CDM

Kansas Water Office
U. S. Army Corps of Engineers
Kansas City District

Kansas Reservoir Assessment

March 23, 2011

Final Report

Kansas Reservoir Assessment

Final Report

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Acronyms

BVYC	Blue Valley Yacht Club
CADSWES	Center for Advanced Decision Support for Water Environmental Systems
CDM	CDM Federal Programs Corporation
cfs	cubic feet per second
GCCVB	Geary County Conventions and Visitors Bureau
IMPLAN	Impact Analysis for Planning
KDWP	Kansas Department of Wildlife and Parks
KSRA	Kansas Rowing Association
KSU	Kansas State University
KWO	Kansas Water Office
PAS	Planning Assistance to States
RCC	Reservoir Control Center
USACE	United States Army Corps of Engineers

Executive Summary

Introduction

Perry Lake, Milford Lake, and Tuttle Creek Lake were authorized by the Flood Control Acts of 1938 and 1944 and constructed by the U.S. Army Corps of Engineers (USACE). The current federally authorized uses for the lakes include flood control, navigation, water supply, water quality, recreation, fish, and wildlife. The USACE manages and operates the reservoirs. The State of Kansas and the Kansas River Water Assurance District own portions of the conservation pool in each of the reservoirs. The Kansas Water Office (KWO) administers the State's Water Marketing and Water Assurance Programs to help meet the water supply needs of municipalities and industries in Kansas.

Historically, it has been viewed by the KWO and the citizens of Kansas that navigation releases made from Perry Lake, Milford Lake, and Tuttle Creek Lake significantly impact recreation, water supply, and other reservoir uses with little benefit related to navigation on the Missouri River.

Typically, the three reservoirs are operated to maintain 1,000 cubic feet per second (cfs) minimum flow at the DeSoto gage for water quality purposes.[1] The additional 3,000 cfs flow for Missouri River navigation support translates to between six and seven tenths of a foot when the Missouri River is near the 41,000 cfs Kansas City navigation target.[2]

Through the Federal Planning Assistance to States (PAS) program, the USACE and the KWO have teamed together and retained CDM Federal Programs Corporation (CDM) to complete the Kansas Reservoir Assessment with the goal of providing documentation of the current uses of Perry Lake, Milford Lake, and Tuttle Creek Lake and estimating the value of recreation and water supply uses to the regions served by the reservoirs. In addition, the study describes the impacts to existing uses at the reservoirs due to releases made to support navigation on the Missouri River.

Economics Analysis

Recreation

The results of this study show that spending related to recreation use at Perry Lake, Milford Lake, and Tuttle Creek Lake is upwards of $45.3 million annually (Table ES-1).

[1] FINAL DRAFT Navigation Study: Milford, Tuttle Creek, Perry Lakes, USACE, July 13, 2009. 1
[2] USACE. 1

Table ES-1
Total Annual Visitor Spending, 2009 Dollars

Lake	Total Annual Visitor Spending, 2009 Dollars
Perry Lake	$15,812,579
Milford Lake	$17,127,546
Tuttle Creek Lake	$12,372,481
Total	$45,312,606

Approximately 80 to 90 percent of visitors to the lakes are from outside the region, where the region is defined as the county/counties the lake is in. Visitors from outside the region are especially important for the regional economy. In-region visitors that spend money for recreation at the lakes would likely spend their money, or a portion of it, elsewhere in the region. Out-of-region visitors bring new money into the region, which increases spending in the regional economy. Table ES-2 shows estimated spending for each lake by out-of-region visitors. Total annual out-of-region visitor spending contributes almost $38 million.

Table ES-2
Total Annual Visitor Spending by Out-of-Region Visitors, 2009 Dollars

Lake	Total Annual Visitor Spending by Out of Region Visitors, 2009 Dollars
Perry Lake	$12,650,062
Milford Lake	$15,414,792
Tuttle Creek Lake	$9,897,985
Total	$37,962,839

Water Supply

Water supply for municipal and industrial clients is another important use of the lakes. The value of water supply has been estimated at approximately $294 million for in-service water supply as shown in Table ES-3. This value reflects the avoided costs of constructing new reservoirs and estimated mitigation costs.

Table ES-3
Lake Construction, Mitigation, and Water Supply Costs

Lake	Construction Cost[1]	Construction Cost (2010 $)[2]	Mitigation Costs (2010 $)[3]	Total Costs (2010 $)	Water Supply		
					In Service Storage[4], ac-ft	Water Supply Costs	Cost per Acre-foot
Perry Lake	$48,371,706 (1966 $)	$419,442,978	$1,090,246,250	$1,509,689,228	32,739 (4.3%)	$64,916,637	$1,983
Milford Lake	$48,268,843 (1963 $)	$473,366,811	$1,027,581,175	$1,500,947,986	117,491 (10.3 %)	$154,597,643	$1,316
Tuttle Creek Lake	$80,051,031 (1957 $)	$976,976,395	$805,593,675	$1,782,570,070	99,068 (4.2%)	$74,867,943	$756
					Total	$294,382,223	

[1] Provided by USACE Kansas City District
[2] Approximated using ENR-CCI
[3] Estimated using USACE Kansas Stream Mitigation Guidance
[4] Acre-feet (percent of total storage volume)

Impacts from Navigation Releases

In addition to performing an economics analysis on existing recreation and water supply use, the study describes impacts to recreation, waterfowl habitat, and hunting uses, and in-service water supply storage due to navigation releases. The impacts that navigation releases have on these uses were estimated by analyzing the results of the USACE Final Draft Navigation Study, July 13, 2009 and the KWO OASIS modeling simulation. Both studies looked at base model operations (water quality only) and anticipated support levels of navigation. These model scenarios are described below:

Water Quality Only - This scenario represents historic flows and hydrologic conditions from January 1, 1950 through December 31, 2008. The base model run assumes that no navigation support was provided. This scenario is referred to as no navigation scenario.

Anticipated Support Level- The anticipated support level scenario is based on the level of navigation support that was required in 2008 by the Reservoir Control Center (RCC). This is the level of support that is expected to be required by the RCC in future years due to recent changes in navigation support required from the Missouri River upstream of Kansas City. This scenario assumes a 3 to 6 foot drawdown limit. This means that prior to October 1, the first 3 feet below conservation pool are used to support navigation. Between October 1 and the end of the navigation season (typically late November), up to 6 feet of the conservation pool can be used to support navigation. This operation procedure is similar to historic lake operations except no water is held in the flood pools anticipating a navigation requirement. This scenario is referred to as the navigation support scenario.

Recreation

The USACE study results were used to estimate impacts to open water recreation. To estimate how navigation releases change the frequency of low water elevations, the USACE provided daily lake elevations for both the no navigation and navigation support scenarios. Using threshold lake elevations identified for four lake conditions; high, normal, low, and very low, and quality of recreation ratings for each lake condition, the navigation study results were used to estimate the impact to the quality of recreation due to navigation releases.

Table ES-4 shows the lake condition, quality of recreation rating, and threshold elevation. The higher the quality of recreation rating, the higher the quality of recreation experienced. All lakes showed a decrease in the quality of recreation between normal and low lake conditions.

Table ES-4 also shows the average number of days that the lake is at or below the threshold elevation for the recreation season (April – September) and a full year. The difference columns in Table ES-4 report the difference between the number of days at or below the threshold elevation for the navigation support scenario and the number of days at or below the threshold elevation for the no navigation support scenario. A

positive number in the difference column indicates an increase in the number of days annually that the lake is at or below the threshold elevation. At low lake conditions, Table ES-4 shows that the quality of recreation is diminished an additional 3 days at Tuttle Creek Lake and 7 days at Milford and Perry Lakes during the recreation season due to navigation releases. A decrease in the quality of recreation associated with reduced water levels could reduce visitation and adversely affect the local economy.

Table ES-4
Navigation Releases Impacts to Quality of Recreation

Lake Condition	Quality of Rec Rating[1]	Elev (ft)	Recreation Season (Apr – Sep)[2]					Full Year[3]				
			No Navigation		Nav Support		Diff	No Navigation		Nav Support		Diff
			%	Days/yr	%	Days/yr	Days/yr	%	Days/yr	%	Days/yr	Days/yr
Perry Lake												
High	19	904	93%	170	93%	170	0	96%	350	96%	350	0
Normal	66	891.5	19%	35	23%	42	7	29%	106	41%	150	44
Low	56	888	2%	4	6%	11	7	2%	7	15%	55	48
Very Low	29	885	0%	0	4%	7	7	1%	4	6%	22	18
Milford Lake												
High	51	1150	86%	157	86%	157	0	92%	336	92%	336	0
Normal	69	1144.4	15%	27	20%	37	10	29%	106	41%	150	44
Low	62	1141.4	1%	2	5%	9	7	2%	7	15%	55	48
Very Low	40	1138.4	0%	0	1%	2	2	0%	0	3%	11	11
Tuttle Creek Lake												
High	34	1090	85%	156	85%	156	0	91%	332	91%	332	0
Normal	55	1075	7%	13	12%	22	9	27%	99	36%	131	32
Low	46	1072	1%	2	3%	5	3	2%	7	12%	44	37
Very Low	35	1069	0%	0	1%	2	2	0%	0	3%	11	11

[1] Quality of recreation rating based on interview with USACE lake manager.
[2] Recreation season is 183 days. Percentages represent the percent of simulated recreation season where lake level is at or below elevation. Days/yr is the average number of days per recreation season that the lake is at or below elevation.
[3] Full Year analyses include an entire year (January – December). Percentages represent the percent of simulation where lake level is at or below elevation. Days/yr is the average number of days per year that the lake is at or below elevation.

Wildlife Habitat and Hunting

The impact to wildlife habitat and hunting recreation was estimated in a similar manner as impacts to recreation. The 2010 Lake Level Management Plans, produced by the KWO for each of the lakes, outline recommended seasonal water surface elevations to support waterfowl habitat and hunter access. The daily water levels resulting from the USACE Navigation Study are used to estimate the ability of the no navigation and navigation support scenario to meet the recommended water levels to support wildlife and hunter access.

As shown in Table ES-5, navigation releases reduce the number of days that individual lake level management criteria for sustaining waterfowl habitat and hunter access are obtained by 18 days at Tuttle Creek Lake, 20 days at Milford Lake and 23 days at Perry Lake. This deviation from the established criteria is expected to

reduce the extent of waterfowl habitat and hunter access, thereby reducing visitor spending on activities such as hunting and sightseeing. In addition, the intrinsic value of providing natural habitat for waterfowl would be reduced.

Table ES-5
Navigation Releases Impacts to Waterfowl Habitat and Hunting

Lake	Average Annual Number of Days Meeting Waterfowl Habitat and Hunter Access Criteria[1]		Difference, days (Nav Support – No Nav)
	No Navigation	Nav Support	
Perry Lake	75	52	-23
Milford Lake	61	41	-20
Tuttle Creek Lake	51	33	-18

[1] Criteria for Perry Lake is elevation of 893.7 feet or greater from September 1 to January 15. Criteria for Milford Lake is elevation of 1146.7 feet or greater from September 1 to January 1. Criteria for Tuttle Creek Lake is elevation of 1079 feet or greater from September 1 to December 5.

Water Supply Storage

Results of the KWO OASIS model show that each in-service water supply volume is reduced in the lakes under the navigation support scenario. However, the in-service water supply volume is not fully depleted under any of the modeled scenarios which suggest that existing water supply demand can be met under both no navigation and navigation support scenarios.

Perry Lake and Milford Lake have a fraction of the total water supply storage that has been called into service by the KWO[3]. Of the water supply storage available at Perry Lake, 16.67 percent has been called in to service by the KWO. Milford Lake has allocated 33.88 percent of its water supply storage as in-service storage. If the in-service water supply storage is fully depleted, the State has the option to purchase the remaining future use water supply storage from the USACE to help meet their demands. As more water supply storage is placed into service, less water is available for navigation support. If 100 percent of the water supply is placed into service, no navigation releases will be made from the water supply storage in these lakes; however, navigation releases from the flood control storage may be possible.

In Tuttle Creek Lake, 100 percent of the water supply storage is in-service. Therefore, at this lake, there is no future use storage available for purchase if the existing in-service storage is not able to meet water supply demands.

In 2008, the USACE performed an analysis to determine the extent to which Milford, Perry, and Tuttle Creek Lakes supplied navigation support on the Missouri River from January 1969 until October 2007 while the lakes were below multipurpose pool elevation[4]. The results of the study indicated that over that time period (37.4 years) water was released from Perry Lake in support of navigation on the Missouri River

[3] Kansas Water Office Surplus Water Available in Water Marketing Program Lakes Calendar Year 2010, November 2009
[4] USACE Support of Missouri River navigation flows from Milford, Perry, and Tuttle Creek Lakes, April 15, 2008

while the pool elevation was below the multipurpose pool a total of 149 days. The number of days that releases were made at Milford Lake was 166 days, and for Tuttle Creek Lake 429 days.

The KWO OASIS simulation for the period of 1950 to 2008 (59 years) resulted in 1,737 days that navigation releases were made at Perry Lake, 1,748 days at Milford Lake and 1,748 days at Tuttle Creek Lake. The number of days where navigation releases were made in the OASIS model was much greater than the number of days where historical releases were made from the multipurpose pool. There are multiple reasons for this. One is because historically, a number of navigation releases have been made using the lower portion of the flood control pools and not from the multipurpose pools. In the past, the USACE has prudently operated the lower portion of each lake's flood control zone for navigation support when appropriate.

Also, the navigation demand assumed in the modeling was higher than actually experienced during the period from 1969 through 2007. The navigation demand is higher because of the changed operation for Missouri River navigation support that increases the demand on the Kansas River projects.

In addition to the 3/6 foot drawdown criteria for navigation releases, another protective measure that is built into reservoir operations to ensure uninterrupted provision of firm water supply yield is to allocate all inflow to in-service storage when it drops below 25 percent of its full volume.

Conclusions

Releases due to navigation impact quality of recreation and waterfowl habitat and hunting. Impacts to these uses translate to an economic loss for the State and the local economies. While the results of this study show that navigation releases do cause some impact to lake access for recreation purposes and the quality of recreation, the impacts to recreation may be considered temporary in some instances. For example, boat ramps can be extended to provide open water access for a wider range of lake levels, or marina slips can be converted to a movable system that allows for slips to extend out into the lake to provide access during low water. There is a cost associated with implementing these solutions which is not itemized in this report. The solutions could, however, make the lake more accessible and potentially reduce the loss of visitation due to poor lake access and potentially minimize economic losses as well.

To further describe the loss of visitation due to navigation releases, further definition of how water levels would affect visitation levels is needed. For example, if a boat ramp is unusable, visitors could either go to another boat ramp, choose not to boat, or choose not to visit the lake at all. These options would have varying direct effects on the regional economy. More data could be collected on visitors' behavior or reaction due to low or high water levels through a survey of users or detailed data on visitor use at boat ramps or other facilities affected by changes in water levels.

Analysis of impacts suggests that in some cases operations plans could be modified to mitigate effects observed. For example, reservoir release plans could stipulate that no

navigation releases are permissible several days in advance of and during scheduled high-profile recreation events at the reservoirs. Special events attract large numbers of recreationists and result in a greater benefit to the regional economy than weekends without special events scheduled. Additionally, reservoir release plans could similarly be modified to stipulate that no navigation releases are permissible during critical wildlife management periods.

The economic analysis focuses on direct impacts of recreation at Perry, Milford, and Tuttle Creek Lakes. Direct impacts, defined for this study as changes in spending for recreation activities at the lakes, result in indirect and induced impacts as recreation outfitters purchase input supplies and pay labor income to employees. Indirect and induced impacts also benefit the regional economy. The Impact Analysis for Planning (IMPLAN) model, developed by the Minnesota IMPLAN Group Inc. can be used to estimate indirect and induced economic impacts using the direct impacts identified in this study. IMPLAN can also be used to estimate direct, indirect, and induced effects to employment, measured by number of jobs, and value added, measured in annual dollars. Increased visitation could generate demand for additional employment and increase salaries.

The economic analysis conducted for this study measures the regional economic contribution that recreation at the lakes provide. The U.S. Water Resources Council Principles and Guidelines define recreation benefits to the nation as the willingness to pay for recreation activities. Visitors may be willing to pay more than the existing park fees, and food and supply costs for recreation. This unpaid value that visitors would be willing to pay is referred to as consumer surplus. Consumer surplus can be measured through various methods, including contingent valuation surveys or detailed travel cost models. Additional study could be conducted to estimate consumer surplus and the value to the nation of recreation, rather than the regional economic contributions estimated in this study.

In summary, potential for further study include:

- Collecting more data on visitor behavior or reaction due to low or high water levels through a user survey or facility (boat ramp, marina, etc.) use data.
- Using IMPLAN to estimate indirect and induced economic impacts using the direct impacts identified in this study.
- Estimating consumer surplus and the value to the nation of recreation at the study lakes.

Section 1
Introduction

1.1 Purpose and Objectives

Perry Lake, Milford Lake, and Tuttle Creek Lake were authorized by the Flood Control Acts of 1938 and 1944 and constructed by the U.S. Army Corps of Engineers (USACE). In addition to flood control, these reservoirs provide a variety of services including water supply, water quality, recreation, wildlife habitat, and navigation support on the Missouri River. The USACE manages and operates the reservoirs. The State of Kansas and the Kansas River Water Assurance District own portions of the conservation pool in each of the reservoirs. The Kansas Water Office (KWO) administers the State's Water Marketing and Water Assurance Programs to help meet the water supply needs of municipalities and industries in Kansas.

Historically, it is the opinion of the KWO and the citizens of Kansas that navigation releases made from Perry Lake, Milford Lake, and Tuttle Creek Lake significantly impact recreation, water supply, and other reservoir uses with little benefit related to navigation on the Missouri River.

Typically, the three reservoirs are operated to maintain 1,000 cubic feet per second (cfs) minimum flow at the DeSoto gage for water quality purposes.[1] The additional 3,000 cfs flow for Missouri River navigation support translates to between six and seven tenths of a foot when the Missouri River is near the 41,000 cfs Kansas City navigation target.[2]

Through the Federal Planning Assistance to States (PAS) program, the USACE and the KWO have teamed together and retained CDM Federal Programs Corporation (CDM) to complete the Kansas Reservoir Assessment with the goal of providing documentation of the current uses of Perry Lake, Milford Lake, and Tuttle Creek Lake and estimating the value of recreation and water supply uses to the regions served by the reservoirs. In addition, the study describes the impacts to existing uses at the reservoirs due to releases made to support navigation on the Missouri River. This document serves as the summary report for the Kansas Reservoir Assessment. Report organization is discussed below.

[1] FINAL DRAFT Navigation Study: Milford, Tuttle Creek, Perry Lakes, USACE, July 13, 2009. 1
[2] USACE. 1

1.2 Report Organization

The following sections are included in the report:

Section 2 Perry Lake – Section 2 summarizes the data collected to document existing uses and describe impacts to uses based on changes in water levels at Perry Lake. In addition, an economic analysis is performed to estimate visitor spending related to recreation at the lake and to estimate the value of water supply provided by existing lake storage.

Section 3 Milford Lake – Section 3 summarizes the data collected to document existing uses and describe impacts to uses based on changes in water levels at Milford Lake. In addition, estimates of visitor spending related to recreation and an estimation of the value of water supply storage provided by lake is presented.

Section 4 Tuttle Creek Lake – Section 4 summarizes the data collected to document existing uses and describe impacts to uses based on changes in water levels at Tuttle Creek Lake. In addition, estimates of visitor spending related to recreation and an estimation of the value of water supply storage provided by lake is presented.

Section 5 Impacts Analysis – Section 5 provides estimates of the impacts that navigation releases have on open water recreation, wildlife habitat and hunting, and water supply storage.

Section 6 Summary and Conclusions – Section 6 summarizes the results of the study and presents the conclusions. This section also provides recommendations for future study efforts.

Section 7 References – Section 7 lists references used in this study.

Section 2
Perry Lake

2.1 Background

Perry Lake is located in Jefferson County in northeast Kansas (Figure 2-1). Jefferson County is largely rural, but close to three major urban centers: Topeka and Lawrence, Kansas and the Kansas City, Missouri metropolitan area. In 2009, the county's population was 18,207, which is a slight decrease from the 2000 population of 18,426. The Jefferson County seat is Oskaloosa, which had a population of 1,165 in 2000 and 1,136 in 2009.

Figure 2-1
Perry Lake Location Map

Perry Lake was constructed from March 1964 to January 1969 with multipurpose objectives including flood control, water supply, recreation, navigation, and wildlife management. The initial cost of construction of the dam and reservoir was approximately $48.4 million (excluding costs of supplemental recreation development).[1] Since the lake's construction, flood damage prevention has been estimated at $5,426,109,000.[2]

The State of Kansas has under contract 196,394 acre-feet of the conservation pool in Perry Lake to be used for water supply purposes. Only a portion of this storage (32,739 acre-feet) has been called into service by the State.

Perry Lake[3]	
Drainage Area, square miles	1,117
Total Storage Volume, acre-feet	765,100
Conservation Pool Elevation, feet	891.5
Flood Pool Elevation, feet	920.6
Water Surface, acres	11,150
Shoreline, miles	160

Perry Lake and surrounding lands offer numerous recreation opportunities. There are five campgrounds located around the lake (Figure 2-2). The USACE maintains Rock Creek, Slough Creek, Longview, and Old Town campgrounds; and the Kansas Department of Wildlife and Parks (KDWP) maintain Perry State Park. Perry State Park has campground and cabin facilities.

The local economy benefits from recreation and visitor spending at Perry Lake. The Kansas Reservoir Assessment included the collecting and review of existing data to document lake uses and to estimate impacts to uses due to changes in lake water levels. The data collected was then used to perform an economic valuation of recreation activities and visitor spending. This section describes the data collection and economic valuation performed for Perry Lake. Section 5 discusses the impacts to existing uses due to changes in water levels.

2.2 Data Collection and Review

The data that was collected as part of this study included interviews of the lake operations manager and concessionaries, USACE estimated visitation data and usage breakdown, historical lake elevations, critical elevations for open water access points, and related economic studies on Perry Lake.

[1] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, August 27, 2010
[2] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, December 20, 2010
[3] Perry Lake Website – http://www.nwk.usace.army.mil/pe/WhoWeAre.cfm, accessed October 6, 2010.

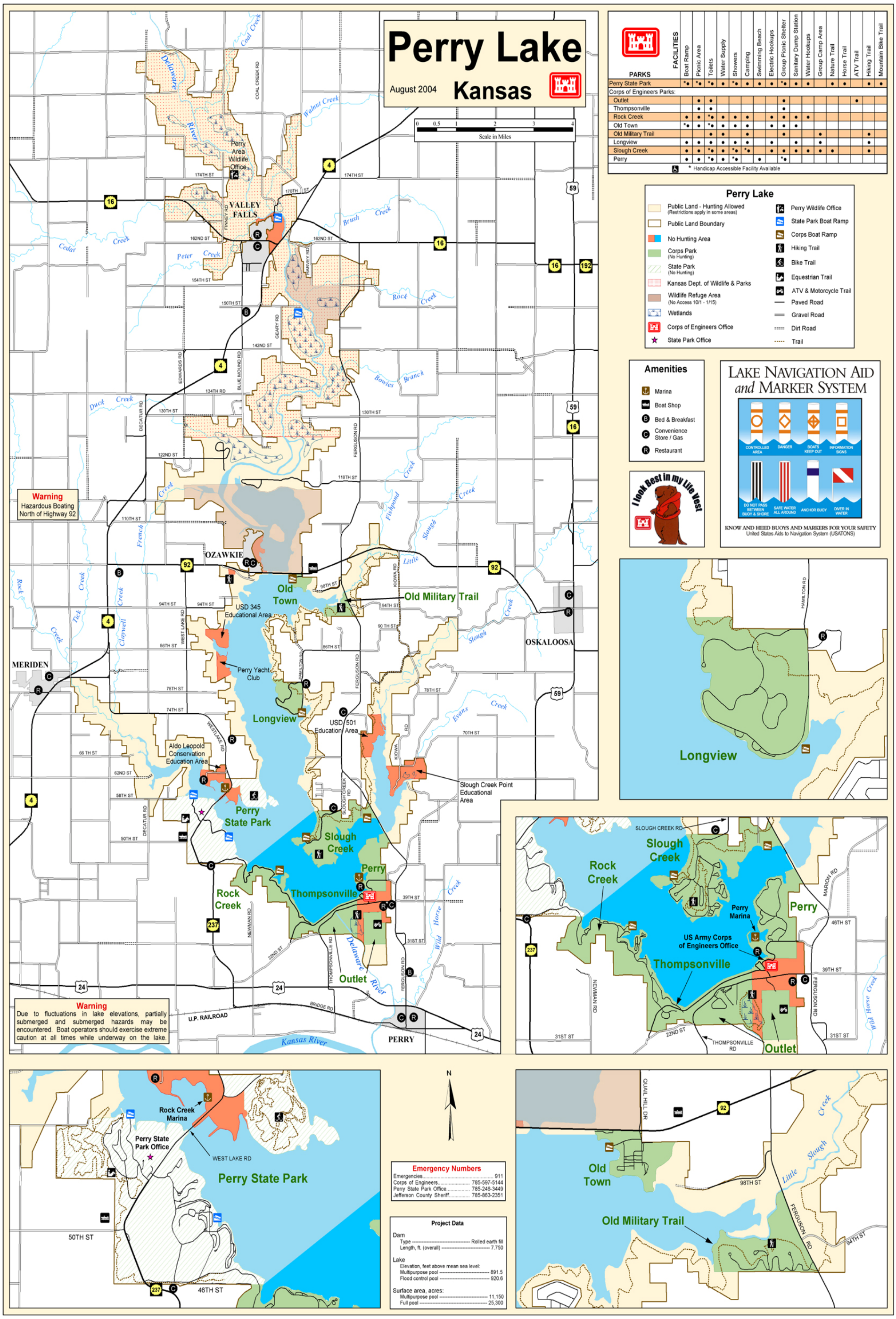

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Figure 2-2
Perry Lake Parks and Recreation Features

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2.2.1 Site Visit and Interviews

A site visit was conducted at Perry Lake to gather available information related to the study and to interview concessionaries and other lake stakeholders. The purpose of the interviews was to gather information on existing operations, and to determine critical threshold water surface elevations at which operations are significantly impacted. On March 24, 2010, CDM conducted a site visit to Perry Lake and interviewed the following individuals:

- USACE Perry Lake Project Office – Manager Mr. Ken Wade
- Perry Yacht Club – Representative Mr. Ron Finney
- Perry Marina – General Manager Mr. Bryan Best
- Perry Lake State Park – Park Ranger Ms. Michelle Campbell and Park Manager Mr. Larry Cadoret
- KDWP – Fishery Biologist Mr. Kirk Tjelmeland
- Rock Creek Marina – Owner Mr. Dennis Hewitt

2.2.1.1 USACE Perry Lake Project Office

Mr. Ken Wade is the lake operations manager at Perry Lake. Mr. Wade provided rate sheets for camping facilities and total number of campsites for each park.

To assist with estimating the impacts of water levels on existing uses, Mr. Wade completed a Quality of Recreation Use Survey for estimating the quality of recreation benefits at Perry Lake under several different water surface elevations. The survey is discussed in more detail in Section 2.2.6.

Mr. Wade was interviewed regarding potential impediments to operations at various water surface elevations. The conservation pool elevation at the lake is 891.5 feet. At 3.5 feet below conservation pool (888 feet), Mr. Wade stated that there is some impact to uses that are operated by the USACE. At 6.5 feet below the conservation pool (885 feet) during recreation season, there are adverse impacts to uses because of the now-visible submerged hazards. At water surface elevations above 900 feet, parts of the park are shut down due to flooding.

2.2.1.2 Perry Yacht Club

Mr. Ron Finney was interviewed as a representative of the Perry Yacht Club. The Perry Yacht Club is a private recreational boating club. The club leases land from the USACE and charges membership and slip rental fees. The club includes between 150 to 160 slips. Maintenance of the slips is primarily volunteer labor, with help hired for larger projects. Slip rental rates are based on total slip length and are $41 per foot per year with a minimum of $820 per year rental fee. Day sail membership fees are $500 per year for trailer and land stored boats.

Impacts to Perry Yacht Club operations during low water levels include loss of club membership, which has been estimated to be between 20 and 25 percent. High water levels require docks to be adjusted. Cables to docks are manually loosened and tightened as water levels shift and includes labor costs of one employee. In the high waters of 1992, usage of the club decreased. At 899 feet, the sidewalk near the club is underwater, and at 892 feet, the parking lot is under water. Elevations below 889 feet, deep draft boats hit cables and mud in shallower parts of the cove. Rapid lowering of water in the cold season has caused damage to docks.

2.2.1.3 Perry Marina

Mr. Bryan Best is the general manager for Perry Marina. Perry Marina rents a total of 435 slips and averaged between 92 and 95 percent occupancy over the last 10 years. The use charge for the boat ramp at Perry Marina is $3 per vehicle per day. The marina will serve approximately 100 cars a day on a holiday weekend.

Deviation in water levels greater than 2 feet from the conservation pool elevation (i.e. 891 +/- 2 feet) increase operations costs significantly. Pirate's cove slips (76 slips) are unusable during low water levels as they sit in a shallow area of the cove. During 2002, the water levels in Perry Lake were low and approximately 35 slips were unusable. There is an increase in reported lower unit damage on vessels during low water levels. At Perry Marina, docks can be moved in and out to reach open water areas as water levels fluctuate. Moving all docks requires five to six men for five days of labor. Low water levels also reduce the ability to rent end slips (8 to 10 total) and can cause losses of revenue from reduced grocery sales estimated at $30,000 per month.

At high water levels, the marina sustains more structural damage than at low water levels. At elevation 900 feet, the marina parking lot is flooded. Boat ramps start to close down when water levels reach between 898 feet and 899 feet. At these water surface elevations, the public does not use the marina even though emergency access ramps are provided. Additional labor is required to ferry people to their boats under high water levels. At high water levels, when the marina breakwater is underwater, increased wave action results in increased structural damages to vessels. Clean up is required after high water subsides. The estimated loss of revenue for high water events is $40,000 to $45,000 per event.

2.2.1.4 Perry Lake State Park

Mr. Larry Cadoret is the park manager and Ms. Michelle Campbell is the park ranger at Perry Lake State Park. The Perry Lake State Park provides camping facilities with 110 sites with utility hookups and over 200 primitive camping sites.[4] The park also includes picnic areas, hiking and horseback riding trails, and four cabins. There is a charge per vehicle to enter the park and annual permits can be purchased.

[4] Perry Lake State Park website, http://www.kdwp.state.ks.us/news/State-Parks/Locations/Perry , accessed October 12, 2010

The park manager was asked to describe the impact of water levels on park use and operations. At elevation, 896.5 feet one boat ramp is taken out of the water and at elevation 897.5 feet both ramps are taken out. When the water surface elevation is between 899.5 and 900.5 feet, approximately 50 percent of the primitive campgrounds are underwater. The occupancy rate of the 110 utility camping sites is not dependent upon water levels. After high water events, park staff is often required to remove debris, replant grass, and resurface roads with gravel. The *2009 Annual Report* for Perry Lake was received along with estimate of 2007 flood damages and repairs. The estimated 2007 flood damages were $28,700.

The State park staff stated that no effect on visitation has been estimated under low water conditions. They have noticed that open water recreation has been impacted and boat traffic on the lake decreases with low water levels. At elevation 882.5 feet, two of the four boat ramp lanes do not reach the open water and are not used. This requires that visitors wait in line longer than usual to put their boats in the water.

2.2.1.5 KDWP Fishery

Kirk Tjelmeland is the fisheries biologist at Perry Lake State Park. Mr. Tjelmeland was interviewed to gain information on how lake water levels impact fish populations and fishing recreation. Mr. Tjelmeland stated that seasonal timing of water level fluctuations is key for maintaining healthy fish populations. A spring rise in water levels (ideally 4 feet fluctuation) at Perry Lake gives flood cover for fish (white bass and crappy), assisting in spawning. If the spring rise does not occur, fish spawning is hindered and a decrease in fish populations is noticed approximately two to three years later. When water is released from the lake, fish take a couple days to adjust to the new environment and catches are lower during this time.

2.2.1.6 Rock Creek Marina

Mr. Dennis Hewitt is the owner of Rock Creek Marina. Rock Creek Marina has a total of 407 slips that are available for rent. Approximately 70 percent of the visitors to the marina are engaged in pleasure boating and 30 percent are fishing.

Mr. Hewitt was interviewed to gather information on how lake levels impact the use of the marina and its operations. When the water level is at elevation 893.5 feet, the lake looks healthier and people like to use it. At very high levels, fewer people will use the lake. The breakwater in front of the marina breaches with high water approximately once a year. This causes an increase in wave action and damage to vessels. Logs and debris can also be seen floating in high water.

The marina does not have the capability to move docks in and out as water levels change. This is because the docks are on a stationary spud system. At elevation 889.5 feet, the marina moves boats from slips to avoid damage from low water levels. When the lake drops to an elevation of 886 feet, there is an estimated 25 to 45 percent loss of business at Rock Creek Marina. Low water levels in fall and winter do not impact visitation significantly. During low water in 2000 and 2001, visitation dropped because people were scared of boating in the lake with underwater hazards exposed. Drawdown of water levels in winter months can cause damage to infrastructure by ice.

