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ECONOMIC VALUATION OF SOME WETLAND OUTPUTS OF MUD LAKE, MINNESOTA-SOUTH DAKOTA

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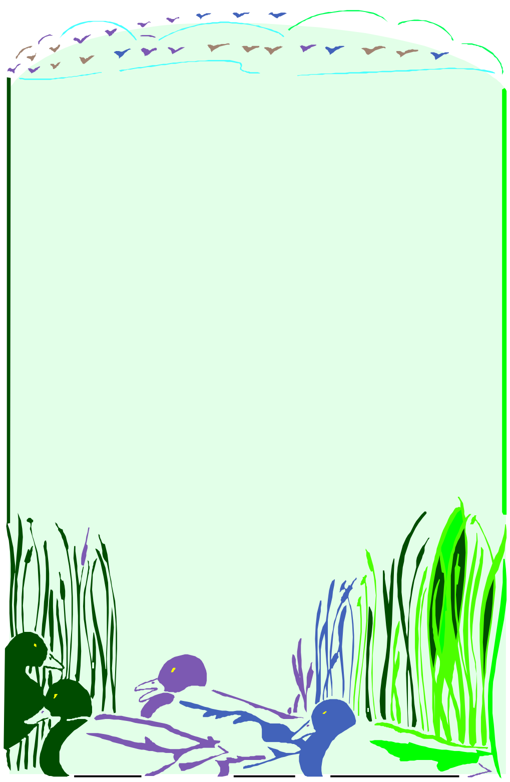

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This report can also be found at this web site:

http://agecon.lib.umn.edu/ndsu.html

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ABSTRACT

The objective of this study was to estimate some economic values of Mud Lake, a managed, lacustrine wetland on the Minnesota-South Dakota border. Several outputs of Mud Lake were identified and an economic value was estimated for each. Flood control was valued at approximately $440 per acre, based on dollar damages prevented; water supply, using public utility revenues, was valued at $94 per acre; fish/wildlife habitat, recreation, and aesthetics were valued at about $21 per acre using the Contingent Valuation Method; and corrective expenditures were used to evaluate water quality at a negative per acre value of $180. When capitalized at 6 percent, the estimated total annual value of these four outputs is $6,250 per acre. These values can assist managers and policy makers in making decisions regarding the opportunity costs of Mud Lake management options or of wetland alterations or preservation. These snapshot values of Mud Lake "at the margin" are estimated under the assumption that all other wetlands and water resources in the region are unchanged.

Keywords: wetland, outputs, economic valuation, flood control, water supply, water quality, recreation, aesthetics, fish/wildlife habitat, contingent valuation method.

Economic Valuation of Some Wetland Outputs of Mud Lake, Minnesota-South Dakota

Lisa A. Roberts and Jay A. Leitch*

INTRODUCTION

Most natural landscape services, such as wildlife habitat and aesthetics, are not included in market prices. To some degree, these services are overlooked in decision making, partly because the social outputs are unrecognized by private landowners and, as a result, a value of zero (or infinity) is often implicitly assigned to them. When development outputs (e.g., agriculture, industry, construction) are marketable and the opportunity costs of natural services are undervalued or not valued, decisions may be biased toward development (Shabman and Bertelson 1979). In the case of publicly owned water resources, such as wetlands, such inefficient uses of resources may result when the values of non-market goods are unknown.

PURPOSE

The purpose of this study was to approximate some economic values of Mud Lake, a managed "wetland" on the border between Minnesota and South Dakota, to provide information to promote more efficient and effective management of Mud Lake and its wetlands, and to demonstrate some methods for wetland evaluation.

There is a wide chasm between wetland economics and physical/natural wetland science. This, and similar studies, are "meta-analyses," "envelope analyses," "ballpark estimates," "getting on the paper," "zeroing in," "first approximations," . . . . They are not meant to present precise numbers resulting from fine-tuned, rigorous analysis. Rather they are an attempt to zero in on what might be a number suitable or sufficient for public policy making purposes. What is most important is adherence to sound economic principles and concepts. Another benefit of these types of studies is identification of the weak links in wetland science.

STUDY AREA

Mud Lake and its associated wetlands are along the Minnesota-South Dakota border, between White Rock Dam on the southern (upstream) end and Reservation Dam on the northern (downstream) end (Roberts 1997) (Figure 1). Mud Lake is approximately 7.5 miles long and 2.5 miles wide, with an average depth of 1.7 feet, and a full pool capacity of 85,000 acre feet. Mud Lake has a maximum depth of 5 feet in the channel area and bays. The associated wetlands have a maximum depth of about 2 feet (Salberg 1997). The study area follows the 981 feet msl (mean sea level) elevation, which is the full pool elevation established by the U.S. Army Corps of Engineers. The Bois de Sioux River begins at White Rock Dam and flows north. Mud Lake is

