APPENDIX L:

SOCIOECONOMIC TECHNICAL INFORMATION AND ANALYSIS

This page intentionally left blank

APPENDIX L:

SOCIOECONOMIC TECHNICAL INFORMATION AND ANALYSIS

The socioeconomic analysis of changes in Glen Canyon Dam operations conducted for the Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) included a number of parts:

- Analysis of changes in recreational activity in Lake Mead, Lake Powell, and the Colorado River in terms of recreation use values, non-use (passive use) values, and regional economic impacts; and

- Analysis of the regional economic impacts of changes in retail electricity prices resulting from changes in Western Area Power Administration (Western) wholesale electricity rates, and the analysis of the impacts of the construction and operation of additional Western customer utility generating capacity.

L.1 RECREATION ECONOMIC ANALYSES

L.1.1 Recreation Use Values

Estimation of use values associated with potential changes in recreational resources under each of the alternatives used benefits transfer methods; this involves applying existing use value data or estimates for a particular time period, site, level of resource quality, or combination thereof at an original or study site to a policy site for which data are not available. The benefits transfer method involves choosing study and policy sites with similar socioeconomic and environmental characteristics, similar recreational activities, and similar ranges of change in recreational quality.

Benefits transfer studies involve either the transfer of use values from a study site or the transfer of a statistical model used to estimate use values. The traditional benefits transfer approach to valuing recreation has been to employ existing use values from either travel cost or contingent valuation studies conducted at a study site, adjusting estimates to account for inflation by converting the original values to current dollars using the consumer price index (CPI) or some other price index, and applying them to analysis at the policy site. Given improvements in valuation techniques over time, however, the preferred approach is to employ statistical recreation models developed for a study site at a policy site. Proposed alternative-specific information about variables in the model can be gathered for the policy site. This information is used in conjunction with coefficients from the study site to estimate recreation visitation and/or value at the policy site, allowing the model transfer technique to improve the validity of the results compared to the use value transfer approach.

Benefits transfer methods present a reliable alternative to conducting original research when the analysis is not expected to be controversial, when time and budget constraints prevent the pursuit of original research, or when original research efforts have already been conducted at most of the geographic areas of interest. Because statistical models have been developed for estimating recreation value per trip for two of the three river reaches in the Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP) study area—Glen Canyon and Upper Grand Canyon—and models estimating recreation use have been developed for Lake Powell and Lake Mead, while other studies have estimated values per trip for recreation use of Lake Powell and Lake Mead, the benefits transfer methods provides a useful and reliable approach to estimating river use values and lake visitation. More information on the background literature, data, and assumptions in applying the benefits transfer method to the analysis undertaken for the EIS can be found in Reclamation (2014).

For the EIS, the net economic value of recreation was estimated for Lake Powell, Lake Mead, and three reaches of the Colorado River—Glen Canyon (from Glen Canyon Dam to Lees Ferry), Upper Grand Canyon (from Lees Ferry to Diamond Creek), and Lower Grand Canyon(from Diamond Creek to Lake Mead)—using two utility programs:

- The Lake_Full program was used to estimate recreation economic value for Lake Powell and Lake Mead.

- The GCRec_Full utility program was used to estimate the economic value for recreation on the Colorado River.

L.1.1.1 Lake_Full Utility Model

The Lake_Full utility model incorporates the recreation-use relationships for Lake Powell and Lake Mead described in Neher et al. (2013). The model operates on a monthly time step and was designed to use all years and all traces of monthly data supplied by the Colorado River Storage Simulation (CRSS) model. The utility uses the end-of-month (EOM) reservoir contents to predict recreation use at the specified reservoir. The user supplies a unit economic value per trip and the utility employs the predicted recreation use in a given month and the unit economic value to calculate the monthly economic value of recreation. This calculation is repeated for each month in the period of analysis and for each hydrologic trace or sequence. The major analytical modeling steps are shown in Figure L-1.

The user also supplies appropriate inflation, escalation, and discount rates for the intended analysis. The Lake_Full utility program employs these economic inputs to compute the present economic value of recreation for each hydrologic trace present in the dataset. The results of these computations are reported for each reservoir as summary metrics computed from the distribution of trace present economic values. Current versions of the utility model output the 5% exceedance, 10% exceedance, 25% exceedance, mean, median (50% exceedance), standard deviation, 75% exceedance, 90% exceedance, and 95% exceedance.

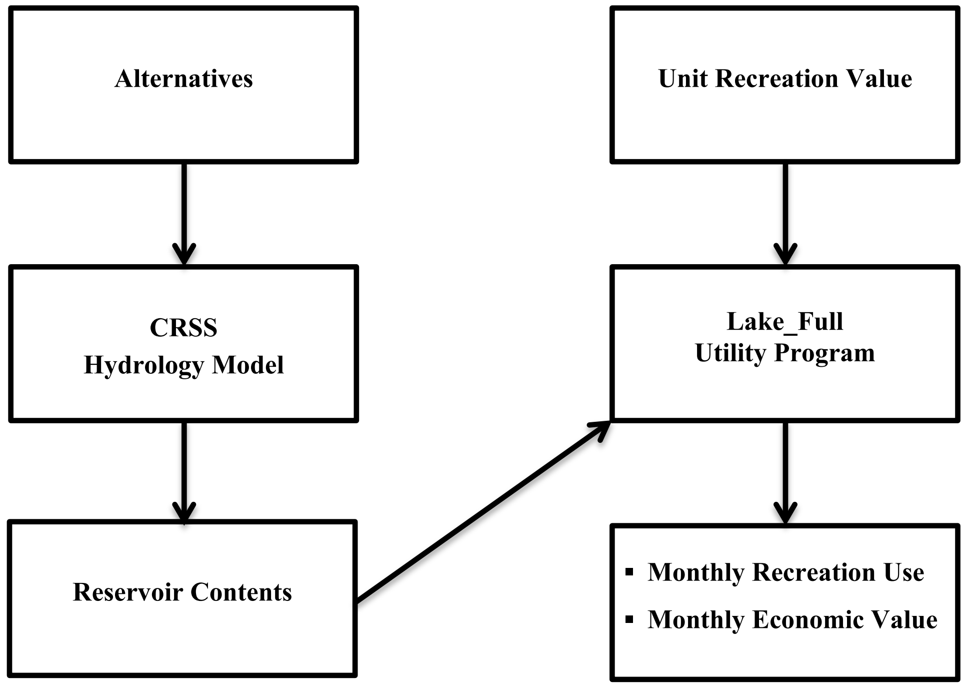

FIGURE L-1 Elements of the Lake_Full Utility Model

L.1.1.2 GCRec_Full Utility Model

The GCRec_Full utility model uses the recreation value relationships for Glen Canyon and Upper Grand Canyon estimated by Bishop et al. (1987). For purposes of this study, these relationships are extended to the Lower Grand Canyon. The model operates on a monthly time step and was designed to use all years and all traces of monthly data supplied by the CRSS model. The utility uses the mean monthly release from Glen Canyon Dam and the presence or absence of daily fluctuations exceeding 10,000 cfs per day during the month to predict the economic value of day-use rafting and angling in Glen Canyon and the economic value of commercial and private whitewater boating in the Upper Grand Canyon. The user also supplies the monthly recreation use, by activity. The utility employs the recreation use in a given month and the estimated economic value per trip to calculate the monthly net economic value of recreation for each activity. These calculations are repeated for each month in the period of analysis and for each hydrologic trace or sequence in the supplied dataset. The major analytical modeling steps are shown in Figure L-2.