2.2.2 Visitation Data

Table 2-1 shows annual and average visitation at Perry Lake from 2001 to 2009. Visitation varies seasonally and is typically higher during the spring and summer. Based on zip code data at campgrounds provided by KDWP, approximately 20 percent of visitors are from within the county and 80 percent originate from outside Jefferson County, including other counties within Kansas and other states. Visitation at Perry Lake has fluctuated from a low of about 384,000 in 2005 to a high of about 809,000 in 2002. Visitation increased in 2008 and 2009, and was close to 2002 levels.

Table 2-1
Annual Visitation at Perry Lake

Year	Visitors
2001	668,067
2002	809,282
2003	738,704
2004	403,146
2005	384,368
2006	768,637
2007	698,095
2008	805,725
2009	807,205
Average	**675,914**

Source: USACE Operations and Maintenance Business Information Link 2010

The USACE maintains data for monthly visitation by activity. Activities vary by season. Boating and water contact sports decrease during the winter months resulting in hunting and fishing being a larger percentage of total recreation during the these months. The peak recreation season is generally defined as April 1 through September 30. Table 2-2 summarizes average visitation by activity and percentages for the peak and off-peak recreation seasons at Perry Lake. Boating and fishing are the main activities during the peak season months. Fishing and sightseeing are the main activities during the off-peak season months. Hunting is also popular during the off-peak season.

2.2.3 Historical Lake Elevations

Historical lake elevations provided by the USACE are shown in Figure 2-3. Lake levels fluctuate throughout the year and from year to year. The historical lake elevations are compared with visitation estimates in Section 6.

Table 2-2
Visitation Estimates by Recreation Activity at Perry Lake

	April - September		October-March	
	Number of Visitors	Percent of Total Visitors	Number of Visitors	Percent of Total Visitors
Camping	28,051	6.2%	8,016	3.6%
Picnicking	22,317	5.0%	11,133	4.9%
Boating	100,709	22.3%	23,170	10.3%
Fishing	110,463	24.5%	61,260	27.2%
Hunting	17,248	3.8%	31,590	14.0%
Water Skiing	24,263	5.4%	-	0.0%
Swimming	24,595	5.5%	-	0.0%
Other	47,783	10.6%	36,070	16.0%
Sightseeing	75,350	16.7%	49,541	22.0%
Winter Activities	-	0.0%	4,357	1.9%
Total	450,778	100.0%	225,136	100.0%

Source: USACE 2010 (email from David White, dated June 14, 2010)

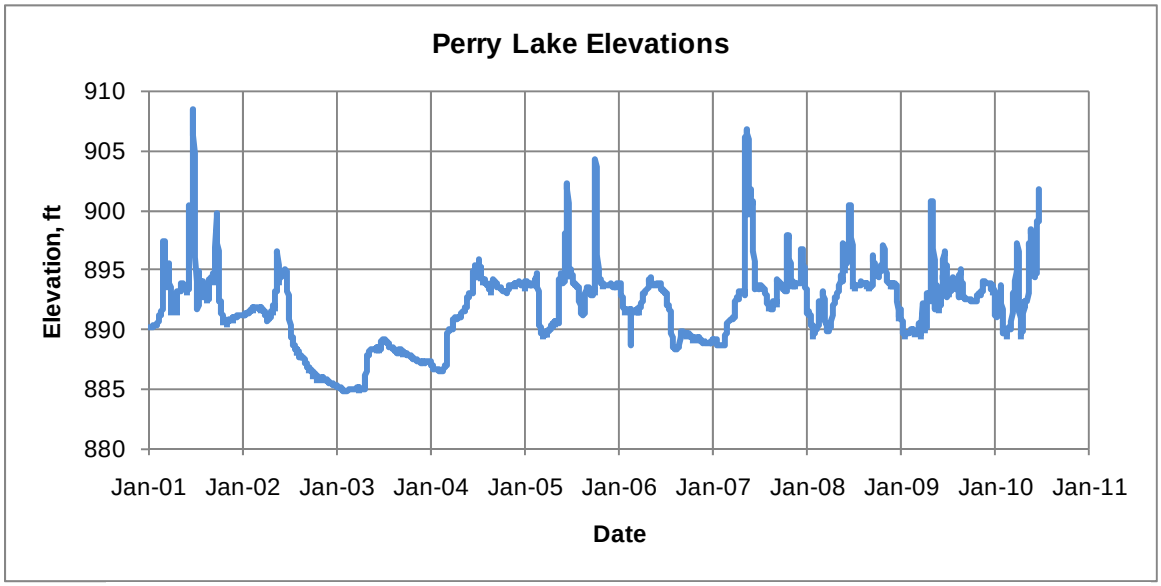

Figure 2-3
Historical Elevations of Perry Lake

2.2.4 Critical Elevations

Several critical elevations were identified for Perry Lake. Critical elevations are elevation at which facilities become unusable due to either high or low water levels. The critical elevations for Perry Lake are shown in Table 2-3. These elevations are used in Section 5 to determine how lake accessibility is impacted as a result of releases for navigation support.

Table 2-3
Perry Lake Critical Elevations

Ramp/Location	Elevation (feet)
Boat Ramp and Privy, Slough Creek Bridge	840
Longview Boat Ramp	870.5
Devils Gap Boat Ramp / Peninsula Point Privy	872
Old Town Boat Ramp	880
Perry Yacht Club Cove Low Water Threshold	889
Perry Yacht Club Parking	892
North Boat Ramp, State Park	897
South Boat Ramp, State Park	898
Entrance, Perry Boat Ramp	899
Perry Yacht Club Sidewalk	899
C Loop Road at Rock Creek Park	900
Portions of Old Town Campground	900
Privy Old Town Camp Retrieval Elevation	900
Rock Creek Sail Harbor Parking Lot	900
Parking Lot Perry Marina	901
Road to Limestone Cove and Hickory Ridge	902
East Entrance Perry Marina	903
Lift Station Rock Creek Marina	903
South Entrance Rock Creek Park	903
North Entrance, Rock Creek Park	904
South Entrance Perry Beach and Marina	905
Old Town Toilet Boat Ramp	906
Breakwater, Perry Marina	907
Rock Creek Marina Breakwater	911

2.2.5 Previous Studies

The USACE estimates Value to the Nation of USACE facilities. National spending profiles are used to estimate daily visitor spending. In 2006, the USACE estimated the direct regional economic impact to output of recreation spending at Perry Lake to be about $20.2 million and the indirect effect to be about $20.9 million. [5] Indirect effects were calculated using the Impact Analysis for Planning (IMPLAN) model, developed by the Minnesota IMPLAN Group Inc.

[5] Direct effects represent changes in final demand; indirect effects include both indirect and induced impacts. Indirect impacts are changes in expenditures within the region in industries supplying goods and services and induced effects are changes in expenditures of household income. Output represents the value of production of goods and services by businesses in the regional economy.

2.2.6 Quality of Recreation Use Survey

Mr. Wade, the USACE Perry Lake manager was asked to perform a quality of recreation use survey for four lake conditions:

- The lake at **normal** pool levels – i.e. the elevation where the lake normally operates.
- The lake at **low** levels – i.e. the elevation where visitors begin to complain that the water levels are too low for good recreation.
- The lake at **very low** levels – i.e. the elevation where the lake is at or approaching the lower limit of the conservation pool.
- The lake at **high** levels – i.e. the elevation where visitors begin to complain that water levels are too high for good recreation.

Elevations were chosen to represent the threshold pool elevations for each of the lake conditions above. Table 2-4 shows these elevations.

Table 2-4
Threshold Pool Elevations for Perry Lake

Lake Condition	Elevation, feet
High Pool	904
Normal Pool	891.5
Low Pool	888
Very Low Pool	885

The quality of recreation use rating was based on five criteria:

- Recreational experiences available
- Availability of alternative comparable facilities
- Carrying capacity
- Accessibility
- Environmental/aesthetic quality

Each criterion has five sub-categories that have point values that can be assigned. Figure 2-4 shows each criterion and corresponding judgment factors.

In evaluating the criterion, Mr. Wade first made a judgment of which sub-category best represents the situation at the lake, and then picked an appropriate point value within the range of points available. This procedure generally follows the instructions of the USACE Economics Guidance Memorandum 09-03 for computing unit day values for recreation.

Criteria	Judgment factors					Points
1. Recreation experience Total points possible: 30	Two general activities[1] 0 – 4 pts.	Several general activities 5 – 10 pts.	Several general activities; one high quality value activity[2] 11 – 16 pts.	Several general activities; more than one high quality value activity 17 – 23 pts.	Numerous high quality value activities; some general activities 24 – 30 pts.	
2. Availability of other comparable facilities Total points possible: 18	Several within 1 hour travel time; a few within 30 minute travel time 0 – 3 pts.	Several within 1 hour travel time; none within 30 minute travel time 4 – 6 pts.	One or two within 1 hour travel time; none within 45 minute travel time 7 – 10 pts.	None within 1 hour travel time 11 – 14 pts.	None within 2 hour travel time 15 – 18 pts.	
3. Carrying capacity (facility ability to meet demands Total points possible: 14	Minimum facility development for health and public safety 0 – 2 pts.	Basic facility to conduct activities 3- 5 pts.	Adequate facilities to conduct without deterioration of the resource or the activity experience 6 – 8 pts.	Facilities provide better than average ability to meet demands at site 9 – 11 pts.	Facilities provide ultimate ability to meet demands at site 12 – 14 pts.	
4. Accessibility (to site and within site) Total points possible: 18	Limited access to site or within site 0 – 3 pts.	Fair access, poor quality roads to site; limited access within site 4 – 6 pts.	Fair access, fair quality roads to site; fair – good access within site 7 - 10 pts.	Good access, good quality roads to site; fair – good access within site 11 - 14 pts.	Good access, high standard roads to site; good access within site 15 - 18 pts.	
5. Environmental/ Aesthetic Quality Factors[3] Total points possible: 20	Low aesthetic factors that significantly lower quality 0 – 2 pts.	Average aesthetic quality factors that lower quality to a minor degree 3 – 6 pts.	Above average aesthetic quality factors 7 - 10 pts.	High aesthetic quality factors 11 – 15 pts.	Outstanding aesthetic quality factors 16 – 20 pts.	
					Total Points Assigned:	

Additional points to note in rating:

[1] General activities are those that are common to the region.
[2] High quality value activities are those that are uncommon to the region, and/or which are of unusually high quality.
[3] Factors to consider include toporgraphy, water quality, vegetation, pests, climate, adjacent areas.

Figure 2-4
Quality Of Recreation Survey Criterion Judgment Factors

The results of the quality of recreation survey are presented in Figure 2-5. The survey shows a clear reduction in the quality of recreation for both high (blue column) and low (yellow column) and very low (purple column) water levels, with high water levels causing the largest relative reduction in quality of recreation compared to what is experienced at normal pool elevations (black column).

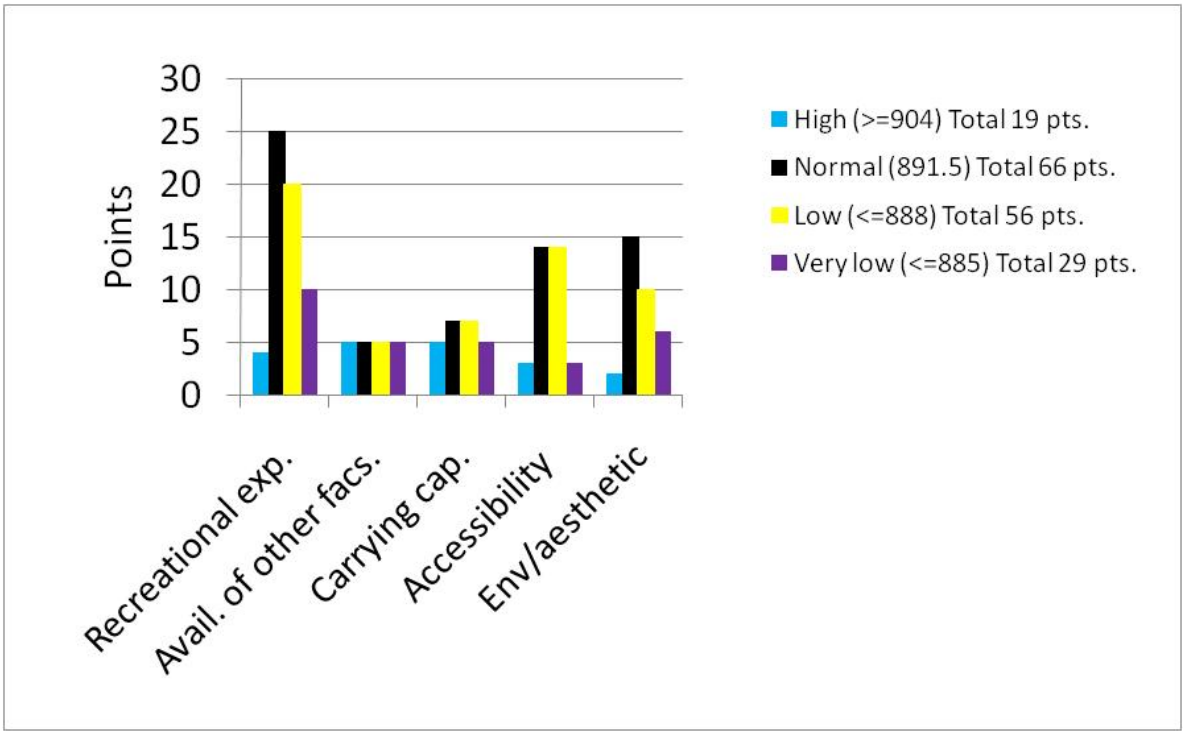

Figure 2-5
Quality of Recreation Survey Results for Perry Lake

2.3 Economic Evaluation

The economic evaluation for Perry Lake was performed to estimate contributions to the regional economy from recreation and water supply benefits. The sections below give a brief overview of the regional economy and are followed by the valuation of recreation and water supply benefits.

2.3.1 Regional Economy

The regional boundary for Perry Lake is defined as Jefferson County. Perry Lake dam and facilities associated with recreation at the lake are in Jefferson County. A summary of the regional economy is presented below.

2.3.1.1 Household and Personal Income

Table 2-5 shows household income characteristics in Jefferson County from the 2000 U.S. Census. In 1999, 1,219 individuals, about 6.7 percent, lived below the poverty level.

Table 2-5
1999 Household[1] Income in Jefferson County

Income Range	Number	Percent
Less than $10,000	475	6.9
$10,000 to $14,999	388	5.7
$15,000 to $24,999	752	11
$25,000 to $34,999	790	11.5
$35,000 to $49,999	1,520	22.2
$50,000 to $74,999	1,760	25.7
$75,000 to $99,999	739	10.8
$100,000 to $149,999	294	4.3
$150,000 to $199,999	53	0.8
$200,000 or more	71	1
Median household income (dollars)	45,535	

[1] Total number of households is 6,842
Source: US Census Bureau 2000, accessed 2010
http://factfinder.census.gov/servlet/QTTable?_bm=y&-gr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-_lang=en&-_sse=on&-geo_id=05000US20087

In 2008, Jefferson County had a total personal income of $584.2 million. The per capita personal income was $31,907, which ranked 78th in the State and was 82 percent of the State average of $38,886. The 2008 per capita personal income reflected an increase of 5 percent from 2007. In 1998, the per capita personal income of Jefferson County was $21,539 and ranked 66 th in the State. The 1998 to 2008 average annual growth rate was 4 percent. Jefferson County has been growing similar to the average State growth rate of 4.1 percent.

2.3.1.2 Industry and Employment

Table 2-6 shows industry earnings and employment in Jefferson County in 2008. The industries with the highest earnings and employment were construction and government and government enterprises. Retail trade employed 381 people and earned about $6.2 million in 2008. Accommodation and food services employed 160 people and earned about $1.9 million.

Table 2-7 shows the number of establishments by industry and sales in Jefferson County, provided by the 2007 Economic Census. Retail trade had the most establishments and highest sales in the county.

2.3.1.3 Sales Tax

The Kansas retailers' sales and use taxes is a combination of the State rate of 6.3 percent, effective October 2010, plus any local tax percentage levied by a county or a city. Jefferson County imposes a local sales tax of 1 percent, resulting in a total of 7.3 percent sales tax in the county.

Local tax distributions are disbursed to cities, counties, and other local governments by the State. The Kansas Department of Revenue is responsible for the correct allocation of the funds. The amounts are based on the local share of retail sales and use taxes collected. Table 2-8 show State sales tax collected from Jefferson County and local tax distribution to the county.

Table 2-6
2008 Industry Earnings and Employment Estimates in Jefferson County

Industry	Industry Earnings (1,000 $)	Employment (number of employees)
Forestry, fishing, and related activities	(D)	(D)
Mining	(D)	(D)
Utilities	(D)	(D)
Construction	$44,976	946
Manufacturing	$10,453	265
Wholesale trade	(D)	(D)
Retail trade	$6,217	381
Transportation and warehousing	$2,685	99
Information	(D)	(D)
Finance and insurance	$5,309	194
Real estate, rental, and leasing	(D)	(D)
Professional, scientific, and technical services	$3,132	169
Management of companies and enterprises	0	0
Administrative and waste services	$2,290	207
Educational services	(D)	(D)
Health care and social assistance	(D)	(D)
Arts, entertainment, and recreation	$2,279	150
Accommodation and food services	$1,861	160
Other services, except public administration	$13,761	430
Government and government enterprises	$50,434	1286
Total	$178,612	6,354

(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
Source: Bureau of Economic Analysis (BEA) 2010 http://www.bea.gov/regional/reis/action.cfm

2.3.2 Recreation

Recreation at Perry Lake contributes to Jefferson County's local economy. Visitors from outside Jefferson County travel to Perry Lake for recreation activities, including hiking, swimming, boating, camping, hunting, fishing, and picnicking. Perry Lake has multiple facilities, including campgrounds, cabins, trails, marinas, picnic rentals, and boat rentals. Visitor spending at these facilities and other businesses, such as local food stores, fuel stations, and equipment stores, helps support the economy. Multiple industries benefit from recreation expenditures, including, but not limited to retail trade, arts, entertainment, recreation, accommodation and food services, and other services.

Table 2-7
Industry Establishments and Sales in Jefferson County, 2007

Industry description	Number of employer establishments	Employer sales, shipments, receipts, revenue, or business done ($1,000)	Number of nonemployer establishments[1]	Nonemployer sales, shipments, receipts, revenue, or business done ($1,000)
Retail trade	58	71,260	170	4,341
Information	3	N	11	205
Real estate, rental, and leasing	9	D	79	3,070
Professional, scientific, and technical services	22	4,859	131	3,285
Administrative and Support, Waste Management, and Remediation Services	19	D	138	1,786
Educational services	3	D	16	222
Health care and social assistance	27	14,861	84	1,393
Arts, entertainment, and recreation	7	D	50	628
Accommodation and food services	22	4,409	17	483
Other services (except public administration)	27	6,381	191	3,899

[1] A nonemployer establishment is a business that does not have any paid employees
D: Withheld to avoid disclosing data for individual companies
N: Not available or not comparable
Source: U.S. Bureau of the Census, 2007 Economic Census, accessed 2010

Table 2-8
Jefferson County Sales Tax State Collection and Local Distribution, 2005 through 2009

Year	State Sales Tax Collections	Local Sales Tax Distribution
2005	$4,199,747	$954,799
2006	$4,259,010	$983,105
2007	$4,225,046	$956,171
2008	$4,311,858	$1,009,699
2009	$3,961,850	$999,208

Source: Kansas Department of Revenue
http://www.ksrevenue.org/salesreports.htm

2.3.2.1 Perry Lake Park Fees

KDWP charges fees for use of park facilities. Facility fees are often higher during the peak season than the off peak season. Day visitors at Perry Lake can pay various fees depending on the activity. Vehicle fees are $5 per car at the USACE campgrounds and $3.70 and $4.20 during fall and summer, respectively, at Perry State Park. Picnic

rentals are $20.00 per day at Dedication Point, Swimming Beach, Longview, and Old Town Shelters; and $30.00 per day at Rock Creek Shelter. Trail use fees are $3.50 per person.

Campground fees vary slightly among campgrounds. Table 2-9 summarizes the primary fees for each campground. Other fees apply for utility hookups, second vehicles, overflow camping, etc. Perry State Park also has four cabins with fees of $65 per night on peak season weekends, $55 per night on peak season weekdays and off season weekends, and $45 per night on off season weekdays. Overnight visitors would also need to pay vehicle fees.

Table 2-9
Perry Lake Camping Fees

Park	Fee $/night	
Rock Creek Park		
Non Electric	$12	
Electric (50-amp)	$18	
Electric (30-amp)	$17	
Old Town Park		
Non Electric	$12	
Electric	$16	
Longview Park		
Non Electric	$12	
Electric	$16	
Group	$30	
Slough Creek Park		
Non Electric	$12	
Electric (50-amp)	$18	
Electric (30-amp)	$17	
Electric	$16	
Group	$30	
Perry State Park		
	4/1 - 9/30	10/1 - 3/31
Daily Permit	$ 8.50	$ 7.50

Perry Lake's marinas charge for annual slip rentals, boat rentals, and use of boat launches. Slip rental rates vary based on the size, type of boat (power boat or sail boat), and if the slip is covered or not. The Main Marina has 435 slips. Slip rental rates for power boats range from $1,500 per year for a 20-foot by 10- foot uncovered slip to $4,505 per year for a 52-foot by 16-foot covered slip. The average rental rate at Main Marina is $2,248 per year. Based on the average rate and full occupancy, the marina receives annual fees from slip rentals of about $978,000 per season.

Rock Creek Marina has 407 slips. Slip rental rates for power boats range from $1,350 per year for a 20-foot uncovered slip to $5,202 per year for a 55-foot covered slip. The average rental rate at Rock Creek Marina is $1,319 per year. Boats can also be stored at Pirates Cove for similar rates. Pirates Cove has 76 slips. The average rental rate at Pirates Cove is $2,678 per year. Based on the average rates and full occupancy, the Rock Creek Marina receives annual fees from slip rentals of about $537,000 per season and Pirates Cove receives annual fees of about $203,500 per season.

Boat rentals vary based on the size and type of boat. Daily rental rates are $130 to $160 for fishing boats, $445 for party cats, $375 for a pontoon, and $365 for a ski boat. There are also half day rental rates. Daily boat launch fees are $3 per boat and annual fees are $30 per boat.

Hunting and fishing licenses are distributed by the State. Hunting licenses are $20.50 per year for residents and $42.50 per year for non-residents. Fishing licenses are $20.50 per year for residents and $72.50 per year for non-residents. Hunting and fishing visitors would also need to pay vehicle fees.

2.3.2.2 Visitor Spending by Activity

Visitors spend money on park fees, fuel, food, equipment, and other expenses related to recreation. Spending varies by recreation activity. Camping and overnight stays are typically more expensive than day trips and boating is more expensive than non-boating activities. This analysis estimates daily spending per person by activity at Perry Lake. Local data on campground fees, vehicle fees, boat, equipment, and cabin rentals described above are incorporated into park fees. The USACE has developed national spending profiles to estimate average visitor spending related to grocery, restaurant, fuel, and equipment purchases. Data from the spending profiles are added to local fees to estimate total daily spending by visitor. Appendix A provides background information to support daily spending estimates at Perry Lake.

Table 2-10 summarizes estimated daily visitor spending by activity at Perry Lake. The spending values reflect daily visitor spending within Jefferson County. The park fees reflect average daily local fees associated with each activity, including applicable vehicle, trail use, picnicking, boat launch, boat rentals, camping, and cabin fees. The fees for the remainder of spending categories are from the USACE spending profiles. Sporting goods and boat equipment rental fees for day use (no boat) were removed because fees are reflected in park fees.

2.3.2.3 Total Visitor Spending

Total visitor spending is estimated using recreation visitation data by activity (Section 2.2.2) and the daily spending profiles identified in Table 2-10. Total visitor spending reflects expenditures for all recreation-related activities in Jefferson County, including park fees at Perry Lake and additional spending at food stores, fuel stations, and other businesses in the county. Table 2-11 shows visitor spending during the peak and off-peak seasons and total annual spending. Approximately 69 percent of total spending occurs April through September. Table 2-11 shows that direct spending by visitors to Perry Lake contributes $15.8 million to the Jefferson County economy on an annual basis.

Table 2-10
Average Daily Spending per Person by Activity ($ per visit), 2009 dollars

Spending Category	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Day Use Including Boat Rental	Camping (with boat)	Camping (no boat)	Cabin Rental
Park fees	$2.49	$4.63	$1.49	$50.57	$33.32	$25.36	$60.97
Restaurants, bars, etc.	$3.03	$3.77	$3.77	$3.03	$9.09	$10.43	$10.43
Groceries and takeout food	$4.98	$4.98	$4.98	$4.98	$23.18	$18.88	$18.88
Gas and oil	$7.91	$3.13	$3.13	$7.91	$14.33	$9.89	$8.40
Sporting goods and boat equipment	$3.52	$0.00	$0.98	$3.52	$5.41	$1.71	$2.69
Other expenses	$0.57	$1.51	$1.51	$0.57	$3.80	$6.75	$1.92
Total	**$22.49**	**$18.02**	**$15.86**	**$70.57**	**$89.13**	**$73.01**	**$103.28**

Assumptions:
1. Average of 3 people per party for day and overnight use, based on USACE spending profiles
2. Average of 4 nights for overnight use, based on USACE spending profiles
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities
5. Day use and camping (no boat) park fees include average cost of trail use, picnic rentals, and vehicle fees
6. Day use hunting park fees include vehicle fees and no equipment rental fees
7. Cabin rental park fees includes average cost of car rental and vehicle fees
8. USACE daily spending profiles were adjusted from 1999 to 2009 dollars (USACE profiles used for all categories but park fees)
9. Sporting goods and boat equipment for day use (no boat) reflected in park fees

Table 2-11
Total Annual Visitor Spending for Perry Lake Recreation, 2009 Dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$5,294,972	$3,064,719	$273,596	$1,216,937	$996,876	$76,944	$10,924,045
October – March	$1,898,846	$1,822,137	$501,104	$324,050	$265,452	$76,944	$4,888,534
Total	$7,193,818	$4,886,856	$774,700	$1,540,987	$1,262,328	$153,888	$15,812,579

Assumptions:
1. One half of campers boat
2. Full occupancy at cabins year round, based on site data collection and interviews
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities

2.3.2.4 Annual Revenues

Recreation at Perry Lake also generates some annual revenues. The county benefits from annual marina revenues collected for slip rentals. Perry Lake marina operators indicated the marinas were at full capacity year round. Estimated annual slip rental revenues at Perry Lake marinas is about $1.7 million. The State collects hunting and fishing license revenues. Table 2-12 summarizes license fees for residents and non-residents, which were calculated, based on annual license fees and average annual visitation estimates for hunting and fishing activities. It is assumed that 85 percent of visitors are from within the State and 15 percent are non-residents.

Table 2-12
Annual License Revenues Paid to State from Hunting and Fishing at Perry Lake

Hunting		Fishing		Total
Resident	Non-Resident	Resident	Non-Resident	
$850,994	$531,108	$2,992,276	$1,094,735	$5,469,113

2.3.2.5 Indirect Economic Benefits

The values reported in Sections 2.3.2.3 and 2.3.2.4 represent direct effects of recreation at Perry Lake. There is a multiplier effect that generates additional spending in the economy as a result of the direct effect. For example, money spent for food at a local grocery store is used to purchase supplies from wholesalers and pay for employee labor. Wholesalers then spend money for production inputs and employees spend income on other goods and services. The multiplier effect generally continues until money leaves the region's economy. This analysis does not estimate multiplier effects. Input-output models, such as IMPLAN, are commonly used to calculate regional economic effects using multipliers.

Visitors from outside the region are especially important for the regional economy and multiplier effect. Jefferson County residents that spend money for recreation at Perry Lake would likely spend their money, or a portion of it, elsewhere in the economy, if not at Perry Lake. Money may be spent in different industry sectors, but it would remain in the region. Outside visitors bring new money into the region, which increases spending in the regional economy. As described above, approximately 80 percent of visitors to Perry Lake originate from outside Jefferson County. Therefore, 80 percent of the total spending shown in Table 2-13 would be "new" to the region. Table 2-13 shows estimated spending by out-of-region visitors. The multiplier effect should be calculated using out-of-region spending estimates. Approximately $12.6 million is spent by non-county residents on recreation at Perry Lake. Day use boating activities in the reservoir have the highest spending values, about $5.7 million.

Table 2-13
Total Annual Visitor Spending by Out-of-Region Visitors, 2009 Dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting and Fishing (no boat)	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$4,235,978	$2,451,775	$218,877	$973,550	$797,501	$61,555	$8,739,235
October – March	$1,519,077	$1,457,710	$400,883	$259,240	$212,362	$61,555	$3,910,826
Total	$5,755,054	$3,909,485	$619,760	$1,232,790	$1,009,862	$123,110	$12,650,062

Assumptions:
1. 80 percent of visitors are from outside Jefferson County, based on zip code data

The USACE's *Estimating the Local Economic Impacts of Recreation at Corps of Engineer Project – 196 (1998)* reported sales multipliers at Milford Lake to range from 1.23 to 1.69, meaning that each dollar spent for direct sales results in $0.23 to $0.69 in indirect sales. Milford Lake is the closest lake to Perry Lake that was estimated in the USACE report, and can appropriately represent multipliers for Perry Lake, because of its close proximity. Therefore, with a multiplier of 1.23, indirect annual sales from recreation at Perry Lake would be about $2.9 million. Total economic impacts would be about $15.5 million.

Perry Lake offers the only water-related recreation opportunity in Jefferson County. There are some water-related recreation opportunities in nearby counties, including Clinton Lake in Douglas County (about 27 miles away) and Tuttle Creek Lake in Riley County (about 85 miles away). Adverse effects to Perry Lake recreation would likely result in visitors going to nearby lakes, taking money away from the county economy.

2.3.2.4 Special Events

Perry Lake hosts numerous bass fishing tournaments throughout the spring and summer and a catfish tournament in August. The Great Plains Running Company also hosts some organized trail run events at Perry Lake. Special events typically attract more out-of-region visitors to Perry Lake than a regular weekend without scheduled events. Increased spending during special event weekends is an important boost to the County's economy.

2.3.3 Wildlife Habitat

Wildlife habitat provides economic and intrinsic values to the user. KDWP has leased 10,500 acres of land at the north end of the Perry Reservoir from USACE since 1970. The land is used for wildlife management and public hunting opportunities. The Perry Wildlife Area has 13 marshes that provide about 1,000 acres of wetland habitats. Game species in the area include white-tailed deer, wild turkey, waterfowl, mourning dove, pheasant, quail, squirrel, and rabbit. Non-game species can be found in the area, including a wide array of mammals, birds, reptiles, and amphibians.

Many people visit Perry Lake for hunting and fishing uses, which is supported by the wildlife habitat at the lake. Visitors are willing to pay for park fees, licenses, equipment, and travel costs. This willingness to pay can infer the economic value to the visitor. Average visitation for hunting and fishing from 2001 to 2009 at Perry Lake was 220,561 visitors, 171,723 for fishing and 48,838 for hunting. Based on Table 2-10, average daily visitor spending was $15.86 and $22.49 per day for hunting and fishing. Visitors also had to purchase hunting or fishing licenses (Table 2-12). In total, hunting and fishing generated about $10.1 million, which can be assumed as an estimate of wildlife habitat value. Visitors for sightseeing and wintering activities can also be considered to add to the wildlife habitat value of the lake. Note that these values should not be added to the above recreation values to avoid double counting of visitation expenditures.

Similar to recreation benefits, there is likely some additional consumer surplus not captured by the existing fees. In other words, some visitors may be willing to pay more than the existing fees for hunting and fishing. An additional method to estimate wildlife habitat value is to consider the fees to construct and maintain wetlands around the lake. Constructed wetlands provide similar habitat and costs can be transferred as the value of natural wildlife habitat.

2.3.4 Water Supply

Perry Lake provides water supply to Kansas residents and businesses, which results in economic benefits as water is used for various purposes. Water supply benefits are generally measured through consumer willingness to pay, in accordance with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. Willingness to pay can be estimated using avoided costs for alternative water supplies. In general, the least cost alternative reflects the water supply benefit. For this analysis, alternative water supplies include construction of a new reservoir. Construction costs for Tuttle Creek Lake, Milford Lake, and Perry Lake reservoirs were collected to identify potential reservoir construction costs. Construction costs were adjusted to 2010 dollars using Engineering News Record – Construction Cost Index (ENR-CCI).

Mitigation costs were also added to construction costs to calculate the total reservoir cost. Mitigation costs reflect stream compensation and were calculated by KWO using the USACE Kansas Stream Mitigation Guidance and debit calculator.[6] The KWO estimated the total perennial and stream miles inundated by the three reservoirs and assumed a dam width of 1,000 feet for debit calculations. Debit calculations are included in Appendix B. Table 2-14 summarizes perennial and intermittent stream miles inundated by the reservoirs used to calculate mitigation costs, shown in Table 2-15 below.

