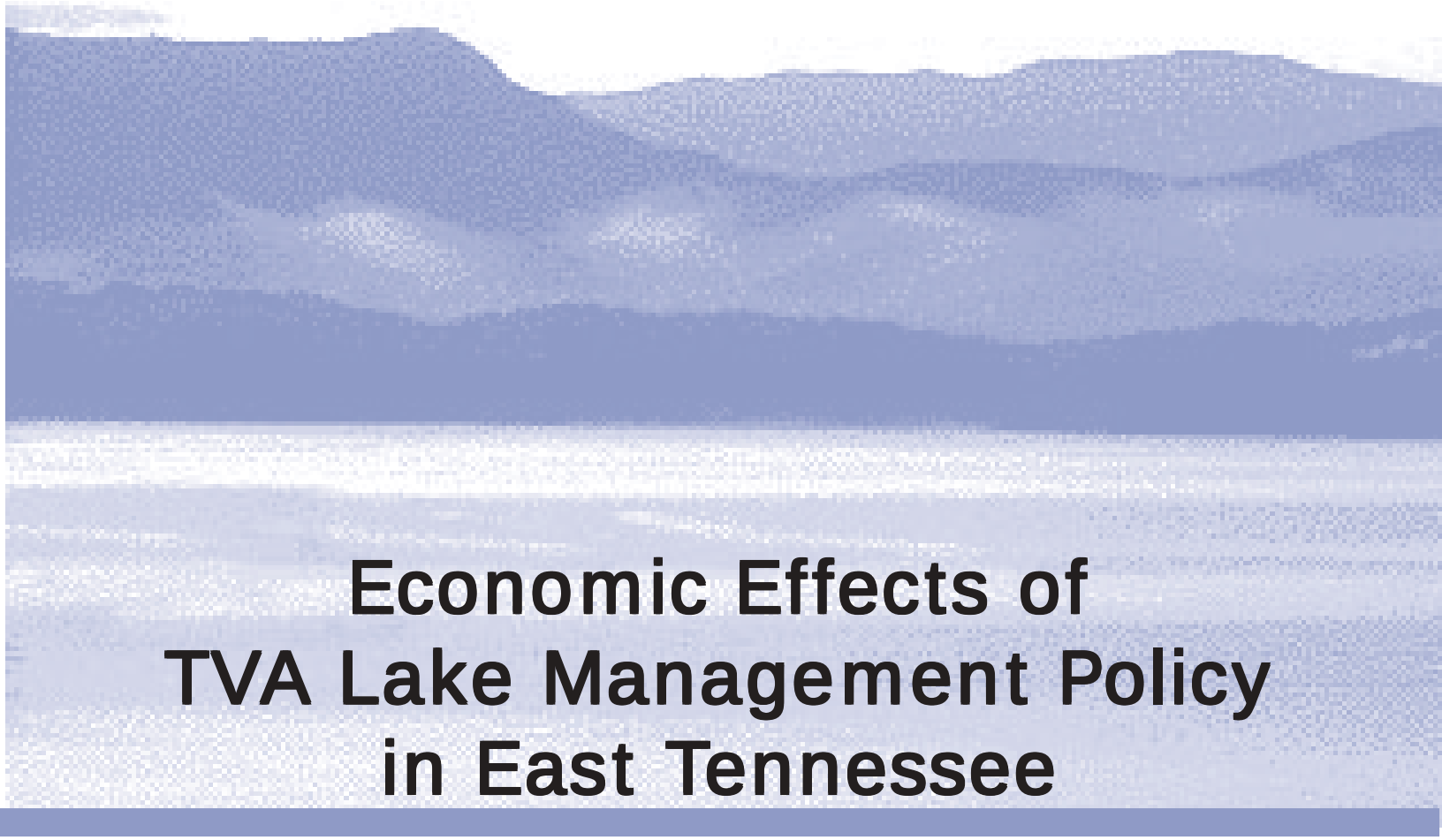


Economic Effects of TVA Lake Management Policy in East Tennessee

A report prepared by the Center for Business and Economic Research at The University of Tennessee, with funding from the U.S. Department of Housing and Urban Development.

May 2003

Center for Business and Economic Research

College of Business Administration
The University of Tennessee
May 2003

Project Manager and Author: Matthew N. Murray
Contributing Authors: Karie Barbour, Brian Hill, Steven Stewart[1]
Survey Coordinator: Yuki Takatsuka

Surveyors
Karie Barbour
Bedros Bozdogan
Kelley Clark
John Deskins
Dave Feather
Steven Fedorov
Candy Garner
Ansley Haman
Kevin Krushenski
Michael Krochonis
Tobin MacDermott

Surveyors, continued
Mark Mundy
D.J. Preyer
William Alex Ransom
Tami Richards
Michael Rickman
Mary Ross
Ryan Russsell
Joan Snoderly
Yuki Takatsuka
William Chandler Wilson
Gail Zasowski

Center for Business and Economic Research Staff

Director
William F. Fox

Associate Director
Matthew N. Murray

Research Assistant Professor
Donald Bruce

Research Associates
Vickie Cunningham
Julie Marshall
Joan Snoderly
Angela Thacker
Betty Vickers

Publications Specialist
Stacia Couch

Program Resource Specialist
Betty Drinnen

Graduate Research Assistants
Karie Barbour
John Deskins
Brian Hill
Tami Richards
Chandler Wilson
Lydia Zhang

Undergraduate Student Assistants
D.J. Preyer
William Ransom
Erin Read

[1]Dr. Stewart is currently serving an appointment in the Department of Hydrology and Water Resources at the University of Arizona.

Economic Effects of TVA Lake Management Policy in East Tennessee

A report prepared by the Center for Business and Economic Research at The University of Tennessee, with funding from the U.S. Department of Housing and Urban Development.

May 2003

The authors would like to thank members of the Land Owners and Users of Douglas and the Cherokee Lake Users Association who provided input and information; area business establishments which allowed surveys to be administered at their facilities; TVA which provided data and other information; and Ken Cordell, John Bergstrom, Paul Jakus and Mike McKee for their time in discussing issues related to the project. All of the views expressed in this report are those of the authors.

Table of Contents

List of Tables and Figures

List of Tables and Figures, continued

Executive Summary

This report explores TVA lake management policy for the thirteen county region of East Tennessee that is in close proximity to Boone, Cherokee, Douglas, Ft. Patrick Henry, Norris, South Holston and Watauga lakes. The specific policy change considered is a delayed drawdown in lake levels for two months, August and September. Estimates of economic impact and economic value associated with a drawdown delay are presented. The estimates rely heavily on primary survey data collected from recreators and households in the lake region and on property tax records for homes on Douglas and Cherokee lakes. Background information on the lake region and its pattern of economic development is presented to place the study and its findings in context.

Estimates of economic impact capture the way in which spending ripples through the economy, supporting job and income creation. The study provides estimates of *net economic impact*, i.e., the jobs and income that would accrue to the region and to the state from nonresident spending should lake levels be sustained through August and September. Also presented are estimates of *gross economic impact*, which reflect changes in spending from a change in lake levels for both residents and nonresidents of the lake region. The estimated economic impacts for a two-month drawdown delay are summarized in Exhibit 1.

The estimates show that $2.35 million in new income and 124 annual full-time equivalent jobs (or 744 jobs in August and September) would be supported by increased nonresident recreation spending if the drawdown on East Tennessee lakes was postponed until the end of September. These benefits would be spread across the lake region in rough proportion to the increased rates of recreator visitation for each lake. Tennessee as a whole would realize a net income gain of $1.9 million and annual job gains totaling 100 (or 600 jobs for the August and September window). The net effects for the state are smaller than for the lake region because the spending of Tennesseans who live outside the lake region are not included in the net amount of recreation spending. The gross economic impacts are significantly larger than the net effects as they reflect increased spending by resident *and* nonresident recreators. The gross income for the lake

Exhibit 1: Summary of Economic Impacts: Two Month Delay in Annual Drawdown

	Net Economic Impacts		Gross Economic Impacts	
	Income	Jobs	Income	Jobs
Lake Region	$2.35	124	$5.40	286
Tennessee	1.9	100	10.6	559

Note: Does not include homeowners' spending; see text. Dollar amounts in millions.

region totals $5.4 million while the total for the state is $10.6 million. The annual jobs sum to 286 for the lake region and 559 for the state as a whole.

The study also estimates the gain in *economic value* that would follow from a delay in the annual drawdown. For recreators, the estimates of economic value are based upon surveys administered from May through September. For households, primary reliance is placed on estimates of economic value based on an analysis of the relationship between lake levels and property values obtained from property tax records. The analysis of property values is confined to a small set of family residences on Douglas and Cherokee lakes.

Based on the results from the *choice model* and the survey of recreators, the estimates indicate an increase in annual economic value of $39.7 million for a one-month delay across the East Tennessee lakes, and an increase in annual economic value of $63.3 million for a two-month delay in drawdown. The results for the individual lakes are shown in Exhibit 2. Maintaining full pool on Fontana Lake (North Carolina) for one month would yield $1.7 million in increased economic value while two additional months would produce gains totaling $2.5 million. These benefits represent national gains for *current* recreators across the lakes.

The statistical analysis of the relationship between property values and lake levels shows that greater distance to pool diminishes property values, indicating that drawdowns lead to measurable reductions in property values. Simulation analysis reveals that for each 100 homes on Douglas Lake a two-month delay in the drawdown would lead to a total gain in property value of $112,210; for each 100 parcels on Cherokee Lake, the total value of property would rise by $65,000. These estimates are quite modest and may reflect the fact that people purchasing homes on the lakes considered here are largely aware of the annual drawdown and are thus more willing to accept the resulting fall in lake levels. Those individuals with a particularly strong taste for higher lake levels may choose to purchase lakefront property on a lake like Fort Loudoun where annual variation in the water level is much smaller rather than on Douglas or Cherokee lakes.

Exhibit 2: Net Gain in Economic Value to the Region as Estimated for Recreators

	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga	Fontana, NC	TN Total
Full Pool to September 1	$770,382	$9,141,009	$9,275,898	$11,422,969	$5,462,934	$3,636,418	$1,686,704	$39,709,610
October 1	$924,230	$13,711,514	$17,124,929	$19,990,197	$7,647,728	$3,878,745	$2,498,276	$63,277,343

Note: See Mathews, 2003 for Fontana estimates.

1. Introduction

This study explores the economic effects arising from TVA lake-management policy on several lakes located in the eastern portion of Tennessee. It is an outgrowth of public pressures within the region for a re-consideration of lake-management policy that would allow lake levels to remain at or near full pool through August and September of each year. The research reported here was funded by a grant from the U.S. Department of Housing and Urban Development. This introduction defines the scope of the research, reviews the methodologies used to estimate economic effects and provides an overview of the structure of the study.

Economic Effects of TVA Lake Management Policy

TVA has multiple policy objectives including power generation, navigation, flood control, environmental stewardship and economic development. In practice these objectives may be in conflict with one another, so TVA must engage in a balancing act in setting goals and implementing policy. TVA itself recognizes the need to balance the competing uses of the resources it manages. The U.S. General Accounting Office has explicitly noted that "In operating these projects, TVA faces a balancing act of how to maximize the benefits of the available water to meet all purposes. TVA's ability to lower and raise the lake levels during the year is a key element in this balancing act" (U.S. GAO).

Priorities have changed over time as the region has developed and as the benefits and costs of different uses of water resources have changed. TVA policy has changed and further changes may be forthcoming in response to this study and the ongoing *Reservoir Operations Study* (*ROS*) being conducted by TVA. But the changes have not always been to the complete satisfaction of stakeholders in the region. A case in point is the problem addressed in this study: the economic consequences of lake-management policy in East Tennessee. Numerous recreators and many residents on and near the various reservoirs maintained by TVA would like to see higher pools through fall and into winter — if not all year long — to support recreation and quality aesthetic views. In light of the weak economic base in many parts of the East Tennessee region (see Section 2 of this report), enhanced recreation activity could prove to be an important complementary source of job creation and tax base expansion. Also important are improvements in aesthetic views, greater accessibility to water and increased lake acreage that can enhance the quality of recreation experiences and enhance property values for residents. So there remain pressures to shift the balance further. These pressures will likely mount as the region develops further and as more people live on and make use of the area lakes.

TVA argues that a policy change in support of delayed drawdowns may compromise flood control, lead to a deterioration in water quality and limit power generation absent new investments in productive capacity. To TVA's credit, there have been some changes to lake management policy over time. Notable was the shift in policy in the early 1970s that allowed for higher winter pools on some lakes and the policy change in the early 1990s that led to a delayed drawdown from Memorial Day to August 1. Many residents on or near TVA managed water systems would like to see further changes made to lake management policy in order to increase recreation benefits, property values and quality of life. Based on a survey of recreators conducted in 2002 (see section 3 below) two-thirds of the Tennessee respondents indicated a willingness to pay more for electricity to enjoy higher lake levels and 57 percent said they would be willing to take more trips during August and September. Well over half of homeowners surveyed on Douglas and Cherokee lakes as part of this project (again, see below) indicated a willingness to pay for higher lake levels.

The tradeoffs and challenges confronting TVA policymakers and area residents are not unique. The following three examples place the regional problem in a broader national context.

- Concerns have surfaced in the region of Cooper Lake Texas, a lake recently developed by the U.S. Army Corps of Engineers, over how lake-level variation will hamper residential development and tourism activity.

- In order to help guide lake management policy on Lake Almanor (California), Pacific Gas and Electric Company recently completed a study examining, among other things, recreational effects and property value effects arising from variations in lake levels. Significant effects were identified for both recreation and property values. For example, an additional one-foot fall from the summer minimum pool means a 2.5 percent reduction in the selling price of a home in the same year.

- The Lower Colorado River Authority was established in 1954 to manage water in central Texas. Competing uses of the river region include recreation and rice production. A 1994 study by the Corps of Engineers showed that recreation spending on Travis Lake was reduced by almost 50 percent while Buchanan Lake saw a one-third reduction in recreation spending due to increased drawdown of lakes. A new study has been commissioned to examine the economic consequences of the drawdown policy and support an assessment of possible policy changes.

Table 1.1 provides an illustration of the drawdown policy for seven lakes in East Tennessee for the period of June to September 30. (The drawdown that ensues into winter leads to a much sharper reduction in lake levels on most of these lakes.) Aside from Ft. Patrick Henry Lake which experiences little water level variation, Boone and Watauga experience the most modest reductions in levels, while Cherokee and Douglas experience larger level reductions of 24 feet. Based on lake-bottom topography these vertical drops in lake levels lead to differential impacts in terms of the extent of shoreline exposed. Hence different recreation activities and residential properties will face different effects from drawdowns.

The primary economic effects of lake drawdowns are reduced recreation spending, reduced *value* (i.e., personal satisfaction) from the recreation experience, and reduced property values that arise from limits on lake access and from a deterioration in the quality of scenic views. Some of these impacts affect regional wellbeing, while others may affect national welfare. These effects are the focus of this report. Specifically the project is intended to offer guidance on the economic consequences of changes in lake management policy that would extend full pool until the end of August or the end of September of each year on seven East Tennessee lakes (see Table 1.1).[1] The study provides estimates of *economic impact*, or the benefits that accrue from recreation-related spending within the region, as well as estimates of *economic value*, i.e., the intrinsic value that would be created for recreators and homeowners from higher lake levels. The study does not address changes in power generation costs and flood control risks, nor the way in which changes in lake levels on the seven lakes considered here translate into changes elsewhere in the TVA system. For example, maintaining higher pools on these lakes may require additional generation capacity to meet peak demand, an increased flood risk for downstream residents and businesses and potentially lower pools for other lakes that give rise to negative economic effects. A complete analysis is required that examines the full set of

Table 1.1. Fall in Lake Levels, June to September 30th

Lake	Approximate Fall in Level (Feet)
Boone	6
Cherokee	24
Douglas	24
Ft. Patrick Henry	--
Norris	21
South Holston	21
Watauga	16

Note: 1991 - 2002 median data for all but Boone. Boone data for 2002.
Source: Based on lake guide curves produced by Tennessee Valley Authority.

[1]In practice, the work reported here is confined to only 6 lakes, excluding Ft. Patrick Henry due to the lack of water variation on this lake. Fontana Lake and Swain County, North Carolina are beyond the scope of the HUD grant that funded this research. However, estimates of economic effects for Fontana Lake are available from a parallel study that has been recently completed. These estimates are reported below.

benefits, costs and tradeoffs confronting TVA that influence national and regional wellbeing. Hopefully this will be the outcome of TVA's *ROS* to be released in 2003. The estimates presented here on economic impact and economic value should prove useful to TVA and those in the East Tennessee region as policy deliberations move forward on how to balance uses of the regional watershed.

Regional Versus National Perspectives on Economic Effects

Economic effects can be analyzed from both a regional and national perspective. Economic impact analysis is the methodology commonly employed to examine economic gains and losses for regional economies. Evaluating economic gains and losses for the nation requires a different approach that captures changes in individual wellbeing, something that cannot be measured simply by tracing the flow of dollars through the economy. Both approaches are discussed here in turn.

Economic Impact Analysis

Regional stakeholders are particularly interested in the economic consequences of lake level management policy for their region of residency. Regional economic effects are typically measured using the tools of *economic impact analysis* (EIA) which capture the way in which spending ripples through an economy creating jobs and income, and expanding tax bases. (Appendix A provides a brief overview of the EIA methodology.) Economic impact analysis is often used to examine the consequences of changes in industrial or business activity on a regional economy.[2] The region is viewed as the exporter of industrial products, and sales to those outside the region lead to a net increase in jobs and income for the producing region. Similarly, EIA has been used extensively to estimate the economic effects arising from changes in recreation and tourism activity. In this case the out-of-region tourist is the source of new spending for the region. For example, a study was completed in 1998 for Land Owners and Users of Douglas Lake that relied on this methodology; Cordell et al. (1990) used similar methods to estimate the effects of lake-level management policy on Fontana Lake for a region of western North Carolina.

It is important to distinguish between economic benefits that accrue to a region of the national economy versus an increase in benefits for the nation as a whole. In many instances the activity explored through the tools of EIA, like the location of a large industrial facility, represents a zero-sum game for the nation, while imparting significant new benefits to a single region. From the nation's perspective it is irrelevant where the industrial firm chooses to locate; regardless of its location, roughly the same number of jobs and the same amount of income will be generated. But the same industrial firm certainly offers significant benefits to its host community as the jobs and income would be lost

[2]For example, see *Economic Benefits of the U.S. Department of Energy for the State of Tennessee*, Center for Business and Economic Research, May 2000.

should the company locate elsewhere. So the firm's location represents a zero-sum game for the nation but a positive-sum game for the region of location.

Recreation spending is no different than the expenditures of the industrial firm that give rise to job and income creation. A simple reallocation of recreation spending across regions of the nation — from one park to another, from one tourist attraction to another — may lead to no net gains to the national economy. But again, one region can benefit significantly from an increase in recreation activity, although this may come at the expense of another recreation site. Similarly within a given region, changes in the allocation of recreation spending may lead to no net gain for the region. In the current context, should local recreation activity increase on the part of local residents in the face of higher lake levels, there is no gain in national economic activity and likely no gain in activity for the lake region itself. The reason is that recreators may simply change the mix of in-region recreation spending. Should local residents choose to spend within the region as opposed to spend outside the region in the face of higher lake levels, the local economy would benefit but there would still be no increase in national economic activity.

Retiree spending is analogous to recreation spending from this perspective. That is, insofar as retirees will choose to live somewhere in the U.S., it is of no real consequence for the nation which state of residency they choose. As retirees move from one community to another, national economic activity is unchanged while regional economic fortunes shift as one region gains at another region's expense.

Regional economic impacts remain highly relevant from the perspective of the region that makes decisions and invests resources to enhance its own welfare. Residents, as well as state and local governments, are rightly concerned about the gains and losses that may be experienced through the economic development process. Economic impact analysis can help identify potential gains for a region, guide resource allocation (like incentives to attract economic activity) and facilitate policymaking. It is always important to examine economic benefits *and* economic costs in order to properly guide policy. For example, while recreation and retirees may represent a source of economic benefits for the region, both visitors and residents require public services and infrastructure that can be costly. Moreover, economic growth can lead to congestion and changes in quality of life that should be identified. While TVA confronts a balancing act in managing the water resources of the Valley, residents and policymakers confront a different yet equally important balancing act in promoting economic development for a region.

Economic impacts arising from recreation are often measured through the use of surveys. This is the approach followed by this study. As discussed more fully below, surveys were administered to recreators and households in the region to identify lake-related expenditures. The expenditure information is in turn used to estimate job and income gains for the state and for the region surrounding the lakes. Emphasis is placed on *net economic impacts*, i.e., the impacts that accrue to the region from spending which comes from outside the region. Nonetheless, *gross impacts*, or the benefits from all recreation spending, are also estimated and reported.

Economic Value Analysis

Of ultimate interest from a national perspective is improvement in economic wellbeing or economic *value*. Economic value is not the same as expenditures, income or jobs. Value is instead psychic wellbeing and accrues through the use of a product or a resource, like taking a recreation trip; it is what someone is willing to pay to purchase a good or service above and beyond the cost to producers of supplying the good or service.[3] Increased value means people are willing to pay more to buy and consume something; increased willingness to pay is a reflection of increased value. In the current context, if lake levels could be increased in late summer and early fall, value and willingness to pay would likely increase on the part of many recreators and many homeowners. As a result, recreators and homeowners would enjoy greater value through increased use and improved view quality. Note that for homeowners and recreators alike there may be no economic *impact* from this policy change as discussed above, i.e., no increased spending, no new jobs and no new income, but there may still be an increase in net economic value. Cordell at al. (1990) estimated a $14 million gain in economic value (in 1988 dollars) should Chatuge, Santeelah, Fontana and Hiwassee lakes be maintained near full pool through October 10th of each year.

The federal government has offered guidelines on how to conduct economic assessments of federal water projects. A primary source is the 1983 report of the U.S. Water Resource Council (*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*); similar principles are embraced in the 1993 guidelines of the U.S. Army Corps of Engineers (*National Economic Development Costs*). For the application to East Tennessee, these guidelines call for an assessment of how changes in lake levels will affect economic value for the national economy. Economic impacts, as discussed above, are not necessarily relevant to the identification of economic value. Increased economic value for recreators and households from higher lake levels must then be compared to any losses in economic value elsewhere in the TVA system. Stewart, Kahn and Jakus prepared a report for TVA that provides

[3]Existence value is not considered here. For example, people may place a value on a resource like a national park or an animal species even if they never visit the park nor see the animal; value accrues simply through existence.

broader coverage of various concepts of value as they relate to evaluation of TVA river operations.

In practice, estimation of economic value is problematic in part because some of the "goods" consumed are not formally purchased or traded in the marketplace. For example, neither "recreation" nor "scenic views" are directly or explicitly purchased. Researchers fall back on two general approaches to estimating economic value: the *stated preference* approach and the *revealed preference* approach. Under the stated preference approach, a researcher simply asks someone about their contingent behavior: What would you be willing to pay to enjoy higher lake levels? This "as if" approach has been widely criticized since there is no way to verify behavior and respondents have an incentive to overstate the benefits (or in other contexts the costs) of policy changes. At the same time, the stated preference approach allows consideration and evaluation of behavioral responses that are otherwise impossible to capture. In the current context, TVA has never delayed the drawdowns on East Tennessee lakes, and thus there is no way to observe how behavior may change in response to a policy change. The estimates presented in this report include measures of economic value based on standard contingent valuation questions, as well as the more sophisticated tools of *conjoint analysis*. Conjoint analysis, which is discussed more completely below, does not as easily lend itself to respondent manipulation.

Researchers prefer to make estimates of value based on revealed preferences, or in other words, actual as opposed to hypothetical behavior. But when it comes to environmental amenities for which there are no markets, this can be difficult in practice. This study makes use of one revealed preference technique, the *hedonic price model* (HPM), to estimate the value of different lake levels on property value. While access to a lake and the quality of a view are not directly purchased with the home, these attributes are certainly bundled with the home and are thus implicitly reflected in home value. Just as one would expect a home near a landfill to have lower value than a similar home elsewhere, one also would expect a lakefront home with a good view and good lake access to enjoy a price premium. Using a sample of properties on Douglas and Cherokee lakes, estimates are made of how variations in lake levels affect property values. This provides a basis for estimates of the property value benefits of a delayed drawdown.