The analyst also supplies appropriate inflation, escalation, and discount rates for the intended analysis. The GCRec_Full utility program employs these economic inputs for computing the present economic value of recreation for each hydrologic trace in the dataset. The results of these computations are aggregated and then reported as summary metrics computed from the distribution of trace present economic values. Current versions of the utility model output the 5% exceedance, 10% exceedance, 25% exceedance, mean, median (50% exceedance), standard deviation, 75% exceedance, 90% exceedance, and 95% exceedance levels.

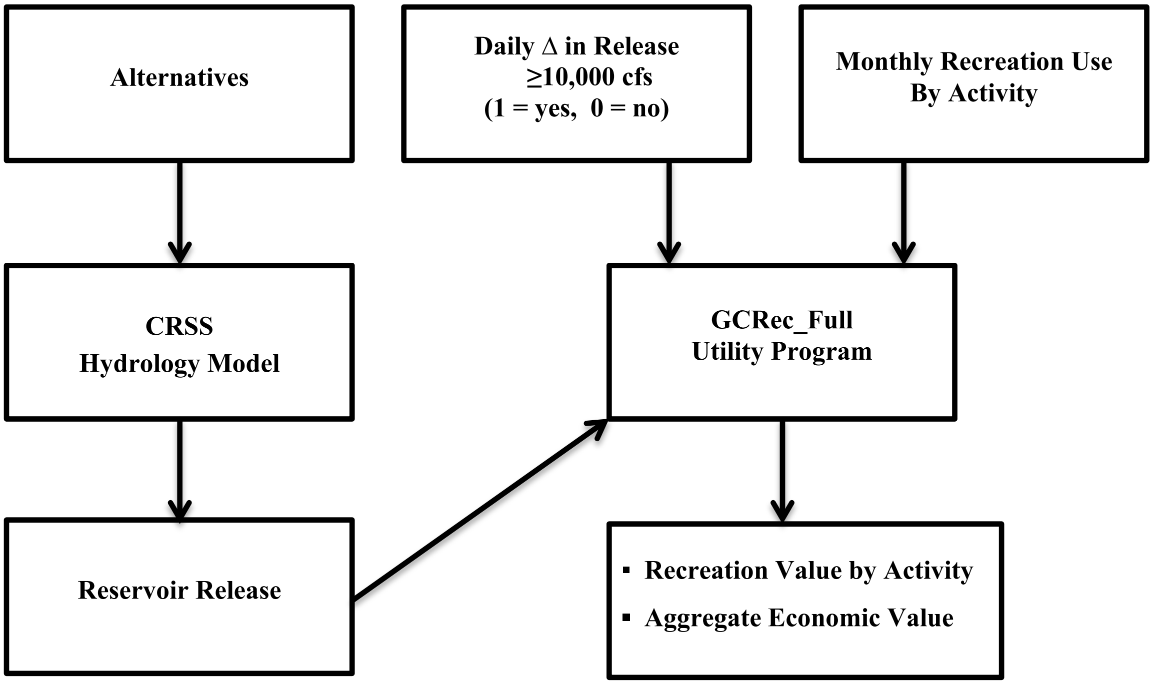

FIGURE L-2 Elements of the GCRec_Full Utility Model

More information on the background literature, data, assumptions, and output for these two models can be found in Reclamation (2014).

L.1.2 Recreation Non-Use Values

Non-use values are values that may be placed on the status of the natural or physical environment by non-users, or individuals who may never visit or otherwise use a natural resource that might still be affected by changes in its status or quality, and may assign a non-use or passive-use economic value to a resource. Although there are two approaches for measuring non-use values—revealed preference and stated preference methods—stated preference methods are typically used.

Stated preference valuation techniques include contingent valuation (CV), which is a means of eliciting the maximum dollar amount an individual would be willing to pay for a resource of a specified quantity and quality. CV methods use surveys to ascertain value by asking people about their willingness to pay (WTP) for a carefully specified change in environmental amenities. The dichotomous choice CV methodology is frequently employed in non-use valuation studies to estimate the net economic value for natural resource amenities. Respondents are presented with a hypothetical situation, including a price that they may be willing to pay for a change in an environmental condition, and they are then asked to respond to a dichotomous choice (yes or no) question. Using the data obtained from these surveys, the probability that an individual will respond "yes" is estimated using logistic regression analysis;

estimated regression coefficients are used to estimate the consumer surplus or net economic value associated with a particular resource.

Stated preference methods also include conjoint analysis, where respondents are presented with the characteristics or attributes of different hypothetical situations, and are then asked to either rank them or choose between them. Using the resultant survey data, the probability that an individual will rank or choose any particular scenario is then estimated, with data used to estimate households' total value for outcome changes associated with each alternative. There is a growing body of work that suggests that CV models and discrete choice methods can yield valid measures of willingness to pay (see, for example, Vossler and Evans [2009], and Vossler et al. [2012]).

Contingent valuation and conjoint methods have been applied widely in policy analysis, in particular in studies relating to measuring non-use values associated with river and lake resources associated with Grand Canyon National Park, Lake Mead National Recreation Area, and Glen Canyon National Recreation Area. Government agencies have also begun to use contingent valuation methods in benefit-cost analyses. The Bureau of Reclamation (Reclamation), for example, used contingent valuation to place a value on the impact of removing dams and restoring river habitat within the Klamath River Basin (RTI International 2012). The non-use values were used in a subsequent benefit-cost analysis (U.S. Department of the Interior 2012).

Contingent valuation surveys have been applied widely in the published economics literature to estimate passive-use values associated with preserving river and lake resources. Sanders et al. (1990), for example, estimated the total value of preserving 15 wild and scenic rivers in Colorado. They reported that Colorado residents expressed a use value of $19.15 and a non-use value of $81.96 per household per year. The total (use and non-use) value of protecting 15 Colorado rivers aggregated over these 12 million households was estimated at approximately $120 million annually, approximately four times the recreation use value. Welsh et al. (1995) estimated the willingness to pay to improve native vegetation, native fishes, game fish, river recreation, and cultural sites in Glen Canyon National Recreation Area and Grand Canyon National Park. Value estimates varied between $17.74 and $26.91 for a U.S. sample, and between $29.05 and $38.02 for a western U.S. sample.

Other studies indicate that the range of values per household or respondent can be large, producing larger ranges in aggregated values. For example, Duffield and Patterson (1991) estimated a willingness to pay $2.24 per licensed angler to maintain fisheries resources, based on a one-time cash donation, while Hanemann et al. (1991) estimated $181 per California household per year. Large ranges in value have also been found in lake studies, with values ranging from about $45 per household annually for the preservation value of Flathead Lake in Montana (Sutherland and Walsh 1985) to about $60 per year for an increment of lake elevation at Mono Lake, California (Loomis 1989). In a 2010 survey, the annual value (in 2011 dollars) of Klamath River Basin restoration after the removal of dams, water sharing agreements, and improved fish habitat was estimated at $122 for households in a 12-county area, $213 by households in the rest of Oregon and California, and $213 in the rest of the United States (RTI International 2012).

