DRAFT PHASE I REPORT

AREA VI RED RIVER CHLORIDE CONTROL: RECREATION STUDY

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Executive Summary

The U. S. Army Corps of Engineers (USACE), Tulsa District (SWT) is conducting a reevaluation of the Congressionally-authorized Area VI project designed to reduce chlorides contributed to the Red River by the Elm Fork of the river's North Fork. As part of the reevaluation, SWT is evaluating how a potential change in the chlorides would affect the recreational fishery of Lake Texoma. In particular, concerns were raised about how a change in chloride would affect the striped bass population and the recreational fishing industry that surrounds it. The purpose of this study is to estimate the economic impact of a change in the recreational fishery.

Lake Texoma is a unique resource which accommodates many water-based activities. In 2006, over 5.8 million people used Lake Texoma for recreational purposes. Of particular interest is the striped bass fishing on Lake Texoma, which is considered some of the best in the country and draws people from all over the United States. With the anglers come all of the associated goods and services that directly benefit the local region, including: bait and tackle, guide services, restaurants, and accommodations.

Evaluating the economic impacts through a survey was determined to be the best method for estimating anglers' reaction to any potential changes in the recreational fishery. A number of methods were considered to administer the survey to a representative sample of the fishing population, including onsite interviews at boat launches, Web-based surveys, and telephone surveys. Due to the size of the lake and the number of access points, onsite interviews were seen as a viable method to capture a representative sample in a cost-effective manner. Internet-based surveys have inherent difficulties when used as a broad-based survey method. Telephone surveys were selected as least invasive to an angler's recreational experience, and were not subject to seasonality concerns.

A special fishing license has been established for Lake Texoma that allows fishing anywhere on the lake. This license can be issued to anyone who would like to fish on the lake, regardless of what State they reside in. To use as a base for the survey, Lake Texoma fishing license data was obtained from the Texas Parks and Wildlife Department for 2006 and 2007.

This data contained the names of people who bought Lake Texoma fishing licenses, with many of the records containing telephone numbers. Review of this data indicated people traveled a long way for the opportunity to fish on Lake Texoma, verifying the significance of the resource.

Based on discussions with USACE, lake managers, local stakeholders, and data collected, a telephone-based survey instrument was developed. The survey instrument incorporates elements of both travel cost method (TCM) and contingent valuation method (CVM) to determine the economic impact of proposed changes to the recreational fishery. The survey is designed to capture angler willingness-to-pay (WTP) for any changes.

This report represents Phase I of the study, which includes a description of the study area, other recreational opportunities, sample design, economic valuation methods, and the survey instrument. Phase II will include survey administration, statistical and econometric analysis of the completed survey questionnaires, determining National Economic Development (NED) benefits (or losses), and conducting a risk and uncertainty analysis.

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Section One: Introduction

1.0 Introduction

The U. S. Army Corps of Engineers (USACE), Tulsa District (SWT) is conducting a reevaluation of the Congressionally-authorized Area VI project designed to reduce chlorides contributed to the Red River by the Elm Fork of the river's North Fork. Congress first tasked the U.S. Public Health Service in the 1950s to look into the source of pollution (salts) on the Red River and in Lake Texoma (USACE 1995). In 1959, USACE was tasked with further "investigating the nature of each source area and to determine if a plan for controlling these areas could be developed" (USACE 1995).

In May 1977, the first Environmental Impact Statement (EIS) was filed with the Environmental Protection Agency (USACE 1996) and in 1991, USACE undertook a reevaluation to meet various environmental laws and regulations, including the National Environmental Policy Act (NEPA, USACE 1995). In 1996, USACE prepared a Supplement to the Final Environmental Statement (USACE 1996).

Based on the Federal Water Project Recreation Act of 1965, which "requires that full consideration be given to the opportunities that Federal multiple-purpose and other water projects afford for outdoor recreation and associated fish and wildlife enhancement" (Water Resources Council 1983), Congress directed SWT to conduct the current reevaluation study to assess the economic, social, and environmental feasibility of Area VI of the Red River Basin Chloride Control Project. The purpose of the Red River Basin Chloride Control Project is to reduce naturally-occurring chlorides that limit or preclude the use of Red River waters for municipal, industrial, or agricultural purposes.

The 1996 Supplement to the Environmental Statement identified several environmental issues, including the "impacts of decreased chloride concentrations in the Red River basin on primary production and sport fish abundance in Lake Texoma" (USACE 1996). The current reevaluation of Area VI includes a reevaluation of Area VI alternatives, costs, benefits, and cumulative impacts to the environment, which includes the impact on recreation due to changes in chloride levels in Lake Texoma and the entire Red River Basin.

Section One: Introduction

Lake Texoma, located on the border between Texas and Oklahoma, has economic importance to the area as a major tourist/recreational destination. It is estimated that 5.8 million visitors came to the region in 2006 for activities on the lake (Loe, personal interview, June 2007). Concerns have been raised about how a change in chloride levels would impact the recreational fisheries of Lake Texoma. In particular, the concern is that striped bass would be negatively affected. To evaluate the economic impact, SWT requires a study directed at addressing a strategy for economic valuation of changes to recreational activities on Lake Texoma and Lake Altus related to Area VI of the Red River Basin Chloride Control Project (Refer to Appendix A for Scope of Work)[1]. The purposes of this report are:

- Refine the recreation study area
- Identify the types of recreation that might be affected by the project
- Inventory the existing recreational opportunities
- Develop economic valuation methods
- Develop a survey instrument

Based on discussions with SWT, the scope of the current study is to focus evaluation efforts on recreational fishing of striped bass on Lake Texoma. SWT determined that changes to other fisheries and other recreational activities on Lake Texoma would be minimal. Therefore, these recreational activities were not evaluated in detail for the current study.

The current efforts and report represent Phase I of the study. This report for Phase I continues as follows. Section 2 provides a study area description. Section 3 outlines existing conditions in the Study Area in terms of recreation. Section 4 provides the sample design. Section 5 discusses economic valuation methods, and Section 6 discusses the survey instrument.

[1] SWT determined that changes to Lake Altus will be minimal; therefore this report only includes information pertaining to Lake Texoma and its affected recreational fisheries.

Phase II will include survey administration; statistical and econometric analysis of the completed survey questionnaires; determining National Economic Development (NED) benefits (or losses); and conducting a risk and uncertainty analysis.

Section Two: Study Area Identification

2.0 Study Area Identification

Lake Texoma is an 89,000 acre lake located on the border between Texas and Oklahoma and was created when the Denison Dam was constructed (Figure 2-1). The lake is a 1 to 2 hour drive north of the Dallas/Fort Worth metroplex, and can be accessed by two major roads (Interstate 35 and Highway 75).

Defining the recreational fishing area of Lake Texoma is important to determine the full economic impacts attributed to the lake and to ensure that any surveying efforts capture a representative sample of the user population. Previous studies have focused on the counties surrounding the lake as the primary area of economical impact. However, for the current study, the study area is defined as where the user population originates from. The following sections present the demographic characteristics of the area surrounding Lake Texoma, and the historical and current definitions of the study areas.

2.1 Demographic Characteristics

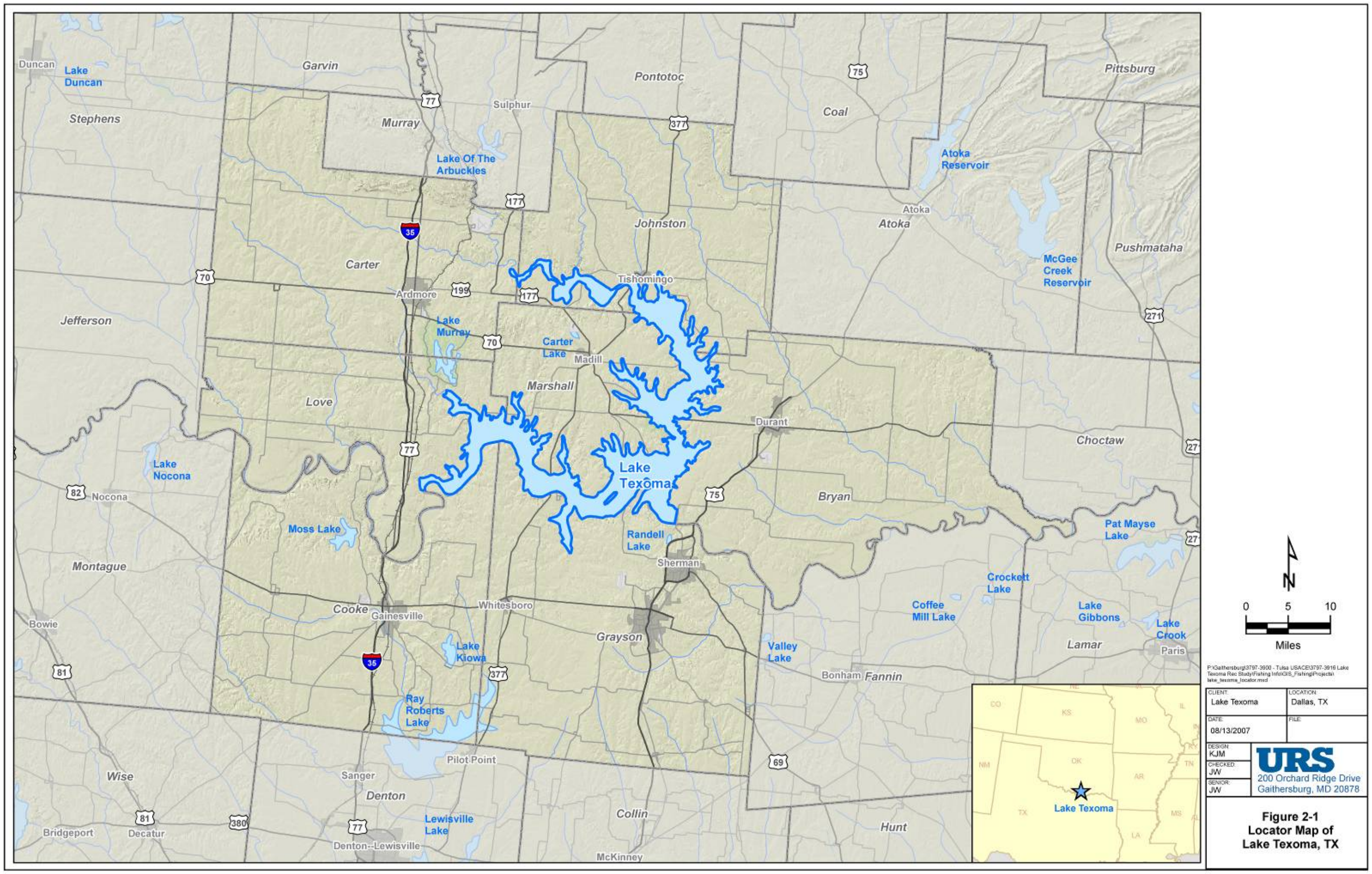
Table 2-1 provides basic demographic information on the seven counties adjacent to Lake Texoma, as well as Texas and Oklahoma. Information is provided on the employment categories that are believed to have the most direct impact from recreational opportunities at the lake.

Table 2-1. Demographic Information by State and County

			Percent Employed in Industries of Interest (%)		
County by State	**Population (2006*)**	**Median Household Income ($)**	**Fishing & Hunting, etc.****	**Retail Trade**	**Recreation, etc.*****
Texas	*23,507,783*	*41,645*	*2.7*	*12.0*	*7.3*
Cooke	38,946	41,200	5.4	13.6	5.3
Grayson	118,478	38,752	1.9	12.5	6.1
Oklahoma	*3,579,212*	*37,109*	*4.1*	*12.0*	*7.5*
Bryan	38,395	29,055	3.8	12.9	7.3
Carter	47,503	32,046	7.9	15.4	7.8
Johnston	10,436	28,306	7.3	11.4	5.4
Love	9,162	34,431	7.3	10.2	8.4
Marshall	14,558	29,344	3.9	13.4	9.4

Source: U.S. Census Population and Housing, 2000
*estimate
**this category also includes the agriculture, forestry, and mining industries
***this category also includes the arts, entertainment, accommodation, and food services industries

Figure 2-1. Area Surrounding Lake Texoma, Texas



Section Two: Study Area Identification

2.2 Historical Study Area

Appendix IX of the 1995 Final Supplement to the Final Environmental Statement of the Red River Chloride Control Project, Texas and Oklahoma, provides an analysis of the economic impacts of fishing on Lake Texoma (USACE 1995b). In these studies, the study area was limited to the economic effects of fishing on the local area (Figure 2-1), including the seven counties in Texas and Oklahoma adjacent to the lake.