A Roadmap of What Is to Come

The remainder of the report is organized as follows. The first section below provides a socioeconomic overview of the lake region that is the focus of this report. The next section provides background and summary statistics on the surveys of recreators and households that were used to estimate economic impacts and economic value. Economic impact estimates are then presented for the lake

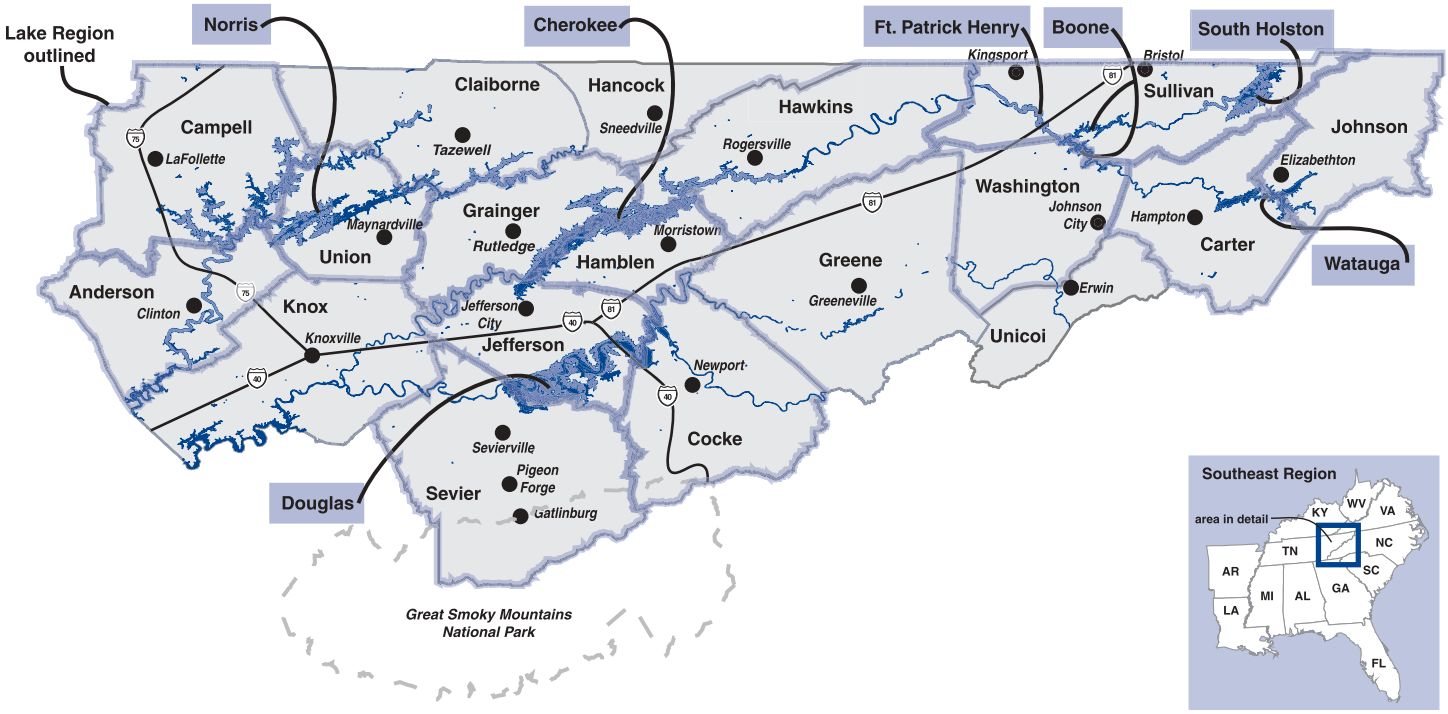
region that is the primary focus of this study, as well as for the state economy. The economic impact estimates reflect the benefits that would accrue from maintaining full pool on the East Tennessee reservoirs to September 1 and to October 1 of each year. The final major section of the report offers estimates of economic value associated with a delayed drawdown. The economic value estimates reflect benefits for recreators and homeowners from a delayed drawdown. The report closes with a brief summary of findings.

2. Placing the Lake Region in Context

The lakes managed by the Tennessee Valley Authority (TVA) on the eastern tributaries of the Tennessee River System are nestled among the rolling hills of upper East Tennessee. Abundant natural resources and a moderate climate make this area a pleasant location in which to live and a desirable destination for thousands of tourists each year. The close proximity of the Great Smoky Mountains, Gatlinburg, Pigeon Forge, the lakes and other popular tourist attractions provides a wide range of recreation opportunities for visitors and residents alike (See Figure 2.1). Three major interstates and an extensive network of scenic state and local roads facilitate travel in the region and provide easy access to each of the lakes for individuals from all areas of the country.

The seven East Tennessee lakes included in this analysis are Boone, Cherokee, Douglas, Ft. Patrick Henry, Norris, South Holston, and Watauga. Summary data for these lakes and the counties they abut are shown in Table 2.1. Hundreds of miles of shoreline and well over 100 thousand acres of navigable waterways offered by these lakes attract individuals seeking recreational activities such as boating, fishing, camping, swimming and picnicking. The same areas have become increasingly attractive for retirees and for families who want to live on or near the water and enjoy its recreational opportunities and scenic views. Most lake visitation occurs during the summer months when temperatures are warm and lakes are at their summer pool water levels. There are roughly

Figure 2.1: Map of the East Tennessee Lake Region



three months of full pool on these lakes. Visitation begins to decline in early August at the lakes on the eastern tributaries as the winter drawdown process begins. The total drawdown on these lakes ranges anywhere between 19 and 55 feet. Recreation for residents who live in immediate proximity to the lake also suffers, as does the aesthetic quality of lake views.

The economies of the counties surrounding each of these lakes benefit from a wide variety of expenditures made by lake visitors from outside the region as well as local residents. Visitors spend money on food, lodging, etc. while residents spend money to support recreational activities (boats, jet skis, and docks) and invest in property and homes. Therefore, this analysis defines the economic impact region or *lake region* as the thirteen Tennessee counties that are contiguous to at least one of the seven lakes (see map above). This thirteen county region is relatively poor by regional and national standards.

Population

Between the years 1990 and 2000, the population of the lake region grew collectively at a compound annual growth rate (CAGR) of 1.5 percent, which was identical to the rate experienced by Tennessee but above the rate of 1.2 percent for the United States. However, not all counties within the lake region achieved the same magnitude of growth. Table 2.2 presents population estimates from 1990 and 2000 as well as the CAGR for each of the thirteen counties within the lake region. During this period, Sevier County grew more rapidly than any other county in the lake region with a CAGR of 3.4 percent, which made it the third fastest growing county in the state. Anderson County grew the least, barely growing at a rate of 0.4 percent per year. The remaining counties grew at annual rates between 0.6 and 3.0 percent over these years. Grainger, Hawkins, Jefferson, Johnson, Sevier, and Union counties all grew at higher rates than did Tennessee,

Table 2.1: Lake Statistics

Lake	Miles of Shoreline	Acres of Surface Water	Yearly Water Level Variation	River	Surrounding TN Counties
Boone	N/A	N/A	26 feet	S. Fork Holston	Sullivan and Washington
Cherokee	400	28,780	40 feet	Holston	Grainger, Hamblen, Hawkins, and Jefferson
Douglas	513	28,420	55 feet	French Broad	Cocke, Jefferson, and Sevier
Ft. Patrick Henry	N/A	N/A	N/A	S. Fork Holston	Sullivan
Norris	809	33,840	35 feet	Clinch	Anderson, Campbell, and Union
South Holston	N/A	N/A	30 feet	S. Fork Holston	Sullivan
Watauga	N/A	N/A	19 feet	Watauga	Carter and Johnson

Source: Tennessee Valley Authority, Reservoirs and Power Plants, <http://www.tva.com/sites/sites_n.htm>.

and their growth represents the majority of the population growth that occurred in the lake region.

Income and Poverty

One of the striking features of the lake region is that it is relatively poor by national standards. As revealed in Table 2.3, per capita personal incomes of the counties in the lake region were much lower than both the 2000 state and national averages of $25,946 and $29,469 respectively.[4] The average per capita income in the lake region in 2000 was $20,018, which represented only 77.2 percent of the Tennessee average and roughly 68 percent of the national average. Eight of the thirteen counties had per capita incomes that were below 80 percent of the Tennessee average, while nine of the thirteen had per capita incomes below 80 percent of the national average. Johnson County had the lowest average income, $14,348, which represented only 55.3 percent of the state average and only 48.7 percent of the national average. Anderson County had the highest average income

Table 2.2: Population Growth and Density

Area	Population 1990	Population 2000	Percent Change	CAGR 1990 - 2000	State population growth rank	Population per square mile 2000
Anderson	68,406	71,269	4.2	0.4	91	210.9
Campbell	35,178	39,940	13.5	1.3	63	83.2
Carter	51,668	56,810	10.0	1.0	78	166.6
Cocke	29,205	33,632	15.2	1.4	51	77.5
Grainger	17,151	20,717	20.8	1.9	35	74.0
Hamblen	50,696	58,179	14.8	1.4	54	361.4
Hawkins	44,680	53,696	20.2	1.9	37	110.3
Jefferson	33,095	44,560	34.6	3.0	6	162.6
Johnson	13,818	17,517	26.8	2.4	19	58.8
Sevier	51,449	71,723	39.4	3.4	3	121.2
Sullivan	143,886	152,897	6.3	0.6	90	370.2
Union	13,758	17,874	29.9	2.7	14	79.8
Washington	92,732	107,450	15.9	1.5	47	329.6
Lake Region	645,722	746,264	15.6	1.5		160.6
Tennessee	4,894,492	5,702,027	16.5	1.5		138.3
United States	249,622,814	282,124,631	13.0	1.2		79.8

Notes: Rankings are among all 95 Tennessee counties and were ordered highest to lowest.
Source: Bureau of Economic Analysis, Table CA1-3.

[4]Personal income includes wages and salaries; proprietors' income; dividends; interest; rent; "other" labor income and transfer payments from the government.

($26,032) of all the counties in the lake region for 2000, making it the only county to surpass the Tennessee average. All counties in the lake region saw positive growth in nominal per capita personal income between 1995 and 2000. However, only Hamblen, Johnson, and Cocke counties saw larger growth over this five year time span than did Tennessee, and none saw growth as large as that experienced by the U.S as a whole. A consequence is that all counties in the lake region saw their standing relative to the nation fall between 1995 and 2000.

Two other measures of economic wellbeing, percent of persons below the poverty level and median household income, are presented in Table 2.4. In 1999, the poverty rate in the lake region (13.9 percent) exceeded the poverty rates of Tennessee (12.8 percent) and the U.S. (11.9 percent). Cocke County had the sixth highest poverty rate out of all 95 Tennessee counties and the highest

Table 2.3: Per Capita Personal Income (in Dollars)

Area	1995	2000	Percent Change	Percent of TN Average (2000)	Percent of US Average (2000)
Anderson	$22,179	$26,032	17.4	100.3	88.3
Campbell	14,377	17,075	18.8	65.8	57.9
Carter	15,129	18,112	19.7	69.8	61.5
Cocke	14,801	18,280	23.5	70.5	62.0
Grainger	14,418	17,414	20.8	67.1	59.1
Hamblen	19,096	24,060	26.0	92.7	81.6
Hawkins	16,675	19,255	15.5	74.2	65.3
Jefferson	16,808	19,986	18.9	77.0	67.8
Johnson	11,836	14,348	21.2	55.3	48.7
Sevier	19,066	22,275	16.8	85.9	75.6
Sullivan	20,853	24,451	17.3	94.2	83.0
Union	12,900	15,070	16.8	58.1	51.1
Washington	20,127	23,882	18.7	92.0	81.0
Lake Region	16,790	20,018	19.2	77.2	67.9
Tennessee	21,449	25,946	21.0	100.0	88.0
United States	23,255	29,469	26.7	113.6	100.0

Notes: All estimates are by place of residence.
Lake region per capita income values are averages for the 13 county region.
Source: U.S. Department of Commerce, Bureau of Economic Analysis.

poverty rate among the 13 lake counties at 19.8 percent. The poverty rates of Campbell and Johnson Counties also ranked among the top ten in 1999. Sullivan County had the lowest poverty rate (12.1 percent) in the lake region and joined Hamblen, Sevier and Washington Counties as the only counties to have poverty rates below the state average.

The median household income of the lake region was $29,995 in 1999, which represented only 82.5 percent of the average Tennessee median household income of $36,360. Individually, all thirteen counties failed to reach the average for Tennessee (and the nation). Anderson County had the highest median household income of the lake counties ($35,483 or 97.6 percent of the state average) in 1999, while Johnson County had the lowest median household income ($23,067 or 63.4 percent of the state average).

Table 2.4: Persons Below Poverty Level and Median Household Income, 1999

	Persons Below Poverty Level (%)		Median Household Income ($)	
Area	Percent	Rank	Average	Percent of TN Average
Anderson	13.0	61	$35,483	97.6
Campbell	19.6	8	25,285	69.5
Carter	15.7	24	27,371	75.3
Cocke	19.8	6	25,553	70.3
Grainger	16.0	22	27,997	77.0
Hamblen	12.7	68	32,350	89.0
Hawkins	14.0	48	31,300	86.1
Jefferson	13.7	52	32,824	90.3
Johnson	19.2	9	23,067	63.4
Sevier	12.4	70	34,719	95.5
Sullivan	12.1	77	33,529	92.2
Union	17.3	16	27,335	75.2
Washington	12.3	71	33,116	91.1
Lake Region	13.9		29,995	82.5
Tennesse	12.8		36,360	100.0
United States	11.9		40,816	112.3

Note: Rankings are among all 95 Tennessee counties and were ordered highest to lowest.
Source: U.S. Census Bureau.

Employment and Earnings

Table 2.5 presents data on employment and earnings for the lake region and the state of Tennessee. The unemployment rate shown in the second column of this table is a resident-based measure that represents the percent of the county labor force that was unemployed on average in 2000. The unemployment rate in the lake region was 4.4 percent in 2000 and was a half percentage point higher than the unemployment rate in Tennessee. However, only seven of the thirteen counties had unemployment rates that were higher than the Tennessee average. Among the thirteen counties in the lake region, Union County had the lowest unemployment rate (3.3 percent) followed closely by Sullivan and Anderson Counties with unemployment rates of 3.5 and 3.6 percent respectively. Johnson County had the highest unemployment rate (7.6 percent) but only had the 12th highest unemployment rate among the 95 Tennessee counties.

Table 2.5: Employment and Earnings, 2000

Area	Number of Employers	Unemployment Rate	Rank of Unemployment Rate	Annual Average Wages	Wages as Percent of TN Average	Rank of Average Annual Wages
Anderson	1,453	3.6	75	$34,532	113.1	5
Campbell	571	6.4	16	20,726	67.9	80
Carter	618	5.1	40	21,455	70.3	74
Cocke	416	6.7	15	23,758	77.8	55
Grainger	204	4.3	59	21,001	68.8	79
Hawkins	550	3.8	71	26,988	88.4	27
Hamblen	1,172	4.5	53	27,270	89.3	28
Jefferson	556	3.9	68	26,634	87.2	29
Johnson	207	7.6	12	21,291	69.7	76
Sevier	2,076	6.0	22	19,801	64.9	86
Sullivan	3,062	3.5	80	31,595	103.5	9
Union	168	3.3	83	20,347	66.6	84
Washington	2,340	3.8	74	24,717	81.0	43
Lake Region	13,393	4.4		24,624	0.81	
Tennessee	119,408	3.9		30,532		

Notes: Includes total private industries only.
The unemployment rate is a resident-based measure; however, the wage data are employer-based.
Rankings are among all 95 Tennessee Counties and were ordered highest to lowest.

Sources: Tennessee Department of Labor & Workforce Development, Employment Security Division, Research and Statistics Section, 2000 Covered Employment and Wages in Tennessee, June 2001 and Tennessee Department of Labor & Workforce Development, Employment Security Division, Research and Statistics, CPS Labor Force Summary.

The remaining columns of Table 2.5 present employer-based average wage data for the lake region. (The per capita income data above reflect earning from all sources for *residents* of the region.) The employer-based earnings data presented here reflect the nature of jobs within the lake region, jobs that might be held by residents or nonresidents of the area. The average annual wage of the lake region was $5,908 less than the Tennessee average in 2000. Average wages for the thirteen-county region ranged from $34,532 to $19,801 (a difference of $14,731). Employees received the highest average annual wage in Anderson County (due in large part to the presence of DOE and ORNL), amounting to 113.1 percent of the state average. Employees received the lowest average annual wage in Sevier County, only 64.9 percent of the state average. Seven of the thirteen counties had average wages that were less than 80 percent of Tennessee's average, and only two counties (Anderson and Sullivan) had average wages that exceeded the state average.

Impact of Tourism

Every year thousands of visitors flock to East Tennessee to enjoy the numerous amenities offered by its pleasant climate and proximity to the Great Smoky Mountains and other points of interest. This tourism activity generates a wide variety of benefits to local economies such as tax revenues from travel-related expenditures and new employment opportunities. Table 2.6 provides a brief summary of the economic impacts of travel on the counties in the lake region produced from an economic model (County Travel Economic Impact Model) developed by the U.S. Travel Data Center using survey data from the U.S. Census Bureau and other sources. The data were compiled on U.S. residents traveling to Tennessee for overnight stays away from home or day trips to places 100 or more miles from home. Nonresident spending related to enjoying East Tennessee lakes managed by TVA is embedded in these data.

Between the years 1995 and 2000, visitors increased their travel expenditures not only in Tennessee but also in the lake region. During this five-year span, the lake region also experienced an increase in its percentage of the total Tennessee travel expenditures. In 1995, travel expenditures in the lake region accounted for 15.7 percent of the state total, while in 2000 this figure rose to 16.1 percent. Travelers spent over $9.9 billion in Tennessee in 2000 and approximately $1.6 billion of this spending occurred within the lake region. The majority of the lake region expenditures (63.2 percent) occurred in Sevier County, which is no surprise considering that Gatlinburg and Pigeon Forge draw huge crowds during most months of the year. In fact, Sevier County is ranked third behind Davidson and Shelby Counties in total travel expenditures among all 95 Tennessee counties. However, Sullivan and Washington Counties also attracted enough travel expenditures to earn them top ten rankings in the state.

Two important economic impacts generated by travel expenditures are increases in tax revenues and employment. In 2000, travel expenditures generated a total of $292 million in local tax receipts in Tennessee and $50.6 million (or 17 percent of the state total) in the lake region. The lake area also benefited from 13.7 percent (23.3 thousand jobs) of travel-generated employment in 2000. Nearly 58 percent of the local tax revenues and 70 percent of the new jobs created by tourism in the lake region went to Sevier County, while the remaining impacts were spread fairly evenly across the other twelve counties.

Table 2.6: Travel Expenditures and Travel-Generated Local Tax Receipts and Employment (Expenditures and receipts in millions of dollars; employment in thousands)

	Total Travel Expenditures				Local Tax	Travel-generated
Area	1995	2000	% Change	Rank 2000	Receipts	Employment
Anderson	$60.6	$66.8	10.1	15	$1.42	0.80
Campbell	30.5	35.4	16.2	25	1.82	0.43
Carter	16.6	20.2	21.6	42	1.26	0.16
Cocke	24.8	27.0	8.7	31	1.19	0.39
Grainger	10.0	10.9	9.4	60	2.08	0.08
Hamblen	45.3	53.6	18.3	20	1.17	0.51
Hawkins	17.5	20.9	19.1	40	1.14	0.20
Jefferson	23.4	29.3	24.8	28	2.12	0.31
Johnson	6.0	7.0	17.3	70	0.53	0.07
Sevier	728.1	1,011.3	38.9	3	29.19	16.21
Sullivan	138.5	183.2	32.3	6	4.97	2.55
Union	4.0	4.5	13.1	85	0.66	0.03
Washington	106.6	130.4	22.3	9	3.01	1.55
Lake Region	1,211.9	1,600.4	32.1		50.56	23.29
Tennessee	7,720.8	9,933.0	28.7		291.88	169.43

Notes: Estimates represent expenditures by U.S. residents traveling away from home overnight, or on day trips of 200 round-trip miles or more. Local tax reciepts include revenues from both local sales and property taxes.

Source: U.S. Travel Data Center, The Economic Impact of Travel on Tennessee Counties, 2000, a study prepared for the Tennessee Department of Tourist Development.

3. Recreator and Household Surveys

The main objectives of this study are to quantify the economic impact and economic value of delayed drawdowns. To achieve these objectives, heavy reliance is placed on two primary data sources that provide important inputs from both recreators and property owners. The first primary data source is a survey of lake recreators. The data collected from this survey administered on six East Tennessee lakes provide estimates of trip-related expenditures, changes in intended lake use in response to higher lake levels and willingness to pay for delayed drawdowns. These data also provide an excellent summary of the level and types of recreation that occur at lakes throughout the year. The second primary data source is a survey of property owners on Cherokee and Douglas lakes. These data also provide estimates of recreation-related expenditures and willingness to pay for delayed drawdown; however, they also include a first-hand account of the effects of delayed drawdown on recreation opportunities and aesthetic benefits experienced by property owners. The section that follows describes how each of these surveys was conducted and briefly summarizes reported data as an introduction to the analysis that follows in later sections; Section 4 of the report provides detail on expenditures related to recreators and households. The survey instruments are reproduced in Appendix B and Appendix C to this report. Appendix D provides detailed summary tables on responses to select recreation survey questions for each of the six lakes where surveys were conducted.

Survey of Recreators

The recreation survey was conducted throughout the summer of 2002 as a personal interview with recreators at various sites on each of the lakes included in this analysis. Budget considerations and lake-specific utilization rates guided administration of the surveys. Survey work began in early May and continued until late September and took place on different days and different times of day to ensure the data would capture a wide variety of recreators at various points during the recreation season. Survey efforts were intensified as utilization of the lakes increased and as the summer progressed towards the months most relevant to the proposed policy change: August and September. A summary of survey activity across lakes is provided in Table 3.1. A total of 1,218 surveys were completed during 111 survey days scattered across the various lakes during this five-month period. Cherokee, Douglas and Norris lakes were the primary focus of survey efforts as past visitation counts were higher at these lakes than at the others. Roughly 69 percent of the surveys were collected from one of these three lakes. Budgetary constraints limited survey efforts at Boone, South Holston, and Watauga as per day survey costs were increased due to higher travel cost.

Table 3.1: Summary of Survey Activity by Lake

Reservoir	Number of Survey Days	Number of Completed Surveys	Response Rate (%)
Boone	11	125	74
Cherokee	23	265	70
Douglas	28	327	76
Norris	25	244	72
South Holston	12	143	73
Watauga	12	114	80
Totals	**111**	**1,218**	**74.2**

The survey was well received by recreators as response rates ranged from 70 percent at Cherokee Lake to 80 percent at Watauga Lake. Although high response rates are common with in-person interviews, the high response rates achieved by this survey may reflect the high level of interest recreators have in lake recreation and lake levels. A list of survey sites at each lake is provided in Table 3.2.

Each of the lakes in this analysis provides visitors with numerous recreational activities including boating, fishing, swimming, picnicking and camping opportunities. Thus a wide variety of recreators participated in the on-site interviews. An overview of participation in various lake activities by visitors on the day of the survey and during prior visits to the lake is provided in Table 3.3. On the day of the survey, boating was the most popular activity as nearly 46 percent of participants pursued this activity. Over a third of survey participants were engaged in fishing and swimming activities. Fewer visitors were planning to camp or picnic on the day of the survey (22.3 and 30.6 percent). Recreators used the lakes for multiple activities on the day of the survey and have participated in a variety of activities in the past. Over 50 percent of survey participants had engaged in boating, fishing, swimming and picnicking opportunities during a prior visit to the lake at which they were surveyed; only 44 percent had camped at the survey lake in the past.

As shown in Figure 3.1 the majority of visitors surveyed (65 percent) made day trips to the lake. Only 8 percent made a two-day trip, 7 percent a three-day trip, and 4 percent a four-day trip. Trips of a five-day duration or longer were fairly common among visitors as 16 percent of those surveyed fell into this category. Most recreators visited the lake with one or more friends or family members as shown in Figure 3.2. Only 13 percent of survey participants made solo trips to the lake.