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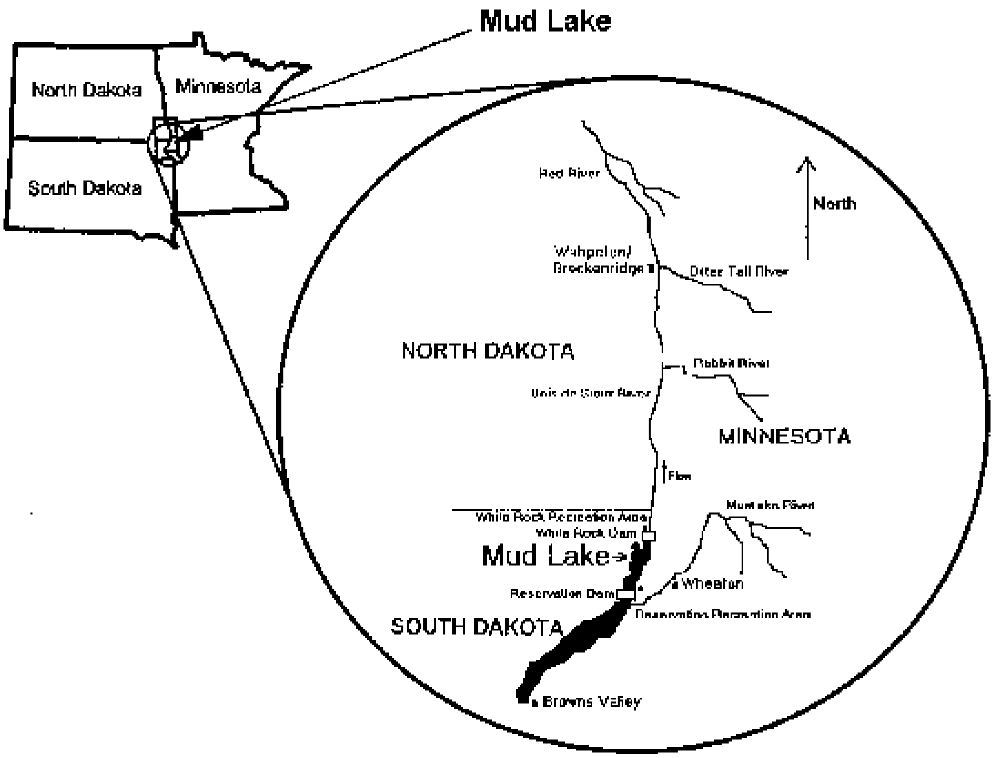

Figure 1. Mud Lake Area, Minnesota-South Dakota

a lacustrine wetland, while the associated wetlands are permanently, semipermanently, or seasonally flooded palustrine wetlands (U.S. Department of the Interior 1991a and 1991b).

Prior to construction of the dams, Mud Lake was a densely vegetated marsh with a meandering channel. It was an overflow basin for Lake Traverse which has an average channel depth of 8 to 10 feet (Braatz 1993). A local farmer describes this area as “originally just a wide, meandering stream, with miles of swamp, lots of muskrats. . . . My Dad tells stories about the fantastic hunting and fishing” (Braatz 1993, p. 12). However, this was changed when the area began to be managed for flood control. The Lake Traverse Project was completed in 1942 and changes began soon thereafter as a result of reduced water current and decreasing water depth. Mud Lake eventually became a shallow, mostly unvegetated, open-water area (Braatz 1993), which is still a wetland, but it is a different type than before modification.

WETLAND BENEFICIARIES

Value of any good is based on perspective and context--there is no single, universal value measure. Wetlands, for example, can be valued from at least four perspectives leading to four types of values: owner, user, region, and society (Leitch and Hovde 1996). Owner values are derived from marketable wetland products and services (e.g., forage, water, aquatic plants). Owner value is the market return (monetary or nonmonetary) from wetland outputs along with the owner's personal use (or non-use) values. User values capture the benefits from consumption or use of wetland-related outputs (e.g., recreation, water quality enhancement). Net worth of a wetland is the amount users are willing to pay for the satisfaction provided by its products or services (i.e., outputs). Regional values (e.g., gross business volumes, employment) are derived from wetland-related business activity. Regional values were not estimated in this study. Social value is the net value of a wetland's outputs to "society." Social value can be measured by aggregating user values and owner values (Leitch and Hovde 1996). Social and owner values were evaluated as one, since Mud Lake is publicly owned.

WETLAND EVALUATION METHODS

Economic values of wetlands have been frequently discussed conceptually and also estimated at many locations (Leitch and Ludwig 1995). Evaluation techniques are similar to those routinely used by resource and environmental economists for many non-market goods and services. The shortcoming of natural resource valuation methods is more often lack of data from physical, biological, and natural scientists than a paucity of valuation techniques.

There are many examples of wetland valuation in the literature (Leitch and Ludwig 1995). For example, Lynne et al. (1981) evaluated the economic productivity of Florida's Gulf Coast blue crab fishery in relation to the availability and characteristics of marsh (i.e., wetland) acreage using a bioeconomic model. Batie and Wilson (1978) examined the economic value of Virginia's coastal wetlands in relation to oyster production by estimating a physical production function for oyster harvest in coastal wetlands in Virginia. Gosselink et al. (1974) estimated the monetary value of marsh on the Atlantic and Gulf coasts for production, aquaculture development, waste assimilation, and total "life support" as a value ranging from $2,000 to $82,000 per acre. Their methods included reviewing the dollar value of shell fisheries and sport fishing activities, evaluating the potential for aquaculture development by using dollar values and an income capitalization approach, and estimating the cost of the next best alternative wastewater treatment option (Gosselink et al. 1974). Life support value of wetlands has been estimated using energy content per acre (Shabman and Batie 1978).

Farber and Costanza (1987) estimated the economic value of a wetland system in Terrebonne Parish, Louisiana to be from $0.44 to $590 per acre (1983 dollars) using a willingness-to-pay (WTP) approach for commercial fishing and trapping, recreation, and wind damage protection. Bell (1989) used marginal productivity theory to value Florida fisheries. The marginal value product of a Florida salt marsh was estimated to be $27.48 per acre (Bell 1989).

PROCEDURE

The selected wetland outputs evaluated were flood control, water supply, fish and wildlife habitat, recreation and aesthetics, and disamenities related to water quality (i.e., taste and odor problems) (Roberts 1997). Monetary values were estimated for two beneficiary groups--users and society--and aggregated to estimate an economic value of some of the wetland-related outputs of Mud Lake to society.