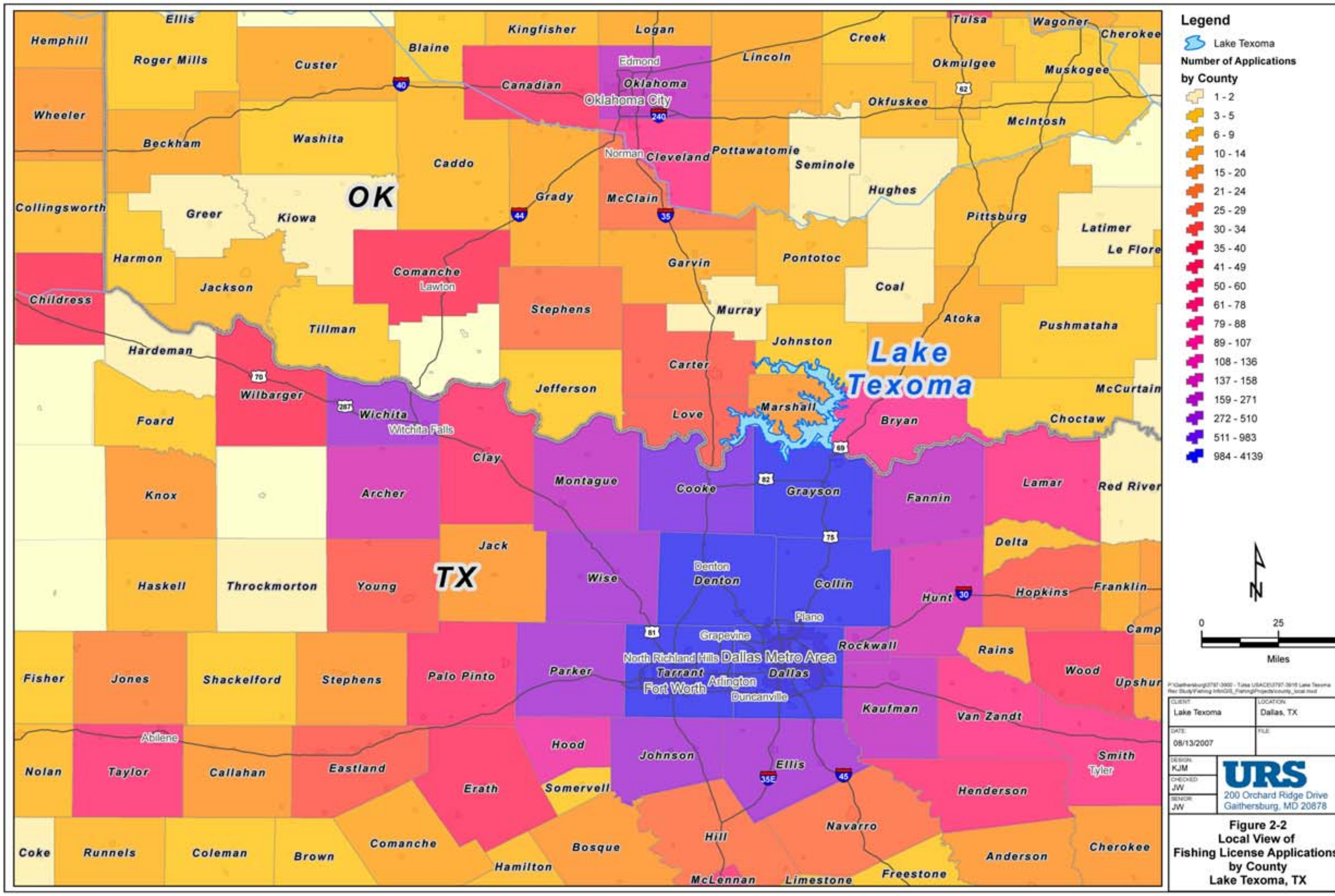
2.3 Revised Study Area

Previous studies have defined the study area as the area directly adjacent to Lake Texoma. However, it was determined during the course of the study that Lake Texoma is used by people from outside such a narrowly-defined area. Therefore, redefining the study area was necessary.

Since Lake Texoma is on the boundary between Oklahoma and Texas, fisherman can use fishing licenses issued from either state to fish on Lake Texoma; however, they can only fish within the waters that are considered part of their respective state (e.g., a Texas fishing license will only work on the Texas portion of the lake). A special fishing license was established for Lake Texoma that allows fishing anywhere on the lake. Lake Texoma fishing license data was obtained from the Texas Parks and Wildlife Department for 2006 and 2007.

Because there were large numbers of people purchasing fishing licenses from outside the local area, the study area was expanded to a regional level, including the cities of Tulsa and Oklahoma City in Oklahoma, and the Dallas-Fort Worth metroplex in Texas. Figure 2-2 visually depicts the number of fishing licenses purchased in the local region (by county). A large number of fishing licenses were purchased in the Dallas-Fort Worth metroplex, with relatively fewer licenses purchased in nearby Oklahoma City and Tulsa.

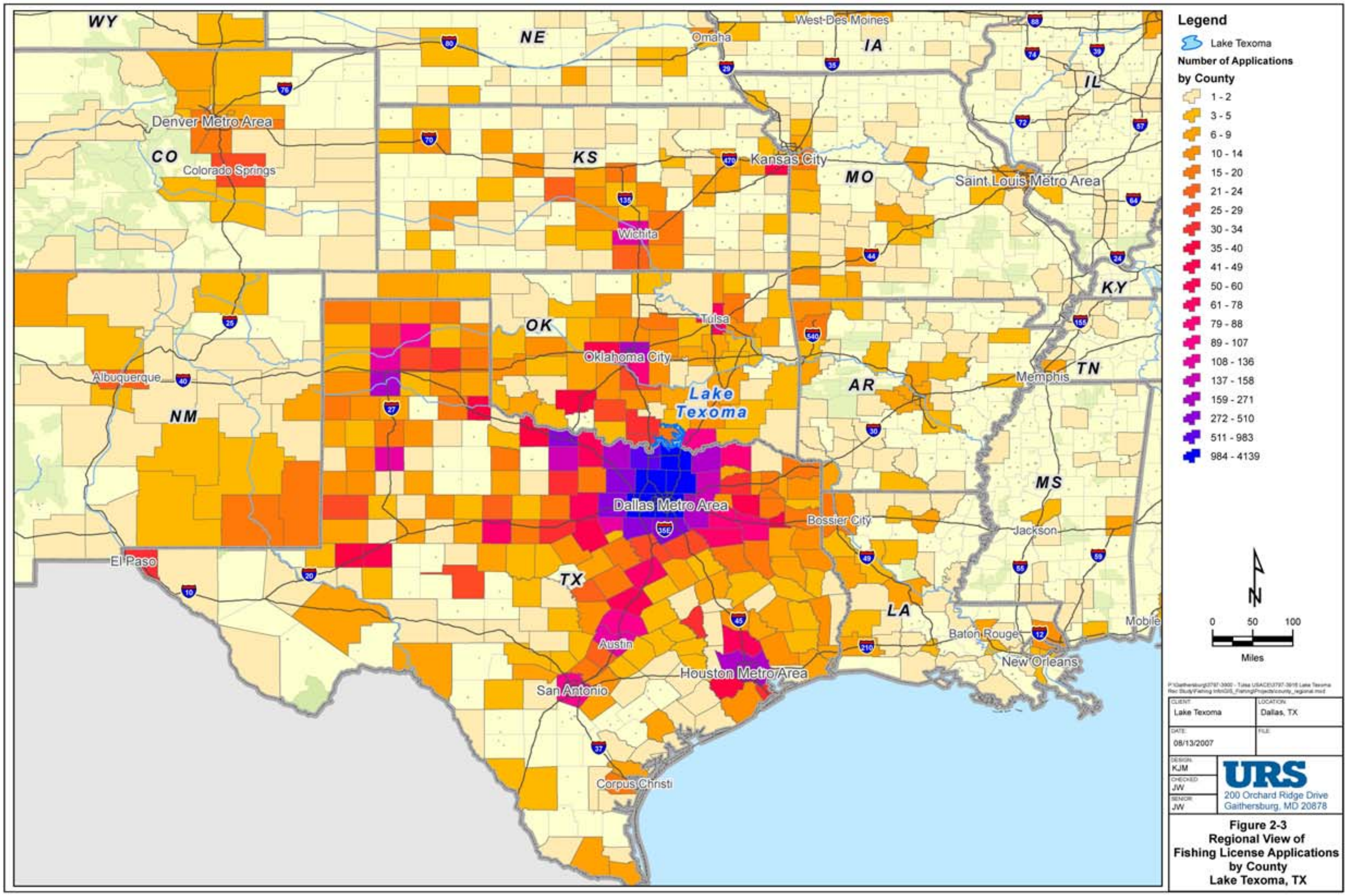
Figure 2-2. Fishing License Sales for the Local Region, by County



Section Two: Study Area Identification

Further analysis of the fishing license data indicated that licenses were purchased from distant areas including, but not limited to, Kansas and Colorado. Therefore a broader regional view was considered for the study area. As can be seen in Figure 2-3, fishermen travel from great distances for the opportunity to fish on Lake Texoma. This highlights the unique significance of Lake Texoma as a fishing destination and the importance of this resource to the broader region.

Figure 2-3. Fishing License Sales for Broad Region, by County



3.0 Inventory of Existing Conditions

The presence of substitute recreation sites is an important consideration when the recreation quality at the site of interest may be altered. If alternate recreation sites are available, people have other options other than adjusting to the change. For example, two recreation sites (Site A and Site B) are located within 15 miles of each other and are nearly identical in their quality/quantity of recreation opportunities. If Site A is closed, people may not be negatively affected because they can simply go to Site B instead. However, if the site of interest has no substitutes or significantly inferior substitutes, people are likely to be affected by negative changes because they cannot easily obtain the same recreation experience elsewhere.

Although there are other lakes in the region that provide similar recreation resources to Lake Texoma (described below under *alternative recreation locations*), Lake Texoma falls under the second category of recreation sites described above. The lake is large, covering approximately 89,000 acres. Few lakes in the U.S. are this large and lakes of comparable size are typically located a considerable distance away in states such as Minnesota and Michigan. In addition to its size, Lake Texoma is one of the only U.S. lakes where striped bass can spawn naturally. Striped bass is a highly sought game fish that is stocked in several lakes across the country. Not having to stock the lake saves time and money, allows for year-round fishing, and means that the species population is not subject to budgetary or political pressures that face some fish-stocking programs. Lake Texoma is a unique recreational resource and while people can always fish elsewhere, the experience will not be a comparable substitution.

The following subsections provide a review of the current opportunities for outdoor recreation at Lake Texoma and other lakes in Texas and Oklahoma.

3.1 Outdoor Recreation Opportunities: Lake Texoma

Outdoor recreation opportunities information is based on informal discussions with USACE personnel, city officials, and local stakeholders that occurred during the site visit in June 2007, published literature, and research of available services at Lake Texoma.

Section Three: Inventory of Existing Conditions

Lake Texoma is a popular outdoor recreation location; according to the Denison, Texas Department of Commerce, approximately 5.8 million people visit the lake each year (Loe, personal interview, June 2007). Anglers pursue striped bass, catfish, crappie, sand bass, and largemouth bass, with striped bass being the most sought after game fish. Competitive fishing events, commonly for striped bass, are held annually on Lake Texoma (Loe, personal interview, June 2007). It is estimated that there are between 450 and 700 fishing guides who provide services on the lake. Other water-based recreation activities include boating, waterskiing, jetskiing, and swimming. Lake Texoma facilities are also popular for family reunions, camping, hiking, and golfing.

