and research. Given the considerable magnitude of our first-cut loss estimates we argue that primary valuation studies in the Spring Valley area are both warranted and justified.

Summary Table of Key Results:

Area	Annual economic value	Present value of economic benefits **under no groundwater export** for a 70 year horizon (2% discount rate)
Swamp Cedar Natural Area and Shoshone Ponds Natural Area	$1.97 million	$73.7 million*
Cleve Creek Recreation Area	$36,000 - $120,000	$1.3 million – $9.5 million
Sacramento Pass Recreation Area	$72,000 - $240,000	$2.7 million – $19 million

* For a defined stakeholder population of Nevada and Utah households

I) Introduction

The primary objective of this study is to assess the economic value, in dollars, of wetland areas in Spring Valley, NV. Given time and budget constraints, this analysis builds on secondary information reported in existing publications on wetland valuation. These secondary data are processed through a Meta-Regression model (MRM). The results of this model are then combined with basic information on Spring Valley wetlands and regional demographics to produce an estimate of the *annual* value these lands provide through habitat services and recreational opportunities to the local and state-wide population. We then use recently submitted scientific scenarios regarding the potential impact on these wetlands of the proposed groundwater transfer from Spring Valley to the Las Vegas area to generate estimates of the *total economic losses over time* to various underlying population segments.

The study also addresses a secondary objective. It estimates the annual economic benefits generated to visitors of the Cleve Creek and Sacramento Pass Recreation Areas and briefly discusses the potential economic implications of a hypothetical closure of these sites.

II) The Economic Valuation of Spring Valley Wetlands

Study Area and Scientific Background

Spring Valley in White Pine County, east-central NV, is approximately 9.5 miles wide (east – west) and 95 miles long (north-south). It distinguishes itself from other valleys in the great Basin by its high elevation (5500 – 6000 feet), and its relatively abundant water resources, provided by over 100 natural springs (Charlet, 2006). These springs together with snowmelt retained by a hardpan soil layer (Lanner, 2006) support numerous wetlands spread throughout the Valley. For this study we will focus on two specific wetland areas: (i) the Swamp Cedar Natural Area (SCNA), and (ii) the Shoshone Ponds Natural Area (SPNA).

The Swamp Cedar Natural Area (SCNA), a marshy ecosystem with natural ponds and meadows, is located in Spring Valley approximately 23 air miles east of the town of Ely. It contains 3200 acres of public land administered by the Bureau of Land Management (BLM). It also supports a large stand of Rocky Mountain Junipers (*Juniperus scopulorum*), commonly referred to as "Swamp Cedars". These Spring Valley Cedars have been described as "globally unique" as they have adapted to a distinctly different environment than is characteristic for the main population of their species (Charlet, 2006, Lanner, 2006). While the Swamp Cedars of Spring Valley have not yet received extensive genetic study, experts hypothesize that they may merit recognition as their own unique variety (Lanner, 2006). The SCNA can be reached via dirt roads branching from Highway 50. It offers recreational opportunities for hiking, primitive camping, and wildlife viewing, although it does not feature a designated access road, parking area, developed trail system or established campgrounds (BLM, 1980).

The Shoshone Pond Natural Area (SPNA) is located approximately 13 miles south of the SCNA in Southern Spring Valley. It contains 1240 acres of public land managed by the BLM. It features two important natural resources: (i) a second stand of "Swamp Cedars" of the same ecotypical variety as those found in the SCNA, and (ii) three manmade, spring-fed pools and a stockpond that harbor two rare species of fish, the relict dace (*Relictus solitarius*) and the Pahrump poolfish (*Empetrichthys latos*). The relict dace is listed by the Nevada Natural Heritage database as "imperiled and vulnerable in Nevada and globally", while the Pahrump poolfish, for which the Shoshone ponds constitute one of only three remaining habitats, has been federally listed as an endangered species since 1969. The SPNA has a designated access road off of Highway 93. While lacking maintained hiking trails or established campsites, the SPNA offers recreational opportunities for hiking, primitive camping, and wildlife viewing (BLM, 1980(b)).

Both Natural Areas have been noted as providing valuable habitat to wildlife such as pronghorn antelope (Charlet, 2006). Hunting is permitted in both areas, except for the northeastern portion of SPNA, which contains the above described manmade facilities and a small livestock enclosure.

Resource Valuation and Benefit Transfer

In general, there are two types of economic benefits that can flow to a local economy from the recreational and environmental amenities provided by its natural resource areas, such as wetlands, wilderness areas, wildlife refuges, and bird sanctuaries. The first type of benefit is related to revenues from visitors' expenditures, such as those described for the Spring Valley region in Rajala's (2006) report. The second type of economic benefit is related to the value locals (or any other relevant group of stakeholders) themselves derive from these natural amenities. Such values can arise through direct use of these lands (for example through hunting, fishing, wildlife viewing or other forms of outdoor recreation), or through the simple notion that these areas and their natural amenities are "doing well" and will be available for active use to future generations. The latter types of economic benefits are often referred to as "non-use" values in the empirical economic literature.

Both use and non-use values are often grouped under the designation of "*non-market values*", as they flow from resource services that are not directly linked to commodities bought and sold in traditional markets. As a result, a set of custom-tailored economic and econometric tools are required to translate these latent values into actual currency. This, in turn, enables analysts and policymakers to compare these non-market benefits to policy costs and other economic figures in a broader benefit-cost-analytical framework. Standard references for the general approach of environmental and resource valuation are Champ et al. (2003), and Freeman (2003). An accessible text with specific focus on the valuation of outdoor recreation is Loomis and Walsh (1997).

The concept of non-market valuation as an approach to derive economic values for natural resources entered the political and legal arena in 1980 with the signing into law of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as "Superfund", administered by the Department of the Interior (DOI) and the U.S. Environmental Protection Agency (EPA). While the original draft of this regulation declared the inclusion of *non-use* values in liability provisions acceptable only as a final resort, a 1989 federal court of appeals ruled that non-use values should be included in environmental damage assessments, and instructed the DOI to redraft the CERCLA stipulations (Mathis et al., 2003). This landmark decision had a critical impact on the court rulings following the 1989 Exxon Valdez oil spill. It also led to a variety of new damage assessment regulations in the early 1990s largely administered by the National Oceanic and Atmospheric Administration (NOAA). In 1992 a "Blue Ribbon" panel of economic experts convened by NOAA officially confirmed the legitimacy of non-market valuation techniques to assess environmental assets and damages within judicial process (Jones, 1997). Since then, non-market valuation has been employed in numerous legal proceedings around the country, including water management disputes (e.g. Loomis, 1997).