Table 3.2: Survey Sites

Lake	Sites	
Boone	Boone Dam Recreation Area	
Cherokee	Cherokee Dam Recreation Area	Grainger County Park
	Cherokee Park	Public Boat Ramp on 25E
Douglas	Dandridge Boat Dock	Smokey View Campground
	Douglas Dam Recreation Area	Swann's Marina
	Douglas Lake Marina	Tail Waters
Norris	Anderson County Park	Loyston Point Recreation Area
	Cove Creek Boat Dock	Norris Dam Marina
	Cove Lake Boat Ramp	Norris Dam State Park
South Holston	421 Bridge Lake Access	Osceola Island Recreation Area
	Jacobs Creek Recreation Area	Painter Creek Marina
	Knob Park	South Holston Dam Recreation
	Little Oak Mountain Recreation Area	
Watauga	Carden's Bluff Camping Area	Shook Branch Recreation Area
	Fish Springs Dock	Sink Boat Ramp
	Mallard Cove Marina	Watauga Dam Recreation Area
	Rat Branch	

Table 3.3: Participation in Lake Activities

	Percent of Visitors Participating	
Activity	On the Day of the Survey	During a Prior Visit
Boating	45.6	64.0
Camping	22.3	43.6
Fishing	37.0	62.5
Picnicking	30.6	51.3
Swimming	39.3	56.4
Other	22.4	11.7

Figure 3.1: Percent of Visitors by the Number of Days Spent at the Lake

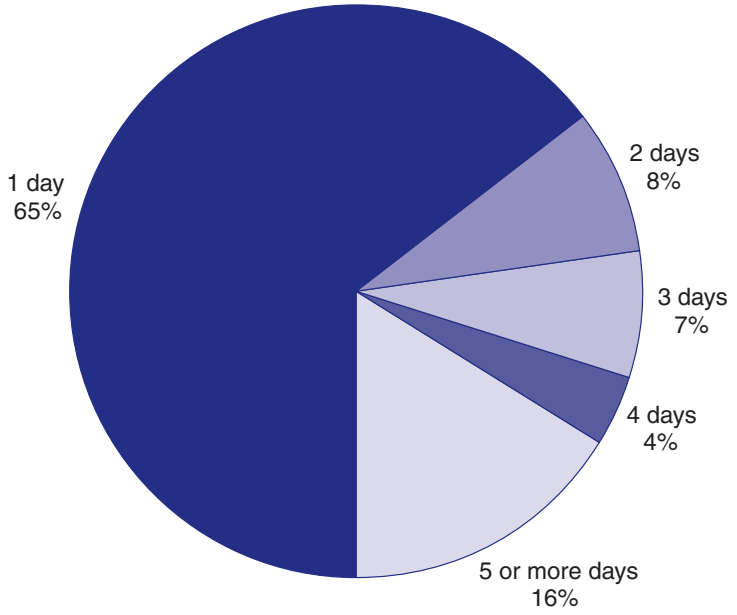


Figure 3.2: Percent of Visitors by the Number of Individuals in the Party

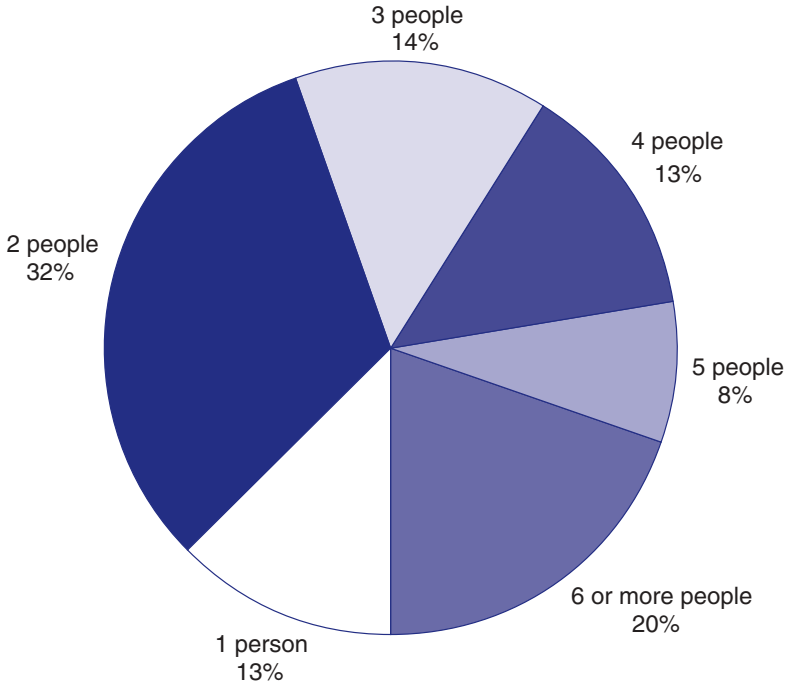


Table 3.4 provides a breakdown of survey respondents by various demographic characteristics. The average recreator was a male, high school graduate of the age of 45 who earned between $40,000 and $50,000 a year. The majority of recreators either had a high school diploma, associates degree or some college. Recreators were fairly evenly distributed across income categories. Survey participants were twice as likely to be male than female.

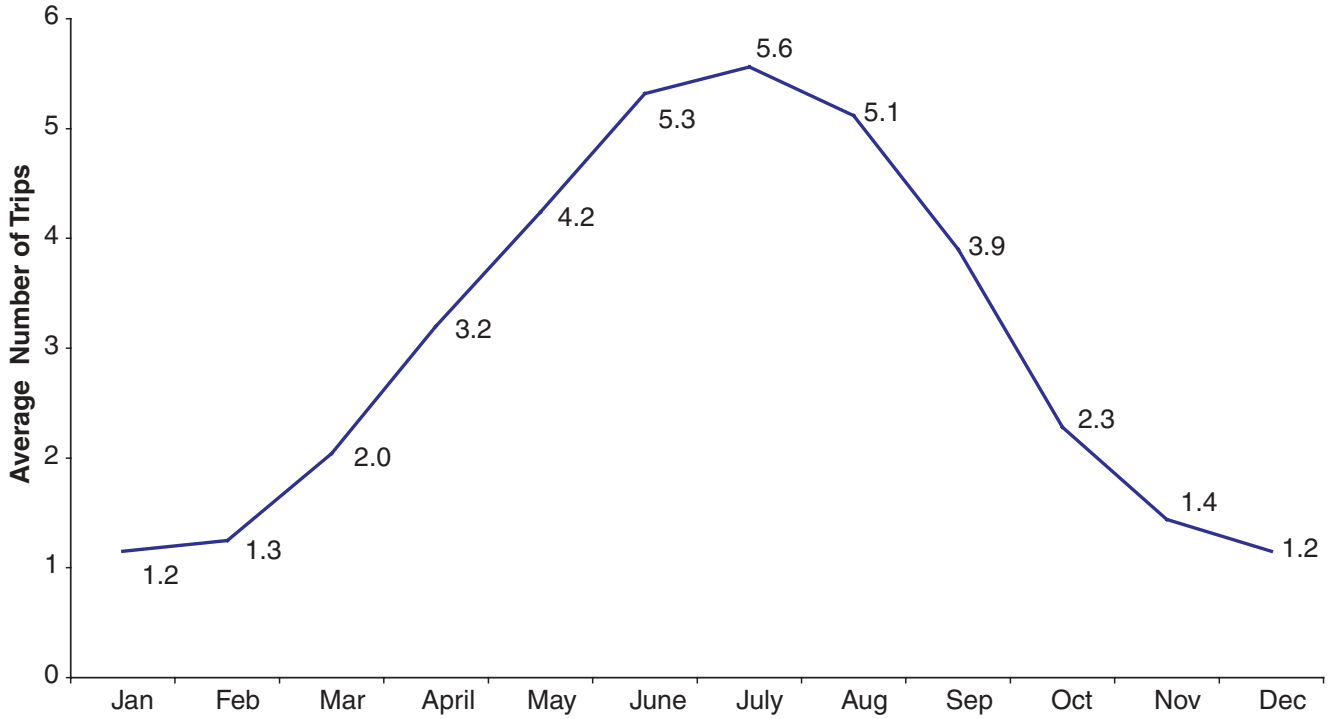
Table 3.4: Characteristics of Recreation Survey Respondents

	Average
Age	45
Education	**Percent**
Elementary or some high school	14.3
High school graduate / GED	38.0
Trade or vocational certification	4.6
Some college / Associates degree	23.9
College graduate	14.6
Post-graduate degree	4.7
Gender	
Female	29.7
Male	70.3
Income	
Less than $10,000	2.4
$10,000 to $19,999	7.0
$20,000 to $29,999	12.3
$30,000 to $39,999	12.2
$40,000 to $49,999	14.1
$50,000 to $59,999	10.2
$60,000 to $69,999	9.5
$70,000 to $79,999	8.2
$80,000 to $89,999	4.2
$90,000 to $99,999	2.6
More than $100,000	7.8
No Response / Don't Know	9.7

The average recreator took 36.6 trips to the survey lake at which he or she was interviewed in the twelve months prior to the survey; however, on average these trips were not uniformly scattered throughout the year. Figure 3.3 shows the average number of trips taken to the survey lake in each month. Notice that during the early months of the year when lakes were at their lowest levels and weather conditions were poor recreators took fewer than 1.5 trips on average. However, as lake levels began to rise and weather conditions improved the average recreator took more trips to the lake each month. By May when lakes had almost reached full-pool levels the average recreator took 4.2 trips. With an average of 5.5 trips, July was the peak month for lake visitation. Once drawdown began in early August the average number of lake visits starts to fall off sharply. This rate of decline actually increases in September, coinciding with a more significant reduction of water levels and the beginning of the school year.

To the extent that weather conditions remain fairly mild in August and September, some of the decline in lake use during these months may be attributed to early drawdowns. To investigate this hypothesis, survey participants were asked how their lake visitation would change given a delay in drawdown. Approximately 57 percent of the survey respondents claimed that they would make more trips to the lake if water levels were higher in August and September. On average they would increase their lake use by 8.7 trips. Of those who would

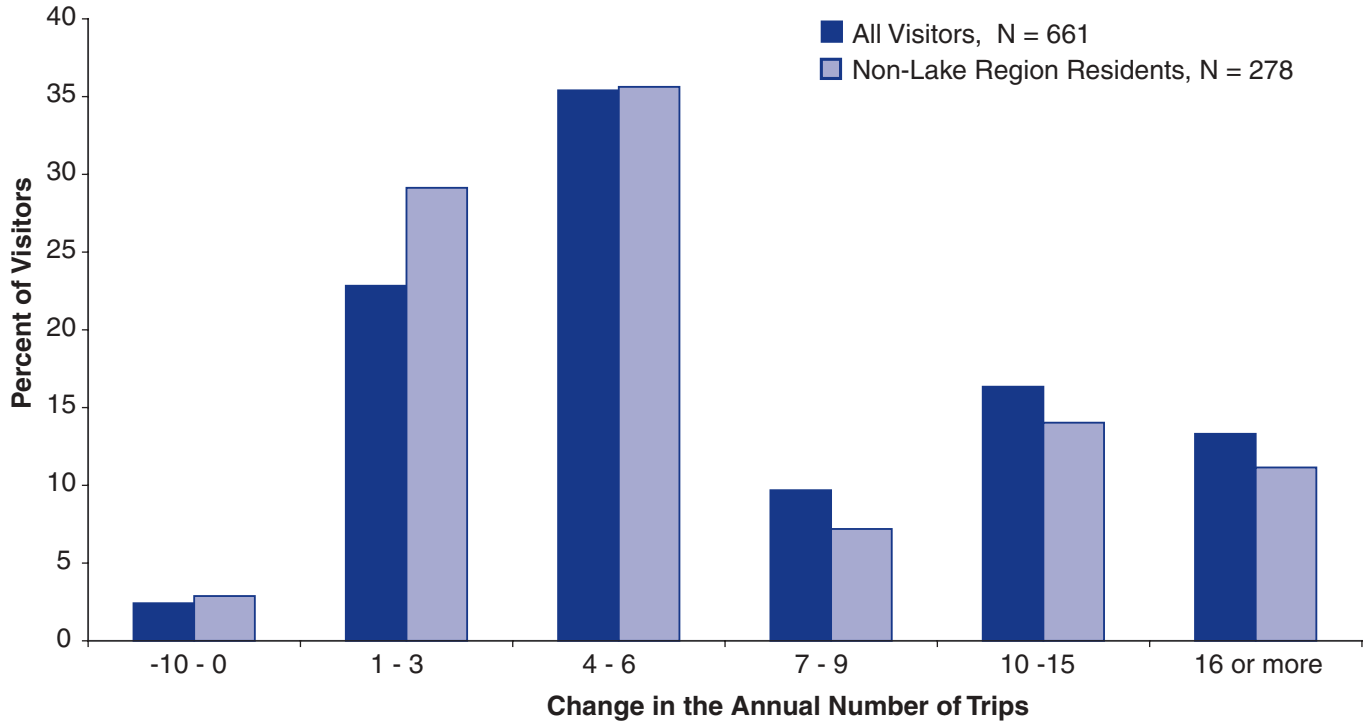
Figure 3.3: Average Number of Trips Taken to the Survey Lake Each Month



increase the number of trips they make to the lake due to delayed drawdowns, only 4 percent claimed that they would decrease the number of trips they made during other months of the year to compensate for the increased visits in August and September. The average decrease in the number of trips was only 3.3. According to these estimates overall lake visitation would increase significantly if drawdowns were to be delayed.

Figure 3.4 shows the stated net change in lake visitation that would result from delayed drawdowns for all recreators surveyed and separately for those who reside outside the lake region. Non-lake region residents are more likely to increase annual trips to the lake by 1 to 6 trips than are all recreators, while all recreators are more likely to increase their annual number of trips by more than 6. These results suggest that although non-lake region residents would visit the lake more often as a consequence of delayed drawdowns, travel cost may prevent them from increasing their visits at the same rate as those within close proximity of the lake. Less than 2.5 percent of all visitors would actually decrease the number of annual trips to the lake as a result of delayed drawdowns. This finding is difficult to explain. One possibility is that some fisherman actually may prefer lower lake levels as it is believed that this leads to a greater concentration of fish and thus better daily catches. This anecdotal story surfaced several times over the course of the study.

Figure 3.4: The Effects of Delaying Drawdown on Lake Visitation



Survey of Households

The recreation survey provides important data for the analysis of the economic impact and economic value of delaying drawdowns. But is also has an important limitation. The recreation survey was conducted as an on-site survey at common recreation sites, including campgrounds and boat ramps. As a result it will not capture property owners who do not use these public recreation sites either because they have direct access to the lake from their own property or have private community access. In order to capture homeowner responses, this analysis relies on a second form of primary data, a survey of property owners who live on or near Cherokee or Douglas lakes.

The property owners survey was constructed to collect specific information regarding recreation-related expenditures made by lake residents, economic values of delayed drawdowns and the effects of drawdown on lake access and aesthetic benefits. Surveys were mailed to property owners beginning in late September after mailing addresses of property owners located within a one-half mile radius of either Cherokee or Douglas lakes were obtained from a national marketing company, *infoUSA*. The half-mile radius was chosen so that non-lakefront properties, which also receive recreational and aesthetic benefits from the lake and thus would be affected by delayed drawdowns, would also be included in the analysis. The initial data set provided by *infoUSA* included 5,709 addresses of property owners living on Cherokee Lake and 2,012 addresses of property owners living on Douglas Lake. From this data set, 1,000 addresses from each lake were randomly selected to receive surveys. Reminder notes were sent to the same households a couple of weeks after delivery of the initial survey instrument to encourage completion and return of the survey. The household survey is reproduced in Appendix C.

Table 3.5 provides a summary of the responses to the survey. Of the 1,000 surveys mailed to residents of Cherokee Lake, only 122 were completed and returned. Another 118 were returned as undeliverable, which resulted in an overall response rate of 13.8 percent. The response from Douglas Lake was somewhat better. Of the 1,000 surveys mailed to residents of Douglas Lake, 215 were completed and returned. Another 150 were returned as undeliverable, as a result the overall response rate for Douglas was 25.3 percent.

Table 3.5 also divides the survey responses into various property classifications, defined in terms of the nature of the view of the lake from the home and the type of lake access. Nearly 48 percent of the surveys received from Cherokee Lake were completed by property owners who lived within five miles of the lake but had no lake view or access to the water. Approximately 20 percent of the surveys received from Cherokee were completed by property

owners with a view of the lake and direct access to the water. The remaining surveys completed from the Cherokee group were from residents who were fairly evenly distributed across the remaining property classifications. In contrast, nearly 44 percent of the surveys completed from the Douglas group were from property owners with both a view of the lake and direct access to water. Only 23 percent of the Douglas surveys were completed by residents who lived within 5 miles of the lake but had no lake view or access to the water.

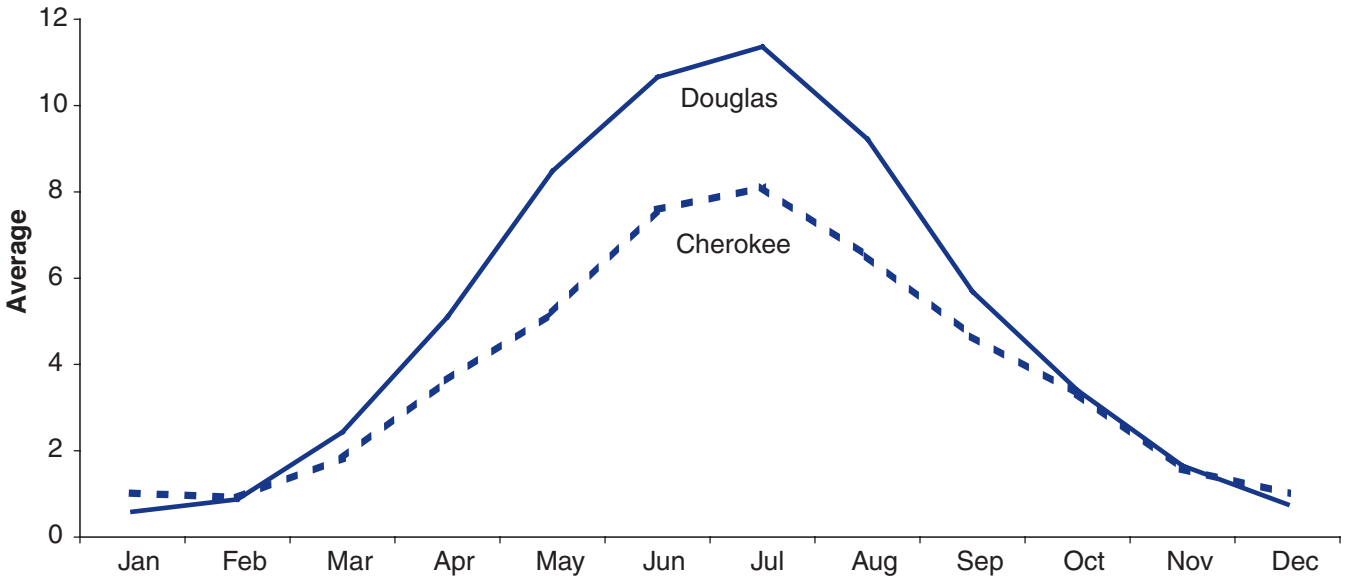
Property owners enjoy numerous recreational and aesthetic benefits due to their close proximity to the lake. These benefits can be significantly affected by lake drawdowns. Figure 3.5 shows the average number of times the lake is accessed with a watercraft each month by property owners on Cherokee and Douglas lakes. Both lakes are accessed more often during the summer months when lake levels are at full-pool. Except for the winter months, property owners on Douglas Lake access the water more frequently than do property owners on Cherokee Lake. This finding is likely due to the fact that more respondents from Douglas have direct lake access. Once drawdown begins in early August, monthly lake use by property owners drops dramatically. Almost 66 percent of Douglas residents and 38 percent of Cherokee residents claimed that their primary form of lake access was restricted during drawdown.

Table 3.5: Summary of Household Survey Responses

	Cherokee	Douglas
Number of surveys completed	122	215
Response rate (%)	13.8	25.3
Property classification (% of surveys)		
View of the lake and direct access to water	19.8	43.5
View of the lake but no access to the water	9.1	10.8
View of the lake and access via neighboring property or common subdivision access	9.1	13.1
No view of the lake but access via neighboring property or common subdivision access	5.8	6.5
Located within 5 miles of the lake but no lake view or access to the water	47.9	22.9
Other	5.8	2.8
No response	2.5	0.5

Note: Response rates were adjusted to account for the number of undelieverable surveys.

Figure 3.5: Average Number of Times Per Month Lake is Accessed with a Watercraft by Property Owners



Roughly 56 percent of all survey respondents have a view of the lake from somewhere on the property during the months of May through July. This number declines slightly to 50 percent for the month of August when drawdown begins and decreases further to 41 percent by September. By December, when lakes are at their winter-pool water levels, only 28 percent of all survey respondents have a view of the lake. As evidenced by these responses, the recreation and aesthetic benefits received by lake property owners are dramatically affected by TVA's drawdown policies. However, surprisingly only about half of the survey participants claimed to have knowledge of TVA's drawdown policies prior to purchasing the property.

As reported in Table 3.6, if drawdowns were delayed by an additional month or two, most property owners would take advantage of the higher water levels by increasing their lake utilization. Approximately 56 percent of the sample of Cherokee residents and 72 percent of the sample of Douglas residents would

Table 3.6: The Effects of Delaying Drawdown on Lake Utilization by Property Owners

	Percent	
Change in Utilization	**Cherokee**	**Douglas**
Increase	55.9	72.0
Decrease	1.8	0.0
No change	34.2	23.7
No response	8.1	4.3

increase the number of times they access the lake in August and September if drawdown was delayed. On average, survey respondents who indicated that they would use the lake more frequently if drawdowns were delayed would access the lake 8.6 additional times in the month of August and 9.6 additional times during the month of September. Only 1.8 percent of the survey participants from Cherokee would decrease their lake utilization in response to delayed drawdowns. The remaining participants would either not change their behavior or had no response to this particular question.

Finally, Table 3.7 provides an overview of the characteristics of the property owners who responded to the survey. The majority of property owners who participated in this survey were male and 55 years old on average. Over 60 percent of participants had at least some college education. The majority of participants had annual household incomes between $20,000 and $60,000.

Table 3.7: Characteristics of Household Survey Respondents

Average Age	55
Education	**Percent**
Elementary or some high school	8.2
High school graduate / GED	24.3
Trade or vocational certification	8.2
Some college / Associates degree	30.0
College graduate	16.1
Post-graduate degree	13.2
Gender	
Female	27.3
Male	72.7
Income	
Less than $10,000	5.8
$10,000 to $19,999	7.5
$20,000 to $29,999	15.0
$30,000 to $39,999	13.3
$40,000 to $49,999	11.6
$50,000 to $59,999	10.2
$60,000 to $69,999	7.2
$70,000 to $79,999	5.1
$80,000 to $89,999	5.5
$90,000 to $99,999	4.8
More than $100,000	10.2
No Response / Don't Know	3.8

4. Economic Impacts Arising from Expenditures

In this section estimates of economic impact for the lake region arising from a delayed drawdown to the end of September are presented. Estimates of new income and new jobs that would follow from increased spending are presented. The emphasis is on expenditures by lake visitors who do not live in the thirteen county impact region immediately surrounding the lakes — Anderson, Campbell, Carter, Cocke, Grainger, Hamblen, Hawkins, Jefferson, Johnson, Sevier, Sullivan, Union, and Washington counties — but who made trip expenditures within the thirteen county region. These expenditures are referred to as *net expenditures*. Also presented are estimates of the statewide economic impact arising from potential changes in spending by nonresidents of the state. This new spending can be expected to give rise to the *net* creation of new jobs, new income for workers and entrepreneurs and net additions to the tax base for state and local governments. Net expenditures are calculated here, but in fact, net expenditures are a poor measure of economic benefits for a region since most spending will immediately be transferred outside the region to where most goods and services are produced. For example, most goods that a retailer sells are produced outside the region. Only a small share of expenditures actually remains within the region as wages, salaries and profits, and it is for this reason that the emphasis in this report is placed on income and jobs created. The methodology used to evaluate economic impacts is discussed in Appendix A.

Also reported in this section are *gross expenditure* estimates that reflect expenditures by all recreators. Gross expenditure estimates for a sample of households on Douglas and Cherokee lakes are also presented. For the multi-county lake-impact region, this includes people who live within the region and make a trip to the lake as well as nonresident visitors who spend within the local economy. For the state this includes all spending that takes place in Tennessee by both residents and nonresidents of the state. Changes in lake use by residents of the region will likely result in a transfer of expenditures within the region and hence no net increase in jobs or income for the regional economy. For example, a family from within the region may spend an afternoon at the lake instead of going to a restaurant and as spending on lake-related recreation rises, spending is reallocated away from the restaurant. Regional activity is neither increased nor enhanced simply by a reallocation of existing spending. However, when the lake visitor comes from out of the region, new expenditures are introduced into the region. This spending can and does increase regional economic activity, create new jobs and income and create net expansions in the tax base. In essence, the region is exporting a recreation service to out-of-region consumers. A similar argument can be made regarding in-state spending by nonresidents and the income and jobs supported by this spending.

To evaluate the economic impact of recreation spending and household spending, the surveys discussed above that were administered during the spring and summer of 2002 are used. Based on survey questions and survey responses, estimates of net and gross economic impacts were made. In total, 1,218 individuals were interviewed at Boone Lake, Cherokee Lake, Douglas Lake, Norris Lake, South Holston Lake, and Watauga Lake[5] about their expenditures related to the visit. In addition, 2,000 surveys were sent to homeowners on Douglas and Cherokee lakes. Additional information regarding the surveys is contained in an earlier section of this report. The estimation of state-level economic impacts relies on (RIMSII) multipliers acquired from the U.S. Bureau of Economic Analysis. No multipliers are available for individual counties in the state so a statewide multiplier is assumed for purposes of estimating lake-region economic impacts.

Net Expenditure Impacts

The driving force for job and income creation is expenditures related to recreation on East Tennessee lakes. The steps taken to arrive at estimates for the lake region are presented in considerable detail below. A similar procedure was employed in generating statewide economic impact estimates, which are also presented below. Unless otherwise noted, the estimates apply to a drawdown delay extending through the end of September.

Net Economic Impacts: Lake Region

One section of the Lake Level Survey administered to recreators exclusively focused on expenditures related to trips. Question 7 (see Appendix B) asked about trip expenditures on food, transportation, lodging, fuel, etc. The responses regarding trip expenditures were then divided by the number of people in the party and the length of the trip to estimate the average expenditure-per-person-per-day. The estimated per person mean expenditure in region by out-of-region visitors (net expenditures) differs among lakes ranging from $8.91 per day on Boone Lake to $33.72 per day on South Holston Lake. The estimates of net spending per person per day are shown in Table 4.1. For Douglas and Cherokee

Table 4.1: Expenditures Per Person, Per Day

Lake	Net Expenditures
Boone	$8.91
Cherokee	16.82
Douglas	26.13
Norris	13.02
South Holston	33.72
Watauga	15.84
Average (Simple)	19.07

[5]Since lake level drawdowns do not occur at Ft. Patrick Henry, it was excluded from the body of the analysis.

lakes, the net spending numbers are $26.13 and $16.82. In comparison, estimates of recreation-related expenditures based on a 1998 survey show that $25.50 per day was spent on Douglas Lake and $46.05 per day was spent on Cherokee Lake. Differences between the two surveys' results may reflect the sites and dates chosen to conduct the surveys. Given the large diversity of sites and times chosen for the current project, coupled with a much larger number of surveyed people, greater confidence is placed on the newer figures. These figures are generally consistent with research conducted elsewhere. For example, the Pacific Gas and Electric Company's *Upper North Fork Feather River Project* found estimates ranging from $9.08 to $17.87 spent per person, per day on a trip to Lake Almanor, California.