Wetland attributes, functions, and outputs were characterized from a review of the literature (Table 1). Attributes are the physical characteristics of a wetland and may include features such as size and location, vegetation, water chemistry, soil type, hydrology, and landscape diversity. Functions are what the wetland does physically, biologically, and chemically and are driven by wetland attributes. Outputs are the specific goods and services that result from various wetland functions valued by humans. Wetland value begins with wetland attributes, which influence wetland outputs or transformation into economic functions, which in turn, contribute to

Table 1. Wetland Attributes, Functions, and Outputs

Attributes (physical/chemical characteristics)	
Size	Diversity of the landscape and ecology
Shape	Hydrology
Volume	Water chemistry
Area	Permanence
Location	Turbidity
Vegetation	Substrate texture
Functions (what it does)	
Flood water storage	Sedimentation stabilization
Fish/Wildlife habitat	Nutrient removal/cycling
Groundwater recharge and discharge	
Outputs (goods and services)	
Flood control	Aesthetics (open space)
Fish, waterfowl, and wildlife	Education and research
Water supply	Agricultural uses
Water quality	Reduce erosion
Recreational use	Gene pool maintenance

Sources: Brett Hovde. 1993. *Dollar Values of Two Prairie Potholes.* M.S. thesis, North Dakota State University, Fargo; William J. Mitsch and James G. Gosselink. 1993. *Wetlands.* Second edition, Van Nostrand Reinhold, New York; and Council for Agricultural Science and Technology. 1994. *Wetland Policy Issue.* Ames, Iowa.

economic values. In this sense, the function, or the wetland itself, is not valued directly, but it is the services from the wetland that impact social well-being and wetland value (CAST 1994).

The values of flood control, water supply, and water quality were estimated indirectly using secondary data, while the value of fish/wildlife habitat, recreation, and aesthetics was estimated using primary data. Flood control was evaluated by damages prevented. Water supply was evaluated by estimating a residual return to public water utilities. Primary data were acquired through a mail survey using the Contingent Valuation Method to evaluate fish and wildlife habitat, recreation, and aesthetics. Water quality was evaluated by estimating the extra costs of water treatment. Finally, the monetary values for each output were aggregated to estimate a static, snapshot, approximate economic value for Mud Lake. A major obstacle to more direct and objective valuation methods is the limited scientific understanding of the relationships between attributes, functions, and outputs of wetlands and the wide variability in wetland characteristics (Scodari 1990).

WETLAND OUTPUT VALUE ESTIMATION

Values for each of the selected outputs were estimated independently, at a point in time, assuming all other conditions were unchanged. Obviously, values would likely change over time and/or as other landscapes are modified.

Flood Control

The U.S. Army Corps of Engineers (1972) estimated that the annual flood loss resulting from a reduction in wetland acreage in 1971 in the Charles River, Massachusetts, watershed was $158,000 (equivalent to about $594,700 in 1995 dollars [Council of Economic Advisers 1996]). Flood damages could be reduced with the appropriation of 8,422 acres of wetlands in the Charles River area. This flood damage reduction is equivalent to approximately $76 per wetland acre ($280 in 1995 dollars). Thibodeau and Ostro (1981) concluded the capitalized flood control value of wetlands within the Charles River basin was approximately $2,000 per wetland acre ($3,353 in 1995 dollars). Gupta and Foster (1975) reported flood control values and values of other outputs of wetlands. They incorporated the flood control benefits estimate from the Charles River study (U.S. Army Corps of Engineers 1972). At a capitalization rate of 5.375, their estimate of the value of flood control benefits was approximately $1,488 per acre (Gupta and Foster 1975) or about $4,200 per acre in 1995 dollars.

The primary purpose of the Lake Traverse-Bois de Sioux Project is flood control along the Bois de Sioux River and, to a lesser degree, in the Red River Valley (U.S. Army Corps of Engineers 1993). Wahpeton, North Dakota (pop. 8,751), Breckenridge, Minnesota (pop. 3,708), and agricultural areas along the Bois de Sioux River often experience spring flooding. Federal flood control projects on Lake Traverse, Mud Lake, and the Otter Tail River provide some protection from floods for these communities (U.S. Army Corps of Engineers 1990). The flood water retention function of Mud Lake is unlike that of natural wetlands in some ways (e.g., water levels are controlled), but it is, nonetheless, a "wetland."

The Bois de Sioux River flood plain contains approximately 95,000 acres, which includes Bois de Sioux River and Rabbit River drainage areas (U.S. Army Corps of Engineers 1990). The difference between the peak inflow into Lake Traverse and the outflow (i.e., unregulated vs. regulated flow) was used to approximate the value of damages prevented by the project. The U.S. Army Corps of Engineers evaluates damages each year at Wahpeton/Breckenridge, Fargo/Moorhead, and agricultural reaches (Carlson 1996).

Flood control provided by Mud Lake and adjacent wetlands is valued as a whole. These two components of water retention are not separated because the adjacent wetlands are inundated at full pool; therefore, flood control benefits were evaluated from the outlet of White Rock Dam (northern end of Mud Lake) to the extent of susceptible downstream areas.

Lake Traverse has a full pool (981 feet msl) capacity of 164,500 acre feet and a conservation pool (976 feet msl) capacity of 106,000 acre feet, leaving 58,500 acre feet available for flood storage. Mud Lake, on the other hand, has a full pool (981 feet msl) capacity of 85,000 acre feet and a conservation pool capacity (972 feet msl) of 6,500 acre feet, leaving 78,500 acre feet available for flood storage. The combined flood water storage capacity of the two reservoirs is 137,000 acre feet. Mud Lake stores approximately 54 percent, Lake Traverse 43 percent, and wetlands associated with Mud Lake about 3 percent of total flood storage (Table 2).

Table 2. Storage Capacity of Lake Traverse and Mud Lake Area

	Flood Storage	Percentage
	(Acre Feet)	
Lake Traverse	58,500	43
Mud Lake	74,500	54
Mud Lake Wetlands	4,000	3
Totals	137,000	100

The 11-year total damages prevented, expressed in real (inflated) 1995 dollars, are about $42 million. Mud Lake and associated wetlands contribute about 57 percent of these savings, or approximately $24 million (Table 3). The 11-year simple annual average damage prevented is about $2.2 million. This annual flood damage prevention estimate assumes (1) only one flood event per year, (2) optimal operation of reservoir pools for flood control, (3) all associated wetlands are "empty" immediately before the flood event, and (4) the depth-damage relationship is linear.