Table 2-14
Stream Miles Inundated by Reservoirs

Reservoir	Stream Type (miles)		Total (miles)
	Intermittent	Perennial	
Perry Lake	40.3	46.2	86.6
Milford Lake	40.2	43.9	84.2
Tuttle Creek Lake	28.7	44.1	72.8

Tuttle Creek Lake Reservoir has 99,068 acre-feet dedicated to in-service water supply uses, which is 4.2 percent of the total reservoir storage volume of 2,367,017 acre-feet. The reservoir has 241,747 acre-feet dedicated to water conservation uses, which allows for future increases in water supply.

Milford Lake Reservoir has 117,491 acre-feet dedicated to in-service water supply uses, which is 10.3 percent of the total reservoir storage volume of 1,145,485 acre-feet. The reservoir has 346,785 acre-feet dedicated to water conservation uses.

[6] USACE Kansas Stream Mitigation Guidance (KSMG) – Version 2, 25 June 2010
http://www.nwk.usace.army.mil/regulatory/CompMit/KS/KSMG_Guidance_25Jun2010.pdf

Perry Lake Reservoir has 32,739 acre-feet dedicated to in-service water supply uses, which is 4.3 percent of the total reservoir storage volume of 765,100 acre-feet. The reservoir has 196,394 acre-feet dedicated to water conservation uses.

Table 2-15 presents total construction costs, estimated at the midpoint of the construction period, for the three reservoirs. Only the proportion of total reservoir costs attributable to water supply is considered when calculating the water supply value.

Table 2-15
Reservoir Construction and Mitigation Costs

Reservoir	Construction Cost	Construction Cost (2010 $)	Mitigation Costs (2010 $)	Total Costs (2010 $)
Perry Lake	$48,371,706 (1966 $)	$419,442,978	$1,090,246,250	$1,509,689,228
Milford Lake	$48,268,843 (1963 $)	$473,366,811	$1,027,581,175	$1,500,947,986
Tuttle Creek Lake	$80,051,031 (1957 $)	$976,976,395	$805,593,675	$1,782,570,070

Table 2-16 summarizes the fraction of total reservoir costs for water supply purposes. The reservoir costs attributed to water supply indicate the amount it would cost to develop a new water supply for Kansas residents. These costs would be avoided by providing water from Perry Lake for water supply purposes, and reflect the value of the water supply. The lowest cost alternative for reservoir construction would be $756 per acre-foot. This would be the incremental benefit of increased water supply at Perry Lake. Based on in-service water supply of 32,739 acre-feet, total water supply value at Perry Lake would be about $24.8 million.

Table 2-16
Reservoir Costs for Water Conservation Purpose

Reservoir	Percentage of Total Reservoir Storage for Water Conservation	Reservoir Costs Attributed to Water Conservation	Cost per Acre-foot
Perry Lake	4.3%	$64,916,637	$1,983
Milford Lake	10.3%	$154,597,643	$1,316
Tuttle Creek Lake	4.2%	$74,867,943	$756

2.4 Summary and Conclusions

Perry Lake is an important recreational asset that contributes substantially to the local economy of Jefferson County. The lake also provides wildlife and water supply benefits. An average of about 676,000 people visit the lake each year, approximate 67 percent visit April through September. Boating, fishing, and sightseeing activities have the largest amount of visitors.

Table 2-17 shows recreation at the lake generates about $15.8 million in direct spending annually. Day users with a boat contribute most to annual spending, about $7.2 million. Marina slip rentals contribute up to $1.7 million per year. State charges for hunting and fishing licenses generate about $5.5 million, based on annual visitation data for hunting and fishing at Perry Lake.

Perry Lake supports habitat for migratory and native waterfowl and several game species. Habitat value was estimated as willingness to pay for hunting and fishing uses. Based on this method, habitat at Perry Lake would be about $10.1 million.

Lastly, Perry Lake provides water supply to Kansas residents. Based on existing reservoir construction and mitigation costs, water supply benefits from the lake would be about $24.8 million.

Table 2-17
Summary of Benefits at Perry Lake

Use	Annual Benefits
Recreation[1]	$15.8 million
Hunting and Fishing License Revenue	$5.5 million
Habitat Value	$10.1 million
Water Supply	$24.8 million

[1] Direct Spending

Section 3
Milford Lake

3.1 Background

Milford Lake is located in Geary County, Kansas near the town of Milford, Kansas (Figure 3-1). The lake is approximately 113 miles from Wichita, Kansas, 35 miles from Manhattan, Kansas, and 131 miles from Kansas City, Missouri. In 2009, the population of Geary County was 31,751, which is a 14 percent increase over the 2000 population of 27,947. The Geary County seat is Junction City, which had a population of 18,886 in 2000 and 20,932 in 2009.

Figure 3-1
Milford Lake Location Map

Milford Lake was constructed beginning in 1962 with multipurpose objectives including flood control, water supply, recreation, water quality, navigation, and wildlife. The cost of construction of the dam and reservoir was approximately $48.3 million[1]. It has been estimated that Milford Lake has provided $1,276,932,000 in flood damage prevention.[2]

The State of Kansas has under contract 346,785 acre-feet of the conservation pool in Milford Lake to be used for water supply purposes. Only a portion of this storage (117,491 acre-feet) has been called into service by the State.

The local economy benefits from recreation and visitor spending at Milford Lake. Two private marinas and numerous private, Sate, and Federal owned parks attract visitors to Milford Lake for camping, hunting, fishing, boating, sightseeing, and other outdoor activities (Figure 3-2). The Kansas Reservoir Assessment included the collecting and review of existing data to document these uses and to estimate impacts to uses due to changes in lake water levels. The data collected was then used to perform an economic valuation of recreation activities and visitor spending. This section describes the data collection and economic valuation performed for Milford Lake. Section 5 discusses the impacts to existing uses due to changes in water levels.

Milford Lake[3]	
Drainage Area, square miles	24,882
Total Storage Volume, acre-feet	1,145,485
Conservation Pool Elevation, feet	1144.4
Flood Pool Elevation, feet	1176.2
Water Surface, acres	15,700
Shoreline, miles	163

3.2 Data Collection and Review

Data pertaining to the study was collected and reviewed. The data included interviews of the lake operations manager and concessionaries, USACE estimated visitation data and usage breakdown, historical lake elevations, critical elevations for allowing open water access, and previous economic studies related to the Kansas Reservoir Assessment.

3.2.1 Site Visit and Interviews

One site visit was conducted at Milford Lake to gather information related to the study that was readily available at the lake project office, and to conduct in-person interviews with concessionaries. The purpose of the interviews was to gather information on existing operations and to collect data on how operations are impacted during high and low water levels.

[1] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, August 27, 2010
[2] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, December 20, 2010
[3] Milford Lake Website - http://www.nwk.usace.army.mil/mi/ - Accessed September 20, 2010

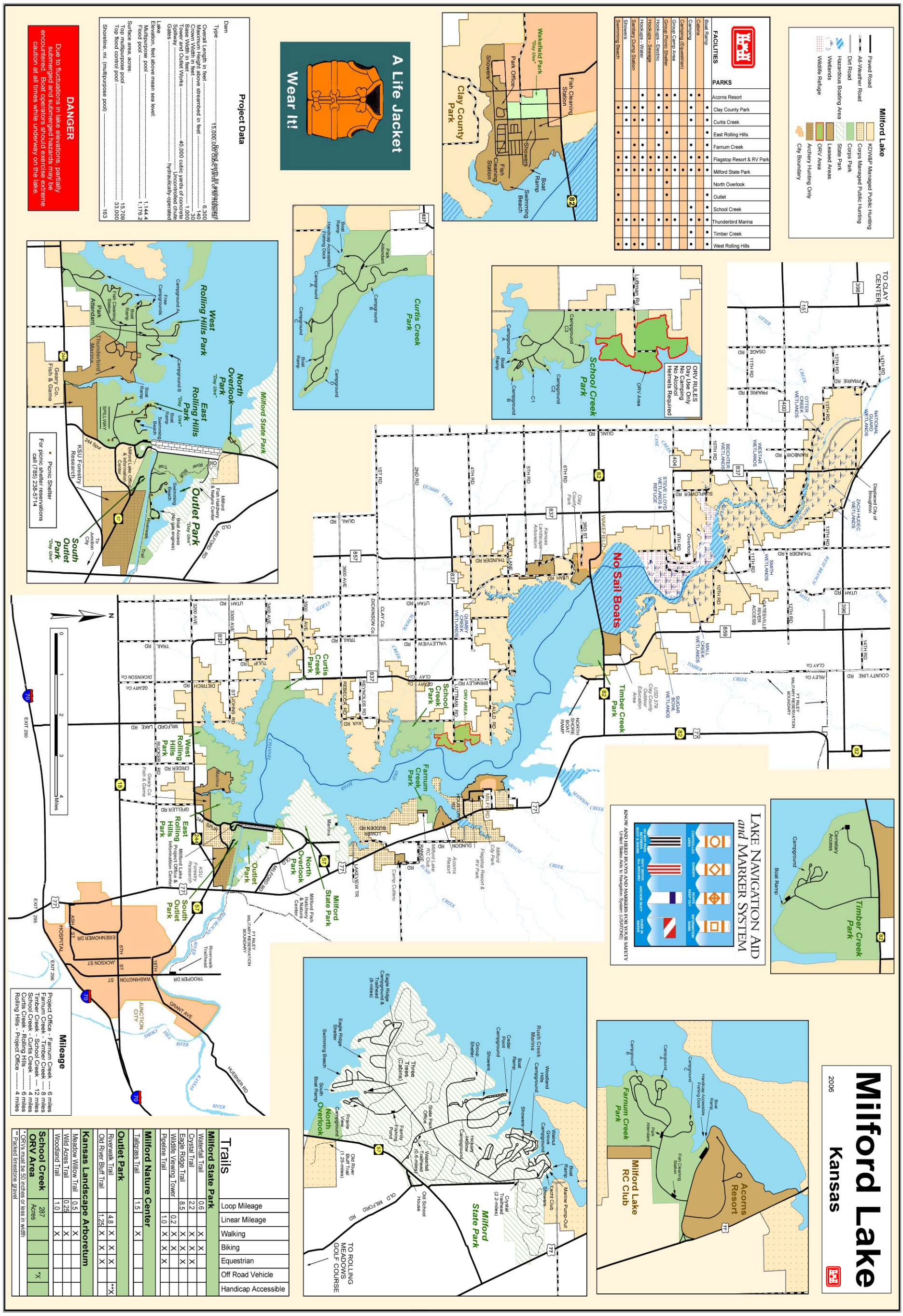

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Figure 3-2
Milford Lake Parks and Recreation Features

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On April 13, 2010, CDM conducted a site visit to Milford Lake and interviewed the following individuals:

- USACE Milford Lake Project Office – Project Manager Mr. R. J. Harms
- Milford Lake Marina – Owner Mr. Tim Date
- Flagstop Resort and RV Park – Owner Mr. Gary Boen
- Thunderbird Marina – Owners Mr. John Deam and Mrs. Kay Deam

3.2.1.1 USACE Milford Lake Operations Project Manager

Mr. R.J. Harms is the current operations project manager at the Milford Project Office. To assist with documenting existing uses and economic valuation of recreation, Mr. Harms provided rate sheets for camping facilities and total number of campsites for each park.

To assist with estimating the impacts of water levels on existing uses, Mr. Harms completed a Quality of Recreation Use Survey for estimating the quality of recreation benefits at Milford Lake under several different water surface elevations, high pool, normal pool, low pool, and very low pool. This survey is discussed in more detail in Section 3.2.5. Mr. Harms also provided hard copies of historical water levels at Milford Lake and pictures of high and low water levels.

In addition, Mr. Harms was interviewed regarding potential impediments to operations at various lake elevations. The conservation pool at the lake is 1144.4 feet. At 3 feet below the conservation pool (1141.4 feet), Mr. Harms stated that there are no big impacts to uses for areas operated by the USACE. At 5 or 6 feet below the conservation pool (1139.4 to 1138.4 feet), there are adverse impacts to uses during the recreation season because of the now-visible hazards which were previously underwater, and some boat ramps are not usable. At water levels 5 or 6 feet above conservation pool (1149.4 to1150.4 feet) Thunderbird Marina experiences flooding at campsites and within the parking lot. At these high water elevations, parts of the park are inaccessible and are shut down.

3.2.1.2 Milford Lake Marina

Mr. Tim Date is the current owner of Milford Lake Marina. The marina is a commercial marina that has a total of 71 slips for rent. In typical years they are able to rent 100-percent of their slips. Mr. Date is investing in a dock and slip systems which will provide flexibility with changing water levels. This increase in flexibility costs approximately 20 to 25 percent over stationary equipment, but makes it easier to operate on a lake with fluctuating water levels.

Marina store customers include 75 to 80 percent general visitation off the lake with other visitors as slip renters. Primary revenues for the marina include slip rental fees with storage unit fees and store purchases as supplemental revenue. The marina has a total of 61 storage spaces and 30 outdoor sailboat storage spaces.

Mr. Date stated that the lake draws many visitors from Nebraska and Manhattan, Kansas. Some visitors travel from Topeka, Kansas and Kansas City, Missouri.

3.2.1.3 Flagstop Resort and RV Park

Mr. Gary Boen is the current owner of the Flagstop Resort and RV Park. The campground facility includes primitive sites, electrical hookups, and cabins. The property contains 180 camping sites and 16 cabins. Mr. Boen indicated that there is no decrease in use of the property during low water levels; however, the on-site boat ramp is inaccessible. At low water levels, visitors generally do have access to the adjacent boat ramp operated by the City of Milford. Elevation of the campground boat ramp is unknown. At high water levels (approximately 1149.4 feet), the main access road to the rental cabins is flooded; however, a secondary access road is usable although it is less convenient. The campground typically runs at full capacity from June through September.

3.2.1.4 Thunderbird Marina

Thunderbird Marina is a private marina with cabins, campsites, and boat slips rentals. The total number of slips is 154 which includes both covered slips and open slips. The property includes 100 to 120 campsites and eight cabins. Boat ramps are on spuds and move only up and down and not out into the lake to accommodate low water levels. At low water levels houseboats might have a problem with touching the lake bottom. Usage of the marina declines when water is low, because people are scared to use the lake unless they are very familiar with it. At water levels 5 to 6 feet over the conservation pool (1149.4-1150.4 feet), 16 campsites are inaccessible and at 5 feet high (1149.4 feet) the parking lot is under water. When the parking lot is flooded, ferry boats are used to take people to their slips. At 5 to 6 feet over the conservation pool (1149.4-1150.4 feet) visitation is at approximately 30 percent. At the time of the interview, all slips at the marina were rented.

3.2.1.5 Phone Interviews

Phone interviews were conducted of property owners and other entities that were identified as being possible data sources for the study, but were unavailable during the time of the site visit. The following entities were contacted and interviewed by telephone:

- Acorns Resort
- KDWP Wildlife and Parks
- Geary County Conventions and Visitors Bureau

Acorns Resort

Acorns Resort is a private campground that includes primitive and electrical sites, one and two bedroom cabins, and a nine-room mini lodge. The entire facility is about three years old and it is located on the east side of Milford Lake. The owner of Acorns Resort is Mr. Mike Harris. Mr. Harris was interviewed to gather information on existing operations at the resort and any changes to that operation as a result of high or low water levels.

Acorns resort has at total of 27 campsites with utility hookups, 8 primitive campsites, and 7 year-round cabins. Two of the cabins sleep up to 12 people. There is a nine room lodge on the property and each room sleeps between four and six people.

Mr. Harris's wife organizes three adventure races per year and five trail runs per year at Milford Lake. Adventure races attract between 75 and 150 people mostly from out of State. Trail runs attract about 30 participants, mostly local.

Mr. Harris indicated that even though water levels do not impact accessibility to his property, they do impact visitation numbers. Recently, when high water levels were advertized at the lake and the USACE parks closed campsites and canceled reservations, people avoided the lake. As a result, business at Acorns Resort was reduced by an estimated 25 percent. Mr. Harris has not experienced severely low water levels in the four years that he has been the owner of Acorns resort.

KDWP

Mr. Tony Reitz is the director of Milford State Park. Mr. Reitz said that the State park has 90 campsites with electricity and water hookups, 50 campsites with electricity, water and sewer hookup, 108 primitive camping sites, and 5 cabins. An additional 5 cabins are expected to open soon. The full utility campsites experience over 90 percent occupancy on fair weather days during the recreation period. If water level is greater than 9 feet over the conservation pool (1153.4 feet) approximately 30 to 40 sites are shut down due to flooding conditions. Mr. Reitz stated that no noticeable impact to visitation at the park is observed during low water levels. High water levels do not appear to impact day use visitation as people still use swimming beaches and some come to view the high water. Visitation may even increase during high water levels due to increase in public interest. Camping use is impacted because of the sites that are inaccessible. Mr. Reitz provided additional information on special events that are held in the park.

Junction City Geary County Conventions and Visitors Bureau

The Junction City and Geary County Conventions and Visitors Bureau (GCCVB) was contacted to gather information on the benefits and value that Milford Lake provides to the area. Mr. Rick Dykstra is the assistant director of the GCCVB and he provided the following information[4]:

- Based on 30+ years of being actively involved in fishing and hunting, Mr. Dykstra estimates a safe daily spending number for fishing for locals at $45.00 per day per capita and for non-residents at $85.00 per day per capita. Some reports have $210.00 to $345.00 per day which is too high for the area. The most sought after species of fish in Kansas is Bass. Milford Lake has all three types of Bass; Largemouth, Smallmouth, and Spotted.

- Milford Lake is the number one attraction in the Junction City/Geary County area and brings thousands of dollars in tax revenue each month to the region.

[4] Email Correspondence with Rick Dykstra, September 16, 2010

3.2.2 Visitation Data

Table 3-1 shows annual and average visitation at Milford Lake from 2001 to 2009. Visitation varies seasonally and is typically higher during the spring and summer. Based on zip code data at campgrounds provided by KDWP, approximately 10 percent of visitors are from within the county and 90 percent originate from outside Geary County, including other counties within Kansas and other states. Table 3-1 indicates that visitation has fluctuated from a low of about 492,600 visitors in 2004 to a high of about 897,000 visitors in 2009. Visitation during 2007 through 2009 has been substantially higher than the 9-year average.

Table 3-1
Annual Visitation at Milford Lake

Year	Visitors
2001	643,163
2002	695,276
2003	550,031
2004	492,648
2005	493,593
2006	681,085
2007	746,666
2008	876,786
2009	897,089
Average	**675,149**

Source: USACE Operations and Maintenance Business Information Link 2010

The USACE maintains data for monthly visitation by activity. Activities vary by season. Boating and water contact sports decrease during the winter months resulting in hunting and fishing as a larger percentage of total recreation during the these months. The peak recreation season is generally defined as April 1 through September 30. Table 3-2 summarizes average visitation by activity and percentages for the peak and off-peak recreation seasons at Milford Lake. During both the peak and off-peak seasons, fishing is the most popular activity at Milford Lake, followed by sightseeing. Hunting is the only activity in which visitation increases in the off-peak season relative to the peak season.

3.2.3 Historical Lake Elevations

Historical lake elevations provided by the USACE are shown in Figure 3-3. Lake levels fluctuate throughout the year and from year to year. The historical lake elevations are compared with visitation estimates in Section 6.

3.2.4 Critical Elevations

Several critical elevations were identified for Milford Lake. Critical elevations are elevations at which facilities become unusable due to either high or low water levels. The USACE supplied elevations for the bottom of boat ramps as shown in Table 3-3. The elevations are not exact, but are estimated to assist boaters in launching during

low water conditions. These elevations are used in Section 5 to determine how lake accessibility is impacted as a result of releases for navigation support.

Table 3-2
Visitation Estimates by Recreation Activity at Milford Lake

	April - September		October-March	
	Number of Visitors	Percent of Total Visitors	Number of Visitors	Percent of Total Visitors
Camping	50,721	10.9%	7,476	3.6%
Picnicking	34,272	7.4%	32,633	15.6%
Boating	61,421	13.2%	36,350	17.4%
Fishing	102,282	22.0%	56,880	27.2%
Hunting	7,248	1.6%	10,406	5.0%
Water Skiing	20,800	4.5%	-	0.0%
Swimming	50,319	10.8%	-	0.0%
Other	62,697	13.5%	15,307	7.3%
Sightseeing	75,915	16.3%	50,423	24.1%
Winter Activities	-	0.0%	-	0.0%
Total	**465,675**	**100.0%**	**209,474**	**100.0%**

Source: USACE 2010 (email from David White, dated June 14, 2010)

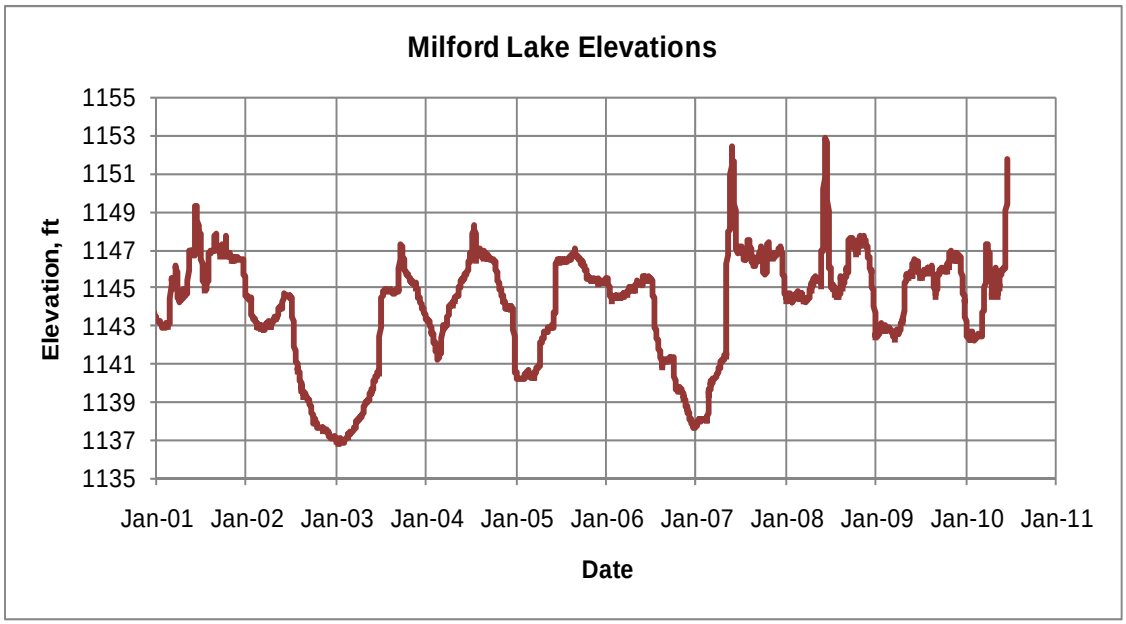

Figure 3-3
Historical Elevations of Milford Lake

Table 3-3
Milford Lake Boat Ramp Elevations

Boat Ramp	Bottom of Ramp
Milford State Park (Marina)	1115
East Rolling Hills	1115
West Rolling Hills	1127
School Creek	1127
Milford	1127
Curtis Creek (Campground)	1127
Farnum Creek	1127
Milford State Park (South Ramp)	1127
Thunderbird (North Ramp)	1127
Timber Creek	1131
Clay County Park	1137
Curtis Creek (Public)	1139.07

3.2.5 Previous Studies

In 2008, Craig Smith and John Leatherman with the Kansas State University (KSU) studied the economic impact to the region arising from direct recreation expenditures in the area. The study estimated direct economic impacts based on 2007 visitation data and USACE national spending profiles for average daily visitor spending. Table 3-4 summarizes regional economic impacts, including direct and indirect effects, to the region's output, value added, and employment from recreation expenditures for Milford Lake. [5] Direct impacts to output were estimated to be about $7.6 million in 2007 dollars.

Table 3-4
Milford Lake Total Economic Contributions

Impact Measure	Direct 2007 Dollars	Indirect 2007 Dollars	Total 2007 Dollars
Output	$7,574,919	$3,087,958	$10,662,877
Value Added	$3,653,684	$1,659,095	$5,312,779
Employment	159	34	193

Source: Smith, Craig. Et. al. 2008

The study also evaluated the non-market benefits, or additional consumer surplus, attained from recreation at Milford Lake. Consumer surplus reflects a visitor's true willingness to pay, which may include any unpaid value enjoyed by visitors for use of the site. Using existing willingness to pay estimates, the study calculated additional non-market benefits of up to $17.6 million annually for recreation opportunities at Milford Lake.

[5] Direct effects represent changes in final demand; indirect effects include both indirect and induced impacts. Indirect impacts are changes in expenditures within the region in industries supplying goods and services and induced effects are changes in expenditures of household income. Output represents the value of production of goods and services by businesses in the regional economy. Value added consists of wages and salaries, proprietor's and property incomes, dividends and interest, and indirect business taxes.

The USACE also estimates Value to the Nation of USACE facilities. Similar to the study done by Craig (2008), national spending profiles are used to estimate daily visitor spending. In 2006, the USACE estimated the direct regional economic impacts of recreation spending at Milford Lake to be about $18.5 million and the indirect effect to be about $14.2 million. Indirect effects were calculated using the IMPLAN model, developed by the Minnesota IMPLAN Group Inc.

3.2.6 Quality of Recreation Use Survey

Mr. Harms, the USACE Milford Lake manager was asked to perform a Quality of Recreation Use Survey for four lake conditions:

- The lake at **normal** pool levels – i.e. the elevation where the lake normally operates.
- The lake at **low** levels – i.e. the elevation where visitors begin to complain that the water levels are too low for good recreation.
- The lake at **very low** levels – i.e. the elevation where the lake is at or approaching the lower limit of the conservation pool.
- The lake at **high** levels – i.e. the elevation where visitors begin to complain that water levels are too high for good recreation.

Elevations were chosen to represent the threshold pool elevations for each of the lake conditions above. Table 3-5 shows these elevations.

Table 3-5
Threshold Pool Elevations for Milford Lake

Lake Condition	Elevation, feet
High Pool	1150.0
Normal Pool	1144.4
Low Pool	1141.4
Very Low Pool	1138.4

The quality of recreation use rating was based on five criteria:

- Recreational experiences available
- Availability of alternative comparable facilities
- Carrying capacity
- Accessibility
- Environmental/aesthetic quality

Each criterion has five sub-categories that have point values that can be assigned. Figure 3-4 shows each criterion and corresponding judgment factors.

In evaluating the criterion, Mr. Harms first made a judgment of which sub-category best represents the situation at the lake, and then picked an appropriate point value within the range of points available. This procedure generally follows the instructions of USACE Economics Guidance Memorandum 09-03 for computing unit day values for recreation.

Criteria	Judgment factors					Points
1. Recreation experience Total points possible: 30	Two general activities[1] 0 – 4 pts.	Several general activities 5 – 10 pts.	Several general activities; one high quality value activity[2] 11 – 16 pts.	Several general activities; more than one high quality value activity 17 – 23 pts.	Numerous high quality value activities; some general activities 24 – 30 pts.	
2. Availability of other comparable facilities Total points possible: 18	Several within 1 hour travel time; a few within 30 minute travel time 0 – 3 pts.	Several within 1 hour travel time; none within 30 minute travel time 4 – 6 pts.	One or two within 1 hour travel time; none within 45 minute travel time 7 – 10 pts.	None within 1 hour travel time 11 – 14 pts.	None within 2 hour travel time 15 – 18 pts.	
3. Carrying capacity (facility ability to meet demands Total points possible: 14	Minimum facility development for health and public safety 0 – 2 pts.	Basic facility to conduct activities 3- 5 pts.	Adequate facilities to conduct without deterioration of the resource or the activity experience 6 – 8 pts.	Facilities provide better than average ability to meet demands at site 9 – 11 pts.	Facilities provide ultimate ability to meet demands at site 12 – 14 pts.	
4. Accessibility (to site and within site) Total points possible: 18	Limited access to site or within site 0 – 3 pts.	Fair access, poor quality roads to site; limited access within site 4 – 6 pts.	Fair access, fair quality roads to site; fair – good access within site 7 - 10 pts.	Good access, good quality roads to site; fair – good access within site 11 - 14 pts.	Good access, high standard roads to site; good access within site 15 - 18 pts.	
5. Environmental/ Aesthetic Quality Factors[3] Total points possible: 20	Low aesthetic factors that significantly lower quality 0 – 2 pts.	Average aesthetic quality factors that lower quality to a minor degree 3 – 6 pts.	Above average aesthetic quality factors 7 - 10 pts.	High aesthetic quality factors 11 – 15 pts.	Outstanding aesthetic quality factors 16 – 20 pts.	
					Total Points Assigned:	

Additional points to note in rating:

[1] General activities are those that are common to the region.
[2] High quality value activities are those that are uncommon to the region, and/or which are of unusually high quality.
[3] Factors to consider include toporgraphy, water quality, vegetation, pests, climate, adjacent areas.

Figure 3-4
Quality of Recreation Survey Criterion and Judgment Factors

The results of the quality of recreation survey are presented in Figure 3-5. The survey shows a clear reduction in the quality of recreation for high (blue column), low (yellow column), and very low (purple column) water levels, with very low water levels causing the largest relative reduction in quality of recreation compared to what is experienced at normal pool elevations.

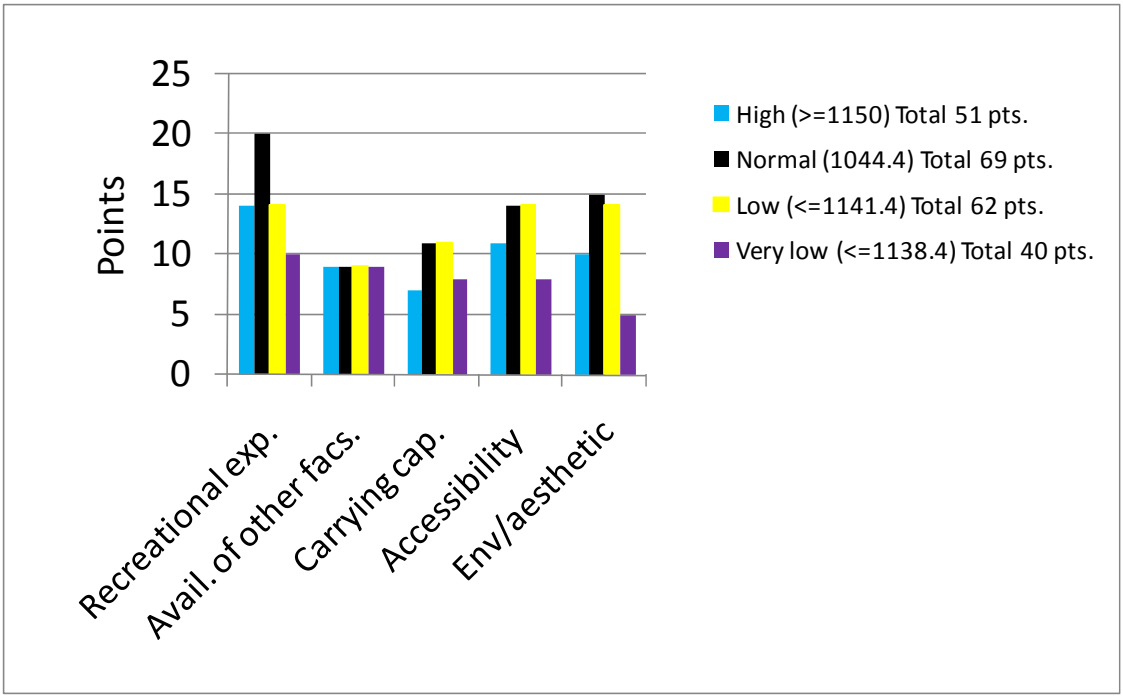

Figure 3-5
Quality of Recreation Survey Results for Milford Lake

3.3 Economic Evaluation

The economic evaluation for Milford Lake was performed to estimate contributions to the regional economy from recreation and water supply benefits. The sections below give a brief overview of the regional economy and are followed by the evaluation of recreation and water supply benefits.

3.3.1 Regional Economy

The regional economic study area for Milford Lake is defined as Geary County. Milford Lake parks and facilities are in Milford and Junction City, both in Geary County. A summary of the regional economy is presented below.

3.3.1.1 Household and Personal Income

Table 3-6 shows household income characteristics in Geary County from the 2006 to 2008 American Community Survey[6]. In 2008, about 9.7 percent of individuals lived below the poverty level.

[6] American Community Survey data is collected during calendar years 2006, 2007, and 2008 and is available for geographic areas with populations of 20,000 or more.

Table 3-6
2008 Household[1] Income in Geary County

Income Range	Number	Percent
Less than $10,000	768	7.3%
$10,000 to $14,999	321	3.1%
$15,000 to $24,999	1,193	11.4%
$25,000 to $34,999	1,464	13.9%
$35,000 to $49,999	2,086	19.9%
$50,000 to $74,999	2,391	22.8%
$75,000 to $99,999	1,215	11.6%
$100,000 to $149,999	818	7.8%
$150,000 to $199,999	87	0.8%
$200,000 or more	158	1.5%
Median household income (dollars)	45,705	(X)

[1] Total number of households is 10,501
Source: US Census Bureau 2010
http://www.factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=05000US20061&-gr_name=ACS_2008_3YR_G00_DP3YR3&-context=adp&-ds_name=&-tree_id=3308&-_lang=en&-redoLog=false&-format=

In 2008, Geary County had a total personal income of about $1.3 billion. The per capita personal income was $41,504, which ranked 18th in the State and was 107 percent of the State average of $38,886. The 2008 per capita personal income reflected an increase of 4.6 percent from 2007. In 1998, the per capita personal income of Geary County was $20,961 and ranked 77th in the State. The 1998 to 2008 average annual growth rate was 7.1 percent. Geary County has been growing faster than the average State growth rate of 4.1 percent.