Understanding nonmarket values affected by proposed operational changes at Glen Canyon Dam (GCD), for both recreational use and environmental non-use values, has been the topic of a considerable number of prior investigations (e.g., Bishop et al. 1987; Welsh et al. 1995). These studies have been important in bringing nonmarket values into consideration for managing the resources of the Colorado River Basin (Harpman et al. 1995; Loomis et al. 2005). In that regard, two additional studies (Loomis 2014 and Jones et al. 2016) have been conducted regarding nonmarket values.

Loomis (2014) concluded that there is a theoretical basis for nonmarket values associated with hydropower and water. He used the example of how people can place value on maintaining the ranching and farming way of life associated with western rural communities as irrigated agriculture landscapes are correlated with open space. In addition, people may place value on the existence and well-being of farming communities. Indirect empirical support for altruism toward farmers is cited in this report. Nonmarket values associated with hydropower and water resources may also exist to the extent that hydropower and developed water assist in the maintenance of Native American Tribe cultural values and social well-being. Loomis (2014) concluded that research on this subject is limited and that additional research may be warranted.

The National Research Council (2005) has concluded that the results of studies using contingent valuation methods are of high quality; however, the results and findings of studies relating to the Colorado River Corridor are considerably outdated. Others have emphasized the need for additional or updated research on the sources and magnitudes of values associated with operational goals (see National Research Council 1999). To address these concerns, the National Park Service (NPS) has conducted a survey to determine non-use values associated withthe impacts of each of the six action alternatives on the endangered humpback chub, sandbars in the Grand Canyon, and populations of large trout in Glen Canyon. The survey used a discrete choice model to estimate household and aggregate willingness to pay for the six action alternatives based on data collected from two household samples, a national sample including all U.S. households, and a regional sample, consisting of all households receiving power from Western Area Power Administration, and including all utilities receiving power from the Glen Canyon Dam. The study involved a repeat contact mail-back survey method (Dillman 2007) in three phases.

The first phase was a survey of a subsample (n = 200) of the total sample population to pretest the survey instrument (24% response rate). These responses were used to conduct preliminary analysis on the data to determine whether the levels were adjusted up or down to create greater differences between the LTEMP alternatives. If more than 80% (n = 160) of individuals in the subsample selected the No Action Alternative, then the cost of the alternatives was adjusted downward. The results from this sample inform the choice of attribute levels in the final conjoint version of the survey mailed to the respondents in the second phase of the study. Once the attributes were evaluated and adjusted, the final mail survey was used to collect data. Two survey instruments, both of which use identical sampling methods, were used. All respondents received the same instructions and answered a series of common introductory questions to determine general socio-demographic background, visitation patterns, recreational preferences, values, and other information. Then 75% (n = 4,668) of individuals in the sample received Survey A with a section that included conjoint questions. The remaining 25%

(n = 1,500) received Survey B, which included contingent valuation questions. The local survey received an 18% reponse rate, the national survey, 12%. The final phase included a short nonresponse phone survey that was used to help test for any nonresponse bias. The results are presented in Neher et al. (2016) and include discussion of the survey, data collection, response rates, analysis of the results, and nonresponse corrections.

Respondents to the survey were given two discrete choice valuation questions relating to different impacts on the endangered humpback chub, sandbars, and large trout populations under each alternative. The effects of changes in hydropower operations were also included in the survey to incorparate a trade-off between improved resource conditions and their costs. In addition to the physical canyon attributes, respondents were asked to choose between current management at no cost and a changed outcome management plan that would cost between $12 and $280 per year per household over a 20-year period. The levels of the cost parameter and the management outcome attributes were varied among 12 versions of the survey to provide an efficient sampling design.

To estimate the parameters of the conjoint model, a standard conditional logit (CL) model was utilized, which used maximum-likelihood methods to estimate the attribute parameters. The parameter estimates from the CL model were then used to estimate the average marginal value of each noncost attribute.

A recently published study (Jones et al. 2016) offers an alternative Total Economic Value analysis to that presented by Neher et al. (2016). The Jones et al. analysis relied on the contingent valuation methodology, which is similar to the methodology used by Welsh et al. (1995) but different from the methodology used by Neher et al. The Neher et al. analysis relied on the choice experiment methodology, which incorporates recent methodological advances in nonmarket valuation. However, the Jones et al. analysis is also different from the Neher et al. analysis because it included two additional attributes: (1) impacts to Native American and rural western communities that depend on hydroelectric production, and (2) increases in air pollution by switching to nonrenewable fossil fuels in the power generation system. The Jones et al. study concludes that including these additional attributes will "significantly decrease WTP for changing Glen Canyon Dam operations, and demonstrate a significant fraction of the population with a positive WTP for maintaining dam operations."

The Jones et al. (2016) study was a pilot study that relied on an internet panel rather than a randomized mail survey; the Tribe and rural western community attributes did not identify specific causal relationships or quantified values to ensure consistent respondent interpretation, and potential air quality impacts associated with increased fossil fuel use may be overstated for the range of alternatives analyzed for LTEMP (see Sections 4.15 and 4.16). While this study created a new framework that provided a different way to evaluate some of the attributes that would not have been analyzed otherwise, the issues discussed above limit the application of this study to the LTEMP EIS.

L.1.3 Regional Recreation Economic Impacts

Economic impacts of changes in recreational activity are measured by changes in visitor expenditures associated with various types of recreational activities, including angling, rafting, and boating. Visitor expenditures in the river corridor may include spending on food and beverages, fishing and boating equipment, gasoline for vehicles and boats, camping fees or motel expenses, guide services, and fishing license fees. Economic impacts also include the secondary effects of changes in expenditures that may occur on income, employment, and tax revenues. The major analytical modeling steps are shown in Figure L-3.

Analysis of these effects was undertaken in the six-county region in which the majority of current Glen Canyon, Grand Canyon, and Colorado River recreational expenditures occur:

- Coconino County and Mohave County, Arizona; and
- Garfield County, Kane County, San Juan County, and Washington County, Utah.

The following data were used in the analysis:

- Changes in visitation rates, by alternative and river reach, from the analysis of changes in activity resulting from changes in lake and river water levels for a range of river and lake segments using the Net Economic Valuation (NEV) model (see Section L.1), and
- Typical per-capita expenditure data by type of activity, based on studies of typical visitor spending patterns reported in existing technical and academic literature.

Data from these sources are combined to produce changes in expenditure by activity type, by year, and by alternative.

Two types of effects result from changes in recreational expenditures: (1) direct effects are employment and income effects in sectors of the economy in which recreational expenditures occur, while (2) indirect effects are employment and income effects in sectors providing materials, equipment, and services to sectors in which recreational expenditures occur. Indirect effects occur when suppliers to local businesses increase or decrease their purchases of equipment, materials, and services from other businesses, and those businesses in turn change their level of purchases. For food and beverages, for example, indirect effects occur when local food manufacturers purchase additional produce from local farmers, and the farmers then purchase additional supplies in order to grow products necessary to meet this demand. Additional, induced effects result from wages paid to households by both directly and indirectly affected businesses.