Table 3. Dollar Damages Prevented by the Lake Traverse Project, Minnesota-South Dakota (1985 - 1995)

Fiscal Year Oct. 1 - Sept. 30	(1) Current Year (Nominal) Damages Prevented	(2) Real 1995 Dollars	(3) Mud Lake Contribution Col. (2) X 0.57
1995	$ 8,767,700	$ 8,767,700	$ 4,997,600
1994	7,188,400	7,392,100	4,213,500
1993	13,892,600	14,652,100	8,351,700
1992	-0-	-0-	-0-
1991	1,418,200	1,586,900	904,500
1990	-0-	-0-	-0-
1989	4,314,000	5,302,000	3,022,100
1988	-0-	-0-	-0-
1987	-0-	-0-	-0-
1986	2,974,000	4,135,400	2,357,200
1985	-0-	-0-	-0-
TOTALS	$38,554,900	$41,836,200	$23,846,600

Sources: Richard Carlson, 1996 and 1997, Personal communication, Regional economist, U.S. Army Corps of Engineers, St. Paul District, St. Paul, Minnesota.

Water Supply

The cost of water supply from alternative sources was used as a proxy for the monetary value of water from wetlands in Massachusetts (Gupta and Foster 1973). The difference between costs of water supply from a wetland and from an alternate source was estimated to be $28 annually for 365,000 gallons of water (or $28 for approximately one acre foot). Gupta and Foster (1973) estimated water supply benefit of wetlands to be $280 per acre ($960 per acre in 1995 dollars).

The secondary purposes of the Lake Traverse-Bois de Sioux Project are water conservation and fish and wildlife preservation. The principal downstream users of Red River water (i.e., water supply from Mud Lake) include Fargo, North Dakota and Moorhead, Minnesota with combined populations of 106,406 (Fargo, 74,111, and Moorhead, 32,295) (U.S. Department of Commerce 1990). Fargo uses about 4 billion gallons annually (12 to 13 million gallons per day). Moorhead uses about 1.6 billion gallons annually (4.5 million gpd) from the Red River (McLain 1996).

During times of high flow (i.e., greater than 500 cfs), such as March through July, water released from Mud Lake does not have any supply value at the margin, since there is already a surplus of water from other contributing sources (Figure 2). However, during times of low flow, such as

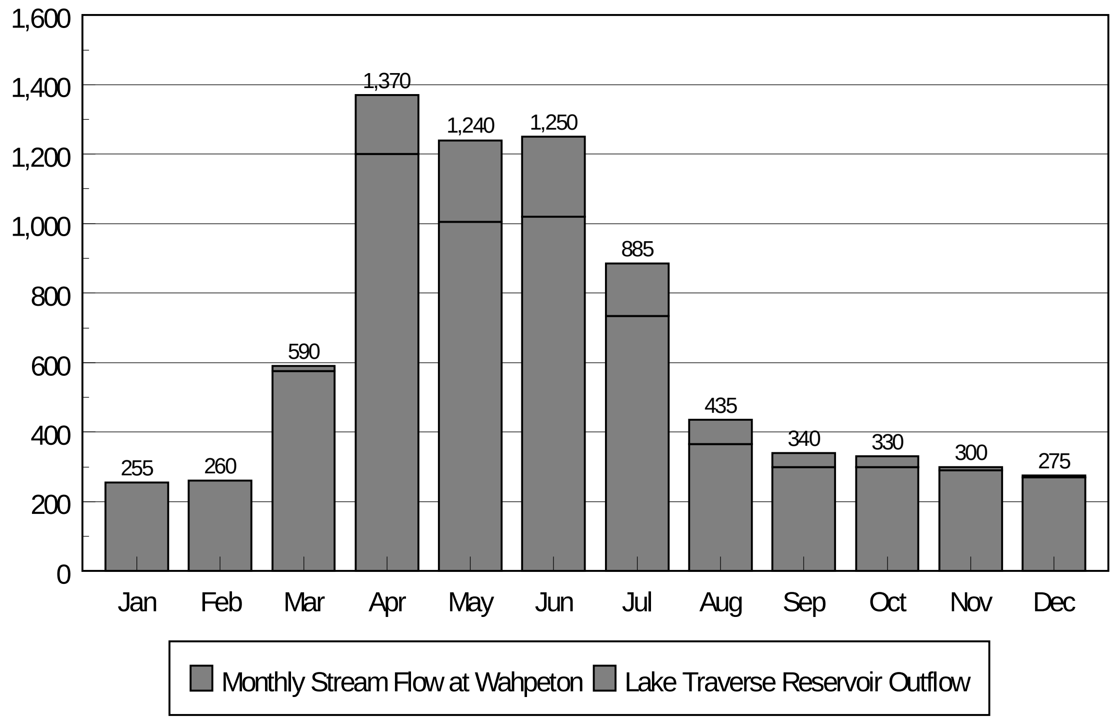

Figure 2. Approximate Outflow of Water From the White Rock Dam, Mud Lake, Minnesota-South Dakota
Source: U.S. Army Corps of Engineers. 1994b. *Water Control Manual, Lake Traverse Project.* St. Paul, Minnesota.

August through December, releases from Mud Lake constitute about 9 percent of the average flow in the Red River (Roberts 1997).

About 74 percent of the approximately 1.6 billion gallons of water used by Moorhead in 1995 came from the Red River. About 9 percent of the Red River water used (approximately 132 million gallons) came from Mud Lake. The Moorhead Water Division had a net operating income of $1,418,236 in 1995. About $94,000 (.74 x .09 x 1,418,236) of their net income can be attributed to Mud Lake water. Mud Lake water likewise contributed approximately $239,000 to the net operating income of the water division for Fargo for an annual total water supply value of $333,000.

