June 2005

County Economic Impacts of APGI's Yadkin Project
FERC No. 2197

Draft Report

Prepared for

PBPower, Incorporated
75 Arlington St.
Boston, MA 02116

Prepared by

Katherine Heller
Laurel Clayton
Wanda Throneburg
RTI International
Health, Social, and Economics Research
Research Triangle Park, NC 27709

RTI Project Number 08984.002

RTI INTERNATIONAL

RTI Project Number
08984.002

County Economic Impacts of APGI's Yadkin Project
FERC No. 2197

Draft Report

June 2005

Prepared for

PBPower, Incorporated
75 Arlington St.
Boston, MA 02116

Prepared by

Katherine Heller
Laurel Clayton
Wanda Throneburg
RTI International*
Health, Social, and Economics Research
Research Triangle Park, NC 27709

*RTI International is a trade name of Research Triangle Institute.

Contents

Figures

Tables

Executive Summary

Alcoa Power Generating Inc. (APGI) is applying to the Federal Energy Regulatory Commission for a new license for the Yadkin Project. The Project consists of four reservoirs, dams, and powerhouses (High Rock, Tuckertown, Narrows, and Falls) located on a 38-mile stretch of the Yadkin River in central North Carolina. The Project generates electricity to support the power needs of Alcoa's Badin Works and its other aluminum operations, or is sold on the open market.

The potential economic impact of changing reservoir water levels as a result of the operation of the Project to local businesses and the counties surrounding the Project reservoirs is of concern to the community. The focus of this study was to identify reservoir related businesses and to examine the impact of changing reservoir water levels on these businesses, property values and other non-recreation related economic impacts to the surrounding 5 county region.

ES.1 RESERVOIR MANAGEMENT SCENARIOS

APGI defined three reservoir management scenarios for High Rock Reservoir to represent the potential range of management options which could be compared to existing reservoir management conditions. Scenario 1 would maintain water levels within three feet of full pond year round. Scenario 2 would allow water levels to vary over the same range as they currently do, but would extend the relatively full pond conditions a month earlier in the spring and a month later in the fall. Scenario 3 would maintain lower water levels during the summer recreation season and would allow water levels to fall farther in the winter than they currently do.

ES.2 IMPACTS TO RESERVOIR-RELATED BUSINESSES

Different types of businesses rely to some extent on the Yadkin Project reservoirs for their business. We began with an exhaustive list of businesses compiled from a variety of sources, and worked with APGI and others to narrow the list for detailed study to those businesses whose major source of revenue was thought to be related to the reservoirs; we termed these "Priority A" businesses. We grouped the identified businesses into three categories: businesses that use the water from the reservoirs in their business (APGI, Alcoa's Badin Works, Duke Energy's Buck Steam Plant, Salisbury-Rowan Water Utility and Tuckertown Water Treatment facility), those whose customers use the reservoirs for recreation or tourism (recreation-related), and those whose customers live near the reservoirs (property-related). We contacted the businesses for a preliminary interview; then, after the Reservoir Management Scenarios were defined, we contacted them again to ask about the impacts of the water levels specified in the alternative Scenarios. We used their responses to estimate percentage impacts on revenues; to preserve confidentiality, we used county-level NAICS code data as the basis for estimating impacts under "low" and "high" impact assumptions. We found that most businesses would benefit from Scenarios 1 and 2 and would be hurt by Scenario 3. County total estimated impacts ranged from a gain of more than $6 million in industry revenues in Rowan and Davidson counties for Scenario 1 to a loss of more than $33 million for Scenario 3. While gains or losses for individual businesses could be substantial, overall these totals represent only a small impact on the affected NAICS codes (at most a gain in revenues of 1.8 percent, or a loss of 6.9 percent).

ES.3 IMPACTS ON PROPERTY VALUES

Another question examined in this study was the extent to which a reservoir enhances the value of residential property, and how that enhancement may be affected by reservoir water level management. To address this question, we undertook a statistical analysis using the hedonic method, a multiple regression technique that allows us to isolate the effect of individual characteristics of a home and its environment on its sale value. We collected data on water levels, and residential

property characteristics and sales values for homes within two miles of the shorelines, for two Yadkin project reservoirs (High Rock and Narrows/Badin) and six others in North Carolina and South Carolina. Our analysis found that proximity to a reservoir enhances sales values. For homes within 0.05 mile of shore, sales prices were more than twice the values for comparable residences elsewhere; the impact of the reservoir declines with distance and is insignificant beyond a half mile from shore. Reservoir management affects the proximity premium, especially for shoreline residences. Using home sales in Rowan County[1], we estimated that Scenario 1 would increase sales prices of properties within 0.05 miles from shore by about $35,000, and homes between 0.05 and 0.5 miles from shore by about $5,000. Scenario 3, on the other hand, is estimated to reduce sales prices of shoreline properties by about $30,000 and to reduce sales prices for other nearby properties by about $4,000.

[1]Davidson County was omitted because its data were not comparable; however, a supplemental analysis including Davidson County is presented in Appendix D.

1 Introduction

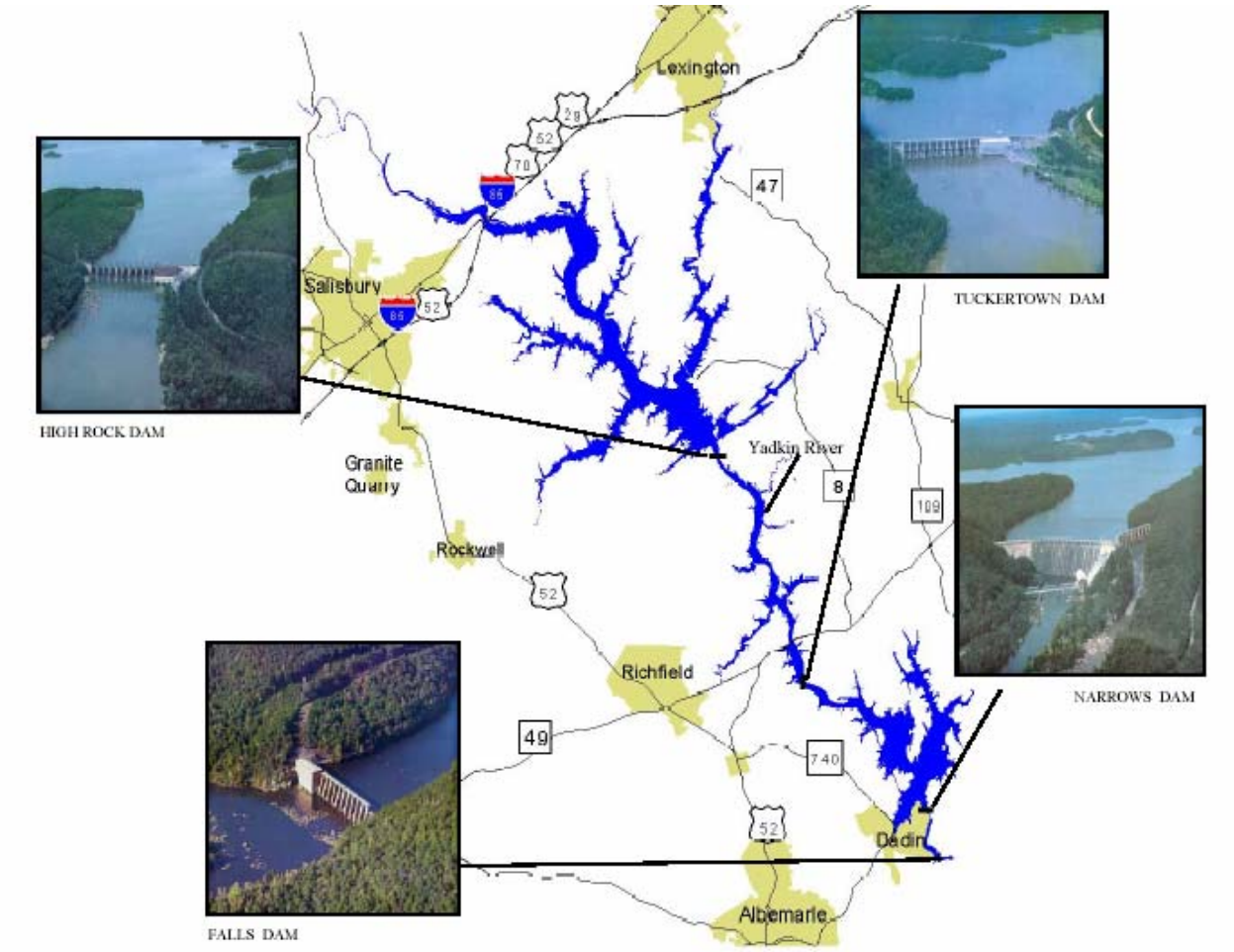
Alcoa Power Generating Inc. (APGI) is applying to the Federal Energy Regulatory Commission for a new license for the Yadkin Project. The Project consists of four reservoirs, dams, and powerhouses (High Rock, Tuckertown, Narrows, and Falls) located on a 38-mile stretch of the Yadkin River in central North Carolina (Figure 1-1). The Project generates electricity to support the power needs of Alcoa's Badin Works and its other aluminum operations, or is sold on the open market.

The potential economic impact of changing reservoir water levels as a result of the operation of the Project to local businesses and the counties surrounding the Project reservoirs is of concern to the community. The focus of this study was to identify reservoir related businesses and to examine the impact of changing reservoir water levels on these businesses, property values and other non-recreation related economic impacts to the surrounding 5 county region.

1.1 BACKGROUND

As part of the relicensing process, in September 2002, APGI prepared and distributed an Initial Consultation Document (ICD), which provides a general overview of the Project and its operation. Agencies, municipalities, non-governmental organizations and members of the public were given an opportunity to review the ICD and identify information and studies that were needed to address relicensing issues. To further assist in the identification of issues and study needs, APGI formed Issue Advisory Groups (IAG) to advise APGI on resource issues throughout the relicensing process. Through

Figure 1-1. The Alcoa Yadkin Project, including High Rock Reservoir, Tuckertown Reservoir, Narrows Reservoir (Badin Lake), and Falls Reservoir



Source: Alcoa Power Generating Inc. (APGI). September 2002. Initial Consultation Document. http://www.alcoa.com/yadkin/en/pdf/documents/Yadkin_ICD_9-02.pdf.

meetings, reviews and comments, the IAGs assisted in developing the Study Plans for the various resource issues, and will further review and comment on the study findings. The County Economics IAG was interested in the relationship between the Project reservoirs and the economies of the five counties surrounding the Project (Montgomery, Stanly, Davidson, Rowan and Davie).

The During the first County Economic Impacts IAG meeting, members identified questions relating to the reservoirs and their impacts on the counties' economies. These individual questions have been grouped into the following four overarching issue areas, as presented at the November 2003 meeting of the County Economic Impacts IAG:

1. What are the reservoir-related businesses in the five-county area, what is their contribution to the economies of the five counties, and how are the businesses affected by the reservoirs?
2. What is the contribution of the reservoirs to surrounding property values and the county tax base?
3. What is the relationship between the reservoirs and recreation, tourism, and visitors?
4. What is the impact of alternative reservoir operating scenarios on the economies of the surrounding five counties (excluding recreation impacts)?

The IAG also identified the potential impacts of reservoir operations on surrounding property values as another area of concern. Finally, the IAG recommended that this study examine the overall economic impact to the counties surrounding the Project associated with changing reservoir water levels. Because the direct impact to the county economies associated with recreational use of the reservoirs was being addressed in a separate study being conducted by Environmental Resources Management (ERM), the focus of the current study was on the non-recreational aspects of economic impacts. This report presents the findings of the Surrounding County Economics Study, following implementation of the Final Study Plan, dated April, 2004. While reasonable attempts have been made to assure the two studies do not consider the same issues, some overlap may occur.

1.2 APPROACH TO ANSWERING THE IAG'S QUESTIONS

The County Economic Impacts IAG raised two essentially separate issues: what is the impact of reservoir operations on reservoir-related businesses, and what is its impact on the value of properties near the reservoirs. Because the issues are largely separate, RTI International (RTI) undertook two separate analyses to address the IAG's questions about the impact of the reservoirs' operations on businesses and property values in the surrounding five counties. Each analysis characterized the impact of the reservoirs under existing or baseline conditions. Next, impacts were evaluated under three alternative water-level scenarios, which were developed jointly by APGI and the IAGs to represent a range of possible operating conditions for the reservoirs in the future.

To address the impacts on non-recreation reservoir related businesses, the analysis first identified and characterized the businesses using information provided by several IAG members. We then conducted voluntary in-depth interviews with identified businesses to explore the nature of the relationship between the businesses and the reservoirs and to assess the impacts of operations at the reservoirs under the three water-level scenarios. The analysis of impacts on nonrecreation reservoir-related businesses is described in Section 2.

To examine the impact of the reservoirs and their operations on property values, we first used geographic information systems (GIS) data to examine property values near the reservoirs and compare them with property values elsewhere in the five counties. Examination of the GIS data revealed that the relationship between the reservoirs and surrounding property values was complex. For this reason, a careful statistical analysis was undertaken to quantify the effect of proximity to the reservoirs and of reservoir operations on home sales prices, while accounting for the other factors affecting property values. This analysis and its results are described in Section 3.

1.3 WATER-LEVEL SCENARIOS

As part of this study, the IAG asked that we analyze the potential economic impacts of future reservoir operating scenarios. To do this, three simplified water-level scenarios were developed for High Rock Reservoir. These scenarios and the simplified characterization of baseline operating conditions are shown in Table 1-1 and Figure 1-2. APGI developed these scenarios to represent a range of possible future operating conditions for water levels in High Rock Reservoir. None of the water-level scenarios are specifically being proposed or chosen as APGI's future target, but were identified to represent a range of potential future operating conditions. The alternatives include near-full year round water levels, extending the period of near full conditions 1 1/2 months earlier in spring and 1 1/2 months later in fall, and lower overall water levels, including a draw down of 20 feet below full pond in the winter. Actual water levels would not necessarily correspond exactly to any scenario, because actual water levels will fluctuate based on river flows, weather conditions and APGI generation. These scenarios, however, provide a basis for analyzing the potential impacts.

Table 1-1. Description of Water Level Management Scenarios for High Rock Reservoir

Alternative	Description
Existing conditions	Simplified version of average historical conditions, with water levels at about 3 feet below full pond (652 feet) from mid-May to mid-September and 10 feet below full pond (645 feet) the rest of the year
Alternative 1	Maintain the water level at 3 feet below full pond (652 feet) year-round
Alternative 2	Maintain the summer water level of 3 feet below full pond (652 feet) from the beginning of April to the end of October, dropping to 10 feet below full pond (645 feet) the rest of the year
Alternative 3	Maintain a slightly lower summer water level at 5 feet below full pond (650 feet) from mid-May to mid-September and a more intense winter drawdown of 20 feet below full pond (635 feet)

Note: Full pool elevation for High Rock Reservoir is 655' (Yadkin local datum)
[a]YD refers to Yadkin Datum, indicating where the elevation is defined.

Figure 1-2. Alternative Water-Level Scenarios for High Rock Lake

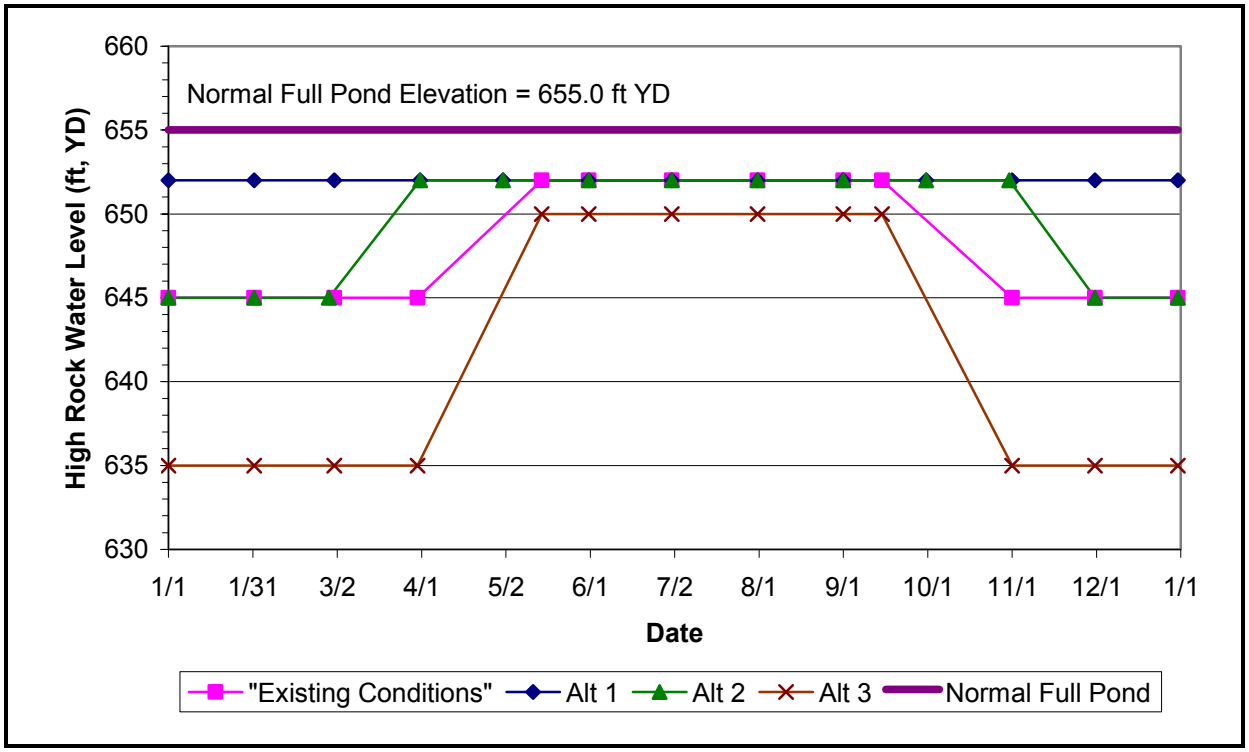


Figure 1-2 illustrates the simplified water-level scenarios used in this study. Full pond for High Rock Reservoir is defined as 655 feet (Yadkin local datum).