Traditionally, survey methodologies or direct field studies of user behavior and preferences are employed to gain a better understanding of these non-market type economic benefits. However, as in the present case, the limitations of available resources, in terms of time and / or budgets, often preempt conducting such primary studies. Fortunately, there has been a rapid accumulation of primary research on resource valuation in the last few decades. This has made the use of output from existing valuation studies to predict outcomes for a new policy context an attractive alternative to launching original studies for resource managers and planners. This approach is known as "Benefit Transfer" (BT) in the empirical economic literature. It has been widely embraced by government agencies, such as the EPA, in recent years (U.S. EPA, 2000, U.S. EPA, 2005). Resource economists have formally adopted this low-cost alternative tool since the early 1990s to estimate the economic effects of a variety of proposed environmental policies, such as water quality improvements (e.g. Johnston et al., 2003), improved access to outdoor recreation (Rosenberger and Loomis, 2000), the management of forest fires (Houtven et al., 2006), and air quality control measures (Smith and Huang, 1995). For a general synthesis and discussion on the techniques and applications of Benefit Transfer, see for example Brouwer (2002), Rosenberger and Loomis (2003) and Moeltner et al. (Forthcoming).

In its most rigorous and reliable form BT is implemented in conjunction with Meta-regression analysis. This process comprises the following steps:

First, the researcher must identify existing studies that have estimated the economic value of natural resources similar to the one in question (aka the "policy site"), ideally for a similar underlying population of stakeholders. These existing sources may include traditional outlets such as journal publications and book chapters, but should also explore the "gray literature" consisting of government reports, departmental working papers, theses and dissertations, and other types of informal publications. In each case, the researcher must use good judgment to decide if the primary analysis underlying these original sources satisfies the dual requirements of "similarity to the policy context of interest" and "scientific rigor and credibility".

Once a suitable set of primary studies has been chosen, the analyst extracts all pertinent quantitative information from these sources and builds a "meta-dataset". Two paradigms guide this process: (i) Each piece of information captured in the dataset must be available from *all* source studies, or, alternatively, retrievable from public sources such as census information, and (ii) the captured values need to correspond to what is known for the policy site. For example, for the wetlands under consideration in this study, basic available information included size in acres, types of recreational opportunities, presence of rare and endangered species, and so forth. Thus, a source study that does not report one or more of these key features for the wetland it analyzes will be of limited value and may potentially be excluded from the database.

Step three then relates the reported measures of economic value from all retained source studies to the features of the respective study sites and the attributes of the individual underlying stakeholder populations within a quantitative statistical framework called "Meta-regression". This technique is described below in more detail. The key output from this estimation step is a set of estimated parameters or coefficients that provide numerical evidence of how economic values are affected by a specific site attribute or population characteristic.

In the final step these estimated parameters are then combined with basic information available for the policy site to form a forecast or prediction of the economic values it generates to underlying stakeholders. These "transferred" estimates are usually expressed as "willingness to pay per day or visit" for applications focusing on direct use of a natural resource or amenity, and as "willingness to pay to preserve a resource" for non-use applications. In either case, they are expressed in actual dollars, and can thus be directly incorporated into larger benefit-cost analyses surrounding the policy question.

Literature Overview and Data

Suitable primary studies for the Meta-regression model were identified using the following sources: Four existing meta-analyses focusing on the economic value of wetlands (Brouwer et al., 1999, Woodward and Wui, 2001, Borisova-Kidder, 2006, Brander et al., 2006), the Environmental Valuation Reference Inventory (EVRI), a searchable database focusing on non-market valuation, and ECONLIT, a standard searchable database for economic literature. The initial criteria for study selection were: (i) Geographic area = USA or Canada, (ii) Exclusion of coastal or marine types of wetlands, (iii) Estimated economic values must include values related to habitat, biodiversity, or species preservation. The latter two criteria flow from the nature of the current policy context: Spring Valley wetlands are distinctly different ecosystems than coastal or marine wetlands, and their economic value is primarily related to habitat and biodiversity services. Thus, we excluded studies that focused on wetlands with the sole functions of flood control or water quality improvements, as well as studies that *only* examined the value of specific wetlands with respect to extractive use (hunting, fishing).

This "first cut" approach produced a set of 24 initial candidate studies. Given the nature of their primary valuation objectives (habitat and biodiversity services, recreational opportunities) all of these sources use survey-based approaches to elicit households' willingness-to-pay (WTP) to preserve or expand a specific existing wetland area. A second round of screening eliminated studies that are based on identical survey instruments *and* target populations (thus valued the same wetland for the same target population), and studies based on surveys that produced response rates below 30 percent. In the case of duplicate studies we retained the study with the most reliable research methodology. The low-response rate criterion was applied to guard against "selection bias", i.e. the possibility that the small segment of those who participated in the survey is not representative of the underlying target population. Only one study fell into that latter category.

These selection refinements resulted in a final set of nine studies deemed suitable for the research context at hand, yielding 12 observations available for our meta-dataset (One study, Blomquist and Whitehead, 1998, reports WTP estimates for four different wetlands). While this sample is not as large as would be ideal, it has several desirable properties. As shown in the Table 1, the selected studies provide good coverage of the geographic target area, with applications from various parts of the United States, and one Canadian contribution (Tkac, 2002). All studies were conducted within the last 15 years and thus use modern survey and estimation methodologies. The underlying target populations are of a general nature with at least regional scope. Specifically, three studies (Loomis et al., 1991, Roberts and Leitch, 1997, and Tkac, 2002) focus on a regional population of stakeholders, while five of the studies are associated with a State-wide target population (Hanemann et al., 1991, Whitehead and Blomquist, 1991, Mullarkey, 1997, Blomquist and Whitehead, 1998, Poor, 1999), and one source (Klocek, 2004) has nation-wide coverage. The sample also exhibits a desirable mix of journal publications, book chapters, government reports, and theses or dissertations. The relatively strong representation by contributions from the "gray" literature eases the traditional concern of "publication bias" in meta-analytical research, i.e. the notion that only valuation results that are surprising or otherwise noteworthy are ever considered by journal editors. It also lends testimony to a thorough search process that went beyond traditional journal outlets.