3.3.1.2 Industry and Employment

Table 3-7 shows industry earnings and employment in Geary County in 2008. The industries with the highest earnings were government and government enterprises and administrative and waste services. The industries with the highest employment were government and government enterprises and retail trade. Retail trade employed 2,059 people and earned about $45.2 million in 2008. Accommodation and food services employed 1,603 people and earned about $26.7 million. Military was the highest earning under the government and government enterprises sector.

Table 3-8 shows the number of establishments by industry and sales in Geary County, provided by the 2007 Economic Census. Retail trade had the most establishments and highest sales in the county.

3.3.1.3 Sales Tax

The Kansas retailers' sales and use taxes is a combination of the State rate of 6.3 percent, effective October 2010, plus any local tax percentage levied by a county or a city. Geary County imposes a local sales tax of 1.25 percent, resulting in a total of 7.55 percent sales tax in the county.

Local tax distributions are disbursed to cities, counties, and other local governments by the State. The Kansas Department of Revenue is responsible for the correct allocation of the funds. The amounts are based on the local share of retail sales and use taxes collected. Table 3-9 show State sales tax collected from Geary County and local tax distribution to the county.

Table 3-7
2008 Industry Earnings and Employment Estimates in Geary County

Industry	Industry Earnings (1,000 $)	Employment (number of employees)
Forestry, fishing, and related activities	(D)	(D)
Mining	(D)	(D)
Utilities	(D)	(D)
Construction	$43,003	1,001
Manufacturing	$34,667	462
Wholesale trade	(D)	(D)
Retail trade	$45,192	2,059
Transportation and warehousing	$10,713	365
Information	$12,233	252
Finance and insurance	$12,883	370
Real estate, rental, and leasing	$7,399	512
Professional, scientific, and technical services	(D)	(D)
Management of companies and enterprises	(D)	(D)
Administrative and waste services	$69,148	1,801
Educational services	$4,562	174
Health care and social assistance	$25,777	858
Arts, entertainment, and recreation	$694	119
Accommodation and food services	$26,668	1,603
Other services, except public administration	$34,099	1,078
Government and government enterprises	$1,924,843	21,424
Total	$2,304,740	33,583

(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals
Source: BEA 2010
http://www.bea.gov/regional/reis/action.cfm

Table 3-8
Industry Establishments and Sales in Geary County, 2007

Industry description	Number of employer establishments	Employer sales, shipments, receipts, revenue, or business done ($1,000)	Number of nonemployer establishments[1]	Nonemployer sales, shipments, receipts, revenue, or business done ($1,000)
Manufacturing	7	D	8	181
Retail trade	96	295,149	161	4,982
Information	13	N	D	D
Real estate, rental, and leasing	34	17,547	114	4,423
Professional, scientific, and technical services	38	D	74	884
Administrative and Support, Waste Management, and Remediation SUVs	27	47,819	98	1,401
Health care and social assistance	53	130,189	134	3,040
Arts, entertainment, and recreation	10	2,502	43	443
Accommodation and food services	73	51,976	32	1,174
Other services (except public administration)	51	13,939	205	4,747

[1] A nonemployer establishment is a business that does not have any paid employees
D: Withheld to avoid disclosing data for individual companies
N: Not available or not comparable
Source: U.S. Bureau of the Census, 2007 Economic Census, accessed 2010
http://factfinder.census.gov/servlet/GQRTable?_bm=y&-ds_name=EC0700A1&-geo_id=05000US20061&-_lang=en

Table 3-9
Geary County Sales Tax State Collection and Local Distribution, 2005 through 2009

Year	State Sales Tax Collections	Local Sales Tax Distribution
2005	$14,462,463	$2,961,643
2006	$18,084,969	$3,664,057
2007	$19,145,785	$4,860,129
2008	$20,621,279	$5,100,478
2009	$18,671,107	$5,211,717

Source: Kansas Department of Revenue, accessed 2010
http://www.ksrevenue.org/salesreports.htm

3.3.2 Recreation

Recreation at Milford Lake contributes to Geary County's local economy. Visitors from outside Geary County travel to Milford Lake for recreation activities, including hiking, swimming, boating, camping, hunting, fishing, and picnicking. Milford Lake has multiple facilities, including campgrounds, cabins, trails, marinas, picnic rentals,

and boat rentals. Visitor spending at these facilities and other businesses, such as local food stores, fuel stations, and equipment stores, helps support the economy. Multiple industries benefit from recreation expenditures, including, but not limited to retail trade, arts, entertainment, recreation, accommodation and food services, and other services.

3.3.2.1 Milford Lake Park Fees

KDWP charges fees for use of park facilities. Facility fees are often higher during the peak season than the off peak season. Day visitors at Milford Lake can pay various fees depending on the activity. Vehicle fees are $3.70 and $4.20 during fall and summer, respectively, at KDWP parks. Picnic rentals are $15.00 per day or $40 per day, depending on size, at Clay County Park, $30 per day at Acorns Resort, and $25 per day or $45 per day at Thunderbird Resort and Marina.

Campground fees vary slightly among campgrounds. Table 3-10 summarizes the primary fees for each campground. Other fees apply for utility hookups, sewage dump, second vehicles, group camping, long-term camping, etc. Milford State Park has five cabins with fees of $65 per night on peak season weekends and $45 per night during off-season and all weekdays. Overnight visitors would also need to pay vehicle fees. Daily boat launch fees are $3 per boat.

Table 3-10
Milford Lake Camping Fees

Park	Fee $/night	
Curtis Creek Park		
Non Electric	$12	
Electric	$16	
Electric and Water	$18	
Farnum Creek Park		
Non Electric	$10	
Electric (30-amp)	$16	
Electric (50-amp)	$17	
West Rolling Hills Park		
Non Electric	$12	
Electric (50-amp)	$19	
Electric (30-amp)	$18	
Clay County		
Non Electric	$10	
Electric (30-amp)	$16	
Electric (50-amp)	$18	
School Creek Park and Timber Lake Park		
Non Electric	$8	
Milford State Park		
	4/1 - 9/30	10/1 - 3/31
Daily Permit	$8.50	$7.50

There are several private resort operators at Milford Lake that have campgrounds and cabin rentals for various fees. Table 3-11 summarizes camping and cabin rental fees at Acorns Resort, Thunderbird Resort and Marina, and Flagstop Resort and RV Park. Acorns Resort also has a lodge with nine rooms for $65 to $120 per night.

Table 3-11
Overnight Fees at
Privately Owned Resorts at Milford Lake

Resort	Fee $/night	
Acorns Resort		
	4/1 - 9/30	10/1 - 3/31
Non Electric	$10	$10
Electric and Water	$25	$22
Cabins (2 night minimum)	$125	$85
Thunderbird Resort and Marina		
Non Electric	$14	
Electric	$22	
Cabins	$45	
Flagstop Resort and RV Park		
Non Electric	$10	
Electric	$25	
Cabin (small)	$60	
Cabin (large)	$95	

Milford Lake's two marinas charge for annual slip rentals, boat rentals, and use of boat launches. Slip rental rates vary based on the size, type of boat (power boat or sail boat) and if the slip is covered or not. Slip rental rates at the Milford Lake Marina range from $730 per year for an 18-foot slip to $2,200 per year for a 50-foot slip. The average rental rate at Milford Lake Marina is $1,260 per year. Based on the average rate and full occupancy, the marina receives annual fees from slip rentals of about $90,000 per season.

Slip rental rates at Thunderbird Resort and Marina range from $890 per season for an 18-foot slip to $1,230 per season for a 40-foot slip. The average rental rate at Thunderbird Marina is $1,011 per season. Based on the average rates and full occupancy, the marina receives annual fees from slip rentals of about $156,000 per season. Pontoons are available for rent for $225 for 8 hours.

Hunting and fishing licenses are distributed by the State. Hunting licenses are $20.50 per year for residents and $42.50 per year for non-residents. Fishing licenses are $20.50 per year for residents and $72.50 per year for non-residents. Hunting and fishing visitors would also need to pay vehicle fees.

3.3.2.2 Visitor Spending by Activity

Visitors spend money on park fees, fuel, food, equipment, and other expenses related to recreation. Spending varies by recreation activity. Camping and overnight stays are typically more expensive than day trips and boating is more expensive than non-boating activities. This analysis estimates daily spending per person by activity at Milford Lake. Local data on campground fees, vehicle fees, boat, equipment, and cabin rentals described above are incorporated into park fees. The USACE has developed national spending profiles to estimate average visitor spending related to grocery, restaurant, fuel, and equipment purchases. Data from the spending profiles are added to local fees to estimate total daily spending by visitor. Appendix A provides background information to support daily spending estimates at Milford Lake.

Table 3-12 summarizes estimated daily visitor spending by activity at Milford Lake. The spending values reflect daily visitor spending within Geary County. The park fees reflect average daily local fees associated with each activity, including applicable vehicle, trail use, picnicking, boat launch, boat rentals, camping, and cabin fees. The fees for the remainder of spending categories are from the USACE spending profiles. Sporting goods and boat equipment rental fees for day use (no boat) were removed because fees are reflected in park fees. In general, visitors that are camping spend more money on a daily basis that day use visitors. Further, visitors spend more on boating activities than non-boating activities because of additional fuel and equipment fees.

Table 3-12
Average Daily Spending per Person by Activity ($ per visit) for Milford Lake Recreation, 2009 Dollars

Spending Category	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Day Use Including Boat Rental	Camping (with boat)	Camping (no boat)	Cabin Rental
Park fees	$2.32	$4.74	$1.32	$39.82	$31.97	$25.11	$51.93
Restaurants, bars, etc.	$3.03	$3.77	$3.77	$3.03	$9.09	$10.43	$10.43
Groceries and takeout food	$4.98	$4.98	$4.98	$4.98	$23.18	$18.88	$18.88
Gas and oil	$7.91	$3.13	$3.13	$7.91	$14.33	$9.89	$8.40
Sporting goods and boat equipment	$3.52	$0.00	$0.98	$3.52	$5.41	$1.71	$2.69
Other expenses	$0.57	$1.51	$1.51	$0.57	$3.80	$6.75	$1.92
Total	**$22.32**	**$18.14**	**$15.69**	**$59.82**	**$87.79**	**$72.77**	**$94.25**

Assumptions:
1. Average of 3 people per party for day and overnight use, based on USACE spending profiles
2. Average of 4 nights for overnight use, based on USACE spending profiles
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities
5. Day use and camping (no boat) park fees include average cost of picnic rentals and vehicle fees
6. Day use hunting park fees include vehicle fees and no equipment rental fees
7. Cabin rental park fees includes average cost of car rental and vehicle fees
8. USACE daily spending profiles were adjusted from 1999 to 2009 dollars (USACE profiles used for all categories but park fees)
9. Sporting goods and boat equipment for day use (no boat) reflected in park fees

3.3.2.3 Total Visitor Spending

Total direct visitor spending in 2009 amounted to $17.1 million and is estimated using recreation visitation data by activity (Section 3.2.2) and the daily spending profiles identified above. Total visitor spending reflects expenditures for all recreation-related activities in Geary County, including park fees at Milford Lake and additional spending at food stores, fuel stations, and other businesses in the county. Table 3-13 shows visitor spending during the peak and off-peak seasons and total annual spending. Day use activities with a boat generate about $6.2 million of visitor spending annually, which is the most of the reported recreation activities. Approximately 69 percent of total spending occurs during April through September.

Table 3-13
Total Annual Visitor Spending for Milford Lake Recreation, 2009 Dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$4,117,235	$4,047,787	$113,708	$1,991,440	$1,650,750	$504,225	$12,425,144
October – March	$2,080,445	$1,783,802	$163,243	$93,326	$77,360	$504,225	$4,702,402
Total	$6,197,680	$5,831,589	$276,951	$2,084,766	$1,728,110	$1,008,450	$17,127,546

Assumptions:
1. One half of campers boat
2. Full occupancy at cabins year round, based on site data collection and interviews
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities

3.3.2.4 Annual Revenues

Recreation at Milford Lake also generates some annual revenues. The county benefits from annual marina revenues collected for slip rentals. Estimated annual slip rental revenues at Milford Lake marinas is about $245,000. Milford Lake marina operators indicated the marinas were at full capacity year round. The State collects hunting and fishing license revenues. Table 3-14 summarizes license fees for residents and non-residents which were calculated based on annual license fees and average annual visitation estimates for hunting and fishing activities. It is assumed that 85 percent of visitors are from within the State and 15 percent are non-residents. Fishing license fees are about $3.8 million or 88 percent of total license revenues.

Table 3-14
Annual License Revenues Paid to State from Hunting and Fishing at Milford Lake

Hunting		Fishing		Total
Resident	Non-Resident	Resident	Non-Resident	
$307,619	$191,986	$2,773,394	$1,014,656	$4,287,655

3.3.2.5 Indirect Economic Effects

The values reported in Sections 3.3.2.3 and 3.3.2.4 represent direct effects of recreation at Milford Lake. There is a multiplier effect that generates additional spending in the economy as a result of the direct effect, commonly referred to as indirect economic effects. For example, money spent for food at a local grocery store is used to purchase supplies from wholesalers and pay for employee labor. Wholesalers then spend money for production inputs and employees spend income on other goods and services. The multiplier effect generally continues until money leaves the region's economy. This analysis does not estimate multiplier effects. Input-output models, such as IMPLAN, are commonly used to calculate indirect economic effects using multipliers.

Visitors from outside the region are especially important for the regional economy and multiplier effect. Geary County residents that spend money for recreation at Milford Lake would likely spend their money, or a portion of it, elsewhere in the economy, if not at Milford Lake. Money may be spent in different industry sectors, but it would remain in the region. Outside visitors bring new money into the region, which increases spending in the regional economy. As described above, approximately 90 percent of visitors to Milford Lake originate from outside Geary County. Therefore, 90 percent of the total spending shown in Table 3-13 would be "new" to the region. Table 3-15 shows estimated spending by out-of-region visitors. The multiplier effect should be calculated using out-of-region spending estimates. Approximately $12.6 million is spent by non-county residents on recreation at Milford Lake. Day use boating activities in the reservoir have the highest spending values, about $5.7 million.

Table 3-15
Total Annual Visitor Spending by Out-of-Region Visitors to Milford Lake, 2009 Dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting and Fishing (no boat)	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$3,705,512	$3,643,008	$102,337	$1,792,296	$1,485,675	$453,803	$11,182,630
October – March	$1,872,401	$1,605,422	$146,919	$83,994	$69,624	$453,803	$4,232,162
Total	$5,577,912	$5,248,430	$249,256	$1,876,289	$1,555,299	$907,605	$15,414,792

Assumptions:
90 percent of visitors are from outside Geary County, based on campground zip code data provided by KDWP

Previous studies have been completed that estimate potential multiplier effects of recreation at Milford Lake. *Economic Contributions of Recreation at Milford Lake* (2008) estimated indirect economic impacts of about $3.1 million in total output. The USACE's *Estimating the Local Economic Impacts of Recreation at Corps of Engineer Project – 196* (1998) reported sales multipliers at Milford Lake to range from 1.23 to 1.69, meaning that each dollar spent for direct sales results in $0.23 to $0.69 in indirect sales. Therefore, with a multiplier of 1.23, indirect annual sales from recreation at Milford Lake would be about $3.5 million. Total direct and multiplier economic impact would therefore be about $18.9 million.

Milford Lake offers the only water-related recreation opportunity in Geary County. Tuttle Creek Lake in Riley County, about 40 miles away from Milford Lake, offers similar water-related recreation opportunities as Milford Lake. Kanopolis and Perry Lakes are about 80 and 100 miles away from Milford Lake, respectively. Adverse effects to Milford Lake recreation would likely result in visitors going to nearby lakes, taking money away from the county economy.

3.3.2.6 Special Events

Milford Lake hosts several special events throughout the year. Special events typically attract more out-of-region visitors to Milford Lake than a regular weekend without scheduled events. For some events, park prices increase due to increased demands. Increased spending during special event weekends is an important boost to the County's economy.

Scheduled special events at Milford Lake include the following:

- **Bluegrass Festival –** The festival is an annual event that features multiple bands throughout the weekend. Campground fees are $30 to $50 for the weekend. The festival draws about 300 to 500 visitors. In 2010, the festival was cancelled due to flooding.

- **Monster Myths –** Monster Myths is a Halloween event free to visitors. The event draws about 1,000 to 1,500 visitors, typically for the day. Visitors must pay parking fees.

- **Milford Lake Birding Festival –** The festival offers guided trips to view native and migratory birds at the lake, wetlands, and native prairie.

- **Extreme Outdoor Water Festival –** The festival, which is free to visitors, attracts about 300 to 500 visitors every August.

- **Fish Tournaments –** Milford Lake hosts multiple fishing tournaments throughout the year for bass, catfish, or walleye. The 2008 B.A.S.S. Federation Nation Championship was held at Milford Lake.

- **Adventure Races and Trail Runs –** Adventure races attract about 75 to 100 visitors and trail runs attract about 30 visitors, mostly local.

3.3.3 Wildlife Habitat

Wildlife habitat provides economic and intrinsic values to the user. The Milford Wildlife Area has about 18,800 acres of managed lands around the lake that support various wildlife species. Milford supports many species of nongame birds, mammals, reptiles, and aquatic life. Game species include quail, pheasant, prairie chicken, duck, goose, rabbit, turkey, deer, and squirrel. The Steve Lloyd Refuge contains an additional 1100 acres. There are currently eight newly formed wetlands, the first of which was created in 2001. These wetlands are all north of Milford Lake, surrounding the Steve Lloyd Refuge area. They range in size from 60 to 250 acres making-up approximately 2,300 acres of wetlands when all pools are full.

Many people visit Milford Lake for hunting and fishing uses, which is supported by the wildlife habitat at the lake. Visitors are willing to pay for park fees, licenses, equipment, and travel costs. This willingness to pay can infer the economic value to the visitor. Average visitation for hunting and fishing from 2001 to 2009 at Milford Lake was about 176,816 visitors, 159,162 for fishing and 17,654 for hunting. Based on Table 3-9, average daily visitor spending was $15.69 and $22.32 per day for hunting and fishing. Visitors also had to purchase hunting or fishing licenses (Table 3-11). In total, hunting and fishing generated about $8.1 million, which can be assumed as an estimate of wildlife habitat value. Visitors for sightseeing and wintering activities can also be considered to add to the wildlife habitat value of the lake.

Similar to recreation benefits, there is likely some additional consumer surplus not captured by the existing fees. In other words, some visitors may be willing to pay more than the existing fees for hunting and fishing. An additional method to estimate wildlife habitat is to consider the fees to construct and maintain wetlands around the lake. Constructed wetlands provide similar habitat and costs can be transferred as the value of natural wildlife habitat.

3.3.4 Water Supply

Milford Lake provides water supply to Kansas residents and businesses, which results in economic benefits as water is used for various purposes. Water supply benefits are generally measured through consumer willingness to pay, in accordance with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. Willingness to pay can be estimated using avoided costs for alternative water supplies. In general, the least cost alternative reflects the water supply benefit. For this analysis, alternative water supplies include construction of a new reservoir. Construction costs for Tuttle Creek Lake, Milford Lake, and Perry Lake reservoirs were collected to identify potential reservoir construction costs. Construction costs were adjusted to 2010 dollars using ENR-CCI index.

Mitigation costs were also added to construction costs to calculate the total reservoir cost. Mitigation costs reflect stream compensation and were calculated by KWO using the USACE Kansas Stream Mitigation Guidance and debit calculator.[7] The KWO estimated the total perennial and stream miles inundated by the 3 reservoirs and assumed a dam width of 1,000 feet for debit calculations. Debit calculations are included in Appendix B. Table 3-16 summarizes perennial and intermittent stream miles inundated by the reservoirs used to calculate mitigation costs, shown in Table 3-14 below.

[7] USACE Kansas Stream Mitigation Guidance (KSMG) – Version 2, 25 June 2010
http://www.nwk.usace.army.mil/regulatory/CompMit/KS/KSMG_Guidance_25Jun2010.pdf
KSMG Spreadsheet - September 2010

Table 3-16
Stream Miles Inundated by Reservoirs

Reservoir	Stream Type (miles)		Total (miles)
	Intermittent	Perennial	
Perry Lake	40.3	46.2	86.6
Milford Lake	40.2	43.9	84.2
Tuttle Creek Lake	28.7	44.1	72.8

Tuttle Creek Lake Reservoir has 99,068 acre-feet dedicated to in-service water supply uses, which is 4.2 percent of the total reservoir storage volume of 2,367,017 acre-feet. The reservoir has 241,747 acre-feet dedicated to water conservation uses, which allows for future increases in water supply.

Milford Lake Reservoir has 117,491 acre-feet dedicated to in-service water supply uses, which is 10.3 percent of the total reservoir storage volume of 1,145,485 acre-feet. The reservoir has 346,785 acre-feet dedicated to water conservation uses.

Perry Lake Reservoir has 32,739 acre-feet dedicated to in-service water supply uses, which is 4.3 percent of the total reservoir storage volume of 765,100 acre-feet. The reservoir has 196,394 acre-feet dedicated to water conservation uses.

Table 3-17 presents total construction costs, estimated at the midpoint of the construction period, for the three reservoirs.

Table 3-17
Reservoir Construction and Mitigation Costs

Reservoir	Construction Cost	Construction Cost (2010 $)	Mitigation Costs (2010 $)	Total Costs (2010 $)
Perry Lake	$48,371,706 (1966 $)	$419,442,978	$1,090,246,250	$1,509,689,228
Milford Lake	$48,268,843 (1963 $)	$473,366,811	$1,027,581,175	$1,500,947,986
Tuttle Creek Lake	$80,051,031 (1957 $)	$976,976,395	$805,593,675	$1,782,570,070

Table 3-18 summarizes the fraction of total reservoir costs for water supply purposes. The reservoir costs attributed to water supply indicate the amount it would cost to develop a new water supply for Kansas residents. These costs would be avoided by providing water from Milford Lake for water supply purposes, and reflect the value of the water supply. The lowest cost alternative for reservoir construction would be $756 per acre-foot. This would be the incremental benefit of increased water supply at Milford Lake. Based on in-service water supply of 117,491 acre-feet, total water supply value at Milford Lake would be about $88.8 million.

Table 3-18
Reservoir Costs for Water Conservation Purpose

Reservoir	Percentage of Total Reservoir Storage for Water Conservation	Reservoir Costs Attributed to Water Conservation	Cost per acre-foot
Perry Lake	4.3%	$64,916,637	$1,983
Milford Lake	10.3%	$154,597,643	$1,316
Tuttle Creek Lake	4.2%	$74,867,943	$756

3.4 Summary and Conclusions

Milford Lake is an important recreational asset that contributes substantially to the local economy of Geary County. The lake also provides wildlife and water supply benefits. An average of about 675,000 people visit the lake each year, approximately 70 percent visit April through September. Fishing and sightseeing activities have the largest amount of visitors.

Table 3-19 shows recreation at the lake generates about $17.1 million in direct spending annually. Day users that boat contribute most to annual spending, about $6.2 million. Marina slip rentals contribute up to $275,000 per year. State charges for hunting and fishing licenses generate about $4.3 million, based on annual visitation data for hunting and fishing at Milford Lake.

Milford Lake supports habitat for migratory and native waterfowl and several game species. Habitat value was estimated as willingness to pay for hunting and fishing uses. Based on this method, habitat at Milford Lake would be about $8.1 million.

Lastly, Milford Lake provides water supply to Kansas residents. Based on existing reservoir construction and mitigation costs, water supply benefits from the lake would be about $88.8 million.

Table 3-19
Summary of Benefits at Milford Lake

Use	Annual Benefits
Recreation[1]	$17.1 million
Hunting and Fishing License Revenue	$4.3 million
Habitat Value	$8.1 million
Water Supply	$88.8 million

[1] Direct Spending

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Section 4
Tuttle Creek Lake

4.1 Background

Tuttle Creek Lake is located in Riley and Pottawatomie Counties, Kansas near the City of Manhattan, Kansas (Figure 4-1). In 2009, Riley County had a population of 71,341 and Pottawatomie had a population of 19,994. Manhattan, in Riley County, is the 8th largest city in the State with an estimated 2009 population of 52,836.

Figure 4-1
Tuttle Creek Lake Location Map

Tuttle Creek Lake was constructed beginning in 1952 with multipurpose objectives including flood control, water supply, recreation, water quality, navigation, and wildlife. The cost of construction of the dam and reservoir was approximately $80 million.[1] It has been estimated that the lake has provided $6,419,311,000 in flood damage prevention since its construction.[2]

The State of Kansas has under contract 99,068 acre-feet of the conservation pool in Tuttle Creek Lake to be used for water supply purposes. All of this storage has been called into service by the State.

The local economy benefits from recreation and visitor spending at Tuttle Creek Lake. One private marina and numerous private, State and Federal owned parks attract visitors to Tuttle Creek Lake for camping, hunting, fishing, boating, sightseeing, and other outdoor activities (Figure 4-2).

Tuttle Creek Lake[3]	
Drainage Area, square miles	9,628
Total Storage Volume, acre-feet	2,257,185
Conservation Pool Elevation, feet	1075.0
Flood Pool Elevation, feet	1136.0
Water Surface, acres	12,350
Shoreline, miles	100

The Kansas Reservoir Assessment included the collecting and review of existing data to document these uses and to estimate impacts to uses due to changes in lake water levels. The data collected was then used to perform an economic valuation of recreation activities and visitor spending. This section describes the data collection and economic valuation performed for Tuttle Creek Lake. Section 5 discusses the impacts to existing uses due to changes in water levels.

4.2 Data Collection and Review

Data pertaining to the study was collected and reviewed. The data included interviews of the lake operations manager and concessionaries, USACE estimated visitation data and usage breakdown, historical lake elevations, critical elevations for open water access, and previous economic studies related to the Kansas Reservoir Assessment.

4.2.1 Site Visit and Interviews

One site visit was conducted at Tuttle Creek Lake to gather information related to the study that was readily available at the lake project office and to conduct in-person interviews with concessionaries. The purpose of the interviews was to gather information on existing operations and to collect data on how operations are impacted during high and low water levels. On May 11, 2010, CDM conducted a site visit to Tuttle Creek Lake and interviewed the following individuals:

[1] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, August 27, 2010
[2] Email correspondence with Allen Holland, Senior Economist, USACE – Kansas City, December 20, 2010
[3] Tuttle Creek Lake Website. Accessed 2010. http://www.nwk.usace.army.mil/tc/

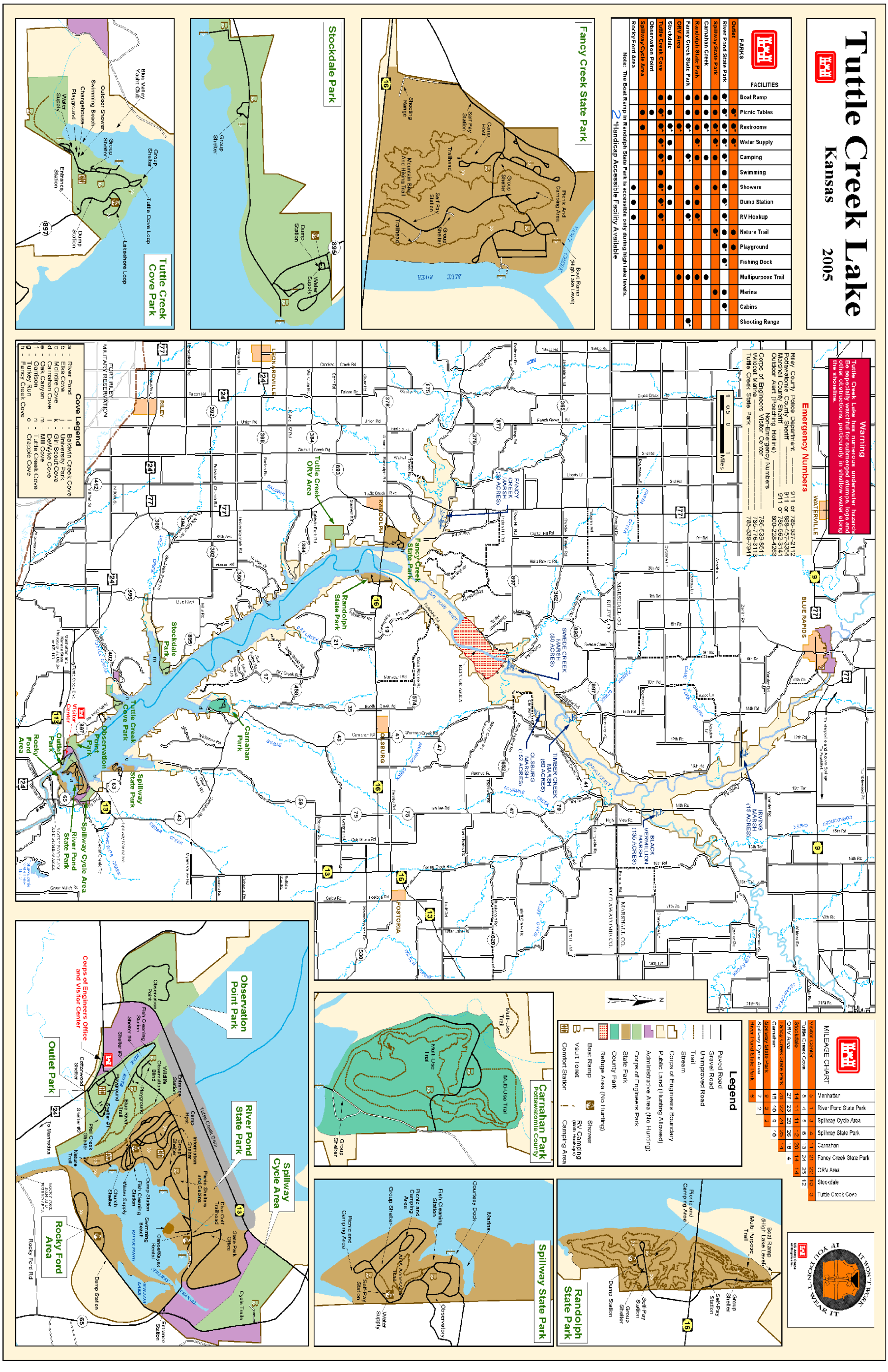

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Figure 4-2
Tuttle Creek Lake Parks and Recreation Features

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- USACE Tuttle Creek Lake Project Office – Project Manager Mr. Brian McNulty
- KDWP Representatives – Manager of Wildlife Area Mr. James Svaty; Region Manager Mr. Chuck Bever; Fisheries Mr. Ely Sprenkle; State Park Manager Mr. Todd Lovin
- Wildcat Marina – Owner Ms. Autumn Wright
- KSU Rowing – Mr. Tony Staten
- Blue Valley Yacht Club (BVYC) – Mr. Jim Crespino

4.2.1.1 USACE Tuttle Creek Lake Operations Project Manager

Mr. Brian McNulty is the current operations project manager at the Tuttle Creek Lake Project Office. To assist with documenting existing uses and economic valuation of recreation, Mr. McNulty provided rate sheets for camping facilities and total number of campsites for each park.

To assist with estimating the impacts of water levels on existing uses, Mr. McNulty completed a Quality of Recreation Use Survey for estimating the quality of recreation benefits at Tuttle Creek Lake under several different water surface elevations, high pool, normal pool, low pool, and very low pool. This survey is discussed in more detail in Section 4.2.5.

4.2.1.2 KDWP Representatives

To assist with documenting existing uses and economic valuation of recreation, four KDWP representatives were asked to provide information on park usage and occupancy. Mr. James Svaty is the manager of the wildlife area, Mr. Chuck Bever is the region manager, Mr. Ely Sprenkle works in fisheries, and Mr. Todd Lovin is the State park manager at Tuttle Creek Lake.

Four State parks are located around the lake and one is below the dam. Typically camping is at 100 percent occupancy for all parks during special events and holiday weekends. Anglers typically come from within 50 miles. Wildlife areas north of the lake include six marshes that are used for waterfowl habitat and hunting. Mr. Svaty mentioned that there are hunter survey cards that are collected which indicate that waterfowl hunters come from all 50 States.

In addition, the representatives from KDWP were interviewed regarding potential impacts to park and wildlife area use during high and low water levels. Tuttle Creek Lake can see large fluctuations in water levels over a short period of time. Rarely the lake experiences water surface increases as much as 6 feet in one day. This is due to the layout and location of the watershed (large but also mostly in a wetter area of the State) and the topography around the lake (long and narrow). Typically, when a navigation release is required the KWO will recommend the water come from Tuttle Creek Lake because it has the capability to fill up quicker than the other lakes.