In order to extrapolate the survey findings to reflect all recreators, the number of visits to each lake must first be calculated. The TVA's *Tennessee River and Reservoir System Operation and Planning Review*[6] offers the only available data on lake utilization for the surveyed lakes. The study reports that the lakes had anywhere from 300,000 visitor-days at Boone and Watauga lakes to 1,400,000 visitor-days at Norris Lake[7] as shown in Table 4.2. Adjusting these data to reflect changes in utilization over time is problematic. The approach taken here to calculate the growth rate in lake utilization from 1990 is to use growth rates of boating, camping, fishing, picnicking and swimming activities through 2002.[8] Participation in these activities at each lake is estimated from the Lake Level Survey. A weighted average growth rate is then calculated for each lake, using actual participation rates in each activity at each lake and growth rates in these same activities from the NSRE study, to be published in Cordell's *Recent Trends in Outdoor Recreation for 21st Century America*. For example, if ten people swim and the growth rate of swimming is 66 percent and 15 people fish and the growth rate of fishing is 25 percent, the weighted average growth rate would be 10/25*0.66 + 15/25*0.25 = 41.4 percent. This application produces a total percent change from 1982-83 to 2000-01. A compound annual growth rate is then calculated and used to adjust the 1990 visitor-days to the current period.

Table 4.2: Number of Visitor-Days

Lake	1990	2002 (Estimated)	Nonresident Trips (%)	Nonresident Visitor-days	Resident Visitor-days
Boone	300,000	339,172	28.0	94,968	244,204
Cherokee	600,000	678,213	31.15	211,263	466,950
Douglas	500,000	565,212	55.25	312,279	252,933
Norris	1,400,000	1,582,725	58.33	923,204	659,521
South Holston	500,000	565,259	51.85	293,087	272,172
Watauga	300,000	339,127	27.52	93,328	245,799
Total	**3,600,000**	**4,069,708**		**1,928,129**	**2,141,579**

[6]TVA has expressed a concern that these estimates are too high. We use these data since they are the only data available.
[7]A visitor-day is an accumulated 12 hours of recreation.
[8]Growth rates of these activities from 1982/83 to 2000/2001 are obtained from the *National Survey of Recreation and Environment* (forthcoming).

Using this method of growth rate estimation, the 1990 visitor-days are updated to provide estimates of 2002 visitor-days as shown in Table 4.2. Cordell et al.'s final report on the *1996 National Survey on Recreation and Environment* estimates the number of trips as exactly one-half the number of visitor-days, so that each trip generated two visitor-days. Thus, "trips" are directly proportional to visitor-days.

The lake-level survey data are then used to estimate the proportion of total visitor-days made by nonresidents. Averaging the percent of trips made by nonresidents from all the lakes shows that an average of 16.05 percent of all trips is made by nonresidents (see Table 4.2). The variation in nonresident use across the lakes is consistent with the location and relative ease of access of each lake for out-of-region recreators. Since trips and visitor-days are directly proportional, the nonresident trip percentages are applied to the estimates of visitor-days to calculate the number of nonresident visitor-days at each lake. This results in an estimated low of 93,328 nonresident visitor-days at Watauga to 923,204 nonresident visitor-days at Norris. Table 4.2 provides figures for all the lakes considered here. Total nonresident visitor-days are estimated at 1,928,129.

A fundamental question addressed by this study is how the number of visitor-days would react in response to delayed lake drawdowns. This is addressed by using nonresidents' responses to survey questions 16b and 17b (see Appendix B). These questions reveal the survey respondents' intentions on how their lake usage will change in response to delayed drawdowns extending through August and through September. Estimates indicate that total nonresident visits would increase from 11.2 percent at Norris Lake to 22.6 percent at Cherokee Lake as shown in Table 4.3. Using the 1996 NSRE assumption that visitor-days are directly proportional to trips, these percentages can then be applied to the number

Table 4.3: Increase in Trips due to Higher Lake Levels

Lake	Percent Increase by Nonresidents	New Nonresident Visitor-days	Percent Increase by All Visitors	New Total Visitor-days
Boone	18.7	17,759	15.7	53,250
Cherokee	22.6	47,745	15.1	102,410
Douglas	13.0	40,596	12.4	70,086
Norris	11.2	103,399	10.6	167,770
South Holston	18.7	54,807	13.6	76,875
Watauga	12.1	11,293	10.8	36,625
Total		**275,599**		**507,016**

of nonresident visitor-days to estimate the change in nonresident usage. For example, if it were estimated that a lake had 100,000 nonresident visitor-days and the survey results indicate that nonresident trips would increase by 10 percent, then the number of new nonresident visitor-days would be 110,000. Estimates of *new* nonresident visitor-days due to delayed drawdowns vary across lakes but totals 275,599 as reported in Table 4.3.

Total new expenditures made within region by out-of-region visitors are arrived at by multiplying the estimate of daily net expenditures (see Table 4.1 above) by the estimate of increased visitation. For example, if there were an estimated 10,000 additional days and people spend an estimated $15 per day, then the increase in expenditures would be $150,000. The final estimates of new expenditures range from $158,233 in nonresident expenditures on Boone to $1,848,101 in nonresident expenditures on South Holston as shown in Table 4.4. In response to delayed drawdowns on the lakes, the total new expenditures by nonresidents in the thirteen county lake-region are estimated at approximately $5.4 million as summarized in Table 4.5.

Table 4.4: Increase in Expenditures due to Higher Lake Levels

Lake	Nonresidents	Total
Boone	$158,233	$287,018
Cherokee	803,078	3,178,811
Douglas	1,060,781	2,417,276
Norris	1,346,253	3,781,510
South Holston	1,848,101	2,120,218
Watauga	178,876	601,760
Total	**5,395,322**	**12,386,593**

Table 4.5: Summary of Increase in Net Expenditures and Visitor-Days

Lake	Net Expenditures Per Person Per Day	2002 Visitor-days	Proportion by Nonresidents	Nonresident Visitor-Days	Percentage Increase Due to Higher Lake Levels	Increase in Nonresident Visitor-days	Increase in Nonresident Expenditures
Boone	$8.91	339,172	28.0	94,968	18.7	17,759	$158,233
Cherokee	16.82	678,213	31.15	211,263	22.6	47,745	803,078
Douglas	26.13	565,212	55.25	312,279	13.0	40,596	1,060,781
Norris	13.02	1,582,725	58.33	923,204	11.2	103,399	1,346,253
South Holston	33.72	565,259	51.85	293,087	18.7	54,807	1,848,101
Watauga	15.84	339,127	27.52	93,328	12.1	11,293	178,876
Total increase for region				**$5,395,322**			

The $5.4 million in expenditures only captures the first round of economic impact, or the direct economic impact. Applying a multiplier to the expenditures captures the indirect and ripple effects of the expenditures throughout the region. For purposes of this study, an expenditure multiplier of 1.4 is assumed for the impact region. Applying this multiplier yields $7.55 million in total expenditure impacts on the multi-county region. These new expenditures are the source of increased personal income and jobs in the economy. In order to calculate how much income will be generated from these new expenditures, estimates of income as a percentage of sales must first be found. Economic census data provide information on sales and payroll from the retail trade and service sectors where expenditure impacts would be concentrated.[9] It is estimated that in Tennessee 21.35 percent of sales goes towards annual payroll in the retail and service sectors. However, other forms of personal income, notably rent, interest, dividend and proprietors' income will also accrue if sales activity increases. These forms of income represent about 46 percent of wage and salary income in Tennessee. Using this information as applied to the expenditure estimates together yields an estimate of $2.35 million in total income generated from the $7.55 million spent within the region.

This new income would then support new jobs within the lake region. An average weighted annual salary for the retail and service sectors is calculated for Tennessee using Census data. This turns out to be $18,960, from which it follows that 124 annual full-time equivalent jobs in the retail and service sectors could be supported. The estimates of spending, income and jobs for the individual lakes and the region as a whole are presented in Table 4.6. In reality, most of the income and hence most of the jobs would be in support of recreation activities in the two months of August and September. Accordingly, a total of 744 jobs could be supported within the two-month window of August and September.[10]

Table 4.6: Estimated Net Economic Impacts from Recreators due to Delayed Drawdown (October 1)

Lake	Increased Spending	Increased Income	Jobs Created
Boone	$221,526	$69,052	4
Cherokee	1,124,310	350,459	18
Douglas	1,485,093	462,918	24
Norris	1,884,754	587,497	31
South Holston	2,587,342	806,500	43
Watauga	250,427	78,060	4
Total	**7,553,452**	**2,354,486**	**124**

Note: Estimates after expenditure multiplier of 1.4 has been applied.

[9]United States Bureau of the Census: http://www.census.gov/epcd/ec97/tn/TN000.HTM

[10]Table 2.6 reports over 23,000 travel-related jobs for the lake region. Netting out Sevier County leaves 7,080 jobs for the rest of the lake region. The estimated 118 jobs stemming from a delayed drawdown implies a 1.7 increase in travel-related jobs for the area.

A parallel study of the economic effects of TVA lake management policy has been undertaken that examines Fontana Lake and Swain and Graham Counties of North Carolina (Mathews, 2003). The preliminary results of this study are presented in Table 4.7. Recreation survey estimates show that 78 percent of Fontana users were nonresidents and 83 percent of additional trips due to a delayed drawdown would come from these nonresidents. There are some different assumptions in the Fontana study versus the study of East Tennessee lakes, including the assumption that recreation visits do not increase over 1990 levels for Fontana. The estimates reveal that as much as $192 thousand in income and 12 (annual) jobs would be created for the two-county area of North Carolina examined in the study due to a two-month delay in the annual drawdown.

Net Economic Impacts: State of Tennessee

The data collected in the recreation survey allow estimation of net economic impacts for the state of Tennessee as a whole. The net impacts for the state arise from nonresidents who spend money anywhere in the state in support of the their recreation activities on the East Tennessee lakes. Steps analogous to those outlined above for the lake region were used to estimate the statewide economic impacts. In this instance, use is made of RIMSII multipliers for the state economy. These multipliers help produce estimates of not only income and jobs but also increased output (i.e., the production of goods and services as reflected in gross state product) that results from increased spending. Industry-specific multipliers are used for broad expenditure categories.

Table 4.8 provides a summary of the benefits for the state economy that would accrue from a two-month delay in the drawdown. It is estimated that over $5 million in output, nearly $1.9 million in income and 100 full-time equivalent jobs would result from a drawdown delay. If all the jobs accrued in

Table 4.7: Net Economic Impact Estimates for Fontana Lake (September 1)

Nonresident trip increase	13 percent
Spending per person per day	$24.57
Increased spending, with multiplier	$356,308
Increased income	$192,406
Jobs created (annual)	12

Note: See Mathews, 2003 for Fontana estimates.

the August-September window, there would be a total of 600 jobs created for the state. Note that embedded in these estimates is a smaller amount of *net* spending than for the lake region, yielding relatively smaller impacts for the state versus the lake region. The reason is that for the lake region itself, spending by Tennesseans who live outside the area provides a source of new spending, but this same spending is not counted as *net* spending for the state as a whole. Despite a larger multiplier for the state than for the lake region, the overall effects are smaller.

Gross Expenditure Impacts

This section summarizes the estimates of gross impacts relying on the recreation survey and the survey of households on Douglas and Cherokee lakes as discussed above. Estimates of gross economic impact for the state using RIMSII multipliers are also presented.

Gross Impacts for the Lake Region: Recreation Survey

Using the lake level survey, gross expenditures on trips to a lake are also estimated. Gross expenditures attempt to capture *all* expenditures made within the thirteen county region immediately surrounding the lakes, including expenditures by people who live in the region as well as those who live outside the region. The estimated mean expenditures per person vary from $5.39 per day at Boone to $34.49 per day at Douglas as summarized in Table 4.9. In some instances, the net versus gross spending figures differ by a wide margin as can be seen by comparing the figures in Table 4.1 with the data in Table 4.9.

Table 4.8: Net Statewide Economic Impacts from Delayed Drawdown (October 1)

	Increased Output	Increased Income	Jobs Created
Net Economic Impact	$5.17	$1.89	100

Note: Dollar amounts in millions. Includes multiplier effects as captured by RIMSII multipliers.

Table 4.9: Summary of Increase in Gross Expenditures and Visitor-Days

	Gross Expenditures Per Person Per Day	2002 Visitor-Days	Percentage Increase Due to Higher Lake Levels	Increase in Visitor-Days	Increase in Gross Expenditures
Boone	$5.39	339,172	15.7	53,250	$287,018
Cherokee	31.04	678,213	15.1	102,410	3,178,811
Douglas	34.49	565,212	12.4	70,086	2,417,276
Norris	22.54	1,582,725	10.6	167,770	3,781,510
South Holston	27.58	565,259	13.6	76,875	2,120,218
Watauga	16.43	339,127	10.8	36,625	601,760
Total increase for region				**$12,386,593**	

The number of visitor-days for each lake in 2002 was calculated above. Multiplying the number of visitor-days at each lake by the average gross expenditures at each lake gives the total annual expenditures within the region. The total gross expenditures range from $1.8 million at Boone Lake to $35.7 million at Norris Lake, for a total of $99.2 million spent within the region on lake trips.

The interesting question for this study is how these expenditures would change in response to delayed drawdowns. Following a procedure analogous to the estimation of net expenditures, the total change in expenditures due to delayed drawdowns can be estimated. Gross expenditures would increase by an average of $2.0 million for the various lakes, for a total change of $12.4 million in gross expenditures due to delayed drawdowns. Summary data are offered in Table 4.9.

This $12.4 million only reflects the first round of spending in the region. Applying an expenditure multiplier of 1.4, as done above in the analysis of net expenditures, the $12.4 million ripples through the economy and creates an estimated $17.34 million in expenditures within the region. Although this gross expenditure estimate does not necessarily reflect the net creation of new jobs or new income for the region, it does offer one perspective on the magnitude of lake-related recreation in the region. The estimates of gross spending, income and jobs are reported in Table 4.10. In light of the estimates of net expenditures presented above, this result indicates that nearly $7 million in recreation spending within the region comes from local residents. Of course this understates spending by local residents since many homeowners directly access the lake from their property and these individuals were not likely captured by surveys at traditional recreation access points.

Table 4.10: Estimated Gross Economic Impacts from Recreators due to Delayed Drawdown (October 1)

Lake	Increased Spending	Increased Income	Jobs Created
Boone	$401,825	$125,253	7
Cherokee	4,450,336	1,387,214	73
Douglas	3,384,187	1,054,885	56
Norris	5,294,114	1,650,228	87
South Holston	2,968,306	925,251	49
Watauga	842,465	262,605	14
Total	**17,341,233**	**5,405,435**	**286**

Note: Estimates after expenditure multiplier of 1.4 has been applied.
Detail may not add to total due to independent rounding.

Gross Economic Impacts from Recreation: Tennessee

The RIMSII multipliers were applied to the gross spending figures from the recreation survey to estimate the statewide economic impacts of a delayed drawdown on lake-related spending across the East Tennessee lakes. As before, broad categories of spending were chosen to correspond to the categorization of the industry-specific multipliers. The estimates reflect spending by residents and nonresidents alike. Table 4.11 provides a snapshot of the estimated impacts. Increased output is estimated at nearly $29 million. Well over $10 million in income and 559 jobs statewide are estimated to accrue from a delayed drawdown.

Gross Impacts for the Lake Region: Property Owners

During the summer of 2002, a survey from The University of Tennessee was sent to a sample of 1,000 property owners on Cherokee Lake and 1,000 property owners on Douglas Lake (see Section 3 above). The purpose was to capture responses on spending (and economic value) that could not be expected from surveys at campgrounds, boat ramps, etc. Certainly people who reside on the lake make use of these facilities, but many may not. They may instead camp on their own property, use their own boat ramp or fish from their own shoreline.

As with the recreation survey, one section of the household survey focused exclusively on expenditures. Question 24 (see Appendix C) asks for property owners' estimates of their annual expenditures on activities directly related to lake use. Using the survey responses, it is estimated that property owners on Cherokee Lake spend an average of $854 annually and property owners on Douglas Lake spend $1,532 annually. These figures are reported in Table 4.12. Property owners may alter their spending patterns because of changes in lake levels, so Question 25 (again see Appendix C) asked property owners their intentions in altering expenditures due to delayed drawdowns. If lake levels remained at or near summer pool in August, it is estimated that property owners on Cherokee Lake and Douglas Lake would increase their annual spending by $62 and $148 respectively. If the lakes remained at or near summer pool until October, it is estimated that property owners on Cherokee and Douglas lakes would increase their annual spending by $67 and $172 respectively (see Table 4.12).

Table 4.11: Gross Statewide Economic Impacts from Delayed Drawdown (October 1)

	Increased Output	Increased Income	Jobs Created
Gross Economic Impact	$28.80	$10.57	559

Note: Dollar amounts in millions. Includes multiplier effects as captured by RIMSII multipliers.

Unlike the recreation survey, there are no readily available statistics on the population of homeowners on Douglas and Cherokee lakes, nor the other lakes addressed in this study. TVA did not have information on lakefront property and property assessment data were deemed to be too inaccurate to base estimates on. Based on the sample of 109 homes on Cherokee Lake and 204 homes on Douglas Lake, the average annual expenditures translates to total annual spending of $93,086 on Cherokee Lake and $312,528 on Douglas Lake. Based on the household survey responses to Question 25 and the above sample sizes, average annual spending would increase by $6,758 on Cherokee Lake and $30,192 on Douglas Lake if the lakes remained at or near summer pool until September. If the lakes remained at or near summer pool until October, average annual spending would increase by $7,303 at Cherokee Lake and $35,088 at Douglas Lake. These figures are also reported in Table 4.12.

The household spending estimates can be added to the estimates of gross impact from recreators presented above. Problematic is extending estimates from the small sample of properties considered here to all lakefront property. Assuming the sample used in this study is representative of all households and, for purposes of illustration, assuming 1,000 lake parcels on Douglas Lake, the total gross homeowner impact for this lake would be $172,000. Similarly, for 1,000 homes on Cherokee Lake, the gross spending impact would total $67,000.

Estimates of income and jobs resulting from household spending, inclusive of multiplier effects, can be easily calculated. For each 1,000 homes on Cherokee Lake it is estimated that only $29,238 in income and about 1.5 full-time-equivalent jobs would be supported by increased household spending due to a two-month delay in the drawdown. For Douglas Lake the results are somewhat larger, representing $75,060 in income and 4.0 jobs. These estimates are all very small. One possible explanation is that people are already spending on assets like boat docks and property improvements to enjoy recreation and a delayed drawdown simply would not change this type of spending in a significant way. Similarly recreation spending related to fishing, swimming, etc. simply may not increase.

Table 4.12: Expenditures of Property Owners

	Cherokee	Douglas
Mean Annual Expenditures	$854	$1,532
Average Increase if Drawdown delayed until September	62	148
Average Increase if Drawdown delayed until October	67	172
Total Increase if Drawdown delayed until September	6,758	30,192
Total Increase if Drawdown delayed until October	7,303	35,088

It is also important to note that these gross impact estimates do not reflect how changes in lake levels might change the number of homes and properties developed on the lakes. This could give rise to significant impacts for the regional economy through increased construction activity. This would in turn boost the local sales and property tax bases significantly. But like the recreation survey, the research here can only reflect current lake users, not those who may choose to use and live on the lake in response to a delayed drawdown. Moreover, the estimates can give the false impression that lakefront property owners are not influenced by the drawdown. This is not necessarily the case, as spending, income and jobs cannot reflect the degree of psychic satisfaction associated with scenic views and the quality of a recreation experience. Capturing these latter effects is the reason economic *value* analysis is employed later in this study.

5. Economic Value Estimates for Recreators and Households

This section of the report presents estimates of economic value associated with delayed drawdowns on the East Tennessee lakes. For recreators, the estimates of economic value are based on survey response data; for households, reliance is placed on both survey response data and on a statistical analysis of the relationship between home values and lake levels for separate samples of households on Douglas and Cherokee lakes. The first major section below provides background on the methods used to elicit measures of economic value through analysis of recreator and household survey data using the tools of *choice modeling* and *contingent valuation*. Both of these tools rely on survey respondent's *stated preferences* for changes in lake levels. The second major section explains the *hedonic price model*, which is used to estimate economic value for homeowners based on *revealed preferences*, i.e., actual home buying patterns.

Economic Valuation

To elicit economic value from recreators and households using surveys, individuals are asked to balance the gain in welfare they experience due to an increase in lake levels on East Tennessee lakes against the loss in welfare they experience due to an increase in electricity rates (for in-state residents). Electricity rates are used as the cost or *price* of higher lake levels for two reasons. First, TVA maintains that its system is optimized to balance all of the service flows for which it is responsible, including electricity generation. Any deviation from optimal operation, in this case maintaining higher lake levels during the peak demand season of August and September, results in foregone revenues. Thus, it is assumed that any revenues lost due to decreased power generation would have to be offset by an increase in electricity rates. Second, it is important for survey respondents to confront a realistic measure of the cost that would be associated with enjoying an increased flow of amenities, in this case greater recreation use and improved aesthetic views. Absent a measure of cost, survey respondents may overstate the benefits derived from a change in lake levels.

Economic theory assumes that if an individual is considering the maximum willingness to pay (WTP) for a policy change, this maximum would be the amount that makes the individual just indifferent between the old policy and old electricity rates and the new higher lake level and the corresponding higher electricity rates. This is illustrated in Figure 5.1. For changes in environmental service flows such as those considered here, willingness to pay provides a measure of the change in economic value. This change in economic value is called *consumer surplus* by economists.[11] Technical details of the consumer surplus measurements used are presented in Appendix E.1 and in the references cited below.

The concept of consumer surplus is endorsed as the appropriate measure of

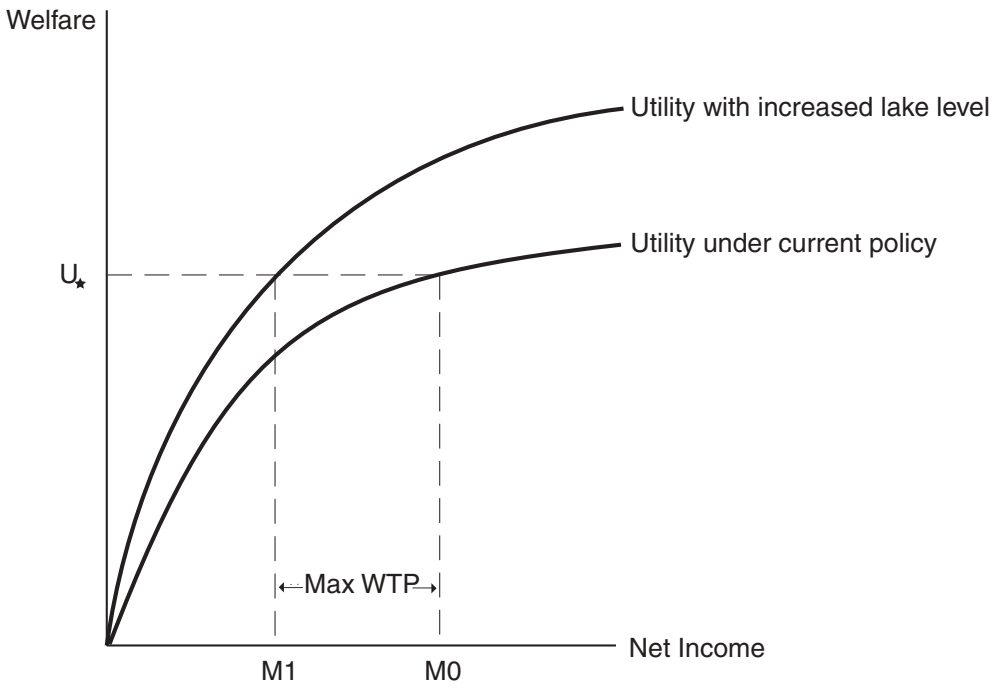
[11]See Stewart, Kahn and Jakus. The concept of consumer surplus is a broad term encompassing five regularly used measures of value including consumer surplus, compensating variation, compensating surplus, equivalent variation, and equivalent surplus (Freeman 1993). Compensating surplus measures are used here. Consumer surplus is technically the maximum willingness to pay minus price, but the direct price of environmental service flows (there is no market for lake level changes) is typically zero. Price effects are handled through the payment mechanism discussed in the text.

change in economic wellbeing by the report the U.S. Water Resources Council in 1983, drafted to guide decision making for federal agencies under the Water Resources Planning Act. In addition, the U.S. Environmental Protection Agency suggests that consumer surplus measures should be used when calculating the economic benefits and costs of environmental regulations (U.S. EPA).

Stated versus Revealed Preference

Economists use two broad classes of valuation instruments to measure the value of environmental and recreation resources to society: revealed preference and stated preference approaches. Revealed preference approaches (RP) are based on the observation of actual behavior and are used to infer value for environmental changes by examining the costs (monetary and otherwise) incurred that are related to the behavior. Examples of revealed preference approaches include the travel cost method, the hedonic price method, and averting behavior models. The hedonic price model, discussed more fully below, is used to provide alternative estimates of economic value for households.