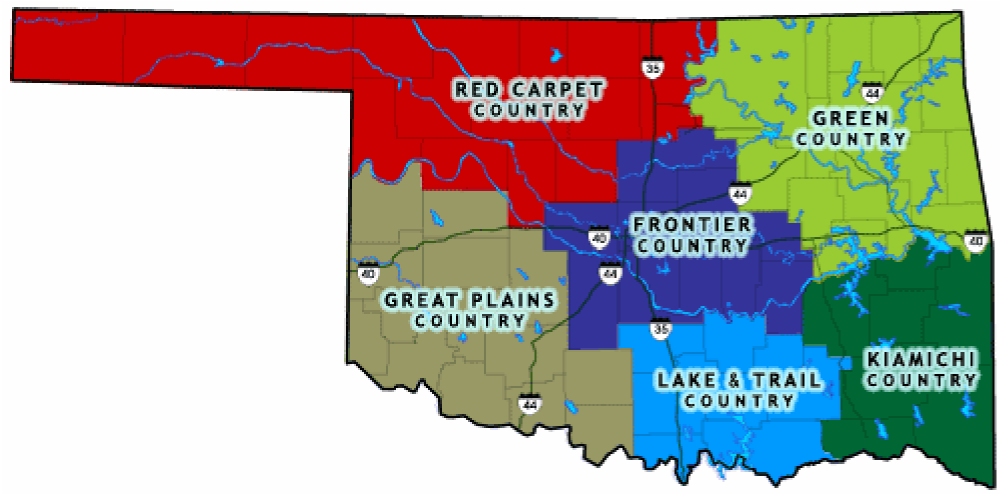
There are 10 USACE parks located around the perimeter of the lake. USACE collects approximately $700,000 in user fees each year at Lake Texoma. Camp spots can be reserved either online or by calling a specific campsite, with approximately 80 percent of campers using the online reservation system. Advance campsite reservations are not required in order to camp at a given location, but are often necessary during weekends and holidays. Approximately 70 percent of visitors are "Golden Age" (senior). Some locations offer day-use facilities, and there are 15 USACE-controlled boat ramps around the lake. An additional 37 private or State ramps are also available for use.

3.2 Additional Recreation Opportunities

3.2.1 Oklahoma

There are many outdoor recreation opportunities in Oklahoma, with the central and eastern portions of the State having the largest number of opportunities. Oklahoma Tourism divides the State in to six regions: Red Carpet Country, Great Plains Country, Frontier Country, Lake and Trail Country, Green Country, and Kiamichi Country (Figure 3-1). Primary alternative recreation sites to Lake Texoma in the State of Oklahoma are located in Green Country.

Figure 3-1. Oklahoma Tourism Regions



Map from Travel Oklahoma. http://www.travelok.com/ada-rec/

Green Country, which includes Tulsa, provides 39 lakes (Oklahoma Online 2007a), with 21 State parks with various recreation facilities. Not all of these State parks are located on or near lakes. However, Lake Keystone State Park is located on Lake Keystone, between Sand Springs and Mannford, just outside of Tulsa. Lake Keystone is home to various recreational fish, including largemouth, smallmouth, white, and striped bass; channel catfish; crappie; sunfish; walleye; and saugeye (Oklahoma Parks, Resorts & Golf 2007). This variety closely resembles what is available on Lake Texoma.

Twenty-seven lakes (Oklahoma Online 2007b) and four State parks are located in Great Plains Country, however fishing and boat access is limited (Travel Oklahoma 2007). Quartz Mountain State Park, which surrounds Lake Altus-Lugert, provides a variety of recreation opportunities, including hunting, fishing, camping, and golfing.

3.2.2 Texas

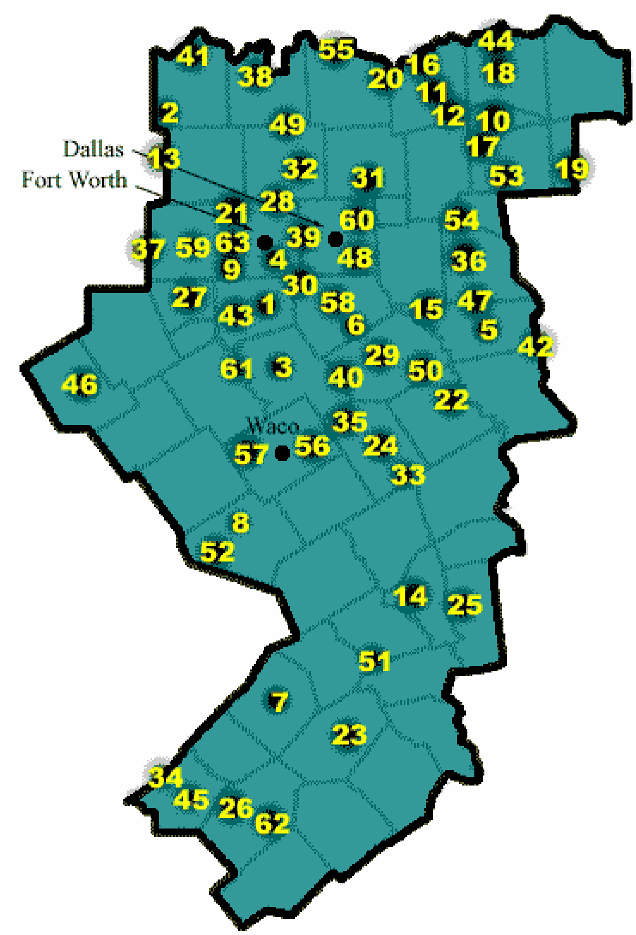
Texas is divided into seven travel regions (Figure 3-2): Panhandle Plains (1 on Figure 3-2), Prairies and Lakes (2), Pineywoods (3), Gulf Coast (4), South Texas Plains (5), Hill Country (6), and Big Bend Country (7). Three areas—Prairies and Lakes, the eastern portion of Hill Country, and Pineywoods—provide similar recreation opportunities to Lake Texoma.

Figure 3-2. Texas Travel Regions

Texas Parks and Wildlife Department. http://www.tpwd.state.tx.us/spdest/findadest/

Lake Texoma is located on the north edge of Prairies and Lakes. There are 60 lakes in the Prairies and Lakes region of Texas, 4 of which Texas Parks and Wildlife Department stocks with striped bass (Texas Parks and Wildlife Department 2007a). The location of the lakes can be seen on Figure 3-3. Eighteen State parks offer access to fishing and other outdoor recreation facilities (Texas Parks and Wildlife Department 2007b) and two parks offer river shore fishing.

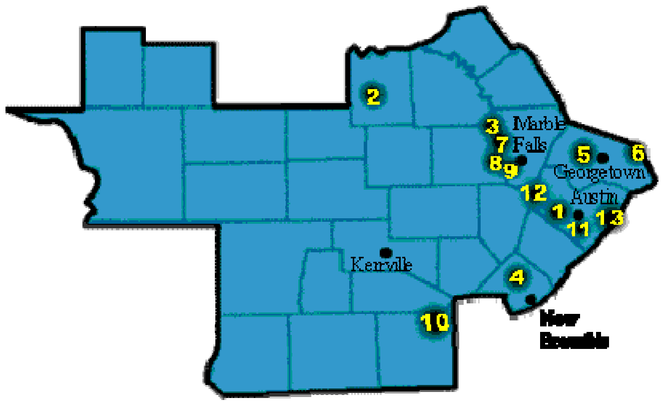
Figure 3-3. Lake Locations in the Prairies and Lakes Travel Region of Texas



Texas Parks and Wildlife Department. http://www.tpwd.state.tx.us/fishboat/fish/recreational/lakes/inplains.phtml

Hill Country, located southwest of the Dallas/Fort Worth metroplex, includes the City of Austin. The east portion of the region offers 13 freshwater lakes (Figure 3-4), 4 of which Texas Parks and Wildlife department stocks with striped bass (Texas Parks and Wildlife Department 2007c). Other recreation opportunities, including hiking, fishing, boating, camping, and golfing, are available throughout the region.

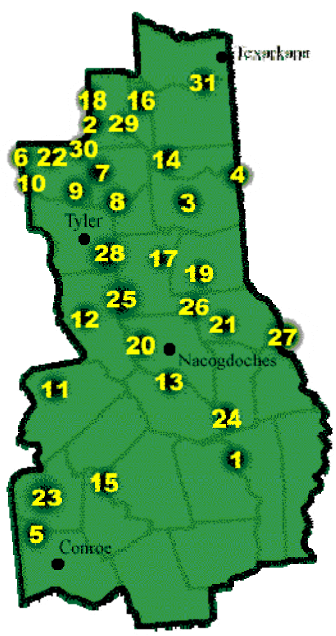
Figure 3-4. Freshwater Lakes Located in Hill Country Travel Region



Texas Parks and Wildlife Department. http://www.tpwd.state.tx.us/fishboat/fish/recreational/lakes/inhillco.phtml

The Pineywoods region is located to the east and southeast of the Dallas/Fort Worth metroplex. There are 31 freshwater lakes with 41 State parks located in this region (Figure 3-5) (Texas Parks and Wildlife Department 2007d). Pineywoods offers a variety of recreation activities similar to those found at Lake Texoma, including striped bass fishing at Livingston Lake.

Figure 3-5. Freshwater Lakes Located in the Pineywoods Travel Region



Texas Parks and Wildlife Department. http://www.tpwd.state.tx.us/fishboat/fish/recreational/lakes/ineast.phtml

In summary, although Lake Texoma offers unique fishing opportunities because of its size, there are alternative fishing recreation areas within the region surrounding the lake. There may also be additional recreation opportunities available in western Arkansas and northwestern Louisiana.

Section Four: Survey Administration and Sample Design

4.0 Survey Administration and Sample Design

Natural resource-based recreation activities (e.g., fishing, hiking, and camping) are complicated to value because a portion of the attributes are consumed outside of the marketplace. Therefore, researchers must employ nonmarket valuation techniques to make reasonable economic value estimates of recreation activities. Nonmarket valuation methods typically utilize survey questionnaires to generate recreational-user demand curves. Questionnaires can be administered via the phone, mail, Internet site, or onsite (in person).

4.1 Survey Administration

The sheer size of Lake Texoma and its large number of access points presents a sampling challenge that is not typical when surveying smaller recreation sites. A site visit was conducted in June 2007, during which several survey administration techniques were considered.

An initial consideration for administering the survey was on-site interviews at the boat launches. To reduce intrusion on the recreation experience, another option was to solicit the names and telephone numbers of people launching boats and conduct the interview via telephone at a later date. However, due to the size of the lake and the number of boat launches, on-site interviews were not deemed viable. Another option considered was to use the historical data collected from day passes submitted by people when they use a launch at an unmanned USACE operated facility. However, the passes could not be used because not enough contact information is collected on the form. In addition, the purchase of the day pass is operated on the honor system and most of the boat launches visited were out of pass forms and therefore people were not able to purchase a pass. Additionally, limiting the survey to only those who use the boat launch would preclude people who fish from shore or the many people who use a guide service. Such a restriction on the sampling frame would result in biased benefit estimates.

Contacting users of the online reservation system for the USACE operated parks via telephone or email appeared to be another viable option. However, the sampling frame would be limited to people who have access to and understand how to use computers. This would preclude collecting information from people of a certain age, education, or income, which could result in biased benefit estimates. Additionally, utilizing the reservation system was not possible because of privacy restrictions.

The ideal sampling frame for the population of recreational fishers is the Lake Texoma fishing license sales data. As described in Section 2, Lake Texoma crosses the state boundary between Texas and Oklahoma. Therefore, a special license is sold specifically for the lake allowing users to fish the entire lake. Because the license data contained information from all states a survey population could be developed that was representative of recreational anglers. Data regarding the Lake Texoma fishing licenses were obtained from the offices of Texas Parks and Wildlife Department for 2006 and 2007 (2007 data was through July). The fishing license data obtained for 2006 and 2007 contained valuable information for use in this study, including the names and telephone numbers of license holders.