Water Quality

Wetlands may affect water quality in a number of ways (Coreil 1993). Excess nitrogen or phosphorus may promote algal blooms and increased growth of undesirable aquatic plants which may affect drinking water quality, recreational activities, and dissolved oxygen levels (Sather and Smith 1984). While considerable work has been done on wetlands and water quality (Lee et al. 1975, Hemond and Benoit 1988, and Whigham et al. 1988), the economic benefits have not been well established.

Some poor water quality indicators in Mud Lake include limited light penetration, rough fish, low dissolved oxygen levels, high algae density, suspended solids, and excess nutrients. Suspected causal factors of water quality problems include high algal production, decay of organic material, and high water temperatures (U.S. Army Corps of Engineers 1994a). "Mud Lake is a good candidate for taste and odor algae (downstream), but it is not the only source. Lake Traverse, Orwell Reservoir, and municipal point sources also contribute" (Holme 1997).

The impact of Mud Lake on water quality in Fargo and Moorhead was estimated using corrective expenditures. Corrective expenditures are those outlays necessary to offset the impact of pollution and are a proxy for the social cost of pollution (Abelson 1996). During some periods of high discharge from Mud Lake, Fargo spends nearly $1,000 per day in extra treatment costs (Hendricksen and Welton 1995). The exact cost and adequacy of alternate water sources (e.g., Sheyenne River, groundwater) has not been fully explored by Fargo or Moorhead. The Red River supplied about 4 billion gallons (90 percent) of water for Fargo in 1995. Extra treatment costs are incurred when Mud Lake water is being discharged at White Rock Dam and Red River flow rates are low (e.g., less than 500 cfs). Red River flow rates are usually lowest when water quality problems in Mud Lake are highest, both typically occur in late summer and early fall. Thus, Red River water quality is likely to be most impacted by poor quality Mud Lake water during August, September, October, and November.

Fargo spends approximately $120,000 in extra treatment costs per year (4 months x 30 days/month x $1000 = $120,000) when using Mud Lake water during low flow periods. Moorhead's treatment costs increase by about $500 per day during that time (McLain 1996). The Red River supplied 73.5 percent of the water for Moorhead in 1995 (Moorhead Public Service 1995), which results in $60,000 in extra treatment costs per year (4 months x 30 days/month x $500 = $60,000). Thus, the water quality value for Mud Lake is negative, totaling -$180,000 for the two cities each year.

Fish/Wildlife Habitat

Lake Traverse and Mud Lake provide habitat for a large number of indigenous wildlife species including, for example, white-tailed deer (*Odecoileus virginianus*), ring-necked pheasants (*Phasianus colchicus*), and non-game mammals, birds, and amphibians. The area is a rest stop for migrating waterfowl and a home for local breeding birds (U.S. Army Corps of Engineers 1993). Deer hunting has not been as popular as in the past, a result of reduced vegetation from flooding (Stage 1995). Now, only local landowners hunt deer in the Mud Lake area (Marts 1995). Some furbearer trapping also occurs in the area.

Some of the fish species in Lake Traverse and the Bois de Sioux River find their way through Reservation and White Rock Dams into Mud Lake; however, recreational fishing in Mud Lake is sporadic, depending on water levels. Commercial fishing of rough fish in Mud Lake is also sporadic, with only one seine haul conducted in the past few years. About 170 tons of rough fish, including carp (*Cyprinus carpio*) and buffalo (*Ictiobus cyprinellus*) were harvested commercially in Mud Lake over the last ten years (Meester 1997).

In 1987, the South Dakota Department of Game, Fish and Parks agreed to sponsor a waterfowl enhancement project on Mud Lake in cooperation with Ducks Unlimited. This project involved constructing ten one-acre waterfowl nesting islands, dredging the main channel, and constructing numerous, smaller loafing islands for waterfowl (Braatz 1993). This work has enhanced the habitat for waterfowl and increased the aesthetic and recreational hunting values of the area.

Recreation and Aesthetics

Recreational values of wetlands are often the most readily recognized wetland values (Coreil 1993). Recreational uses may include sightseeing, hiking, fishing, hunting, swimming, canoeing, photography, wildlife observation, and picnicking (Bardecki 1984). The Contingent Value Method (CVM), a survey method, was used to assess people's preferences for non-market, wetland resources (Mitchell and Carson 1989). Net benefits were estimated by asking people directly how much they value non-market goods. CVM, a stated preference method, is an alternative to other indirect valuation methods which estimate the value of resources by using market data (i.e., revealed preference methods) (Scodari 1990).

A CVM questionnaire (Appendix A) sent to a random sample of 1,034 households within a 30-mile radius of Mud Lake, included questions regarding both habitat and recreational values. Sample size was chosen to obtain a useable response of at least 250 households. The random sample was selected from a combination of four area telephone directories that include areas within a 30-mile radius of Mud Lake. Every 16th non-business listing was mailed a survey instrument.

The questionnaire was organized in such a way as to (1) familiarize respondents with the location of Mud Lake, (2) ask willingness-to-pay questions regarding recreation and fish/wildlife habitat, (3) ask behavioral questions about recreational usage, and (4) identify personal characteristics of the respondents. An initial and two follow-up mailings resulted in an overall response rate of 62 percent (575 respondents). Non-response bias was tested by comparing willingness-to-pay for use, option, and existence values among mailings. Willingness-to-pay amounts among responses to the three mailings did not vary substantially; therefore, response bias was assumed not to be an issue and the sample was assumed to represent the population adequately. This assumption was further supported by comparing county-wide demographics with those of the response sample.

Eighteen percent of respondents had, and 79 percent had not, visited Mud Lake for recreation within the past 12 months. Three percent did not respond to the first question. The dominant activities in which respondents participated at Mud Lake included fishing, sightseeing, pleasure driving, and wildlife observation.