Figure 5.1: Conceptual Illustration of the Economic Value of Higher Lake Levels



Stated preference approaches (SP) are based on survey techniques that ask individuals how they would respond to hypothetical situations. In particular, SP approaches typically require individuals to respond to questions about willingness to pay for potential changes in environmental quality. Stated preference techniques include contingent valuation, conjoint analysis, choice modeling, and contingent behavior. This study uses choice models (CM) and open-ended contingent valuation approaches (CVM) to estimate economic value.

Choice Modeling Framework

The choice model, a variant of conjoint analysis, elicits preferences by asking one to consider a series of policy options (Ben-Akiva and Lerman and Louviere et al.). Each policy option considered consists of attributes, including changes in environmental quality, and cost. In contrast to CVM, which asks individuals to explicitly state their willingness to pay for a proposed policy change, choice models require the individual to choose from a series of possible policies, each having different levels of the attributes. In the current context the attributes might include lake levels, fish stocking, artificial habitat, and cost. This allows the researcher to obtain the *marginal value* individuals place on the attributes, as well as allow the estimation of willingness to pay for any policy that has attributes contained within the span of attributes presented in the survey. Both the CVM and CM models utilize what is called a *random utility framework (RUM)* to explain individuals' preferences for alternative hydrological/economic profiles and are directly estimable from CM and CVM data (Roe et al. and Stevens et al.).

CM asks questions that may be more familiar to individuals. Individuals are asked to choose from possible policies according to the level of attributes each policy has. This can be as trivial as individuals choosing between brands of potato chips, each having many different sizes, flavors, packaging and costs. It also can be as complex as choosing between houses that have different characteristics such as lot size, number of bedrooms, scenic views, school district quality, location and price, and carry a significant financial commitment. In the case studied here individuals are asked to choose between TVA lake level polices, each having a different September 1 level and associated cost.

Figure 5.2 depicts an example choice question from the recreation survey. The subject is presented with background information about TVA, its objectives, and current lake-level management goals. The individual is presented with information linking TVA's lake-level policy with his or her current electricity rates (for state residents), and a suggestion that alteration of TVA's lake level policy will lead to higher electricity rates. Next the subject is presented with six choice sets, each of which is comprised of three options. Each option is a

Figure 5.2: Example Choice Question from the Recreation Survey

Background Information on TVA's current management of East Tennessee Lakes:

-- Tennessee Valley Authority was established to provide flood control, navigation, and electric power in the Tennessee Valley region.
-- TVA tries to balance these competing needs, along with economic development, recreation, and environmental quality.
-- Currently, TVA tries to keep lakes at full pool from June 1st through August 1st.
-- TVA begins draw-downs at TVA lakes on August 1st at reservoirs in the upper portions of the river system to provide flood control and hydroelectric power.
-- TVA is now considering adjusting its August 1st draw-down patterns

In the next few questions, we want you to consider some alternative September 1 levels.

Resident:

In order to maintain higher water levels for this extra month, TVA would have to sacrifice hydropower generation. As a result, average electricity rates in the TVA service area would have to increase. Now we would like to ask for your input on alternative policies.

In answering the following questions, keep in mind that any additional money that you spend on your electricity bill means that you will have less money to spend on other goods and services that may be important to you.

13. Choice Set Analysis -- Version C

	Option 1	Option 2	Option 3
Light Tan			
Average Lake Level September 1	15 ft above normal	5 feet above normal	normal September 1 level "Business as Usual"
Change in Cost	$75/year	$50/year	$0/year
	☐ 1	☐ 2	☐ 3
Blue			
Average Lake Level September 1	10 ft above normal	5 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$10/year	$5/year	$0/year
	☐ 1	☐ 2	☐ 3
Yellow			
Average Lake Level September 1	25 ft below normal	40 ft below normal	normal September 1 level "Business as Usual"
Change in Cost	$0/year	$0/year	$0/year
	☐ 1	☐ 2	☐ 3
Grey			
Average Lake Level September 1	20 ft above normal	10 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$100/year	$5/year	$0/year
	☐ 1	☐ 2	☐ 3
Green			
Average Lake Level September 1	20 ft above normal	10 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$50/year	$25/year	$0/year
	☐ 1	☐ 2	☐ 3
Purple			
Average Lake Level September 1	20 ft above normal	15 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$75/year	$25/year	$0/year
	☐ 1	☐ 2	☐ 3

combination of two attributes: *Average Lake Level* and *Change in Cost*. As used here, change in cost represents the increase in the average yearly expenditure on electricity for residents and the cost of a *Lake Pass* for nonresidents. Each of the three options represents different combinations of *lake level* and *cost*. Option 3 represents the *cost* and the *lake level* under the current policy. The individual is asked to consider each of the three policies and then choose the most preferred option. The subject is presented with this task a total of six times.

One of the frequently mentioned advantages of CMs is that they directly provide marginal values for attributes like lake levels as well as WTP for policies that have multiple effects. In contrast, CVM studies are designed to obtain the value for a single policy change – that policy can represent a change in a single attribute (WTP for higher lake levels) or multiple attributes (higher lake levels that provide better fishing, boating, and picnicking). In this study, use is made of a CM and a CVM to directly value the broad policy of lake level changes. Louviere et al. provide an excellent introduction to the choice modeling technique.

Contingent Valuation Framework

CVM is a survey-based approach that estimates the value of an increase in environmental quality or quantity based on how individuals respond to a question about willingness to pay to obtain the change. While CM analyses are gaining widespread popularity in environmental economics, CVM is the standard method used in stated-preference studies. CVM has been in use since the seminal work of Davis in 1963.[12] Research on CVM accelerated during the 1970s and the use of CVM techniques became widespread by the early 1980s. The merits of CVM have been widely debated (NOAA and Portney), but CVM has become a valuation technique that has received the full burden of scientific investigation and provides estimates as accurate as those from revealed preference studies. The use of CVM has been written into law as a tool to measure economic loss in environmental damage cases, the Exxon Valdez oil spill being the most famous, and has gained wide use as a tool to measure benefits in federal projects (U.S. Water Resource Council and U.S. EPA). See Mitchell and Carson and Diamond and Hausman for background on CVM.

An open-ended CVM question is used here as a follow up to the CM. This allows a point of comparison for the CM analysis and allows respondents to provide values outside the $0-$100 cost rage provided in the CM survey.[13]

Estimation Results: Choice Model

The choice model uses two explanatory variables to predict which of the presented lake levels individuals are likely to choose. The first variable (FEET) measures the change from historical median lake levels on September 1. The

[12]The use of "direct interview methods" was first suggested as a means of measuring the value individuals place on natural resources by S.V. Ciriacy-Wantrup in 1947.
[13]The open-ended CVM responses are conditioned by the subject's exposure to the CM questions that precede it. We acknowledge that the CVM values presented may be different than those that would be obtained in a stand-along CVM, but we do not believe that they would significantly differ.

second variable is the annual increase in expenditures on electricity or the *Lake Pass* (COST) to pay for the change in lake-level policies.[14] Estimates are presented for the East Tennessee lakes other than Ft. Patrick Henry; estimates for Fontana Lake based on the companion study noted elsewhere in this report are also presented.

Economic theory predicts that individuals desire higher lake levels if indeed higher levels are a "good" that provide personal satisfaction.[15] It would be expected that FEET would be positively related to the likelihood of an individual choosing a lake level policy. In contrast, individuals would be expected to be less likely to choose policies that have higher levels of COST associated with them.

The detailed results of the analysis (based on the conditional logit model) of the CM data are presented in Appendix E.2. The models are very robust, i.e. the results are largely stable and consistent across lakes and estimation techniques. For each of the lakes, all variables take on their expected signs and the joint explanatory power of each model is very good (as indicated by high pseudo R^2 measures of goodness of fit).[16] The variable COST is negative and highly significant in each model, suggesting that survey participants were less likely to choose costly options. The variable FEET is positive and highly significant, indicating that options having higher September 1 lake levels were more likely to be chosen than those having lower levels. The variables labeled ASC1 and ASC2 are similar to constant terms in linear regression models and serve to incorporate systematic behavior that is unexplained by the measured variables. The variables ASC1 and ASC2 are negative and significant, which indicates individuals were less likely to choose options one and two in the choice set. This result is not uncommon in the choice model literature and indicates that there is a bias towards the status quo. It suggests that people are generally content with the way things are now and are reluctant to change unless the gains from change (increased lake level) significantly outweigh the costs (increased annual fees).

Table 5.1 CM Welfare Results: Willingness to Pay, Full Pool to September 1

	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga	Fontana, NC
FEET (above historical August 31 median level)	5 ft	16 ft	13 ft	12 ft	15 ft	15 ft	21.2 ft
WTP	$20.28	$120.34	$146.53	$64.44	$86.29	$95.74	$66.61

Note: See Mathews, 2003 for Fontana estimates.

[14]There is a debate in the literature regarding the appropriate unit of measurement for consumer surplus should be the individual or the household (Quiggin 1998). We use the household here because it makes the most sense given the method of financing lake level changes, namely changes in *household level electricity expenditures*. Quiggin (1998) finds that household WTP is less than the sum of the WTPs of the individual household members.

[15]In initial informal discussions with lake users, some users, fishermen especially, indicated that they would prefer lower levels. Most however, preferred higher levels to lower levels.

[16]The pseudo R^2 measures range from .19 to .31, which are very good for cross-sectional data such as this.

The estimation results are used to obtain economic value or surplus measures as outlined in Cameron, Hanemann, and Louviere et al. Table 5.1 presents the calculated willingness to pay measures for feasible September 1 lake-level policies. The measures in the row labeled FEET represent increases over the historical September 1 level. For example, the historical median September 1 level at Cherokee is approximately 16 feet below full summer pool. The full-pool policy results in a compensating surplus measure of $120.34. That is, based on survey responses for the "average" respondent from Cherokee Lake, the choice model estimates indicate that he/she would be willing to pay $120.34 in increased electricity expenditures or the *Lake Pass* to keep full pool for one additional month. The values across columns in Table 5.1 are not directly comparable because each lake has a unique historical drawdown, so the policy for each lake measures a different magnitude of drawdown. At the same time all the values are comparable in that they measure the value of a policy of keeping each lake at full pool for an additional month. The values in Table 5.1 are estimated using the choice model based on the survey data. The willingness to pay measures range from $20.28 for a 20ft increase for Boone to $146.53 for a 13ft increase on Douglas. A unique feature of the choice model is that a single survey can be used to examine multiple policies. Table 5.2 presents the CM estimates of holding full pool through October 1.[17]

Finally, in order to facilitate a comparison between the marginal value of a given amount of water at TVA lakes, we present the value for a 10ft increase over historical September 1 levels in Table 5.3. The value is highest for Douglas ($112.72) and lowest at the companion study site Fontana ($31.42).

Table 5.2 CM Welfare Results: Willingness to Pay, Full Pool to October 1

	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga	Fontana, NC
FEET (above historical September 30 median level)	6 ft	24 ft	24 ft	21 ft	21 ft	16 ft	31.4 ft
WTP	$24.33	$180.51	$270.52	$112.77	$120.80	$102.12	$98.66

Note: See Mathews, 2003 for Fontana estimates.

Table 5.3 CM Welfare Results: 10 Foot Increase in Pool to September 1

	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga	Fontana, NC
FEET (representative 10 ft increase)	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft	10 ft
WTP	$40.55	$75.21	$112.72	$53.70	$57.52	$63.83	$31.42

Note: See Mathews, 2003 for Fontana estimates.

[17]The welfare measures presented in Table 5.2 represent conservative estimates. Because the wording in the survey asked individuals to consider the various average lake levels on September 1, the measures presented in Table 5.2 really represent the value of an additional 30 days at full pool (September 1) but with the reference historical lake level that occurred on October 1. Using Cherokee as an example, the theoretically correct measure would consist of two components: the value of moving from reference to full pool from August 1- September 1 (+16ft) plus the value of reference to full pool from September 1-October 1 (+24ft). Here we measure the 24ft as if it applies for the month of August.

Estimation Results: Contingent Valuation Model

Considered next are the results of an alternative means of measuring value, the contingent valuation method. All of the surveys contained a follow up question that was designed to meet three goals. The first was to have a point of comparison for the CM estimates. The second was to directly inquire about the value of a policy of full pool for two months. Third was to have a means of incorporating socio-economic information as explanatory variables in the analysis. It is important to note that the CVM response is conditioned by the responses of the CM that precede it in the survey instrument. A stand-alone CVM survey would likely provide different results (although they would not likely differ by an order of magnitude) because the survey instrument would have been specifically designed for the CVM task. The surveys administered as part of this study were designed to meet the needs of a CM first; the CVM question only provides corroborating evidence.

The open-ended CVM data are analyzed with specialized statistical tools (the Tobit model) that recognize that many individuals were not willing to pay for a lake level change (i.e., the data are *censored* at zero) while others were willing to pay positive amounts. The empirical model specifies willingness to pay as a function of household income, whether the respondent owns a boat, and the income of the individual. This specification was chosen because we wanted to provide one specification (set of explanatory variables) of the CVM model for all of the lakes. This particular specification provided the best fit when all of the lakes were considered as a whole. Other model specifications that included additional demographic variables and interactions were tested but were found to be inferior to this model when applied to all lakes.[18]

Appendix E.3 presents the estimates for the CVM data for each of the six Tennessee lakes. Following Cummings et al., among others, consumer surplus (i.e., economic value) can be estimated from the open-ended CVM data. Table 5.4 presents consumer surplus results from the CVM. Values provided are in response to the question: "What is the most you would be willing to pay per year to keep lakes at their full pool level until September 1?" Notice that with the exception of Boone, the CVM consumer surplus results are lower than those for the CM exercise presented above. The discrepancy between the CM and CVM

Table 5.4 CVM Results for Program to Keep Full Pool to October 1

CVM Values	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga
Mean WTP	$33.59	$64.09	$71.44	$53.95	$69.87	$45.41
Median WTP	$32.34	$60.86	$70.82	$52.80	$66.81	$38.87

[18]Unique specifications of the WTP for each lake generally lead to more robust coefficient estimates, but similar WTP results.

consumer surplus measures is not uncommon.[19] These results should be seen as evidence that both models capture the values that they purport to measure, but we wish to emphasize that we put more faith in the CM data because the surveys were expressly designed for the CM format.

Estimation Results: Contingent Valuation Method for Households

Because those living on Tennessee lakes are less likely to use public boat ramps and campgrounds where our survey efforts were focused, and lake residents may use and value the lakes in a different way than the general public, we created a separate survey to measure consumer surplus and economic impacts for lake residents. An attempt was made to measure economic value for those living on or near Tennessee lakes in a parallel fashion to the recreation survey. (See the discussion of the household survey in Section 3.) The survey employed CM and CVM questions, but the CM model failed all of our tests of robustness, so here we focus on the CVM data. Many specifications of the CM were tested, but ultimately the household CM modeling failed due to low predictive ability of the models. No model specification was found that had adequate statistical ability. Moreover, it appeared that many survey respondents tended to choose options that had the highest lake level, regardless of the cost of the option. This leads to inconsistencies between choices that subjects made, which then lead to violations in the law of demand - that quantity (here lake level) is a *decreasing* function of price. Thus the model could find no consistency between the attributes presented, individual characteristics, and individuals' choices. Regression output and descriptive statistics for the household CVM estimations are also provided in Appendix E.3.

Note that the CVM estimates presented in Table 5.5 are higher for both lakes than the estimates of recreators' values presented in Table 5.4. The difference is to be expected: lake property owners see gains for every day that lake levels are higher while recreators only see gains when they visit the lake. Furthermore, lakeside property owners may benefit from higher property values as well. We wish to make it clear that the values in Table 5.5 are not representative of TVA ratepayers, only those ratepayers who own property on or very near Cherokee and Douglas lakes. They should not be used to make inferences to the values that the general population may hold.

Table 5.5: Household CVM Results for Program to Keep Full Pool to October 1

CVM Values	Cherokee	Douglas
Mean WTP	$129.47	$94.62
Median WTP	$124.33	$88.44

[19]Various reasons for the disparity have been offered: CVM derives WTP from response to a single question while CM is iterative (Takatsuka); presentation of alternative policies in the CM formats suggests substitute (alternative) policies not available in CVM (Boxall et al. and Ready et al.); CM allows explicit recognition of complements that CVM may not; and the increase in statistical power of the conjoint methods may further explain the differences (Stewart, Takatsuka and Kahn).

Weighted Measures of Welfare

To extend the results of our sample of lake users to the population of users of Tennessee lakes we must make some assumptions about how households, the unit of measure in the CM surveys, relate to the population of all potential users of Tennessee lakes. To make this estimate, data are drawn from the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation to infer the number of households embedded in the population of recreation users on the East Tennessee lakes. A weighted-average of non-duplicated people relative to visitor days for anglers and for wildlife observation is used. This weighted average is 11.3 percent, i.e., just over 11 percent of all visitor days are accounted for by non-duplicated individuals. The rather strong assumption is made that each person represents a non-duplicated household. In practice this will yield an overestimate of actual households. The 11.3 percent figure is then applied to the total visitor days for the lakes under consideration to estimate the number of households. In practice this implies that for every 100 visitor-days, there are about 11 families that are engaged in recreation activities. Coupled with the estimates of welfare per household per lake, this produces a measure of economic value for the aggregate population of recreation users for each lake and for all lakes combined. While we place greater faith in the household-level estimates of value taken from the recreation survey without adjustment for the population, it is necessary to infer from the sampled recreators to the population of all of those who currently use the six TVA lakes in question. Table 5.6 provides adjusted welfare estimates for each of the six TVA lakes in Tennessee, Fontana in North Carolina, and a measure for the total of all Tennessee TVA lakes for a policy that maintains full pool until September 1.[20] The Tennessee total of $39.7 million represents the net gain in welfare for the region *each year* assuming that all lakes are held at full pool until September 1. Table 5.7 presents the regional welfare changes for the policy of holding all lakes at full pool until October 1.

Hedonic Price Estimates of Value for Households

The quality of life for individuals who own property adjacent to the lakes in the study region is affected by TVA's water level management policies in two obvious ways. During the summer months when water levels are at full pool

Table 5.6: Net Gain in Economic Value for Current Recreators: Full Pool to September 1

	Boone	Cherokee	Douglas	Norris	S. Holston	Watauga	Fontana, NC
FEET (above historical August 31 median level)	5 ft	16 ft	13 ft	12 ft	15 ft	15 ft	21.2 ft
Welfare Gain	$770,382	$9,141,009	$9,275,898	$11,422,969	$5,462,934	$3,636,418	$1,686,704
Tennessee Total				**$39,709,610**			

Note: See Mathews, 2003 for Fontana estimates.

[20]The welfare measure presented is for the CM data. We place greater faith in the CM data obtained in the recreation survey and thus use those to provide the welfare change measures.

(approximately 3 months of the year), property owners enjoy a bundle of recreational and environmental amenities generated by the presence of the lake. Many property owners have built private docks from which they access the lake with boats and personal watercraft, while others simply access the lake directly from the shoreline. During the summer, lakefront property owners as well as individuals with property within sight of the lake enjoy an array of water views. When water levels are lowered during the winter months, access to water may be impeded and views of the lake may be dramatically changed. Some property owners may find it costly to access the water from their docks, while others may find it completely impossible when levels fall. Those who access the water directly from the shoreline may be forced to hike across several feet of mud before reaching the lower pool. Lower water levels tend to decrease the quality of lake views by exposing additional shoreline that usually lacks aesthetic appeal. The specific nature of the winter view from a particular parcel of property depends on the topography of lakefront land and the contours of the lake bottom. Parcels of land adjacent to areas of the lake that are fairly deep will still have a view of the lake, but that view may be tarnished by a ring of mud around the waters' edge. Parcels of land adjacent to shallow areas of the lake see more drastic changes in their view as the area that was once lake turns into a mud flat that may extend several hundred feet. In fact, it is not particularly uncommon for the lake to be out of view from some parcels during several months of the year.

As discussed above, recreation and lake views are not individual commodities that can be traded in markets as can automobiles, stocks, and clothing, and as a result they have no direct market price to reveal their value. Instead the value of such goods must be derived through non-market valuation techniques. A parcel of property can be thought of as a bundle of amenities, which includes features of the land, structure, neighborhood and environment. Each of these features contributes either positively or negatively to the value of the entire bundle (in this case the parcel of property). For example, property near high-quality public schools may have greater market value than comparable property near a poor-quality school. Similarly, property near a landfill – a disamenity – may have a lower market price. The value of the amenity (school)

Table 5.7: Net Gain in Economic Value for Current Recreators: Full Pool to October 1

	Boone	Cherokee	Douglas	Norris	S.Holston	Watauga	Fontana, NC
FEET (above historical September 30 median level)	6 ft	24 ft	24 ft	21 ft	21 ft	16 ft	31.4 ft
Welfare Gain	$924,230	$13,711,514	$17,124,929	$19,990,197	$7,647,728	$3,878,745	$2,498,276
Tennessee Total				**$63,277,342**			

Note: See Mathews, 2003 for Fontana estimates.

or disamenity (landfill) is said to be "capitalized" into the value of the property.

Intuitively, one would expect the recreational and aesthetic benefits that individuals enjoy by living in close proximity to the lake to be capitalized into property values. Assuming all other characteristics were the same, properties with water access and views of the lake generally would have higher values; properties with better winter views would also have higher values. Similarly, one would expect the values of lake properties to increase if drawdown is delayed as individuals could then enjoy recreational and aesthetic benefits for an extended period of time. The increase in property values is a reflection of increased *economic value* for the landowners, the region and the nation. It is this line of reasoning that supports a systematic study of property values and lake levels to derive the economic value of a delayed drawdown accruing to property owners.

Relevant Literature

A rather large body of literature developed over the past several decades has provided estimates of the value of attributes associated with water resources such as water quality, water quantity, lake-frontage, lake views and proximity to the water. A summary of the most recent research directly related to the issue of delaying drawdown is presented in Table 5.8. This literature falls under the umbrella of a much larger literature on non-market valuation that estimates the economic values of environmental and resource amenities that are not traded in market settings such as air quality, wetlands, forest services and endangered species.

The general conclusions that emerge from this body of literature include positive premiums for lake-frontage, views and proximity. The premium for lake-frontage ranges from 72 percent (Lansford and Jones) to 125 percent (Benson et al.) relative to similar homes with no lake frontage. Properties with a view of the lake received a premium between 8 percent (Parsons and Wu) and 18 percent (Benson et al.) compared with similar homes with no view. Parsons and Wu also measured the distance from a home to the water and found the sales price negatively related to distance.

The primary focus of the first three studies in Table 5.8 was the impact of water level changes on property values. The studies differed in the specific water level management scenarios they evaluated; however, they all came to the same general conclusion, that lower water levels lead to lower property values. Hanson et al. analyzed the impacts of several management scenarios in the Alabama-Coosa-Tallapoosa and Apalachicola-Flint-Chattahoochee River basins. Their results suggested a positive relationship between permanent changes in both summer and winter pool water levels. A permanent one-foot reduction in the summer full-pool water level resulted in a 4 to 15 percent decrease in property

values, while an eight-foot vertical increase in the winter water level resulted in a 19 percent increase in property values. Khatari-Chhetri and Hite looked at the impact of drawdowns on the sales price of vacant lots on Lake Keowee, South Carolina and estimated that each vertical foot of drawdown decreased property values by $8,454 per acre. Finally, a study by Lansford and Jones examined the impact of deviations in lake-levels on sales prices of homes near Lake Travis in Texas. Lake drawdown was found to have a statistically significant negative impact on the sales price. Specifically, the impact of a six-foot drawdown was approximately $9,492.

Table 5.8: Recent Literature on the Impacts of Water Views, Water Levels and Proximity to Water on Property Values (All Values in 2002 Dollars)

Authors	Policy Evaluated	Empirical Results
Hanson et al.	Impact on property values of alternative water level management policies	As summer full-pool duration was decreased, lakefront property value decreased, and as duration increased property values increased but at a smaller absolute rate. Permanent one-foot reductions in summer full-pool water levels resulted in a 4 to 15 percent decrease in property values. Permanent eight-foot increase in winter pool water levels resulted in a 19 percent increase in property values.
Khatari-Chhertri an Hite	Impact on sales price of vacant lots of lake level draw-downs	Sales price negatively related to draw-down at time of sale. Draw-downs valued at $8,454 per acre per foot of draw-down.
Lansford and Jones	Impact on sales price of lake level draw-downs	Waterfront property has a 72 percent premium (mean sales price $159,200). Lake view from property has 9.6 percent premium. Water level at time of sale is worth about $914 per foot of elevation. Average home worth $9,492 more when lake is full, relative to a sale when lake is down six feet.
Parsons and Wu	Impact of costal land use regulation on housing value	Mean sales price was $181,341. Value declines by $4,175 per mile from water. Water frontage has 73 percent premium relative to no water frontage. A view of water has 8.1 percent premium.
Benson, et al.	Impact of proximity to water on housing values	Lake front home gets 126 percent premium vs. house with no frontage or view (mean sales price $99,578). Lake view adds 18.1 percent relative to no view.

Property Value Analysis

The drawdowns associated with the water level management scenarios evaluated in the studies cited in Table 5.8 pale in comparison to the 20 to 55-foot drops that occur at TVA lakes in the upper Eastern portion of the Tennessee River System and so are not directly comparable. Thus, it would not be wise to attempt to use these impact estimates from other lakes to derive economic values of delaying drawdowns. To calculate values for property owners on Tennessee lakes, this analysis is conducted for a sample of properties on two specific lakes in the region.