Conducting telephone interviews using the data from fishing licenses was selected as the preferred method to reach a representative sample of the user population. In this situation, telephone interviews have several advantages over other methods, including (a) they do not limit potential respondents to the date and time that they are using the lake, (b) they permit a random sample; (c) they avoid having the survey disrupt the recreational experience of respondents; and (d) they result in dramatically lower per-interview costs as compared with onsite interviews. Surveys are administered by interviewers who have been trained in the appropriate protocol for eliciting responses over the telephone. Telephone surveys are typically conducted in the evening or on weekends to ensure maximum representation in the sample.

4.2 Sample Development

The structure of the data was analyzed to develop the sampling design. Unique identifiers (first name, last name, middle initial, suffix, and zip code) were used to eliminate multiple and incomplete records and create a usable sample frame. If an individual had purchased a license in both 2006 and 2007, the phone number from the 2007 license was retained in the file. A field was created to document whether individuals purchased a license in 2006, 2007, or both. This field will allow for testing differences between people who have bought multiple licenses versus those who have only purchased one.

The final data file contained 51,546 records. Of those, 112 cases contained insufficient information on angler residency, and therefore were unusable. The remaining cases numbered 51,434. Of those, 6,365, or 12.35 percent, of the records appear in both 2006 and 2007 license years. The remaining records are split evenly between the two license years (43.79 percent were 2006 only and 43.76 percent were 2007 only). Once the database was prepared, the licensees were divided into three groups: licensees from Texas, licensees from Oklahoma, and licensees from all other States. Of the total records, 44,804 (87.13 percent) were issued to Texans. Of the remaining licensees, 2,024 (3.94 percent) were issued to Oklahomans, and 4,596 (8.94 percent) come from other States.

4.3 Sampling Frame

As indicated by Table 4-1, April, May, and June of 2006 were the months in which the greatest number of licenses is issued; March and July were also heavy months for license issue. Additional analysis revealed that the number of licenses issued in May 2007 was approximately 25 percent higher than in May 2006, whereas the number of licenses issued in June 2007 nearly mirrors that of June 2006. However, in July of 2006, 2,855 licenses were issued, whereas only 648 were issued in July 2007. This could reflect the effects of the heavy rains in the area in the summer of 2007.

Table 4-1. Frequency of 2006 Lake Texoma License Sales by Month

Month	Frequency	Percent (%)
January	1,209	4.17
February	1,003	3.46
March	3,045	10.51
April	4,709	16.25
May	4,599	15.87
June	4,057	14.00
July	2,855	9.85
August	1,647	5.68
September	1,715	5.92
October	2,270	7.83
November	1,426	4.92
December	449	1.55

4.4 Sample Design

The goal of the sample design was to draw sufficiently large samples from each of the three groups of licensees (Texas, Oklahoma, and all others) to facilitate analytic comparisons among them. Given that, and given the relatively small size of the non-Texas portion of the population, it is proposed that a stratified sampling design with logic that follows a random sample design be implemented. To reach a goal of 1,000 completed interviews, it is proposed that interviews with 700 Texas licensees be completed, with the remaining interviews coming from the other portions of the population. Because the number of non-Texas records is so small, all of the records from the two groups of non-Texans in the sampling frame would be used to complete the remaining 300 interviews.

Section Five: Economic Valuation Methods

5.0 Economic Valuation Methods and Surveys

Estimating the value of a change in the striped bass fishery on recreational fishing can be difficult. Because people do not pay directly for the experience of fishing, it is considered a nonmarket good or service. An argument could be made that fishermen do pay for the experience through external costs, such as licenses, bait and tackle, and guide services. However, capturing these costs provides a better estimate of the economic impact of the resource to the economy, as opposed to the value that a fisherman may place on the experience or any changes in the experience. The following section describes different methods that were evaluated to estimate the value of a change in the striped bass fishery at Lake Texoma.

Nonmarket valuation can be separated into two categories: revealed preference and stated preference. The most common revealed preference model used is the travel cost model (TCM). With TCMs, individuals are specifically asked about their actual recreational choices. TCMs are described below in Section 5.1. One type of stated preference model that is commonly used is the contingent valuation model (CVM). A more detailed explanation of CVMs appears in Section 5.2.

5.1 Travel Cost Models

TCMs develop a model relating the observed number of visits to a specific recreation site an individual makes in a predetermined period of time (usually in a year or season) to site attributes, cost of visit, and demographic characteristics. Because the individual's selection of a recreational site represents a discrete choice that can be explained by variables included in the model and unobservable elements (captured in the model's error term), random utility theory (McFadden 1981) provides the theoretical basis for TCMs. Demand for a particular site, demand curve, and willingness to pay (WTP) can be determined within the random utility framework. This model is then used to estimate demand for the specific recreational area and generate the specific site's demand curve. The demand curve permits evaluation of changes in demand (number of trips per year/season) when site features change (e.g., fish catch rate changes). Additionally, an estimate of the individual's WTP to secure these changes can be calculated and compared to the costs of provision.

5.2. Contingent Valuation Models

In contrast to the TCM, demand curves generated with the CVM are based on intended behavior. Instead of observing the actual number of trips made by an individual, a survey is used to assess how many trips an individual might take or how much they might be willing to pay to recreate at a specific site. For example, an individual may be asked to state the number of additional trips he would take if the catch rate of a specific fish species increased by a certain percentage. The hypothetical nature of the survey allows the researcher to explore a greater variety of possible site changes (e.g., improved fishery) than the TCM, yet suffers the disadvantage of relying on intended, rather than actual, behavior. Similar to TCM, the CVM yields demand, demand curves, and WTP for new recreational features. Different types of CVM are described in subsequent sections.

5.2.1 Open-Ended

Open-ended questions allow the respondent to be exact as possible with their stated WTP. If the stated WTP is accurate, they provide the ideal situation for policy makers, because decisions would be made using correct information. However, there are major drawbacks to this form of survey question. Often the respondent is required to place a dollar value on something that he or she has never considered as something people actually pay for. This can make it hard for the individual to provide an accurate value, resulting in respondent frustration and question non-response. For example, the individual was asked, "How much would you be willing to pay to double the catch rate of striped bass in Lake Texoma?" and provided with a blank to fill in. Most people probably never would have thought about putting a specific price on a fish catch rate (as opposed to the overall fishing experience), which can lead to uncertainty and frustration on the part of the respondent.

Open-ended questions tend to have high unit non-response, resulting in unreliable WTP estimates, depending on the severity of the non-response (Champ et al. 2003). This form of survey question can still be very helpful to the researcher in the design of the final survey. Researchers often use focus groups or other mechanisms to pre-test the survey before executing the final instrument. Responses from the open-ended questions in pre-tests can be very useful in determining bid amounts utilized in the final survey questions.

5.2.2 Dichotomous Choice

Dichotomous choice questions are the most common form of contingent valuation because they closely simulate a market situation. These questions take the general form "Would you be willing to pay $10 to double the catch rate of striped bass in Lake Texoma? Yes or No." This simulates a market situation: When an individual goes to the store, set prices exist for the available products. Based on the given price and the individual's need or desire for the product, the person either purchases the item or leaves it on the shelf. By design, the survey question provides the respondent the option to "buy" the circumstances described, by choosing yes or no for the amount provided.

One limitation of dichotomous choice is the inability to narrow the WTP interval for the respondent. Referencing the sample question given above, if an individual is WTP $10 to double the catch rate of striped bass the researcher does not know the respondents true WTP, only that it is at least $10. Alternatively, if the respondent is unwilling to pay $10 to double the catch rate of striped bass, then their WTP lies somewhere between $0 and $9.99, but no additional information is known about their maximum WTP.

5.2.3 Multiple Bounded Discrete Choice

The multiple bounded discrete choice (MBDC) questions are an expansion on the dichotomous choice format. With MBDC, the individual is given a wide range of bid amounts that would be paid over a specific timeframe (e.g., per visit, season, or year). He or she is asked to indicate whether or not they would pay each bid amount with a varying degree of certainty (see example). This format captures a greater amount of information, while still partially simulating the market experience for the respondent. Continuing the example from Section 5.2.2., if the respondent is WTP $10 but not WTP $15 to double the catch rate of striped bass, then a narrow WTP interval ($\$10 \leq WTP < \$25$) is available for analysis and as a basis for policy decisions.

Example of an MBDC Question:

Please indicate the degree of certainty of your willingness to pay (per year) for the catch rate of striped bass on Lake Texoma to double:

Cost to you per year	Definitely No	Probably No	Not Sure	Probably Yes	Definitely Yes
$ 0.01	□	□	□	□	□
$ 0.50	□	□	□	□	□
$ 1.00	□	□	□	□	□
$ 5.00	□	□	□	□	□
$ 10.00	□	□	□	□	□
$ 25.00	□	□	□	□	□
$ 50.00	□	□	□	□	□
$ 75.00	□	□	□	□	□
$ 100.00	□	□	□	□	□
$ 200.00	□	□	□	□	□

Dollar amounts can vary, sometimes including a zero dollar amount. Often, focus groups are utilized to determine the most appropriate bid range to use in the survey instrument. However, most researchers include a very low amount (such as $.01) as the minimum. It can be inferred that an individual is opposed to any change if they are not WTP $.01. In addition, respondents can be asked "yes," "not sure," and "no" to simplify the question.

MBDC are not without their problems. Respondents may anchor their responses and answer all values the same. If an individual answers a large number of questions with "not sure," it may reflect either of two things. First, the respondent may not understand the question; this is minimized by wording questions carefully and through proper pre-testing. The second reason for a large number of "not sure" responses can be that respondents were simply unwilling to discriminate among choices. This can also be described as an indifferent person's version of strategic bidding. Strategic bidding can be a problem with people responding "yes" to WTP for the highest value, even if, in reality, they would (or could) not pay that amount.

5.2.4 Choice Experiments

Similar to TCM, choice experiments utilize the random utility theory developed by McFadden (1981) to connect the deterministic and statistical models. In choice experiments, the respondent faces a series of choices between or among alternatives (typically only two or three at a time). Each alternative is described by a set of attributes (i.e., size, available facilities, hours of operation, cost, etc.) where some form of cost to the respondent is one of the attributes (see example). Therefore, to make the choice, respondents must make trade-offs between or among the attributes presented to them. An individual will choose the alternative that provides him or her with the most net utility. In other words, they choose the alternative that provides them the most satisfaction.

Example of Choice Experiment Question:

Removal of chlorides from the Red River may affect fishing on Lake Texoma. USACE is considering different options that may affect the fishery differently; two options are described below. Please select which plan you would prefer.

Attribute	Plan A	Plan B
catch rate of catfish	increase by 25%	decrease by 10%
catch rate of crappie	increase by 15%	decrease by 20%
catch rate of striped bass	decrease by 20%	increase by 35%
Additional cost to you per year	$7	$10

Which of the two plans would you prefer for one day of fishing?

□ Plan A □ Plan B

Marginal willingness to pay (MWTP) is calculated from choice experiments utilizing the indirect utility function to solve for the compensating variation. The econometrics behind the compensating variation change, depending on the functional form of the model (which varies depending on the design of the choice experiment), the distribution of the error term (which can vary with the estimation method used, i.e., multinomial logit models have error terms that are extreme value distributed), and how many attributes change throughout the choice experiment.

A drawback to choice experiments is the need to include multiple attributes that may be difficult to convey to the individual if visual aids are not possible. In direct connection with this study, more biological information (than what is currently available) may be required to develop reasonable questions. If there is not enough variation among the choice alternatives, changes in the individual's net utility may be minimal. Small differences in utility between options increase the likelihood of a random choice, as opposed to the respondent choosing their true preferred option.