Table 2 provides more detailed information for each observation included in our meta-dataset. Most policy scenarios presented to respondents for a given study stipulated that wetland areas would be lost (due to agricultural activities, mining, or urban sprawl) if no action was taken. Respondents were then asked if they would be willing to pay a specific dollar amount ("bid") into a nature conservation fund or in additional taxes to preserve these lands. Bid amounts were varied over respondents. This allows for the econometric computation of average per-household economic value or "willingness to pay" for the preserved acres of wetland. The only exceptions to this pattern are the studies by Poor, (1999, obs. 7) and Klocek (2004, obs. 9) who asked respondents if they would be willing to contribute to a special fund to create additional acres of wetland (for example by converting drained agricultural areas to their original marshy conditions). The elicitation format via bids and econometric estimation for these two contributions follows the general pattern described above.

All of the included studies asked respondents to value the *entire bundle* of wetland services, including habitat and biodiversity provision, flood control, water filtration, and opportunities for non-consumptive (wildlife viewing, hiking, photography) and consumptive (hunting, fishing) recreational activities. Some studies (Blomquist and Whitehead, 1998, Tkac, 2002) also stress the presence of threatened or endangered species on the wetlands under consideration. Since the surveys targeted the general population of underlying households (as opposed to a specific group of active users), only a relatively small segment of respondents indicated that they had visited the wetland under consideration in the past, as depicted in the "% of active users" column in Table 2. Thus, the lion's share of estimated economic benefits (i.e. reported WTP) is likely associated with non-use or existence values. This is another important and desirable feature of our data set given the current research context, since it can be expected that only a small proportion of the wider population of stakeholders will have actually visited the Spring Valley wetlands considered in this study.

Meta-Regression Model

As can be seen from Table 2, the annual WTP per prototypical household underlying a given study exhibits a wide range – from less than a dollar (observation 9) to close to $300 (observation 1). The aim of the Meta-regression model (MRM) is thus to examine which wetland attributes and population characteristics drive this observed variation in estimate WTP. A series of preliminary estimation runs identified the following simple regression model as most promising specification:

$$\log(wtp_i) = \beta_0 + \beta_1 \cdot \log(inc_i) + \beta_2 \cdot users_i + \beta_3 \cdot \log(acres_i) + \beta_4 \cdot (\log(acres))^2 + \varepsilon_i \qquad (1)$$

Equation (1) states that the natural logarithm of WTP associated with observation *i* *(i=1…12)*, is a function of logged income for the population underlying observation *i*, the percentage of active users for wetland *i*, the logged amount of acres preserved or added as stipulated in the policy scenario for observation *i*, and the same quantity in squared form. The terms β_0 through β_4 are parameters that need to be estimated by the regression model. They are also known as "regression coefficients". The first of these terms, β_0, is often referred to as the regression intercept or constant term. The regression error term, ε_i, is a statistical construct that comprises all unknown or unobserved factors that may also contribute to the observed variation in WTP. It is usually specified to be normally distributed with a mean of zero and variance σ^2. The regression model produces an estimate for this variance term, along with estimates for the regression coefficients.[1]

Meta-Regression Results and Benefit Transfer Predictions

Table 3 captures the estimation results for the MRM. Column 1 shows the variable labels as described above. Column 2 depicts the estimates for the regression coefficients β_0 through β_4. Given the functional forms of our dependent variable (log of WTP), the estimated effect of log(income) can be directly interpreted as elasticity, i.e. as income increases by one percent, WTP increases by 7.7%. Similarly, a one-percent increase in active wetland users amongst the target population increases WTP by 0.17*100 = 17%. Since wetland size ("acres") is included in both logged and squared-logged form, its effect on WTP changes with the level of acreage. This is intuitively sound as it corresponds to the economic paradigm of "diminishing marginal benefits", i.e. the notion that an additional increment of a good or commodity is valued more highly when it is scarce, and less when it is already available in abundance. For example, starting at a base level of 100 acres, a one-percent increase from that level will increase WTP by $1.990 - 2 \cdot 0.19 \cdot \log(100) = 0.24\%$.

---

[1] Given that each WTP observation in our small dataset corresponds to a different wetland or underlying population of stakeholders, it can be expected that our MRM will not have a single variance term σ^2, as would be the case for a standard regression model, but rather that each individual error term ε_i will have its own corresponding variance, σ_i^2. This property is called "heteroskedasticity" in econometric jargon. It is a common feature of meta-regression models that has been noted in virtually every recent meta-analytical contribution to the literature. Ignoring this deviation from the standard regression case can cause misleading regression results and forecasts. We therefore estimate our model in (1) using a White-corrected, or "robust" variance specification (White, 1980).

The third column in Table 3 titled "Standard Error" shows the estimated standard error for each coefficient. This is a measure of accuracy of a given estimate. The larger the standard error relative to the magnitude of the estimated coefficient, the less certain we can be that the estimate is "close" to the "true" unknown parameter, and that its associated explanatory variable really contributes to explaining WTP. In contrast, if the standard error is small compared to the estimate, the estimated coefficient value is declared as "statistically significant". The last column in Table 3 indicates the levels of significance for each estimated coefficient. A larger number of asterisks indicated higher (or "better") levels of significance. In our case, even the least significant regressor ("*users"*) is still significant at the 10% level, a commonly used "lowest acceptable threshold" to assign significance. All other estimates are significant at the 5% level or better. Thus, there is strong evidence that all of our explanatory variables are important contributors in explaining observed WTP values. Naturally these standard errors and significance levels must be interpreted with some caution, since their meaningfulness and reliability decreases with sample size.

In contrast, the meaningfulness of the overall coefficient of determination, labeled as "R^2" in Table 3 is *not* dependent on sample size. The R^2 value provides an overall measure of "Goodness-of-fit" for a given regression model. Our R^2 value of 0.9 indicates that *the specified MRM explains 90% of the observed variability in WTP*. This is an extremely encouraging result – it says that the three chosen explanatory variables – income, percentage of active users, and acres of wetland protected or added – in their chosen functional forms almost fully explain what drives individual WTP estimates for our sample. Thus, despite our small sample size and the simplicity of the specified model our regression specification has substantial explanatory power. As a result, this model should also be able to generate plausible and reasonably accurate Benefit Transfer estimates for our Spring Valley application.