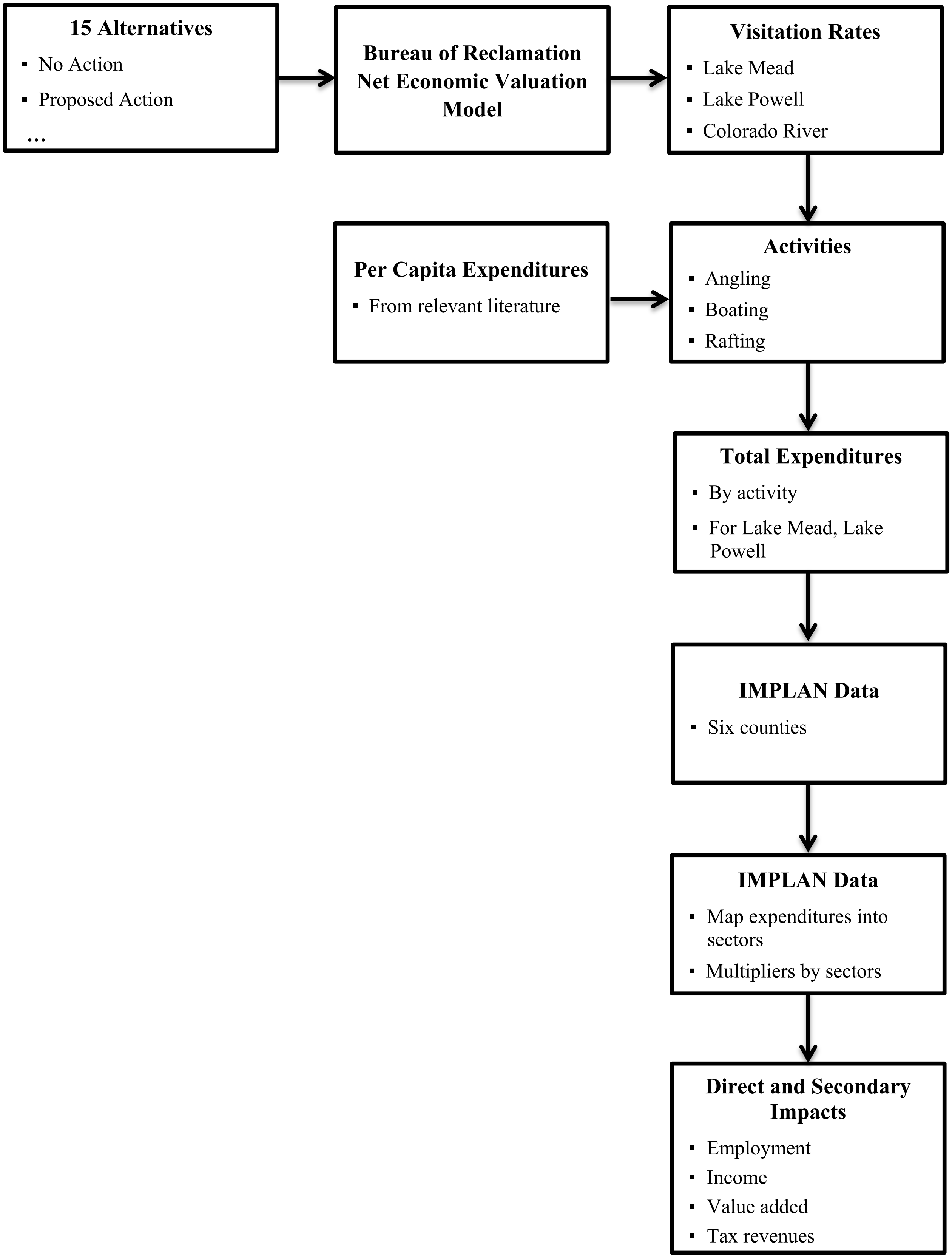

FIGURE L-3 Elements of the Regional Recreation Impacts Analysis

Input-output data and the associated multipliers can be readily used to determine the impact of changes in recreational expenditures through the estimation of multipliers for each sector in the multi-county region in which recreational expenditures occur. These multipliers typically give the total (direct plus indirect plus induced) benefits to the region in terms of employment, income, and taxes. Input-output data includes information for 440 separate North American Industry Classification System (NAICS) industries used by the U.S. Department of Commerce, Bureau of Economic Analysis. These accounts show the flow of commodities between industries and institutional consumers. Industries represented are those in agriculture, mining, construction, manufacturing, wholesale and retail trade, utilities, finance, insurance and real estate, and consumer and business services. Each industry is described in terms of its purchases from, and sales to, all other industries in the local economy.

Input-output accounts also provide information on value added by industry, and sales by industry, to final demand. Value added includes employee compensation (wages and salary payments, benefits, life insurance, retirement, etc.), proprietary income (payments received by self-employed individuals as income), other property-type income (payments received from royalties and dividends), and indirect business taxes (primarily excise and sales taxes paid by individuals to businesses). Final demands include personal consumption expenditures (payments by individuals/households to industries for goods and services used for personal consumption), federal government (military and nonmilitary) purchases and sales, state and local government (public education and non-education) purchases and sales, inventory purchases (unsold annual output), sales (where inventory reduction exceeds additions from production), capital formation (expenditures made to obtain capital equipment), and exports outside the region and nation.

Estimates of the regional economic impacts of changes in recreation expenditure came from the IMPLAN model, an "off-the-shelf" model produced by IMPLAN Group, LLC, that provides county-level and state-level input-output data. The model allows detailed analysis of the impacts of changes in recreation expenditures by mapping changes in expenditures by item (gas, food, lodging, etc.) into the appropriate sectors in the model, and then using IMPLAN multipliers to provide estimates of indirect effects and total effects, by alternative, activity type, and year in terms of employment (full-time equivalent staff, or ftes), income ($m), and the various components of value added ($m), including employment compensation, proprietor income, and tax revenues.

L.1.4 Estimates of Recreational Economic Impacts

Glen Canyon and Grand Canyon attract large numbers of visitors every year (see Section 3.10), and expenditures on gas, food and drink, lodging, guide services, and outdoor equipment are substantial. They produce direct income and employment both in sectors of the economy in which expenditures occur, and in the remainder of the economy; wages and salaries, and dollars spent on the purchases of goods and services, in these sectors circulate through the regional economy, producing indirect effects (effects in other industries) and induced effects (household effects). In 2011, spending by visitors to the Glen Canyon National Recreational Area, Grand Canyon National Park, and Lake Mead National Recreational Area produced 10,301 direct, indirect, and induced jobs and $373.7 million in total income (Table L-1).

TABLE L-1 Total Regional Economic Impacts (Direct, Indirect, and Induced) of Non-Local Recreation Expenditures, 2013

Parameter	Glen Canyon National Recreation Area	Grand Canyon National Park	Lake Mead National Recreation Area	Total
Employment	1,435	6,238	2,628	10,301
Income ($m 2013 dollars)	39.3	235.9	98.5	373.7

Source: Thomas et al. (2014).

As part of the overall impact of recreational visitation, various studies have attempted to estimate the regional economic impacts of specific recreational activities. Douglas and Harpman (1995) estimated that Glen Canyon and Grand Canyon recreational use in the region comprised of Coconino and Mojave Counties supported approximately 585 jobs. More recently, Hjerpe and Kim (2007) estimated that Grand Canyon boating recreation spending supported approximately 394 jobs in Coconino County, with commercial boating producing the majority (357) of the jobs created; Douglas (2005) found that whitewater boating in Grand Canyon National Park supported 438 jobs.