5.3 Uncertainty

Uncertainty will be incorporated into the economic analysis in two primary ways. First, uncertainty will be addressed in the determination of sample size for the telephone surveys. This will be accomplished by multiplying the original estimated sample size, provided by calculation of regression equation utilized in the analysis, by a contingency factor. This factor will serve as a measure of the uncertainty associated with telephone numbers (it is common to have 1 to 5 percent of the phone numbers not match the name in the database) and invalid responses. This last category includes protest and yea-saying respondents. Protest respondents refer to individuals who would not pay any amount for the proposed recreational feature, because they are opposed to the sponsoring agency or the payment vehicle. Yea-saying respondents refer to individuals who would be willing to pay for the recreational feature regardless of the cost of the feature. Failing to account for these respondents in the economic analysis can result in biased estimates of WTP. A proposed range for the contingency factor applied in this study is 5 to 10 percent of the original sample size.

Uncertainty will also be incorporated into the economic analysis by developing confidence intervals around WTP point estimates. Reporting confidence intervals allows the researcher to present a statistically based range of possible WTP values for each evaluated recreational feature. Thus, the researcher is not restricted to stating that WTP is exactly a certain dollar amount. Either Krinsky-Rob procedures or the Delta method, depending on whether the assumption of normality holds, will be used to develop the confidence intervals.

Beyond efforts to incorporate uncertainty into the economic analysis, residual uncertainty may still exist. Primary sources of this uncertainty include the probability that respondents' expressed intentions differ from actual intentions (a common problem with stated preference methods), flaws in the survey, or flaws in survey administration. Efforts will be taken to design the survey to minimize residual uncertainty including conducting a pre-test of the survey instrument.

Section Six: Survey

6.0 Survey

6.1 Survey Instrument

This telephone survey will focus on recreational fishing participation changes on Lake Texoma; striped bass fishery is the primary species of focus. The survey questions are designed to ensure that, through econometric analysis, a statistically valid estimate of user mean WTP can be derived for the lake's recreational fishery.

A survey instrument was developed based on the valuation methods described in Section 5. The survey instrument will combine both TCM and CVM valuation methods to fully assess the impacts to the lake's recreational fishery. Regardless of whether or not the Red River Chloride Control Project takes place, the recreational fishery will deteriorate naturally over time. This survey was designed to estimate angler WTP to maintain the status quo of the fishery to counteract either natural or man-made impacts. Lake Texoma's temporary closure due to flooding in the summer of 2007 provides a unique opportunity to gather information of angler substitution behaviors. Therefore, specific questions were included to determine their substitute fishing locations or if they choose not to fish while the lake was closed.

A sample of the telephone survey is included in Appendix C. There is currently a lot of uncertainty surrounding the impacts of a reduction in chlorides. Therefore, the survey instrument will have to be updated with the correct values when the biological information becomes available.

6.2 Pre-Test of Survey Instrument

The draft survey instrument was pre-tested to ensure that respondents understood the questions and were able to provide appropriate answers. The pre-test was conducted on personnel at contractor offices. In total 10 personnel were asked to conduct the survey. Before this report is finalized personnel at SWT offices will also participate in a pre-test of the survey instrument. The majority of the respondents stated that they understood the questions and were able to provide appropriate answers. Some minor revisions were done to the survey instrument based on the results of the pre-test

6.3 Survey Authorization

Prior to conducting any surveying efforts, the survey instrument has to receive approval from the Office of Management and Budget (OMB). OMB reviews surveys to ensure that it is compliant with Federal regulations and does not unnecessarily burden the public. A submittal package has been produced for OMB. The package states the purpose of the survey, the intended respondents, and specific relationships between questions asked on the survey and those on the pre-approved questionnaires. See Appendix E for the OMB submittal package.

Section Seven: Summary

7.0 Summary

This Phase I Report for the Red River Chloride Control Project refined the recreation study area, discussed potential recreation activities affected by the project, inventoried existing recreation opportunities, developed economic valuation methods, and developed a survey instrument to be utilized in Phase II of this project. The Study Area was defined utilizing fishing license sales data for Lake Texoma. Since Lake Texoma crosses the State boundary between Texas and Oklahoma, a special fishing license can be purchased that is specific to the lake. Most anglers who fish on Lake Texoma purchase this license to fish without concern for which State they are actually in at a given area. These license sales data provide the ideal information to determine where anglers come from to fish on Lake Texoma, therefore determining the local and regional study area.

The inventory of recreational opportunities was facilitated by geographic information systems and interviews with USACE, lake managers, and local stakeholders. Recreational features inventoried focused on area lakes in Texas and Oklahoma. This inventory served to highlight the uniqueness of Lake Texoma considering its size, location within the United States, and its recreational sport fishery. The ability for striped bass to reproduce naturally and sustain a thriving population is perhaps the lake's most unique feature.

Two valuation methods, TCM and CVM, and several limited dependent variable econometric models were presented as means for determining the economic benefits associated with alternative recreational opportunity enhancement plans. Both TCM and CVM are well-known techniques for deriving economic values for nonmarket recreation benefits. The theoretical and data-generating structure of these methods will enable calculation of the economic benefits associated with recreation on Lake Texoma. Moreover, application of these valuation methods will permit an economic comparison of alternative enhancement plans. The principal form of data collection for the TCM and CVM will be telephone surveys. This report provided drafts of the survey and the OMB submittal package.

Phase II of the Red River Chloride Control Project will implement the survey instrument developed in Phase I, and analyze the results in the manner outlined in this report. This analysis will include calculating WTP for the Lake Texoma recreational fishery, and an uncertainty analysis of the data.

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Appendix A: Scope from Phase I

Area VI Red River Chloride Control
RECREATION STUDY
SCOPE-OF-WORK
Contract No. W912BV-04-D1008
Delivery Order No. 16

March 2007

I. INTRODUCTION

The Area VI project will impact the water quality of the Red River, it Elm Fork, OK tributary and Lake Texoma by removing the naturally occurring chloride salts. By doing so, the water would be more suitable for municipal, industrial and agricultural purposes. Though there is a high degree of uncertainty of degree, the reduction of chlorides may have a change the water quality and turbidity of Lake Texoma in way the impact certain species of game fish. As a result, some anglers at the Lake, those who sell goods and services to those anglers, resource agencies, and those with interest in local economic development have expressed concerned about any changes to the fishery.

Altus Lake is a reservoir in southwest Oklahoma that has authorized purpose for providing water for irrigation. The lake is a popular water-based recreation resource. The demand for irrigation water results in lowering of the pool impeding recreation activity at the lake. Because the Area VI project may reduce the demand for Altus water, the lowering of the pool may be less dramatic and less frequent. The degree to which that demands for irrigation form Altus Lake is uncertain. However, the project may improve recreation at the lake, if pool draw-down is reduced, both in terms of frequency and in the lake level.

The USACE, Tulsa District (SWT) requires preliminary study directed at addressing a strategy for economic valuation of changes to recreation resources related to the Area VI Red River Chloride Control Study. The Scope of Work for Phase I activities which will be used to focus a Phase II study which will implement the strategy developed in Phase I. The Phase I activities consisted of the flowing tasks:

- Refine the recreation study area; identify types of recreation that might affected by the project.
- Using existing data inventory existing recreational opportunities. Search literature and interviews with key informants to identify existing recreation activities at Lake Texoma and Lake Altus, including fishing for specific game fish, such as striped bass
- Determine the scope of recreation analysis with recommendations about what recreations resources should be addressed in detail.
- Conceptualize the econometric models needed to generate the demand curves for recreation activities.

- Develop draft survey questionnaire(s) and draft sample (Survey questionnaire needs to collect information for both contingent value method and travel cost method. Plus, the questionnaire needs a question to identify protest responses.) and methodology for conducting Nation Economic Development benefits (losses) associated with the Area VI project.

II. PURPOSE:

The SWT requires the following recreational analysis planning activities be preformed on the Phase I is develop a methodological strategy for data collection, data analysis and report writing for final Corps decision documents (EIS and Study Report) for the Area VI report. This scope-of-work is to identify the activities to be preformed for this recreation study and the report that is due upon completion of this phase of work. All work conducted under this task order shall be in compliance with pertinent USACE Civil Works planning and recreational regulations. **The product of Phase I is to provide a methodology, data collection tools and analytical approach for a Phase II task order.**

Phase I will consist of two primary components, plan of study for National Economic Development benefits and a plan of study of Regional Economic Benefits Study

National Economics Development (NED) Component

- Identify recreation resources, the project outputs of the project potentially impacting recreation, and the impact of recreation activities.
- Identifying sampling methods, including sample size, sample frame/strategy for data collection required for NED analysis
- Identify methodology for NED, in accordance to COE planning guidance
- Finalizing the draft survey instruments, if any, for Office of Management and Budget approval

III. ACTIVITIES

The contractor will perform the following activities for this phase:

National Economic Development Component-

1. Identify Recreation Resources, Project Outputs Impact on Recreation. The Contractor shall work closely with SWT to identify recreation resources that could be impacted by the study including type of water-based activities that may involved (types of fishing, boating, swimming). The contractor shall conduct informal interviews with Corps officials and local experts to determine the nature of the resources and associated recreation activities. Focus will be upon Lake Texoma, OK/TX and Altus Lake, OK. There is likelihood that recreation at Altus lake will NOT be impacted by the project. The purpose is to determine if this effort is to determine if NED analysis needs to be conducted for any changes in Altus recreation. Work should utilize telephone interviews when possible and use Corps lake project staff as much as possible.

2. Identifying Sampling Methods. The contractor will development of a statistical sampling strategy to capture the various water based recreation activities at Lake Texoma and Altus. This contractor will determine the sample frame and size for each group of recreation users. The step provides an overall sampling strategy and methods of executing data collection using the sampling strategy. The contractor will identify which days for collecting data as to capture variations in seasonal use. Most of the surveys would be performed between April and November. Each date for data collection will have associated with it an alternate "rain" date. The contractor will outline a detailed approach to implement the sample and provide a discussion of confidence intervals associated with any variables generated in the NED analysis.

3. NED Analytical Methodology The contractor will develop measures of NED recreation benefits and losses associated with the project, as specified by the COE guidance. URS will review both travel cost and contingent valuation methodologies for estimating recreation users' willingness to pay. The contractor will also provide the theoretical rationale of the measures, assumptions and limitations of the application of those measures. The contractor will specifically recommend the appropriate models to use for provide the NED benefits for project related changes. The contractor will outline a detailed approach to implement the methodology. Provide a method to estimate the risk and uncertainty associated with any willingness to pay estimates generated in the NED analysis.

4. Finalize the Survey Instruments The Contractor will develop a survey instrument for estimating NED recreation benefits. The contractor will develop question items and response categories to reflect the measures identified above. The contractor will conduct a pretest of one survey instruments using Corps employees and other with the contractors organization who is not familiar with the project, or NED recreation benefit analysis, not to exceed 20 persons. The purpose of the pretest is to ensure that respondents understand the questions and are able to give valid, accurate, unambiguous answers. The contractor will outline a detailed approach to implement the survey (data collection).

With input from the pre-test, the Contractor will develop a final draft questionnaire/interview instrument that contains all items used in the survey of those selected to be included in the sample. The Contractor will also develop all the appropriate documentation for submittal of the instrument for approval for use by Office of Management and Budget (OMB), as noted in Corps guidance. SWT will be responsible for final submittal to OMB.

IV. DELIVERABLES

Draft and final reports are due upon completion of all work activities and they will include the following as a minimum:

1. Documents. The contractor will provide two detail documents one reflecting the recommended NED component and one reflecting the work done for RED component.

The NED document will include:

- Discussion the recommendation of the geographic areas of focus (Lake Texoma and/or Lake Altus) project outputs and recreation activities potentially impacted.
- A Draft Survey Instrument (Questionnaire) and associated documentation for OMB approval.
- A Documentation of a clear implementation plan for the sampling, analysis and data collection (execution of survey) for Phase II of this study. Include a plan to estimate risk and uncertainty related to any willingness to pay variable generated in Phase II of the study.
- Bibliographic references, source of information and other documentation to support the recommendation and conclusion go the NED document.

2. Electronic Files The contractor will provide electronic files containing data, report documents and executable files for modeling existing regional economy.

The report is to be generated in an electronic media compatible with Microsoft Word and the Corps' communication format. Modeling file will be one which can be su Initial draft of report shall include five hard copies and the electronic version. Final draft of report shall be of same quantity (5) regarding hard copies.