Table 4 shows annual BT predictions per household and for the entire population of households for three different possible definitions of "stakeholders": Households residing in the four Counties surrounding Spring Valley (White Pine and Lincoln in Nevada, and Millard and Juab in Utah), all households in Nevada, and all households in Nevada and Utah combined. Ultimately, policy makers need to decide which definition of "stakeholder population" is most appropriate in this case. The three examples were chosen to provide some flexibility in this respect. The first two rows of the table depict the number of households and median household income corresponding to each of the three groups. To perform the BT we also need to decide on an estimate for the percentage of households within each stakeholder group that may have visited the SCNA and/or SPNA in the recent past. In the absence of any existing information on actual visitation of these Spring Valley Natural Areas we conservatively set this measure to 5% for the 4-County population, and to 1% for the two larger State-wide populations.

The remainder of the table captures predicted economic values, or WTP, on a per-household basis and for the entire population for each stakeholder group. These are the actual "Benefit Transfers", i.e. the key results of this analysis. Annual per-household WTP is computed as follows:

$$WTP_S = \exp\left\{\hat{\beta}_0 + \hat{\beta}_1 \cdot \log\left(income_S\right) + \hat{\beta}_2 \cdot users_S + \hat{\beta}_3 \cdot \log(4440) - \hat{\beta}_4 \cdot \left(\log(4440)\right)^2 + \frac{1}{2}s^2\right\}, \qquad (2)$$

where WTP_s is the mean WTP per household for stakeholder group *s*, $income_s$ and $users_s$ are the median household income and percentage of active users, respectively, for group *s*, the figure 4440 denotes the combined acreage of SCNA and SPNA, $\hat{\beta}_0$ through $\hat{\beta}_4$ are the estimated regression coefficients from Table 3, and s^2 is the overall regression error (0.56 in our case). The last term in (2) is needed to properly translate predictions for logged WTP into absolute dollar values. Total population figures are then computed by multiplying (2) by the respective number of households for each stakeholder group. For each WTP estimate, Table 4 also provides the lower and upper bound of a 95% confidence interval. However, since these intervals build on the standard errors of the individual coefficient estimates described above, they need to be interpreted with caution given our small sample size.

Generally, our BT results are very plausible given the (stipulated) small percentages of active users, with annual per-household WTP ranging from $0.6 to $1.35 across the three stakeholder groups. These differences across group are primarily driven by higher median household incomes for the larger populations. Overall population estimates of the annual economic value generated by the Spring Valley wetlands under consideration range from close to $7000 per year for the 4-Counties segment to close to $2 million per year for the combined population of Nevada and Utah.

Economic Loss Scenarios

Table 5 extrapolates these annual WTP figures to a 70-year time horizon. This time span reflects the amortization period for the proposed groundwater transfer projected by the Southern Nevada Water Authority (SNWA). The Table displays *cumulative* discounted present values flowing from the two wetland areas to the three stakeholder groups in 10 year increments for three water transfer scenarios: No transfer, labeled as "Status Quo", S.Q. in the Table, transfer with wetlands disappearing two years after transfer commencement ("Scenario 1"), and transfer with wetlands disappearing twenty years after transfer commencement ("Scenario 2"). The two transfer scenarios are based on recent scientific estimates of the survival probabilities of SCNA and SPNA Swamp Cedars under the proposed groundwater extraction. Specifically, Lanner (2006) hypothesizes that the Swamp Cedars of the SCNA would not survive beyond two years after the initiation of the proposed groundwater extraction, while Charlet (2006) deems it as unlikely that the Spring Valley Swamp Cedars will live long past the first twenty years of groundwater drawdown. For simplicity and given the lack of any further scientific forecasts regarding other features of Spring Valley wetlands we interpret the disappearance of the Swamp Cedars as synonymous to the complete cessation of all natural services currently flowing from the two wetlands.

Naturally, the net present values of future resource services also hinges crucially on the chosen discount rate to derive future estimates. The higher the discount rate, the less future service flows are valued today. As shown in Table 5, we choose a rate of 2% for this application. This discount rate is recommended by the U.S. Congressional Budget Office (CBO) for policies that have long-term social implications. It is considered the "Social Rate of Time Preference", i.e. the rate that best reflects society's collective preferences for trade-offs between present and future generations' consumption. The Intergovernmental Panel on Climate Change (IPCC) also suggests that rates as low as 2% may be appropriate for environmental decision making (Ward, 2006, ch. 6). [2]

The figures in Table 5 are thus to be interpreted as follows: For each choice of stakeholder group there are three columns, one for each scenario. The Status Quo (or S.Q.) column lists, in 10 year increments and in units of $1000, the cumulative benefits generated by the two wetland areas in absence of any groundwater draw-downs. For example, the discounted present value (PV) flowing from the two Natural Areas for Nevada over a 40 year horizon is approximately $24.7 million. The PV for both Nevada and Utah over 70 years is estimated at close to $74 million.

In contrast to the Status Quo column, which depicts economic benefits, the figures in the "Scenario 1" and "Scenario 2" columns are to be interpreted as *economic losses* following groundwater

[2] Aside from the definition of relevant stakeholders mentioned above, the choice of discount rates to assess future streams of costs and benefits for a given long-term project is perhaps the single most important decision to be made by policy makers and resource managers.

export. For example, under the two-year desiccation scenario (Scen. 1) and the full 70-year horizon, we estimate a loss of over $32 million to Nevada alone, and $70 million to Nevada and Utah combined. For Scenario 2, under which we stipulate no losses for the first 20 years after project initiation, the discounted 70-year losses are $19 million for Nevada, and $41.5 million for Nevada plus Utah.

There are some important caveats to keep in mind when interpreting the figures in Table 5. First, it is implicitly assumed that none of the components of our estimation model such as real household income, percentage of wetland users, and the number of households in the stakeholder populations change markedly over time. In reality, we could expect that at least the number of households would increase over time, raising the annual economic value of the resources in question, and thus the economic losses that would result from the proposed groundwater extraction and export project. Second, the figures in the table are based on the stylized assumption that the wetlands and all their assets "disappear" instantaneously after the stipulated 2 year or 20 year horizon. Likely, the cessation of wetland services will be a continuous, dynamic process, with gradual replacement of existing ecosystems by others (e.g. Charlet, 2006). More detailed scientific forecasting and primary economic studies would be needed to more appropriately model economic losses associated with these transitional processes. By the same token, these forecasts implicitly assume that after 70 years of groundwater extraction, both wetlands will be instantaneously restored to their original state, i.e. there will be no further losses to society after 70 years. As indicated by scientific evidence this is likely not a realistic stipulation. Thus, policy makers may want to consider extending these loss scenarios further into the future.