In addition to the economic impacts of recreational visitation in Glen Canyon and Grand Canyon, recreation in the region also provides employment and income for Navajo tradespeople selling jewelry and souvenirs to the traveling public along various routes in the region; jewelry production and sales provides 400 to 700 jobs (Reclamation 2011). Jobs held by the Navajo people are especially important because wage earners usually support extended families.

L.2 REGIONAL ELECTRICITY ANALYSES

L.2.1 Regional Electricity Price Impacts

The analysis of increases in electricity rates considered (1) changes in customer utility electricity prices resulting from changes in Glen Canyon Dam operations; and (2) impacts of constructing and operating additional power plants with customer utility capacity expansion plans to replace energy and capacity previously provided by Western

Analyses were conducted in the seven-state region in which Western markets CRSP power: Arizona, Colorado, Nebraska, Nevada, New Mexico, Utah, and Wyoming. This includes the service territories of the eight major Western customer utilities:

- Colorado Springs Utilities,
- Deseret Generation and Transmission Cooperative,

- Navajo Tribal Utility Authority,
- Platte River Power Authority,
- Salt River Project,
- Tri-State Generation and Transmission,
- Utah Municipal Power Agency, and
- Utah Associated Municipal Power Systems.

Separate analyses considered the following:

- The effects changes in Glen Canyon operations and changes in power marketing by the Colorado River Storage Project (CRSP) would have on wholesale electricity rates charged to customer utilities, by state and customer utility, from the GTMax/GTMax Lite models (see Appendix H); and
- The impacts changes in Glen Canyon and CRSP electricity rates would have on commercial, industrial, and residential electricity rates charged by the eight largest Western customer utilities, by state and customer utility, from the ratepayer analysis (see Appendix K).

Data used to analyze the regional economic impact of increases in electricity prices consisted of the following:

- Current and forecasted electricity prices, by state, from Energy Information Administration (EIA) data and other sources; and
- Estimates of the response in customer demand to changes in electricity prices (elasticities) for each customer class—commercial, industrial, and residential—taken from the technical and academic literature.

IMPLAN input-output models (see Section L.1), were used to estimate the regional economic impacts of changes in electricity prices, with a separate IMPLAN model representing each of the seven states in the Western marketing area. The analysis involved a number of steps:

- Aggregation of sectors in each state input-output models into the three customer classes: commercial, industrial, and residential;
- Calculation of electricity expenditure shares for each customer class; and
- Calculation of IMPLAN multipliers for each customer class.

These data, combined with changes in prices and price elasticities, give the total (direct plus indirect plus induced) impact of changes in aggregate electricity prices on the economy of each state, by alternative, state, and year, in terms of employment (ftes), income ($m), and the various components of value added ($m), including employment compensation, proprietor income, and tax revenues. The major analytical modeling steps are shown in Figure L-4.

L.2.2 Regional Electricity Generating Capacity Expansion Impacts

Analysis of the effects changes in Glen Canyon operations would have on electricity rates and capacity expansion required data on capital and operating expenditures, by alternative, including the following:

- Capacity expansion requirements, by state and customer utility, from the GTMax/GTMax Lite models (see Appendix K); and

- Expenditures on materials, equipment, services, direct and indirect labor, by year, from appropriate projects (similar in terms of fuel type, technology, size, and location), from the Jobs and Economic Development Impact (JEDI) model (NREL 2015).

Capacity expansion capital and operating expenditures were mapped into the appropriate sectors in an IMPLAN input-output model for each state, which were then used to estimate the appropriate multipliers to provide estimates of indirect effects and total effects, by alternative and year, in terms of employment (ftes), income ($m), and the various components of value added ($m), including employment compensation, proprietor income, and tax revenues. The major analytical modeling steps are shown in Figure L-5.

L.3 ADDITIONAL SOCIOECONOMIC DATA

Table L-2 contains data pertaining to population, median household income, and poverty in each community in the six-county affected environment forming the basis of the regional recreational economy.

L.3.1 Urban Population in the Six-County Region

Within the six counties in 2010, there were 86 places identified by the U.S. Census Bureau in the region of influence (ROI), including incorporated cities and Census Designated Places CDPs (unincorporated areas). The population of the ROI in 2010 was 83% urban; the largest town, St. George, Utah, had a 2010 population of 72,897; other places in the ROI with more than 10,000 inhabitants include Flagstaff (65,870), Lake Havasu City (52,527), Bullhead City (39,540), Kingman (28,068), New Kingman-Butler (12,134), and Sedona (10,031), all of which are in Arizona. There were 27 smaller towns in the ROI with 2010 populations of between 1,000 and 10,000, and an additional 50 places with populations of less than 1,000.