3. Status Reports. The contractor shall provide monthly status reports on the progress of the study during the course of the study. The reports can be e-mail message providing a short description of the status of the task order work.

V. MATERIALS AND SUPPORT PROVIDED BY SWT:

Corps will provide all relevant documents, data, maps and other information to the contractor. Informal briefings from SWT staff regarding current SWT activities planned or existing in the recreational study area (Such briefings, in necessary, are to be coordinated with POC listed at end of this document.

VI. SCHEDULE:

Start work – No Later Than (NLT) 10 days following Notice to Proceed (NTP).

Initial Draft Report, 5 copies and electronic – [est] 90 days after NTP

SWT review of initial draft and return comments to Contractor; if needed, ITR presentation by Contractor takes place during this time.

Final Report, 5 copies and electronic – [est] 30 days after receipt of SWT initial draft report's comments

VII. INDEPENDENT TECHNICAL REVIEW:

Contractor will provide for one presentation of this report to support SWT's Quality Assurance Program.

IX. POC:

The SWT representative will be Ed Rossman phone number: 918-669-4921; e-mail: Edwin.J.Rossman @usace.army.mil. With 10 days of the NTP, the contractor shall provide SWT a contractor POC for this work.

Appendix B: Memo from Site Visit 12-14 June 2007

Lake Texoma Recreation Study
Notes from Site Visit
June 12-14, 2007

A site visit was conducted for the Lake Texoma Recreation Study associated with Area VI of the Red River Chloride Control Project. The site visit entailed gathering information for the Lake Texoma area to be used when designing the recreational fishing survey instrument and sampling plan. The following are general observations/discussions from the site visit.

<u>Meeting at the Lake Texoma Project Office (6/12/07)</u>

Participants:

Ed Rossman, Planning, Tulsa District
Marc Masnor, Planning, Tulsa District
Bill Barnhart, Area Manager, Tulsa District
Chris Lynch, Texoma Project Office, Tulsa District
Jeanne Hurlbert, Optinet Resources
Judith Walker, URS, Gaithersburg
Jason Weiss, URS, Gaithersburg

- Lake water levels:
  - currently at 621 ft
  - was at 612 ft a year ago
  - 619 ft is normal seasonal pool
  - at 628 ft marinas are significantly affected
  - currently releasing 32,000 cfs from lake
- Lake Texoma has the best fishing in that part of the country
- Striped bass is the major game fish sought by fisherman
- Fish sought by fishermen include:
  - Striped bass (primary fish sought on Lake Texoma)
  - Catfish
  - Crappie
  - Sand bass
  - Largemouth bass
- Diverse socioeconomic levels use the lake
- USACE facilities around lake
  - 10 USACE parks
  - About 80 percent of campers use the online reservation system
  - Reservation system has effectively shortened the stay of campers (people can reserve a site for a certain time, as opposed to arriving early to claim a site)
  - Day-use is available at some of the sites
  - 70 percent of users are “Golden Age”
  - $700,000 collected in user fees each year
- They do not see a lot of changes in the use pattern for the future
- There is a special fishing license that is only good on Lake Texoma
- Lake users are perceived to have a bias against the Red River Chloride Control Project
- 52 boat ramps are located around lake—15 controlled by USACE

- URS should talk to Ron Johnson—Lake Manager for USACE (Ron was out of the office when URS visited)
- Paul Mock (Oklahoma) has done creel surveys and studies around the lake
- Bruce Highsmith (Texas) has done studies around lake on recreational use.

<u>Southern Side of Lake (6/12/07)</u>

A tour was conducted on the southern side of the lake to see recreational facilities and identify potential interview sites.

Participants:

Ed Rossman, Planning, Tulsa District
Marc Masnor, Planning, Tulsa District
Jeanne Hurlbert, Optinet Resources
Judith Walker, URS, Gaithersburg
Jason Weiss, URS, Gaithersburg

- A number of large marinas are located on the southern side of lake
- A lot of higher-end boats were observed
- Many of the slips had permanent dwellings built for weekend use
- Not a lot of activity was observed
- The larger marinas had all necessary facilities located onsite (e.g., restaurants, shops)
- Surrounding area did not appear to capitalize from large numbers of visitors (not many restaurants or shops)
- Roads going to marinas were often small and/or in poor condition

<u>Northern Side of Lake (6/13/07)</u>

A tour was conducted on the northern side of the lake to see recreational facilities and identify potential interview sites.

Participants:

Ed Rossman, Planning, Tulsa District
Marc Masnor, Planning, Tulsa District
Jeanne Hurlbert, Optinet Resources
Judith Walker, URS, Gaithersburg
Jason Weiss, URS, Gaithersburg
Maria Wegner-Johnson, URS, Tulsa

- USACE recreational facilities
    - A number of recreation facilities are located around lake
    - Most facilities had camping and boat launches
    - Only manned seasonally
    - Contractors provide most of the maintenance services
    - Contractors (typically retired persons) staff the entrance booths

- Most entrance booths were staffed part of the day, from mid-day through the evening
    - "Honor system" used when entrance booth is not staffed
    - A few boat launches were closed due to high water
    - Very little activity observed (site visit conducted during the week)
    - Most facilities operate near capacity on summer weekends
    - Day use is not available at some facilities

- Roads going to camp sites and marinas were often small and/or in poor condition
- Surrounding area did not appear to capitalize from large number of visitors (not many restaurants or shops)
- Not a lot of activity was observed at USACE facilities or marinas

<u>Lake Texoma Guided Tour (6/14/07)</u>

Arrangements were made for a guided tour of Lake Texoma to assess the recreational fishing characteristics of the lake. The tour left from the Lighthouse Marina, TX.

Participants:

Jeanne Hurlbert, Optinet Resources
Judith Walker, URS, Gaithersburg
Jason Weiss, URS, Gaithersburg
Lynn (last name not recorded), Fishing Guide, Oklahoma

- Service provided by Lynn, from Oklahoma
- Striped bass are the primary species sought in Lake Texoma
    - Fishing success has been really good recently
    - Catch limits of striped bass are often caught within a couple of hours
    - Bait used is a major factor on fishing success—striped bass prefer live shad
    - Fishing for striped bass is often best with groups of boats
    - 2- to 3-pound fish are typical; it is rare to catch many larger fish
- Lynn did not think that the Red River Chloride Control Project would affect striped bass fishing
    - He prefers more turbid water because it shows signs of life (e.g., algae), whereas clear water does not support many fish
    - He feels that the project is a waste of money, but he is not overly opposed to it
    - He feels that many others are misinformed of the effects
- Approximately 450 guides operate on the lake, most of them are not "official guides," but provide guiding services as a side business
- A number of guides have slips at the marina, with clients meeting at the slip
- A large number of client's cars were observed parked near the slips

<u>Denison Chamber of Commerce (6/14/07)</u>

URS talked with Phyllis Loe, Office Manager, about the project and impacts to the area.

Participants:

Jeanne Hurlbert, Optinet Resources
Judith Walker, URS, Gaithersburg
Jason Weiss, URS, Gaithersburg

- Phyllis was not aware of the Red River Chloride Control Project, nor had she heard any concerns with USACE actions
- Approximately 5.8 million visitors came to region last year for activities on Lake Texoma
- Lake Texoma is a major economic driver in the area
- Phyllis felt that the City of Pottsville, TX, may have a better handle on the public perception of the project

General Observations

- There are a large number of entry points to the lake, and with many of them it may be difficult to survey users of said entry point
- It may be difficult to capture responses from fisherman who use guide services, because boats are often parked at slips in which access is not controlled
- URS did not get an impression of a strong bias against USACE or the Red River Chloride Control Project from the general public
- Weekends are the busy times for the lake, with week days being slow

Appendix C: Survey

Hello, my name is _______________ and I am conducting a survey for research on recreational fishing on Lake Texoma. May I speak with ___________ .

We are collecting information to investigate the change in economic and social benefits of recreational fishing associated with Lake Texoma as part of the Red River Chloride Control Project for the United States Army Corps of Engineers. The Corps of Engineers will use this survey to obtain information to aid in formulating the most economically, socially, and environmentally acceptable plan in accordance with the Water Resources Council Principles and Guidelines. Individual responses will be collected and tabulated by type of response, but information specific to an individual will not be published or released. Individual responses will be retained in our files as backup data and retired to the Record Center after 10 years. Only the tabulated totals of the type of responses will be published in a project report, which will be circulated to the public and other Federal and State water and land management agencies.

We have a few questions that will take less than 8 minutes. Your responses would be appreciated and will greatly aid in our planning effort. Is now a good time to ask you those questions?

1 CORRECT PERSON - NOW IS GOOD TIME
2 CORRECT PERSON – CALL BACK
3 NO - WON'T LET YOU TALK TO CORRECT PERSON
4 CORRECT PERSON NOT AVAILABLE - SCHEDULE CALLBACK
5 CORRECT PERSON REFUSES TO PARTICIPATE

I want to assure you that all the information you give me will be kept strictly confidential. This interview is voluntary. If you don't want to answer any particular question, just tell me. Also, my supervisor may listen to part of the interview for quality control.

Q1: How would you rate, on a scale of 0 to 5—with 0 implying very little to no knowledge, and 5 meaning full knowledge—your knowledge of the recreational opportunities on Lake Texoma? (Please circle only one number)

0 1 2 3 4 5

Q2: How would you rate, on a scale of 0 to 5—with 0 again implying very little to no knowledge, and 5 meaning full knowledge—your knowledge of the Red River Chloride Control Project? (Please circle only one number)

0 1 2 3 4 5

Q3: How would you rate, on a scale of 0 to 5—with 0 again implying very little to no quality, and 5 meaning full quality—the fishing quality of Lake Texoma? (Please circle only one number)

0 1 2 3 4 5

Q4: What is the typical primary purpose of your trips to Lake Texoma?

- ☐ Camping
- ☐ Fishing
- ☐ Boating
- ☐ Swimming
- ☐ Water skiing
- ☐ Other (please specify)________________

Q5: On average, how much time, in hours, do you spend per recreational trip on Lake Texoma?

# of Hours per Trip: ________________________________

Q6: Of these hours, how much time, in hours, do you spend fishing per recreational trip on Lake Texoma?

# of Hours Fishing per Trip: ________________________________

Q7: What is the typical number of people in your group when you recreate on Lake Texoma?

Group Size: ________________________________

Q8: What are the three primary species of fish you target during a typical fishing trip (may target less than three species)?

Fish Species: ___________________________________

Q9: How much effort (i.e., percentage of trip time) do you put towards each of these species?

% Effort for Fish Species A: _________________

% Effort for Fish Species B: _________________

% Effort for Fish Species C: _________________

Q10: How many fish do you catch of each of the three species, excluding the catch of the rest of your group, during a typical trip on Lake Texoma?

# of Fish A Caught: ______________________________

# of Fish B Caught: ______________________________

# of Fish C Caught: ______________________________

Q11: Have you used a guide service when fishing for striped bass on Lake Texoma?

- ☐ Yes
- ☐ No **(Skip to Q14)**

Q12: On average, how many times per year do you use a guide service to catch striped bass?

# of Times Per Year: ________________

Q13: On average, how much per trip, per person, do you spend on guide services to catch striped bass?

$ Spent Per Year: ______________________

Q14: How many total recreational trips, regardless of purpose, have you taken to Lake Texoma in the past 12 months?

# of Trips: ______________________________

Q15: How much time does it take you to travel one-way from your home to a location along Lake Texoma where you begin a typical recreational trip?

# of Minutes: ______________________________

Q16: How many miles do you travel one-way from your home to a location along Lake Texoma where you begin a typical recreational trip?