A survey of property owners on both Cherokee and Douglas lakes (see the discussion above) revealed that an overwhelming majority (91 percent) of those with direct lake access and a view of the water believed the value of their property would increase if water levels remained at summer pool in August and September. Of the remaining respondents, approximately 8 percent believed there would be no change in the value of their property, while only 1 percent thought the value would decrease. When asked to provide a dollar estimate of the effects of delaying drawdown on property values, on average property owners believed that the value of their property would increase by nearly $38,000. While this estimate is based on the subjective opinion of property owners who are likely not experts on property appraisals, the provided figure does fall within the range of the literature cited above. The statistical analysis that follows provides a more objective estimate of the effects of delaying drawdown on property values.

The specific objective of this portion of the analysis is to determine how proposed changes in drawdown affect property values. To this end, data from county property assessment records obtained from Courthouse Retrieval System Inc. are used.[21] The data file contains parcel-specific information on appraisal value, land and structural-improvement characteristics for lakefront parcels surrounding Cherokee and Douglas lakes. Data on the distance to winter pool for each individual property, calculated using geographic information technologies, were matched to the assessment records. There were a total of 148 parcels on Cherokee Lake with residential structures and complete data records and 218 on Douglas Lake. Unfortunately the results of this analysis cannot be extrapolated to other properties on Cherokee and Douglas, nor can they be transferred to properties on other lakes. To do so would require detailed information on the distribution and characteristics of all the properties on each of these lakes. Both time and budget constraints make collecting this information infeasible for this analysis.

The strategy of this analysis is heavily dependent upon the distance to winter pool measure as it is the only variable in the data that uniquely reflects the

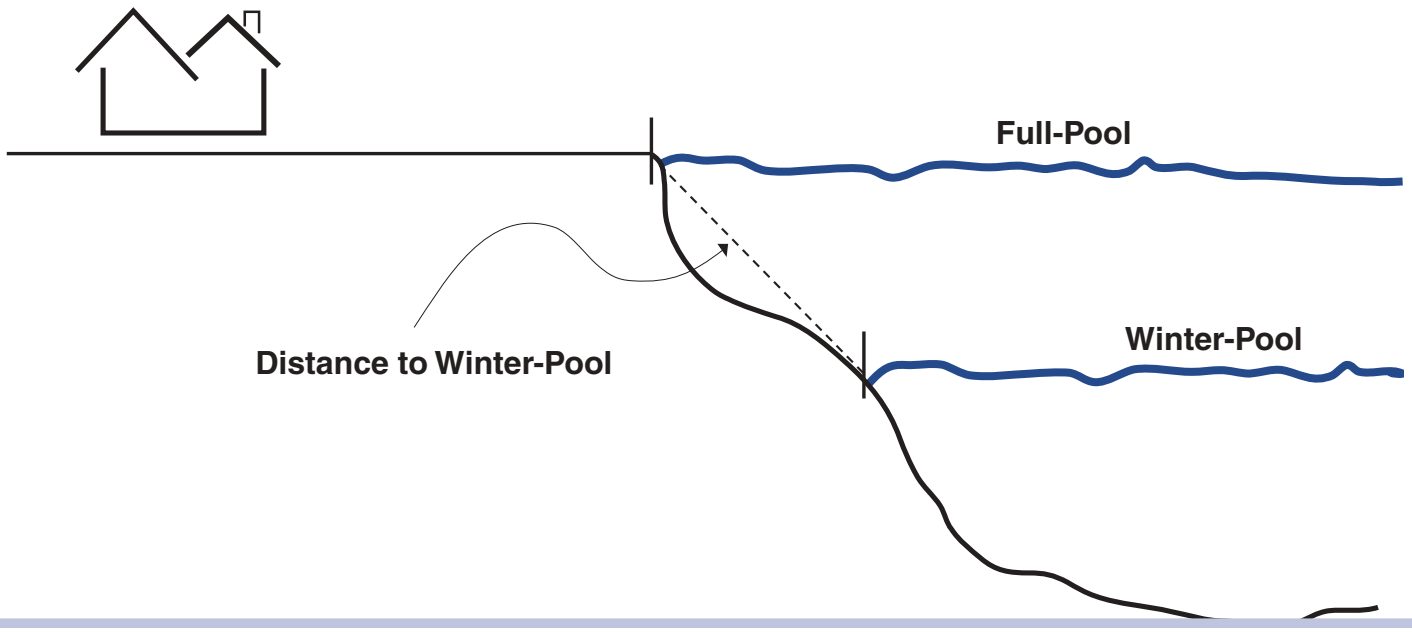
[21]TVA graciously provided access to this data, calculated parcel specific distance measurements and assisted our understanding of the various attributes reported in the data. The University of Tennessee research team also met directly with representatives of Courthouse Retrieval System Inc. to discuss the data.

effects of drawdown on individual parcels. A statistical analysis will be used to determine the effects of variation in distance to winter pool on property values. This estimate will then be used along with actual distance measurements to calculate the total effects of drawdown for the parcels in the sample. The total effect is allocated across the nine-month drawdown season to estimate the benefits of delaying drawdown for one and two months respectively. In this analysis no account is taken of changes elsewhere in the TVA system that might follow from a change in lake management policy that might further enhance or potentially reduce property values.

As illustrated in Figure 5.3, the distance to winter pool variable measures the length (in feet) of a line drawn from the full pool shoreline to the winter pool contour for each parcel of property. The winter pool minimum elevation is constant for each lake (1030 and 945 feet above sea level for Cherokee and Douglas respectively).[22] However, the distance to winter pool will vary for different parcels on the same lake as contours (i.e. the slope of the bank) of the lake bottom differ from one area to the next.

Table 5.9 provides preliminary evidence suggesting a negative relationship between distance to winter pool and a parcel's appraisal value. It shows that the average distance to winter pool from the parcels used in this analysis is decreasing as appraisal value increases. However, no final conclusions about the effects of drawdown on property values can be made from this result alone as it fails to

Figure 5.3: Measuring Distance to Winter-Pool



[22]These estimates were derived from TVA's operating guide curves and represent the median winter pool lake level for the years 1991 to 2001.

consider the effects that other characteristics (which may be related to the distance to winter pool) may have on the value of lake parcels. Nor does this preliminary result provide a systematic method for determining the economic value of the drawdown for property owners. To accomplish these goals, this analysis employs the hedonic price model, a statistical application that provides the bases for much of the literature on valuing water resources. For background on this model, see Freeman.

The hedonic price method provides a statistical technique for allocating the value of a parcel of property across its various characteristics. The price paid for a particular parcel of property is determined by characteristics such as the size of the lot, the size of the house, age of the house, the number of bedrooms, bathrooms, fireplaces, the quality of the surrounding view, etc. The hedonic price model generates an *implicit marginal price* for each characteristic used in the model. In other words, it estimates the increase in the property value for an additional unit of each characteristic while holding all other characteristics constant. Again, these characteristics could include features of a home, other dwellings like barns or garages, or attributes of the lake reflecting accessibility and aesthetic view.

To understand the basic intuition behind an implicit marginal price, imagine a housing market with many buyers competing over a fixed number of houses. Suppose there are two houses for sale with identical characteristics except for the fact that one house is located on two acres of land while the other house is located on only one acre. If it is assumed that individuals value having more land, competition between buyers will bid up the price of the first house until the difference in the price of the two houses just equals the buyer's willingness

Table 5.9: Average Distance to Winter Pool by Appraisal Value

	Distance (values in feet)	
Appraisal Value	**Cherokee**	**Douglas**
Less than $100,000	1,629	2,520
$100,000 - $149,999	283	1,348
$150,000 - $199,999	252	1,496
$200,000 - $299,999	237	1,214
$300,000 or more	224	990

to pay for an extra acre of land. Thus the differences in the prices of the two houses will necessarily reflect the value of an additional acre, or in other words the *implicit marginal price* of an acre of land. One could imagine a similar scenario that would illustrate the implicit marginal price of an additional foot to winter pool (except in this case one would expect that price to be negative).

A separate relationship was estimated for the Cherokee and Douglas parcels respectively to reflect the different housing markets and different features of the respective lakes. The property characteristics that were controlled for in this statistical application are presented in Table 5.10. Implicit marginal prices for an additional foot to winter pool were calculated using the results from the estimation and are presented in Table 5.11. Given the estimation technique, the implicit marginal price of any single characteristic of a parcel is a function of all the characteristics for the parcel that are used in the model. Thus properties with different characteristics will have different implicit marginal prices. For example, a parcel of property with a 2,000 square foot home that is five years old and sits on two acres of land will have a different implicit marginal price for an additional foot to winter pool than will a parcel of property with a 1,000

Table 5.10: Property Features Included in the Statistical Analysis

Characteristics of the Land	Characteristics of the Home
Distance to winter pool (in feet)	Age
Shoreline width (in feet)	Square feet
Acreage	Number of bathrooms
Winter view	Finished basement
Access road type (gravel vs. other)	Exterior type
	Air condition
	Fireplace
	Wooden deck
	Building quality

Table 5.11: Effect of an Additional Foot to Winter Pool on Appraisal Value

	Implicit Marginal Price	
Property Appraisal Value	Cherokee	Douglas
Less than $100,000	-$6.81	-$3.17
$100,000 - $149,999	-8.85	-5.99
$150,000 - $199,999	-13.9	-6.68
$200,000 - $299,999	-18.59	-10.27
$300,000 or more	-24.12	-17.82

square foot home that is 15 years old and sits on one acre of land. Assuming properties with similar appraisal values will have relatively similar characteristics, different implicit marginal prices are reported for five appraisal value categories. The value of an additional foot to winter pool for a parcel of property valued under $100,000 on Cherokee is -$6.81. Stated differently, an additional foot to winter pool will decrease the appraisal value for a parcel of property valued under $100,000 by $6.81, holding all other characteristics of the parcel constant. If there were no drawdown, there would be no negative effect on property values. Given the fact that there is indeed a drawdown, the total effect depends on the distance to winter pool. For a parcel of property located 50 feet from winter pool the total effect of the drawdown on the value of the property would be $340.50. The remaining values from this table can be interpreted in a similar fashion. Notice the marginal effect of an additional foot to winter pool increases in absolute value as appraised value increases and the effect is larger on Cherokee for all appraisal categories.

The total effect of drawdown on the value of an individual property can be calculated by multiplying the implicit marginal price per foot by the distance to winter pool. The first columns in Tables 5.12 and 5.13 simulate this effect on property values given several distance to pool scenarios for properties on Cherokee and Douglas respectively. The total effect of drawdown on property value for a parcel valued at less than $100,000 located 100 feet from the Cherokee winter-pool water level is a loss of $681. As reported in column two, this loss represents 0.94 percent of the mean appraisal value of the parcels that fall into this category. Given a certain distance to pool, the loss in property value rises as appraisal value increases due to the increases in the implicit marginal price shown in Table 5.11. Logically, the loss in property value resulting from drawdown increases with distance to winter pool, as the same implicit marginal prices are multiplied by larger and larger numbers.

Monthly losses in property values resulting from drawdown can be approximated by dividing the total loss (column one of Tables 5.12 and 5.13) by the number of months for which drawdown occurs, which is approximately nine months for both Cherokee and Douglas. Thus, delaying drawdown by one and two months would decrease total losses by one-ninth and two-ninths respectively (see below for qualifications). The benefits of delaying drawdown by one month for individual properties are presented in the third column of Tables 5.12 and 5.13. Again, notice benefits increase with appraisal value as well as distance to winter pool. The benefits of delaying drawdown until September 1st on Cherokee range from $76 for parcels in the first appraisal category 100 feet from winter pool to $6,700 for parcels in the highest appraisal category 2,500 feet from winter pool. The benefits range from $35 to $4,950 for parcels on Douglas. The benefits

from delaying drawdown by two months represent two-ninths of the total and range from $151 to $13,600 on Cherokee and $70 to $9,900 on Douglas.

The aggregate benefits of delaying drawdown for the sample parcels used in this analysis can be calculated using the implicit marginal prices from Table 5.11, the actual distance to winter-pool measurements from the data, and the monthly benefit allocation procedure employed in Tables 5.12 and 5.13. The aggregate benefit to property owners of delaying drawdown for one and two months for the 148 parcels on Cherokee would be $95,529 and $191,058 respectively, while the benefits for the 218 parcels on Douglas would be $244,618 for a one-month delay and $489,236 for a two-month delay. These values are reported to simply provide a better understanding of the magnitudes of the benefits of delaying drawdown. The data file used here contains only a small fraction of the parcels located on Cherokee and Douglas and does not consider the other five lakes studied. Thus these estimates are a small fraction of the total benefits to property owners of delaying drawdown at these lakes. If the estimates are truly representative of the effects for Cherokee and Douglas, they imply that every 100 homes on Cherokee would benefit in total by nearly $65,000 while every 100 homes on Douglas would benefit by roughly $112,210 for each month of delayed drawdown.

Caveats

There are several issues to be considered before any conclusions can be made based on this empirical analysis and prior to its extension to other lakes. First, allocating the effects of the drawdown equally across a nine-month period likely leads to a highly conservative estimate of the benefits of delaying drawdown. Lake residents would likely sustain their recreation activities in the months of August and September as surface and water temperatures remain fairly mild and as daily sunlight remains extensive. Therefore, benefits from higher water levels would be significantly larger in these months than in the winter months. With this in mind, the values derived by this analysis should be regarded as lower bound estimates.

Second, the analysis should be extended to include not only additional lakefront properties but also second and third tier properties. Although second and third tier property owners may not have direct access to the lake, they may have access through a community dock or marina and certainly many have views of the lake and would thus benefit from delayed drawdowns. It is clear from the literature discussed above that proximity and view do matter, independent of access and recreation, which provides another reason the estimates provided here understate the consequences of drawdown.

Table 5.12: Estimated Effects of Drawdown on Individual Property Values for Various Distance to Pool Scenarios (Cherokee Lake)

Distance to Winter Pool = 100 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$681	0.94	$76	$151
$100,000 - $149,999	-889	0.70	99	197
$150,000 - $199,999	-1,390	0.82	154	309
$200,000 - $299,999	-1,859	0.77	207	413
$300,000 or more	-2,412	0.68	268	536

Distance to Winter Pool = 250 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$1,703	2.35	$189	$378
$100,000 - $149,999	-2,221	1.76	247	494
$150,000 - $199,999	-3,475	2.04	386	772
$200,000 - $299,999	-4,648	1.92	516	1,033
$300,000 or more	-6,030	1.70	670	1,340

Distance to Winter Pool = 500 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$3,405	4.71	$378	$757
$100,000 - $149,999	-4,443	3.52	494	987
$150,000 - $199,999	-6,950	4.08	772	1,544
$200,000 - $299,999	-9,295	3.84	1,033	2,066
$300,000 or more	-12,060	3.40	1,340	2,680

Distance to Winter Pool = 1000 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$6,810	9.42	$757	$1,513
$100,000 - $149,999	-8,885	7.04	987	1,974
$150,000 - $199,999	-13,900	8.17	1,544	3,089
$200,000 - $299,999	-18,590	7.67	2,066	4,131
$300,000 or more	-24,120	6.79	2,680	5,360

Distance to Winter Pool = 2500 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$17,025	23.54	$1,892	$3,783
$100,000 - $149,999	-22,213	17.59	2,468	4,936
$150,000 - $199,999	-34,750	20.42	3,861	7,722
$200,000 - $299,999	-46,475	19.18	5,164	10,328
$300,000 or more	-60,300	16.98	6,700	13,400

Table 5.13: Estimated Effects of Drawdown on Individual Property Values for Various Distance to Pool Scenarios (Douglas Lake)

Distance to Winter Pool = 100 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$317	0.45	$35	$70
$100,000 - $149,999	-599	0.49	67	133
$150,000 - $199,999	-668	0.39	74	148
$200,000 - $299,999	-1,027	0.44	114	228
$300,000 or more	-1,782	0.39	198	396

Distance to Winter Pool = 500 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$1,585	2.25	$176	$352
$100,000 - $149,999	-2,995	2.44	333	666
$150,000 - $199,999	-3,340	1.94	371	742
$200,000 - $299,999	-5,135	2.19	571	1,141
$300,000 or more	-8,910	1.96	990	1,980

Distance to Winter Pool = 1000 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$3,170	4.50	$352	$704
$100,000 - $149,999	-5,990	4.88	666	1,331
$150,000 - $199,999	-6,680	3.87	742	1,484
$200,000 - $299,999	-10,270	4.39	1,141	2,282
$300,000 or more	-17,820	3.91	1,980	3,960

Distance to Winter Pool = 2500 feet

	Annual Effects		Benefits of Delayed Drawdown	
Value Categories:	Loss for Property Value	Loss as a Percent of Mean Appraisal Value	One Month Delay, September 1st	Two Month Delay, October 1st
Less than $100,000	-$7,925	11.25	$881	$1,761
$100,000 - $149,999	-14,975	12.21	1,664	3,328
$150,000 - $199,999	-16,700	9.68	1,856	3,711
$200,000 - $299,999	-25,675	10.97	2,853	5,706
$300,000 or more	-44,550	9.78	4,950	9,900

Third, higher property values would increase tax payments made by landowners and property taxes received by local governments. Thus property owners would receive benefits but also be paying for higher water levels through higher taxes; municipalities and their citizens would benefit from increased revenues. This could prove to be an important boost to local government finances in the impact region examined here, a region characterized by a weak tax base.

Fourth, the model used in this analysis assumes that the implicit marginal price of an additional foot to winter pool is constant. Intuitively, it would make sense for the first several feet of drawdown to have a larger effect on property values than the remaining decline. Once water levels have reached some threshold, access to the water may be completely denied and additional decreases in water levels may have little effect. Thus, additional declines would not have as significant of an effect on the wellbeing of property owners. Future analyses should allow this implicit marginal price to decline with distance.

Fifth, if delaying drawdown on the lakes studies here requires that the water levels of other lakes be lowered, the reductions in property values of parcels on these lakes should be taken into account. More generally, delaying drawdown may change water quality, flood risk, etc., potentially affecting property values.

Finally, the estimates are based on variations in distance to pool and property values for two lakes largely known to have large fluctuations in water levels. If lakes were maintained at full pool for another month or two, a different group of individuals may choose to purchase property – people with a stronger taste for access and views – yielding significantly higher property values. With the analysis of recreators, it is impossible to identify current non-users who might use the lakes if levels were higher. Similarly with households, it is impossible to determine how residency patterns might change through higher levels.

After considering these issues, the estimates presented in this analysis provide an initial lower range of the benefits of delaying drawdown on individual properties based on the property's characteristics and distance to winter pool. Aggregating these benefits across all properties on all lakes in the system will be a difficult task as there are no readily available statistics on the number or value of lakefront properties. This analysis finds that the implicit marginal price of an additional foot to winter pool depends on which lake the property is located. Therefore, to calculate the aggregate benefits to property owners, a separate analysis would be necessary for each lake to obtain appropriate measures of the implicit marginal prices. Once these prices are obtained, the benefits of delaying drawdown must be calculated for each individual property and then be aggregated across all properties.

6. Conclusion

This report has examined the economic effects of TVA lake management policy for the region surrounding seven lakes in East Tennessee. Estimates of economic impact and economic value from a delayed drawdown through the end of September have been developed. The estimates are based on surveys of recreators and households, and an analysis of property tax records for a sample of homes on Douglas and Cherokee lakes.

Based on the survey of recreators it is estimated that $5.4 million in new spending would take place within the multi-county lake region on the part of nonresidents should drawdowns be delayed to the end of September. Inclusive of the ripple effects of the multiplier, this initial spending would yield $2.35 million in new income for area residents and 124 annual full-time equivalent jobs (or 744 jobs for the two-month period of August and September). Increased recreation activity by nonresidents would boost Tennessee (as opposed to only lake-region) income by $1.9 million and add 100 annual jobs (or 600 jobs for August and September).

Gains in economic *value* for residents and nonresidents of the lake region would also accrue from a delayed drawdown. Based on the preferred *choice model* estimates, annual economic value would rise by $39.7 million for a one-month drawdown delay and $63.3 million for a two-month drawdown delay. Norris Lake would yield the largest benefits, totaling $11.4 for one month and nearly $20 million for two months. Estimates for Fontana Lake (North Carolina) from a parallel study indicate gains in economic value of $1.7 million and $2.5 million for a one-month and two-month delay in drawdown. Based on a sample of lakefront properties on Cherokee and Douglas lakes, estimates of increased property value were estimated. For each 100 homes on Cherokee Lake it is estimated that total property value would rise by $65,000 while total value on Douglas Lake would grow by $112,210 per 100 parcels of property.

There are two limitations of the current research that need to be noted. First, the study does not consider effects of a delayed drawdown on other parts of the TVA river system, nor the effects on water quality, flood control, power generation and so on. These broader dimensions of the policy question will need to be considered to enable TVA to balance the competing uses of the river system.

Second, the estimates presented here are based on a policy change — a delayed drawdown — that has never taken place. In practice it is impossible to determine the exact nature of recreation use and home values that would follow from a delay in the summer and fall drawdown. For example, if individuals

currently do *not* recreate on the lakes because they are at or near full pool for only three months of the year, it is impossible to capture contingent behavior through a recreation survey. Some of these individuals may choose to recreate in the presence of a delayed drawdown, giving rise to both positive economic impacts and economic values. Again, the survey methods employed in this study cannot capture such behavior. Similarly, it is impossible to determine with precision housing development patterns and hence property value effects under an alternative lake management policy that has never been in place. A one or two month delay in the annual drawdown may support a significant increase in residential development that would ripple through the economy and support increases in economic value for property and home owners. Yet again, the methods employed here cannot estimate these effects with any degree of precision. For example, individuals with a strong preference for access and views who are aware of the drawdowns on East Tennessee lakes would likely choose to purchase a home on a lake like Fort Loudoun which has a modest annual drawdown. Those with less strong preferences may choose a lake like Douglas or Cherokee. With higher pools for one or two months of the year, a different settlement pattern might emerge. These considerations suggest that the estimates presented here are a conservative assessment of the consequences of a delayed drawdown on the multi-county lake region in East Tennessee.

Appendices

Appendix A: Economic Impact Analysis

Whenever an area experiences an increase in economic activity, certain impacts are felt throughout the region. For example, when a new manufacturing facility locates in a region new spending is injected into the economy supporting income and job creation. Similarly, when additional expenditures are made within a region because of higher lake levels, these new expenditures are a source of income and jobs for the local economy. The impact from the new economic activity can be broken down into direct, indirect, and multiplier effects.

Direct effects are those that are directly attributable to the new activity. For example, in the case of a new manufacturing firm the direct effects are the expenditures of the company to purchase inputs and hire workers. In the case of lake levels considered in this report, as people take more trips to the lakes because of delayed drawdowns more spending takes place at local restaurants and other local retail and service establishments. When a local restaurant enjoys higher sales, there are more job opportunities and hence more income for employees.

The receipts of the commercial establishment and the new income for workers also create jobs for other businesses and thus additional income. In this fashion economic activity has indirect and multiplier effects within a regionl. Indirect effects arise from businesses' expenditures on raw materials, services, supplies, and other operating expenses which helps support jobs in other local businesses. For example, a restaurant on the lake may purchase accounting services from local firms, apples from the local farmer, and a new oven from the local retailer. The greater the amount of raw materials and services that can be produced locally, the greater the magnitude of the indirect effect. If raw materials or services have to be imported from outside of the region, then the indirect effect is smaller. When a local retailer sells a good, most of the proceeds go to the community where the good was produced. Thus, the size of a firm's indirect impact on local incomes depends primarily on the dollar value of locally purchased goods and services and whether or not these same goods and services are locally produced or imported into the community. Note that only the value added via the local production process, not the total retail sale, gives rise to additional economic benefits for the community. Only the portion of the expenditure actually retained by the local vendor can be used in the calculation of the firm's indirect income impact on the local economy.

In addition, the amount of indirect employment generated by the business will vary with the amount of under-utilization of workers and capacity existing in local businesses. Although the firm's payments to local vendors increases the amount of local business activity, this will not necessarily lead to significant increases in employment if local firms are currently experiencing excess capacity.

Instead of hiring new workers, managers will utilize the excess capacity first, thereby resulting in a smaller indirect impact than if local supply firms were operating at full capacity.

Finally, multiplier (or ripple) effects are felt within the region as the new income is spent and re-spent within the local economy. Note that it is the new purchasing power from outside the community – the ability to export – that gives rise to the direct and indirect effects, and hence, the multiplier effects as well. For example, part of the wages received by a firm's employees will be spent on housing. If the employee rents an apartment in Jefferson County, a portion of the rent payment will be used to pay local employees of the apartment complex. These employees will in turn spend a portion of their income in the local community, thus adding to the amount of local personal income attributable to the firm's activities. However, during each of these subsequent rounds of spending, a large portion of the income generated leaks out of the local economy through taxes, savings, and spending outside the community, thereby diminishing the increment to local income attributable to these firms.

Total local economic impacts attributable to increased business activity are computed as the sum of the direct, indirect, and multiplier effects. In this study direct effects are reflected in recreator spending and household spending related to recreation activities. The RIMSII multipliers acquired from the U.S. Bureau of Economic Analysis jointly capture indirect and multiplier effects.

University of Tennessee Lake Recreation Study

Date: _____ Interviewer: _____
Location (Site, Lake): _____

Hello, my name is _____ and I am part of a team from the University of Tennessee conducting a survey of users of TVA lakes in East Tennessee.