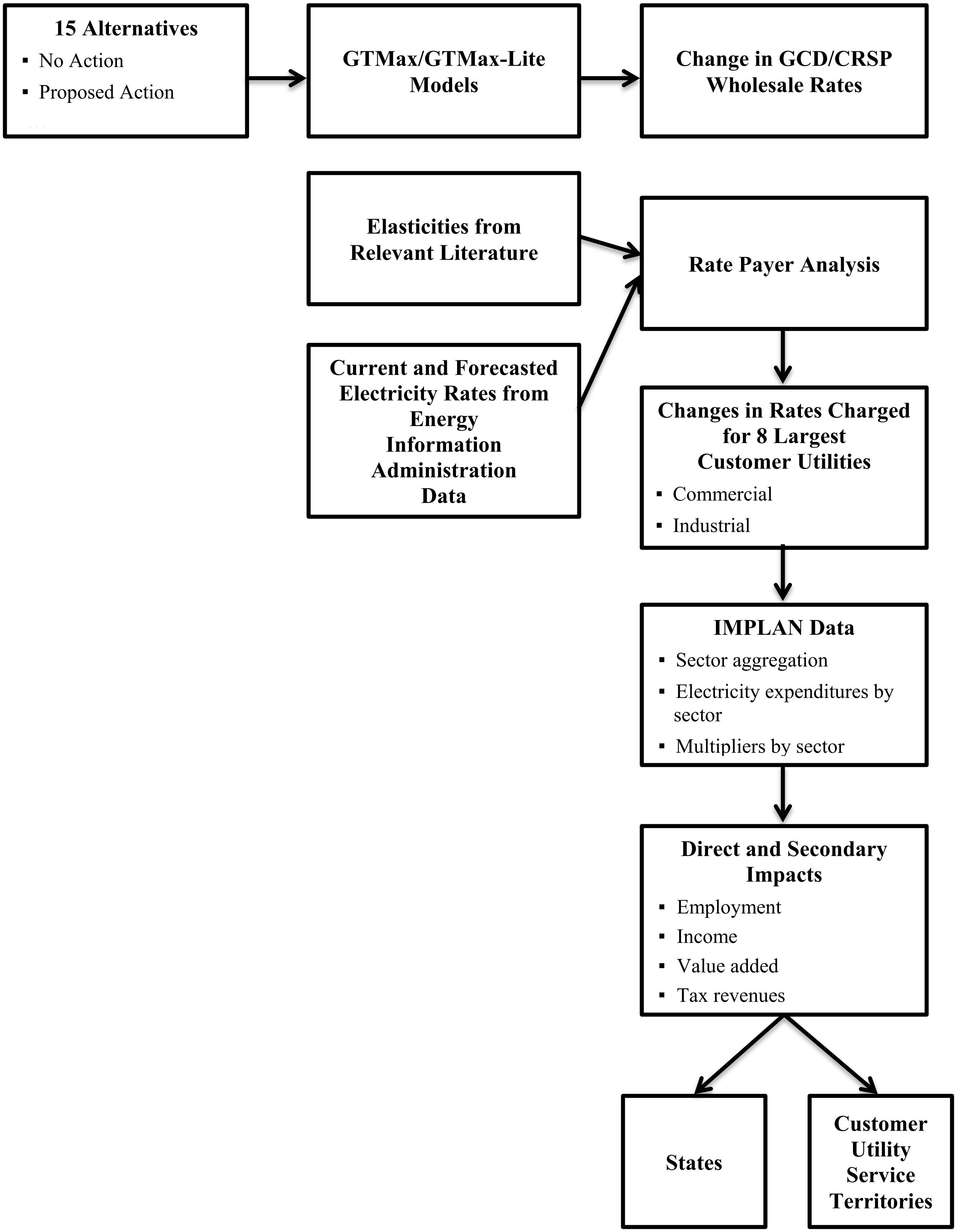

FIGURE L-4 Elements of the Regional Electricity Price Impacts Analysis

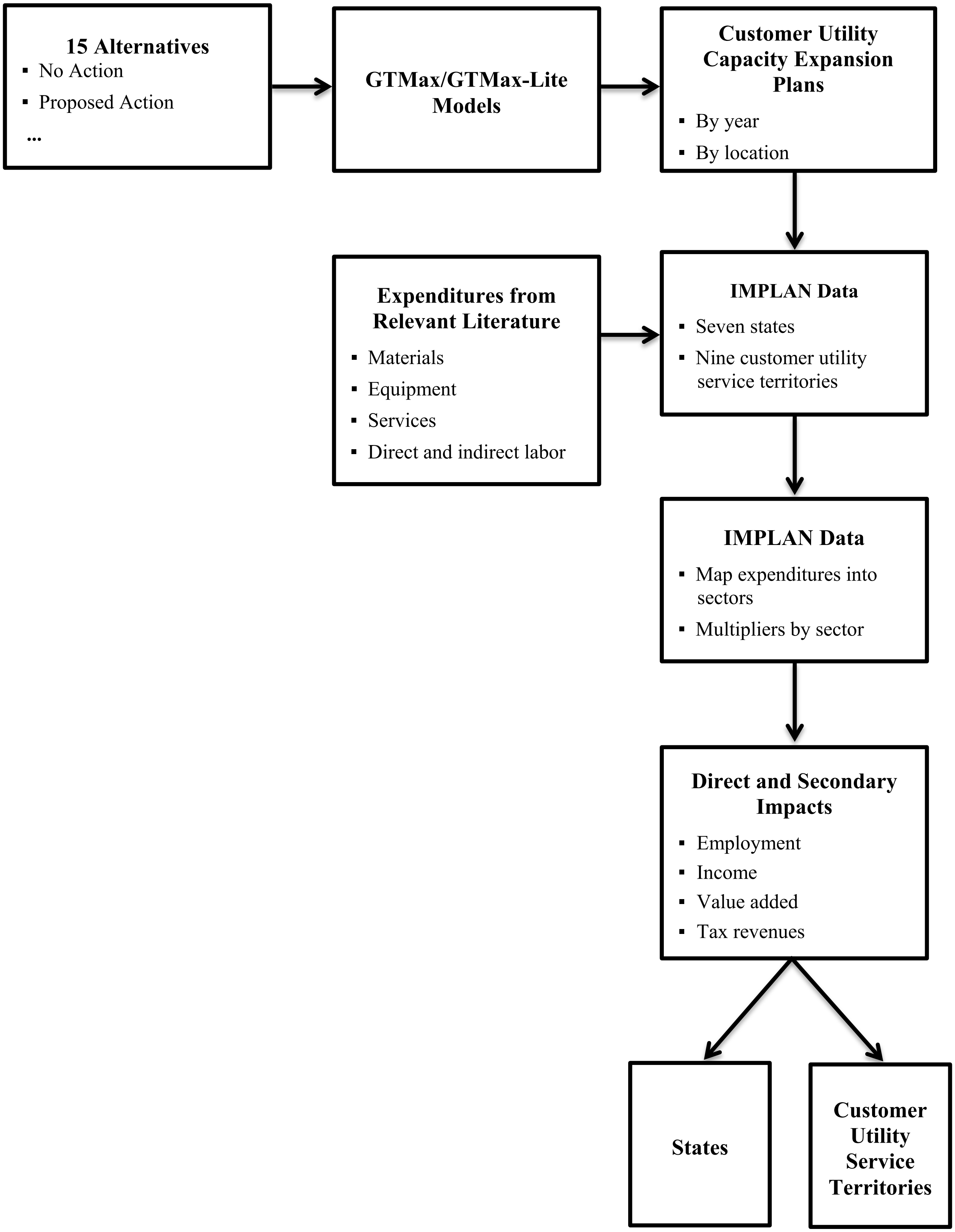

FIGURE L-5 Elements of the Regional Electricity Generating Capacity Expansion Impacts Analysis

TABLE L-2 Urban Population, Income, and Poverty in the Six-County Region

	Population			Median Household Income			
City	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	2000 (2013 dollars)	2010 (2013 dollars)	Average Annual Growth Rate, 2000–2010 (%)	Percent of Individuals Living in Poverty, 2010
Alton	134	119	–1.2	41,712	51,414	2.1	31.4
Aneth CDP	598	501	–1.8	23,393	22,435	–0.4	54.2
Antimony	122	122	0.0	30,439	31,160	0.2	32.9
Apple Valley	NA	701	NA[a]	NA	67,365	NA	1.6
Arizona Village	351	946	10.4	35,723	44,549	2.2	25.6
Big Water	417	475	1.3	40,961	32,623	–2.3	19.9
Bitter Springs CDP	547	452	–1.9	33,666	44,350	2.8	33.5
Blanding	3,162	3,375	0.7	44,631	46,949	0.5	23.0
Bluff CDP	320	258	–2.1	32,341	38,801	1.8	35.4
Boulder	180	226	2.3	40,585	46,618	1.4	0.0
Bryce Canyon City	NA	198	NA	NA	36,724	NA	0.0
Bullhead City	33,769	39,540	1.6	40,884	39,047	–0.5	20.7
Cameron CDP	978	885	–1.0	33,514	23,916	–3.3	46.1
Cannonville	148	167	1.2	38,894	47,407	2.0	7.5
Central	NA	645	NA	NA	50,951	NA	6.0
Colorado City	3,334	4,821	3.8	44,408	43,115	–0.3	35.3
Dammeron Valley	NA	803	NA	NA	66,400	NA	6.4
Desert Hills	2,183	2,245	0.3	36,091	40,971	1.3	20.8
Dolan Springs	1,867	2,033	0.9	23,411	33,736	3.7	8.2
Doney Park CDP	NA	5,395	NA	NA	79,457	NA	7.2
Enterprise	1,285	605	–7.3				0.0
Escalante	818	797	–0.3	43,484	44,363	0.2	7.5
Flagstaff	52,894	65,870	2.2	50,252	52,852	0.5	19.4
Fredonia	1,036	1,314	2.4	40,974	45,168	1.0	7.0
Glendale	355	381	0.7	48,618	51,580	0.6	15.0
Golden Valley	4,515	8,370	6.4	37,686	36,477	–0.3	15.7
Grand Canyon Village CDP	1,460	2,004	3.2	56,931	49,731	–1.3	13.5
Halchita CDP	270	266	–0.1	13,359	12,383	–0.8	47.1
Halls Crossing CDP	89	6	–23.6	36,033	NA	NA	0.0
Hatch	127	133	0.5	50,167	48,576	–0.3	0.7
Henrieville	159	230	3.8	38,556	60,391	4.6	12.1
Hildale	1,895	2,726	3.7	44,209	32,623	–3.0	50.3
Hurricane	8,250	13,748	5.2	44,461	54,311	2.0	7.9
Ivins	4,450	6,753	4.3	55,868	53,417	–0.4	13.4
Kachina Village CDP	2,664	2,622	–0.2	61,828	50,975	–1.9	4.4
Kaibab CDP	275	124	–7.7	29,029	32,451	1.1	24.8
Kaibito CDP	1,607	1,522	–0.5	49,040	34,350	–3.5	31.6
Kanab	3,564	4,312	1.9	47,518	45,176	–0.5	6.5
Kingman	20,069	28,068	3.4	46,112	46,845	0.2	13.2
La Sal CDP	339	395	1.5	35,073	58,457	5.2	0.0