# of Miles: ______________________________

Q17: Could you please list the amount of money you spend in each of the following categories during a typical trip to Lake Texoma (whole numbers please):

Lodging: ______________________________

Food and Beverages: ______________________________

Transportation: ______________________________

Activities/Entertainment: ______________________________

Miscellaneous Expenses: ______________________________

Note to Interviewer: Please read the following:

I would now like to ask you a couple of hypothetical, or "if-then," questions regarding potential changes to the Lake Texoma fishery. Basically, these questions will present you with a proposed change, and then ask you if you would change your visitation habits concerning Lake Texoma. Again, your participation is voluntary, and there are no right or wrong answers. (THIS PARAGRAPH AND SEVERAL OF THE FOLLOWING QUESTIONS WILL BE REFINED WHEN BIOLOGICAL DATA IS AVAILABLE)

Q18: You said that you make **(repeat answer from Q14)** _____ trips per year to Lake Texoma. Due to natural and manmade causes, the fish catch rate on Lake Texoma is expected to decrease over the course of the next several years. This means it may take a longer period of time to catch the same number of fish. If this occurred, would you take fewer trips to Lake Texoma? Please choose one of the following options.

- ☐ I would not take any fewer trips **(Proceed to Q19)**
- ☐ I would take one less trip **(Skip to Q20)**
- ☐ I would take two fewer trips **(Skip to Q20)**
- ☐ I would take at least three fewer trips **(Skip to Q20)**

Q19: Please choose one reason from the following list that best describes your decision not to take fewer trips if the fish catch rate dropped by **[random percentage ranging from 5 percent to 25 percent, even distribution of values across sample]** on Lake Texoma:

- ☐ I am going fishing for the enjoyment of spending time on the water by myself or with friends and family
- ☐ The number of fish I catch per trip is of little concern to me
- ☐ I will enjoy the extra challenge and patience required to catch the fish
- ☐ I catch all of the fish that I want, even with a reduction
- ☐ Other (please describe) ____

Q20: Ok. Now, suppose you had the option to pay for a fish hatchery project that would maintain Lake Texoma's fish catch rates the current level. I am going to provide you a series of dollar amounts that represent a possible additional charge to you, per year, to cover the cost of the hatchery. For each amount, please respond with "yes" (willing to pay the amount annually), "not sure" (may or may not be willing to pay the amount annually), or "no" (will not pay the amount annually):

Cost to you per year		Yes	Not Sure	No
$	0.01	□	□	□
$	1.00	□	□	□
$	5.00	□	□	□
$	10.00	□	□	□
$	25.00	□	□	□
$	50.00	□	□	□
$	75.00	□	□	□
$	100.00	□	□	□
$	250.00	□	□	□
$	500.00	□	□	□

[if all responses NO continue, if WTP>0 SKIP to Q22]

Q21: We have found in studies of this nature that people have a lot of different reasons for answering as they do. Which of the following statements best describes your reasons for answering zero to the previous question?

- ☐ That is what maintaining the current catch rates is worth to me
- ☐ All I can afford at this time
- ☐ Pay enough in taxes
- ☐ Do not want to place a dollar value on fishing experience
- ☐ Not enough information
- ☐ Object to the way the question is asked
- ☐ Other (*please describe*)__________________

Q22: Since Lake Texoma was closed to recreational use for several weeks during this past summer (2007), you were not able to fish on the lake. During the time of the closure, did you fish in other locations?

- ☐ Yes
- ☐ No **(Skip to Q23)**

Q23: Where did you choose to fish instead of Lake Texoma?

List of alternate fishing locations: ____

Note to interviewer: Please read the following before asking the questions:
"*As a conclusion to this survey, I would like to ask a couple of questions about you. Remember that all of your answers are completely confidential.*"

Q24: What is your zip code:

____

Q25: What year were you born? ___________

Q26: How many people presently live in your household?

Household Size: ________________________

Q27: Are you presently employed, retired, student, or unemployed?

- ☐ Employed (including self-employed)
- ☐ Retired
- ☐ Student
- ☐ Unemployed

Q28: Are you currently a member of an outdoor sportsmen's organization or club?

- ☐ Yes
  - Name of organization/group: ______________________________
- ☐ No

Q25: Are you currently a member of a natural resource conservation organization, such as the Nature Conservancy or Ducks Unlimited?

- ☐ Yes
  - Name of organization: ____________________________________
- ☐ No

Q26: Please select the highest level of education you have completed:

- ☐ Grade school
- ☐ Some high school
- ☐ High school graduate
- ☐ Some college or technical school
- ☐ College graduate
- ☐ Graduate or advanced degree

Q27: Please approximate your annual household income before taxes, in 2006: (Please note that this survey is anonymous. This information will ensure that all income groups are represented.)

- ☐ Under $20,000
- ☐ $20,000 to $39,999
- ☐ $40,000 to $59,999
- ☐ $60,000 to $79,999
- ☐ $80,000 to $99,999
- ☐ $100,000 to $119,999
- ☐ $120,000 to $139,999
- ☐ over $140,000

Q28: Do you wish to make any additional comments about fishing on Lake Texoma?

Note to interviewer: read the following:

"Thank you for participating in this survey. The information you have provided will be used by the U. S. Army Corps of Engineers in evaluating the project."

Information to be recorded by the interviewer: The Respondent was:
Q29: Female _____ Yes _____ No
Q30: Cooperative _____ Yes _____ No
Q31: Appeared to understand the questions _____ Yes _____ No
Q32: Appeared to be intoxicated/impaired in some way ______Yes _______No

Interview Number: ______________________

Appendix D: Technical Review of Econometric Models

1. *DEMAND CURVE ESTIMATION: THEORY*

Two principal utility theoretic methods for deriving economic values for nonmarket outdoor recreational attributes (e.g., fish catch rate) include travel cost and contingent valuation. The travel cost method (TCM) is a revealed preference method that models an individual's decision about which site to visit and/or the number of visits to take as a function of the individual's time, income, other personal characteristics, and site-specific attributes, as well as substitute sites. Given the revealed preference framework of TCM, data applied in estimating recreational demand curves are obtained from observing actual recreator behavior. Typical means of acquiring this information include telephone, mail, and onsite surveys. The contingent valuation method (CVM) is a stated preference method that utilizes a constructed market to directly ascertain an individual's willingness to pay (WTP) for a change in recreational site attributes. For example, an individual may be asked to choose the maximum amount they are willing to pay (given budget constraints) for a new recreational feature such as a picnic area. Similar to TCM, data are collected from surveys administered by phone, mail, or in-person.

The theoretical basis for the TCM can be established with a behavioral model or a preference function, based on either random utility theory or the household production function, linked to a model of respondent behavior. CVM relies on similar random utility or household production function frameworks. Random utility theory holds that the decision to visit a site or pay for a new recreational feature represents a discrete action that can be explained by observable characteristics of the decision-maker, measurable attributes of the new feature, and unobservable elements. The household production function provides a framework in which market and nonmarket goods (such as a fish catch rate) are technically combined with an individual's knowledge or experience of these goods in a type of production function that yields services flows. The individual derives direct utility from these final service flows and by maximizing utility subject to a budget constraint yields derived demands for the nonmarket goods. Finally, a simple behavioral model states the number of visits an individual makes within a specified time period (season or year) is a function of the attributes of the sites visited (q), cost of visiting (p), and demographics (z). From this behavioral model, demand for site j can be expressed as:

$$r_{ij} = r(p_{ij}, q_{ij}; z_i) \qquad [1]$$

where i indexes individual recreators and j indexes visited sites. The expected relationship between trip costs p and number of visits r is negative (i.e., increasing costs of visiting site j lead to reductions in visits to that site) whereas the relationship should be positive for improvements in site attributes q. The relationship between demographics z and visits is unknown and specific to each study area. Random utility theory and the household production function yield a similar demand equation for visits.

Typical characteristics of an individual that might be included in z_i include age, household size, wage, and residential location. Site-specific attributes c_r may include number of access points (such as boat launches), quality of picnic areas, and average fish catch rate. Finally, p_r captures all costs associated with visiting the site, which include an admission fee (e.g., boat launch fee, if applicable), monetary cost of travel (such as gas, wear and tear on the vehicle, food, lodging, etc.), round-trip travel time, and time spent on site.

Once information has been collected for all the terms in equation [1], a count data model—such as the negative binomial (NB)—can be applied to the estimation of a recreation demand curve. Estimation of the NB model will yield the estimated demand for trips (i.e., recreation), in terms of trips made per year. A demand curve can then be constructed by varying site attributes (c_r) or trip costs (p_r), and by observing corresponding changes in number of trips (r_i) taken.

The purpose of exploring the underlying utility theory for each method is to show the link between attributes that influence an individual's decision to recreate or pay for a new recreational feature and corresponding econometric models that yield WTP measures. Under the random utility framework, the dependent variable in econometric estimation is discrete and can be modeled by a number of limited dependent variable models that include mixed logit, multinomial logit, and probit. The behavioral model of the TCM is econometrically estimated with either a Poisson or negative binomial model. These models share the limited dependent variable structure of the discrete choice models but differ based on a finite dependent variable. Last, the household production function can be estimated by either count data or discrete choice models, depending on the specification of utility.

2. DEMAND CURVE ESTIMATION: ECONOMETRICS

Count data models applied to the estimation of demand for recreation are based on the theoretical model of equation [1] plus an econometric error term ε:

$$r_i = r(p_{ij}, q_{ij}; z_i) + \varepsilon_i \qquad [2]$$

Since r_i is defined by a finite number of non-negative values $(r_i \geq 0)$, ε_i can be specified to follow either the Poisson or gamma distribution. The latter distribution gives rise to the negative binomial model, which may be preferred over Poisson because it is not subject to the unrealistic assumption of equal mean and variance, incorporates unobserved heterogeneity across individuals, and has a wider tail at the end of the distribution. A wider tail is important for capturing the behavior of a few individuals who take many trips—a likely characteristic of recreators in the Lake Texoma area.

The formal econometric model of the negative binomial is given by:

$$\pi_i(y = r \mid X) = \left\{ \left[\frac{\Gamma(y + \alpha - 1)}{y!(\Gamma\alpha - 1)} \right] * \left[\frac{\alpha - 1}{\alpha - 1 + \mu} \right]^{\alpha - 1} * \left[\frac{\mu}{\alpha - 1 + \mu} \right]^{y - 1} \right\} \qquad [3]$$

where y is the observed number of trips, r is the predicted number of trips, X captures all of the regressors on the right-hand side of equation [1], α is the overdispersion parameter (measuring extent to which variance exceeds the mean), and mean μ is given an exponential functional form $\mu = \exp(\beta' X)$, where β is a vector of estimated parameters β_0, β_z, β_q, and β_p (Long 1997). Equation [3] states the probability the predicted number of trips (r) will equal the observed, or actual, number of trips (y), conditional on individual, site, and cost attributes, is equal to a nonlinear function of these attributes, observed trips, and the extent of overdispersion. Estimation of equation [3] yields values for r, which represent the estimated demand for trips (i.e., recreation). Equation [3] is appropriate for modeling recreation demand when data collection is conducted by either telephone or mail, since survey respondents may or may not be recreators. If a sufficient number of respondents to the telephone survey are nonusers (i.e., y = 0) such that there are two distinct groups of respondents, users and nonusers, then equation [3] can be expanded to model each group jointly. The specific form of this econometric model is given by the zero inflated negative binomial model. However, if onsite surveys are used for data collection, then equation [3] should be augmented to account for strictly non-negative visits (y > 0) by respondents. This adaptation of equation [3] yields the truncated negative binomial model.

The fundamental component of an econometric model for travel cost is given by the term for the mean of the distribution of trips taken by all surveyed recreators, i.e., μ. The expected value of μ is given a linear econometric structure when the distribution is assumed Poisson or negative binomial. That is, E[μ] = β′X. This linear relationship connects the total number of trips made by an individual to the attributes of the individual, characteristics of the site, and costs associated with each visit. This relationship can be expressed mathematically in the following manner (assuming a single site):

$$y_i = \beta_0 + \beta_z z_i + \beta_q q_i + \beta_p p_i + \varepsilon_i \qquad [4]$$

where y is the total number of trips made by the individual, β_0 is an intercept term, z denotes individual attributes, q denotes site-specific characteristics, and p denotes trip costs. Typical attributes of an individual that might be included in z include age, household size, wage, and residential location. Site-specific attributes (q) may include catch rates for certain fish species, number of access points (such as boat launches), quality of picnic areas, and number of persons seen during visit (surrogate measure for extent of crowding). Finally, p captures all costs associated with visiting the site, which include an admission fee (e.g., boat launch fee), monetary cost of travel (e.g., gas, wear and tear on the vehicle, food, lodging, etc.), round-trip travel time, and time spent on site.