Alternative water-level scenarios were only developed for High Rock Reservoir. Tuckertown and Falls Reservoirs have very limited storage and are already operated within a narrow zone of fluctuation (generally 3 feet or less). Narrows Reservoir has some storage available but typically fluctuates less than 3 feet from full pond on a year round basis. Because the concerns voiced by the IAG focused on operations at High Rock Reservoir and the alternative water level scenarios are defined for High Rock Reservoir, our analysis of impacts focuses mainly on businesses and properties located on High Rock Reservoir.

1.4 OVERALL APPROACH

In the sections that follow, we profile baseline conditions by examining the impact of the reservoirs under existing water-level management on reservoir related businesses and properties. Then we evaluate the impacts of alternative High Rock water level scenarios by comparing expected conditions under each alternative with existing conditions. Section 2 examines impacts on local reservoir related businesses, and Section 3 examines impacts on property values around the reservoirs. Both impact analyses focus on High Rock Reservoir because the alternative water-level scenarios are defined for High Rock Reservoir. Finally, Section 4 draws some general conclusions.

2 Impacts on Reservoir-Related Businesses

To assess the impacts of water level scenarios on reservoir related businesses, RTI conducted surveys of various business owners. We recognized that different types of businesses rely, in varying capacities, on the Yadkin River reservoirs in the five-county study region. The reservoirs support a number of services both directly and indirectly, including hydropower generation, household and industrial water supply, recreation, and tourism. The impact of different reservoir management strategies on the businesses associated with these services, or reservoir related businesses, can be significant.

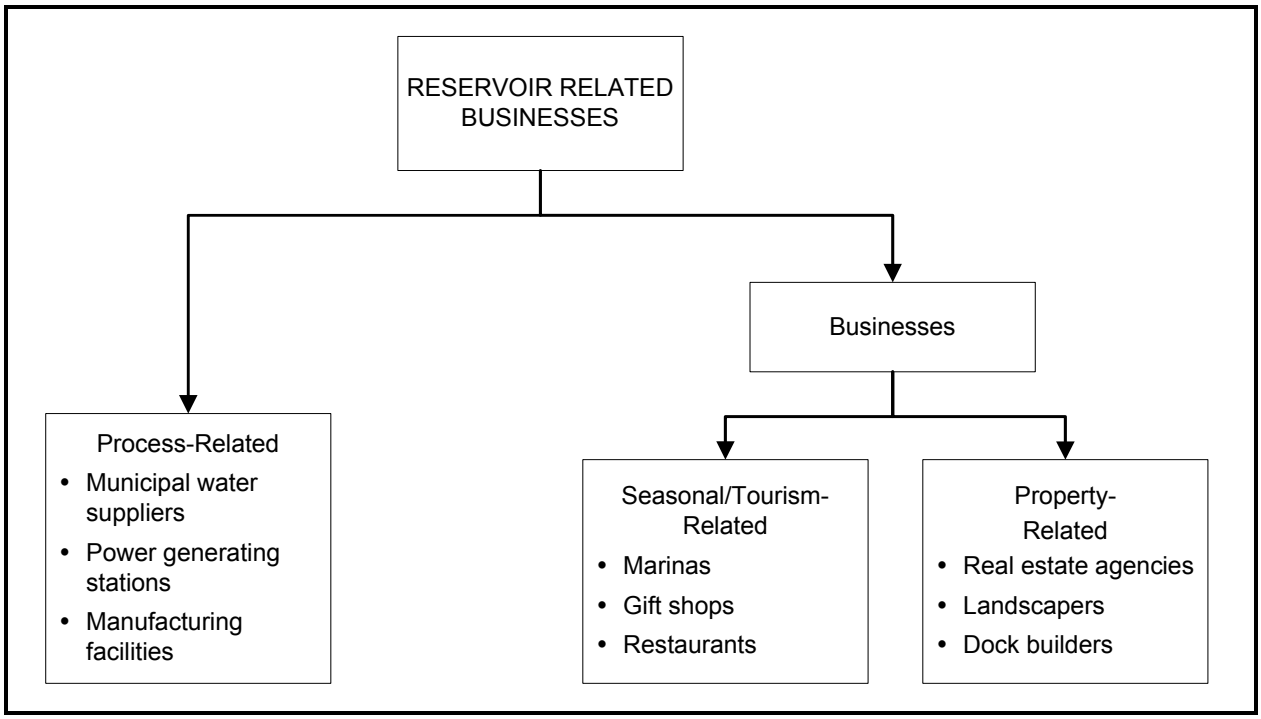
2.1 TYPES OF ESTABLISHMENTS

Two types of establishments, illustrated in Figure 2-1 and discussed in more detail below, are impacted by how the reservoirs are operated: those with customers attracted to the reservoir for recreational or residential purposes and those using the water in their business operations. We compiled data on businesses in each category separately, to enable us to model the impacts on them differently if that were desirable to reflect the different mechanisms through which the reservoirs affect the businesses.

2.1.1 Seasonal/Tourism-Related and Property-Related Businesses

Businesses falling into the first category include restaurants, construction companies, marinas, and boat repair shops. These businesses are most affected by how the water level affects the

Figure 2-1. Classification of Establishments



demand for their products and services, and they can be further divided into seasonal/tourism-related and property-related businesses.

We classified businesses as related to the season/tourism or property value depending on whether the reservoir water levels

- affect the seasonal use of the reservoir and thus indirectly affect demand for these businesses' services, or
- affect reservoir related property (demand, values, etc.) and thus indirectly affect demand for these businesses' services.

Individual businesses often fall somewhere between fully seasonal/tourism-related and fully property-related, such as restaurants serving both visitors and residents or construction companies building both permanent and summer vacation homes. However, we classified businesses into a primary group to simplify the data collection and analysis.

Based on survey responses, seasonal/tourism-related businesses depend largely on people visiting the reservoir during the summer recreation season. Some of these

businesses shut down during the winter months while others are open year-round with the majority of their sales occurring during the summer season. Restaurants, marinas, and bait shops are considered seasonal/tourism-related businesses. These businesses are affected by reductions[1] in the reservoir water level and by an associated reduction in the number of visitors desiring to recreate on the reservoir. Based on the survey responses, reductions in the water level of 5 feet or more in the summer season can significantly affect these businesses, especially if the water level were to drop low enough so that boats could no longer navigate in certain areas of the reservoir or could not use business facilities such as boat launches and docks. In addition to variation of the water level during the summer, extending or curtailing the summer season is expected by the respondents to affect seasonal/tourism-related businesses.

Property-related businesses provide services associated with land and buildings surrounding the reservoirs. As property values and demand increase, the demand for the services of these businesses increases. Examples of property-related businesses include real estate agencies, dock builders, and general contractors. These businesses are affected by the demand for developing property adjoining the reservoirs and improving existing residences on the reservoir. The water level year-round, not just during the summer recreation season, affects these businesses.

Table 2-1 shows the division of businesses in the sample by North American Industry Classification System (NAICS) code into these two categories. Seasonal/tourism-related businesses and property-related businesses are expected to react differently to the alternatives, which consist of keeping the water level in the reservoir constant year-round, lengthening the summer recreation season, and lowering the water level further in the winter season. We discuss our findings regarding the potential impacts of the alternatives on the businesses after describing the methodology used to build the list of reservoir related establishments and summarizing the results from the interviews with some of these establishments.

[1]When queried, businesses indicated that when they cite water level reductions, they are generally thinking of reductions or drops that are sustained over a significant period of time—at least several weeks.

Table 2-1. Business Types Included, by NAICS Code

NAICS Code	Description	Group
23541	Masonry and Stone Contractors	Property-related
23593	Excavation Contractors	Property-related
23611	Residential Building Construction	Property-related
23799	Other Heavy and Civil Engineering Construction	Property-related
44122	Motorcycle, Boat, and Other Motor Vehicle Dealers	Seasonal/tourism-related
44422	Nursery and Garden Centers	Property-related
44511	Supermarkets and Other Grocery (except Convenience) Stores	Seasonal/tourism-related
44512	Convenience Stores	Seasonal/tourism-related
45111	Sporting Goods Stores	Seasonal/tourism-related
53121	Offices of Real Estate Agents and Brokers	Property-related
53229	Other Consumer Goods Rental	Seasonal/tourism-related
56173	Landscaping Services	Property-related
71393	Marinas	Seasonal/tourism-related
72119	Other Traveler Accommodation	Seasonal/tourism-related
72121	RV (Recreational Vehicle) Parks and Recreational Camps	Seasonal/tourism-related
72221	Limited-Service Eating Places	Seasonal/tourism-related
81341	Civic and Social Organizations	Not applicable

2.1.2 Process-Related Establishments

Other types of facilities not included in the business categories above are also expected to be affected by reservoir operations. Duke Energy's Buck Steam Station, municipal water suppliers, and APGI use the water in the reservoir in business operations. For these businesses, the effect of reservoir water levels on the costs of operating their facilities, instead of the demand for their product or service, is the main impact expected. The ability of their process to react to reservoir operations, such as the height of the water intake pipe and filtration system requirements, determines how different plans for managing the reservoir would affect these establishments.

2.2 DATA SOURCES

Determining whether an establishment is reservoir related depends on both the type of business and its proximity to the reservoir. Municipal water suppliers, Buck Steam Station, and APGI's operations use water directly from the reservoirs for use in the business process, inextricably linking these facilities to the management of the reservoirs. For other businesses, the link to the reservoirs is not as evident. RTI used an iterative process to assemble a list of these businesses.

2.2.1 Creation of a Master List

RTI gathered information from numerous sources to compile a master list of all the businesses in the five-county area that we thought were reservoir related (more than 800 businesses) then narrowed the list based on an assessment of what share of their business is tied to the reservoirs. Sources of potential businesses included lists from Chambers of Commerce and reservoir related associations. Some businesses were on more than one list. The High Rock Business Owner's Association (HRBOA) list consisted of approximately 85 businesses that had been affected by the drop in reservoir level in 2002 and expect to be affected if changes occur in the management of the reservoirs' water level. Most businesses on the HRBOA list are located within a 15-mile distance from the shoreline, though some out-of-state boat dealers were listed.

Chamber of Commerce lists for the five counties were used as major sources. Businesses of the types determined to be potentially reservoir related (such as boat dealers, restaurants, and real estate agencies) and located near the reservoirs were included. IAG members, APGI, and several others who are knowledgeable about the area provided input (by phone or e-mail) on the list of businesses. A Web search was also used to find businesses that met the criteria for inclusion.

2.2.2 Selection Process

When an overall master list of businesses was compiled by combining information from these sources, RTI then used information on type of business and distance from the reservoir to refine the list. While attempting to be as inclusive as possible, we also wished to focus our assessment on businesses most closely tied to the reservoirs. This would enable us to make the best assessment of impacts possible given the project

schedule and resources. Both directly and indirectly affected businesses were included. However, some businesses were deliberately excluded in an effort to avoid double-counting impacts covered in the ERM recreation impact study. When we could determine location, proximity to the reservoir was considered. Out-of-state businesses were excluded. When exact location was known, only businesses a mile or less from shoreline were included. When only the rough location was known (such as general location on an online map source), businesses within approximately 5 miles of the shoreline were included. Businesses specifically identified as reservoir related, such as in-state businesses on the HRBOA list and businesses mentioned specifically by contacts, were added. Businesses known to be closed were deleted from the lists. Of the more than 800 businesses identified from our compiled sources, approximately 260 remained candidates for being reservoir related.

In the next step in refining the list, RTI, in consultation with staff at APGI, used a three-level coding scheme to narrow the list of businesses to those most likely to be affected by the reservoir:

- Priority A: A business depending on reservoir-oriented activity and/or residents, and so defined because of the nature of the business or the proximity of the reservoir. These businesses most likely receive the majority of their revenue from reservoir-related activities. Examples include marinas, boat dealerships, tackle shops, convenience stores, and building contractors.
- Priority B: Similar to Priority A, a business depending on reservoir-oriented activity and/or residents, and is so defined because of the nature of the business or the proximity of the reservoir. Unlike Priority A, these businesses most likely receive a much smaller share of their revenue from reservoir-related activities. Examples include restaurants, hardware stores, and lodging in close proximity to the Project.
- Priority C: A business not likely to depend on reservoir related activity and/or residents for any significant share of its revenue. Reservoir related purchases and/or customer traffic are incidental. Proximity to the reservoir is coincidental and independent of the revenue stream.

Approximately 15 percent of the businesses on the list were classified as Priority A, 35 percent as Priority B, and 45 percent

as Priority C. It was also determined that several of the businesses on the initial list had closed (about 5 percent). Businesses coded as Priority A, municipal water suppliers, Duke Energy's Buck Steam Station, and Alcoa's Badin Works were included on a list of 44 reservoir related businesses that were approached to participate in the survey.

After the initial interviews were conducted, contacts recommended adding several additional businesses. Only three of the businesses would be potentially affected by the alternatives for different management of High Rock Reservoir. The remaining seven conduct business near Narrows Reservoir. In total, 54 reservoir related businesses were examined in this study.

Appendix A lists the businesses included on the master list (approximately 260 businesses) and the assigned priority code. Appendix B contains information on the businesses included in the final list (54 businesses), including whether the businesses were surveyed. Since the reservoir water level scenarios would only impact businesses on or near High Rock Reservoir, 30 seasonal/tourism-related and property-related businesses and process-related businesses including Duke Energy's Buck Steam Station, Salisbury-Rowan Utilities, and Alcoa's Badin Works are included in the final analysis of the scenarios.

2.3 DATA COLLECTION

To develop data regarding water level impacts, RTI used two rounds of surveys. During the first round, businesses provided general information, confirmed that the business is reservoir related, and described the general impact of the reservoir water level on the business. The Priority A businesses were contacted during this round of interviews.

After the scenarios were determined, a second round of interviews was conducted to gather more specific information related to the reservoir management alternatives in order to quantify impacts. This round of interviews included a subset of the Priority A and additional businesses to gather estimates on the impact of the water level alternatives on different types of reservoir related businesses around High Rock Reservoir. Process-related businesses were contacted during the second round of interviews, at which time both general information related to the businesses and estimates of the impacts of the

alternatives were obtained. Appendix B identifies which businesses were surveyed during each round of interviews.

Reservoir related businesses were contacted by phone and e-mail (when applicable). Roughly half of the businesses provided information for the analysis. We attempted to contact businesses generally two to three times, leaving messages when possible. Some were unwilling to provide information while others never responded or did not pick up the phone. E-mail messages were sent when an e-mail address was known, but we received responses from only five businesses via e-mail during the initial round of interviews.

To obtain as consistent a set of information on each business as possible, a predetermined set of 16 to 19 questions, depending on the type of establishment, was asked of each business. The main components of the questionnaire administered were:

- basic information (name, address, county, reservoir, contact information);
- general information (business or process description, annual revenue, number of employees, withdrawal rate for steam station, and water suppliers); and
- influence of the reservoir on the facility and the impact of variation in reservoir water level on the facility (local clients, how does variation affect business/operations, change in sales/costs in a typical year when the reservoir level is down and during the 2002 drought).

Survey questions from both rounds of interviews are provided in Appendix C.