Mr. Bever, KDWP regional manager, expressed difficulties in managing wildlife habitat on Tuttle Creek Lake due to water level decreases made for navigation releases. He expressed that untimely draw down is damaging to fish habitats. A drawdown in the middle of summer is detrimental to fish management because large flows move fish through the outlet and cause them to migrate from the lake. The lake experiences higher turbidity at elevation 1072 feet which impacts fish habitat, crappie, and white bass population.

Ideally, KDWP park managers would like to see the water level at 3 feet above conservation pool to provide better boating conditions for the park users. A low pool during a holiday weekend is detrimental to park usage and a decrease in visitation has been observed. Large releases (greater than 20,000 cfs) at the outlet cause flooding at the River Pond Park located below the dam.

When the lake is at 1072 feet, only two of the six marshes are available for hunting. These marshes are fed by pumps, one from groundwater, and one from the channel that feeds the reservoir. These marshes are also smaller than their usual size when lake elevation is less than 1072 feet, which tends to concentrate the hunting population. For the wildlife areas along the river, higher water levels (greater than 1080 feet) are more detrimental than lower water levels because crop fields flood. The potential 3 foot drawdown before October 1 and the 6 foot drawdown after October 1 for navigation releases could be detrimental to waterfowl hunting.

4.2.1.3 Wildcat Marina

Ms. Autumn Wright has been the owner of Wildcat Marina since 2005. The marina has a total of 63 boat slips and four jet ski slips. The slips are on cables, which allow the facility to move up and down with lake levels. Ms. Wright estimates that 30 percent of her revenue is gas and groceries, while 70 percent is slip rentals. Wildcat Marina sees visitors from within the State, including Wichita and Kansas City, and from out of State, primarily Nebraska.

Ms. Wright was interviewed regarding impacts to marina operation and use during high and low water levels. In 2007 and 2008, the marina experienced a loss in revenue of $30,000 per month due to high water levels (1090 to 1100 feet). At this time, there was no way to ferry boat owners into the marina. In 2005, the water was low (1072 feet and below) and boats had to be removed from 22 slips that reside in shallow areas. Typically, refunds are made if slips are inaccessible in August, but not if low water levels occur near the end of the lease season (April 15 to October 15). At high water levels, the marina does allow visitors to rent boats.

4.2.1.4 KSU Rowing Team

Mr. Tony Staten has been affiliated with the KSU rowing team since 2005. Mr. Staten was interviewed to gather data on recreation use related to the KSU rowing team. The varsity rowing team uses the lake beginning the last part of August through December 15. Then is back on the lake in mid-March until mid-May at which point the students leave the campus for the summer.

The lake is also used for a club program run by the Kansas Rowing Association (KSRA), which has high school and masters groups. There is also a KSU men's club team that uses the facilities. The varsity team hosts one home competition a year usually scheduled for the fall. Competitions do not typically draw many spectators. KSRA races in the summer.

The KSU rowing team is essential to KSU Division I sports classification because the university must have 16 team sports to maintain status. Scholarships are given to between 30 and 35 students for rowing ranging from full tuition to tuition and living expenses depending upon the situation.

Mr. Staten was also interviewed on how lake water levels impact the rowing club's activities. At a lake elevation of 1090 feet and above the water is at the bottom of the stairs that the team uses to launch the boats and it is difficult to get the boats in and out of the water. Debris is also a problem with high lake levels. With a north wind, the team can only row in the cove area. It is typical that the team has to limit practice to the cove 3 or 4 days of the week due to high winds. A minimum 3 foot depth in the cove is sufficient for rowing if the bottom is clear of underwater hazards. Therefore, low water levels where the cove is less than 3 feet deep would reduce the number of days the team can practice. If the lake gets below 1072 feet, rowing is hazardous.

As a former marina owner on the lake, Mr. Staten stated that the most revenue loss was from debris in the cove under high water situations. In 2006 or 2007, 40 acres of debris was reportedly against the dam face. Approximate 70 percent of customers at the marina under Mr. Staten's ownership were local Manhattan residents.

4.2.1.5 Blue Valley Yacht Club

Mr. Jim Crespino is the current president of the BVYC. BVYC membership is approximately 50 members with most members being local with the exception of one member who resides in Wichita, Kansas. Members of the club moor between 18 and 22 boats at the club cove. The club stores approximately 25 day sail boats on land at the site. Membership fees are $100 with $150 per season for mooring and $85 per season for on-land storage. Membership monies are used for maintenance of facilities (moving, painting, fixing) and to pay the lease to USACE.

BVYC also sponsors local Sea-Base scouting camp one weekend per year. Sea Scouts also use the site for storage and have access all year. KSU sailing club has 6 to 10 members who use the site. From mid-April to the end of September there are between 6 to 8 member boats using the lake on any given weekend.

Mr. Crespino was interviewed to determine the impacts of lake water levels on BVYC activities. When the lake is low, it is difficult to navigate, but most members are familiar with the lake and know where to leave the cove to avoid getting stuck.

4.2.2 Visitation Data

Table 4-1 shows annual and average visitation at Tuttle Creek Lake from 2001 to 2009. Visitation varies seasonally and is typically higher during the spring and summer. Based on zip code data at campgrounds provided by KDWP, approximately

30 percent of visitors are from within the county and 70 percent originate from outside Riley and Pottawatomie counties, including other counties within Kansas and other States. Table 4-1 indicates that visitation has fluctuated from a low of about 441,000 visitors in 2008 to a high of about 680,000 visitors in 2003. Visitation during 2001 through 2003 was substantially higher than the 9-year average.

Table 4-1
Annual Visitation at Tuttle Creek Lake

Year	Visitors
2001	672,814
2002	746,408
2003	679,663
2004	496,948
2005	570,485
2006	542,748
2007	454,996
2008	441,141
2009	540,228
Average	**571,715**

Source: USACE Operations and Maintenance Business Information Link 2010

The USACE maintains data for monthly visitation by activity. Activities vary by season. Boating and water contact sports decrease during the winter months resulting in hunting and fishing as a larger percentage of total recreation during the these months. The peak recreation season is generally defined as April 1 through September 30. Table 4-2 summarizes average visitation by activity and percentages for the peak and off-peak recreation seasons at Tuttle Creek Lake. During both the peak and off-peak seasons, other and sightseeing are the most popular activities at Tuttle Creek Lake. Fishing, boating, and picnicking have had similar visitation levels during the peak season.

Table 4-2
Visitation Estimates by Recreation Activity at Tuttle Creek Lake

	April - September		October-March	
	Number of Visitors	Percent of Total Visitors	Number of Visitors	Percent of Total Visitors
Camping	10,713	2.9%	7,279	3.6%
Picnicking	25,853	7.0%	16,704	8.3%
Boating	23,235	6.3%	8,710	4.3%
Fishing	26,265	7.1%	19,429	9.7%
Hunting	3,898	1.1%	2,630	1.3%
Water Skiing	7,804	2.1%	887	0.4%
Swimming	12,936	3.5%	2,917	1.5%
Other	156,779	42.3%	73,336	36.5%
Sightseeing	103,194	27.8%	69,146	34.4%
Winter Activities	0	0.0%	-	0.0%
Total	370,676	100.0%	201,039	100.0%

Source: USACE 2010 (email from David White, dated June 14, 2010)

4.2.3 Historical Lake Elevations

Historical lake elevations provided by the USACE are shown in Figure 4-3. Lake levels fluctuate throughout the year and from year to year. The historical lake elevations are compared with visitation estimates in Section 6.

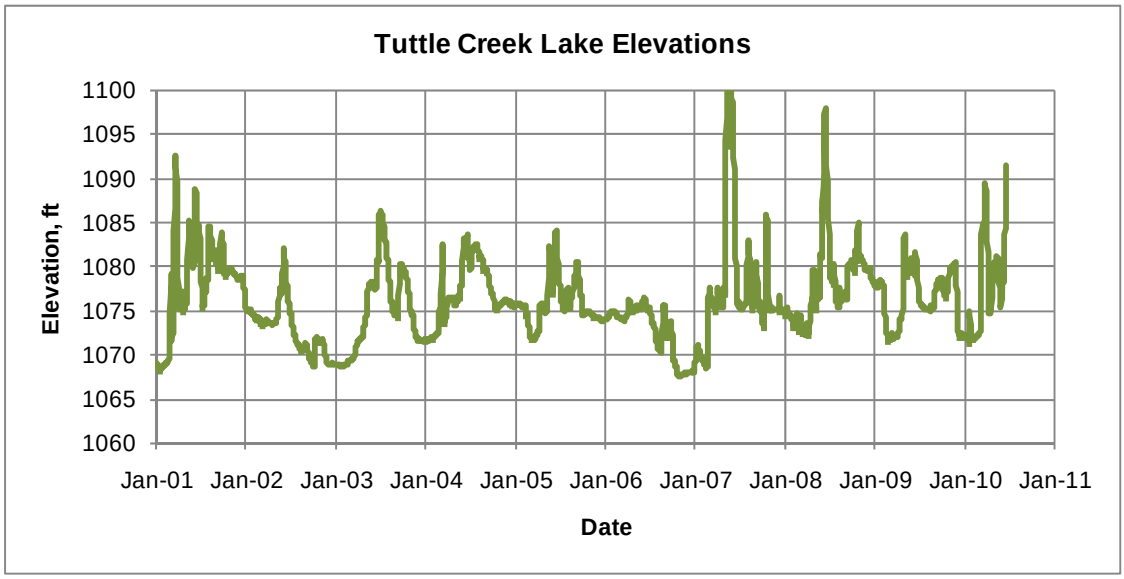

Figure 4-3
Historical Elevations of Tuttle Creek Lake

4.2.4 Critical Elevations

Several critical elevations were identified for Tuttle Creek Lake. Critical elevations are elevations at which facilities become unusable due to either high or low water levels. The USACE supplied elevations for boat ramp bottoms for each boat ramp as shown in Table 4-3. The elevations are not exact, but are estimated to assist boaters in launching during low water conditions. These elevations are used in Section 5 to determine how lake accessibility is impacted as a result of releases for navigation support.

Table 4-3
Tuttle Creek Lake Boat Ramp Elevations

Boat Ramp	Bottom of Ramp, feet
Tuttle Cove Park	1061.47
Spillway State Park	1062.09
Sunset Cove	1064
Mill Cove	1069
Blue Valley Yacht Club	1069
Oak Canyon	1069.2
Lakeside Heights	1069.7
University Park	1070
Stockdale #1	1072

4.2.5 Previous Studies

In 2008, Craig Smith and John Leatherman with KSU studied the economic impact to the region arising from direct recreation expenditures in the area of Tuttle Creek Lake. The study estimated direct economic impacts based on 2007 visitation data and USACE national spending profiles for average daily visitor spending. Table 4-4 summarizes regional economic impacts, including direct and indirect effects, to the region's output, value added, and employment from recreation expenditures for Tuttle Creek Lake[4]. Direct impacts to output were estimated to be about $3.7 million in 2007 dollars.

Table 4-4
Tuttle Creek Lake Total Economic Contributions

Impact Measure	Direct 2007 Dollars	Indirect 2007 Dollars	Total 2007 Dollars
Output	$3.7 million	$1.4 million	$5.1 million
Value Added	$1.7 million	$0.8 million	$2.5 million
Employment	82	15	97

Source: Smith, Craig. Et. al. 2008

The study also evaluated the non-market benefits, or additional consumer surplus attained from recreation at Tuttle Creek Lake. Consumer surplus reflects a visitor's true willingness to pay, which may include any unpaid value enjoyed by visitors for use of the site. Using existing willingness to pay estimates, the study calculated additional non-market benefits of up to $4.5 million annually for recreation opportunities at Tuttle Creek Lake.

The USACE also estimates Value to the Nation of USACE facilities. Similar to Smith and Leatherman (2008), national spending profiles are used to estimate daily visitor spending. In 2006, the USACE estimated the direct regional economic impacts of recreation spending at Tuttle Creek Lake to be about $10.3 million and the indirect effect to be about $7.6 million. Indirect effects were calculated using the IMPLAN model, developed by the Minnesota IMPLAN Group Inc.

4.2.6 Quality of Recreation Use Survey

Mr. McNulty, the USACE Tuttle Creek Lake manager was asked to perform a Quality of Recreation Use Survey for four lake conditions:

- The lake at **normal** pool levels – i.e. the elevation where the lake normally operates.
- The lake at **low** levels – i.e. the elevation where visitors begin to complain that the water levels are too low for good recreation.

[4] Direct effects represent changes in final demand; indirect effects include both indirect and induced impacts. Indirect impacts are changes in expenditures within the region in industries supplying goods and services and induced effects are changes in expenditures of household income. Output represents the value of production of goods and services by businesses in the regional economy. Value added consists of wages and salaries, proprietor's and property incomes, dividends and interest, and indirect business taxes.

- The lake at **very low** levels – i.e. the elevation where the lake is at or approaching the lower limit of the conservation pool.

- The lake at **high** levels – i.e. the elevation where visitors begin to complain that water levels are too high for good recreation.

Elevations were chosen to represent the threshold pool elevations for each of the lake conditions above. Table 4-5 shows these elevations.

Table 4-5
Threshold Pool Elevations for Tuttle Creek Lake

Lake Condition	Elevation, feet
High Pool	1090
Normal Pool	1075
Low Pool	1072
Very Low Pool	1069

The quality of recreation use rating was based on five criteria:

- Recreational experiences available

- Availability of alternative comparable facilities

- Carrying capacity

- Accessibility

- Environmental/aesthetic quality

Each criterion has five sub-categories that have point values that can be assigned. Figure 4-4 shows each criterion and corresponding judgment factors. In evaluating the criterion, Mr. McNulty first made a judgment of which sub-category best represents the situation at the lake, and then picked an appropriate point value within the range of points available. This procedure generally follows the instructions of Economics Guidance Memorandum 09-03 for computing unit day values for recreation.

The results of the quality of recreation survey are presented in Figure 4-5. The survey shows a reduction in the quality of recreation for high (blue column), low (yellow column) and very low (purple column) water levels, with high water levels causing the largest relative reduction in quality of recreation compared to what is experienced at normal pool elevations.

Criteria	Judgment factors					Points
1. Recreation experience Total points possible: 30	Two general activities[1] 0 – 4 pts.	Several general activities 5 – 10 pts.	Several general activities; one high quality value activity[2] 11 – 16 pts.	Several general activities; more than one high quality value activity 17 – 23 pts.	Numerous high quality value activities; some general activities 24 – 30 pts.	
2. Availability of other comparable facilities Total points possible: 18	Several within 1 hour travel time; a few within 30 minute travel time 0 – 3 pts.	Several within 1 hour travel time; none within 30 minute travel time 4 – 6 pts.	One or two within 1 hour travel time; none within 45 minute travel time 7 – 10 pts.	None within 1 hour travel time 11 – 14 pts.	None within 2 hour travel time 15 – 18 pts.	
3. Carrying capacity (facility ability to meet demands Total points possible: 14	Minimum facility development for health and public safety 0 – 2 pts.	Basic facility to conduct activities 3- 5 pts.	Adequate facilities to conduct without deterioration of the resource or the activity experience 6 – 8 pts.	Facilities provide better than average ability to meet demands at site 9 – 11 pts.	Facilities provide ultimate ability to meet demands at site 12 – 14 pts.	
4. Accessibility (to site and within site) Total points possible: 18	Limited access to site or within site 0 – 3 pts.	Fair access, poor quality roads to site; limited access within site 4 – 6 pts.	Fair access, fair quality roads to site; fair – good access within site 7 - 10 pts.	Good access, good quality roads to site; fair – good access within site 11 - 14 pts.	Good access, high standard roads to site; good access within site 15 - 18 pts.	
5. Environmental/ Aesthetic Quality Factors[3] Total points possible: 20	Low aesthetic factors that significantly lower quality 0 – 2 pts.	Average aesthetic quality factors that lower quality to a minor degree 3 – 6 pts.	Above average aesthetic quality factors 7 - 10 pts.	High aesthetic quality factors 11 – 15 pts.	Outstanding aesthetic quality factors 16 – 20 pts.	
					Total Points Assigned:	

Additional points to note in rating:

[1] General activities are those that are common to the region.
[2] High quality value activities are those that are uncommon to the region, and/or which are of unusually high quality.
[3] Factors to consider include toporgraphy, water quality, vegetation, pests, climate, adjacent areas.

Figure 4-4
Quality of Recreation Survey Criterion and Judgment Factors

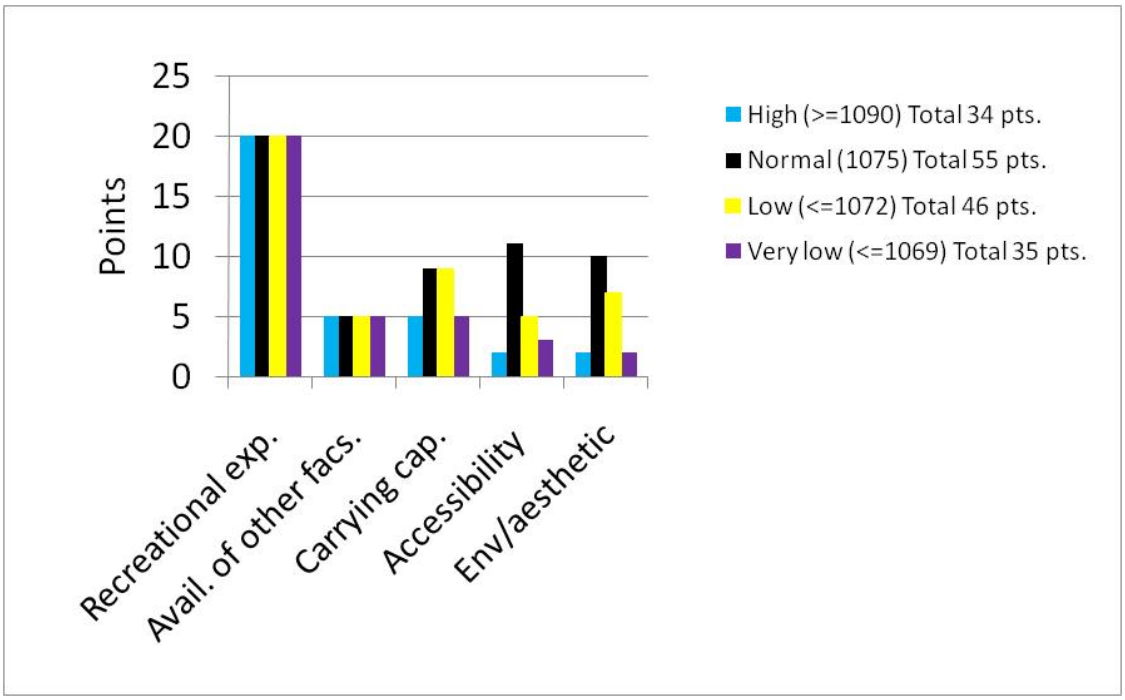

Figure 4-5
Quality of Recreation Survey Results for Tuttle Creek Lake

4.3 Economic Evaluation

The economic evaluation for Tuttle Creek Lake was performed to estimate contributions to the regional economy from recreation and water supply benefits. The sections below give a brief overview of the regional economy and are followed by the valuation of recreation and water supply benefits.

4.3.1 Regional Economy

The regional economic study area for Tuttle Creek Lake is defined as Riley and Pottawatomie counties where Tuttle Creek Lake dam and facilities associated with recreation at the lake are located. A summary of the regional economy is presented below.

4.3.1.1 Household and Personal Income

Riley County

Table 4-6 shows household income characteristics in Riley County from the 2006 to 2008 American Community Survey[5]. In 2008, about 9.7 percent of individuals lived below the poverty level.

[5] American Community Survey data is collected during calendar years 2006, 2007, and 2008 and is available for geographic areas with populations of 20,000 or more.

Table 4-6
2008 Household[1] Income in Riley County

Income Range	Number	Percent
Less than $10,000	2,829	11.8%
$10,000 to $14,999	1,272	5.3%
$15,000 to $24,999	3,454	14.4%
$25,000 to $34,999	2,881	12.0%
$35,000 to $49,999	4,055	16.9%
$50,000 to $74,999	3,867	16.1%
$75,000 to $99,999	2,503	10.4%
$100,000 to $149,999	2,067	8.6%
$150,000 to $199,999	762	3.2%
$200,000 or more	359	1.5%
Median household income (dollars)	40,096	(X)

[1] Total number of households is 24,049.
Source: US Census Bureau 2010
http://www.factfinder.census.gov/servlet/QTTable?_bm=y&-context=qt&-qr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-tree_id=403&-redoLog=true&-all_geo_types=N&-_caller=geoselect&-geo_id=05000US20161&-search_results=01000US&-format=&-_lang=en

In 2008, Riley County had a total personal income of about $2.7 billion. The per capita personal income was $38,025, which ranked 37th in the State and was 98 percent of the State average of $38,886. The 2008 per capita personal income reflected an increase of 6.9 percent from 2007. In 1998, the per capita personal income of Riley County was $19,966 and ranked 89th in the State. The 1998-2008 average annual growth rate was 6.7 percent.

Pottawatomie County

Table 4-7 shows household income characteristics in Pottawatomie County from the 2000 Census. In 1999, about 9.7 percent of individuals lived below the poverty level.

Table 4-7
1999 Household[1] Income in Pottawatomie County

Income Range	Number	Percent
Less than $10,000	517	7.6
$10,000 to $14,999	460	6.7
$15,000 to $24,999	921	13.5
$25,000 to $34,999	965	14.2
$35,000 to $49,999	1,410	20.7
$50,000 to $74,999	1,498	22
$75,000 to $99,999	633	9.3
$100,000 to $149,999	332	4.9
$150,000 to $199,999	36	0.5
$200,000 or more	46	0.7
Median household income (dollars)	40,176	

[1] Total number of households is 6,818.
Source: US Census Bureau 2000
http://www.factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=05000US20149&-qr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-_lang=en&-_sse=on

In 2008, Pottawatomie County had a total personal income of about $700 million. The per capita personal income was $35,382, which ranked 57th in the State and was 91 percent of the State average of $38,886. The 2008 per capita personal income reflected an increase of 5.8 percent from 2007. In 1998, the per capita personal income of Pottawatomie County was $21,507 and ranked 67th in the State. The 1998 to 2008 average annual growth rate was 5.1 percent.

4.3.1.2 Industry and Employment

Riley County

Table 4-8 shows industry earnings and employment in Riley County in 2008. The industries with the highest earnings were government and government enterprises and health care and social assistance. The industries with the highest employment were government and government enterprises and retail trade, followed closely by accommodation and food services. Retail trade employed 3,874 people and earned about $89.7 million in 2008. Accommodation and food services employed 3,728 people and earned about $53.3 million.

Table 4-8
2008 Industry Earnings and Employment Estimates in Riley County

Industry	Industry Earnings (1,000 $)	Employment (number of employees)
Forestry, fishing, and related activities	(D)	(D)
Mining	(D)	(D)
Utilities	(D)	(D)
Construction	$82,503	1,949
Manufacturing	$34,590	847
Wholesale trade	$36,619	810
Retail trade	$89,730	3,874
Transportation and warehousing	(D)	(D)
Information	$33,232	894
Finance and insurance	$51,508	1,245
Real estate, rental, and leasing	$15,489	938
Professional, scientific, and technical services	$51,458	1,291
Management of companies and enterprises	$10,571	143
Administrative and waste services	$57,445	2,607
Educational services	$17,038	652
Health care and social assistance	$149,778	3,402
Arts, entertainment, and recreation	$4,659	437
Accommodation and food services	$53,292	3,728
Other services, except public administration	$74,474	2,286
Government and government enterprises	$598,550	11,674
Total	$1,386,133	37,664

(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals
Source: BEA 2010
http://www.bea.gov/regional/reis/action.cfm

Table 4-9 shows number of establishments by industry and sales in Riley County, provided by the 2007 Economic Census. Professional, scientific, and technical services had the most establishments in the county, 608 employer and non-employer establishments. Retail trade had 552 total establishments and accommodation and food services had 176 total establishments in the county. Retail trade had the highest sales of all industries, based on the reported data.

Table 4-9
Industry Establishments and Sales in Riley County, 2007

Industry Description	Number of Employer Establishments	Employer Sales, Shipments, Receipts, Revenue, or Business Done ($1,000)	Number of Nonemployer Establishments[1]	Nonemployer Sales, Shipments, Receipts, Revenue, or Business Done ($1,000)
Manufacturing	28	D	32	$1,311
Retail trade	270	$728,603	282	$7,162
Information	33	N	40	$338
Real estate and rental and leasing	105	$50,335	303	$22,586
Professional, scientific, and technical services	156	D	452	$10,244
Administrative and Support, Waste Management, and Remediation Services	67	$79,648	183	$2,524
Educational services	23	D	124	$840
Health care and social assistance	167	$257,949	263	$7,831
Arts, entertainment, and recreation	26	$10,749	147	$1,638
Accommodation and food services	158	$125,435	18	$818
Other services (except public administration)	135	$279,334	303	$6,038

[1] A nonemployer establishment is a business that does not have any paid employees
D: Withheld to avoid disclosing data for individual companies
N: Not available or not comparable
Source: U.S. Bureau of the Census, 2007 Economic Census, accessed 2010
http://factfinder.census.gov/servlet/GQRTable?_bm=y&-ds_name=EC0700A1&-geo_id=05000US20161&-_lang=en

Pottawatomie County

Table 4-10 shows industry earnings and employment in Pottawatomie County in 2008. The industries with the highest earnings were manufacturing and government and government enterprises. The industries with the highest employment were manufacturing, health care and social assistance, and government and government enterprises. Retail trade employed 1,592 people and earned about $32.8 million in 2008. Accommodation and food services employed 494 people and earned about $6.5 million.

Table 4-10
2008 Industry Earnings and Employment Estimates in Pottawatomie County

Industry	Industry Earnings (1,000 $)	Employment (number of employees)
Forestry, fishing, and related activities	(D)	(D)
Mining	590	57
Utilities	(D)	(D)
Construction	42,576	1,479
Manufacturing	103,005	2,094
Wholesale trade	20,604	588
Retail trade	32,845	1,592
Transportation and warehousing	(D)	(D)
Information	13,306	325
Finance and insurance	15,195	737
Real estate and rental and leasing	8,688	774
Professional, scientific, and technical services	(D)	(D)
Management of companies and enterprises	(D)	(D)
Administrative and waste services	27,541	759
Educational services	1,829	233
Health care and social assistance	36,475	1,675
Arts, entertainment, and recreation	1,833	383
Accommodation and food services	6,464	494
Other services, except public administration	19,163	803
Government and government enterprises	56,991	1,515
Total	463,570	16,023

Source: BEA 2010
http://www.bea.gov/regional/reis/action.cfm
(D) Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.

Table 4-11 shows number of establishments by industry and sales in Pottawatomie County, provided by the 2007 Economic Census. Retail trade had the most establishments in the county, 279 employer and non-employer establishments. Accommodation and food services had 47 total establishments in the county. Manufacturing had the highest sales of all industries, based on the reported data.

Table 4-11
Industry Establishments and Sales in Pottawatomie County, 2007

Industry description	Number of employer establishments	Employer sales, shipments, receipts, revenue, or business done ($1,000)	Number of nonemployer establishments[1]	Nonemployer sales, shipments, receipts, revenue, or business done ($1,000)
Manufacturing	33	329,645	19	357
Retail trade	98	283,927	181	4,690
Information	10	N	11	76
Real estate, rental, and leasing	21	7,776	83	5,248
Professional, scientific, and technical services	43	D	135	4,165
Administrative and Support, Waste Management, and Remediation Services	34	14,863	129	1,392
Educational services	3	D	32	295
Health care and social assistance	49	56,254	147	3,022
Arts, entertainment, and recreation	7	2,428	60	460
Accommodation and food services	32	11,780	15	1,056
Other services (except public administration)	46	10,492	173	4,325

[1] A nonemployer establishment is a business that does not have any paid employees
D: Withheld to avoid disclosing data for individual companies
N: Not available or not comparable
Source: U.S. Bureau of the Census, 2007 Economic Census
http://factfinder.census.gov/servlet/GQRTable?_bm=y&-geo_id=05000US20149&-ds_name=EC0700A1&-_lang=en

4.3.1.3 Sales Tax

The Kansas retailers' sales and use taxes is a combination of the State rate of 6.3 percent, effective October 2010, plus any local tax percentage levied by a county or a city. Riley County and Pottawatomie County each impose a local sales tax of 1.0 percent, resulting in a total of 7.3 percent sales tax in the counties.

Local tax distributions are disbursed to cities, counties, and other local governments by the State. The Kansas Department of Revenue is responsible for the correct allocation of the funds. The amounts are based on the local share of retail sales and use taxes collected. Tables 4-12 and 4-13 show State sales tax collected from Riley County and Pottawatomie County and local tax distribution to the counties, respectively.

4.3.2 Recreation

Recreation at Tuttle Creek Lake contributes to the regional economy. Visitors from outside Riley and Pottawatomie counties travel to Tuttle Creek Lake for recreation activities, including hiking, swimming, boating, camping, hunting, fishing, and picnicking. Tuttle Creek Lake has multiple facilities, including campgrounds, cabins, trails, marinas, picnic rentals, and boat rentals. Visitor spending at these facilities and other businesses, such as local food stores, fuel stations, and equipment stores, helps support the economy. Multiple industries benefit from recreation expenditures,

including, but not limited to retail trade, arts, entertainment, and recreation, accommodation and food services, and other services.

Table 4-12
Riley County Sales Tax State Collection and Local Distribution, 2005 through 2009

Year	State Sales Tax Collections	Local Sales Tax Distribution
2005	$30,531,829	$6,275,560
2006	$35,286,170	$6,973,620
2007	$37,023,284	$7,475,109
2008	$39,411,429	$7,893,105
2009	$35,375,240	$7,785,340

Source: Kansas Department of Revenue
http://www.ksrevenue.org/salesreports.htm

Table 4-13
Pottawatomie County Sales Tax State Collection and Local Distribution, 2005 through 2009

Year	State Sales Tax Collections	Local Sales Tax Distribution
2005	$17,760,437	$2,067,913
2006	$19,948,607	$3,918,981
2007	$20,286,150	$4,002,684
2008	$21,110,503	$4,281,122
2009	$17,919,759	$4,121,402

Source: Kansas Department of Revenue
http://www.ksrevenue.org/salesreports.htm

4.3.2.1 Tuttle Creek Lake Park Fees

KDWP and USACE charges fees for use of park facilities. Facility fees are often higher during the peak season than the off peak season. Day visitors at Tuttle Creek Lake can pay various fees depending on the activity. Vehicle fees are $3.70 and $4.20 during fall and summer, respectively, at KDWP parks. Picnic rentals are $25.00 per day or $21 per day in the River Pond Area at Tuttle Creek Park. Visitors can also rent kayaks, canoes, or tubes at Tuttle Creek Park. Kayaks and canoes rent for $20 per day and tubes rent for $6 per day. Boat ramp fees are $3 per boat at Tuttle Creek Cove Park. The USACE makes available a $30 annual day use pass.

Campground fees vary slightly among campgrounds. Table 4-14 summarizes the primary fees for each campground. Other fees apply for utility hookups, sewage dump, second vehicles, group camping, long-term camping, etc. The State parks have seven cabins with fees of $65 per night for peak season weekends, $55 per night for peak season weekdays and off-season weekends, and $45 per night during off-season weekdays. Overnight visitors would also need to pay vehicle fees.

Table 4-14
Tuttle Creek Lake Camping Fees

Park	Fee $ per night	
Stockdale Park		
Non Electric	$12	
Tuttle Creek Cove, Carnahan Creek, and Rocky Ford Parks		
Non Electric	$12	
Electric	$18	
Randolph, Spillway, River Pond, and Fancy Creek State Parks		
	4/1 - 9/30	10/1 - 3/31
Daily Permit	$ 8.50	$ 7.50

Wildcat Marina at Tuttle Creek Lake charges for annual slip rentals and boat rentals. Slip rental rates at the Wildcat Marina are $900 per year and $1,000 per year for a 24-foot slip, $1,200 per year for a 30-foot slip, and $1,800 per year for a 42-foot slip. The average rental rate at Wildcat Marina is $1,225 per year. Based on the average rate and full occupancy, the marina receives annual fees from slip rentals of about $77,000 per season. Visitors can also rent boats at Wildcat Marina. Pontoons rental rates are $200 to $250 for a full day rental.

Hunting and fishing licenses are distributed by the State. Hunting licenses are $20.50 per year for residents and $42.50 per year for non-residents. Fishing licenses are $20.50 per year for residents and $72.50 per year for non-residents. Hunting and fishing visitors would also need to pay vehicle fees.

4.3.2.2 Visitor Spending by Activity

Visitors spend money on park fees, fuel, food, equipment, and other expenses related to recreation. Spending varies by recreation activity. Camping and overnight stays are typically more expensive than day trips and boating is more expensive than non-boating activities. This analysis estimates daily spending per person by activity at Tuttle Creek Lake. Local data on campground fees, vehicle fees, boat, equipment, and cabin rentals described above are incorporated into park fees. The USACE has developed national spending profiles to estimate average visitor spending related to grocery, restaurant, fuel, equipment purchases. Data from the spending profiles are added to local fees to estimate total daily spending by visitor. Appendix A provides background information to support daily spending estimates at Tuttle Creek Lake.