TABLE L-2 (Cont.)

City	Population 2000	Population 2010	Population Average Annual Growth Rate, 2000–2010 (%)	Median Household Income 2000 (2013 dollars)	Median Household Income 2010 (2013 dollars)	Median Household Income Average Annual Growth Rate, 2000–2010 (%)	Percent of Individuals Living in Poverty, 2010
La Verkin	3,392	4,060	1.8	48,633	47,997	–0.1	14.8
Lake Havasu City	41,938	52,527	2.3	49,377	46,630	–0.6	11.6
LeChee CDP	1,606	1,443	–1.1	65,443	59,912	–0.9	20.7
Leeds	547	820	4.1	55,804	54,936	–0.2	8.3
Leupp CDP	970	951	–0.2	29,029	30,848	0.6	29.8
Mesquite Creek	205	416	7.3	44,812	46,206	0.3	23.7
Mexican Hat CDP	88	31	–9.9	77,999	NA	NA	0.0
Moenkopi CDP	901	964	0.7	52,368	56,229	0.7	33.5
Mohave Valley	13,694	2,616	–15.3	46,430	57,353	2.1	11.8
Mohave Ranch Estates	28	52	6.4	NA	43,179	NA	0.0
Montezuma Creek CDP	507	335	–4.1	39,739	32,851	–1.9	23.4
Monticello	1,958	1,972	0.1	48,606	42,026	–1.4	8.8
Mountainaire CDP	1,014	1,119	1.0	55,804	67,333	1.9	3.5
Munds Park CDP	1,250	631	–6.6	56,050	59,620	0.6	3.8
Navajo Mountain CDP	379	354	–0.7	19,205	46,473	9.2	24.1
New Harmony	190	207	0.9	46,785	45,071	–0.4	3.1
New Kingman-Butler	14,810	12,134	–2.0	35,061	31,765	–1.0	23.0
Oljato-Monument Valley CDP	864	674	–2.5	43,545	47,742	0.9	40.6
Orderville	596	577	–0.3	48,389	34,357	–3.4	16.0
Page	6,809	7,247	0.6	63,495	53,787	–1.6	17.2
Panguitch	1,623	1,520	–0.7	45,320	43,910	–0.3	14.0
Parks CDP	1,137	1,188	0.4	53,959	66,850	2.2	8.4
Peach Springs	600	1,090	6.2	24,613	45,636	6.4	40.0
Pine Valley	NA	186	NA	NA	81,015	NA	0.0
Rockville	247	245	–0.1	51,295	44,069	–1.5	6.5
Santa Clara	4,630	6,003	2.6	71,389	73,078	0.2	3.4
Sedona	10,192	10,031	–0.2	59,581	53,149	–1.1	10.8
Spanish Valley CDP	181	491	10.5	67,923	74,055	0.9	0.0
Springdale	457	529	1.5	56,287	38,727	–3.7	2.6
St. George	49,663	72,897	3.9	49,385	51,815	0.5	11.1
Supai CDP	0	208	NA	0	40,063	NA	48.0
Tonalea CDP	562	549	–0.2	43,370	15,357	–9.9	46.5
Toquerville	910	1,370	4.2	46,048	48,648		12.2
Tropic	508	530	0.4	57,495	64,354	1.1	7.6
Tselakai Dezza CDP	103	109	0.6	63,921	144,726	8.5	7.5
Tuba City CDP	8,225	8,611	0.5	52,160	49,509	–0.5	24.5
Tusayan CDP	562	558	–0.1	47,237	53,468	1.2	6.6
Valle CDP	NA	832	NA	NA	31,511	NA	36.4
Veyo	NA	483	NA	NA	31,511	NA	4.6
Virgin	394	596	4.2	NA	52,160	NA	4.5
Washington	8,196	18,761	8.6	47,810	55,407	1,5	11.7

TABLE L-2 (Cont.)

	Population			Median Household Income			
City	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	2000 (2013 dollars)	2010 (2013 dollars)	Average Annual Growth Rate, 2000–2010 (%)	Percent of Individuals Living in Poverty, 2010
White Mesa CDP	277	242	–1.3	18,601	21,100	1.3	37.7
Williams	2,842	3,023	0.6	43,906	46,072	0.5	19.3
Willow Valley	585	1,062	6.1	53,099	37,577	–3.4	23.5
Winslow West CDP	131	438	12.8	11,161	35,122	12.1	45.9

[a] NA = data not available.

Source: U.S. Census Bureau (2013).

Urban population in the ROI grew at an average annual rate of 2.9% over the period from 2000 to 2010, although growth rates within the ROI varied considerably. Winslow West, Arizona, grew at an average annual rate of 12.8%; Spanish Valley, Utah, at 10.5%; and Arizona Village, Arizona, at 10.4% during this period, with higher than average growth also experienced in Washington, Utah (8.6%); Mesquite Creek, Arizona (7.3%); Mojave Ranch Estates, Arizona (6.4%); Golden Valley, Arizona (6.4%); Peach Springs, Arizona (6.2%); and Willow Valley, Arizona (6.1%). The remaining places experienced lower growth rates between 2000 and 2010, with 29 places experiencing negative growth rates during this period. Rural population in the ROI grew at an annual average rate of 7.5% between 2000 and 2010.

L.3.2 Urban Income in the Six-County Region

Median household incomes in 2010 varied considerably across places in the ROI. Ten places in the Arizona portion of the ROI had median incomes that were higher than the average for the state ($50,991); these included Doney Park ($79,457), Mountainaire ($67,333), Parks ($66,850), LeChee ($59,912), Munds Park ($59,620), Mohave Valley ($57,353), and Moenkopi ($56,229). Twenty-eight places in the Arizona portion of the ROI had median incomes lower than the state average, and two places, Cameron ($23,916) and Tonalea ($15,357), had incomes that were less than half that of the state average. In 21 places, more than 20% of individuals were living in poverty, with poverty particularly marked in four communities, Supai (48.0% of individuals), Tonalea (46.5%), Cameron (46.1%), and Winslow West (45.9%).