RTI assured businesses that their responses would remain confidential, with results only reported in aggregate. For that reason, survey results for the individual businesses are not identified in this report.

2.4 SUMMARY OF RESPONSES OF INITIAL INTERVIEWS

RTI initially interviewed reservoir related businesses during August and September 2004 (first round of interviews) to gather general information on the business and determine how the business is affected by variations in the reservoir water level. Businesses on High Rock and Narrows reservoirs were included in this round of interviews.

2.4.1 Businesses (Seasonal/Tourism-Related and Property-Related)

Approximately half of the 37 businesses contacted during the first round of interviews provided information for this analysis. Publicly available information on the businesses augmented the general information. Although several businesses did not contribute data to the analysis, the information provided by those businesses that were interviewed can be used to illustrate the prevailing views of the general impacts of the management of the reservoirs on reservoir related businesses.

Summary of General Information

Annual revenue estimates from the reservoir related, non-process businesses surveyed ranged from $50,000 to over $16 million per business entity. Over 80 percent of the businesses with revenue estimates had less than $1 million in sales. Table 2-2 shows the distribution of businesses by revenue range; revenue data are based on interview data for businesses that provided revenue estimates and publicly available data.[2,3] Several of the facilities on the list were determined to be associations or other non-business entities, with no revenue in the traditional sense; these included a home-owner's association, several boat clubs, and the Wildlife Resources Commission boat ramp.

Table 2-2. Annual Revenue Distribution

Annual Revenue	Number of Businesses[a]	Percentage of Businesses[a,b]
Less than $500,000	18	40%
$500,000 to $999,999	19	42%
$1 to $4.9 million	6	13%
$5 million or more	2	4%
Total	45	100%

[a]Process-related businesses are not included.

[b]Percentages do not sum to total due to rounding.

[2]The analysis presented in Section 2.5.2 does not use these values. A more general revenue estimate is used, based on county-level 2-digit North American Industry Classification System (NAICS) code data, to maintain confidentiality.

[3]ReferenceUSA revenue data was used for 14 of the businesses that did not agree to an interview or did not provide a revenue estimate during the interview. For the remaining 19 businesses, revenue estimates were derived from Risk Management Association's (RMA's) Annual Statement Studies 2002–2003.

For three of the businesses, local customers make up the entirety of the clientele. One business depends totally on tourists. Approximately 50 percent to 90 percent of the clientele for the remaining 13 businesses responding to this question are local residents.[4]

Impacts of the Reservoirs' Water Levels on Reservoir Related Businesses

Estimates of the potential impact of the reservoir water levels on reservoir related sales varied considerably among the businesses on High Rock and Narrows reservoirs. Only one respondent said that the business is not affected by variation in the reservoir water level. This business is located farther from the reservoir than many of the other businesses that were interviewed and the business is not located at that spot because of proximity of the reservoir. When asked about a typical drop in the reservoir water levels, most businesses interpreted it as about a 5-foot drop in the water level from full pond, sustained over at least a few weeks. Businesses that expected to be affected estimated impacts that ranged from an 8 percent to 65 percent drop in sales. The most common response was a 50 percent drop in sales (five businesses), with an average of about 35 percent for those that indicated some drop in sales. For most, the 2002 drought year was the worst year recently. The sustained reduction in the water levels, experienced at High Rock and Narrows reservoirs in 2002 (exceeding 10 feet for some time on High Rock Reservoir), was estimated by responding businesses to have caused a range of 19 percent to 100 percent drop in sales, with an average of 64 percent for those who indicated some drop in sales during the 2002 drought period relative to typical seasons. The business indicating the smallest drop in revenue (18 percent to 20 percent during 2002) stated that the business had no profit during the drought year, and two businesses indicated losing all revenue during the 2002 drought year.

During the reservoir related business interviews, respondents tended to reference the 2002 drought year often. In some cases, the estimate of a decrease in sales due to a typical drop in reservoir water levels may be biased by the memories of the impact of the drought year on the business. Note that some

[4]Those responding that "most" of their clients are from the local area are included in this estimate.

businesses were reported to be out of business as a result of the loss in sales during the drought year. Those businesses are not included in this analysis because they would not be affected by any future changes in management of the reservoirs. We do include businesses that are still in operation under different management.

2.4.2 Municipal Water Suppliers

The three water suppliers with intakes located on the Yadkin Project reservoirs providing information for this analysis had significantly different responses to the questions. The City of Albemarle treatment facilities (Tuckertown Water Treatment Facility and Hwy 52 Water Treatment Facility) serve almost all of Stanly County. Intakes are located on the Tuckertown and Narrows reservoirs. According to the City of Albemarle, treatment costs increase if the water level drops by more than 3 feet in the Tuckertown Reservoir and by more than 12 feet in the Narrows Reservoir. Chemical treatment can be used to address water quality changes due to small drops in the water level, but if the typical water level were to drop farther, capital investments in a new treatment process would be required.

According to Salisbury-Rowan Utilities, the opposite effect occurs at the Salisbury-Rowan Utilities Water Treatment Plant and Salisbury-Rowan Utilities Wastewater Treatment Plant (collectively the Salisbury-Rowan Utilities). The intake and discharge points of the Salisbury plant are located on the Yadkin River above the main body of High Rock Reservoir. However, according to Salisbury, the water level in High Rock Reservoir does affect plant operations. In its response to the survey, Salisbury reported that as the water level in High Rock Reservoir increases, sedimentation problems in the vicinity of their water intake increases, thus increasing treatment costs.

2.4.3 Duke Energy's Buck Steam Station

High Rock Reservoir is also used as cooling water for Duke Energy's Buck Steam Station. Almost all of the water withdrawn from the reservoir is returned, less the nominal amount lost in evaporation and steam ejection. Buck Steam Station must comply with temperature limitations of the discharged water and water use restrictions when the water level is 10 feet or more below full pond. Additional costs are incurred when the water level drops 6 feet below full pond during the summer months due to temperature limitations. Lower water levels also

result in increased maintenance due to increased turbidity. According to Duke Energy, all units at the Buck Steam Station would be forced offline if the water level falls to 14.9 feet below full pond. Duke Energy reported that the equivalent of millions of dollars of lost energy production resulted from the drop in water level in 2002 of as much as 24 feet below full pond.

2.4.4 Alcoa's Badin Works and Alcoa Power Generating Inc.

The Yadkin Project hydropower system historically has been operated to provide electricity for Alcoa's Badin Works, an aluminum smelter and other aluminum operations. Aluminum smelting requires large amounts of low cost, reliable electricity. APGI, a subsidiary of Alcoa Inc., owns and operates the Yadkin hydropower developments, controlling the dams on High Rock, Tuckertown, Narrow, and Falls reservoirs. APGI uses the water in the reservoirs to generate economical, clean, reliable electricity. Operation of the reservoirs only indirectly affects Badin Works through its use of the power generated by the Yadkin Project. Smelting operations at Badin Works were reduced and later curtailed so that the plant uses only some of the electricity generated by APGI. The remaining generation is sold into the electricity market and helps to offset the cost of electricity used to operate Alcoa's other domestic aluminum smelting operations. High Rock Reservoir is operated as a seasonal storage facility with a fall-winter drawdown to allow for refill during the later winter and spring. The water level is drawn down in preparation for the high inflows. APGI uses short-term variations in the water level of the reservoirs to maximize the quantity and value of the generation.

2.5 ALTERNATIVE RESERVOIR OPERATING SCENARIOS

Of the reservoir related businesses identified for this study, only those businesses located on or near High Rock Reservoir (which includes about two-thirds of the businesses on the revised list, or 30 businesses) and Duke Energy's Buck Steam Station, Alcoa's operations, and the Salisbury-Rowan Utilities would be potentially directly affected by the alternative reservoir water level management scenarios. The initial interviews with reservoir related businesses referred to variation in water level of the reservoir during the summer recreation season. These estimates provide general insights but

are not useful in anticipating the impact of the alternatives on the businesses because the alternatives all assume relatively high and steady conditions during the summer season. Therefore, once the alternative water level scenarios had been identified, follow-up interviews were conducted in January 2005 with a select group of businesses on High Rock Reservoir (second round of interviews). The alternative water level scenarios considered for this study are presented in Section 1 and summarized in Table 1-1. RTI informed businesses during interviews that these alternatives were chosen to represent a range of possible operating conditions that might be considered for High Rock Reservoir in the future and that none of the alternatives is being proposed by APGI nor has in any way been selected as the future operating alternative for the Yadkin Project.

In considering the potential effects of these alternative water level scenarios on their business, RTI instructed businesses to compare the alternatives to the simplified description of existing conditions as described in the scenarios. Appendix C includes the language used to describe the scenarios to the businesses. While existing conditions assume a summer season of mid-May to mid-September (Memorial Day to Labor Day), a season of April to October may be closer to the actual current conditions.

Many of the businesses tended to associate the alternatives with changes in the summer recreation season. If the water level were more stable year-round, it is reasonable to assume that the recreation season could be extended from March to November. (This could vary, either longer or shorter, depending on the weather in the particular year.) Currently, the season is limited to the months when the water level is maintained at a relatively high level, such as within 5 feet of full pond.

2.5.1 Qualitative Assessment of High Rock Water Level Alternatives

The effects of the alternative water level scenarios for High Rock Reservoir were evaluated for both seasonal/tourism-related and property-related businesses. For seasonal/tourism-related businesses, which rely on tourists, we expect that the alternative water level scenarios would cause immediate impacts in that recreational visitation from one day to the next would change with the water level, holding all other variables

constant. (The direct impacts to county economies associated with changes in recreational use rates predicted to occur under the various water level alternatives are the subject of a separate study being conducted by ERM.) Some long-run effects are also expected as popularity of the reservoir changes and more/fewer visitors are attracted to the reservoir from year to year.

For property-related businesses, the scenarios would cause a more long-run effect. Assurance that the water level will remain constant from year to year and proof of that commitment are needed before large increases in sales for these businesses can occur. Property owners need to feel secure in their investment in their waterfront or waterview property for these businesses to experience growth in sales.

Scenario 1—Near Full Year-Round

Regardless of the seasonality of the business, reservoir related business respondents indicated that Scenario 1 (maintaining High Rock Reservoir within three feet of full pond year-round) was preferable to all other alternatives and existing conditions. The temperate climate of North Carolina would potentially allow for some year-round recreational use of the reservoir if the water level were maintained at a higher level, and it would be more aesthetically pleasing for visitors and property owners. Some businesses would have to change their business practices under this scenario but indicated that they are willing to accept this initial increase in cost to buy more equipment or change business practices. These businesses believe they would experience an increase in sales in the long run because of increased interest in the reservoir.

The opinion of many business owners is that a reservoir that is more full and constant creates the expectation that the reservoir will be there in the future. Their belief is that with a more constant water level, such as that described by Scenario 1, people would be more apt to invest in property around the reservoir, property values would rise, and more recreators visit. Fishing tournaments and other events would be more likely to be drawn to the reservoir, which can cause a significant inflow of money to many businesses on the reservoir (e.g., restaurants, accommodations) as well as bring recognition to the area. These business owners stated that even if the events are held during the summer when the water level is currently

near full pond, a reservoir near full pond year-round builds confidence and attracts bigger events that are typically booked well in advance of the event date.

Both seasonal/tourism-related and property-related businesses prefer a constant water level year-round ranging from full pond to no more than 5 feet below full pond. However, respondents disagreed on the ideal water level. In some instances, slightly below full pond allows for full access to the reservoir. One business pointed out that some boats (pontoon boats) cannot pass under some bridges if the water level is higher than 5 feet below full pond. However, one business stated that even a 5-foot drop prohibits some people in the coves from accessing the reservoir. Another respondent preferred that the water be kept at full pond rather than a few feet below to reduce sediment transfer. Businesses were in agreement that water levels lower than 5 feet below full pond reduce access to the reservoir and recreation, thus negatively affecting their businesses especially if they occur during the summer months.

Scenario 2—Extended Near-Full Water Level

Businesses indicated that Scenario 2 was favored over existing conditions but was not as desirable as Scenario 1. Because the largest portion of sales for many businesses corresponds to the increased use during the summer season, this is the period they consider to be most important. Extending the summer season by keeping the water level near full pond for a longer period of time is expected to increase sales.

Some businesses mentioned that they could understand a short (such as 1.5 to 2 month) drawdown in the winter for APGI's purposes and to allow property owners to build/repair piers. The drawdown would need to be at a reasonable level such as 8 feet below full pond (the water depth required at the end of private piers per APGI's Shoreline Management Plan requirements). In addition, businesses suggested that better communication is needed from APGI about the need for the drawdown, the level of drawdown, and the dates of the drawdown. Consistency in water levels was also noted as a key component.

Scenario 3—Larger Winter Drawdown

Strong negative reactions were common in the interview responses related to Scenario 3. Some businesses indicated

that they would likely go out of business if this alternative were implemented. The slightly lower summer water level would have little impact. However, for property-related businesses and in some instances seasonal/tourism-related businesses, those interviewed indicated that in their view, the 20-foot winter drop would be "devastating" to their businesses. Property values were predicted to drop.

Although fluctuations during the summer months can greatly affect visitation to the reservoir on a daily basis, the drop in water level in the winter may have an effect as well. For property owners and businesses related to the investment decisions of property owners, these winter drawdowns are the main concern. These businesses felt that property owners would be less likely to invest in property that only has a reservoir for a portion of the year

2.5.2 Quantitative Assessment of Alternatives

The following quantitative assessment combines limited interview data and publicly available data to provide a range of estimates of the potential impacts. These estimates are illustrative rather than precise point estimates of the influence of reservoir policy on the profitability of reservoir related businesses.

Businesses (Seasonal/Tourism-Related and Property-Related)

Quantifying the impact of the reservoir management scenarios on the businesses is difficult for several reasons. Only the Priority A businesses (as discussed in Section 2.2.2) were included in the analysis, limiting the pool of respondents to those expected to be most affected by changing water levels. Other businesses not included in our analysis may also be affected by changes in management of the reservoir water levels. For this reason, interview responses may not provide enough data to reliably capture the impacts on all businesses that might be affected by changes in the management High Rock Reservoir water levels. Businesses tended to have difficulty reacting to hypothetical situations. Also, they were not always able to remain objective while responding to the questions because of their memories of the effects of the 2002 drought and their emotional attachment to the reservoir. Despite these limitations, within the context of available resources and data, the interview responses provide invaluable

insight into how businesses expect to be affected by reservoir water levels.

Although responding to these situations was understandably difficult, some businesses were willing to provide rough estimates of the impacts of the alternative water level scenarios on their business. Overall, Scenario 1 is projected to result in a 10 percent to 20 percent increase in sales. Scenario 2 is anticipated to have a smaller positive impact, ranging from a 2 percent to 10 percent increase in sales. Scenario 3 would have a negative impact, with expectations ranging from a 20 percent to 100 percent decrease in sales.

For seasonal/tourism-related businesses, the difference in the increase in sales between Scenarios 1 and 2 is expected to be smaller than for property-related businesses. The season associated with Scenario 1 would be similar to that of Scenario 2 mainly because of the weather. Several businesses noted that tourism on the reservoir decreases as the temperature falls, regardless of the reservoir's water level. Property-related businesses are expected to have a larger increase in sales for Scenario 1 compared to Scenario 2 because they rely on the investment decisions of property owners.

The ranges of impacts for the alternatives on local businesses are based on the limited number of responses from the second round of interviews and our best judgment. Again, these results should not be generalized and are expected to vary considerably for individual businesses based on many factors. All results are compared to the simplified depiction of High Rock Reservoir water levels under existing conditions.[5] These impact estimates were computed using the range of percentages described above. Annual revenue for an individual business was approximated using the average annual sales, receipts, and shipments by two-digit North American Industry Classification System (NAICS) code for establishments in the relevant industries in Rowan and Davidson counties from the 1997 Economics Census for all industries except for the construction industry, which is based on data at the state level.[6] Table 2-3

[5]Actual current conditions do not closely match those presented with the alternatives. Although respondents were instructed to compare the alternatives to the representation of existing conditions, the hypothetical baseline also introduced uncertainty into their estimates.

[6]Construction industry estimates are not reported at the county level.

presents the range of potential impacts per business by multiplying the range of impacts by the revenue estimates for that NAICS code. Values were converted to 2003 dollars using the producer price index for all commodities. Then, estimated total industry impacts are obtained by multiplying the low and high impact estimates times the number of businesses in each NAICS in the two counties.