Table 4-15 summarizes estimated daily visitor spending by activity at Tuttle Creek Lake. The spending values reflect daily visitor spending within the regional economy. The park fees reflect average daily local fees associated with each activity, including applicable vehicle, trail use, picnicking, boat launch, boat rentals, camping, and cabin fees. The fees for the remainder of spending categories are from the USACE spending profiles. Sporting goods and boat equipment rental fees for Day Use (no boat) were removed because fees are reflected in park fees.

Table 4-15
Average Daily Spending per Person by Activity ($ per visit)
for Tuttle Creek Lake Recreation, 2009 Dollars

Spending Category	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Day Use Including Boat Rental	Camping (with boat)	Camping (no boat)	Cabin Rental
Park Fees	$2.37	$5.94	$1.33	$31.00	$30.25	$22.78	$41.97
Restaurants, bars, etc.	$3.03	$3.77	$3.77	$3.03	$9.09	$10.43	$10.43
Groceries and takeout food	$4.98	$4.98	$4.98	$4.98	$23.18	$18.88	$18.88
Gas and oil	$7.91	$3.13	$3.13	$7.91	$14.33	$9.89	$8.40
Sporting goods and boat equipment	$3.52	$0.00	$0.98	$3.52	$5.41	$1.71	$2.69
Other expenses	$0.57	$1.51	$1.51	$0.57	$3.80	$6.75	$1.92
Total	**$22.37**	**$19.33**	**$15.70**	**$51.00**	**$86.06**	**$70.44**	**$84.28**

Assumptions:
1. Average of 3 people per party for day and overnight use, based on USACE spending profiles
2. Average of 4 nights for overnight use, based on USACE spending profiles
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities
5. Day use and camping (no boat) park fees include average cost of picnic rentals and vehicle fees
6. Day use hunting park fees include vehicle fees and no equipment rental fees
7. Cabin rental park fees includes average cost of car rental and vehicle fees
8. USACE daily spending profiles were adjusted from 1999 to 2009 dollars (USACE profiles used for all categories but park fees)
9. Sporting goods and boat equipment for Day use (no boat) reflected in park fees

4.3.2.3 Total Visitor Spending

Total visitor spending is estimated using recreation visitation data by activity (Section 3.2.2) and the daily spending profiles identified above. Total visitor spending reflects expenditures for all recreation-related activities in the region, including park fees at Tuttle Creek Lake and additional spending at food stores, fuel stations, and other businesses in the county. Table 4-16 shows visitor spending during the peak and off-peak seasons and total annual spending. Approximately 64 percent of total spending occurs April through September.

Table 4-16
Total Annual Visitor Spending for Tuttle Creek Lake Recreation, 2009 Dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$1,281,610	$5,774,643	$61,180	$377,048	$308,621	$164,348	$7,967,451
October – March	$649,170	$3,133,225	$41,286	$229,308	$187,693	$164,348	$4,405,030
Total	$1,930,780	$8,907,868	$102,466	$606,356	$496,314	$328,696	$12,372,481

Assumptions:
1. One half of campers boat
2. Full occupancy at cabins year round, based on site data collection and interview information
3. Day use and camping (with boat) includes the following activities: boating, fishing, and water skiing
4. Day use and camping (no boat) includes the following activities: picnicking, swimming, other, sightseeing, and winter activities

4.3.2.4 Annual Revenues

Recreation at Tuttle Creek Lake also generates some annual revenues. The county benefits from annual marina revenues collected for slip rentals. Interviews with local marina operators indicated marina slips were fully rented out for the whole year. Estimated annual slip rental revenues at Wildcat Marina is about $77,000. The BVYC leases land from the USACE and provides moorings, a private boat ramp, a lift, and a picnic shelter. The membership fee is $100. The Yacht Club charges $150 per boat mooring and $85 to store a boat on land. In 2010, the club had 50 members, 22 moored boats, and 25 boats stored on land. Based on membership and fees, the BVYC earned about $10,500 per year.

The State collects hunting and fishing license revenues. Table 4-17 summarizes license fees for residents and non-residents. It is assumed that 85 percent of visitors are from within the State and 15 percent are non-residents. The values in Table 4-17 were calculated based on annual license fees and average annual visitation estimates for hunting and fishing activities

Table 4-17
Annual License Revenues Paid to State from Hunting and Fishing at Tuttle Creek Lake

Hunting		Fishing		Total
Resident	Non-Resident	Resident	Non-Resident	
$113,752	$70,993	$796,210	$291,296	$1,272,252

4.3.2.5 Indirect Economic Effects

The values reported in Sections 4.3.2.3 and 4.3.2.4 represent direct effects of recreation at Tuttle Creek Lake. There is a multiplier effect that generates additional spending in the economy as a result of the direct effect. For example, money spent for food at a local grocery store is used to purchase supplies from wholesalers and pay for employee labor. Wholesalers then spend money for production inputs and employees spend income on other goods and services. The multiplier effect, also referred to as indirect effects, generally continue until money leaves the region's economy. This analysis does not estimate indirect effects. Input-output models, such as IMPLAN, are commonly used to calculate regional economic effects using multipliers.

Visitors from outside the region are especially important for the regional economy and multiplier effect. Residents from the region that spend money for recreation at Tuttle Creek Lake would likely spend their money, or a portion of it, elsewhere in the economy, if not at Tuttle Creek Lake. Money may be spent in different industry sectors, but it would remain in the region. Outside visitors bring new money into the region, which increases spending in the regional economy. As described above, approximately 70 percent of visitors to Tuttle Creek Lake originate from outside Riley and Pottawatomie counties. Therefore, 70 percent of the total spending shown in Table 4-15 would be "new" to the region. Table 4-18 shows estimated spending by out-of-region visitors. The multiplier effect should be calculated using out-of-region spending estimates. Approximately $8.7 million is spent by non-county residents on

recreation at Tuttle Creek Lake. Day use non-boating activities in the reservoir have the highest spending values, about $6.2 million.

Table 4-18
Total Annual Visitor Spending by Out-of-Region Visitors to Tuttle Creek Lake, 2009 dollars

	Day Use (with boat)	Day Use (no boat)	Day Use Hunting (no boat)	Camping (with boat)	Camping (no boat)	Cabin Rental	Total
April – September	$897,127	$4,042,250	$42,826	$263,934	$216,035	$115,044	$5,577,215
October – March	$454,419	$2,193,258	$28,900	$160,516	$131,385	$115,044	$3,083,521
Total	$1,351,546	$6,235,507	$71,726	$424,449	$347,420	$230,087	$8,660,736

Assumptions:
70 percent of visitors are from outside Riley and Pottawatomie counties, based on campground zip code data

Previous studies have been completed that estimate potential multiplier effects of recreation at Tuttle Creek Lake. *Economic Contributions of Recreation at Tuttle Creek Lake* (2008) estimated indirect economic impacts of about $1.4 million in total output. The USACE *Estimating the Local Economic Impacts of Recreation at Corps of Engineer Project – 196* (1998) reported sales multipliers at Milford Lake to range from 1.23 to 1.69, meaning that each dollar spent for direct sales results in $0.23 to $0.69 in indirect sales. Milford Lake is the closest lake to Tuttle Creek Lake that was estimated in the USACE report, and can appropriately represent multipliers for Tuttle Creek Lake because of its close proximity. Therefore, with a multiplier of 1.23, indirect annual sales from recreation at Tuttle Creek Lake would be about $2.0 million. Total economic impacts would be about $10.6 million.

Tuttle Creek Lake offers the only water-related recreation opportunity in Riley and Pottawatomie counties. Milford Lake in Geary County, about 25 miles away from Tuttle Creek Lake, offers similar water-related recreation opportunities as Tuttle Creek Lake. Perry and Kanopolis Lakes are about 85 and 115 miles away from Tuttle Creek Lake, respectively. In addition, two State lakes in Pottawatomie County and Pillsbury Crossing in Riley County provide alternate (and quite popular) water-related recreation opportunities. Adverse effects to Tuttle Creek Lake recreation would likely results in visitors going to nearby lakes, taking money away from the county economy.

4.3.2.6 Special Events

Tuttle Creek Lake hosts several special events throughout the year. Special events typically attract more out-of-region visitors to Tuttle Creek Lake than a regular weekend without scheduled events. For some events, park prices increase due to increased demands. Increased spending during special event weekends is an important boost to the County's economy.

The largest annual special event at Tuttle Creek Lake is the Country Stampede, a 4-day concert held over the last weekend June. The event includes performances by multiple hit country music artists with many vendors and exhibitors. In 2010, the event drew 160,000 visitors throughout the weekend. In 2010, campsites could be

reserved for $180 at the gate for the 4 days. Additional vehicle fees for camping were $85 per vehicle. General vehicle fees were $45 per car without access to campground. General admission tickets for the event were $75 for a single day and $130 for the entire 4-day event. Reserved seats cost $275 for the 4-day event. Attendees receive a discount for early purchases. The Country Stampede contributes significant revenues to the regional economy through local retail purchases, hotel accommodations, and sales tax revenues.

Tuttle Creek Lake hosts other special events throughout the year, including but not limited to the following:

- **Fish Tournaments –** Fish tournaments are held at various times throughout the year at Tuttle Creek Lake.
- **Horse Trail Rides –** The Randolph area hosts competitive horse trail rides.
- **Shooting Clinics and Hunter Courses –** The Fancy Creek Shooting Range in Tuttle Creek State Park has instructional shooting workshops. There are also hunter education courses in October with a 50 student capacity.

4.3.3 Wildlife Habitat

Wildlife habitat provides economic and intrinsic values to the user. There are about 12,200 acres of managed lands around the lake that support various wildlife species. Managed species include white-tailed deer, turkey, quail, pheasants, squirrels and doves. KDWP also has 480 acres of constructed wetlands to provide food and shelter to migrating shorebirds and waterfowl.

Many people visit Tuttle Creek Lake for hunting and fishing uses, which is supported by the wildlife habitat at the lake. Visitors are willing to pay for park fees, licenses, equipment, and travel costs. This willingness to pay can infer the economic value to the visitor. Average visitation for hunting and fishing from 2001 to 2009 at Tuttle Creek Lake was about 52,200 visitors, 45,694 for fishing and 6,528 for hunting. Based on Table 4-15, average daily visitor spending was $15.70 and $22.37 per day for hunting and fishing. Visitors also had to purchase hunting or fishing licenses (Table 4-17). In total, hunting and fishing generated about $2.4 million, which can be assumed as an estimate of wildlife habitat value. Visitors for sightseeing and wintering activities can also be considered to add to the wildlife habitat value of the lake.

Similar to recreation benefits, there is likely some additional consumer surplus not captured by the existing fees. In other words, some visitors may be willing to pay more than the existing fees for hunting and fishing. An additional method to estimate wildlife habitat is to consider the fees to construct and maintain wetlands around the lake. Constructed wetlands provide similar habitat and costs can be transferred as the value of natural wildlife habitat.

4.3.4 Water Supply

Tuttle Creek Lake provides water supply to Kansas residents and businesses, which results in economic benefits as water is used for various purposes. Water supply benefits are generally measured through consumer willingness to pay, in accordance with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. Willingness to pay can be estimated using avoided costs for alternative water supplies. In general, the least cost alternative reflects the water supply benefit.

For this analysis, alternative water supplies include construction of a new reservoir. Construction costs for Tuttle Creek Lake, Milford Lake, and Perry Lake reservoirs were collected to identify potential reservoir construction costs. Construction costs were adjusted to 2010 dollars using ENR-CCI index. Mitigation costs were also added to construction costs to calculate the total reservoir cost. Mitigation costs reflect stream compensation and were calculated by KWO using the USACE Kansas Stream Mitigation Guidance and debit calculator.[6] Debit calculations are included in Appendix B. The KWO estimated the total perennial and stream miles inundated by the 3 reservoirs and assumed a dam width of 1,000 feet for debit calculations. Table 4-18 summarizes perennial and intermittent stream miles inundated by the reservoirs used to calculate mitigation costs, shown in Table 4-19 below.

Table 4-19
Stream Miles Inundated by Reservoirs

Reservoir	Stream Type (miles)		Total (miles)
	Intermittent	Perennial	
Perry Lake	40.3	46.2	86.6
Milford Lake	40.2	43.9	84.2
Tuttle Creek Lake	28.7	44.1	72.8

Tuttle Creek Lake Reservoir has 99,068 acre-feet dedicated to in-service water supply uses, which is 4.2 percent of the total reservoir storage volume of 2,367,017 acre-feet. The reservoir has 241,747 acre-feet dedicated to water conservation uses, which allows for future increases in water supply.

Milford Lake Reservoir has 117,491 acre-feet dedicated to in-service water supply uses, which is 10.3 percent of the total reservoir storage volume of 1,145,485 acre-feet. The reservoir has 346,785 acre-feet dedicated to water conservation uses.

Perry Lake Reservoir has 32,739 acre-feet dedicated to in-service water supply uses, which is 4.3 percent of the total reservoir storage volume of 765,100 acre-feet. The reservoir has 196,394 acre-feet dedicated to water conservation uses.

[6] USACE Kansas Stream Mitigation Guidance (KSMG) – Version 2, 25 June 2010
http://www.nwk.usace.army.mil/regulatory/CompMit/KS/KSMG_Guidance_25Jun2010.pdf
KSMG Spreadsheet - September 2010

Table 4-20 presents total construction costs, estimated at the midpoint of the construction period, for the three reservoirs.

Table 4-20
Reservoir Construction and Mitigation Costs

Reservoir	Construction Cost	Construction Cost (2010 $)	Mitigation Costs (2010 $)	Total Costs (2010 $)
Perry Lake	$48,371,706 (1966 $)	$419,442,978	$1,090,246,250	$1,509,689,228
Milford Lake	$48,268,843 (1963 $)	$473,366,811	$1,027,581,175	$1,500,947,986
Tuttle Creek Lake	$80,051,031 (1957 $)	$976,976,395	$805,593,675	$1,782,570,070

Table 4-21 summarizes the fraction of total reservoir costs for water supply purposes. The reservoir costs attributed to water supply indicate the amount it would cost to develop a new water supply for Kansas residents. These costs would be avoided by providing water from Tuttle Creek Lake for water supply purposes, and reflect the value of the water supply. The lowest cost alternative for reservoir construction would be $756 per acre-foot. This would be the incremental benefit of increased water supply at Tuttle Creek Lake. Based on in-service water supply of 99,068 acre-feet, total water supply value at Tuttle Creek Lake would be about $74.9 million.

Table 4-21
Reservoir Costs for Water Conservation Purpose

Reservoir	Percentage of Total Reservoir Storage for Water Conservation	Reservoir Costs Attributed to Water Conservation	Cost per Acre-Foot
Perry Lake	4.3%	$64,916,637	$1,983
Milford Lake	10.3%	$154,597,643	$1,316
Tuttle Creek Lake	4.2%	$74,867,943	$756

4.4 Summary and Conclusions

Tuttle Creek Lake is an important recreational asset that contributes substantially to the local economy of Riley and Pottawatomie counties. The lake also provides wildlife and water supply benefits. An average of about 572,000 people visit the lake each year, approximate 65 percent visit during April through September. Sightseeing and "other" activities have the largest amount of visitors. Other activities may include special events, including the Country Stampede, which drew about 160,000 visitors for one weekend in 2010.

As shown in Table 4-22, recreation at the lake generates about $12.4 million in direct spending annually. Day users without a boat contribute most to annual spending, about $8.9 million. Marina slip rentals contribute up to $87,500 per year. State charges for hunting and fishing licenses generate about $1.3 million, based on annual visitation data for hunting and fishing at Tuttle Creek Lake.

Table 4-22
Summary of Benefits at Tuttle Creek Lake

Use	Annual Benefits
Recreation[1]	$12.4 million
Hunting and Fishing License Revenue	$1.3 million
Habitat Value	$2.4 million
Water Supply	$74.9 million

[1] Direct Spending

Tuttle Creek Lake supports habitat for migratory and native waterfowl and several game species. Habitat value was estimated as willingness to pay for hunting and fishing uses. Based on this method, habitat at Tuttle Creek Lake would be about $2.4 million. Lastly, Tuttle Creek Lake provides water supply to Kansas residents. Based on existing reservoir construction and mitigation costs, water supply benefits from the lake would be about $74.9 million.

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Section 5
Impacts Analysis

5.1 Background

The KWO and the citizens of the State have expressed concern that releases from Perry Lake, Milford Lake, and Tuttle Creek Lake to support navigation on the Missouri River can greatly impact the quality of recreation and other uses of the lakes.

Navigation releases from Perry Lake and Milford Lake are made from the water supply storage volume that has not been called into service by the State. Until all the storage is called into service by the State, multipurpose objectives of the remaining storage will be to supplement Missouri River flows for navigation within operating limits selected, to provide a relatively stable pool in the interest of recreation, to augment low flows and improve water quality in the Kansas River, and to enhance fish and wildlife habitat. If 100 percent of the water supply volume is called into service for Perry and Milford lakes, navigation releases from the water supply volume would not occur at these lakes; however, navigation support from the flood control zone could still be possible. Navigation releases from Tuttle Creek Lake are made from the water quality storage volume and the flood control storage.

Interviews with lake managers and other stakeholders confirmed that large increases or decreases in water levels increase operations costs and reduce the quality of recreation experienced at the lake. The analysis described in this section estimates the impacts that navigation releases have on open water recreation and wildlife habitat and hunting.

The impacts analysis consisted of analyzing the results of two separate studies:

- USACE *Kansas Planning Assistance to States Final Draft Navigation Study*, July 13, 2009
- KWO *OASIS Modeling Study*, performed September 2010

A summary of each of the studies and a discussion of how each was used in the impacts analysis is provided below.

5.2 USACE Navigation Study

5.2.1 Summary

To quantify the impacts that navigation releases have on lake elevations and recreation uses, the USACE performed a navigation study, which involved RiverWare model runs of the Kansas River Basin to identify the relative effects of navigation support on Milford Lake, Tuttle Creek Lake, and Perry Lake elevations and downstream flows. RiverWare is a software program developed and maintained by the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES). RiverWare is used to model river basin operations and can be used to

manage daily schedules and to support long-term planning[1]. The RiverWare model runs were performed using historic flows and hydrologic conditions from January 1, 1950 through December 31, 2008. The final report from the USACE navigation study is included in Appendix C.

The USACE study looked at base model operations (water quality only) and several combinations of navigation support and lake operations methods. Two of the model runs produced as part of the navigation study were used in the impacts analysis and are summarized below:

Water Quality Only - This scenario represents historic flows and hydrologic conditions from January 1, 1950 through December 31, 2008. The base model run assumes that no navigation support was provided. Assumptions used in the RiverWare model are described in the *2009 Final Draft Navigation Study* shown in Appendix B. This scenario is referred to as no navigation scenario presented in this report.

Anticipated Support Level- The anticipated support level scenario is based on the level of navigation support that was required in 2008 by the Reservoir Control Center (RCC). This is the level of support that is expected to be required by the RCC in future years due to recent changes in navigation support required from the Missouri River upstream of Kansas City. This scenario assumes a 3 to 6 foot drawdown limit. This means that prior to October 1, the first 3 feet below conservation pool are used to support navigation. Between October 1 and the end of the navigation season (typically late November), up to 6 feet of the conservation pool can be used to support navigation. This operation procedure is similar to historic lake operations except no water is held in the flood pools anticipating a navigation requirement. This scenario is referred to as the navigation support scenario presented in this report.

5.2.2 Role in Impacts Analysis

The USACE study results were used to estimate impacts to open water recreation. The results of the Quality of Recreation Use Surveys completed by each of the lake managers showed that open water recreation is negatively impacted when water levels are low. To estimate how navigation releases change the frequency of low water elevations, the USACE provided daily lake elevations for both the no navigation and navigation support scenarios. Using the threshold lake elevations identified by lake managers in the quality of recreation use surveys, the navigation study results were used to estimate average number of days that the lake is at or below the threshold elevations.

The impact to wildlife habitat and hunting recreation can be estimated in a similar manner. The 2010 Lake Level Management Plans, produced by the KWO for each of the lakes, outline recommended seasonal water surface elevations to support waterfowl habitat and hunter access. The daily water levels resulting from the USACE navigation study are used to estimate the ability of the no navigation and navigation

[1] RiverWare – River Basin Modeling for Today and Tomorrow, downloaded from http://cadswes.colorado.edu/riverware/overview.html on October 5, 2010.

support scenario to meet the recommended water levels to support wildlife and hunter access.

5.3 KWO OASIS Modeling

5.3.1 Study Summary

To supplement the lake performance information provided by the USACE, the KWO used the Kansas River OASIS model to evaluate the effects of navigation on in-service water supply storage in each lake. The Kansas River OASIS model was originally developed by Hydrologics, Inc. to evaluate water supply storage purchase requirements for the Kansas River Water Assurance District #1. The OASIS model is similar to the Riverware model used by the USACE in that it simulates the routing of water through a system of lakes and rivers. The KWO uses the Kansas River OASIS model to evaluate operations in the basin and their effects on the storage allocations in each lake.

The same modeling scenarios (no navigation scenario and navigation support scenario) were performed using the OASIS model as were performed by the USACE in the navigation study. The OASIS model was run from January 1, 1950 through December 31, 2008. When navigation support was needed, releases were made from water quality storage in Tuttle Creek Lake and future use storage in Milford and Perry Lakes. No releases from in-service water supply storage were required. The KWO OASIS simulation resulted in 1,737 days that navigation releases were made at Perry Lake, 1,748 days at Milford Lake, and 1,748 days at Tuttle Creek Lake.

The number of days where navigation releases were made in the OASIS model was much greater than the number of days where historical releases were made from the multipurpose pool. There are multiple reasons for this. One is because historically, a number of navigation releases have been made using the lower portion of the flood control pools and not from the multipurpose pools. In the past, the USACE has prudently operated the lower portion of each lake's flood control zone for navigation support when appropriate.

Also, the navigation demand assumed in the modeling was higher than actually experienced during the period from 1969 through 2007. The navigation demand is higher because of the changed operation for Missouri River navigation support that increases the demand on the Kansas River projects.

Despite making no releases from in-service water supply storage for navigation support, the OASIS model results showed a difference in the in-service water supply storage remaining when comparing the two modeling scenarios. The most significant factor contributing to this difference is how the inflows to each lake are allocated to the various storage components in the lake. For example, in a hypothetical drought year, water quality storage in Tuttle Creek Lake could be released to support navigation and be depleted. Also, during this same hypothetical year releases from in-service water supply storage are required to meet demands. Since both pools are low, inflows to the lake are allocated between the pools if the water supply storage is greater than 25 percent of its full volume. As a result, it takes longer for either pool to

refill. If the water supply storage reaches less than 25 percent capacity all inflow is allocated to water supply until the level reaches 25 percent capacity.

If no releases from water quality storage are required for navigation, the water quality pool does not decrease as quickly. Releases from in-service water supply storage will still be needed to meet demands. Inflows will again be allocated between the pools, and the water quality storage will fill to capacity more quickly than the water supply storage. Once the water quality storage is filled, the remaining inflows will refill the water supply storage, resulting in more in-service water supply storage than during the navigation support scenario.

5.3.2 Role in Impacts Analysis

The KWO OASIS model results were used to compare the volume of water supply storage under no navigation and navigation support scenarios.

5.4 Results

During the data collection effort, lake operators and other stakeholders were asked to describe how their operations and facilities are impacted by changes in lake water levels. This information, along with the results from the USACE Navigation Study provide a basis for estimating impacts to open water recreation, wildlife habitat and hunting, and in-service water supply storage for Perry Lake, Milford Lake, and Tuttle Creek Lake due to releases from lake storage related to navigation support.

5.4.1 Perry Lake

5.4.1.1 Open Water Recreation

Interviews with stakeholders at Perry Lake (summarized in Section 2) revealed that quality of recreation and lake operations are significantly impacted from high and low water levels. The marina operators interviewed indicated that low water levels increase their costs of operation, necessitating additional man-hours to move docks and slips out into the lake to access open water.

Low water levels discourage open water activities such as boating, fishing, and swimming at Perry Lake. Interviews with park operators indicate that day use recreation such as sightseeing and hiking is not significantly impacted by low water levels. High water levels at Perry Lake flood campsites and reduce access to areas of the park that are used for activities such as hiking and sightseeing. High water levels also reduce the quality of the recreational experience for open water activities because of an increase in floating debris.

The USACE Navigation Study was used to estimate the frequency that threshold lake levels identified as part of the Quality of Recreation Survey occur. Table 5-1 shows that the number of days at which the quality of recreation is impacted (low pool and very low pool compared to normal pool) under the navigation support scenario compared to the no navigation scenario. Perry Lake would have an increase of 7 days during the recreation season (48 days over the full year) at which the lake is at or below the low pool threshold elevation. The Perry Lake operator also noted a

decrease in the quality of recreation under high pool lake conditions compared to normal pool lake conditions. For Perry Lake, there was no change in the frequency of high pool conditions due to navigation releases.

Table 5-1
Perry Lake - Impacts to Quality of Recreation

Lake Condition	Quality of Rec Rating[1]	Elev (feet)	Recreation Season (Apr – Sep)[2]					Full Year				
			No Navigation		Nav Support		Diff	No Navigation		Nav Support		Diff
			%	Days/yr	%	Days/yr	Days/yr	%	Days/yr	%	Days/yr	Days/yr
High	19	904	93%	170	93%	170	0	96%	350	96%	350	0
Normal	66	891.5	19%	35	23%	42	7	29%	106	41%	150	44
Low	56	888	2%	4	6%	11	7	2%	7	15%	55	48
Very Low	29	885	0%	0	4%	7	7	1%	4	6%	22	18

Lowest Modeled Elevation: No Nav 884.1; Nav Support 881.0
[1]Quality of Recreation Rating derived from Quality of Recreation Survey discussed in Section 2
[2]Recreation season is 183 days.

The USACE Navigation Study was also used to estimate the frequency that critical lake elevations were achieved. The critical lake elevations represent elevations at which access to specific recreation-related areas would be affected. Identification of critical lake elevations for Perry Lake is discussed in Section 2.2.3. Table 5-2 shows the number of days over the recreation season at which each critical elevation is equaled or exceeded for selected recreation sites. The difference column in Table 5-2 shows the increase in the number of days that the critical elevation is reached under the navigation support scenario compared to no navigation support. In some instances, the navigation support scenario would improve recreation conditions at Perry Lake. Table 5-2 shows the following impacts to Perry Lake uses as a result of navigation releases:

- All ramps are accessible at low water levels.
- The Perry Yacht Club Cove low water threshold is reached approximately 9 more days resulting in a decrease in the number of days that deep keel boats will be able to use the cove.
- The Perry Yacht Club Parking area is flooded 7 days less than under the no navigation scenario.

Table 5-2
Number of Days Annually that Perry Lake is at or Below the Critical Elevation [1,2]

Ramp/Location	Elevation, feet	Recreation Season (Apr – Sep)[3]		Difference days/year
		No Navigation, Days/year	Nav Support, Days/year	
Boat Ramp Slough Creek Bridge	840	0	0	0
Longview Boat Ramp	870.5	0	0	0
Devils Gap Boat Ramp	872	0	0	0
Old Town Boat Ramp	880	0	0	0
Perry Yacht Club Cove Low Water Threshold	889	8	17	9
Perry Yacht Club Parking	892	41	48	7
North Boat Ramp, State Park (top of ramp)	897	155	155	0
South Boat Ramp, State Park (top of ramp)	898	158	158	0
Entrance, Perry Boat Ramp	899	160	160	0
Perry Yacht Club Sidewalk	899	160	160	0
C Loop road at Rock Creek Park	900	162	162	0
Portions of Old Town Campground	900	162	162	0
Rock Creek Sail Harbor Parking Lot	900	162	162	0
Parking Lot Perry Marina	901	164	164	0
Road to Limestone Cove & Hickory Ridge	902	166	166	0
East Entrance Perry Marina	903	168	168	0
Lift Station Rock Creek Marina	903	168	168	0
South Entrance Rock Creek Park	903	168	168	0
North Entrance, Rock Creek Park	904	170	170	0
South Entrance Perry Beach and Marina	905	172	172	0
Breakwater, Perry Marina	907	175	175	0
Rock Creek Marina Breakwater	911	180	180	0

[1] Conservation pool elevation is 891.5
[2] Lowest Modeled Elevation: No Nav 884.1; Nav Support 881.0
[3] Recreation season is 183 days.

Impacts to the quality of recreation and recreation facilities are directly related to recreation expenditures and the contribution of recreation at the lake to the county economy. If facilities are closed because of low water levels, visitors may not travel to the lake for water-based recreation and the county economy would not benefit from recreation spending. Some visitors may continue to visit the lake if water levels are low for non-water based activities. If all facilities are shut down for an additional 49 days throughout the year, because navigation releases result in lower water levels, open water recreation (boating, swimming, water skiing, and fishing) activities would be affected. Assuming that no visitors use the lake for water-based recreation at average recreation visitation levels reported for the 2001 – 2009 period estimated losses in visitation for day uses would be 1,429 per day during the peak recreation season (April through September) and 464 per day during the off-peak season

(October through March). Recreation expenditures could be reduced by $588,000, based on daily visitation losses and an average daily spending of $20.26 for day use activities.

5.4.1.2 Wildlife Habitat and Hunting

Wildlife habitat includes aquatic habitat that support fish populations and wetland and upland habitats. Hunting and fishing recreation are the primary benefits associated with wildlife habitat. Interviews with State park operators at Perry Lake indicated that wildlife habitat, especially wetland and aquatic habitat are impacted by lake water levels. Correct seasonal timing of operations is critical for maintaining fish populations. A springtime rise and stabilization in water levels gives necessary cover for spawning fish (white bass and crappy). If a spawn season is interrupted, decreases in fish populations are experienced by recreational fishermen 2 to 3 years later.

The 2010 Water Plan for Perry Lake indicates that water levels should be maintained at an elevation of 893.7 feet from September 1 to January 15 to support waterfowl habitat and hunter access. Using the USACE no navigation and navigation support scenarios to look at water levels for this time frame over 59 years show that under no navigation support this criterion is reached an average of 75 days per year during this critical period. During the navigation support scenario the optimum conditions for supporting wildlife is met on average 52 days per year, an average decrease in 23 days.

Reductions in wildlife value can result in an economic loss to the county. Visitors interested in hunting, fishing, and wildlife viewing may not come to the lake if chances of seeing wildlife are reduced as a result of low lake levels. They could go to an alternate lake if they suspect hunting, fishing, and viewing opportunities would be better than at Perry Lake. Estimated daily spending for fishing and hunting is $22.49 and $15.86, respectively. Fishing and hunting licenses are also required. If visitation is reduced for hunting and fishing, daily spending and license purchases would not occur. This would be a direct loss to the county economy. There is also an intrinsic value to residents knowing the lake supports diverse fish and wildlife that cannot be easily monetized. If habitat and wildlife at Perry Lake decrease, the intrinsic value of wildlife would also decrease.

5.4.1.3 Water Supply Storage

Navigation releases are not made directly from the in-service water supply pool; however, the OASIS model analysis performed by the KWO showed that when navigation releases are made, in-service water supply storage is reduced compared to the no navigation scenario (for the reasons of inflow allocation discussed above). Figure 5-1 compares the frequency of water supply storage volumes at Perry Lake under no navigation and navigation support scenarios.

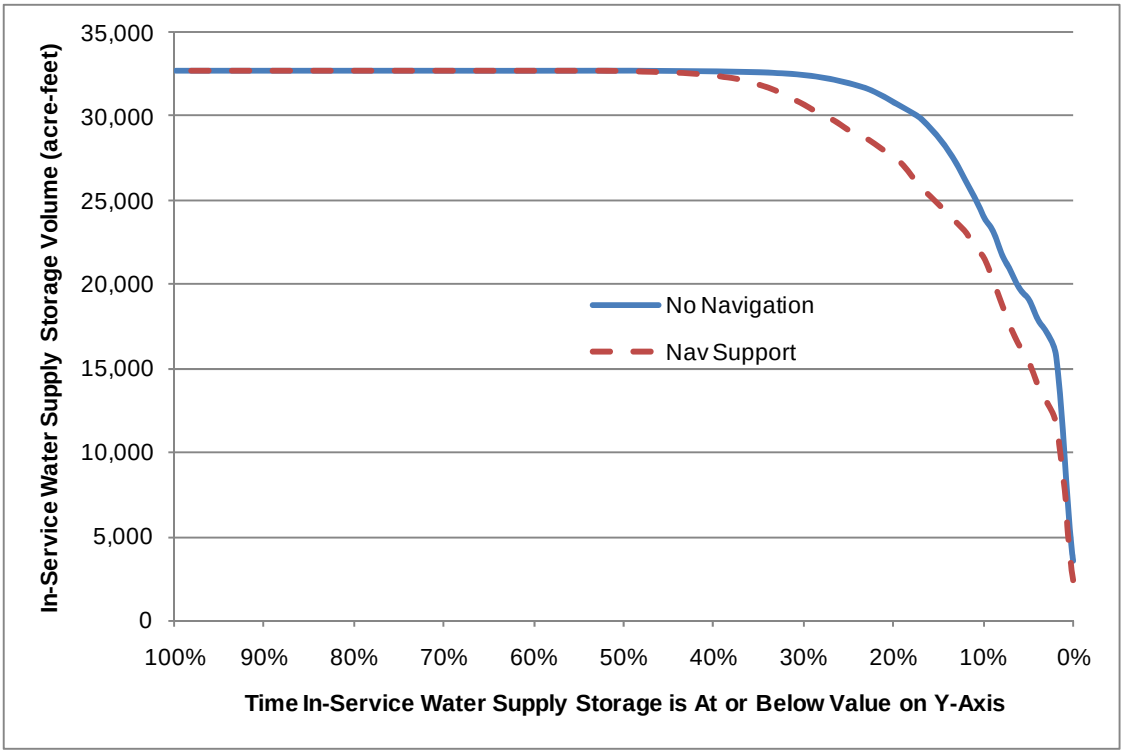

Figure 5-1
Water Supply Storage at Perry Lake

Figure 5-1 shows the percent of time that the in-service water supply volume in the lake is at or below the values on the Y-axis. The maximum in-service water supply volume for Perry Lake is 32,737 acre-feet. This is represented in Figure 5-1 as 100 percent of the time the water supply storage is at or below 32,737 acre-feet.