Survey participants were asked "If Mud Lake was managed primarily for water-related recreation and fish/wildlife habitat, what would you be willing to pay through an annual use permit to participate in recreational activities at Mud Lake?" In response to this "use value" question, most respondents (75 percent) stated $0 (nothing), followed by 10 percent stating $1 to $5 annually, 12.5 percent saying from $6 to $50, and ½ percent willing to pay $51 or more (Table 4). Respondents chose $0 (nothing) because they were not familiar with the Mud Lake Area (40.9 percent),

> Mud Lake does not have any value to me (31.3 percent),
> I do not care about Mud Lake (17.2 percent),
> Mud Lake is too far from my home (13.2 percent),
> Out-of-state license requirement (9.4 percent), or
> It does not have the recreational facilities I need (8.3 percent).

Negative values were not provided as choices on the questionnaire, although some respondents might have chosen a negative dollar amount for use, option, or existence value(s).

Approximately 3 percent chose not to respond to the question, "What is the maximum amount you would be willing to pay through an annual voluntary donation to ensure that recreational activities and fish/wildlife habitat at Mud Lake are available in the future to you or your descendants?" Responses to this type of question represent option or bequest values. The majority of respondents (68 percent) said they would be willing to pay $0 (nothing) to ensure the resources were available in the future. This was followed by approximately 15 percent stating $1 to $5 annually, and 9 percent said $11 to $25 annually (Table 4).

Responses to the question, "What is the maximum amount you would be willing to pay through an annual voluntary donation to ensure that recreational activities and fish/wildlife habitat at Mud Lake are available for other people, even if you do not intend to visit the Mud Lake area?" were used to estimate an existence value for Mud Lake resources. About 3.5 percent did not respond to the question, while 71 percent chose $0 (nothing), and nearly 25 percent said somewhere between $1 and over $51 annually (Table 4).

Willingness to pay for use, option/bequest, and existence values regarding Mud Lake were low, with only about one-fourth of the respondents reporting a positive value (Table 4). This apparently low value may be attributed to lack of knowledge about Mud Lake or to preferences for nearby substitute water-based recreation sites, of which there are many.

Other Wetland Outputs

Wetlands may provide beneficial outputs beyond those evaluated here, such as groundwater recharge, education and research, or location for development. In addition, they may lead to negative outputs such as negative aesthetics, offensive odor, mosquitoes, or crop depredation. A full accounting of both beneficial and adverse outputs was not attempted here and may not be necessary for many policy-type decisions regarding water resources. However, it may be necessary to at least identify those other outputs and recognize the general effect their values may have on any total value estimates.

Table 4. Willingness-to-Pay Amounts For Mud Lake Area Use, Option/Bequest, and Existence Values

USE VALUE[a]

	Respondent			Range	
Response	Percentage	Frequency	Total Housing Units[d]	Low	High
No Response	1.9	11	307	--	--
$0	74.8	430	12,102	--	--
$1 to $5	10.3	59	1,666	$1,666	$8,332
$6 to $10	8.7	50	1,408	8,445	14,076
$11 to $25	3.1	18	502	5,517	12,539
$26 to $50	0.7	4	113	2,945	5,663
$51+	0.5	3	81	4,126	> 4,126
TOTALS	100.0	575	16,179	$22,699	≥ $44,736

OPTION/BEQUEST VALUE[b]

	Respondent			Range	
Response	Percentage	Frequency	Total Housing Units[d]	Low	High
No Response	3.1	18	502	--	--
$0	68.5	393	11,082	--	--
$1 to $5	14.6	84	2,362	$2,362	$11,811
$6 to $10	9.0	52	1,456	8,737	14,561
$11 to $25	3.1	18	502	5,517	12,539
$26 to $50	1.2	7	194	5,048	9,708
$51+	0.5	3	81	4,131	> 4,131
TOTALS	100.0	575	16,179	$25,795	≥ $52,750

EXISTENCE VALUE[c]

	Respondent			Range	
Response	Percentage	Frequency	Total Housing Units[d]	Low	High
No Response	3.5	20	566	--	--
$0	70.6	406	11,422	--	--
$1 to $5	15.0	86	2,427	$2,427	$12,134
$6 to $10	8.0	46	1,294	7,766	12,943
$11 to $25	2.1	12	340	3,737	8,494
$26 to $50	0.5	3	81	2,103	4,405
$51+	0.3	2	49	2,475	> 2,475
TOTALS	100.0	575	16,179	$18,508	≥ $40,451

[a] Question 2 on the questionnaire (Appendix A).
[b] Question 4 on the questionnaire (Appendix A).
[c] Question 5 on the questionnaire (Appendix A).
[d] The number of housing units in the 30-mile radius was used to extrapolate the sample data.

SUMMARY

The annual flood control benefits from Mud Lake and associated wetlands are about $2.2 million, or about $440 per acre per year (Table 5). The flood control benefits represent about 92 percent of the total benefits estimated in this study. This is expected because the lake (wetland) is manipulated for flood control purposes. Water supply benefits are about $94,000, or $94 per acre per year, representing 4 percent of the total benefits. Again, water supply is a project purpose. Most flood control and water supply benefits are a result of manipulation of the outlet control structures (Reservation and White Rock Dams). Fish and wildlife habitat, aesthetics, and recreation benefits were estimated to be about $102,000, or $21 per acre per year (these benefits are spread across a larger area than flood control and water supply), and represent about 4 percent of the total benefits. A negative output, water quality degradation, was estimated to cost downstream water users about $180,000 per year in extra treatment costs, representing a negative, per acre value of $180. The value of selected beneficial wetland outputs (i.e., flood control, water supply, habitat, recreation, and aesthetics) totaled approximately $2,396,000 or from $94 to $440 per acre. Adverse wetland outputs (i.e., water quality) were valued at about minus $180,000 or about minus $180 per acre. The aggregate annual social dollar value was approximately $2,216,000 ($375 per acre) with a capitalized value of about $36,933,000 ($6,250 per acre) using a 6-percent discount rate.

CONCLUSIONS AND IMPLICATIONS

Even though the results of this study are first approximations and rest on some bold assumptions, they should provide useful benchmarks for resource managers and encourage others to develop better estimates. Assumptions were made to develop plausible estimates and to provide an approximate economic value estimation for the various wetland outputs of Mud Lake. It is difficult to evaluate the wetland outputs of controlled areas. Mud Lake is managed primarily for flood control, which makes it extremely difficult to separate the reservoir contribution and the “wetland” contribution.