The total estimated impacts for all of the seasonal/tourism-related and property-related businesses potentially impacted by the reservoir water level scenarios range from an increase in revenue of over $6 million to a decrease in revenue of almost $34 million. The low and high total county impact estimates for each NAICS under each scenario are also shown in Table 2-3. To provide a context for interpreting the possible impacts of the scenarios, we compared them to total sales, receipts, or shipments for the affected industries (2-digit NAICS) in Davidson and Rowan counties. We found that the impacts, while possibly substantial for individual businesses, represent relatively small shares of the revenues of affected industries in the counties. Scenario 1 impacts represent an increase of at most 1.38 percent in county-level industry totals. Scenario 2 projects impacts less than one percent of county-level industry totals. Scenario 3 projects negative business impacts ranging from -0.2 percent to -6.9 percent of industry revenues for the affected counties. Because the affected industries are only part of the counties' economies, the impacts on the county-wide economies would be even smaller; we therefore would not anticipate widespread economic impacts as a result of the scenarios.

Duke Energy's Buck Steam Station

Duke Energy must meet its obligation to provide power to its customers regardless of the water level in High Rock Reservoir. When Buck Steam Station is not available to produce this power, Duke Energy may have to purchase replacement power on the market or produce the power at a higher cost facility.

Table 2-3. Potential Scenario Business Impacts by Industry (in 2003 dollars)

Industry 2-Digit NAICS Code and Description	Impact per Business		Number of Affected Businesses in Industry	Estimated Total Impact on Affected Businesses in the Industry		Total Revenue for Rowan and Davidson Counties by Industry[b]	Impact as a Percent of Total Industry Revenue (%)	
	Low	High		Low	High		Low	High
Alternative 1								
23 Construction[a]	$121,000	$243,000	5	$605,000	$1,215,000	NA	NA	NA
44-45 Retail trade	$194,000	$388,000	9	$1,746,000	$3,492,000	$1,691,156,000	0.10%	0.21%
53 Real estate and rental and leasing	$36,000	$72,000	5	$180,000	$360,000	$54,721,000	0.33%	0.66%
56 Administrative and support and waste management and remediation services	$67,000	$134,000		None	None	$85,609,000	None	None
71 Arts, entertainment, and recreation	$142,000	$285,000	3	$426,000	$855,000	$61,973,000	0.69%	1.38%
72 Accommodation and foodservices	$55,000	$110,000	8	$440,000	$880,000	$169,786,000	0.26%	0.52%
Total all industries				$3,397,000	$6,802,000			
Range							0.10%	1.38%
Alternative 2								
23 Construction[a]	$24,000	$121,000	5	$120,000	$605,000	NA	NA	NA
44-45 Retail trade	$39,000	$194,000	9	$351,000	$1,746,000	$1,691,156,000	0.02%	0.10%
53 Real estate and rental and leasing	$7,000	$36,000	5	$35,000	$180,000	$54,721,000	0.06%	0.33%
56 Administrative and support and waste management and remediation services	$13,000	$67,000		None	None	$85,609,000	None	None
71 Arts, entertainment, and recreation	$28,000	$142,000	3	$84,000	$426,000	$61,973,000	0.14%	0.69%
72 Accommodation and foodservices	$11,000	$55,000	8	$88,000	$440,000	$169,786,000	0.05%	0.26%
Total all industries				$678,000	$3,397,000		0.02%	0.69%
Alternative 3								
23 Construction[a]	–$243,000	–$1,213,000	5	–$1,215,000	–$6,065,000	NA	NA	NA
44-45 Retail trade	–$388,000	–$1,938,000	9	–$3,492,000	–$17,442,000	$1,691,156,000	–0.21%	–1.03%
53 Real estate and rental and leasing	–$72,000	–$358,000	5	–$360,000	–$1,790,000	$54,721,000	–0.66%	–3.27%
56 Administrative and support and waste management and remediation services	–$134,000	–$672,000		None	None	$85,609,000	None	None
71 Arts, entertainment, and recreation	–$285,000	–$1,425,000	3	–$855,000	–$4,275,000	$61,973,000	–1.38%	–6.90%
72 Accommodation and foodservices	–$110,000	–$549,000	8	–$880,000	–$4,392,000	$169,786,000	–0.52%	–2.59%
Total all industries				–$6,802,000	–$33,964,000		–0.21%	–6.90%

[a]County-level revenue estimates are not provided for the construction industry. These data are based on North Carolina averages of revenue per construction establishment.

[b]Source: U.S. Department of Commerce, Bureau of the Census. Economic Census 1997.

Duke indicates that when the water level in High Rock Reservoir falls to 10 feet below full pond, generation is lost. At 14.9 feet below full pond, they indicate further lost generation.[7] Unless Buck Steam Station is offline, an additional cost is incurred when the water level is 6 feet or more below full pond as a result of poor condenser performance due to lower pump pressure and more turbidity.

For Scenarios 1 and 2, Duke Energy could generate electricity at Buck Steam Station instead of purchasing the power on the market or producing the power at a higher-cost facility, thus resulting in a cost savings for the company. Also, the company would avoid the additional costs attributable to poor condenser performance during lower water periods. Greater generation is expected under Scenario 1 than Scenario 2 for Buck Steam Station. However, generation would be lost under Scenario 3, requiring the company to rely on higher-cost generation or purchase power on the open market.

Municipal Water Suppliers

The Salisbury-Rowan Utilities plant is the only water supplier that might be affected by the alternative High Rock water level management scenarios. Contrary to the seasonal/tourism-related and property-related businesses and Buck Steam Station, Scenarios 1 and 2 could have a negative impact on the Salisbury-Rowan Utilities because of the potential of increased sedimentation problems and backwater effects based on interview responses provided by the utility. Scenario 3, which would result in a larger drawdown and lower water levels during the summer months, could potentially have a positive impact on the water supplier compared to existing conditions because sedimentation problems and backwater effects may be reduced under this alternative compared to existing conditions. Dollar estimates are not possible because limited information is available on the impact of specific water levels on the cost of operations at this establishment.

[7]During the summer months, operating costs increase more at 6 feet below full pond. The scenarios analyzed here do not drop to 6 feet below full pond during the summer months. However, it is important to note that Buck Steam Station may incur these costs if the water level fall below the summer water levels for each scenario.

Alcoa's Badin Works and Alcoa Power Generating Inc.

Alcoa generally benefits from the current operation of the Yadkin Project and the resulting changes in the reservoir water levels. Based on interview responses provided by Alcoa, Scenario 1 would negatively affect APGI, and thus indirectly Badin Works and Alcoa Inc., by reducing the variation in allowable water levels at High Rock Reservoir. Available storage capacity would not be utilized and the amount of power generated by APGI would be reduced, primarily as a result of additional spilled water. The impacts associated with Scenarios 2 and 3 are uncertain. Although Scenario 2 allows for a winter drawdown, the drawdown would occur during a shorter period of time. This may or may not allow APGI to maximize the value of its generation. Under Scenario 3, the option of lowering the water level this extent may occasionally be beneficial to APGI, maintaining the water level at the lower elevations reduces head on generators, increases the chances that the reservoir may not refill during the spring, and may ultimately result in less than optimum operating conditions.

2.6 SUMMARY OF RESULTS FOR RESERVOIR RELATED BUSINESSES

Based on the survey responses of numerous businesses related to the reservoir, the water level in the reservoirs, particularly High Rock Reservoir, affects reservoir related businesses in the counties surrounding the Yadkin Project. Although the county-level impacts may not be excessive, individual businesses can be greatly affected when the reservoirs are drawn down. Several businesses reported that extended drawdowns, especially during the summer recreation season, can result in establishments going out of business. Some establishments rely on the reservoirs to attract visitors and permanent residents, while others use the water in the production process. Different uses of the reservoirs and varying levels of dependency on the reservoirs produce a range of impacts in response to different scenarios.

Interviews with reservoir related businesses confirm that establishments generally preferred the water levels be kept within a few feet below full pond year-round, with the exception of one of the water suppliers. Likewise, RTI's rough estimates of the impacts, based on assumptions and limited interview

data, show that the greatest positive impacts would occur under Scenario 1.

The second preference of reservoir related businesses tended to be that of Scenario 2, with an extended summer season and an announced winter drawdown of less than 10 feet below full pond. Scenario 2 produces some positive impacts to reservoir related businesses by lengthening the recreation season, but these differences are less than those expected under Scenario 1.

Extreme drawdowns (greater than 10 feet such as included in Scenario 3) are not considered acceptable by reservoir related businesses. Relatively large negative impacts are predicted to occur under Scenario 3 for the seasonal/tourism-related and property-related businesses located on High Rock Reservoir.

To put potential impacts under each scenario in context, we compared estimated impacts on affected businesses to total receipts in Rowan and Davidson counties for their respective industries. Scenario 1 impacts represent an increase of at most 1.38 percent in county industry totals. Scenario 2 projects impacts less than one percent of county-level industry sales. Scenario 3 projects negative business impacts ranging from -0.2 percent to -6.9 percent of industry revenues for the affected counties. Thus, while the scenarios may have significant positive or negative impacts on individual businesses, we do not expect substantial impacts on the county-wide economy, even under Scenario 3.

Another important finding from the interviews was that reservoir related businesses consider consistency in water levels from year to year as important as consistency within the year. For example, in the real estate business multiple years of stable water level are needed to build peoples' confidence and affect property values. During interviews in the summer of 2004, a real estate business indicated that the market was finally recuperating this year with more houses selling, although the market value of these houses was still depressed compared to predrought sales prices. A similar trend can be found with respect to fishing tournaments on High Rock Reservoir. Years at a sufficient water level must occur before people are willing to book fishing tournaments.

2.7 ACKNOWLEDGEMENTS

The assistance provided by all businesses and individuals that supplied information for this analysis is greatly appreciated. Many businesses were willing to respond to multiple phone interviews and provide detailed information. The input from local businesses, water suppliers, and Buck Steam Station was vital to the analysis provided in this section of the report, and we thank them for their contributions. We would also specifically like to thank those people who took the time to provide input on the master list of businesses: Tim Russell, Greg Scarborough, Stephany Farquhar, Robert Petree, and Melissa Fleig.

3 Property Impacts

The overall objective of the Surrounding County Economic Impact Study is to document and analyze the relationship of the Project reservoirs to the economies of the surrounding five counties under current reservoir operations and other alternative water-level scenarios. This section uses publicly available information to characterize the baseline effects of the reservoirs on property values within selected surrounding counties and estimates the impact of alternative water-level scenarios.

3.1 LAND VALUES AND DISTANCE

Initially, we examined data on assessed property values (both land value and total value) in each of the five surrounding counties, to see if we could discern a relationship between these values and distance from the Yadkin Project reservoirs. We surmised that proximity to the reservoirs might cause properties located near the shorelines to be more valuable, per acre, than properties located farther away. Proximity to other geographic features, such as cities or highway corridors, may also have a positive impact on property values. If proximity to the reservoirs has a positive impact on property values, we would expect the area near the reservoir to have a higher share of the county's assessed property value than of the county's land area.

Table 3-1 shows that, for all counties except Davie and Stanly, the share of land value for parcels within 300 feet of the Yadkin system is greater than the share of acreage. Considering all parcels within 1 mile of the reservoir, the share of land value is greater than the share of acreage in Montgomery and Davidson counties. As the distance from the reservoir increases, the

Table 3-1. Land Values and Acreage as Percentage of County Total

	300 ft from Reservoir		1 mile from Reservoir	
County	**% Value**	**% Area**	**% Value**	**% Area**
Davie	0.25	0.86	1.25	2.88
Rowan	12.10	8.84	21.85	25.29
Stanly	2.12	2.66	NA	NA
Montgomery	30.50	2.31	37.64	6.11
Davidson	14.70	8.42	25.64	22.14

influence of the reservoir on property value decreases. Because many other factors affect property value, there is not a smooth, predictable relationship between proximity to a reservoir and property value.

The data on assessed values suggest a relationship between proximity to a reservoir and land value, but many other property characteristics may also influence the value of a piece of land. To examine the influence of the reservoirs, we must use statistical techniques that enable us to isolate the influence of individual property characteristics on property value.

3.2 THEORY AND METHODS

In this section, we use a statistical technique called the hedonic method to analyze the influence of individual property characteristics on property value. The hedonic method was developed by economists (Lancaster, 1966; Rosen, 1974) who recognized that a commodity such as a home is actually a bundle of characteristics, including physical characteristics (such as lot size, square feet, number of bedrooms, etc.) and characteristics of its location (such as school quality, proximity to employment centers or transportation, and proximity to amenities such as parks or reservoirs). How much people are willing to pay for a house depends on how much they value the characteristics.

The hedonic method is an application of the multiple regression statistical technique. In general, multiple regression analysis explains the value of a dependent variable as a function of multiple independent variables. It essentially allows us to perform a "controlled experiment," estimating the influence of

each independent variable separately while controlling for the rest. The hedonic method permits us to examine the contribution to home value of each separate characteristic of the home, including characteristics of the structure, lot, and environment. By using the hedonic analysis technique, we can derive the marginal price for any modeled characteristics of home price. That is, we can determine the amount home buyers are willing to pay for a small change in a characteristic. Although our analysis reveals interesting results for the marginal prices of all home characteristics, we are most interested in the amount consumers are willing to pay (through an increase or decrease in home sales price) for proximity to the reservoir and for a change in the reservoir management plan resulting in, for example, a smaller range of water levels or a longer summer season.

The basic form of the models used in our hedonic analysis is as follows:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots + \beta n\text{-}1Xn\text{-}1 + \beta nXn + \mu \quad (3.1)$$

where Y represents the sales price of an individual home and the X values represent the observable characteristics for that home. The variable on the left-hand side of the equals sign is called the dependent variable, and the variables on the right-hand side are called the independent or explanatory variables. We use statistical software, to find numerical values for the coefficients (β) associated with each characteristic. The value of the coefficient shows the influence the associated X characteristic has on the home sales price. The error term μ accounts for the portion of home sales price not explained by the X characteristics. By including different combinations of characteristics or changing the way the characteristics relate to each other and home sales price, we can find the model that best fits the data and minimizes the error term.

3.2.1 Similar Studies and Their Findings

As part of this study, we examined several publications related to property values and reservoirs, but many of these studies focused on the value of water quality or the value of a lakefront view to homeowners (Benson et al., 1998; Gibbs et al., 2002; Bond et al., 2002). Three studies, however, examine the relationship between reservoir management and property values and can be used to guide our expectations and serve as

comparison for our results. Additionally, although our data do not allow us to directly calculate the economic effects of extending the near full recreation season on High Rock Reservoir (Scenario 2), we may be able to make predictions about this effect based on the findings of other studies.

Hanson and Hatch (2001) focused their research on valuing property effects related to annual drawdowns for reservoirs in the Alabama-Coosa-Tallapoosa system. They performed a contingent valuation analysis by mailing surveys to Reservoir Martin (Alabama) lakefront property owners asking them to estimate their property values and how they thought those values might change because of permanent changes in reservoir management. Not surprisingly, residents expressed that the summer full-pond level was the most important water condition, followed by the length of time at summer full pond. The analysis results indicate a 0.58 percent decrease in lakefront property value when the summer full pond season is shortened by 1 day. Additionally, results show that a permanent 1-foot decrease in summer full-pond water level would lead to a 9.8 percent decrease in lakefront property values.

Lansford and Jones (1995) performed a hedonic price analysis similar to ours to determine the effect of reservoir-level variation on property values. They collected sales data on homes on or near Lake Austin and Lake Travis in Texas and attempted to explain the sales price as a function of reservoir-level variation from the long-term average over the 3 months prior to the home sale. At the times of the analyzed home sales around Lake Travis, the reservoir level was roughly 6 feet below the historical average. For average homes around Lake Travis, a 1-foot increase in average reservoir levels during the 3 months before the sale results in a $650 increase in home sales price (a 0.52 percent increase at the mean sales price). This result is different from zero at the 10 percent but not the 5 percent significance level. The authors also present and discuss results for Lake Austin, but the effect is not statistically different from zero.

A study commissioned by the Tennessee Valley Authority (TVA) (Murray, 2003) examined the economic effects of delaying winter drawdown for Cherokee Reservoir and Douglas Reservoir in eastern Tennessee. For lakeside properties located within

100 feet of the winter water level on Cherokee Reservoir, the benefits (as measured by the expected change in assessed property value) of delaying the winter drawdown by 1 month range from $76 to $268, depending on the property assessment value. Delaying the drawdown by 2 months produces benefits ranging from $151 to $536. These findings suggest that a longer near-full season would enhance property values along High Rock Reservoir, although the magnitudes are not comparable.