The deviation between the no navigation and navigation support lines in Figure 5-1 indicate that in-service storage volume is reduced as a result of the navigation support scenario compared to no navigation support. In-service water supply storage volumes less than 32,737 acre-feet are more frequent under the navigation support compared to no navigation support. For example, an in-service water supply storage volume of 20,000 acre-feet is reached more frequently under navigation support (9 percent of the time) than under no navigation support (6 percent of the time).

The model runs show a difference in water supply storage available due to the accounting method used. Each of the lake's allocated purposes gets an amount of inflow proportional to their allocation. If only one beneficial purpose takes water from a lake, that purpose receives all the inflow to the lake. If two purposes with equal allocations take water from a lake, they each receive half of the lake's inflow as a credit until their allocated storage is refilled. If one of the purposes does not use any water, all their inflow is credited to the other beneficial purpose because their allocation cannot be more than full. Essentially, a purpose using water benefits from other purposes not using any water. The accounting effect of this phenomenon will decrease as more water supply storage is placed into service and the portion of the lake inflow assigned to water supply increases. As more water supply storage is placed into service, less water is available for navigation support. If 100 percent of the

water supply is placed into service, no navigation releases will be made from the water supply storage in Perry Lake; however, navigation releases from the flood control storage may be possible.

It is also important to note that for both the modeled scenarios the in-service water supply storage volume is not fully depleted. The lowest in-service water supply volume modeled under the no navigation scenario was 3,501 acre-feet and 2,362 acre-feet for the navigation support scenario. On Figure 5-1, this is the volume of in-service water supply that corresponds with 0 percent of the time that the in-service water supply storage is at or below. This result indicates that water supply demands from the in-service water supply storage are met.

5.4.2 Milford Lake

5.4.2.1 Open Water Recreation

Interviews with stakeholders at Milford Lake (summarized in Section 3) revealed that quality of recreation and lake operations are significantly impacted from high and low water levels. The marina operators interviewed indicated that low water levels increase their costs of operation, necessitating the removal of boats from moored areas and shallow slips.

Low water levels discourage open water activities such as boating, fishing, and swimming at Milford Lake due to exposed underwater hazards and overall unsafe appearance of the lake. Interviews with park operators indicate that day use recreation such as sightseeing and hiking is not significantly impacted by low water levels. High water levels at Milford Lake flood campsites and reduce access to areas of the park that are used for activities such as hiking and sightseeing. High water levels also reduce the quality of the recreational experience for open water activities because of an increase in floating debris.

The USACE Navigation Study was used to estimate the frequency that threshold lake levels identified as part of the Quality of Recreation Survey occur. Table 5-3 shows that the number of days at which the quality of recreation is impacted (low pool and very low pool compared to normal pool) under the navigation support scenario compared to the no navigation scenario. Milford Lake sees an increase in 7 days during the recreation season (48 days over the full year) at which the lake is at or below the low pool threshold elevation. The Milford Lake operator also noted a decrease in the quality of recreation under high pool lake conditions compared to normal pool lake conditions. For Milford Lake, there was no change in the frequency of high pool conditions due to navigation releases.

Table 5-3
Milford Lake - Impacts to Quality of Recreation

Lake Condition	Quality of Rec Rating[1]	Elev (ft)	Recreation Season (Apr – Sep)[2]					Full Year				
			No Navigation		Nav Support		Diff	No Navigation		Nav Support		Diff
			%	Days/yr	%	Days/yr	Days/yr	%	Days/yr	%	Days/yr	Days/yr
High	51	1150	86%	157	86%	157	0	92%	336	92%	336	0
Normal	69	1144.4	15%	27	20%	37	10	29%	106	41%	150	44
Low	62	1141.4	1%	2	5%	9	7	2%	7	15%	55	48
Very Low	40	1138.4	0%	0	1%	2	2	0%	0	3%	11	11

Lowest Modeled Elevation: No Nav 1138.9; Nav Support 1135.8
[1]Quality of Recreation Rating derived from Quality of Recreation Survey discussed in Section 3
[2]Recreation season is 183 days.

The USACE Navigation Study was also used to estimate the frequency that critical lake elevations were achieved. The critical lake elevations represent elevations at which access to specific areas are impacted. Identification of critical lake elevations for Milford Lake is discussed in Section 3.2.4. Table 5-4 shows the number of days over the recreation season for which each critical elevation is reached. The difference column in Table 5-4 shows the increase in the number of days that the critical elevation is achieved under the navigation support scenario compared to no navigation support. Boat ramps would be unusable when critical elevation is achieved; however, visitors may be able to use alternate boat ramps. Table 5-4 shows the following impacts to Milford Lake uses as a result of navigation releases:

- The boat ramp at Clay County Park is inaccessible for 2 more days during the recreation season due to low water levels.
- The Curtis Creek public ramp is inaccessible for 2 more days during the recreation season due to low water levels.

Impacts to the quality of recreation and recreation facilities are directly related to recreation expenditures and the contribution of recreation at the lake to the county economy. If facilities are closed because of low water levels, visitors may not travel to the lake for water-based recreation and the county economy would not benefit from recreation spending. Some visitors may continue to visit the lake if water levels are low for non-water based activities. If all facilities are shut down for an additional 48 days throughout the year, because navigation releases result in lower water levels, open water recreation (boating, swimming, water skiing, and fishing) activities would be affected. Assuming that no visitors use the lake for water-based recreation, at average recreation visitation levels reported for the 2001 to 2009 period, estimated losses in visitation for day uses would be 1,290 per day during the peak recreation season (April through September) and 512 per day during the off-peak season (October through March). Recreation expenditures could reduce by $607,000, based on daily visitation losses and an average daily spending of $20.23 for day use activities.

Table 5-4
Number of Days Annually that Milford Lake is at or Below the Critical Elevation [1,2]

Ramp/Location	Elevation, ft	Recreation Season (Apr – Sep)[3]		Difference days/yr
		No Navigation, Days/yr	Nav Support, Days/yr	
Milford State Park (Marina)	1115	0	0	0
East Rolling Hills	1115	0	0	0
West Rolling Hills	1127.00	0	0	0
School Creek	1127	0	0	0
Milford	1127	0	0	0
Curtis Creek (Campground)	1127	0	0	0
Farnum Creek	1127	0	0	0
Milford State Park (South Ramp)	1127	0	0	0
Thunderbird (North Ramp)	1127	0	0	0
Timber Creek	1131	0	0	0
Clay County Park	1137	0	2	2
Curtis Creek (Public)	1139.07	0	2	2

[1] Conservation pool elevation is 1144.4
[2] Lowest Modeled Elevation: No Nav 1138.9; Nav Support 1135.8
[3] Recreation season is 183 days.

5.4.2.2 Wildlife Habitat and Hunting

Wildlife habitat includes aquatic habitat that support fish populations and wetland and upland habitats. Hunting and fishing recreation are the primary benefits associated with wildlife habitat. Interviews with State park operators at Milford Lake indicated that wildlife habitat, especially wetland and aquatic habitat are impacted by lake water levels. Correct seasonal timing of operations is critical for maintaining access for migrating waterfowl and hunters.

The 2010 Water Plan for Milford Lake indicates that water levels should be maintained at an elevation of 1146.7 feet from September 1 to January 1 to support waterfowl habitat and hunter access. Using the USACE no navigation and navigation support scenarios to look at water levels for this time frame over 59 years show that under no navigation support this criterion is reached an average of 61 days per year during this critical period. During the navigation support scenario the optimum conditions for supporting wildlife is met on average 41 days per year, an average decrease in 20 days.

Reductions in wildlife value can result in an economic loss to the county. Visitors interested in hunting, fishing, and wildlife viewing may not come to the lake if chances of seeing wildlife are reduced as a result of low lake levels. They could go to an alternate lake if they suspect hunting, fishing, and viewing opportunities would be better than at Milford Lake. Estimated daily spending for fishing and hunting is $22.32 and $15.69, respectively. Fishing and hunting licenses are also required. If

visitation is reduced for hunting and fishing, daily spending and license purchases would not occur. This would be a direct loss to the county economy. There is also an intrinsic value to residents knowing the lake supports diverse fish and wildlife that cannot be easily monetized. If habitat and wildlife at Milford Lake decrease, the intrinsic value of wildlife would also decrease.

5.4.2.3 Water Supply Storage

Navigation releases are not made directly from the in-service water supply pool; however, the OASIS model analysis performed by the KWO showed that when navigation releases are made, in-service water supply storage is reduced compared to the no navigation scenario (for the reasons of inflow allocation discussed previously). Figure 5-2 shows the frequency of in-service water supply storage volumes at Milford Lake under no navigation and navigation support scenarios.

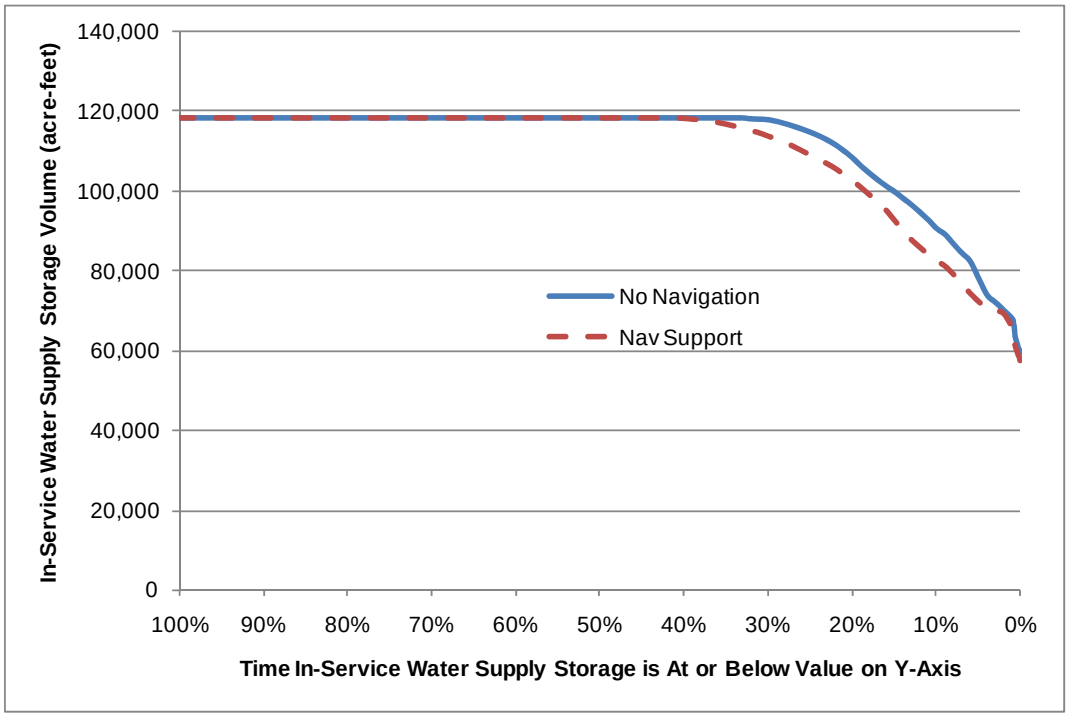

Figure 5-2
Water Supply Storage at Milford Lake

The maximum in-service water supply volume for Milford Lake is 118,253 acre-feet. This is represented in Figure 5-2 as 100 percent of the time the water supply storage is at or below 118,253 acre-feet.

The deviation between the no navigation and navigation support lines in Figure 5-2 indicate that in-service storage volume is reduced as a result of the navigation support scenario compared to no navigation support. In-service water supply storage volumes less than 118,253 acre-feet are more frequent under the navigation support compared to no navigation support. For example, an in-service water supply storage volume of 80,000 acre-feet is reached more frequently under navigation support (8 percent of the time) than under no navigation support (5 percent of the time).

The model runs show a difference in water supply storage available due to the accounting method used. Each of the lake's allocated purposes gets an amount of inflow proportional to their allocation. If only one beneficial purpose takes water from a lake, that purpose receives all the inflow to the lake. If two purposes with equal allocations take water from a lake, they each receive half of the lake's inflow as a credit until their allocated storage is refilled. If one of the purposes does not use any water, all their inflow is credited to the other beneficial purpose, because their allocation cannot be more than full. Essentially, a purpose using water benefits from other purposes not using any water. The accounting effect of this phenomenon will decrease as more water supply storage is placed into service and the portion of the lake inflow assigned to water supply increases. As more water supply storage is placed into service, less water is available for navigation support. If 100 percent of the water supply is placed into service, no navigation releases will be made from the water supply storage in Milford Lake; however, navigation releases from the flood control storage may be possible.

It is also important to note that for both the modeled scenarios the in-service water supply storage volume is not fully depleted. The lowest in-service water supply volume modeled under the no navigation scenario was 59,462 acre-feet and 57,701 acre-feet for the navigation support scenario. On Figure 5-2, this is the volume of in-service water supply that corresponds with 0 percent of the time that the in-service water supply storage is at or below. This result indicates that water supply demands from the in-service water supply storage are met.

5.4.3 Tuttle Creek Lake

5.4.3.1 Open Water Recreation

Interviews with stakeholders at Tuttle Creek Lake (summarized in Section 4) revealed that quality of recreation and lake operations are significantly impacted from high and low water levels. The marina operators interviewed indicated that low water levels increase their costs of operation, necessitating additional man-hours to move docks and slips out into the lake to access open water.

Low water levels discourage open water activities such as boating, fishing, and swimming at Tuttle Creek Lake. Interviews with park operators indicate that day use recreation such as sightseeing and hiking is not significantly impacted by low water levels. High water levels at Tuttle Creek Lake flood campsites and reduce access to areas of the park that are used for activities such as hiking and sightseeing. High water levels also reduce the quality of the recreational experience for open water activities because of an increase in floating debris.

The USACE Navigation Study was used to estimate the frequency that threshold lake levels identified as part of the Quality of Recreation Survey occur. Table 5-5 shows that the number of days at which the quality of recreation is impacted (low pool and very low pool compared to normal pool) under the navigation support scenario compared to the no navigation scenario. Tuttle Creek Lake sees an increase in 3 days during the recreation season (37 days over the full year) at which the lake is at or below the low pool threshold elevation. The Tuttle Creek Lake operator also noted a

decrease in the quality of recreation under high pool lake conditions compared to normal pool lake conditions. For Tuttle Creek Lake, there was no change in the frequency of high pool conditions due to navigation releases.

Table 5-5
Tuttle Creek Lake - Impacts to Quality of Recreation

Lake Condition	Quality of Rec Rating[1]	Elev (ft)	Recreation Season (Apr – Sep)[2]					Full Year				
			No Navigation		Nav Support		Diff	No Navigation		Nav Support		Diff
			%	Days/yr	%	Days/yr	Days/yr	%	Days/yr	%	Days/yr	Days/yr
High	34	1090	85%	156	85%	156	0	91%	332	91%	332	0
Normal	55	1075	7%	13	12%	22	9	27%	99	36%	131	32
Low	46	1072	1%	2	3%	5	3	2%	7	12%	44	37
Very Low	35	1069	0%	0	1%	2	2	0%	0	3%	11	11

Lowest Modeled Elevation: No Nav 1168.5; Nav Support 1165.8
[1]Quality of Recreation Rating derived from Quality of Recreation Survey discussed in Section 4
[2]Recreation season is 183 days.

The USACE Navigation Study was also used to estimate the frequency that critical lake elevations were achieved. The critical lake elevations represent elevations at which access to specific areas are impacted. Identification of critical lake elevations for Tuttle Creek Lake is discussed in Section 4.2.3. Table 5-6 shows the number of days over the recreation season for which each critical elevation is reached. The difference column in Table 5-6 shows the increase in the number of days that the critical elevation is achieved under the navigation support scenario compared to no navigation support. Table 5-6 shows the following impacts to Tuttle Creek Lake uses as a result of navigation releases:

- The Blue Valley Yacht Club, Mill Cove, Oak Canyon, and Lakeside Heights Ramps are inaccessible for 2 additional days due to low water levels.
- The ramp at University Park is inaccessible 2 additional days due to low water levels.
- The Stockdale #1 Ramp is inaccessible 3 additional days due to low water levels.

Impacts to the quality of recreation and recreation facilities are directly related to recreation expenditures and the contribution of recreation at the lake to the county economy. If facilities are closed, because of low water levels, visitors may not travel to the lake for water-based recreation and the county economy would not benefit from recreation spending. Some visitors may continue to visit the lake if water levels are low for non-water based activities. If all facilities are shut down for an additional 49 days throughout the year, because navigation releases result in lower water levels, open water recreation (boating, swimming, water skiing, and fishing) activities would be affected. Assuming that no visitors use the lake for water-based recreation, at average recreation visitation levels reported for the 2001 to 2009 period, estimated losses in visitation for day uses would be 386 per day during the peak recreation

season (April through September) and 176 per day during the off-peak season (October through March). Recreation expenditures could reduce by $149,000, based on daily visitation losses and an average daily spending of $20.85 for day use activities.

Table 5-6
Number of Days Annually that Tuttle Creek Lake is at or Below the Critical Elevation [1,2]

Ramp/Location	Elevation, ft	Recreation Season (Apr – Sep)[3]		Difference days/yr
		No Navigation, Days/yr	Nav Support, Days/yr	
Tuttle Cove Park	1061.47	0	0	0
Spillway State Park	1062.09	0	0	0
Sunset Cove	1064	0	0	0
Blue Valley Yacht Club	1069	0	2	2
Mill Cove	1069	0	2	2
Oak Canyon	1069.2	0	2	2
Lakeside Heights	1069.7	0	2	2
University Park	1070	0	2	2
Stockdale #1	1072	2	5	3

[1] Conservation pool elevation is 1075 ft
[2] Lowest Modeled Elevation: No Nav 1168.5 ft; Nav Support 1165.8 ft
[3] Recreation season is 183 days.

5.4.3.2 Wildlife Habitat and Hunting

Wildlife habitat includes aquatic habitat that support fish populations and wetland and upland habitats. Hunting and fishing recreation are the primary benefits associated with wildlife habitat. Interviews with State park operators at Tuttle Creek Lake indicated that wildlife habitat, especially wetland and aquatic habitat are impacted by lake water levels. Correct seasonal timing of operations is critical for maintaining fish populations. A springtime rise and stabilization in water levels gives necessary cover for spawning fish (white bass and crappy). If a spawn season is interrupted, decreases in fish populations are experienced by recreational fishermen 2 to 3 years later.

The 2010 Water Plan for Tuttle Creek Lake indicates that water levels should be maintained at an elevation of 1079 feet from September 1 to December 5 to support waterfowl habitat and hunter access. Using the USACE no navigation and navigation support scenarios to look at water levels for this time frame over 59 years show that under no navigation support this criterion is reached an average of 51 days per year during the critical period. During the navigation support scenario the optimum conditions for supporting wildlife is met on average 33 days per year, an average decrease in 18 days.

Reductions in wildlife value can result in an economic loss to the county. Visitors interested in hunting, fishing, and wildlife viewing may not come to the lake if chances of seeing wildlife are reduced as a result of low lake levels. They could go to an alternate lake if they suspect hunting, fishing, and viewing opportunities would be better than at Tuttle Creek Lake. Estimated daily spending for fishing and hunting is $22.37 and $15.70, respectively. Fishing and hunting licenses are also required. If visitation is reduced for hunting and fishing, daily spending and license purchases would not occur. This would be a direct loss to the county economy. There is also an intrinsic value to residents knowing the lake supports diverse fish and wildlife that cannot be easily monetized. If habitat and wildlife at Tuttle Creek Lake decrease, the intrinsic value of wildlife would also decrease.

5.4.3.3 Water Supply Storage

Navigation releases are not made directly from the water supply pool; however, the OASIS model analysis performed by the KWO showed that when navigation releases are made, in-service water supply storage is reduced compared to the no navigation scenario (for the reasons of inflow allocation discussed above). Figure 5-3 shows the frequency of water supply storage volumes at Tuttle Creek Lake under no navigation and navigation support scenarios.

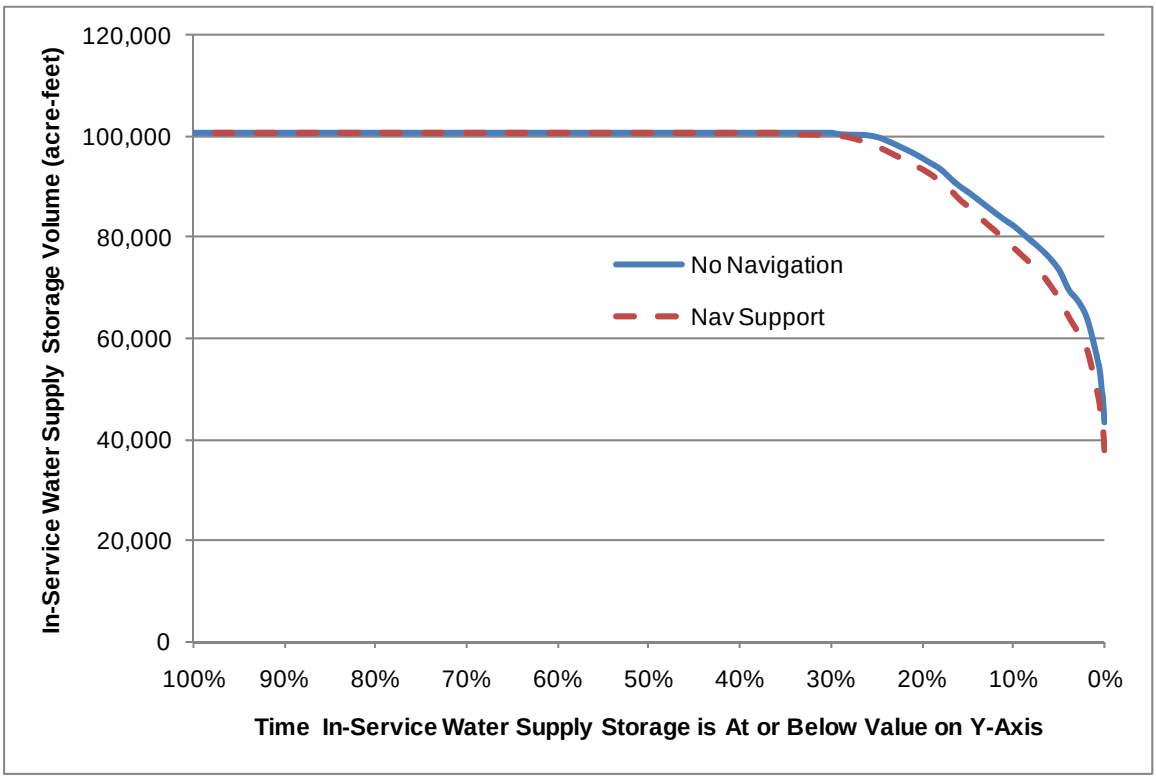

Figure 5-3
Water Supply Storage at Tuttle Creek Lake

The maximum in-service water supply volume for Tuttle Creek Lake is 100,531 acre-feet. This is represented in Figure 5-3 as 100 percent of the time the water supply storage is at or below 100,531 acre-feet.

The deviation between the no navigation and navigation support lines in Figure 5-3 indicate that in-service storage volume is reduced as a result of the navigation support scenario compared to no navigation support. In-service water supply storage volumes less than 100,531 acre-feet are more frequent under the navigation support compared to no navigation support. For example, an in-service water supply storage volume of 80,000 acre-feet is reached more frequently under navigation support (12 percent of the time) than under no navigation support (9 percent of the time).

The model runs show a difference in water supply storage available due to the accounting method used. Each of the lake's allocated purposes gets an amount of inflow proportional to their allocation. If only one beneficial purpose takes water from a lake, that purpose receives all the inflow to the lake. If two purposes with equal allocations take water from a lake, they each receive half of the lake's inflow as a credit until their allocated storage is refilled. If one of the purposes does not use any water, all their inflow is credited to the other beneficial purpose because their allocation cannot be more than full. Essentially, a purpose using water benefits from other purposes not using any water. The accounting effect of this phenomenon will decrease as more water supply storage is placed into service and the portion of the lake inflow assigned to water supply increases.

For both the modeled scenarios, the in-service water supply storage volume is not fully depleted. The lowest in-service water supply volume modeled under the no navigation scenario was 43,488 acre-feet and 37,836 acre-feet for the navigation support scenario. On Figure 5-3, this is the volume of in-service water supply that corresponds with 0 percent of the time that the in-service water supply storage is at or below. This result indicates that water supply demands from the in-service water supply storage are met.

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Section 6
Summary and Conclusions

6.1 Summary

This section summarizes the key components of the study for each of the three lakes including regional economics, visitation, historical lake levels, economic analysis, and impacts from navigation releases.

6.1.1 Regional Economics

Milford Lake and Tuttle Creek Lake are located in regions that include larger urban centers. As a result, these lake regions have higher income levels and industry earnings than Perry Lake, which is in rural Jefferson County.

6.1.2 Lake Visitation

Of the three lakes included in this study, Perry Lake had the highest average visitation from 2001 to 2009 with an average of 675,914 visitors annually followed closely by Milford Lake with an average annual visitation of 675,194 (Table 6-1). Tuttle Creek Lake has the lowest average annual visitation of 571,715.

Table 6-1
Annual Visitation at Study Lakes

Year	Visitors to Perry Lake	Visitors to Milford Lake	Visitors to Tuttle Creek Lake
2001	668,067	643,163	672,814
2002	809,282	695,276	746,408
2003	738,704	550,031	679,663
2004	403,146	492,648	496,948
2005	384,368	493,593	570,485
2006	768,637	681,085	542,748
2007	698,095	746,666	454,996
2008	805,725	876,786	441,141
2009	807,205	897,089	540,228
Average	**675,914**	**675,149**	**571,715**

Source: USACE Operations and Maintenance Business Information Link 2010

As shown in Figure 6-1, a decrease in visitation at all three lakes was observed in 2004 and 2005 compared to previous years. From 2006 to 2009 visitation at Milford Lake and Perry Lake returned to or exceed pre 2004 levels, while visitation at Tuttle Creek Lake remained lower than 2003 levels.

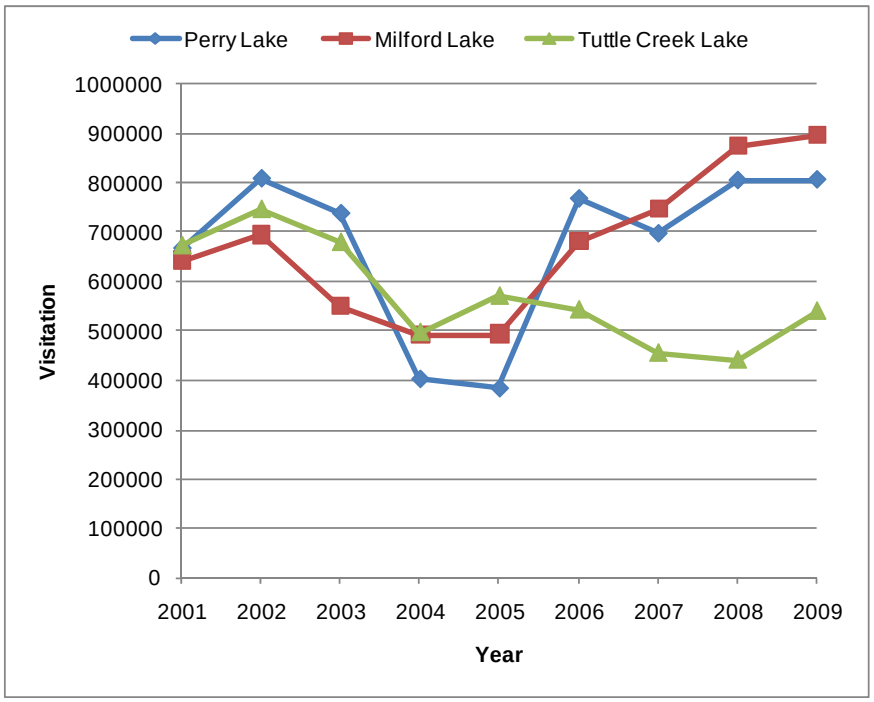


Figure 6-1
Visitation at Perry, Milford, and Tuttle Creek Lakes

Table 6-2 summarizes average visitation by activity and percentages for the peak and off-peak recreation seasons at the three study lakes. At both Perry Lake and Milford Lake, fishing is the main recreation activity during the recreation season and off-season. At Tuttle Creek Lake, the largest percent of visitors participate in "other" activities during both the recreation season and off-season. Hunting is also popular during the off-peak season.

Table 6-2
Visitation Estimates by Recreation Activity for Study Lakes

	Percent of Total Visitation					
	Perry Lake		Milford Lake		Tuttle Creek Lake	
	April - September	October-March	April - September	October-March	April - September	October-March
Camping	6.2%	3.6%	10.9%	3.6%	2.9%	3.6%
Picnicking	5.0%	4.9%	7.4%	15.6%	7.0%	8.3%
Boating	22.3%	10.3%	13.2%	17.4%	6.3%	4.3%
Fishing	24.5%	27.2%	22.0%	27.2%	7.1%	9.7%
Hunting	3.8%	14.0%	1.6%	5.0%	1.1%	1.3%
Water Skiing	5.4%	0.0%	4.5%	0.0%	2.1%	0.4%
Swimming	5.5%	0.0%	10.8%	0.0%	3.5%	1.5%
Other	10.6%	16.0%	13.5%	7.3%	42.3%	36.5%
Sightseeing	16.7%	22.0%	16.3%	24.1%	27.8%	34.4%
Winter Activities	0.0%	1.9%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: USACE 2010 (email from David White, dated June 14, 2010)

6.1.3 Historical Lake Levels

Historical lake elevations provided by the USACE are shown in Figure 6-2. Lake levels fluctuate throughout the year and from year to year. The period of low visitation (2004 and 2005) is shaded in grey. By visual inspection of Figure 6-2, each of the lakes shows a decrease in water levels prior to the low visitation period. This may provide insight into the relationship between lake levels and visitation; however, more data is necessary to draw a definitive conclusion on the impact of lake levels to visitation numbers.

6.1.4 Quality of Recreation Survey

The USACE lake managers each completed a quality of recreation survey for the lake for which they are responsible. As shown in Table 6-3, Perry Lake shows the greatest relative reduction in quality of recreation experience related to changes in water level. At high pool lake conditions (904 feet), the quality of recreation rating dropped 47 points from 66 at normal pool to 19 at high pool. At very low pool lake conditions (885 feet), the quality of recreation rating dropped 37 points from 66 at normal pool to 29 at very low pool. Milford Lake showed the next largest reduction in quality of recreational experience due to low water levels with a quality of recreation rating 29 points below that given to normal pool conditions (69). Tuttle Creek Lake experienced the smallest decrease in quality of recreation for low pool elevations with a 20-point reduction in quality of recreation rating from normal pool conditions (55).