Once information has been collected for all the terms in equations [3] and [4], the negative binomial (NB) model can be applied to the estimation of recreation demand. A demand curve can then be constructed by varying site attributes (q) or trip costs (p) and observing corresponding changes in number of trips (r) taken. Finally, WTP to pay for additional trips (r*), conditional recreational improvements denoted by X*, can be calculated from equation [3]:

$$WTP(r^* \mid X^*) = \frac{-\exp \beta' X^*}{\beta_p} \qquad [5]$$

where β is a vector of estimated parameters (excluding β_p) and β_p is the parameter estimate for the variable measuring trip costs (i.e., p).

Random Utility Theory

As mentioned earlier, there are essentially two primary theoretical approaches for generating demand curves in the TCM. The behavioral model is outlined in equations [2] through [5]. The utility theory approach holds that an individual derives utility or satisfaction from outdoor recreation trips and is willing to forgo consumption of other goods and services in order to take more trips. If URS assumes that satisfaction derived from taking these trips can be decomposed into observable and unobservable components, then a random utility model of recreation behavior can be formulated:

$$\mu_{ij} = v_{ij}(r, w, s \mid X) + \varepsilon_{ij} \qquad [6]$$

where μ denotes latent utility, *i* indexes recreators, *j* denotes a particular site visited by *i*, *r* denotes outdoor recreation trips, *w* indexes market goods consumed by each individual, *s* denotes all other nonmarket goods and services from which each individual derives utility, and *X* captures all of the regressors on the right-hand side of equation [1]. The first component on the right-hand side of equation [6] is termed the systematic or observable component, since its elements are constant across all trips taken by each individual and the elements can be measured by the researcher. The second term on the right-hand side of equation [6] is termed the stochastic or unobservable component, since it captures all of the individual and trip-specific factors that are unknown to the researcher.

Random utility theory posits that an individual will choose site *j* over some other site *k,* as long as the utility derived from *j* exceeds that from *k*. For example, an individual may choose to visit the Cache National Wildlife Refuge instead of the Bald Knob National Wildlife Refuge, because there are better opportunities to view bald eagles, which is a source of enjoyment for the individual. URS can write this choice of the individual (visit site *j* instead of *k*) mathematically:

$$\mu_{ij} > \mu_{ik} \rightarrow j = 1, k = 0; j, k \in Q, j \neq k \qquad [7]$$

Equation [7] states that if the utility an individual derives from visiting site *j* is greater than that derived from visiting site *k*, then the individual will visit site *j* (*j* = 1) and not *k* (*k* = 0). The additional components in equation [7] place restrictions on *j* and *k* such that both sites have to be elements of the set of all recreation sites available to the individual (denoted by *Q*) and must also be mutually exclusive (that is, an individual cannot visit sites *j* and *k* simultaneously).

In order to econometrically analyze the choice of site *j* over *k* (i.e., equation [7]), URS must make two significant assumptions. First, that the systematic component *v*(.) in equation [6] can be written in a linear form:

$$v_{ij}(r, w, s|X) = \beta_i{}'X_j \qquad [8]$$

Given this assumption, substituting equation [8] into equation [6], and forming a probability over which site will be chosen yields the following:

$$\pi(\mu_{ij} > \mu_{ik}|X) = \pi(j = 1|X) = F[\beta_i{}'(X_{ij} - X_{ik}) > \varepsilon_{ik} - \varepsilon_{ij}] = F(v^* > \varepsilon^*) \qquad [9]$$

where π is the probability operator, *F* is the cumulative distribution function of the utility difference between the two sites, and v^* and e^* are compact notation for the utility difference. The second assumption for econometrically analyzing site choice holds that the stochastic term ε_{ij} must follow a Type I extreme value distribution. Given this assumption and applying equation [9] yields a specific econometric structure for site choice analysis:

$$\pi(\mu_{ij} > \mu_{ik}\Big|X) = F(v^* > \varepsilon^*) = \frac{\exp \beta_i{}'X_j}{\sum Q \exp \beta_i{}'XQ} \qquad [10]$$

Equation [10] represents the conditional logit model. Equation [10] can be modified to estimate the multinomial logit, mixed logit, or probit models.

Parameter estimates derived from estimating equation [10] are applied to the calculation of WTP (i.e., economic values) for a change in recreational attributes *q* from q_o (status quo level) to q^* (improved level):

$$WTP = \frac{1}{\beta_p}\{\beta' X_0 - \beta' X^*\} \qquad [11]$$

where β_p is the parameter estimate for the variable measuring costs incurred by individuals for visiting sites *j* or *k*, β is a conformable vector of estimated parameters (excluding the cost parameter) for site- and individual-specific variables included in equation [10], and X_o and X^* are vectors of independent regressors representing the status quo and improved levels of *q*, respectively.

3. CONTINGENT VALUATION METHOD

The basic premise for the CVM is that an economic value can be derived for an inherently unpriced, or nonmarket, good by econometrically analyzing individual responses to hypothetical changes in this good. These changes are presented to the respondent in a survey, or constructed market, and the responses solicited are choices between the status quo (i.e., the respondent prefers the good in its current state) and an improved (or possibly, degraded) state. If the latter is chosen, then the respondent is asked to state or choose the maximum amount of money he is willing to pay to secure the change.

Based on the above description of a standard contingent valuation survey, the respondent makes a discrete decision between paying for an improvement in the nonmarket good and the status quo. An individual will choose the improved state over the status quo as long as the net utility derived is positive. For the purpose of this exposition, suppose the survey presented the individual with two options, one of which contains an improved fish catch rate with an associated fee of $5 per year, and the other the status quo of no improvements without a fee. The individual will choose the improved catch rate as long as the net utility (need to account for utility loss caused by the fee increase) from the recreational improvement exceeds the utility derived from simply utilizing the fishery at its present catch rate. Similar to the random utility theory specification of the TCM, the basic econometric structure for analyzing choice is given by:

$$\pi_i(IM = 1|p_i, q_i, r_i) = \frac{\exp(\beta_0 IM + \beta_z zIM + \beta_q qIM + \beta_p pIM)}{\left\{\exp\left(\beta_0 IM + \beta_z zIM + \beta_q qIM + \beta_p pIM\right) + \exp\left(\beta_0 SQ + \beta_z zSQ + \beta_q qSQ + \beta_p pSQ\right)\right\}}$$

[12]

where π is the probability operator, *IM* denotes the improved level of the recreational fishery, *SQ* denotes the status quo level, and all other variables are defined as before. Equation [12] links random utility theory to recreation demand estimation and states that the probability an individual will choose to pay for the new catch rate, rather than forgo payment and continue to enjoy the status quo, is conditional upon the costs associated with the improvements to the fishery, specific species affected, and personal attributes such as income and residential location. WTP for the new catch rate is calculated from the parameter estimates in equation [12] in a manner similar to equation [11].

A probability model is necessary because the analysis relies on intended, as opposed to actual, behavior. Thus, only the probability an individual will choose a specific option can be estimated. The probability model, equation [12], links random utility theory to recreation demand estimation and states that the probability an individual will choose the improved state, rather than the status quo, is conditional upon the costs associated with the improved condition, specific recreational features, and such personal characteristics as income and residential location. Given certain assumptions regarding the distribution of the error term, the probability an individual will make this choice can be econometrically modeled by the multinomial logit, mixed logit, or probit models. Parameter estimates derived from estimating one of these limited dependent variable models can then be used to derive WTP measures (i.e., economic values) for a change in recreational attributes c_r from the status quo level to an improved level:

$$WTP = \frac{\beta_2 c_r}{\beta_3 p_r} \qquad [13]$$

where $\beta_2 c_r$ is the parameter estimate for the variable capturing the improved recreational feature, and $\beta_3 p_r$ is the parameter estimate for the variable measuring costs incurred by individuals for the improved state.

Contingent valuation can also be linked with the TCM to capture both actual and intended behavior. The methods are combined by simply augmenting standard travel cost questions of respondent origin, monetary costs of travel, and number of trips to the site with a separate question asking the individual to state how many more trips he or she would be willing to take if the site was improved. Continuing the earlier example, instead of asking the individual if he would be willing to pay an additional $5 fishing license fee, the question would be posed in the following way: "If improvements were made to this recreational fishery such that more fish could be caught per hour, and all other aspects of your trip remained the same (i.e., travel costs and crowding do not change), how many more trips would you be willing to take?" If the average cost per trip is $20, and the average individual states he is willing to take at least one additional trip, then an economic value of $20 per person can be placed on the improvements. Aggregating this value over all current and potential recreators yields the total economic value for the new recreational feature.

Two econometric models can be applied to the analysis of data collected from a linked contingent valuation-travel cost (CVM-TCM) survey. The first is a Heckman, or two-stage, model. These models are based on a limited dependent variable (i.e., the left-hand side of equation [2] can now assume only finite or discrete values) and consist of two stages. In the first stage, the probability an individual will not make additional trips is modeled with a logistic or probit model. In the second stage, ordinary least squares or a negative binomial model is used to empirically estimate the number of trips an individual will take as a function of elements included on the right-hand side of equation [2]. Similar to econometric analysis of travel cost data, the Heckman, or two-stage, model will generate demand, demand curves, and WTP for new recreational features. The second econometric model for analyzing data from a CVM-TCM survey would be an ordered logistic or probit model. However, to apply these models, the survey question would have to be phrased in a manner similar to the standard contingent valuation question. That is, the individual would be asked if she would be willing to take X more trips (instead of paying $5 more to fish) if the improvements were made to this fishery.

Collectively, the 13 equations in this appendix show the connection between economic theory, observed recreator behavior (whether observed at the recreational site or in a survey setting), and econometric derivation of an economic value in the form of WTP for changes in recreational attributes. The TCM and CVM are the environmental valuation techniques underlying these equations and providing the link between nonmarket recreational features and economic benefits assessment.

Appendix E: OMB Support

SUPPORTING STATEMENT
SURVEY OF CURRENT USERS
Red River Chloride Control Project
Lake Texoma, Texas and Oklahoma

The Corps of Engineers will use this survey to obtain information to aid in the economic evaluation of alternatives designed to reduce chloride levels in the Red River. The information will be used to estimate exiting angler WTP to maintain the recreational fisheries at its current level. Officials have estimated that approximately 5.8 million people use Lake Texoma each year. The visitors range from the Dallas/Fort Worth area to international travelers. A pre-test of the survey was conducted by staff not connected with the project. The purpose of the test was to ensure the respondent will understand the questions asked of them. Fewer than 10 people were surveyed during this pre-test.

The survey will be conducted via the telephone **[insert time period once Phase II schedule is approved]**. The State of Texas provided a database with license data for Lake Texoma. Since the lake crosses the State boundary between Texas and Oklahoma, a specific license can be purchased to fish only on Lake Texoma. These data formed the basis of our sampling frame. The project goal is to have a final sample size of 1,000 usable surveys. Based on distribution of license sales, 700 completed surveys will come from Texas residents, and the remaining 300 will come from people who reside elsewhere. Respondents will be selected at random utilizing the license database and stratification (700 Texas, 300 elsewhere). Surveys will be conducted primarily in the evenings and weekends, when people have a greater tendency to be home. Please see the table below to relate questions on the proposed survey to pre-approved OMB surveys. The White River survey served as the primary model for this survey and was approved by OMB in September 2004.

Proposed Survey-Lake Texoma Recreational Angers	OMB 0710-0001 Recreation Value	OMB 0710-0001 White River Navigation Improvement Project Recreational Benefits Assessment
Question 1 to 3		Question 1 & 2
Question 4 to 7		Question 4 to 7
Question 8 to 10		Question 8 & 9
Question 14 to 17		Question 13 to 16
Question 18 & 19		Question 17 & 18
Question 24 to 28	Question 7 to 19	Question 24 to 28