Our work differs from these previous studies in several key ways. First, the geographic scope of our analysis is larger than that of comparable studies, so the results may be more generally applicable. Second, the reservoirs included in our analysis are managed by different corporations and organizations and operate according to a variety of management plans. Additionally, the variety of our underlying data allows us to draw more general conclusions about the value of proximity and the impact of water-level changes on home sales prices. Because our analysis includes different types of reservoirs located in different geographic areas, we can control for these differences to separate the impact of reservoir management on home sales prices.

3.3 DATA COLLECTION

The first step in assessing the relationship between home sales price and reservoir water levels was to obtain appropriate data. Using only the tax parcels located around the Yadkin Project reservoirs would not have provided sufficient observations to allow us to measure the impact of reservoir management on property levels, so we expanded the scope of our study to include other large reservoirs within North Carolina, South Carolina, and Virginia. The reservoirs in this large group were operated by several different companies for different purposes, such as flood control, recreation, and water storage and represented a variety of management alternatives. Once we had a large list of reservoirs, we narrowed down the list using several criteria. First, we had to be able to obtain detailed information about actual reservoir water. Second, we had to be able to obtain spatial data at the tax-parcel level from the county or counties surrounding the reservoir, including a recent sales price and property characteristics.

For each reservoir we obtained daily elevation levels for the period 2002–2003. We then calculated the range of values for each reservoir during this time period by subtracting the lowest reservoir level from the highest. Although our water level data include a year that does not represent typical reservoir operations (due to the drought during the summer of 2002), the range variable serves as an indicator of whether the reservoir water level is typically relatively stable or variable. Reservoirs that had the most monthly variation also had the largest range values, while reservoirs that were generally stable had smaller range values.

There is no statewide format for property tax data, so one of our most time-consuming tasks was to consolidate the information from each county into a single dataset. We eliminated the counties without sales price information for each tax parcel.[1] Because we wished to compile data on comparable properties and thus were primarily interested in home sales, we decided not to include any observations that had a building value of zero.

Not all tax parcels with sales price data were included in our final dataset. Believing, based on our review of the literature, that the majority of the impact of reservoir water levels would be felt within a relatively short distance of the shore, we limited the dataset to properties within two miles of the shore. Many of these properties are located in areas that have recently experienced large booms in development. Because modeling the process of urban and suburban development is beyond the scope of this study, we decided to limit the analysis to sales that took place during or after the year 2000. Because factors affecting purchases of very small properties and relatively large properties may be systematically different from those affecting typical residential properties, we eliminated the 652 observations with lot sizes greater than 5 acres and the 2,075 observations with lot sizes less than 0.1 acre.

Some of the counties indicated whether a home sale was qualified (in other words, whether the sale was a genuine open

[1]Unfortunately, Davidson County, which includes much of the shoreline of High Rock Reservoir, does not provide home sales data, and is thus omitted from our primary analysis.

market transaction).[2] For those counties, we included only qualified sales. To attempt to exclude non-qualified sales in other counties, we excluded all observations in which the assessed total value of the building and property was more than twice as much as the sales price. There were 8,030 of these observations.

Our final dataset includes properties surrounding seven reservoirs in eight counties (see Table 3-2). As noted above, Davidson County, which has significant shoreline along High Rock Reservoir, does not provide home sales data and thus is omitted from our main analysis. Because Davidson County residences represent such an important group of affected residences for any management scenarios affecting High Rock Reservoir, we included Davidson County in a supplemental analysis reported in Appendix D. In the supplemental analysis, we use assessed value as a proxy for home sales price, and year of most recent assessment as a proxy for year of sale. While assessed value is related to home sales price, it is based on judgment rather than market transactions, and is a less accurate measure of homeowners' valuation of the property characteristics, including proximity to the reservoir and reservoir operations. While the results of the two analyses are generally similar, we believe that the analysis reported here is more accurate.

According to hedonic theory, a home's value is a function of its characteristics, so we needed to include as many home-specific variables as possible for all observations in the data set. The property tax data from each county included the sales price and sales year for each property, and we were able to calculate the acreage of each parcel as well as various distance measures using ArcView software.

Ideally, we would be able to include the size of each house, the number of bedrooms and bathrooms, and other home-specific characteristics in our model. In our final set, only 35 percent of observations included the number of bedrooms, and 67 percent included the year of construction. To include as much

[2]Although the exact definition of a qualified sale varies across states and counties, it generally refers to an "arms-length" sale that occurs on the open market between two unrelated parties each seeking to maximize their gain from the transaction (Nebraska, 2005).

Table 3-2. Home Sales by County for Each Reservoir in Dataset

Reservoir	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Wake	York	Total
B. Everett Jordan Lake	583					691		1,274
Badin Lake			186		142			328
Falls of Neuse Reservoir						3,060		3,060
High Rock Reservoir				216				216
Lake Norman		2,849						2,849
Lake Tillery			192		294			486
Lake Wylie		1,132					4,898	6,030
Mountain Island Lake		1,688						1,688
Total	583	5,669	378	216	436	3,751	4,898	15,931

information about each home as possible in our models, we supplemented the tax parcel data with Census data for the Census block group in which the home is located. The 2000 Census included many housing characteristics, including a count of the number of bedrooms by home and the median year of home construction by Census block group. If the tax parcel data included home-specific information on number of bedrooms or year of construction, we used that; if not, we used the Census block group median values.

3.3.1 Descriptive Statistics

Table 3-3 presents the average values for selected home characteristics by county. It is important to note that these homes are not necessarily representative of all homes in the county, only those homes that meet the criteria described above. Almost 90 percent of the observations come from the three largest counties. There is a great deal of variation across counties in terms of sales price and the year of home construction, with a difference of more than $300,000 between home sales prices in Chatham and Rowan counties and a gap of 37 years between the average year of construction for homes in Wake and Stanly counties. The Road Distance and Reservoir Distance variables measure the straight line distance in miles from the edge of each land parcel to the closest interstate, U.S. highway, or NC state highway and to the closest reservoir. Each home is associated with only one reservoir, the one it is closest to. For more detailed statistics for the entire sample of homes, see Table 3-4. Although less than 10 percent of the home sales in our dataset are on APGI reservoirs, we chose to include homes on several reservoirs to improve the statistical precision and generality of our estimates.

Each reservoir is managed differently, but all of them have a management plan to control variation in water levels. Table 3-5 shows information on reservoir levels based on daily elevation over the 2002 to 2003 calendar years. These measurements are presented in feet, with full pond taking the value of zero.

The effects of the drought in the summer of 2002 can be seen by comparing the minimum levels in 2002 versus the minimum levels in 2003 or by comparing the ranges for the summers (defined as May through September) of 2002 and 2003. For most reservoirs, the 2003 range is much smaller than the 2002 range, reflecting the fact that the drought resulted in unusually

Table 3-3. Mean Values of Home Characteristics by County

	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Wake	York, SC
Observations	583	5,669	378	216	436	3,751	4,898
Parcel area[a]	1.12	0.54	0.41	1.04	0.72	0.68	0.41
Sales price	$417,070	$227,764	$229,585	$119,141	$115,715	$354,863	$221,526
Year built[b]	1992	1995	1984	1980	1961	1998	1986
Road distance	1.92	1.67	4.12	4.20	2.35	1.41	3.92
Reservoir distance	0.84	0.92	0.19	0.50	0.50	1.26	0.80
Percentage in urban area	4.3	69.1	0	0	0	52.7	78.3
Bedrooms[b]	2.9	3.3	2.4	2.7	2.8	3.3	3.0

[a]In acres.

[b]Supplemented with Census data when required.

Table 3-4. Detailed Statistics for All Observations (n = 15,931)

Variable	Mean	Standard Deviation	Minimum	Maximum
Parcel area[a]	0.565	0.705	0.1000014	4.99984
Sales price	$258,203	229,134	$6,000	$9,315,000
Sales year	2001.46	1.16	2000	2004
Year built[b]	1991	12.75	1850	2004
Road distance	2.42	2.05	0	8.13
Reservoir distance	0.92	0.64	0.0000335	1.99904
Percentage in urban area	0.61	0.49	0	1
Bedrooms[b]	3.15	0.51	1	7

[a]In acres.

[b]Supplemented with Census data when required.

Table 3-5. Reservoir-Level Data (for 2002−2003 unless indicated)

	B. Everett Jordan Reservoir	Badin Reservoir	Falls of Neuse Reservoir	High Rock Reservoir	Lake Norman	Lake Tillery	Lake Wylie	Mountain Island Reservoir
Range	23.89	16.64	18.83	24.04	6.91	3.50	6.23	7.17
Average	0.38	−2.28	−1.69	−5.73	−2.76	−0.59	−2.84	−2.70
Standard deviation	3.41	3.16	3.19	5.52	1.72	0.50	1.24	1.04
Minimum (2002)	−6.13	−11.98	−7.41	−24.04	−6.3	−3.41	−6.20	−5.31
Maximum (2002)	6.46	−0.06	3.92	−0.42	−0.88	−0.10	−0.79	−1.02
Minimum (2003)	−0.09	−16.64	−0.61	−11.52	−4.07	−2.85	−3.90	−4.07
Maximum (2003)	17.76	0	11.42	0	0.61	0.09	0.03	1.86
Summer range (2002)	6.21	10.90	6.68	19.58	5.28	2.34	3.58	2.47
Summer range (2003)	5.38	3.16	4.63	3.90	2.95	2.85	3.31	3.10
Counties	2	2	1	1	1	2	2	1

low summer water levels in 2002. As noted above, we use these years to reflect the general stability or variability of each reservoir.

Table 3-6 provides a preliminary look at the relationship between home sales price and distance to the nearest reservoir. For each county, the homes are divided into five categories based on their sales price. Each category contains 20 percent of a county's home sales and shows the average distance to the reservoir for those homes. Although there are a few exceptions, the general trend shows that home sales price increases as the distance to the reservoir decreases. This supports the assertion that proximity to a reservoir increases home sales price.

Table 3-6. Average Distance (in Feet) to Reservoir by Home Sales Price

Sales Price	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Wake	York
Bottom 20%	6,093	6,135	2,005	2,373	3,637	6,883	5,094
20–40%	6,114	6,051	1,790	3,960	3,737	7,188	4,430
40–60%	3,249	4,862	574	2,869	3,402	7,281	4,226
60–80%	3,263	4,412	381	2,773	1,975	6,394	4,715
Top 20%	3,477	2,712	273	1,138	471	5,641	2,579

3.4 DATA ANALYSIS AND RESULTS

Although the general methods of hedonic analysis are well accepted and tested, the exact form of the model used in data analysis varies across studies, depending on available data, the scope of the analysis, and the best-fitting functional form. We tested many different models by varying the functional form and including different variables and interaction terms to arrive at the final model presented and interpreted below. Table 3-7 presents the definitions of variables used in the models as well as our expectations about their influence on home value. Variables that have positive coefficient values have a positive influence on home sales price, while variables with negative coefficient values have a negative influence on home sales price, holding all other factors constant. For example, we expect that the coefficient on the number of bedrooms in the home should be positive, that is, an increase in the number of bedrooms should lead to an increase in home sales price.

Table 3-7. Regression Variables: Definitions and Characteristics

Variable	Description	Expected Direction of Influence	Dummy Variable?
Sales price	Home sales price		N
Sales year	Year home sale occurred	>0	N
Build year	Year home was built	>0	N
Beds	Number of bedrooms in home	>0	N
Area	Area of tax parcel in acres	>0	N
Reservoir distance	Distance from edge of parcel to nearest reservoir	<0	N
Reservoir05	Parcel is within 0.05 miles of reservoir	>0	Y
Reservoir1	Parcel is between 0.05 and 0.1 miles of reservoir	>0	Y
Reservoir2	Parcel is between 0.1 and 0.2 miles of reservoir	>0	Y
Reservoir34	Parcel is between 0.2 and 0.4 miles of reservoir	>0	Y
Reservoir5	Parcel is between 0.4 and 0.5 miles of reservoir	>0	Y
Above lev	Reservoir associated with parcel is operated above full pond	?	Y
Urban res	Reservoir associated with parcel is located in an urban area	>0	Y
Range	Range of reservoir levels between 2002 and 2003, in feet	<0	N

This type of model allows us to separate the effect that a single variable has on home sales prices from the effect of all other variables. The coefficient of each quantitative variable represents the percentage change in home sales price resulting from a one-unit increase in that quantitative variable, holding all other variables in the model constant. Holding the other variables constant controls for the influence they may have on home sales price and makes it possible to examine the influence of one variable at a time.

The interpretation of the coefficient value depends on the functional form of the model. We chose to use what is called a semilogarithmic form for our model, which relates the natural log of the sales price to home characteristics. The advantage of this functional form is that the coefficients measure relative, rather than absolute, influence on sales price. For example, if

the coefficient on bedrooms was 0.35, we would interpret this to mean that the addition of one bedroom would result in a 35 percent increase in home sales price, holding all other characteristics constant.

We include two types of variables in our model: quantitative and qualitative. Quantitative variables take on a range of values and are reasonably continuous across this range. Bedrooms, acreage, and reservoir-level range are examples of quantitative variables. A qualitative variable does not have an intuitive numeric value; instead, qualitative values, such as county names, are divided into categories, which are represented by "dummy variables." The use of dummy variables allows us to indicate whether a specific home has a given characteristic. In some of our models, we control for the location of a home by including county-specific dummy variables that take on a value of either 1 or 0, depending on whether the home is located within a certain county or not. We include a more detailed discussion of the interpretation of these variables along with the results of our models.

3.4.1 Final Model

As noted above, we experimented with different variables and functional forms to identify the model that best described the attributes that affect home sales prices for homes near reservoirs. For example, we initially measured distance from the reservoir as a continuous variable, then converted to using dummy variables for homes located within discrete distance ranges of the reservoir. We initially included a dummy variable for reservoirs located near Charlotte or the Triangle. Then we converted to using dummy variables for the counties in which the homes were located, which are intended capture the effects of all of the attributes of each county that aren't captured in other variables. The results for the final model are shown in Table 3-8.

Findings

The existence of a reservoir increases home values substantially for homes located within 0.2 miles of the shoreline. These impacts are shown in the coefficients of the distance dummy variables. In semilogarithmic models where the dependent variable is a natural log, the coefficient on dummy variables must be transformed to be interpreted

Table 3-8. Final Regression Model Including Interaction Term Variable

Number of Observations	15,931	F(17, 15,913)	602.61
R-squared	0.3917	Prob > F	0.0000
Adjusted R-squared	0.3910		

Variable	Coefficient	Standard Error	t-Statistic	P > |t|
Sales year	0.026	0.004	7.03	0.000
Build year	0.010	0.000	25.81	0.000
Beds	0.332	0.009	38.98	0.000
Area	0.092	0.006	15.79	0.000
Reservoir05	0.720	0.026	27.95	0.000
Reservoir1	0.345	0.719	17.79	0.000
Reservoir2	0.337	0.015	22.54	0.000
Reservoir34	0.067	0.015	4.41	0.000
Reservoir5	0.035	0.020	1.75	0.080
Reservoir05r	−0.023	0.003	−9.17	0.000
Chatham	1.080	0.051	21.35	0.000
Mecklenburg	0.437	0.028	15.55	0.000
Montgomery	0.487	0.037	13.21	0.000
Rowan	−0.022	0.056	−0.39	0.696
Wake	1.034	0.041	25.22	0.000
York	0.574	0.027	21.48	0.000
Range	−0.004	0.002	−1.91	0.056
Constant	−61.046	7.410	−8.24	0.000

correctly. The formula to compute the percentage change in home values caused by the dummy variable is 100*{exp(coefficient)-1}. Using that formula, we find that homes located between 0.1 and 0.2 miles of the shoreline have sales values 40 percent higher than homes more than 0.5 miles from shore; homes between 0.05 mile and 0.1 mile of the reservoir have sales values 41 percent higher than comparable homes located more than 0.5 miles from the reservoir. A location less than 0.05 miles from the reservoir increases home sales value by just over 100 percent relative to comparable homes located more than 0.5 miles from the reservoir, holding all other variables constant (see the sample calculation below).

Using the formula above, the effect on sale price of being located within 0.05 miles of shoreline, holding other variables constant is given by

$$100*\{e^{(0.720)}-1\} = 105.4\%$$

To put these values into context, an additional bedroom increases home sales price by 33 percent, other attributes held constant. Thus, a location next to the shoreline has an impact on home sales price that is roughly equivalent to three additional bedrooms. The existence of the reservoirs provides a substantial benefit to owners of homes nearby, which is reflected in higher sales prices.

Examining the impact of reservoir water level variability (range) shows that increasing the range has a small negative impact on home sales values. The range coefficient represents the expected percentage drop in home sales price caused by a 1-foot increase in water level range for homes located between 0.05 and 2 miles from a reservoir. For all homes in the sample, the average home sales price is expected to decrease 0.44 percent per one foot increase in range.