General Caveats and the Need for a Primary Valuation Study

This entire BT analysis is based on secondary, aggregated information extracted from existing sources. After a thorough literature search, we found twelve studies that qualify for this BT application. The secondary nature of our data and the small sample size underlying our estimation impose several limitations on the accuracy and validity of our results.

First, our analysis is based on the implicit assumption that households in Kentucky, Nebraska, etc have the same underlying preferences for wetland preservation as households in the Great Basin. This assumption is questionable given the vastly different sets of substitute wetlands and alternative recreational opportunities available to different populations around the country.

Second, our small sample size and the lack of detailed information on specific attributes of wetland areas considered in original studies preempts a more thorough examination of the effect of various wetland features (other than acreage) on WTP. Each of the wetlands underlying these studies is unique in some sense, and wetland size in acres alone is not necessarily a reliable proxy for wetland quality attributes. For example, it is quite possible that the Spring Valley wetlands are valued more highly than predicted in our analysis given their function as habitats for a globally unique stand of trees, and two threatened / endangered fish species. On the other hand, many of the included wetlands in our meta-regression offer richer recreational opportunities than the Spring Valley areas. This, in turn, could inflate our BT estimates.

Third, the true impact of wetland size on WTP is not well captured by our model. Although our specification reflects the realistic notion of "diminishing marginal benefits" from wetland size as described above, estimated marginal benefits turn de fact negative at a size level of approximately 200 acres. In other words, we could have derived higher BT predictions for smaller wetland sizes. Naturally, this is somewhat counterintuitive. One would expect this "turning point" to occur at a much higher size level. This model flaw is a direct result of our small sample size and our corresponding disability to include more refined quality characteristics in our specification. Yet, the chosen model fits the underlying data extremely well, so this flaw is in some sense a small price to pay in exchange for plausible coefficient estimates for the other explanatory variables, small standard errors, and reasonable tight confidence intervals.

Fourth, and related to third, one could argue that the SCNA and SPNA ought to be valued separately. Using our BT model, this would more than double aggregate WTP predictions. We decided to pool the two areas for valuation purposes since this strategy best corresponds to the bulk of scenarios underlying our meta-data. In most of these studies, respondents were asked to value groups, bundles, or large areas of non-contiguous wetlands. A separate valuation of the Spring Valley areas using our MRM would likely lead to an over-estimation of combined economic benefits. It should be noted though that it would be straightforward to design a primary valuation study that elicits separate benefit figures for the two areas.

In summary, we are confident that our estimated annual WTP figures are well within a conservative range of estimates likely produced by primary research with direct focus on Spring Valley and the underlying stakeholder population. However, the shortcomings of our secondary data set, the uniqueness of the wetlands under consideration, and the distinctly unique policy context in this case call for a primary, survey based valuation study to allow for the computation of more accurate estimates of the economic benefits flowing from Spring Valley wetlands.

III) Cleve Creek and Sacramento Pass Recreation Areas

There are two recreation areas with camping facilities located in or near Spring Valley: Cleve Creek and Sacramento Pass. Both are administered by the BLM. There is some concern that these recreational facilities may be affected by the proposed groundwater transfers. Since the exact nature of these potential effects has not yet been scientifically examined or described in any detail, we will focus in this brief discussion solely on the status quo benefits flowing from the two facilities.

The Cleve Creek Campground (CCCG) is located at the western edge of Spring Valley on the East side of the Shell Creek Range approximately 45 miles east of Ely, and five air miles northwest of the Swamp Cedar Natural Area. It can be reached via a maintained dirt road off State Route 893. The camping area includes eight designated sites. It features a picnic area, toilets, and garbage facilities, but no drinking water or showers. Most sites are situated along Cleve Creek, a year-round stream that offers some fishing opportunities. The area also affords access to hiking trails and hunting opportunities. The campground is open year-round. Currently, there a no fees charged for either day use or overnight stays. According to the Ely BLM office, Cleve Creek has received 5723 visitation days in 2006 (as of mid-October).

The Sacramento Pass Recreation Area (SPRA) is located off Highway 6-50, approximately 50 miles east of Ely, and five air miles east of the Swamp Cedar Natural Area. The area features shaded picnic facilities, toilets, and a fishing pond. It allows for dispersed camping in undesignated sites. It is open year-round and can be used free-of-charge. The Ely BLM office reports 11503 visitation days for the first 9.5 months of 2006. An additional attraction of the SPRA is its proximity to Great Basin National Park (GBNP), located approximately 20 road miles to the southeast. Therefore, it is likely that the SPRA fulfills the functions of both a rest stop for travelers to or from GBNP, and an overflow camping area when the campgrounds within GBNP are fully occupied.

In theory, a Benefit Transfer (BT) / Meta-regression approach as employed in section I of this study for Spring Valley wetlands could be used to derive a rough estimate of the economic benefits flowing from these two recreation sites to day users and campers. However, such a time-intensive approach was beyond the scope of this study. Instead, we will rely on an existing BT study on outdoor recreation to assess the economic value of these two areas. Specifically, Rosenberger and Loomis (2001), [henceforth referred to as R&L] have derived benefit measures for 21 recreation activities based on 163 individual studies conducted between 1967 and 1998. This is by far the most extensive and most cited meta-dataset for outdoor recreation in the empirical economic literature. However, it should be stressed that contrary to our Meta-Regression Model (MRM) from section I, the MRM underlying R&L's study was *not* designed to estimate benefits for a specific site or policy context. Instead, R&L's aim was to use a single model to predict economic values for a large set of outdoor activities. Their meta-data include extremely diverse outdoor destinations with vastly different sets of substitutes available to the underlying population of visitors – from national "flagship" sites such as the Grand Canyon or Yosemite, to State Parks and rest stops of regional or local importance. This breadth of destination types and this high level of generality of analysis are convenient when the primary research objective is to generate nationally representative estimates for each activity for the "prototypical U.S. site and visitor", as was the case for the R&L study. The drawback of this approach is that the model is less well suited to generate BT predictions for any specific destination or visitor group.