Although not all wetlands are the same, and the outputs may vary because of physical characteristics (i.e., landscape, vegetation, water depth), this study, and applied techniques, should assist other researchers in future wetland valuation studies. This research should also aid resource managers in making better decisions regarding reservoir drawdown schedules and the effects on habitat, fish, waterfowl, and water quality.

One implication of this study is that not all wetland functions always have positive outputs. Negative outputs need to be analyzed along with the positive outputs in order to find a comprehensive net social value.

This was a static valuation study. Changes in environmental factors, management decisions (e.g., flood control strategies, drainage, wildlife management), demographics, or societal values may affect the estimates of economic values of this area. The estimated economic values may also change if the total number of wetlands increases or decreases or if the quality of wetland resources changes. Additional wetland valuation studies are needed to provide a broader sample of locations, site specific characteristics, and wetland types to continue to zero in on the economic values of such resources and to develop better valuation methods.

Table 5. Approximate Annual Dollar Values for Mud Lake and Associated Wetlands[a]

Output	Values			
		Per Acre		
	Total	5,000 Acres[b]	1,000 Acres[c]	Percent
	------------------------Dollars--------------------------			
Beneficial Outputs:				
Flood Control	2,200,000	440	NA	92
Water Supply/Conservation	94,000	NA	94	4
Fish/Wildlife Habitat, Recreation, and Aesthetics				
Use Value	34,000	7	NA	1
Option Value	39,000	8	NA	2
Existence Value	29,000	6	NA	1
SUBTOTAL	2,396,000	461	94	100
All Other Outputs	Not Estimated			
Detrimental Outputs:				
Water Quality	-180,000		-180	
SUBTOTAL	2,216,000			
All Other Outputs	Not Estimated			
TOTAL	2,216,000 +/- the value of the other outputs			

[a] Point value estimates were rounded. Mid-points of estimated ranges were selected to represent the range.
[b] Acres of all wetlands in the Mud Lake area attributable to flood control, fish/wildlife habitat, recreation, and aesthetics.
[c] Acres in Mud Lake attributable to water supply and water quality.

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APPENDIX A

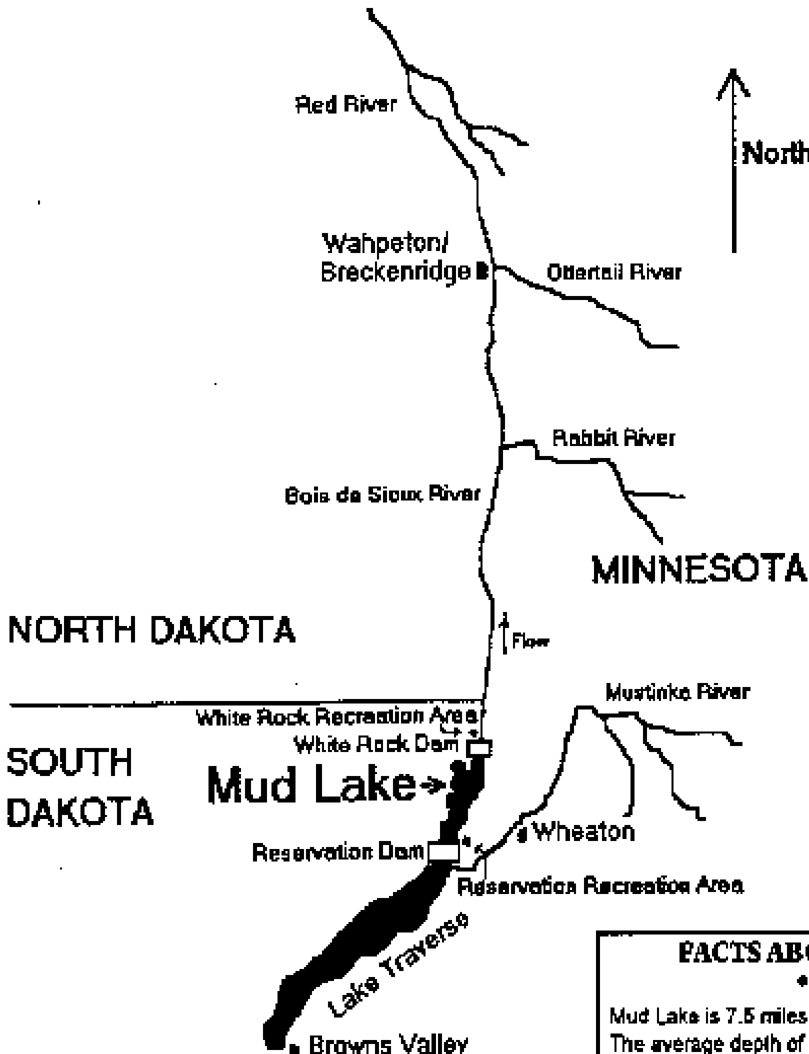
Survey

APPENDIX A. QUESTIONNAIRE REGARDING THE MUD LAKE RECREATION AND WILDLIFE HABITAT STUDY

SUMMER 1996

MUD LAKE RECREATION AND WILDLIFE HABITAT STUDY

The purpose of this study is to estimate the recreational and wildlife habitat values of Mud Lake (which is part of the Lake Traverse Project). The map below shows the location of Mud Lake and the surrounding area. The study area includes only Mud Lake's wetlands, White Rock Dam Recreational Area, and Reservation Dam Recreational Area.



FACTS ABOUT MUD LAKE

Mud Lake is 7.6 miles in length
The average depth of Mud Lake is 1.7 feet
Full pool capacity of Mud Lake is 65,000 acre ft.
Lake Traverse Project construction began in 1939
The project was put into operation in Dec. of 1941

Please answer the following questions for all persons living at your address.