We suspected that the impact of water level variability might be greatest for homes located closest to the reservoir. In the final model, we include an interaction term for Reservoir05 and range. The coefficient on the Reservoir05*Range interaction term represents the additional drop in home sales price expected for homes within 0.05 mile of a reservoir. For homes within 0.05 mile of a reservoir, a 1-foot increase in range leads to a 2.74 percent decrease in average home sales price.

Table 3-9 applies the coefficients to typical homes in Rowan County near High Rock Reservoir.[3] It shows the expected changes in home sales price for homes near High Rock Reservoir due to a 1-foot increase in the reservoir water level range. As explained above, the homes within 0.05 mile of the reservoir experience a larger change in sales price, both in absolute and relative terms, than other homes in Rowan County. Compared to homes located more than 0.05 mile from High Rock Reservoir, homes within 0.05 mile would experience a $3,250 greater drop in home sales prices.

[3]See Appendix D for a supplemental analysis including Davidson County, which does not have comparable data.

Table 3-9. Expected Home Sales Price Changes in Rowan County in Response to a One-Foot Increase in Water Level Range, by Distance Category

Distance	Sales Observations	Average Price	Percentage Change	New Price	Change in Price
Average (0.5 mile)	216	$119,141	−0.44	$118,612	–$529
Homes <0.05	69	$136,688	−2.74	$132,946	–$3,742
Homes between 0.05 and 0.5	147	$110,905	−0.44	$110,412	–$493
Homes >0.5	79	$88,165	−0.44	$87,773	$392

Rowan County had 216 useable home sale observations located within 2 miles of High Rock Reservoir. This provides enough observations to confidently interpret the analysis results for homes located within 0.05 mile of the reservoir, homes located more than 0.5 mile from the reservoir, and homes located at least 0.05 mile from the reservoir (as a group). Estimates for smaller distance bands (from 0.05 mile to 0.1 mile, for example) are based on a small number of sales and are less reliable. Thus, we present results for groups of homes created by combining several smaller distance bands.

3.4.2 Scenario Analysis

Our model design enables us to evaluate the effect on home sales prices of the implementation of different High Rock water-level scenarios. As detailed elsewhere in this report, the three scenarios differ from each other and from existing conditions in terms of range, drawdown timing, and winter and summer elevations. We discuss the implications of each alternative on home sales price below.

According to APGI, existing conditions result in a range of about 12 feet in a typical year.

Scenario 1 creates a relatively stable reservoir level that has no planned seasonal drawdown. Water levels in this scenario can vary from full pool by as much as 3 feet; we can apply the regression results to simulate the effects of this operation alternative.

Under Scenario 2, water levels may fall as much as 10 feet below full pond, and the summer recreation season would be extended one month in the spring and one month in the fall.

The impacts measured in Table 3-10 result from assuming a slightly smaller water level range for Scenario 2 than for existing conditions. We do not have sufficient information to quantify the impact of the longer recreation season. Other studies show that extending the summer full-pond season has a positive effect on property values (Hanson and Hatch, 2001; Murray, 2003). Based on these studies, we expect that extending the summer full-pond season would have a positive impact on property values, but we are unable to quantify that aspect of Scenario 2.

Table 3-10. Estimated Home Sales Prices by Scenario and Distance

	Existing Conditions	Range		
		Scenario 1	Scenario 2	Scenario 3
Distance	12' Range	3' Range	10' Range	20' Range
Homes <0.05	$136,700	$170,400	$144,200	$106,700
Homes between 0.05 and 0.5	$110,900	$115,300	$111,900	$106,600
Homes >0.5	$88,200	$91,700	$88,900	$85,100

Scenario 3 has the largest planned range of all alternatives, allowing water levels to fall by as much as 20 feet below full pool. The summer full-pond level is 2 feet lower than the other alternatives, and the summer season is the same length as that under existing conditions.

Table 3-10 shows the average sales price by distance for the 2002 to 2003 range values and for the range values associated with each alternative. As expected, decreases in range lead to increases in home sales prices at all distance levels. The increase in home sales price is especially apparent for homes within 0.05 mile of High Rock Reservoir. By contrast, under Scenario 3 the increased range has a substantial negative impact on home sales prices, especially for homes within 0.05 mile of the reservoir. For these homes, the increased range under Scenario 3 causes the shoreline premium to essentially disappear, so that homes bordering the reservoir have predicted home sales values similar to those between 0.05 and 0.5 miles from the reservoir.

3.4.3 Property Tax Implications

If water level management of a reservoir has an impact on home sales prices, and if those sales price impacts are reflected in changes in assessed values, then the counties surrounding the reservoir may experience changes in the county tax base. As a home becomes more or less desirable to potential buyers, the county assessed value may change. This change could result in an increase or decrease in county property tax revenue. Table 3-11 presents the countywide tax rates for each of the five counties surrounding the Yadkin system.

Table 3-11. Countywide Tax Rates

County	Tax Rate (per $100)	Tax Rate Year
Stanly	0.6675	2002
Rowan	0.63	2004
Davie	0.55	FY 2003–2004
Davidson	0.53	2004
Montgomery	0.58	2004

To obtain a rough estimate of the tax revenue impacts of the scenarios, assuming that the assessed values for all the homes located within 2 miles of the shore were revised to reflect the average increase or decrease in sales value under each scenario, Rowan county could receive $20,000 more in property taxes under Scenario 1 and could receive $23,100 less in property taxes under Scenario 3 (see Table 3-12).

Table 3-12. Possible Change in Rowan County Tax Receipts under Each Scenario

Distance from Shoreline	Number of Homes	Scenario 1	Scenario 2	Scenario 3
		3’ Range	10’ Range	20’ Range
Homes <0.05	69	14,700	3,260	–13,000
Homes between 0.05 and 0.5	147	4,100	930	–3,980
Homes >0.5	79	1,700	350	–1,540
Total	295	20,500	4,540	–18,600

3.5 CONCLUSION

The existence of a reservoir and the management of that reservoir both have a measurable impact on home sales price for homes located near the reservoir. Homes closer to the reservoir sell at a premium compared to homes farther away. Additionally, homes located on a reservoir with relatively stable water levels will sell for a higher price than otherwise identical homes on a reservoir with a larger range of water levels. Current owners have paid prices that reflect the proximity of their homes to the reservoir, and the expected variability of water levels within the reservoir. Changes in reservoir water level management have the potential to provide existing owners with windfall benefits (if water levels become more stable) or losses (if water levels vary over a wider range).

Assuming that higher home sales prices are reflected in higher assessed value for property taxation, any change in management that increases home sales prices has the potential to slightly increase tax revenue for a county. Conversely, a change in management that decreases home sales price may result in decreased county tax revenues.

Any change in management, however, must still allow the reservoir to meet the needs for which it was designed. In the case of the Yadkin project reservoirs, the water management must permit APGI to continue to meet its power generation requirements.

4 Conclusions

The APGI Yadkin Project reservoirs provide recreational, aesthetic, and power services that benefit individuals and business in the surrounding communities. The existence of the reservoirs, apart from their operation for hydropower production, creates economic benefits for the communities, but these benefits can vary according to reservoir water levels resulting from Project operations. The purpose of this study was to characterize these benefits under baseline conditions and attempt to estimate how they would be affected by changes in reservoir levels under alternative water-level management scenarios. Since High Rock reservoir is the only one of the four Yadkin Project reservoirs that routinely experiences seasonal changes in water levels, the focus of most of this study was on High Rock.

Businesses in the five counties surrounding the Yadkin Project have been established partially because the Project reservoirs attract tourists and residents to the area. Many residential communities are located along the reservoir shorelines, and parcels of land near the reservoirs have higher values per acre than parcels in other parts of the counties. Many local businesses depend on the reservoirs to attract customers (residents and visitors) to the area; a few businesses use water from the Yadkin Project reservoirs in their business operations. In interviewing potentially affected businesses, we identified three types of effects on businesses. Businesses may be affected because they use the water directly in their operations, because they serve tourists who are drawn to the area by the existence of the reservoirs, or because they serve residents drawn to the area by the existence of the reservoirs.

Members of the Surrounding County Economic Impact IAG expressed concern about the variability of water levels in High Rock Lake, undeniably exacerbated by their experiences during the severe drought of 2002. Thus, our economic impact assessment focuses on impacts at High Rock Lake. To analyze potential impacts, we compared the effect of water levels on businesses and property values under existing conditions to the potential effects under alternative water-level management scenarios. In a simplified characterization of operations under existing conditions, High Rock Lake is generally operated at about 3 feet below full pond elevation for the summer months and is drawn down 10 feet below full pond from November to April. APGI developed three simplified alternative water level scenarios to represent a range of possible alternative reservoir operations at High Rock Lake. The Yadkin Project's other reservoirs would be indirectly affected under these scenarios, but we did not address these impacts quantitatively.

Under Scenario 1, the reservoir would be held within 3 feet of full pond for the entire year. This alternative is preferred by those who live on the reservoir because seasonal drawdowns would not limit their use of boat docks and other facilities. Under this alternative, our analysis suggests that the surrounding Counties could expect to see an increase in home sales prices compared to current sales prices, especially for homes located within 0.05 mile of a reservoir. Most reservoir related businesses also prefer Scenario 1 because it would extend the recreation season as long as the weather would allow, attract more year-round residents, and allow business operations to continue unhampered throughout the year. Two businesses, Salisbury-Rowan Utility and APGI, would be potentially negatively affected under this management scenario. The municipal water supplier may experience increased sedimentation problems and backwater effects under this alternative, which would increase costs at the facility. APGI would be limited in their ability to manage the water to maximize power generation and its value under Scenario 1.

Scenario 2 proposes extending the "near full" reservoir season, and shortening the winter drawdown to a period of only 3 months. This would extend the summer season and increase opportunities for lake recreation. Precisely quantifying the effect this alternative would have on home sales prices for homes near the reservoirs is difficult, but the overall effect

would be positive. Businesses generally favor any extension of the recreation season and expect positive impacts under this alternative, although impacts are not anticipated to be as large as the positive impacts expected under Scenario 1. The recreation season would likely be similar under Scenarios 1 and 2 because of weather conditions; thus, seasonal/tourism-related businesses are expected to have similar impacts under Scenarios 1 and 2. Drawdowns are reported to be beneficial to the Salisbury-Rowan Utility, so reducing the length of the winter drawdown could potentially negatively affect this facility. The impact of this alternative on APGI is likely to result in some loss of generation due to an increase in water spilled.

Scenario 3 proposes a lower reservoir level in the summer and a larger winter drawdown. The proposed summer elevation is 5 feet below full pond, and the annual drawdown is to 20 feet below full pond. The length of the summer season would not change compared to existing conditions. This alternative would result in a fall in average home sales prices for homes near the reservoir, caused in part by the aesthetic effects of the larger winter drawdown. Effects on property value and habitat quality due to the more severe winter drawdown could result in negative impacts on both property-related and seasonal/tourism-related businesses. Many businesses interviewed indicated that they expect to go out of business if Scenario 3 were implemented. Duke's Buck Steam station would be forced offline during the winter if the water level were to drop to the level stipulated in the Scenario 3 winter drawdown. Salisbury-Rowan Utility would be potentially positively affected under this alternative because of a potential reduction in the possibility of sedimentation problems. The impact of this alternative on APGI is not known.

Overall, our study found that the existence of the Yadkin Project reservoirs provides an economic benefit to the surrounding counties. Changing the operation of High Rock Lake would either increase or decrease these economic benefits by influencing home sales prices (and thus the county tax base) and the operations of local businesses. Scenario 1 is expected to have the largest overall positive economic benefit, followed by Scenario 2 and the existing operating conditions. The implementation of Scenario 3 would most likely decrease the current overall economic benefit provided by the reservoirs.

Impacts on individual businesses and home sales prices may be significant, but the number of businesses and properties affected directly is relatively small. Thus, we estimate that the impacts on the overall county economies or tax base would be relatively small.

References

Alcoa Power Generating Inc. (APGI). September 2002. Initial Consultation Document. <http://www.alcoa.com/yadkin/en/pdf/documents/Yadkin_ICD_9-02.pdf>.

Benson, Earl D, Julia L. Hansen, Arthur L. Schwartz, and Greg T. Smersh. 1998. "Pricing Residential Amenities: The Value of a View." *Journal of Real Estate Finance and Economics* 16(1):55-73.

Bond, Michael T., Vicky L. Seiler, Michael J. Seiler. 2002. "Residential Real Estate Prices: A Room with a View." *Journal of Real Estate Research* 23(1-2):129-37.

Gibbs, J.P., J.M. Halstead, K.J. Boyle, and J.C. Huang. 2002. "An Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties." *Agricultural and Resource Economics Review* 31(1):39-46.

Hanson, Terrill R. and L. Upton Hatch. 2001. "Impact of Reservoir Water Level Changes on Lakefront Property and Recreational Values." Presented as part of a Southern Rural Development Center and Farm Foundation Regional Workshop: Current Issues Associated with Land Values and Land Use Planning.

Lancaster, Kelvin J. 1966. "A New Approach to Consumer Theory." *The Journal of Political Economy* 74:132-157.

Lansford Jr., Notie H. and Lonnie L. Jones. 1995. "Effects of LCRA Lakes on Riparian Property Values: Recreational and Aesthetic Components of Lake Side Housing in the Colorado River Basin." Technical Report No. 170. Texas Water Resources Institute. The Texas A&M University System.

Murray, Matthew N. 2003. "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.

Nebraska Department of Property Assessment and Taxation. 2005. "Sales Qualification Procedures for the State Sales File." Directive 05-2. January 13, 2005. Available at: <http://pat.nol.org/directives/pdf/Dir05-2SalesQualificationProcedures.pdf>.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82:34-55.

U.S. Department of Commerce, Bureau of the Census. 1997. Economic Census. <http://www.census.gov/epcd/www/econ97.html>. As obtained in January 2005.

Appendix A: Master List of Potentially Reservoir Related Businesses

As discussed in Section 2.2, RTI created a list of approximately 260 businesses that might be considered reservoir related. A three level coding scheming, described in Section 2.2.2 and reproduced below, was used to classify these businesses as to the likelihood that they would be impacted by different management of the reservoir water levels.

- Priority A: A business depending on reservoir-oriented activity and/or residents, and so defined because of the nature of the business or the proximity of the reservoir. These businesses most likely receive the majority of their revenue from reservoir-related activities. Examples include marinas, boat dealerships, tackle shops, convenience stores, and building contractors.
- Priority B: Similar to Priority A, a business depending on reservoir-oriented activity and/or residents, and is so defined because of the nature of the business or the proximity of the reservoir. Unlike Priority A, these businesses most likely receive a much smaller share of their revenue from reservoir-related activities. Examples include restaurants, hardware stores, and lodging in close proximity to the Project.
- Priority C: A business not likely to depend on reservoir related activity and/or residents for any significant share of its revenue. Reservoir related purchases and/or customer traffic are incidental. Proximity to the reservoir is coincidental and independent of the revenue stream.

Priority A businesses, some additional businesses suggested by contacts, and process-related businesses were contacted by RTI regarding this project.