Of the 21 activities examined in that study, camping and picnicking are the most relevant for our purpose. As shown in Table 6, based on 22 studies and 40 observations with focus on camping, R&L estimate the per-person and visitation day benefit from this activity at close to $40 (in 2006 currency). Drawing from a considerably smaller set of studies and observations for picnicking (7 and 12, respectively), the authors estimate the per-person, per-visitation day value of this activity at $45.5. Not surprisingly given the diversity of studies and recreation sites included in R&L, the 95% confidence intervals for these estimates, also shown in Table 6, are extremely wide. For example, the true value of a day of camping to the prototypical recreationist at a given location may be as low as $2.2, and as high as $250.

To translate R&L's figures into valuation estimates for the CCCG and SPRA, we must first decide which proportions of the observed visitation days as reported by the local BLM are associated with camping and picnicking, respectively, for each site. Numerically speaking, the exact split-up of visitation days across the two activities is not too critical since the R&L estimates are fairly similar for these two activities. Thus, in absence of any further information on this issue we simply choose the average for each pair of "low", "estimate", and "high" figures given in Table 6 to approximate the "activity-averaged" benefits for the two recreation areas.

The resulting figures are captured in Table 7. As depicted in the upper section of the table, our per-person and visitation day point estimate is approximately $42, with corresponding lower and upper bounds of $6 and $202, respectively. Using approximated annual visitation counts (in visitor-days) of 6,000 for CCCG and 12,000 for SPRA (extrapolating the BLM October estimates to a 12 month period), annual benefit estimates are derived to lie between $35,400 and $1.2 million with a point estimate of $254,100 for CCCG. The corresponding figures for SPRA are bounds of $70,800 and $2.4 million, respectively, and a point estimate of approximately $508,000.

Given the composition of the R&L data set, as well as the size, infrastructure, and location of the two areas under consideration we would expect actual benefits to be situated in the lower half of the confidence intervals shown in Table 7. Extrapolating the lower bounds and midpoints of these annual benefit estimates to a 70-year horizon produces discounted present values of between $1.3 million and $9.5 million for Cleve Creek, and between $2.7 million and $19 million for Sacramento Pass. Naturally, in absence of any information on visitor origins and composition, the geographic definition of this underlying population of benefit recipients is unclear. As for the Spring Valley wetlands, only a primary study with direct focus on these two sites would be able to generate more accurate estimates of economic values, and a better understanding of the underlying population of users.

V) Conclusion

The Spring Valley Area is endowed with numerous natural areas and recreation sites that have the potential to generate substantial economic benefits to the local, regional, and state-wide population. For some of these areas, most notably the wetlands discussed in section I, there is a relatively high probability that they will be adversely affected by the proposed groundwater transfers. Expressing the associated economic losses to society in dollars would be best accomplished by a primary non-market type economic valuation study for these lands. To date, such a study has not yet been conducted. Given time and budget constraints, we employ the standard alternative of a Benefit Transfer approach and meta-regression modeling to estimate annual benefit flows, in dollars, generated by these sites to underlying stakeholders.

While our model produces reasonable estimates, we also stress the limitations of our approach, and the need to conduct a primary valuation study for these areas. We feel that the most meaningful way to interpret our secondary-data results is to use them as a strong indication that the economic losses associated with a potential disappearance of Spring Valley wetlands could be of substantial magnitude, and that therefore primary economic research is both warranted and justified. Given the large geographic scale of the proposed groundwater extraction project, and the potentially irreversible nature of its environmental implications, it is imperative that decision makers be informed of all economic benefits and costs involved. These considerations should also include non-market type values associated with affected natural areas. We hope that this report will aid in creating awareness that such values exist and that they can be of important magnitude.

VI) References

Blomquist, G. C., and J. C. Whitehead. "Resource Quality Information and Validity of Willingness to Pay in Contingent Valuation." *Resource and Energy Economics* 20 (1998): 179-196.

Borisova-Kidder, A. "Meta-Analytical Estimates of Values of Environmental Services Enhanced by Government Agricultural Conservation Programs." Doctoral Dissertation, Ohio State University, 2006.

Brander, M. L., R. J. G. M. Florax, and J. E. Vermat. "The Empirics of Wetland Valuation: A Comprehensive Summary and Meta-Analysis of the Literature." *Environmental and Resource Economics* 33(2006): 223-250.

Brouwer, R. (2002) Environmental Value Transfer: State of the Art and Future Prospects, *Comparative Environmental Economic Assessment*, ed. R. J. G. M. Florax, P. Nijkamp, and K. G. Willis. Cheltenham, U.K. and Northampton, MA, Edward Elgar.

Brouwer, R., I. H. Langford, I. J. Bateman, and R. K. Turner. "A Meta-Analysis of Wetland Contingent Valuation Studies." *Regional Environmental Change* 1, no. 1 (1999): 47-57.

Bureau of Land Management, (1980) Swamp Cedar Instant Study Area, Bureau of Land Management, Ely Field Office. http://www.nv.blm.gov/wilderness/ely/Swamp%20Cedar%20ISA.pdf.

Bureau of Land Management, (1980(b)) Shoshone Pond Instant Study Area, Bureau of Land Management, Ely Field Office. http://www.nv.blm.gov/wilderness/ely/Shoshone%20Ponds.pdf.

Champ, P. A., K. J. Boyle, and T. C. Brown. *A Primer on Nonmarket Valuation*. The Economics of Nonmarket Goods and Resources. Edited by I. J. Bateman. Dordrecht / Boston / London: Kluwer Academic Publishers, 2003.

Charlet, D. (2006) Effect of Interbasin Water Transport on Ecosystems of Spring Valley, White Pine County, NV. Report submitted to the Office of the State Engineer of the State of Nevada, June 2006 (Exhibit # 3030).

Freeman III, A. M. *The Measurement of Environmental and Resource Values*: Resources for the Future, Washington, D.C., 2003.

Hanemann, M., J. Loomis, and B. Kanninen. "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation." *American Journal of Agricultural Economics* 73, no. 4 (1991): 1255-1263.

Houtven, G. V., B. Depro, and S. K. Pattanayak (2006) Benefits Transfer of a Third Kind: An Examination of Structural Benefits Transfer. Paper presented at the Allied Social Sciences Meetings in Boston, January 2006.