We would be grateful if you would take about 10 minutes to answer a series of questions about your use of TVA lakes. Your participation in this survey is completely voluntary. I want to assure you that the information you provide will be kept strictly confidential and if you do not wish to answer any particular question, just let me know. No reference will be made in oral or written reports which could link you in any way to the study.

If you have any questions concerning the nature or outputs of this research you may contact: Professor Steven Stewart at 974-1710. If you have questions about your rights as a participant, contact the Compliance Section of the UT Office of Research at 974-3466.

We would like to begin by asking you a few questions about your use of TVA lakes.

1. (a) What activities do you have planned for your trip today?

☐1 Boating ☐2 Camping ☐3 Fishing ☐4 Picnicking ☐5 Swimming ☐6 Other _____

(b) Are you fishing from a boat or from the bank?

☐1 Bank ☐2 Boat ☐3 Both

(c) What kind of boating are you participating in?

☐1 Canoe ☐2 Fishing ☐3 Kayak ☐4 Leisure Boating ☐5 Skiing ☐6 Other _____

2. What other activities have you participated in at this lake in the past?

☐1 Boating ☐2 Camping ☐3 Fishing ☐4 Picnicking ☐5 Swimming ☐6 Other _____

3. How many people are in your party today (including yourself)? _____

4. How many days will you spend on this visit to the lake? _____

Version C

5. Please think about your visits to this lake over the past twelve months. Which months did you use the lake? How many trips did you make to the lake in . . *month?*

July _____	Oct _____	Jan _____	Apr _____
Aug _____	Nov _____	Feb _____	May _____
Sept _____	Dec _____	Mar _____	June _____

6. Have you made trips to any of the following lakes in the past 12 months? If so, how many visits have you made to each of these lakes in the past 12 months?

Name	Visited (Yes/No)		Number of Visits
Boone	☐ 1 Yes	☐ 2 No	_____
Cherokee	☐ 1 Yes	☐ 2 No	_____
Douglas	☐ 1 Yes	☐ 2 No	_____
Fontana	☐ 1 Yes	☐ 2 No	_____
Fort Patrick Henry	☐ 1 Yes	☐ 2 No	_____
Norris	☐ 1 Yes	☐ 2 No	_____
South Holston	☐ 1 Yes	☐ 2 No	_____
Watauga	☐ 1 Yes	☐ 2 No	_____

7. To the best of your knowledge, how much would you estimate that your group has spent on the following items for this trip? In which county or town was this money spent?

Item		Dollars	County/Town
(a)	**Food, drinks, and refreshments**	_____	_____
(b)	**Round trip cost for transportation**	_____	_____
(c)	**Lodging (motels, campgrounds, etc.)**	_____	_____
(d)	**Boat or personal watercraft**	_____	_____
(e)	**Boat launching fees**	_____	_____
(f)	**Private land access fees**	_____	_____
(g)	**Boating, fishing, or camping rental/supplies**	_____	_____
(h)	**Other expenses: specify**	_____	_____

Version C

8. Do you currently have a fishing license in the state of Tennessee? ☐ 1 Yes ☐ 2 No

9. Do you currently own a boat? ☐ 1 Yes ☐ 2 No

10. Do you currently own a personal watercraft (jet ski)? ☐ 1 Yes ☐ 2 No

11. Do you own property with a view of this or any other TVA lake? ☐ 1 Yes ☐ 2 No

12. Are you a resident of Tennessee? ☐ 1 Yes ☐ 2 No

Background Information on TVA's current management of East Tennessee Lakes:

-- Tennessee Valley Authority was established to provide flood control, navigation, and electric power in tl Tennessee Valley region.

-- TVA tries to balance these competing needs, along with economic development, recreation, and environmental quality.

-- Currently, TVA tries to keep lakes at full pool from June 1st through August 1st.

-- TVA begins draw-downs at TVA lakes on August 1st at reservoirs in the upper portions of the river system to provide flood control and hydroelectric power.

-- TVA is now considering adjusting its August 1st draw-down patterns

In the next few questions, we want you to consider some alternative September 1 levels.

Resident:

In order to maintain higher water levels for this extra month, TVA would have to sacrifice hydropower generation. As a result average electricity rates in the TVA service area would have to increase. Now we would like to ask for your input on alternative policies.

In answering the following questions, keep in mind that any additional money that you spend on your electricity bill means that you will have less money to spend on other goods and services that may be important to you.

Non-Resident:

In order to maintain higher water levels for this extra month, TVA would have to sacrifice hydropower generation. To offset lost hydropower revenues, TVA would implement a system where lake users would purchase a Lake Pass good for one year at all TVA lakes. The cost of the pass would depend on the amount of lost hydropower generation. Now we would like to ask for your input on alternative policies.

In answering the following questions, keep in mind that any additional money that you spend on your Lake Pass means that you will have less money to spend on other goods anc services that may be important to you.

Currently, the average September 1 lake level is 20 feet below full pool. Options 1 and 2 of the following Choice Sets represent changes from the average September 1 lake level. Option 3 is always "Business as Usual" -- in other words, Option 3 indicates that TVA would make no change to its current draw-down patterns.

Version C

13. Choice Set Analysis -- Version C

	Option 1	Option 2	Option 3
Light Tan			
Average Lake Level September 1	15 ft above normal	5 feet above normal	normal September 1 level "Business as Usual"
Change in Cost	$75/year	$50/year	$0/year
	☐ 1	☐ 2	☐ 3
Blue			
Average Lake Level September 1	10 ft above normal	5 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$10/year	$5/year	$0/year
	☐ 1	☐ 2	☐ 3
Yellow			
Average Lake Level September 1	25 ft below normal	40 ft below normal	normal September 1 level "Business as Usual"
Change in Cost	$0/year	$0/year	$0/year
	☐ 1	☐ 2	☐ 3
Grey			
Average Lake Level September 1	20 ft above normal	10 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$100/year	$5/year	$0/year
	☐ 1	☐ 2	☐ 3
Green			
Average Lake Level September 1	20 ft above normal	10 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$50/year	$25/year	$0/year
	☐ 1	☐ 2	☐ 3
Purple			
Average Lake Level September 1	20 ft above normal	15 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$75/year	$25/year	$0/year
	☐ 1	☐ 2	☐ 3

Version C

IF A NONRESIDENT, SKIP TO #15.

14. Are you generally willing to pay slightly more for electricity if it means that lake levels would remain at higher levels throughout the year?

☐ 1 Yes ☐ 2 No

15. What is the most you would be willing to pay per year to have lakes kept at their full pool level until September 1st?

$ _____

16. (a) Would you make more trips to this lake if water levels were higher in August and September?

☐ 1 Yes ☐ 2 No

(b) If yes, how many more trips? _____

IF NO, SKIP TO #18.

17. (a) If you were to increase your visits during the months of August and September, would you come less often during other months of the year?

☐ 1 Yes ☐ 2 No

(b) If yes, how many fewer visits would you make? _____

18. Do you think TVA should keep lake levels higher in winter months if it increases the risk of flooding downstream?

☐ 1 Yes ☐ 2 No

19. Did you know about TVA's policy to begin drawing down reservoirs on August 1st before taking part in this survey?

☐ 1 Yes ☐ 2 No

20. Please consider the following attributes related to TVA lakes: Fishing opportunities, Boating opportunities, Scenic quality, Water quality, etc. As I name each one again, please rate the level of importance you place on each attribute when choosing a lake recreation site on a scale from 1 to 5 with 1 being the lowest and 5 being the highest.

Attribute	Rate (1 to 5) 5 = highest
Fishing Opportunities	_____
Boating Opportunities	_____
Scenic Quality of a Lake	_____
Water Quality	_____
What else	_____

Version C

21. In what zip code do you live? _____

22. What is the highest level of education you have completed?

Elementary or some high school	☐ 1	Some college/Associates degree	☐ 4
High school graduate/GED	☐ 2	College graduate	☐ 5
Trade or vocational certification	☐ 3	Post-graduate degree	☐ 6

23. What year were you born? _____

24. To your knowledge, is your occupation (or employer) affected in any way other than electricity rates by TVA's water level management policies?

☐ 1 Yes ☐ 2 No

25. About how much was your gross household income last year?

Less than $10,000	☐ 1	$60 to $69,999	☐ 7
$10 to $19,999	☐ 2	$70 to $79,999	☐ 8
$20 to $29,999	☐ 3	$80 to $89,999	☐ 9
$30 to $39,999	☐ 4	$90 to $99,999	☐ 10
$40 to $49,999	☐ 5	More than $100,000	☐ 11
$50 to $59,999	☐ 6	Don't know	☐ 12

26. What is your race?

☐ 1 White ☐ 2 Black ☐ 3 Other (specify) _____

To be completed by the interviewer:
Respondents gender:

☐ 1 Male ☐ 2 Female

Version C

13. Choice Set Analysis -- Version D

	Option 1	Option 2	Option 3
Light Tan			
Average Lake Level September 1	20 ft above normal	15 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$25/year	$10/year	$0/year
	[ ]1	[ ]2	[ ]3
Blue			
Average Lake Level September 1	10 ft above normal	5 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$100/year	$25/year	$0/year
	[ ]1	[ ]2	[ ]3
Yellow			
Average Lake Level September 1	10 ft below normal	5 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$0/year	$100/year	$0/year
	[ ]1	[ ]2	[ ]3
Grey			
Average Lake Level September 1	15 ft above normal	10 ft below normal	normal September 1 level "Business as Usual"
Change in Cost	$50/year	$10/year	$0/year
	[ ]1	[ ]2	[ ]3
Green			
Average Lake Level September 1	20 ft above normal	10 ft above normal	normal September 1 level "Business as Usual"
Change in Cost	$50/year	$25/year	$0/year
	[ ]1	[ ]2	[ ]3
Purple			
Average Lake Level September 1	25 ft below normal	40 ft below normal	normal September 1 level "Business as Usual"
Change in Cost	$5/year	$10/year	$0/year
	[ ]1	[ ]2	[ ]3

Version D

The University of Tennessee

Lake Study: A Survey of Property Owners

Summer, 2002

If you have any questions concerning this survey, you may contact Matt Murray, Associate Director of the Center for Business and Economic Research, at (865) 974-6084. If you have questions about your rights as a participant, contact the Compliance Section of the UT Office of Research at (865) 974-3466.

Please return your completed survey in the Business Reply Envelope provided or mail it to:

Center for Business and Economic Research
The University of Tennessee
100 Glocker Building
1000 Volunteer Boulevard
Knoxville, TN 37996-4170

The University of Tennessee -- Lake Property Survey

1. How would you classify the property at the address this survey was sent to? *(Check only one)*

   ☐ PRIMARY RESIDENCE

   ☐ SECONDARY RESIDENCE

   ☐ VACATION HOME

   ☐ OTHER (E.G. FARM LAND, FOREST, BUSINESS)*(Please specify)* _____

2. Do you:

   ☐ RENT/LEASE

   ☐ OWN

3. Which TVA lake is this property closest to?

   ☐ CHEROKEE

   ☐ DOUGLAS

4. Which category **best describes** this property in relation to this lake?

   ☐ LOCATED WITHIN 5 MILES OF THE LAKE, BUT NO LAKE VIEW OR ACCESS TO THE WATER

   ☐ VIEW OF THE LAKE, BUT NO ACCESS TO THE WATER

   ☐ VIEW OF THE LAKE AND ACCESS VIA NEIGHBORING PROPERTY OR COMMON SUBDIVISION ACCESS

   ☐ VIEW OF THE LAKE AND DIRECT ACCESS TO THE WATER

   ☐ NO VIEW OF THE LAKE, BUT ACCESS VIA NEIGHBORING PROPERTY OR COMMON SUBDIVISION ACCESS

   ☐ OTHER *(Please specify)* _____

5. If this property borders the lake, what is the approximate length of frontage in feet?

   _____ FEET OF FRONTAGE

6. Do you access the lake using some form of watercraft for *(Check all that apply)*

   ☐ BOATING

   ☐ FISHING

   ☐ SWIMMING

   ☐ SKIING

   ☐ SIGHTSEEING

   ☐ OTHER *(Please explain)* _____

7. What other activities have you participated in at this lake? *(Check all that apply)*

- ☐ CAMPING
- ☐ FISHING FROM THE BANK
- ☐ PICNICKING
- ☐ HIKING
- ☐ SUNBATHING
- ☐ OTHER *(Please explain)* _____

8. Do you have direct watercraft access from this property?

- ☐ YES *(Skip to Question 10)*
- ☐ NO

9. If NO, how do you access the lake? *(Check all that apply)*

- ☐ COMMUNITY BOAT SLIP
- ☐ PUBLIC BOAT RAMP
- ☐ PRIVATE DOCK OR MARINA
- ☐ I DO NOT ACCESS THE LAKE WITH WATERCRAFT
- ☐ OTHER *(Please specify)* _____

10. **How many times** per month do you access the lake with watercraft? *(Record number in box)*

- ☐ JANUARY
- ☐ FEBRUARY
- ☐ MARCH
- ☐ APRIL
- ☐ MAY
- ☐ JUNE
- ☐ JULY
- ☐ AUGUST
- ☐ SEPTEMBER
- ☐ OCTOBER
- ☐ NOVEMBER
- ☐ DECEMBER

11. Do you pay a fee each time you access the lake?

☐ YES

☐ NO *(Skip to Question 13)*

12. If YES, what is the average fee per access?

$ _____ *(amount per access)*

13. Do you have a view of the lake **from your home** at any time of the year?

☐ YES *(Skip to Question 15)*

☐ NO

14. If NO, do you have a view of lake water **from any part of this property at** any time of the year?

☐ YES

☐ NO *(Skip to Question 17)*

15. Do you have a view of lake water from any part of this property at any time during the months of May through July?

☐ YES

☐ NO *(Skip to Question 17)*

16. If YES, does lake water remain in view in the following months:

AUGUST	☐	YES
	☐	NO
SEPTEMBER	☐	YES
	☐	NO
DECEMBER	☐	YES
	☐	NO
MARCH	☐	YES
	☐	NO

17. Check the description that **best** fits the view of the lake from this property in each month. *(Check only one description for each month.)*

	WATER	MUD/ LAKE BOTTOM	EXPOSED SHORELINE	ROCK OUT-CROPPING	OTHER *(Please specify in space provided)*
AUGUST	☐	☐	☐	☐	
SEPTEMBER	☐	☐	☐	☐	
DECEMBER	☐	☐	☐	☐	
MARCH	☐	☐	☐	☐	

18. How do lower water levels affect your use of the lake in August and September?

☐ USE LAKE **MORE** FREQUENTLY DUE TO LOWER WATER LEVELS *(Continue to Question 19)*

☐ USE LAKE **LESS** FREQUENTLY DUE TO LOWER WATER LEVELS *(Skip to Question 20)*

☐ NO CHANGE IN USE DUE TO LOWER WATER LEVELS *(Skip to Question 22)*

19. How many **fewer** times would you access the lake if it remained at or near normal summer pool through

AUGUST _____ *(number of **fewer** times)*

SEPTEMBER _____ *(number of **fewer** times)(Skip to Question 22)*

20. How many **more** times would you access the lake if it remained at or near normal summer pool through

AUGUST _____ *(number of **additional** times)*

SEPTEMBER _____ *(number of **additional** times)*

21. You have indicated that you would access the lake more in August or September if it remained at or near normal summer pool. Would this cause you to increase, decrease, or not change the number of times you access the lake the rest of the year?

☐ INCREASE _____ *(number of **additional** times)*

☐ DECREASE _____ *(number of **fewer** times)*

☐ NO CHANGE

22. What improvements have you made to enjoy the lake and its view? *(Check all that apply)*

☐ LANDSCAPING

☐ BUILT A BOATHOUSE

☐ BUILT A PATIO/DECK

☐ BUILT A BOAT DOCK

☐ OTHER *(Please specify)* _____

23. To the best of your knowledge, what are your annual expenditures for using and enjoying the lake?

$ _____

24. When you use the lake, how much would you estimate your total annual spending to be on each of the following? Also indicate the town and county where you make the majority of the expenditures. Please confine your estimates of spending to those activities directly related to lake use.

	Dollars	Town	County
A. FOOD, DRINKS AND REFRESHMENTS			
B. DOCK AND DOCK MAINTENANCE			
C. BOAT, CANOE, PERSONAL WATERCRAFT, ETC.			
D. BOATING, FISHING, OR CAMPING RENTAL/SUPPLIES			
E. BOAT LAUNCHING FEES			
F. PRIVATE LAND ACCESS FEES			
G. COMMERCIAL DOCK OR MARINA			
H. OTHER EXPENSES *(Please specify)* _____			
_____			

25. Would your expenditures go up or down (and by how much) or not change at all if the lake remained at or near normal summer pool in the months of:

AUGUST	☐	UP	$ _____ *(Dollar amount increase)*
	☐	DOWN	$ _____ *(Dollar amount decrease)*
	☐	NO CHANGE	
SEPTEMBER	☐	UP	$ _____ *(Dollar amount increase)*
	☐	DOWN	$ _____ *(Dollar amount decrease)*
	☐	NO CHANGE	
OTHER MONTHS OF THE YEAR	☐	UP	$ _____ *(Dollar amount increase)*
	☐	DOWN	$ _____ *(Dollar amount decrease)*
	☐	NO CHANGE	

26. Do you **currently** own a personal watercraft (jet ski)?

☐ YES
☐ NO

27. Do you **currently** own a canoe, kayak, or sailboat?

☐ YES
☐ NO

28. Do you **currently** own any other type of boat?

- ☐ YES
- ☐ NO

29. Before purchasing this property, did you know about TVA's policy to begin drawing down reservoirs on August 1?

- ☐ YES
- ☐ NO

30. When lake levels are brought down in late July/early August, is your primary form of lake access restricted?

- ☐ YES
- ☐ NO
- ☐ DO NOT ACCESS

31. If you own a dock, does the lake remain accessible after the draw-down?

- ☐ YES *(Skip to Question 34)*
- ☐ NO *(Continue to Question 32)*
- ☐ NO DOCK *(Skip to Question 34)*

32. If NO, do you use an alternative boat ramp to access the lake?

- ☐ YES
- ☐ NO

33. What, if any, additional cost do you incur to put your boat on the lake for the following months?

AUGUST $_____ *(total amount for the month)*

SEPTEMBER $_____ *(total amount for the month)*

34. If you own a dock, what is the lowest level at which your dock is usable?

_____

35. If you have lake frontage, what is the approximate vertical drop in feet from normal June pool at or near the shoreline of this property in the following months?

AUGUST _____ *(vertical drop in feet)*

SEPTEMBER _____ *(vertical drop in feet)*

DECEMBER _____ *(vertical drop in feet)*

MARCH _____ *(vertical drop in feet)*

36. If you have lake frontage, what is the average distance in feet from the June shoreline of this property to the water during the following months?

AUGUST _____ *(average distance in feet)*

SEPTEMBER _____ *(average distance in feet)*

DECEMBER _____ *(average distance in feet)*

MARCH _____ *(average distance in feet)*

37. If lake levels remained at normal summer pool in August and September, what effect would it have on the value of this property?

☐ DECREASE $ _____ *(amount of decrease)*

☐ INCREASE $ _____ *(amount of increase)*

☐ NO CHANGE

38. Do you think TVA should keep lake levels higher in winter months if it increases the risk of flooding downstream?

☐ YES

☐ NO

39. Please consider the following attributes related to TVA lakes: Fishing opportunities, Boating opportunities, Scenic quality, Water quality, etc. Please rate the level of importance you place on each attribute when choosing a lake home site on a scale from 1 to 5 with 1 being the lowest and 5 being the highest.

Attribute	**Rate (1 to 5) 5 = highest**
FISHING OPPORTUNITIES	_____
BOATING OPPORTUNITIES	_____
SCENIC QUALITY OF A LAKE	_____
WATER QUALITY	_____
OTHER *(Please specify)*	_____ _____

Background Information on TVA's current management of East Tennessee Lakes:

-- Tennessee Valley Authority was established to provide flood control, navigation, and electric power in the Tennessee Valley region.
-- TVA tries to balance these competing needs, along with economic development, recreation, and environmental quality.
-- Currently, TVA tries to keep lakes at normal summer pool from June 1st through August 1st.
-- TVA begins draw-downs at TVA lakes on August 1st at reservoirs in the upper portions of the river system to provide flood control and hydroelectric power.
-- TVA is now considering adjusting its August 1st draw-down patterns.

The University of Tennessee -- Lake Property Survey

In the next few questions, we want you to consider some alternative September 1 levels.

In order to maintain higher water levels for this extra month, TVA would have to sacrifice hydropower generation. As a result, average electricity rates in the TVA service area would have to increase. Now we would like to ask for your input on alternative policies.

In answering the following questions, keep in mind that any additional money that you spend on your electricity bill means that you will have less money to spend on other goods and services that may be important to you.

Currently, the average September 1 lake level is 20 feet below full pool. Options 1 and 2 of the following Choice Sets represent changes from the average September 1 lake level. Option 3 is always "Business as Usual" -- in other words, Option 3 indicates that TVA would make no change to its current draw-down patterns.

For each lettered question below (A through F), please place an "X" in the box below your choice (either Option 1, Option 2, or Option 3). When making your choice, only consider the three options presented for each lettered set. For instance, when reviewing the options in Choice Set B, do not consider the options in Choice Set A. Please note that some choices actually represent further reductions in the water levels.

40.

	Option 1	Option 2	Option 3
A. **Average Lake Level on September 1**	15 ft above normal	5 feet above normal	normal "Business as Usual"
Cost	$75/year ☐	$50/year ☐	$0/year ☐
B. **Average Lake Level on September 1**	10 ft above normal	5 ft above normal	normal "Business as Usual"
Cost	$10/year ☐	$5/year ☐	$0/year ☐
C. **Average Lake Level on September 1**	25 ft below normal	40 ft below normal	normal "Business as Usual"
Cost	$0/year ☐	$0/year ☐	$0/year ☐
D. **Average Lake Level on September 1**	20 ft above normal	10 ft above normal	normal "Business as Usual"
Cost	$100/year ☐	$5/year ☐	$0/year ☐
E. **Average Lake Level on September 1**	20 ft above normal	10 ft above normal	normal "Business as Usual"
Cost	$50/year ☐	$25/year ☐	$0/year ☐
F. **Average Lake Level on September 1**	20 ft above normal	15 ft above normal	normal "Business as Usual"
Cost	$75/year ☐	$25/year ☐	$0/year ☐

41. Are you generally willing to pay slightly more for electricity if it means that lake levels would remain at higher levels throughout the year?

- ☐ YES
- ☐ NO *(Skip to Question 44)*

42. What is the most you would be willing to pay per year to have lakes kept at their normal summer pool level from **August 1 to September 1**?

$ _____

43. What is the most you would be willing to pay per year to have lakes kept at their normal summer pool level from **September 1 to October 1**?

$ _____

44. Have you been surveyed this summer by UT regarding recreational use of lakes?

- ☐ YES
- ☐ NO

45. Are you a resident of Tennessee?

- ☐ YES
- ☐ NO

46. In what ZIP Code is your primary place of residence?

_____

47. What is the highest level of education you have completed?

- ☐ ELEMENTARY OR SOME HIGH SCHOOL
- ☐ HIGH SCHOOL GRADUATE/GED
- ☐ TRADE OR VOCATIONAL CERTIFICATION
- ☐ SOME COLLEGE/ ASSOCIATES DEGREE
- ☐ COLLEGE GRADUATE
- ☐ POST-GRADUATE DEGREE

48. What year were you born?

_____

49. To your knowledge, is your occupation (or employer) affected in any way other than electricity rates by TVA's water level management policies?

- ☐ YES
- ☐ NO
- ☐ DON'T KNOW

50. About how much was your gross household income last year?

- ☐ LESS THAN $10,000
- ☐ $10,000 to $19,999
- ☐ $20,000 to $29,999
- ☐ $30,000 to $39,999
- ☐ $40,000 to $49,999
- ☐ $50,000 to $59,999
- ☐ $60,000 to $69,999
- ☐ $70,000 to $79,999
- ☐ $80,000 to $89,999
- ☐ $90,000 to $99,999
- ☐ MORE THAN $100,000
- ☐ DON'T KNOW

51. What is your race?

- ☐ WHITE
- ☐ BLACK
- ☐ OTHER *(Please specify)* _____

52. What is your gender?

- ☐ MALE
- ☐ FEMALE

Thank you. Please write any additional comments on the back of this survey.

A summary of survey results will be posted on our website at http://cber.bus.utk.edu. Upon its completion, copies of our complete study will be made available to the public.

The University of Tennessee -- Lake Property Survey

In the next few questions, we want you to consider some alternative September 1 levels.

In order to maintain higher water levels for this extra month, TVA would have to sacrifice hydropower generation. As a result, average electricity rates in the TVA service area would have to increase. Now we would like to ask for your input on alternative policies.

In answering the following questions, keep in mind that any additional money that you spend on your electricity bill means that you will have less money to spend on other goods and services that may be important to you.

Currently, the average September 1 lake level is 20 feet below full pool. Options 1 and 2 of the following Choice Sets represent changes from the average September 1 lake level. Option 3 is always "Business as Usual" -- in other words, Option 3 indicates that TVA would make no change to its current draw-down patterns.

For each lettered question below (A through F), please place an "X" in the box below your choice (either Option 1, Option 2, or Option 3). When making your choice, only consider the three options presented for each lettered set. For instance, when reviewing the options in Choice Set B, do not consider the options in Choice Set A. Please note that some choices actually represent further reductions in the water levels.

40.