Business Name	**Priority**
Affordable Car Rental Inc	C
Agner's Amoco Svc Inc	C
Albemarle After Dark	C
Alco 18	C
Ann's Kitchen	C
Applebee's Neighborhood Grill (Linwood, NC)	C
Arby's (Lexington, NC)	C
B & R Realty, Inc.	B
B & R Roofing	C
B&T Construction & Loader	B
Backcountry Barbecue	B
Badin Lake Boat & Tennis Club	Out of business
Badin Lake Family Fun Center	Out of business
Badin Lake Family Restaurant	A
Badin Lake General Store	A
Badin Lake Jet Ski Rentals (PWC)	A
Badin Lake Marina	Out of business
Badin Lake Realty	A
Badin Shores Resort Owner Assn (or Badin Shores Resort Owner Associates Inc)	A
Baker's Discount Grocery	C
Beck's Wholesale Bait	B
Becky's Restaurant & Grill	B
Big Oak Farms	C
Billie's Café	C
Bill's Truck Stop Restaurant	C
Bi-Lo Grocery (Lexington, NC)	B
Biscuit King (Lexington, NC)	B
Black's Upholstery	C
Bobby's Mobil Svc	C
Bogan's Radiator Shop	C
Boggs Realty	B
Bojangles Chicken Restaurant (Denton, NC)	B
Bojangles' Famous Chicken (Spencer, NC)	C
Butterflies & Daisies	C
Byerly Automotive	C
Cabin Creek Berry Farm	C

Business Name	**Priority**
Cap'n Steven's Lakeside (or Captain Steven's Seafood)	B
Captain's Galley Restaurant	A
Carolane Propane Gas Inc.	B
Carolina Boat Center	Out of business
Carolina Boat Center, LLC	A
Carolina Crown Properties (or Rowan Rentals)	B
Carolina Gardens & Gifts	C
Carolina Piedmont Properties	B
Carolina Realty of Rowan	B
Catawba Auto Repair & Sales	C
CCC Pier Deck and Mulch (or CCC Pier builders)	A
Central Carolina Boat Club Inc.	A
Century 21 – Lohr Realty	B
Century 21 Swicegood, Wall & McDaniel	C
Christo's Original (or Cristos Restaurant)	B
Chuck's Automotive & Diesel	C
Clark's Garage	C
Classic Restaurant	B
Clinard Oil Co., Inc.	B
Cline's Truck Svc	C
Coldwell Banker - Crown Real Estate	B
Coley's Tavern	B
Comfort Suites (Lexington, NC)	B
Conrad & Hinkle Grocery	B
Cook's Barbecue (or Lexington BBQ)	B
Country Christian Books & Gifts	C
Country Curve Florist & Gifts	C
Country Hearth Inn	B
Country Road Log Homes	B
Country Side Motors	C
Countrywide Services	C
Cracker Barrel Old Country Store (Lexington, NC)	C
Crossroads	B
Crystal Bay Homeowners Association	Not applicable
Custom Pier Design	A
D & E Marina and Storage (or D & E Marine)	A
D & O Builders	B
Dan Nicholas Park & Campground	B
Daves Music	C
Davidson Trailer Repair Inc	C

Business Name	Priority
Davidson Truck & Auto	C
Dee's Catering Svc	C
Denton Pit Stop	B
Denton Propane	B
Domino's Pizza (Lexington, NC)	B
Donnie Mullinix Store	B
Doub Plumbing	C
Earley's Auto Repair	C
Eastgate Cinemas Theatre (or UA Eastgate 5) (Albemarle, NC)	C
Ellis Crossroads Grocery	B
Escape The Daily Grind	C
Fast Stop (New London, NC)	B
First Bank (Richfield, NC)	B
Fish Tales Marina & Grille Inc	A
Flat Swamp Grocery	B
Flower Basket	C
Flower Shoppe	C
Flowers Plus	C
Food Lion (Albemarle, NC)	C
Food Lion (Lexington, NC)	B
Food Lion (Richfield, NC)	B
Food Lion (Spencer, NC)	C
Galloway's 76 (Richfield, NC)	C
Gerald's Hair Ctr & Day Salon	C
Glover Realty	B
Gold Hill Watercraft	B
Hallco Manufacturing Ind	C
Hammer Truck Sales	C
Hampton Inn (Albemarle, NC)	B
Hanes Service	C
Happy Day's Tavern	C
Hardee's (Lexington, NC)	B
Harmanco's	C
Heart of Albemarle Motel	C
High Rock Boat & Ski Club	A
High Rock Boat Dock Marina Inc. (High Rock Boat Dock Beach Club)	A
High Rock Lake Marina and Campground	A
High Rock Lake Rentals	A
High Rock Motors	C
High Rock Realty	A

Business Name	**Priority**
High Rock Sales, Inc	B
Hills Minnow Farm (HMF Distributors)	A
Hoff's Grill	C
Hoffman Auto Rental & Leasing	C
Hogans Prop Shop & Accessories	B
Hoh, Jr. Inc.	C
Holiday Inn Express (Lexington, NC)	B
Holiday Inn Express Hotel & Suites (Albemarle, NC)	B
Hoover's 24 Hour Tire Svc	C
Hudson's Garage	C
Huffman High Performance	C
Huffman's Peaches and Produce	B
Hunan Chinese Restaurant	C
I 85 Amoco (Salisbury, NC)	B
Ingram Marine Center	B
Inner City Transmissions	C
Ivan's	B
Jack's Grocery	B
Jac-Lyn's Flowers & Gifts	C
Jimmy's Barbecue	B
Jimmy's Lakeside Restaurant	A
Jin Jin Chinese Restaurant	C
John's Tavern	B
Joseph's Pizzeria	Out of business
K & M Wholesale Co	C
Ketner Jr, Glenn E - Ketner Center	C
Kirby Realty Company	B
Kountry Korner Hardware	B
Kountry Market	B
L W Watson Inc	C
La Dolce Vita (or Pinocchio Restaurant)	C
La Fuente Mexican Restaurant	C
Lake Front Properties and more… (formerly Paula Noonan Real Estate)	A
Land Marine, Inc.	B
Lentz General Store	B
Lexington Lawn & Garden	B
Lexington Tool & Specialty Co	C
Liberty Feed & Seed Store	B
Lone Hickory Hardware	C
Lowe's Foods (Denton, NC)	B

Business Name	**Priority**
Lyon Loretta Barber	C
Main Street Emporium	C
Marion Grubb Construction (or Grubb Construction)	A
Marks 24 Mobile Tire Svc	C
Martin Motor Co	C
Martin's Auto Sales	C
Master Tech Auto & Heavy Truck	C
Mc Donald's (Lexington, NC)	B
McClures Bait & Tackle Shop	C
Merritt's Auto & Machine Inc	C
Michael's Grocery	B
Mimi's Mini Mart	A
Mock Tire & Automotive Co	C
Motel Restaurant (Richfield, NC)	B
New London Grocery	B
Newsome Auto Svc	C
North Stanly Florist	C
N-Tunes Car Stereo, Marine, Inc.	B
N-Tunes Car Stereo, Marine, Inc.	B
Old Country Store	B
Old North State Club at Uwharrie Point	A
Original Boat Dock, Inc.	A
Owens Construction and Realty	B
Pansy Hunt Realty (or Pansy Hunt Properties)	B
Park In Grill	C
Pat & Mick's Fish House	B
Peninger Distributing	B
Penninger Bait/Service (or Penninger Tire and Wheel)	B
Performance Yamaha and Kawasaki	C
Phillips Printing	C
Piedmont Boat Club Inc.	A
Piedmont Cheerwine (or Cheerwine Bottling Co)	C
Piedmont Fleet Svc	C
Piedmont Honda-Kawasaki-Polaris (or Piedmont Polaris)	B
Pizza Hut (Lexington, NC)	B
Pizza Oven (Lexington, NC)	B
Pizza Stop	C
Produce Corner	C
Quality Trailer Repair	C
Queen Realty & Construction, LLC	B

Business Name	**Priority**
Ralph Brinkley & Sons Auto	C
Ray’s Cycle Shop, Inc.	B
RHR Distributing	B
Richfield Bp Inc	B
Richfield Used Truck Parts	C
Ricks Restaurant	B
Robert Hedrick Construction	B
Roger Milan Construction	C
Ron White’s Interstate Marine, Inc.	A
Rowan County Tax / GIS site	Not applicable
Rowan Museum	C
Rowan Realty	B
Rumors	C
Salvage Grocery	C
Schwan's Frozen Foods	C
Seasons Family Restaurant	Out of business
Shaw’s Bait and Tackle	A
Smiley's Gas & Grocery (Smiley's Convenience Store)	A
Smiley's Tamarac Marina, Inc	A
Sodexho-Marriott Food Svc	C
South Lexington Auto Repair	C
Southern BBQ #2 (or Southern BBQ Too)	A
Southmont Grocery	A
Speedy Lohr's BBQ	A
Sports Country	B
Spring Garden Chinese Restaurant	C
Stanly Ace Hardware (Richfield, NC)	C
Stanly Power Equipment	C
Steed Properties Inc.	A
Steve's Barbecue	B
Studio One	C
Subway Sandwiches & Salads (Spencer, NC)	C
Super 8 Motel (Lexington, NC)	B
Tackle Sac	Out of business
Taco Bell (Lexington, NC)	B
Tar Heel Sportsman	B
Teri's Social Club	C
The Loading Dock (formerly Fat Cat's Pizza)	A
Thousand Trails Preserve (Thousand Trails Inc)	C
Totem Lakes Campground	C

Business Name	**Priority**
Tracks End Restaurant	C
Trade Wind Treasures	C
Trading Post (Denton, NC)	C
Trinity Cycles	C
Trotter's Sports and Marine Inc.	Out of business
Uncle Glen's (formerly Jim's Bar-B-Q)	A
Union Café	B
Usborne Books	C
Uwharrie Point Marina	B
Uwharrie Realty (or Uwharrie Real Estate)	A
Vehi Care/Ssd	C
Wallace Realty	B
Waterfront Properties	A
Watford Realty (or Ben Watford Realty)	B
Wendy's (of Richfield)	C
Whip-O-Will Family Campground	A
Whitley's Restaurant Inc	B
Wildlife Resource Commission Boat Ramp	Not applicable
Wilson Carter Supply	B
Wright's Flower Shop	C
Yadkin Texaco Svc Station	C
Zaxby's (Lexington, NC)	B

Appendix B: Final List of Reservoir Related Businesses

The following businesses were identified as reservoir related. The businesses listed as Priority A were contacted during the initial round of interviews to gather general information on the impact of the reservoir on the business. Following these interviews, RTI obtained contact information for process-related businesses as well as additional businesses to supplement the original Priority A list. A subset of the combined Priority A and additional businesses were contacted after the alternatives had been established to gather estimates on the impact of the alternatives on different types of reservoir related businesses around High Rock Lake. These estimates are part of the information used to determine the percentage revenue increases/decreases associated with each of the alternatives.

A summary of the data provided by these businesses as well as RTI's analysis based on this data are discussed in Section 2 of the report.

Business Name		**Round 1: General Information**		**Round 2: Alternative Impact Estimates**		**Included in Scenario Analysis**
		Contacted	***Survey information obtained***	***Contacted***	***Survey information obtained***	
Badin Lake Family Restaurant	Priority A	✔	✔			
Badin Lake General Store	Priority A	✔	✔			
Badin Lake Jet Ski Rentals (PWC)	Priority A	✔				
Badin Lake Realty	Priority A	✔	✔			
Badin Shores Resort Owner Assn	Priority A	✔	✔			
Big Foot Trading Post (formerly Shaw's Bait and Tackle)	Priority A	✔	✔	✔		✔
Captain's Galley Restaurant	Priority A	✔	✔			

Business Name		Round 1: General Information		Round 2: Alternative Impact Estimates		Included in Scenario Analysis
		Contacted	*Survey information obtained*	*Contacted*	*Survey information obtained*	
Carolina Boat Center, LLC	Priority A	✔				✔
CCC Pier Deck and Mulch (or CCC Pier builders)	Priority A	✔				✔
Central Carolina Boat Club Inc.	Priority A	NA	NA	NA	NA	
Custom Pier Design	Priority A	✔	✔	✔	✔	✔
D & E Marina and Storage (or D & E Marine)	Priority A	✔	✔	✔	✔	✔
Fish Tales Marina & Grille Inc	Priority A	✔	✔			
High Rock Boat & Ski Club	Priority A	✔				✔
High Rock Boat Dock Marina Inc. (High Rock Boat Dock Beach Club)	Priority A	✔				✔
High Rock Lake Marina and Campground	Priority A	✔	✔	✔	✔	✔
High Rock Lake Rentals	Priority A	✔				✔
High Rock Realty	Priority A	✔				✔
Hills Minnow Farm (HMF Distributors)	Priority A	✔				✔
Jimmy's Lakeside Restaurant	Priority A	✔				✔
Lake Front Properties and more… (formerly Paula Noonan Real Estate)	Priority A	✔	✔	✔	✔	✔
Marion Grubb Construction (or Grubb Construction)	Priority A	✔				✔
Mimi's Mini Mart	Priority A	✔				✔
Old North State Club at Uwharrie Point	Priority A	NA	NA	NA	NA	
Original Boat Dock, Inc.	Priority A	✔				✔
Piedmont Boat Club Inc.	Priority A	NA	NA	NA	NA	
Ron White's Interstate Marine, Inc.	Priority A	✔				✔
Smiley's Convenience Store	Priority A	✔	✔	✔	✔	✔
Smiley's Tamarac Marina, Inc	Priority A	✔	✔	✔	✔	✔
Southern BBQ #2 (or Southern BBQ Too)	Priority A	✔	✔			✔
Southmont Grocery	Priority A	✔	✔	✔		✔
Speedy Lohr's BBQ	Priority A	✔				✔
Steed Properties Inc.	Priority A	✔				✔
The Loading Dock (formerly Fat Cat's Pizza)	Priority A	✔	✔	✔		✔
Uncle Glen's	Priority A	✔				✔
Uwharrie Real Estate	Priority A	✔	✔	✔	✔	✔

Business Name		Round 1: General Information		Round 2: Alternative Impact Estimates		Included in Scenario Analysis
		Contacted	*Survey information obtained*	*Contacted*	*Survey information obtained*	
Waterfront Properties	Priority A	✔				✔
Whip-O-Will Family Campground	Priority A	✔	✔			
Alcoa's Badin Works[a]	Process related		✔	✔	✔	✔
APGI's Yadkin Hydro Project[a]	Process related		✔	✔	✔	✔
Denton Utilities	Process related			✔		
Duke Energy's Buck Steam Plant[a]	Process related		✔	✔	✔	✔
Salisbury-Rowan Utilities (Salisbury-Rowan Utilities Water Treatment Plant and Salisbury-Rowan Utilities Wastewater Treatment Plant)[a]	Process related		✔	✔	✔	✔
Tuckertown Water Treatment Facility (or Hwy. 52 Water Treatment Facility)[a]	Process related		✔	✔	✔	
BMW Construction	Additional			✔		✔
Budd's Landscaping Service	Additional					
Highway 49 Sporting Goods	Additional					
Moore's Grading	Additional					
Norbert Snider Construction	Additional			✔		✔
Randy Sells Stone Masonry	Additional					
Taylorbuilt Homes	Additional					
Tom's Creek Nursery[a]	Additional		✔	✔	✔	✔
Uwharrie Lakes Builders, LLC (or Uwharrie Point Building Co.)	Additional					
Uwharrie Point Real Estate	Additional					

[a]Round 1 general information was obtained during "Round 2" when the scenario impact estimates were obtained. Contacts for these businesses were obtained after the initial round of interviews had been completed.

NA: Not applicable

Appendix C: Reservoir Related Business Survey Questions

As discussed in Section 2.3, two rounds of interviews were used to gather data on reservoir related businesses. During the first round of interviews, which included only seasonal/tourism-related and property-related businesses, respondents provided general information on the business, confirmed that the business is reservoir related, and described the general impact of the reservoir water level on the business. The survey was conducted over the phone or through e-mail. Section C-1 includes the questionnaire used for this round of interviews.

The second round of interviews included the process-related businesses and a subset of the seasonal/tourism-related and property-related businesses. This round of interviews focused on gathering more specific information related to the reservoir management alternatives in order to quantify impacts. Since the process-related businesses were not included in the Round 1 interviews, general information as well information specific to the alternatives was collected. E-mail was generally used to gather this data; the survey questions are described in Section C-2. Follow-up questions in subsequent e-mails were used to clarify responses and fill-in any gaps.

The seasonal/tourism-related and property-related businesses surveyed in the Round 2 interviews were first screened through a phone call. During the screening phone call, businesses included in the Round 2 interviews were asked whether they consider their business to be seasonal to confirm whether the business is recreational/tourism-related or property-related. At this time, these businesses also responded to questions about the months of their season, percentage revenue earned during

these months, whether the season was due to recreators visiting the reservoir or better working conditions, and types of things that influence the number of visitors to High Rock thus impacting their business sales. Both seasonal/tourism-related and property related businesses described things that cause fluctuation in their business or influence the demand for their services. The importance of the influence of the reservoir water level was also addressed. General information that had not been obtained during the Round 1 interviews (such as for the additional business) was also collected during this call.

After the screener, a follow-up phone interview was scheduled to gain the businesses' input on the alternative reservoir water level scenarios. RTI sent the businesses the letter and list of questions in Section C-3, along with a copy of Figure 1-2, prior to the follow-up interview to allow the businesses the opportunity to look at the alternatives and think about what effect they would have on their business.[1] The phone interview followed the questions listed in the letter, with some additional prompting if the business needed to elaborate on or explain a response.

C-1 ROUND 1 (GENERAL): SEASONAL/ TOURISM-RELATED AND PROPERTY-RELATED BUSINESSES

My company, RTI International, is conducting an analysis of the economic impacts of the Yadkin Project for APGI. Part of this study involves determining possible economic impacts on reservoir related businesses in Davie, Davidson, Montgomery, Rowan, and Stanly counties.

We are in the process of gathering information from businesses that may be affected if the reservoirs (High Rock, Tuckertown, Narrows, and Falls reservoirs) were managed differently. We would like to obtain information on your business for the analysis. Please provide the following information to the best of your knowledge. Provide a rough estimate if you are unable to supply an exact figure.