Johnston, R. J., E. Y. Besedin, and R. F. Wardwell. "Modeling Relationships between Use and Nonuse Values for Surface Water Quality: A Meta-Analysis." *Water Resources Research* 39, no. 12 (2003): 1363.

Jones, C. A. "Use of Non-Market Valuation Methods in the Courtroom: Recent Affirmative Precedents in Natural Resource Damage Assessment." Water Resources Update 109 (1997): 10-18.

Klocek, C. A. "Estimating the Economic Value of Canaan Valley National Wildlife Refuge: A Contingent Valuation Approach." Doctoral dissertation, West Virginia University, 2004.

Lanner, R. M. (2006) The Effect of Groundwater Pumping Proposed by the Southern Nevada Water Authority on The "Swamp Cedars" (*Juniperus Scopulorum*) of Spring Valley, Nevada. Report submitted to the Office of the State Engineer of the State of Nevada, June 2006 (Exhibit #3040).

Loomis, J., M. Hanemann, B. Kanninen, and T. Wegge (1991) WTP to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage, *The Economics and Management of Water and Drainage in Agriculture*, ed. A. Dinar, and D. Zilberman. Norwell, Massachusetts, Kluwer Academic Publishers, pp. 411-429.

Loomis, J. B. "Use of Non-Market Valuation Studies in Water Resource Management Assessment." Water Resources Update 109 (1997): 5-9.

Loomis, J. B., and R. G. Walsh. *Recreation Economic Decisions*. State College, Pennsylvania: Venture Publishing, Inc., 1997.

Mathis, M., A. Fawcett, and L. Konda. (2003) "Valuing Nature: A Survey of the Non-Market Literature." Valuing Nature in Texas Report # VNT-03-01.

Moeltner, K., K. J. Boyle, and R. W. Paterson. "Meta-Analysis and Benefit-Transfer for Resource Valuation: Addressing Classical Challenges with Bayesian Modeling." *Journal of Environmental Economics and Management* (Forthcoming).

Mullarkey, D. "Contingent Valuation of Wetlands: Testing Sensitivity to Scope." Doctoral dissertation, University of Wisconsin, 1997.

Poor, P. J. "The Value of Additional Central Flyway Wetlands: The Case of Nebraska's Rainwater Basin Wetlands." *Journal of Agricultural and Resource Economics* 24, 1 (1999): 253-265.

Rajala, K. "Summary of Information Regarding the Economic Value Generated by Agricultural and Recreational Activity in Spring Valley, White Pine County." (2006) . Report submitted to the Office of the State Engineer of the State of Nevada, June 2006.

Roberts, L. A., and J. A. Leitch. (1997) "Economic Valuation of Some Wetland Outputs of Mud Lake, Minnesota-South Dakota." 381. Department of Agricultural Economics, North Dakota Agricultural Experiment Station, North Dakota State University, Fargo, ND 58105.

Rosenberger, R. S., and J. B. Loomis. "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36, 4 (2000): 1097-1107.

Rosenberger, R. S., and J. B. Loomis. (2001) "Benefit Transfer of Outdoor Recreation Use Values." Gen. Tech. Rep. RMRS-GTR-72. Technical Report supporting the Forest Service Strategic Plan (2000 Revision). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Rosenberger, R. S., and J. B. Loomis (2003) Benefit Transfer, in *A Primer on Nonmarket Valuation*, ed. P. A. Champ, K. J. Boyle, and T. C. Brown. Dordrecht / Boston / London, Kluwer Academic Press.

Shogren, J. F., S. Y. Shin, D. J. Hayes, and J. B. Kliebenstein. "Resolving Differences in Willingness to Pay and Willingness to Accept." *American Economic Review* 84, no. 1(1994): 255-270.

Smith, V. K., and J.-C. Huang. "Can Markets Value Air Quality? A Meta-Analysis of Hedonic Property Value Models." *Journal of Political Economy* 103, no. 1(1995): 209-227.

Swanson, T., and A. Kontoleon (2004) What Future for Environmental Liability? The Use of Liability Systems for Environmental Regulation in the Courtrooms of the United States and the European Union, Green Giants? Environmental Policy of the United States and the European Union, ed. N. Vig, and M. Faure, MIT Press.

Tkac, J. M. "Estimating Willingness to Pay for the Preservation of the Alfred Bog Wetland in Ontario: A Multiple Bounded Discrete Choice Approach." Master's Thesis, Macdonald Campus, Gill University, 2002.

U.S. EPA. (2005) "Environmental Economics: Research Strategy." EPA/600/R-04/195. Office of Research and Development, National Center for Environmental Research, and Office of Policy, Economics and Innovation, U.S. Environmental Protection Agency, Washington D.C.

U.S. EPA. (2000) "Guidelines for Preparing Economic Analyses." USEPA 240-R-00-003. Office of the Administrator, U.S. Environmental Protection Agency, Washington, D.C.

Ward, F. A. *Environmental and Natural Resource Economics*. Upper Saddle River, New Jersey: Pearson Education, Inc., 2006.

White, H. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48(1980): 817-838.

Whitehead, J. C., and G. C. Blomquist. "Measuring Contingent Values for Wetlands: Effects of Information About Related Environmental Goods." *Water Resources Research* 27, 10 (1991): 2523-2531.

Woodward, R. T., and Y.-S. Wui. "The Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37 (2001): 257-270.

Table 1: Selected Source Studies for the Meta-regression Model

study ID	Authors	Source	Pub. Year	Data year	Study Area	Underlying target population	Sample size	Response rate
1	Loomis et al .	book chapter	1991	1989	Wetlands in the San Joaquin Valley, CA	San Joaquin Valley households	227	35%
2	Hanemann et al.	journal article	1991	1989	Wetlands in the San Joaquin Valley, CA	CA households outside the San Joaquin Valley	576	51%
3	Whitehead and Blomquist, 1991	journal article	1991	1989	Clear Creek wetland area in Western KY	Kentucky households	215	31%
4	D. Mullarkey	PhD dissertation	1997	1994	110 acres of undesignated wetlands in northwest Wisconsin	Wisconsin households	280	60%
5	Roberts and Leitch	Government Report	1997	1996	Mud Lake wetland area on SD / MN border	Households within 30 miles of study area (Richland County, ND; Roberts County, SD; Traverse County, MN)	575	62%
6	Blomquist and Whitehead	journal article	1998	1990	Various wetland habitats in Western KY	Kentucky households	449	70%
7	J. Poor	Journal article	1999	1996	Rainwater Basin Wetlands, NB	Nebraskan households	952	46%
8	J. M. Tkac	Master's thesis	2002	2001	Alfred Bog, Ontario, CA	Households in the United Counties of Prescott and Russell, Ontario	339	57%
9	C. A. Klocek	PhD dissertation	2004	1996	Canaan Valley National Wildlife Refuge	U.S. Households	390	74%