	Option 1	Option 2	Option 3
A. **Average Lake Level on September 1**	20 ft above normal	15 feet above normal	normal "Business as Usual"
Cost	$25/year	$10/year	$0/year
	☐	☐	☐
B. **Average Lake Level on September 1**	10 ft above normal	5 ft above normal	normal "Business as Usual"
Cost	$100/year	$25/year	$0/year
	☐	☐	☐
C. **Average Lake Level on September 1**	10 ft below normal	5 ft above normal	normal "Business as Usual"
Cost	$0/year	$100/year	$0/year
	☐	☐	☐
D. **Average Lake Level on September 1**	15 ft above normal	10 ft below normal	normal "Business as Usual"
Cost	$50/year	$10/year	$0/year
	☐	☐	☐
E. **Average Lake Level on September 1**	20 ft above normal	10 ft above normal	normal "Business as Usual"
Cost	$50/year	$25/year	$0/year
	☐	☐	☐
F. **Average Lake Level on September 1**	25 ft above normal	40 ft below normal	normal "Business as Usual"
Cost	$5/year	$10/year	$0/year
	☐	☐	☐

Appendix D.1: Survey Summary Statistics for Boone Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	28.0	
(N all = 125, N out=35)	Tennessee	88.8	62.9
Participation in lake activities	Boating	1.6	2.9
(N all = 125, N out= 35)	Camping	100.0	100.0
	Fishing	4.0	2.9
	Picnicking	30.4	34.3
	Swimming	76.0	80.0
	Other	33.6	22.9
Number of individuals in the party	1	14.4	8.6
(N all = 125, N out= 35)	2	24.0	28.6
	3	21.6	17.1
	4	8.0	5.7
	5	13.6	17.1
	6 or more	18.4	22.9
Number of days spent at the lake	1	96.8	94.3
(N all = 125, N out= 35)	2	1.6	2.9
	3	1.6	2.9
	4	0.0	0.0
	5 or more	0.0	0.0
Were visitors aware of the drawdown policy?	No	64.5	67.7
(N all=124, N out=34)	Yes	35.5	32.4
Were visitors willing to pay for delayed drawdown?	No	44.3	48.0
(N all=113, N out = 25)	Yes	55.8	52.0
		Average	
Average expenditures per person per day	Gross	$5.39	
(N all=125, N out=21)	Net		$8.91
Average stated willingness to pay for delayed drawdown		$31.35	$29.36
(N all=110, N out=28)			

Appendix D.2: Survey Summary Statistics for Cherokee Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	30.9	
(N all = 264, N out=82)	Tennessee	91.7	75.6
Participation in lake activities	Boating	41.5	53.7
(N all = 265, N out= 82)	Camping	18.1	29.3
	Fishing	36.2	52.4
	Picnicking	44.9	36.6
	Swimming	41.9	48.8
	Other	19.6	14.6
Number of individuals in the party	1	12.1	12.2
(N all = 265, N out= 82)	2	28.3	29.3
	3	12.5	9.8
	4	13.6	9.8
	5	6.0	2.4
	6 or more	27.6	36.6
Number of days spent at the lake	1	75.1	61.0
(N all = 265, N out= 82)	2	6.4	9.8
	3	2.3	6.1
	4	1.9	3.7
	5 or more	14.3	19.5
Were visitors aware of the drawdown policy?	No	41.1	47.6
(N all = 265, N out= 82)	Yes	58.9	52.4
Were visitors willing to pay for delayed drawdown?	No	31.1	29.0
(N all=251, N out = 69)	Yes	68.9	71.0
		Average	
Average expenditures per person per day	Gross	$31.03	
(N all=260, N out=51)	Net		$16.82
Average stated willingness to pay for delayed drawdown		$59.95	$43.22
(N all=234, N out = 69)			

Appendix D.3: Survey Summary Statistics for Douglas Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	54.7	
(N all = 327, N out=179)	Tennessee	83.2	70.4
Participation in lake activities	Boating	59.0	60.3
(N all = 327, N out=179)	Camping	27.2	34.1
	Fishing	51.1	53.1
	Picnicking	18.4	22.4
	Swimming	27.5	27.4
	Other	17.1	15.6
Number of individuals in the party	1	12.5	9.5
(N all = 327, N out=179)	2	40.4	38.6
	3	13.8	13.4
	4	13.5	15.6
	5	7.0	7.8
	6 or more	12.8	15.1
Number of days spent at the lake	1	52.9	40.2
(N all = 327, N out=179)	2	8.6	11.2
	3	8.9	12.9
	4	4.9	6.2
	5 or more	24.8	29.6
Were visitors aware of the drawdown policy?	No	33.0	39.0
(N all = 324, N out= 177)	Yes	67.0	61.0
Were visitors willing to pay for delayed drawdown?	No	26.7	31.1
(N all=273, N out = 132)	Yes	73.3	68.9
		Average	
Average expenditures per person per day	Gross	$34.49	
(N all=322, N out=151)	Net		$26.13
Average stated willingness to pay for delayed drawdown		$58.45	$44.04
(N all=285, N out = 154)			

Appendix D.4: Survey Summary Statistics for Norris Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	57.4	
(N all = 242, N out=138)	Tennessee	92.2	86.2
Participation in lake activities	Boating	56.6	59.3
(N all = 244, N out=140)	Camping	29.9	37.1
	Fishing	36.5	31.4
	Picnicking	40.2	41.4
	Swimming	49.2	52.9
	Other	20.5	20.0
Number of individuals in the party	1	8.2	4.3
(N all = 244, N out=140)	2	30.3	30.7
	3	13.5	12.1
	4	16.4	17.9
	5	9.8	12.9
	6 or more	21.7	22.1
Number of days spent at the lake	1	56.2	49.3
(N all = 244, N out=140)	2	8.2	9.3
	3	11.9	15.0
	4	7.8	9.3
	5 or more	16.0	17.1
Were visitors aware of the drawdown policy?	No	42.4	43.2
(N all = 243, N out= 139)	Yes	57.6	56.8
Were visitors willing to pay for delayed drawdown?	No	37.9	41.1
(N all=232, N out = 129)	Yes	62.1	58.9
		Average	
Average expenditures per person per day	Gross	$22.54	
	Net		$13.02
Average stated willingness to pay for delayed drawdown		$46.45	$33.48
(N all=229, N out = 132)			

Appendix D.5: Survey Summary Statistics for South Holston Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	51.8	
(N all = 142, N out=74)	Tennessee	54.9	16.2
Participation in lake activities	Boating	51.8	51.4
(N all = 143, N out=74)	Camping	27.3	27.0
	Fishing	37.1	28.4
	Picnicking	23.8	23.0
	Swimming	32.9	32.4
	Other	24.5	31.1
Number of individuals in the party	1	14.0	12.2
(N all = 143, N out=74)	2	26.6	28.4
	3	16.1	17.6
	4	10.5	6.8
	5	7.0	9.5
	6 or more	25.9	25.7
Number of days spent at the lake	1	58.7	54.1
(N all = 143, N out=74)	2	10.5	14.9
	3	10.5	6.8
	4	4.9	9.5
	5 or more	15.4	14.9
Were visitors aware of the drawdown policy?	No	41.6	40.5
(N all = 142, N out= 74)	Yes	58.5	59.5
Were visitors willing to pay for delayed drawdown?	No	30.6	12.5
(N all=98, N out = 32)	Yes	69.4	87.5
		Average	
Average expenditures per person per day	Gross	$27.58	
	Net		$33.72
Average stated willingness to pay for delayed drawdown		$53.41	$41.56
(N all=135, N out = 71)			

Appendix D.6: Survey Summary Statistics for Watauga Lake

		Percent	
		All Visitors	Out of Region Visitors
Residency of visitors	Non-lake region	27.2	
(N all = 113, N out=30)	Tennessee	85.8	46.7
Participation in lake activities	Boating	40.4	58.1
(N all = 114, N out=31)	Camping	22.8	19.4
	Fishing	34.2	41.9
	Picnicking	23.7	38.7
	Swimming	19.3	22.6
	Other	29.8	12.9
Number of individuals in the party	1	16.7	6.5
(N all = 114, N out=31)	2	34.2	38.7
	3	13.2	19.4
	4	16.7	19.4
	5	7.0	0.0
	6 or more	12.3	16.1
Number of days spent at the lake	1	57.9	61.3
(N all = 114, N out=31)	2	16.7	9.7
	3	5.3	12.9
	4	1.8	0.0
	5 or more	18.4	16.1
Were visitors aware of the drawdown policy?	No	49.1	62.1
(N all = 112, N out= 29)	Yes	50.9	37.9
Were visitors willing to pay for delayed drawdown?	No	37.3	31.6
(N all=102, N out = 19)	Yes	62.8	68.4
		Average	
Average expenditures per person per day	Gross	$16.43	
	Net		$15.84
Average stated willingness to pay for delayed drawdown		$43.68	$40.93
(N all=103, N out = 27)			

Appendix E.1: Welfare Theory

The welfare measures assume that an individual is able to identify wellbeing in two alternative states: both with and without a change in TVA policy. Equation 1 represents the indirect utility function under the contingent valuation model. It can be interpreted as follows: the utility of option 1 having option 1's prices quantities/qualities, the individual's current income M, and a compensating payment CS, is equal to the utility for Option 0 at 0's prices, quantities/qualities, and income. That is CS is the transfer from income (increase in electricity expenditure that makes one just indifferent between having Option 1 (higher lake levels) and Option 0 (the current, lower lake levels). CS represents the maximum willingness to pay for Option 1.

Equation 2 represents indirect utility under the choice model. It can be interpreted similarly to Equation 1, except that the lake level attribute enters into the utility function directly.

1) $CVM: v^1(p^1, q^1(\textit{increase Sept 30 lake level}), m - CV, z) + \varepsilon^1 = v^0(p^0, q^0(\textit{status quo}), m, z) + \varepsilon^0$

2) $ChoiceModel: v^1(p^1, q^1(\textit{higher level}), m - CV, z) + \varepsilon^1 = v^0(p^0, q^0(\textit{status quo level}), m, z) + \varepsilon^0$

Following standard techniques (Hanneman and Louviere et al.), the contingent valuation and choice model indirect utility functions can be inverted to specify a willingness to pay function that measures CS, the change in welfare, above. The willingness to pay function can be estimated directly with the survey data.

The econometric specification of welfare change is then:

3) $WTP(CVM) = -(\alpha + \beta_2 Z^* + \varepsilon) / \beta_{PMT}$

4) $WTP(CHOICE) = -[(\alpha + \beta_1 PMT + \beta_2 \textit{lake level}^1 + \beta_3 Z^* + \varepsilon)_{higherlevel} - (\alpha + \beta_1 PMT + \beta_2 \textit{lake level}^0 + \beta_3 Z^* + \varepsilon)_{statusquolevel}] / \beta_{PMT}$

Where Z represents socioeconomic information and the superscripts *, 1, and 0 represent mean value, with policy, and without policy. From inspection of the components of the policy change it is clear that attributes enter directly into the WTP equation in the choice model, while in the CVM equation, they do not, i.e. ecosystem attributes are components of an individual's utility function in CM, while in CVM utility comes from the policy being evaluated.

Because of the considerable debate within environmental economics on the use of socioeconomic data in RUM models, and to be as conservative as possible with the study results, both this study and the concurrent Fontana lake study do not consider socioeconomic characteristics in the CMs. Instead, they are incorporated into the CVM models.

Appendix E.2: Choice Model Analysis Regression Tables

Boone

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.0145	0.00316	-4.574	0
FEET	0.05879	0.00739	7.959	0
ASC1	-1.74966	0.18525	-9.444	0
ASC2	-1.10258	0.11998	-9.189	0
SQ		2.85224		
#obs		745		
Psuedo R2		0.314		

Cherokee

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.00952	0.0017	-5.583	0
FEET	0.07159	0.00503	14.227	0
ASC1	-1.1859	0.11069	-10.713	0
ASC2	-0.88082	0.07906	-11.141	0
SQ		2.06672		
#obs		1580		
Psuedo R2		0.189		

Douglas

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.00694	0.00151	-4.589	0
FEET	0.07825	0.00503	15.566	0
ASC1	-1.132	0.10258	-11.041	0
ASC2	-1.24555	0.07737	-16.098	0
SQ		2.37755		
#obs		1936		
Psuedo R2		0.199		

Norris

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.01359	0.00203	-6.686	0
FEET	0.07299	0.00567	12.862	0
ASC1	-1.31475	0.12438	-10.57	0
ASC2	-1.06221	0.08585	-12.373	0
SQ		2.37696		
#obs		1434		
Psuedo R2		0.237		

Appendix E.2: Choice Model Analysis Regression Tables, continued

South Holston

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.01124	0.002593	-4.336	0
FEET	0.064681	0.007007	9.231	0
ASC1	-1.41515	0.157975	-8.958	0
ASC2	-1.20374	0.112096	-10.738	0
SQ		2.61889		
#obs		858		
Psuedo R2		0.249		

Watauga

Variable	Coefficient	Std. Dev.	T-stat	P-val
COST	-0.0114	0.00312	-3.66	0
FEET	0.07279	0.00932	7.81	0
ASC1	-1.58696	0.20044	-7.917	0
ASC2	-1.40752	0.13684	-10.286	0
SQ		2.99448		
#obs		649		
Psuedo R2		0.274		

Appendix E.3: Contingent Valuation Method Econometric Tables

Table E.3a: Tobit Analysis of Open-Ended CVM Data for Recreation Survey

Boone

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	21.74275	8.79797	2.471	0.0135
INC2	0	0.00015	0.008	0.994
OWNBT	7.58784	11.54233	0.657	0.5109
EDUC	0.00291	0.03596	0.081	0.9355
Sigma	48.9536222	3.976043	12.312	0

Cherokee

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	20.07951	15.43892	1.301	0.1934
INC2	0.0001	0.00022	0.438	0.6616
OWNBT	21.56028	14.72783	1.464	0.1432
EDUC	0.04893	0.08545	0.573	0.5669
Sigma	107.81852	5.77226	18.679	0

Douglas

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	-21.07639	19.32428	-1.091	0.2754
INC2	0.00061	0.00019	3.197	0.0014
OWNBT	25.88944	14.21765	1.821	0.0686
EDUC	3.99223	4.54425	0.879	0.3797
Sigma	104.0568	5.02191	20.721	0

Norris

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	-21.49917	18.60736	-1.155	0.2479
INC2	0.00032	0.00018	1.779	0.0752
OWNBT	3.91962	12.96735	0.302	0.7624
EDUC	9.33587	4.10166	2.276	0.0228
Sigma	89.0663	5.10939	17.432	0

Appendix E.3: Contingent Valuation Method Econometric Tables

Table E.3a: Tobit Analysis of Open-Ended CVM Data for Recreation Survey, continued

South Holston

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	-18.9538	32.95213	-0.575	0.5652
INC2	0.00065	0.00033	1.994	0.0462
OWNBT	9.64217	22.94528	0.42	0.6743
EDUC	1.6602	7.59606	0.219	0.827
Sigma	126.5958	9.13141	13.864	0

Watauga

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	16.58698	16.66068	0.996	0.3195
INC2	-0.00018	0.00023	-0.788	0.4306
OWNBT	39.13019	16.42725	2.382	0.0172
EDUC	0.00606	0.07945	0.076	0.9392
Sigma	77.50518	7.00146	11.07	0

Appendix E.3: Contingent Valuation Method Econometric Tables
Table E.3b: Descriptive Statistics for Recreation Survey CVM Models

Boone

Variable	Mean	Std Dev	Min	Max	#obs
INC2	54795.92	32115.44	10000	120000	98
OWNBT	0.236364	0.426792	0	1	110
EDUC	2.740741	1.38328	1	6	108

Cherokee

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	60283.02	29832.31	10000	120000	212
OWNBT	0.493562	0.501035	0	1	233
EDUC	2.835498	1.441239	1	6	231

Douglas

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	64431.37	29032.47	10000	120000	255
OWNBT	0.701754	0.458293	0	1	285
EDUC	3.045775	1.407206	1	6	284

Norris

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	66201.92	31230.75	10000	120000	208
OWNBT	0.620087	0.486428	0	1	229
EDUC	3.132159	1.487463	1	6	227

South Holston

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	64094.49	33744	10000	120000	127
OWNBT	0.562963	0.497867	0	1	135
EDUC	3.296296	1.545692	1	6	135

Watauga

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	62688.17	33399.42	10000	120000	93
OWNBT	0.485437	0.502232	0	1	103
EDUC	3.166667	1.617254	1	6	102

Table E.3c: Tobit Analysis of Open-Ended CVM Data for Household Survey

Cherokee

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	13.88703	45.74684	0.304	0.7615
INC2	0.001242	0.000693	1.791	0.0734
Sigma	202.3142312	22.354056	9.05	0

Douglas

Variable	Coefficient	Std. Dev.	T-stat	P-val
Constant	-7.070408	18.215203	-0.388	0.6979
INC2	0.00136523	0.00026555	5.141	0
Sigma	101.47107	7.1985005	14.096	0

Table E.3d: Descriptive Statistics for Household Survey CVM Models

Cherokee

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	59166.66	29738.82	10000	110000	48

Douglas

Variable	Mean	Std.Dev.	Min	Maximum	# obs
INC2	64423.08	29945.81	10000	110000	104

Appendix E.4: Hedonic Estimation Results

	Cherokee			Douglas		
Variable	**Coefficient**	**P-Value**	**Marginal Effect**	**Coefficient**	**P-Value**	**Marginal Effect**
Above average building quality	0.470	0.000	20821.71	1.887	0.001	26946.37
Below average building quality	-0.591	0.156	-26147.23	-3.561	0.000	-50843.12
Winter view	0.418	0.014	18487.19	0.138	0.793	1972.97
Air condition	0.081	0.625	3587.17	1.695	0.004	24206.49
Finished basement	0.547	0.000	24203.86	0.771	0.102	11005.42
Siding exterior	-0.161	0.454	-7142.17	-0.984	0.039	-14056.03
Gravel access road	0.412	0.306	18246.55	-0.676	0.142	-9656.21
Fireplace	0.100	0.461	4411.02	0.470	0.291	6711.86
Wooden deck	-0.115	0.336	-5109.39	0.661	0.126	9431.84
Distance to winter pool (in feet)	0.000	0.000	-12.88	-0.019	0.005	-5.93
Shoreline width (in feet)	0.000	0.098	22.93	0.026	0.360	20.72
Square feet	0.001	0.000	37.65	0.148	0.000	46.77
Age	-0.035	0.000	-1803.32	-0.108	0.372	-336.28
Acres	0.025	0.553	1119.90	0.995	0.000	9108.44
Number of bathrooms	0.388	0.000	17792.98	1.206	0.018	11578.82
Constant	20.663					
Lambda	1.044	0.000		0.484	0.008	
Theta	0.098	0.261		0.194	0.010	
Log likelihood	-1706.21			-2623.30		
Number of observations	148			218		

Note: The Hedonic Price functions used in this analysis were estimated using a Box-Cox transformation.

Appendix F: References

Arrow, K., R. Solow, P.R. Portnety, E.E. Leamer, R.Radner and H. Schuman. "Report of the NOAA Panel on Contingent Valuation," Federal Register, 58(10) (January 15): 4601-4614. 1993.

Ben-Akiva, M. and S.R. Lerman. *Discrete Choice Analysis: Theory and Application to Travel Demand*. Boston: MIT Press, 1985.

Benson, E.D., J.L. Hansen, A.L. Schwartz, Jr., and G.T. Smersh. "Pricing Residential Amenities: The Value of a View." *J. Real Estate Finance and Economics*, 16(1):55-73. 1998.

Boxall, P., W.L. Adamowicz, J. Swait, M. Williams, J. Louviere. "A Comparison of State Preference Methods for Environmental Valuation." *Econogical Economics,* 18:243-253. 1996.

Cameron, T. "A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management*. 15(3):355-379. 1988.

Ciriacy-Wantrup, Siegfried V. "Capital Returns from Soil-Conservation Practices." *Journal of Farm Economics.* Vol. 29. 1181-1196. 1947.

Cordell, H.K. et al. "Economic Value and Impacts of Outdoor Recreation at Western North Carolina Lakes Under Different Management Alternatives: Final Report." U.S.D.A. Forest Service and The University of Georgia. May 1990.

Cordell, H.K. et al. "Participation Trends in Outdoor Recreation: A Report on the National Survey on Recreation and Environment." In Cordell, H. Ken, et al. *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*. Champaign, IL: Sagamore Publishing. 1999.

Cordell, H.K., et al. Chapter 2, *Recent Trends, In Outdoor Recreation for 21st Century America*. Venture Publishing, College Station, PA. Forthcoming in 2003.

Cummings, R., D. Brookshire, and W. Schulze. "Valuing Environmental Goods: An Assessment of the Contingent Valuation Method." Totowa, N.J.: Rowman and Allanheld, 1986.

Davis, Robert K. "The Value of Outdoor Recreation: An Economic Study of the Maine Woods." Ph.D. dissertation, Harvard University. 1963.

Diamond, P.A. and J.A. Hausman. "Contingent valuation: is some number better than no number." *Journal of Economic Perspectives*, 8:45-64. 1994.

Economic Benefits of the U.S. Department of Energy for the State of Tennessee, Center for Business and Economic Research, May 2000.

Freeman, A.M. III. "Property Value Models." *The Measurement of Environmental and Resource Values*, Washington, D.C.: Resources for the Future: Chapter 11. 367-420. 1993.

Hanemann, W.M. "Valuing the Environment through Contingent Valuation." *Journal of Economic Perspectives*, 8(4):19-43. 1994.

Hanson, T.R., L.U. Hath and H.C. Clonts. "Economic Impact of Reservoir Water Level Changes." Working Paper.

Khatari-Chhetri, J.B. and J.C. Hite. "Impact of an Interbasin Water Transfer on the Market Values of Lakeshore Properties." Working Paper, Strom Thurmond Institute, Clemson University, August 1989.

Lansford, N.H., Jr. and L.L. Jones. "Recreational and Aesthetic Value of Water Using Hedonic Price Analysis." *J. Agric. And Resource Economics*, 20(2):341-355. 1995.

Louviere, J., D. Henscher and J. Swait. "Stated Choice Methods-Analysis and Application." Cambridge: Cambridge University Press, 2000.

Mathews, Leah G. *Draft Fontana Lake Level Study Final Report.* Asheville: University of North Carolina at Asheville, April, 2003.

Mitchell, R. and R. Carson. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington D.C.: Resources for the Future, 1989.

Murray, M.N., et al. "*Economic and Fiscal Consequences of TVA's Draw-Down of Cherokee and Douglas Lakes*." Center for Business and Economic Research, The University of Tennessee, October 1998.

Pacific Gas and Electric Company, *Upper North Fork Feather River Project*, FERC Project No. 2105, Study 36. 2002.

Parsons, G.R. and Y. Wu. "The Opportunity Cost of Coastal Land Use Controls: An Empirical Analysis." *Land Economics*, 67(3):308-316. 1991.

Portney, P.R. "The Contingent Valuation Debate: Why Should Economists Care?" *Journal of Economic Perspectives*, 8:1-18. 1994.

Quiggin, J. "Individual, household and community willingness to pay for public goods." *American Journal of Agricultural Economics.* 80(1):58-63. 1998.

Ready, R.C., J. Whitehead and G. Blomquist. "Contingent Valuation When Respondents Are Ambivalent." Economics and Management, 29(2):181-196. 1995.

Roe, B., K.J. Boyle and M.F. Teisl. "Using Conjoint Analysis to Derive Estimates of Compensating Variation." *Journal of Environmental Economics and Management*, 31(2):145-159. 1996.

Stevens, T., C. Barret and C. Willis. "Conjoint Analysis of Groundwater Protection Programs." *Agriculture and Resource Economics Review,* October, 1997. 229-236.

Stewart, S.L., J.R. Kahn and P.M. Jakus. "Economic Values and TVA River Operations." Project report in support of TVA Activity Authorization Contract No. 99R2A-252850, August 2001.

Stewart, S.L., Y. Takatsuka and J. Kahn. "Choice Model and Contingent Valuation Estimates of the Benefits of the Ecosystem Protection." The University of Tennessee Working Paper, 2002.

Takatsuka, Y. "A Comparison of Iterative Contingent Valuation and Choice Model Willingness to Pay." The University of Tennessee Working Paper, 2003.

Tennessee Valley Authority. "Tennessee River and Reservoir System Operation and Planning Review: Final Environmental Impact Statement." December 1990.

U.S. Army Corps of Engineers, "National Economic Development Procedures Manual – National Economic Development Costs." *National Economic Development Procedures Manual*. Institute for Water Resources, 1993.

U.S. Bureau of the Census. *1997 Economic Census: Summary Statistics for United States.* <http://www.census.gov/epcd/ec97/tn/TN000.HTM>.

U.S. Department of the Interior and U.S. Department of Commerce. *2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation,* October 2002. <http://www.census.gov/prod/www/abs/fishing.html>.

U.S. Environmental Protection Agency. "Guidelines for Preparing Economic Analyses." EPA 240-R-00-003. September 2000.

U.S. General Accounting Office. "Tennessee Valley Authority: Future Study of Lake Levels Should Involve Public and Consider Costs and Benefits." 1999.

U.S. Travel Data Center. "The Economic Impact of Travel on Tennessee Counties: A Study a study prepared for the Tennessee Department of Tourist Development. 2000.

U.S. Water Resource Council. "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies," Washington, D.C.: U.S. Government Printing Office, 1983.