Nine places in in the Utah portion of the ROI had median incomes higher than the state average ($59,014) in 2010; these included Tselakai Dezza ($144,726), Enterprise ($104,585), Pine Valley ($81,015), Spanish Valley ($74,055), and Santa Clara ($73,078). Thirty-six places had median incomes lower than the state average, and three places, Aneth ($22,435), White Mesa ($21,100), and Halchita ($12,383), had incomes that were less than half the state average.

In 11 places, more than 20% of individuals were living in poverty, with higher poverty levels in four communities, Aneth (54.2% of individuals), Hildale (50.3%), Halchita (47.1%), and Oljato-Monument Valley (40.6%).

Median income growth rates within the ROI varied considerably over the period from 2000 to 2010. In the Arizona portion of the ROI, 39 places had annual average growth rates higher than the state rate (–0.7%), with high growth rates in Winslow West (12.1%) and Peach Springs (6.4%) during this period. The remaining places experienced lower growth rates between 2000 and 2010, with 15 places experiencing negative growth rates. In the Utah portion of the ROI, 24 places had annual average growth rates higher than the state rate (–0.6%), including Navajo Mountain (9.2%), Tselakai-Dezza (8.5%), and Enterprise (8.0%). The remaining places experienced lower growth rates between 2000 and 2010, with 16 places experiencing negative growth rates.

L.4 REFERENCES

Bishop, R., K. Boyle, M. Welsh, R. Baumgartner, and P. Rathbun, 1987, *Glen Canyon Dam Releases and Downstream Recreation: An Analysis of User Preferences and Economic Values*, Glen Canyon Environmental Studies Report No. 27/87, Bureau of Reclamation, Washington, DC.

Dillman, D., 2007, *Mail and Internet Surveys: The Tailored Design*, Second Edition, New York: Wiley and Sons, Inc.

Douglas, A., 2005, *Colorado River Environmental and Recreational Values below Glen Canyon Dam: Fort Collins*, Colo., U.S. Geological Survey.

Douglas, A., and D. Harpman, 1995, "Estimating Recreation Employment Effects with IMPLAN for the Glen Canyon Dam Region," *Journal of Environmental Management* 44:233–247.

Duffield, J., and D. Patterson, 1991, "Inference and Optimal Design for a Welfare Measure in Logistic Contingent Valuation," *Land Economics*, 67:225–239.

Hanemann, M., J. Loomis, and B. Kanninen, 1991, "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation," *American Journal of Agricultural Economics* 73:1255–1263.

Harpman, D., M. Welsh, and R. Bishop, 1995, "Nonuse Economic Value: Emerging Policy Analysis Tool, *Rivers* 4(4): 280–291.

Hjerpe, E., and Y.-S. Kim, 2007, "Regional Economic Impacts of Grand Canyon River Runners," *Journal of Environmental Management* 85:137–149.

Jones, B.A., R.P. Berrens, H.C. Jenkins-Smith, C.L. Silva, D.E. Carlson, J.T. Ripberger, K. Gupta, and N. Carlson, 2016, "Valuation in the Anthropocene: Exploring Options for Alternative Operations of the Glen Canyon Dam," *Water Resources and Economics* 14: 13–30.

Loomis, J.B., 1989, "Test-Retest Reliability of the Contingent Valuation Method: A Comparison of General Population and Visitor Responses," *American Journal of Agricultural Economics* 71:76–84.

Loomis, J., A.J. Douglas, and D.A. Harpman, 2005, "Recreation Use Values and Nonuse Values of Glen and Grand Canyons, pp. 153–164 in *The State of the Colorado River Ecosystem in the Grand Canyon*, S.P. Gloss, J.E. Lovich, and T.S. Melis (eds.), U.S. Geological Survey Circular 1282.

Loomis, J.B., 2014, *Market and Non-Market Values of Water Resources and Non-Market Values of Hydropower Associated with Glen Canyon Dam: A Theoretical Framework and Literature Review*, Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, Colorado, May.

National Research Council, 1999, *Downstream: Adaptive Management of Glen Canyon Dam and the Colorado River Ecosystem*, National Academy Press, Washington, DC.

National Research Council, 2005, *Valuing Ecosystem Services: Toward Better Environmental Decision-making*, National Academy Press, Washington, DC.

Neher, C., J. Duffield, and D. Patterson, 2013, "Modeling the Influence of Water Levels on Recreational Use at Lakes Mead and Powell," *Lake and Reservoir Management* 29(4):233–246.

Neher, C., J. Duffield, and D. Patterson, 2016, *Glen Canyon Total Value Survey: Report on Estimated Total Value Associated with Glen Canyon LTEMP EIS Alternative Characteristics*, University of Montana, Missoula, July.

NREL (National Renewable Energy Laboratory), 2015, *Jobs and Economic Development Impact (JEDI) Model Homepage*. Available at http://www.nrel.gov/analysis/jedi.

Reclamation (Bureau of Reclamation), 2011, *Environmental Assessment: Non-Native Fish Control Downstream from Glen Canyon*, Dec. Available at http://www.usbr.gov/uc/envdocs/ea/gc/nnfc/index.html.

Reclamation, 2014, *Recreation Economic Analysis for the Long-Term Experimental and Management Plan Environmental Impact Statement*, Draft Economics Technical Report EC-2014-03, Jun. 24.

RTI International, 2012, *Klamath River Basin Restoration Non Use Value Survey – Final Report*, prepared for U.S. Bureau of Reclamation, Jan. Available at http://klamathrestoration.gov/sites/klamathrestoration.gov/files/DDDDD.Printable.Klamath%20Nonuse%20Survey%20Final%20Report%202012%5B1%5D.pdf.

Sanders, L., R. Walsh, and J. Loomis, 1990, "Toward Empirical Estimation of the Total Value of Protecting Rivers," *Water Resources Research*, 26(7):1345–1357.

Sutherland, R., and R. Walsh, 1985, "Effect of Distance on the Preservation Value of Water Quality," *Land Economics* 61:281–291.

Thomas, C., C. Huber, and L. Koontz, 2014, *2012 National Park Visitor Spending Effects: Economic Contributions to Local Communities, States and the Nation*, Natural Resource Report NPS/NRSS/EQD/NRR-2014/765, U.S. Department of the Interior, Feb. Available at http://www.nature.nps.gov/socialscience/docs/NPSVSE2012_final_nrss.pdf.

U.S. Census Bureau, 2013, *American Fact Finder*. Available at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Department of the Interior, 2012, *Economics and Tribal Summary Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon*, Denver CO. Available at http://klamathrestoration.gov/sites/klamathrestoration.gov/files/2013%20Updates/Econ%20Studies%20/h.Economics_Tribal_FULL_7-24-2012(accessible).pdf.

Vossler, C., and M. Evans, 2009, "Bridging the Gap between the Field and the Lab: Environmental Goods, Policy Maker Input, and Consequentiality," *Journal of Environmental Economics and Management* 58:338–345.

Vossler, C., M. Doyon, and D. Rondeau, 2012, "Truth in Consequentiality: Theory and Field Evidence on Discrete Choice Experiments," *American Economic Journal: Microeconomics* 4:145–171.

Welsh, M., R. Bishop, M. Phillips, and R. Baumgartner, 1995, *Glen Canyon Dam, Colorado River Storage Project, Arizona—Final Nonuse Values Study Summary Report*, EC-97-09, U.S. Bureau of Reclamation, Oct. 1997.

This page intentionally left blank