Table 2: Detailed Study Information

study ID	WTP per HH and year*	Policy scenario	Wetland type	Original wetland area (acres)	Official designation	% of active users	HH Income*
1	284.15	Prevent loss of 58,000 acres	unspecified	85,000	Includes several NWRs and WMAs	46%	66776 (s)
2	248.23	Prevent loss of 58,000 acres	unspecified	85,000	Includes several NWRs and WMAs	38%	82061 (s)
3	17.39	Prevent loss of 5000 acres	bottomland hardwood forests wetlands	84,000	none	16%	52258 (s)
4	1.7 (a)	Prevent loss of 110 acres	unspecified	110	none	unspecified (prob. <1%)	43,880 (m)
5	3.03	Preserve 5,000 acres for future generations	permanently, semi-permanently, or seasonally flooded lacustrine wetlands	5,000	none	18%	38,745 (m)
6a	2.62	Prevent loss of 500 acres	permanently flooded freshwater marsh	3,968	none	14,2%	38,207 (s)
6b	7.27	Prevent loss of 500 acres	temporarily flooded bottomland hardwoods	70,080	none	14,2%	38,207 (s)
6c	5.7	Prevent loss of 500 acres	seasonally flooded bottomland hardwoods	25,216	none	14,2%	38207 (s)
6d	17.37	Prevent loss of 500 acres	permanently flooded bottomland hardwood	1,408	none	14,2%	38207 (s)
7	27.18	Increase wetlands by 41,000 acres	unspecified	34,000	none	52%	41238 (s)
8	4.66 (a)	Prevent loss of 10,378 acres	domed peat bog with boreal forest	10,378	Class 1 Wetland / ANSI	29%	46024 (m)
9	0.63 (a)	Purchase and preserve 23,292 acres currently in private hands	high elevation moist valley	708	NWR	2%	64532 (s)

*All monetary figures are in current (2006) U.S. dollars
(a)= originally elicited as lump sum payment; annualized using a discount rate of 6%
(s)= sample mean as reported in source study / (m) = census median (sample income not reported)
HH = household
NWR = National Wildlife Refuge / WMA = Wildlife Management Area / ANSI = Area of Natural and Scientific Interest

Table 3: Meta-Regression Results

Variable		Estimated Coefficient	Standard Error	
intercept		-87.032	(9.104)	***
log(income)		7.720	(0.685)	***
users		0.166	(0.014)	*
log(acres)		1.990	(0.985)	**
[log(acres)]2		-0.190	(0.065)	***
R2		0.900		
n = 12				

*** = Significant at 1% level
** = Significant at 5% level
* = Significant at 10% level
R^2 = Coefficient of determination ("Goodness-of-Fit")
n = Sample size

Table 4: Benefit Transfer Predictions for Different Populations

	4 Counties	Nevada	Nevada and Utah
Total # of HHs (2000 Census)	11,118	751,165	1,452,446
Median HH Income (2003 figures, expressed in 2006 dollars)	41,852*	49,774.00	50,549**
Estimated % of SV Wetland Users	5	1	1
Annual WTP per HH ($)			
Low	0.14	0.36	0.41
Estimate	0.61	1.20	1.35
High	1.08	2.04	2.30
Total Annual Value ($)			
Low	1,528	272,731	595,737
Estimate	6,793	902,420	1,966,122
High	12,058	1,532,109	3,336,506

4 Counties = White Pine, Lincoln (NV), Millard, Juab (UT)
HH = households
* Weighted average across Counties
** Weighted average across States
Low = lower bound of 95% confidence interval
High = upper bound of 95% confidence interval

Table 5: Economic Value and Loss Predictions

(Cumulative discounted present values in 000 dollars)

	Discount Rate = 2%								
Year	4 Counties			Nevada			Nevada and Utah		
	S.Q. (gains)	Scen.1 (losses)	Scen.2 (losses)	S.Q. (gains)	Scen.1 (losses)	Scen.2 (losses)	S.Q. (gains)	Scen.1 (gains)	Scen.2 (gains)
10	61	48	0	8,106	6,354	0	17,661	13,844	0
20	111	98	0	14,756	13,004	0	32,149	28,332	0
30	152	139	41	20,211	18,459	5,455	44,034	40,217	11,885
40	186	173	75	24,686	22,934	9,930	53,784	49,967	21,635
50	213	200	102	28,357	26,605	13,601	61,783	57,965	29,634
60	236	223	125	31,369	29,617	16,613	68,344	64,527	36,195
70	255	242	144	33,840	32,087	19,084	73,727	69,910	41,578

S.Q. = Status Quo (no groundwater transfers)
Scen. 1 = Scenario 1 (wetlands disappear within 2 years)
Scen. 2 = Scenario 2 (wetlands disappear within 20 years)

Table 6: Benefit Transfer Estimates for Camping and Picnicking Reported in Rosenberger and Loomis (2001)

Number of included studies and observations		
	Camping	Picnicking
Studies	22	7
Observations	40	12
Economic benefit per activity day and person		
	Camping	Picnicking
Low	2.18	9.62
Estimate	39.18	45.51
High	249.49	153.52

All currency figures are in 2006 dollars
Low = lower bound of 95% confidence interval
High = upper bound of 95% confidence interval

Table 7: Benefit Transfer Predictions for Recreation Areas in the Spring Valley Region

Approximated economic benefit per activity day and person for both areas	
Low	5.9
Estimate	42.35
High	201.5
Projected annual benefits for Cleve Creek Campground (based on 6,000 annual visitation days)	
Low	35,400
Estimate	254,100
High	1,209,000
Projected annual benefits for Sacramento Pass Recreation Area (based on 12,000 annual visitation days)	
Low	70,800
Estimate	508,200
High	2,418,000

All currency figures are in 2006 dollars
Low = lower bound of 95% confidence interval
High = upper bound of 95% confidence interval