1. Have you or other people in your household visited Mud Lake for recreational purposes within the past 12 months?

____ YES   ____ NO ➡ SKIP AHEAD TO QUESTION 2

IF YES, which recreational activities have you or other people in your household participated in within the last 12 months? (Please estimate the total number of days of participation for each activity for you and other household members.)

RECREATIONAL ACTIVITIES	TOTAL DAYS OF PARTICIPATION DURING THE PAST 12 MONTHS
FISHING (ICE OR OPEN WATER)	____ DAYS
WATERFOWL HUNTING	____ DAYS
UPLAND, BIG GAME, OR FURBEARER HUNTING	____ DAYS
TRAPPING	____ DAYS
SIGHTSEEING/PLEASURE DRIVING	____ DAYS
PICNICKING	____ DAYS
BICYCLING	____ DAYS
BOATING	____ DAYS
CANOEING	____ DAYS
HIKING, WALKING/JOGGING	____ DAYS
WILDLIFE OBSERVATION	____ DAYS
PHOTOGRAPHY (NATURE AND WILDLIFE)	____ DAYS
SNOWMOBILING	____ DAYS
OTHER (PLEASE LIST) ________________	____ DAYS
________________	____ DAYS

The next section is about the recreational and fish/wildlife habitat value of Mud Lake TO YOU. The details presented in this section DO NOT reflect any indication of a proposed management plan on behalf of the local, state, or federal governments.

2. The functions of the Lake Traverse Project, which includes the Mud Lake area, are flood control, water supply and storage, and preservation of fish and wildlife. If Mud Lake were managed **PRIMARILY FOR WATER-RELATED RECREATION AND FISH/WILDLIFE HABITAT**, what is the MAXIMUM amount you would be WILLING TO PAY through an annual use permit to participate in recreational activities at Mud Lake?

____ $0 (NOTHING) ➡ GO TO QUESTION 3

____ $1 TO $5 ANNUALLY
____ $6 TO $10 ANNUALLY
____ $11 TO $25 ANNUALLY
____ $26 TO $50 ANNUALLY
____ $51 OR MORE ANNUALLY

} SKIP AHEAD TO QUESTION 4 AND DO NOT ANSWER QUESTION 3

3. If you chose $0 (NOTHING) in Question 2, which statements best explain your answer. (Check as many that apply)

_____ I AM NOT FAMILIAR WITH THE MUD LAKE AREA

_____ MUD LAKE DOES NOT HAVE ANY VALUE TO ME

_____ I DO NOT CARE ABOUT MUD LAKE

_____ MUD LAKE IS TOO FAR FROM MY HOME

_____ OUT-OF-STATE HUNTING, FISHING, OR TRAPPING LICENSE REQUIREMENT

_____ MUD LAKE DOES NOT HAVE THE RECREATIONAL FACILITIES I NEED

_____ THERE ARE OTHER RECREATIONAL SITES THAT I PREFER TO VISIT. (PLEASE LIST ONE OR TWO SITES)_____

_____ OTHER REASONS (PLEASE LIST) _____

4. What is the MAXIMUM amount you would be WILLING TO PAY through an annual voluntary donation to ensure that recreational activities and fish/wildlife habitat at Mud Lake are available **IN THE FUTURE TO YOU OR YOUR DESCENDANTS**?

_____ $0 (NOTHING)

_____ $1 TO $5 ANNUALLY

_____ $6 TO $10 ANNUALLY

_____ $11 TO $25 ANNUALLY

_____ $26 TO $50 ANNUALLY

_____ $51 OR MORE ANNUALLY

5. What is the MAXIMUM amount you would be WILLING TO PAY through an annual voluntary donation to ensure that recreational activities and fish/wildlife habitat at Mud Lake are **AVAILABLE FOR OTHER PEOPLE**, even if you do NOT intend to visit the Mud Lake area?

_____ $0 (NOTHING)

_____ $1 TO $5 ANNUALLY

_____ $6 TO $10 ANNUALLY

_____ $11 TO $25 ANNUALLY

_____ $26 TO $50 ANNUALLY

_____ $51 OR MORE ANNUALLY

In the next section, we would like to find out some characteristics of our survey respondents.

6. Which best describes your home area?

_____ RURAL NONFARM

_____ FARM OR RANCH

_____ COMMUNITY UNDER 1,000

_____ CITY BETWEEN 1,001 AND 5,000

_____ CITY BETWEEN 5,001 AND 10,000

_____ CITY 10,001 AND OVER

PLEASE TURN PAGE →

7. How far is the one-way distance to Mud Lake from your home? ______ MILES

8. What is your gender? _____ MALE _____ FEMALE

9. What is your age? ______ YEARS

10. How many people, including yourself, live in your household? (Please circle)

1 2 3 4 5 6 7 8 9 10 OR MORE

11. What is the highest level of education completed by anyone living in your household? (Please check ONE answer)

_____ GRADE SCHOOL (1 TO 8 YEARS)
_____ HIGH SCHOOL (9 TO 12 YEARS)
_____ COLLEGE OR TRADE SCHOOL (13 TO 16 YEARS)
_____ GRADUATE OR PROFESSIONAL SCHOOL (MORE THAN 16 YEARS)

12. Please indicate the income category that best describes the total gross income from all sources (before taxes and deductions) by you and your family in 1995. (Check one category)

_____ LESS THAN $5,000
_____ $5,000 TO $9,999
_____ $10,000 TO $14,999
_____ $15,000 TO $24,999
_____ $25,000 TO $34,999
_____ $35,000 TO $49,999
_____ $50,000 TO $74,999
_____ $75,000 TO $99,999
_____ $100,000 OR MORE

Do you have any suggestions about the management of Mud Lake?

Please do not remove the address label. This will help us ensure that you will not receive another Mud Lake Recreational Survey in future mailings. Your responses will be kept confidential. You will not be identified personally in the results of our study.

Please return this questionnaire in the self-addressed, business reply envelope that is provided.