[1]Only seasonal/tourism-related businesses, as identified in the screener, were asked questions related to an operating season. Property-related businesses typically operate year-round and are therefore not impacted on a seasonal basis.

The first seven items refer to basic information that will be used to verify the information we currently have on your business.

1. Name of business
2. Your name (or person to contact in the future)
3. Phone number
4. Address
5. Email address (where future emails and results of the analysis will be sent)
6. County the business is located in
7. Reservoir closest to the business

Items 8 through 10 refer to general information about the business.

8. Tell me about your business
9. Annual revenue (range is acceptable)
10. Number of employees

Items 11 through 16 refer to the influence of the reservoir on the business and the impact of variation in reservoir level on the business.

11. About how many clients are from the local area? (Are most of your clients tourists?)
12. How does variation in the reservoir level affect the business?
13. Is the business located where it is because of the reservoir?
14. About how much is revenue/sales (percentages are acceptable) affected during a typical year when the reservoir level is down? About how much does your bottom-line/profit change?
15. Was the drought year (2002) noticeably the worst year recently?
16. About how much was revenue/sales (percentages are acceptable) affected during the drought year? About how much did your bottom-line/profit change?

Please let me know if you wish this information to be kept confidential. If so, we will only report the information you provide in combined form. Examples may be cited, but the business will not be identified.

Thank you for your help. Please contact me by phone at 919-541-6261 or email at wthroneburg@rti.org if you have any

questions on what we are using this information for or what information we need.

Thank you.

C-2 ROUND 2 (GENERAL AND ALTERNATIVE SPECIFIC): PROCESS-RELATED BUSINESSES

My company, RTI International, is conducting an analysis of the economic impacts of the Yadkin Project for APGI. Part of this study involves determining possible economic impacts on facilities in Davie, Davidson, Montgomery, Rowan, and Stanly counties.

We are in the process of gathering information from facilities that may be affected if the reservoirs (High Rock, Tuckertown, Narrows, and Falls reservoirs) were managed differently. We would like to obtain information on your business for the analysis. Please provide the following information to the best of your knowledge. Provide a rough estimate if you are unable to supply an exact figure.

The first seven items refer to basic information that will be used to verify the information we currently have on your facility.

1. Company name & Facility name
2. Your name (or person to contact in the future)
3. Phone number
4. Address
5. Email address (if the email address to which this was sent is incorrect)
6. County the facility is located in
7. Reservoir used by the facility

Items 8 through 11 refer to general information about the facility.

8. Tell me about your process and how you use the water
9. Annual revenue (range is acceptable); if this facility does not have a revenue estimate, please provide other measure of production
10. Number of employees
11. Current withdrawal rate (MGD)

Items 12 through 18 refer to the influence of the impact of variation in reservoir level on the facility.

12. How are operations affected when the reservoir water is drawn down?
13. How much would the reservoir water level need to fall (in feet) before equipment or operations need to be modified?
14. Are costs affected during a typical year when the reservoir water level falls (such as in the winter when the water level is lower)? By how much do costs change? What percentage of these costs are due to a difference in water quality treatment costs?
15. What steps did you use to deal with the drought in 2002? What were the costs of adjustment during the drought year?
16. What would be the change in costs if the water level were more variable:
    a. If the water level went up and down more often?
    b. If the water level stayed down for a longer period of time?
    c. If the typical water level dropped farther (such as 20 feet below full pond in the winter, approximately 10 feet below average current winter conditions)?
17. What would be the effect and change in costs if the water level were systematically more stable (such as 2 to 3 feet below full pond year round)?
18. How much would costs have to increase before you would ask for new rates?

Thank you for your help. Please contact me by phone at 919-541-6261 or e-mail at wthroneburg@rti.org if you have any questions on what we are using this information for or what information we need.

Thank you.

C-3 ROUND 2 (ALTERNATIVE SPECIFIC): SEASONAL/TOURISM-RELATED AND PROPERTY-RELATED BUSINESSES

Dear _____,

Thank you for agreeing to provide information on the possible impact on your business of different management scenarios for the water level of High Rock Lake. As I mentioned on the phone, this is a follow-up to our conversation this past summer.

In order to better understand the impact on your business, a range of alternatives have been developed for use in the analysis. These alternatives were chosen to represent a "range" of operating conditions that might be considered for High Rock Lake in the future. None of the alternatives is being proposed by APGI nor has in any way been selected as the future operating alternative for the Yadkin Project. They are just simplified representations of a range of alternative operating scenarios for High Rock Lake.

These alternatives are presented in a graph on the following page. "Existing Conditions" represents a simplified version of average historical conditions, with water levels at about 3 feet below full pond (652 feet) from mid-May to mid-September and 10 feet below full pond (645 feet) the rest of the year.

Alternative 1 would maintain the water level at 3 feet below full pond (652 feet) year round. Alternative 2 would maintain the summer water level of 3 feet below full pond (652 feet) from the beginning of April to the end of October. Alternative 3 would maintain a slightly lower summer water level at 5 feet below full pond (650 feet) and a more intense winter draw down of 20 feet below full pond (635 feet).

I have also included the list of questions I will be asking in our next conversation about the alternatives presented in the graph. This will give you some time to think about your response before our phone conversation.

According to my records, the next phone interview has been scheduled for ___ on _____. Please let me know if this date or time is no longer convenient for you. I can be reached by phone at 919-541-6261 or by e-mail at wthroneburg@rti.org. Also, please contact me if you have any questions.

Thank you for your help.

Sincerely,

Wanda W. Throneburg

RTI International
Phone: (919) 541-6261
Fax: (919) 541-6683
E-mail: wthroneburg@rti.org

(We inserted a full page version of Figure 1-2 here.)

Based on the graph, think about your answers to the following questions. These questions will be discussed in your scheduled phone interview with RTI International at __ on _____.

Some of these questions ask you to compare an alternative with "existing conditions", shown as a pink line on the graph. This is a historical average of the water level and might not reflect what occurred in the last few years. However, please compare the alternatives to this representation of present conditions for this analysis.

Existing Conditions

1. What months of the year would make up your season in the "existing conditions" scenario?

Alternative 1 – Constant water level year round

1. Would your season change if the water level were kept at about 3 feet below full pond year round?
    a. What would be the months of the new season?
2. Would annual sales change if the water level followed Alternative 1?
    a. By what percentage compared to "existing conditions
    b. Why do you think annual sales would change by that amount?

Alternative 2 – Extending summer water level

1. Would your season change if the water level were higher longer (from the beginning of April to the end of October)?
    a. What would be the months of the new season?
2. Would annual sales change if the water level followed Alternative 2?
    a. By what percentage compared to "existing conditions"?
    b. Why do you think annual sales would change by that amount?

Alternative 3 – Larger decrease in water level in the winter and slightly lower in summer

1. Would your business be impacted if the water level were 5 feet below full pond in the summer (about 2 feet lower than the summer "existing conditions")?

2. Would your business be impacted if the water level in the winter was drawn down 20 feet below full pond (about 10 feet lower than the winter "existing conditions")?
3. Would your season change if the water level were slightly lower in the summer and drawn down to 20 feet below full pond in the winter?
    a. What would be the months of the new season?
4. Would annual sales change if the water level followed Alternative 3?
    a. By what percentage compared to "existing conditions"?
    b. Why do you think annual sales would change by that amount?

D Davidson County Supplemental Analysis

The analysis provided in the Section 3 outlines expected changes in home sales prices due to changes in reservoir management. As noted in Section 3, we only included in our analysis homes for which home sales prices were available. Unfortunately, we did not have this data for Davidson County; instead, we have only assessed value. Assessed value is generally correlated with sales price to some extent; however, because it reflects the assessor's judgment as to the value of home characteristics rather than a market-based measure of homeowners' willingness to pay for those characteristics, we chose to omit Davidson County from our main analysis.

Davidson County contains many of the homes bordering High Rock Lake, however, and thus is very important in understanding the potential impacts of reservoir management scenarios, so we felt it was critical to assess the impacts in some way. In this appendix, we repeat the same methods used to generate the results in Section 3 to estimate expected changes to assessed values in Davidson County. The most recent property assessment in Davidson County occurred in 2001, so all homes within 2 miles of High Rock Reservoir were assigned a "sales year" of 2001 and a "home sales price" equivalent to the total assessed value of the property. All parcels used in the analysis had structures and nonzero building assessed values.

Although all other observations in the analysis are for home sales price rather than assessed value, the dummy variable representing Davidson County may at least partially control for

this discrepancy. We recalculated the values in all relevant tables from Section 3 and present the results below. Note that, rather than numbering the tables in Appendix D consecutively, we number them to correspond to the comparable tables in Section 3, to facilitate comparisons.

Table D.3-2. Home Sales by County for Each Reservoir in Dataset

Reservoir	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Davidson	Wake	York	Total
B. Everett Jordan Lake	583						691		1,274
Badin Lake			186		142				328
Falls of Neuse Reservoir							3,060		3,060
High Rock Reservoir				216		6,082			6,298
Lake Norman		2,849							2,849
Lake Tillery			192		294				486
Lake Wylie		1,132						4,898	6,030
Mountain Island Lake		1,688							1,688
Total	583	5,669	378	216	436	6,082	3,751	4,898	22,013

Table D.3-3. Mean Values of Home Characteristics by County

	Davidson	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Wake	York, SC
Observations	6,082	583	5,669	378	216	436	3,751	4,898
Parcel area[a]	0.95	1.12	0.54	0.41	1.04	0.72	0.68	0.41
Sales price*	$119,463	$417,070	$227,764	$229,585	$119,141	$115,715	$354,863	$221,526
Year built[b]	1981	1992	1995	1984	1980	1961	1998	1986
Road distance	4.95	1.92	1.67	4.12	4.20	2.35	1.41	3.92
Reservoir distance	0.55	0.84	0.92	0.19	0.50	0.50	1.26	0.80
Percentage in urban area	0	4.3	69.1	0	0	0	52.7	78.3
Bedrooms[b]	2.6	2.9	3.3	2.4	2.7	2.8	3.3	3.0

[a]In acres.

[b]Supplemented with Census data when required.

*Assessed value plus deferred value for Davidson County.

Table D.3-4. Detailed Statistics for All Observations (n = 22,013)

Variable	Mean	Standard Deviation	Minimum	Maximum
Parcel area[a]	0.67	0.78	0.10	5.00
Sales price*	$219,871	261,746	$2,660	$22,409,900
Sales year	2001	1.01	2000	2004
Year built[b]	1988	11.96	1850	2004
Road distance	3.12	2.48	0	9.41
Reservoir distance	0.82	0.65	0.00	2.00
Percentage in urban area	0.44	0.50	0	1
Bedrooms[b]	3.01	0.50	1	7

[a]In acres.

[b]Supplemented with Census data when required.

*Assessed value plus deferred value for Davidson County.

Table D.3-6. Average Distance (in Feet) to Reservoir by Home Sales Price

Sales Price	Davidson	Chatham	Mecklenburg	Montgomery	Rowan	Stanly	Wake	York
Bottom 20%	3,369	6,093	6,135	2,005	2,373	3,637	6,883	5,094
20–40%	3,778	6,114	6,051	1,790	3,960	3,737	7,188	4,430
40–60%	3,445	3,249	4,862	574	2,869	3,402	7,281	4,226
60–80%	2,390	3,263	4,412	381	2,773	1,975	6,394	4,715
Top 20%	1,483	3,477	2,712	273	1,138	471	5,641	2,579

Table D.3-8. Final Regression Model Including Interaction Term Variable

Number of Observations	22,013	F(18, 21,994)	1093.50
R-squared	0.4723	Prob > F	0.0000
Adjusted R-squared	0.4718		

Variable	Coefficient	Standard Error	t-Statistic	P > |t|
Sales year	0.026	0.004	6.19	0.000
Build year	0.009	0.000	22.48	0.000
Beds	0.335	0.009	35.89	0.000
Area	0.121	0.005	24.15	0.000
Reservoir05	0.616	0.024	25.94	0.000
Reservoir1	0.357	0.018	19.34	0.000
Reservoir2	0.365	0.013	27.17	0.000
Reservoir34	0.035	0.013	2.67	0.008
Reservoir5	0.034	0.019	1.76	0.079
Reservoir05r	–0.008	0.001	–6.50	0.000
Davidson	0.129	0.048	2.68	0.007
Chatham	1.171	0.054	21.68	0.000
Mecklenburg	0.438	0.031	14.00	0.000
Montgomery	0.480	0.041	11.84	0.000
Rowan	0.013	0.061	0.22	0.829
Wake	1.135	0.044	25.97	0.000
York	0.570	0.030	19.14	0.000
Range	–0.012	0.002	–5.17	0.000
Constant	–59.267	8.303	–7.14	0.000

Findings

Adding Davidson County to the analysis slightly changes the regression results. Because we substantially increase the number of observations, the share of home price variation explained by the regression equation increases. The overall effect of water level range on home sales price increases but the effect of water level range for homes within 0.05 miles of a reservoir is smaller. The home price premium conveyed by a location within 0.05 mile of the shoreline is smaller. The use of assessed values rather than sales prices for Davidson County

(nearly 1/3 of observations) most likely causes these changes. If assessed values reflect physical characteristics of the home, but do not adequately measure the value of the reservoir to homeowners closest to the reservoir, this may dampen the measured impacts of proximity to the reservoir and its management on homes closest to the shoreline (and thus most affected by the reservoir). Additionally, we have very little information about how the assessed value is calculated, so it is difficult to determine the potential impacts of the scenarios on home sales prices in Davidson County. Keeping these limitations in mind, we have estimated the expected changes in home sales price and assessed value for Rowan and Davidson Counties, respectively. These results are presented in the tables below.

Table D.3-9a. Expected Change in Home Sales Price in Rowan County per Foot of Additional Water Level Range, by Distance Categories

Distance	Sales Observations	Average Price	Percentage Change	New Price	Change in Price
Average (0.5 mile)	216	$119,141	–1.23	$117,679	–$1,462
Homes <0.05	69	$136,688	–2.07	$133,861	–$2,827
Homes between 0.05 and 0.5	147	$110,905	–1.23	$109,544	–$1,361
Homes >0.5	79	$88,165	–1.23	$87,083	–$1,082

Table D.3-9b. Expected Change in Home Assessed Value in Davidson County per Foot of Additional Water Level Range, by Distance Category

Distance	Sales Observations	Average Price	Percentage Change	New Price	Change in Price
Average (0.5 mile)	6,082	$119,463	–1.23	$117,997	–$1,466
Homes <0.05	1,546	$140,720	–2.07	$137,810	–$2,910
Homes between 0.05 and 0.5	4,536	$112,218	–1.23	$110,841	–$1,377
Homes >0.5	2,266	$108,040	–1.23	$106,714	–$1,326

Table D.3-10a. Rowan County Estimated Home Sales Prices by Scenario and Distance

	Existing Conditions	Range		
		Scenario 1	Scenario 2	Scenario 3
Distance	12' Range	3' Range	10' Range	20' Range
Homes <0.05	$136,700	$162,100	$142,300	$114,000
Homes between 0.05 and 0.5	$110,900	$115,300	$111,900	$107,000
Homes >0.5	$88,200	$91,700	$88,900	$85,000

Table D.3-10b. Davidson County Estimated Home Assessed Values by Range and Distance

	Existing Conditions	Range		
		Scenario 1	Scenario 2	Scenario 3
Distance	12' Range	3' Range	10' Range	20' Range
Homes <0.05	$140,700	$166,900	$146,500	$117,400
Homes between 0.05 and 0.5	$112,200	$124,600	$115,000	$101,200
Homes >0.5	$108,000	$120,000	$110,700	$97,400

Table D.3-12a. Possible Change in Rowan County Tax Receipts under Each Scenario

Distance from Shoreline	Number of Homes	Scenario 1	Scenario 2	Scenario 3
		3' Range	10' Range	20' Range
Homes <0.05	69	11,000	2,430	–9,870
Homes between 0.05 and 0.5	147	4,100	930	–3,610
Homes >0.5	79	1,700	350	–1,590
Total	295	16,800	3,710	–15,070

Table D.3-12b. Possible Change in Davidson County Tax Receipts under Each Scenario

Distance from Shoreline	Number of Homes	Scenario 1	Scenario 2	Scenario 3
		3' Range	10' Range	20' Range
Homes <0.05	1,546	215,000	47,500	–191,000
Homes between 0.05 and 0.5	2,270	149,000	33,700	–132,000
Homes >0.5	2,266	114,000	32,400	–127,000
Total	6,082	508,000	113,600	–450,000