Table 6-3
Quality of Recreation Rating for Perry Lake, Milford Lake, and Tuttle Creek Lake

	Perry Lake		Milford Lake		Tuttle Creek Lake	
Lake Condition	Elevation, feet	Quality of Rec Rating	Elevation, feet	Quality of Rec Rating	Elevation, feet	Quality of Rec Rating
High Pool	904	19	1150.0	51	1090	34
Normal Pool	891.5	66	1144.4	69	1075	55
Low Pool	888	56	1141.4	62	1072	46
Very Low Pool	885	29	1138.4	40	1069	35

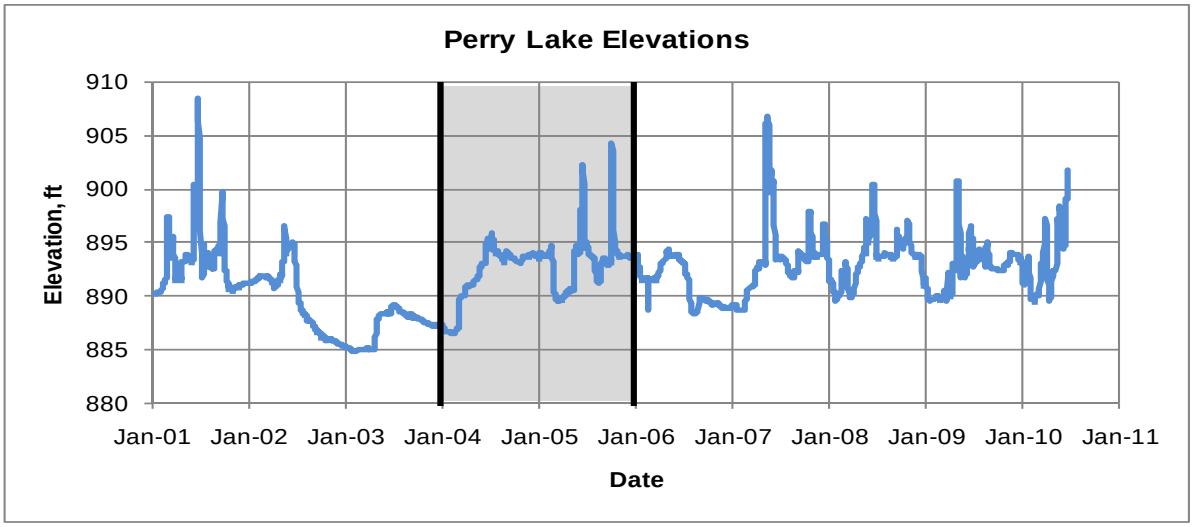
6.1.5 Economics Analysis

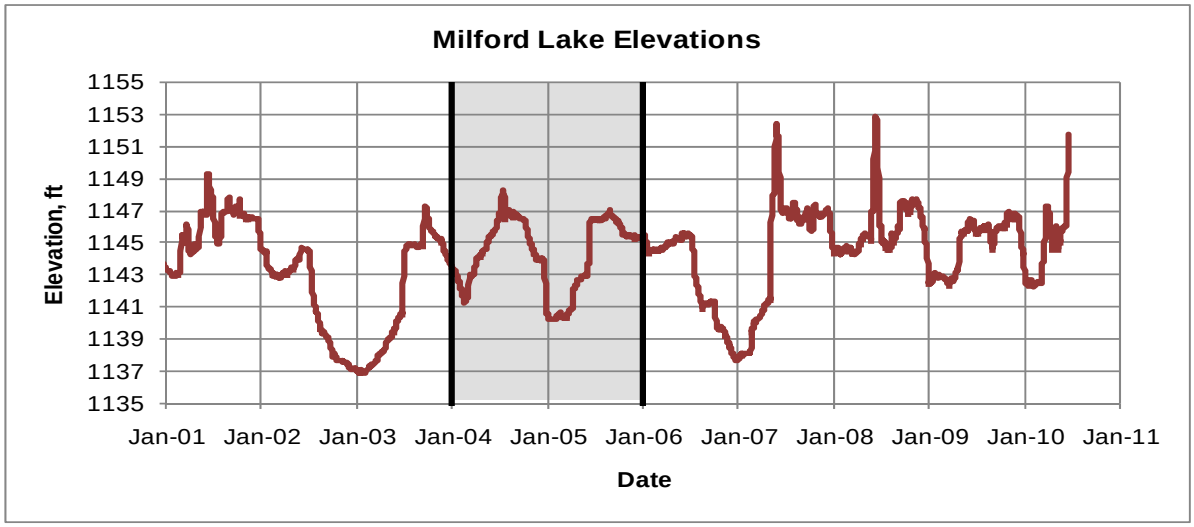
6.1.5.1 Recreation

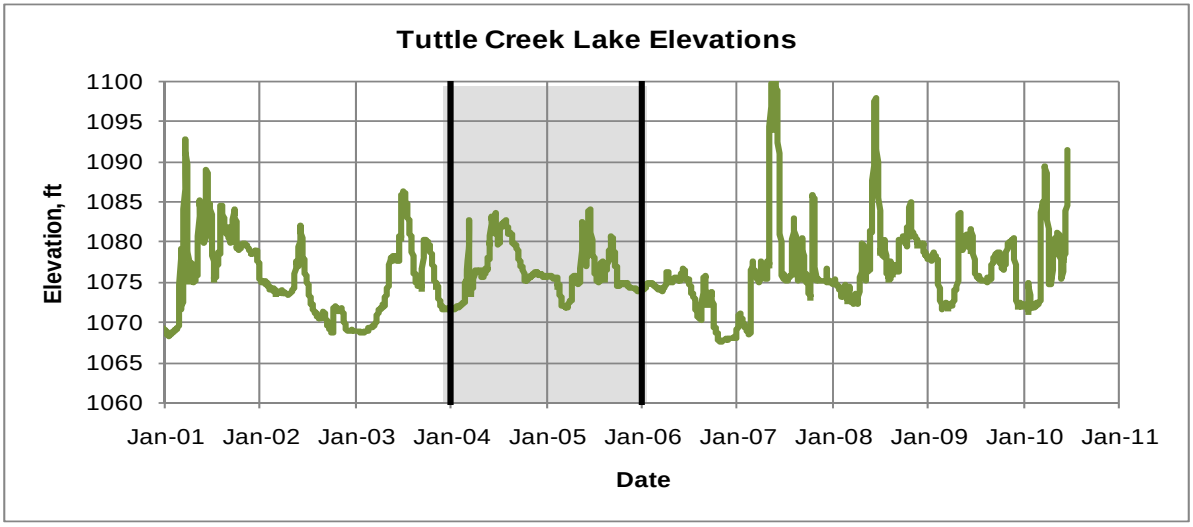
The results of this study show that spending related to recreation use at Perry Lake, Milford Lake, and Tuttle Creek Lake is upwards of $45.3 million annually (Table 6-4).

Table 6-4
Total Annual Visitor Spending, 2009 Dollars

Lake	Total Annual Visitor Spending, 2009 Dollars
Perry Lake	$15,812,579
Milford Lake	$17,127,546
Tuttle Creek Lake	$12,372,481
Total	**$45,312,606**







Note: Shaded portion denotes period of low visitation

Figure 6-2
Historical Lake Levels at Perry, Milford, and Tuttle Creek Lakes

Visitors from outside the region are especially important for the regional economy. In-region visitors that spend money for recreation at the lakes would likely spend their money, or a portion of it, elsewhere in the region. Out-of-region visitors bring new money into the region, which increases spending in the regional economy. Approximately 80 to 90 percent of visitors to the lakes are from outside the region, where the region is defined as the county the lake is in. Table 6-5 shows estimated spending by out-of-region visitors. Total annual out-of-region visitor spending contributes almost $38 million.

Table 6-5
Total Annual Visitor Spending by Out-of-Region Visitors, 2009 Dollars

Lake	Total Annual Visitor Spending by Out of Region Visitors, 2009 Dollars
Perry Lake	$12,650,062
Milford Lake	$15,414,792
Tuttle Creek Lake	$9,897,985
Total	**$37,962,839**

6.1.5.2 Water Supply

Water supply for municipal and industrial clients is another important use of the lakes. The value of in-service water supply has been estimated at approximately $294 million (Table 6-6). This value reflects the avoided costs of constructing new reservoirs and estimated mitigation costs.

Table 6-6
Lake Construction, Mitigation, and Water Supply Costs

Lake	Construction Cost[1]	Construction Cost (2010 $)[2]	Mitigation Costs (2010 $)[3]	Total Costs (2010 $)	Water Supply		
					In Service Storage[4], ac-ft	Water Supply Costs	Cost per Acre-foot
Perry Lake	$48,371,706 (1966 $)	$419,442,978	$1,090,246,250	$1,509,689,228	32,739 (4.3%)	$64,916,637	$1,983
Milford Lake	$48,268,843 (1963 $)	$473,366,811	$1,027,581,175	$1,500,947,986	117,491 (10.3 %)	$154,597,643	$1,316
Tuttle Creek Lake	$80,051,031 (1957 $)	$976,976,395	$805,593,675	$1,782,570,070	99,068 (4.2%)	$74,867,943	$756
					Total	**$294,382,223**	

[1] Provided by USACE Kansas City District
[2] Approximated using ENR-CCI
[3] Estimated using USACE Kansas Stream Mitigation Guidance
[4] Acre-feet (percent of total storage volume)

6.1.6 Impacts from Navigation Releases

In addition to performing an economics analysis on existing recreation and water supply use, the study describes impacts to recreation, and waterfowl habitat and hunting uses, and in-service water supply storage volume due to navigation releases.

To estimate how navigation releases change the frequency of low water elevations, the USACE provided daily lake elevations for both the no navigation and navigation support scenarios. Using threshold lake elevations identified for four lake conditions; high, normal, low, and very low, and quality of recreation ratings for each lake condition, the navigation study results were used to estimate the impact to the quality of recreation due to navigation releases.

Table 6-7 shows the lake condition, quality of recreation rating, and threshold elevation. The higher the quality of recreation rating, the higher the quality of recreation experienced. All lakes showed a decrease in the quality of recreation between normal and low lake conditions.

Table 6-7 also shows the average number of days that the lake is at or below the threshold elevation for the recreation season (April – September) and a full year. The difference columns in Table 6-7 report the difference between the number of days at or below the threshold elevation for the navigation support scenario and the number of days at or below the threshold elevation for the no navigation support scenario. A positive number in the difference column indicates an increase in the number of days annually that the lake is at or below the threshold elevation. At low lake conditions, Table 6-7 shows that the quality of recreation is diminished an additional 3 days at Tuttle Creek Lake and 7 days at Milford and Perry Lakes during the recreation season due to navigation releases. A decrease in the quality of recreation associated with reduced water levels could reduce visitation and adversely affect the local economy.

As shown in Table 6-8, navigation releases reduce the number of days that individual lake level management criteria for sustaining waterfowl habitat and hunter access are obtained to between 18 and 23 days. This deviation from the established criteria is expected to reduce the extent of waterfowl habitat and hunter access, thereby reducing visitor spending on activities such as hunting and sightseeing. In addition, the intrinsic value of providing natural habitat for waterfowl would be reduced.

Results of the KWO OASIS model show that each in-service water supply volume is reduced in the lakes under the navigation support scenario. However, the in-service water supply volume is not fully depleted under any of the modeled scenarios, which suggest that existing water supply demand can be met under both no navigation and navigation support scenarios. In addition, it should be noted that the number of days where navigation releases were made in the OASIS model was much greater than the number of days where historical releases were made from the multipurpose pool. The reason for this is because historically, a number of navigation releases have been made using the lower portion of the flood control pools and not from the multipurpose pools.

Table 6-7
Navigation Releases Impacts to Quality of Recreation

Lake Condition	Quality of Rec Rating[1]	Elev (ft)	Recreation Season (Apr – Sep)[2]					Full Year[3]				
			No Navigation		Nav Support		Diff	No Navigation		Nav Support		Diff
			%	Days/yr	%	Days/yr	Days/yr	%	Days/yr	%	Days/yr	Days/yr
Perry Lake												
High	19	904	93%	170	93%	170	0	96%	350	96%	350	0
Normal	66	891.5	19%	35	23%	42	7	29%	106	41%	150	44
Low	56	888	2%	4	6%	11	7	2%	7	15%	55	48
Very Low	29	885	0%	0	4%	7	7	1%	4	6%	22	18
Milford Lake												
High	51	1150	86%	157	86%	157	0	92%	336	92%	336	0
Normal	69	1144.4	15%	27	20%	37	10	29%	106	41%	150	44
Low	62	1141.4	1%	2	5%	9	7	2%	7	15%	55	48
Very Low	40	1138.4	0%	0	1%	2	2	0%	0	3%	11	11
Tuttle Creek Lake												
High	34	1090	85%	156	85%	156	0	91%	332	91%	332	0
Normal	55	1075	7%	13	12%	22	9	27%	99	36%	131	32
Low	46	1072	1%	2	3%	5	3	2%	7	12%	44	37
Very Low	35	1069	0%	0	1%	2	2	0%	0	3%	11	11

[1] Quality of recreation rating based on interview with USACE lake manager.
[2] Recreation season is 183 days. Percentages represent the percent of simulated recreation season where lake level is at or below elevation. Days/yr is the average number of days per recreation season that the lake is at or below elevation.
[3] Full Year analyses include an entire year (January – December). Percentages represent the percent of simulation where lake level is at or below elevation. Days/yr is the average number of days per year that the lake is at or below elevation.

Table 6-8
Navigation Releases Impacts to Waterfowl Habitat and Hunting

Lake	Average Annual Number of Days Meeting Waterfowl Habitat and Hunter Access Criteria[1]		Difference, days (Nav Support – No Nav)
	No Navigation	Nav Support	
Perry Lake	75	52	-23
Milford Lake	61	41	-20
Tuttle Creek Lake	51	33	-18

[1] Criteria for Perry Lake is elevation of 893.7 feet or greater from September 1 to January 15. Criteria for Milford Lake is elevation of 1146.7 feet or greater from September 1 to January 1. Criteria for Tuttle Creek Lake is elevation of 1079 feet or greater from September 1 to December 5.

Perry Lake and Milford Lake have a fraction of the total water supply storage that has been called into service by the KWO[1]. Of the water supply storage available at Perry Lake, 16.67 percent has been called in to service by the KWO. Milford Lake has allocated 33.88 percent of its water supply storage as in-service storage. If the in-service water supply storage is fully depleted, the State has the option to purchase the remaining future use water supply storage from the USACE to help meet their demands. As more water supply storage is placed into service, less water is available for navigation support. If 100 percent of the water supply is placed into service, no navigation releases will be made from the water supply storage in these lakes; however, navigation releases from the flood control storage may be possible.

In Tuttle Creek Lake, 100 percent of the water supply storage is in-service. Therefore, at this lake, there is no future use storage available for purchase if the existing in-service storage is not able to meet water supply demands.

In 2008, the USACE performed an analysis to determine the extent to which Milford, Perry, and Tuttle Creek Lakes supplied navigation support on the Missouri River from January 1969 until October 2007 while the lakes were below multipurpose pool elevation[2]. The results of the study indicated that over that time period (37.4 years) water was released from Perry Lake in support of navigation on the Missouri River while the pool elevation was below the multipurpose pool at total of 149 days. The number of days that releases were made at Milford Lake was 166 days, and for Tuttle Creek Lake 429 days.

In addition to the 3 to 6 foot drawdown criteria for navigation releases, another protective measure that is built into reservoir operations to ensure uninterrupted provision of firm water supply yield is to allocate all inflow to in-service storage when it drops below 25 percent of its full volume.

6.2 Conclusions

Releases due to navigation impact quality of recreation and waterfowl habitat and hunting. Impacts to these uses translate to an economic loss for the State and the local economies. While the results of this study show that navigation releases do cause some impact to lake access for recreation purposes and the quality of recreation, the impacts to recreation may be considered temporary in some instances. For example, boat ramps can be extended to provide open water access for a wider range of lake levels, or marina slips can be converted to a movable system that allows for slips to extend out into the lake to provide access during low water. There is a cost associated with implementing these solutions, which is not itemized in this report. The solutions could, however, make the lake more accessible and potentially reduce the loss of visitation due to poor lake access, and potentially minimize economic losses as well.

[1] Kansas Water Office Surplus Water Available in Water Marketing Program Lakes Calendar Year 2010, November 2009
[2] USACE Support of Missouri River navigation flows from Milford, Perry, and Tuttle Creek Lakes, April 15, 2008

To further describe the loss of visitation due to navigation releases, further definition of how water levels would affect visitation levels is needed. For example, if a boat ramp is unusable, visitors could either go to another boat ramp, choose not to boat, or choose not to visit the lake at all. These options would have varying direct effects on the regional economy. More data could be collected on visitors' behavior or reaction due to low or high water levels through a survey of users or detailed data on visitor use at boat ramps or other facilities affected by changes in water levels.

Analysis of impacts suggests that in some cases operations plans could be modified to mitigate effects observed. For example, reservoir release plans could stipulate that no navigation releases are permissible several days in advance of and during scheduled high-profile recreation events at the reservoirs. Special events attract large numbers of recreationists and result in a greater benefit to the regional economy than weekends without special events scheduled. Additionally, reservoir release plans could similarly be modified to stipulate that no navigation releases are permissible during critical wildlife management periods.

The economic analysis focuses on direct impacts of recreation at Perry, Milford, and Tuttle Creek Lakes. Direct impacts, defined for this study as changes in spending for recreation activities at the lakes, result in indirect and induced impacts as recreation outfitters purchase input supplies and pay labor income to employees. Indirect and induced impacts also benefit the regional economy. The IMPLAN can be used to estimate indirect and induced economic impacts using the direct impacts identified in this study. IMPLAN can also be used to estimate direct, indirect, and induced effects to employment, measured by number of jobs, and value added, measured in annual dollars. Increased visitation could generate demand for additional employment and increase salaries.

The economic analysis conducted for this study used available data provided by the USACE and KWO to measure the regional economic contribution that recreation at the lakes provide. The U.S. Water Resources Council Principles and Guidelines define recreation benefits to the nation as the willingness to pay for recreation activities. Visitors may be willing to pay more than the existing park fees, and food and supply costs for recreation. This unpaid value that visitors would be willing to pay is referred to as consumer surplus. Consumer surplus can be measured through various methods, including contingent valuation surveys or detailed travel cost models. Additional study could be conducted to estimate consumer surplus and the value to the nation of recreation, rather than the regional economic contributions estimated in this study.

In summary, potential for further study include:

- Collecting more data on visitor behavior or reaction due to low or high water levels through a user survey or facility (boat ramp, marina, etc.) use data.
- Using IMPLAN to estimate indirect and induced economic impacts using the direct impacts identified in this study.
- Estimating consumer surplus and the value to the nation of recreation at the study lakes.

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Section 7
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Appendix A
Visitation and Local Spending Data

Appendix A
Visitation and Local Spending Data

This appendix includes visitation data by activity and fee data collected from local parks at Perry, Milford, and Tuttle Creek Lake to support daily spending estimates.

A.1 Visitation Data by Activity

Visitation data was collected from USACE Kansas City District Activity Distribution Reports. The reports estimate the distribution of visits among activities. Table A-1 summarizes the percentages per activity of total visitation at the lakes during the spring and summer months (April-September) and fall and winter months (October-March). Camping visitation is assumed to include overnight visitors at campgrounds and cabin rentals. Picnic, hunt, swim, other, sightsee, and winter activities are assumed to be day use, non-boating activities. Boat, fish, and ski are assumed to be day use, boating activities. Table A-2 on the following pages shows the visitation estimates by activity based on the percentages in Table A-1.

Table A-1
Visitation Percentages per Activity

Reservoir	Seasons	Camping	Picnic	Boat	Fish	Hunt	Ski	Swim	Other	Sightsee	Winter
Perry	April-Sept	6.2%	5.0%	22.3%	24.5%	3.8%	5.4%	5.5%	10.6%	16.7%	0.0%
	Oct-March	3.6%	4.9%	10.3%	27.2%	14.0%	0.0%	0.0%	16.0%	22.0%	1.9%
Tuttle	April-Sept	2.9%	7.0%	6.3%	7.1%	1.1%	2.1%	3.5%	42.3%	27.8%	0.0%
	Oct-March	3.6%	8.3%	4.3%	9.7%	1.3%	0.4%	1.5%	36.5%	34.4%	0.0%
Milford	April-Sept	10.9%	7.4%	13.2%	22.0%	1.6%	4.5%	10.8%	13.5%	16.3%	0.0%
	Oct-March	3.6%	15.6%	17.4%	27.2%	5.0%	0.0%	0.0%	7.3%	24.1%	0.0%

Table A-2 Visitation per Activity

April-Sept - Q3, Q4
Oct-Mar - Q1, Q2

Perry		Camping	Picnic	Boat	Fish	Hunt	Ski	Swim	Other	Sightsee	Winter	Total
2001	Q1, Q2	10350	14,374	29,915	79,095	40,787	0	0	46,571	63,964	5,625	290,682
	Q3, Q4	23484	18,683	84,312	92,478	14,439	20,312	20,591	40,003	63,082	0	377,385
2002	Q1, Q2	7001	9,723	20,236	53,504	27,590	0	0	31,503	43,269	3,805	196,633
	Q3, Q4	38124	30,330	136,872	150,130	23,441	32,975	33,427	64,941	102,408	0	612,649
2003	Q1, Q2	8350	11,597	24,136	63,815	32,907	0	0	37,574	51,607	4,538	234,525
	Q3, Q4	31374	24,960	112,639	123,549	19,291	27,137	27,509	53,443	84,277	0	504,179
2004	Q1, Q2	4520	6,278	13,065	34,544	17,813	0	0	20,340	27,936	2,457	126,954
	Q3, Q4	17187	13,673	61,704	67,681	10,568	14,866	15,069	29,277	46,167	0	276,192
2005	Q1, Q2	3693	5,128	10,673	28,220	14,552	0	0	16,616	22,821	2,007	103,711
	Q3, Q4	17465	13,894	62,702	68,775	10,738	15,106	15,313	29,750	46,914	0	280,657
2006	Q1, Q2	9969	13,845	28,814	76,182	39,285	0	0	44,856	61,608	5,418	279,975
	Q3, Q4	30409	24,192	109,172	119,747	18,697	26,302	26,662	51,799	81,683	0	488,662
2007	Q1, Q2	9289	12,901	26,849	70,987	36,606	0	0	41,797	57,407	5,048	260,884
	Q3, Q4	27207	21,645	97,678	107,139	16,729	23,532	23,855	46,345	73,083	0	437,211
2008	Q1, Q2	9987	13,870	28,866	76,320	39,356	0	0	44,937	61,720	5,428	280,482
	Q3, Q4	32685	26,003	117,345	128,711	20,097	28,271	28,658	55,676	87,798	0	525,243
2009	Q1, Q2	8986	12,480	25,974	68,674	35,413	0	0	40,435	55,536	4,884	252,382
	Q3, Q4	34526	27,467	123,953	135,959	21,229	29,863	30,272	58,812	92,742	0	554,823

Tuttle		Camping	Picnic	Boat	Fish	Hunt	Ski	Swim	Other	Sightsee	Winter	Total
2001	Q1, Q2	8,428	19,340	10,085	22,495	3,045	1,027	3,378	84,910	80,058	0	232,767
	Q3, Q4	12,717	30,691	27,584	31,180	4,627	9,264	15,357	186,120	122,506	0	440,047
2002	Q1, Q2	9,121	20,930	10,914	24,344	3,296	1,111	3,656	91,890	86,639	0	251,899
	Q3, Q4	14,291	34,490	30,997	35,039	5,200	10,411	17,258	209,154	137,668	0	494,509
2003	Q1, Q2	8,621	19,782	10,315	23,010	3,115	1,050	3,455	86,852	81,889	0	238,089
	Q3, Q4	12,762	30,798	27,679	31,288	4,643	9,297	15,410	186,765	122,931	0	441,574
2004	Q1, Q2	7,650	17,554	9,154	20,418	2,764	932	3,066	77,069	72,665	0	211,270
	Q3, Q4	8,256	19,925	17,907	20,242	3,004	6,014	9,970	120,829	79,531	0	285,678
2005	Q1, Q2	7,995	18,346	9,567	21,339	2,889	974	3,204	80,546	75,943	0	220,803
	Q3, Q4	10,106	24,389	21,919	24,777	3,677	7,362	12,204	147,899	97,349	0	349,682
2006	Q1, Q2	5,659	12,986	6,771	15,104	2,045	689	2,268	57,013	53,755	0	156,291
	Q3, Q4	11,169	26,954	24,224	27,383	4,064	8,136	13,487	163,453	107,587	0	386,457
2007	Q1, Q2	5,767	13,233	6,900	15,392	2,084	702	2,311	58,097	54,778	0	159,264
	Q3, Q4	8,547	20,626	18,537	20,954	3,110	6,226	10,321	125,081	82,330	0	295,732
2008	Q1, Q2	5,538	12,709	6,627	14,782	2,001	675	2,220	55,797	52,609	0	152,958
	Q3, Q4	8,329	20,100	18,064	20,419	3,030	6,067	10,057	121,888	80,228	0	288,183
2009	Q1, Q2	6,735	15,455	8,059	17,976	2,434	820	2,699	67,853	63,975	0	186,006
	Q3, Q4	10,237	24,706	22,204	25,099	3,725	7,458	12,362	149,820	98,613	0	354,222

Table A-2 Visitation per Activity (continued)												
Milford		**Camping**	**Picnic**	**Boat**	**Fish**	**Hunt**	**Ski**	**Swim**	**Other**	**Sightsee**	**Winter**	**Total**
2001	Q1, Q2	5,816	25,388	28,280	44,251	8,095	0	0	11,908	39,228	0	162,967
	Q3, Q4	52,302	35,341	63,336	105,472	7,474	21,449	51,889	64,652	78,282	0	480,196
2002	Q1, Q2	6,582	28,728	32,000	50,073	9,160	0	0	13,475	44,389	0	184,407
	Q3, Q4	55,643	37,598	67,382	112,209	7,952	22,819	55,203	68,781	83,282	0	510,869
2003	Q1, Q2	6,219	27,144	30,236	47,312	8,655	0	0	12,732	41,942	0	174,240
	Q3, Q4	40,931	27,657	49,566	82,540	5,849	16,785	40,607	50,595	61,262	0	375,791
2004	Q1, Q2	5,313	23,188	25,830	40,418	7,394	0	0	10,877	35,830	0	148,850
	Q3, Q4	37,446	25,302	45,346	75,513	5,351	15,356	37,150	46,288	56,046	0	343,798
2005	Q1, Q2	4,396	19,187	21,373	33,444	6,118	0	0	9,000	29,648	0	123,167
	Q3, Q4	40,346	27,262	48,858	81,362	5,766	16,546	40,027	49,873	60,387	0	370,426
2006	Q1, Q2	8,015	34,986	38,972	60,982	11,156	0	0	16,411	54,059	0	224,582
	Q3, Q4	49,722	33,597	60,211	100,268	7,105	20,391	49,328	61,462	74,419	0	456,503
2007	Q1, Q2	10,222	44,617	49,700	77,769	14,227	0	0	20,928	68,941	0	286,405
	Q3, Q4	50,131	33,873	60,707	101,093	7,164	20,558	49,734	61,968	75,032	0	460,261
2008	Q1, Q2	11,427	49,878	55,560	86,939	15,905	0	0	23,396	77,070	0	320,174
	Q3, Q4	60,626	40,964	73,415	122,256	8,664	24,862	60,146	74,940	90,739	0	556,612
2009	Q1, Q2	9,296	40,577	45,200	70,728	12,939	0	0	19,033	62,699	0	260,473
	Q3, Q4	69,340	46,852	83,968	139,828	9,909	28,436	68,791	85,711	103,782	0	636,616
Average Visits 2001-2009 per Activity												
		Camping	**Picnic**	**Boat**	**Fish**	**Hunt**	**Ski**	**Swim**	**Other**	**Sightsee**	**Winter**	**Total**
Perry	Q1, Q2	8,016	11,133	23,170	61,260	31,590	0	0	36,070	49,541	4,357	225,136
	Q3, Q4	28,051	22,317	100,709	110,463	17,248	24,263	24,595	47,783	75,350	0	450,778
Tuttle	Q1, Q2	7,279	16,704	8,710	19,429	2,630	887	2,917	73,336	69,146	0	201,039
	Q3, Q4	10,713	25,853	23,235	26,265	3,898	7,804	12,936	156,779	103,194	0	370,676
Milford	Q1, Q2	7,476	32,633	36,350	56,880	10,406	0	0	15,307	50,423	0	209,474
	Q3, Q4	50,721	34,272	61,421	102,282	7,248	20,800	50,319	62,697	75,915	0	465,675

A.2 Park Facility Fee Data

Fee data was collected from parks and facilities at Perry, Milford, and Tuttle Creek Lakes and used to calculate the park fees portion of the visitor daily spending estimates. Park fees include overnight fees, vehicle fees, entrance fees, and equipment rental fees. Overnight fees vary depending on the campground and type of site (i.e., utility or non-utility site). If multiple fees existed at a particular lake, the average of all fees was taken for the daily spending estimates. The following tables summarize the estimates used for park fees in the visitor spending profiles, based on data collected from each lake during the 2010 site visits (described in Section 2, 3, and 4 of the main report). Sections 2, 3, and 4 of the main report include the complete daily visitor spending profiles and total spending estimates.

A.2.1 Perry Lake Summary Table

Table A-3
Average visitor spending by Activity

Fees represent average of existing fees at all Perry Lake park facilities

Camping					
	4	night average stay			
	3	person average party size			
Camping	$14.54	per night	$19.39	per person	
4 cabins	4	people per cabin			
Cabins	$60.00	per night summer	$60.00	per person	
Cabins	$50.00	per night fall	$50.00	per person	
Vehicle fees	$4.60	per day summer	$6.13	per person	
	$4.35	per day fall	$5.80	per person	
Picnic/Sightsee/Swim/Other/Winter					
	3	person average party size			
Vehicle fees	$4.60	per day summer	$1.53	per person	
	$4.35	per day fall	$1.45	per person	
Day use areas	$2.78	per person	$3.14	per person	
Trail Fees	$3.50	per person			
Fish	licenses are annual fees				
License fee	$20.50	residents			
	$72.50	non-residents			
Hunt					
License fee	$20.50	residents			
	$42.50	non-residents			
	$22.50	non-residents 5-day fishing			
Boat/Ski					
Boat launch	$3.00	per day	$1.00	per person	
Vehicle fees	$4.60	per day summer	$1.53	per person	
	$4.35	per day fall	$1.45	per person	
Boat Rentals	$48.08	per person per day	$48.08	per person	
Annual Boat Fees					per season
Main Marina	$2,248.44	per slip per season	435	slips	$978,070
Rock Creek Marina	$1,319.00	per slip per season	407	slips	$536,833
Pirates Cove	$2,678.09	per slip per season	76	slips	$203,535
					$1,718,438

Summary	summer	fall	AVG	
Campers	$25.52	$25.19	$25.36	per person
Boat fees	$2.53	$2.45	$2.49	per person
Non-boat day use	$4.67	$4.59	$4.63	per person
Cabins	$66.13	$55.80	$60.97	per person
Boat fees with Rental	$50.61	$50.53	$50.57	per person
Day use hunting fishing	$1.53	$1.45	$1.49	per person

A.2.2 Milford Lake Summary Table

Table A-4
Average visitor spending by Activity

Fees represent average of existing fees at all Milford Lake park facilities

Camping					
	4	night average stay			
	3	person average party size			
Camping	$14.88	per night	$19.84	per person	
23 cabins	6	people per cabin			
Cabins	$77.50	per night summer	$51.67	per person	
Cabins	$62.50	per night fall	$41.67	per person	
Vehicle fees	$4.20	per day summer	$5.60	per person	
	$3.70	per day fall	$4.93	per person	
Picnic/Sightsee/Swim/Other/Winter					
	3	person average party size			
Vehicle fees	$4.20	per day summer	$1.40	per person	
	$3.70	per day fall	$1.23	per person	
Day use areas	$3.43	per person			
Fish					
License fee	$20.50	residents			
	$72.50	non-residents			
Hunt					
License fee	$20.50	residents			
	$42.50	non-residents			
	$22.50	non-residents 5-day fishing			
Boat/Ski					
Boat launch	$3.00	per day	$1.00	per person	
Vehicle fees	$4.20	per day summer	$1.40	per person	
	$3.70	per day fall	$1.23	per person	
Boat Rentals	$37.50	per person per day	$37.50	per person	
Annual Boat Fees					per season
Milford Lake Marina	$ 1,262.32	per slip per season	71	slips	$89,625
Thunderbird Marina	$ 1,011.12	per slip per season	154	slips	$155,712
					$245,337

Summary	summer	fall	AVG	
Campers	$25.44	$24.77	$25.11	per person
Boat fees	$2.40	$2.23	$2.32	per person
Non-boat day use	$4.83	$4.66	$4.74	per person
Cabins	$57.27	$46.60	$51.93	per person
Boat fees with Rental	$39.90	$39.73	$39.82	per person
Day use hunt fish	$1.40	$1.23	$1.32	per person

A.2.3 Tuttle Creek Lake Summary Table

Table A-5
Average visitor spending by Activity

Fees represent average of existing fees at all Tuttle Creek Lake park facilities

Camping					
	4	night average stay			
	3	person average party size			
Camping	$13	per night	$17.48	per person	
7 cabins	6	people per cabin			
Cabins	$60.00	per night summer	$40.00	per person	
Cabins	$50.00	per night fall	$33.33	per person	
Vehicle fees	$4.10	per day summer	$5.47	per person	
	$4	per day fall	$5.13	per person	
Picnic/Sightsee/Swim/Other/Winter					
	3	person average party size			
Vehicle fees	$4.10	per day summer	$1.37	per person	
	$3.85	per day fall	$1.28	per person	
Day use areas	$2.56	per person			
Trail Fees	$3.50	per person			
Swim area	$1.00	per person			
Canoe/kayak	$20.00	per day	$10	per person	
Tube	$6.00	per day	$6	per person	
Fish					
License fee	$20.50	residents			
	$72.50	non-residents			
Hunt					
License fee	$20.50	residents			
	$42.50	non-residents			
	$22.50	non-residents 5-day fishing			
Boat/Ski					
Boat launch	$3.00	per day	$1.00	per person	
Vehicle fees	$4.10	per day summer	$1.37	per person	
	$3.85	per day fall			
Boat Rentals	$28.63	per person per day	$28.63	per person	
Annual Boat Fees					per season
Wildcat Marina	$1,225	per slip per season	63	slips	$77,175
Blue Valley Yacht Club	$100	membership fee	50	members	$5,000
	$150	per boat mooring	22	boats	$3,300
	$85	per boat on land	25	boats	$2,125
					$87,600

Summary	summer	fall	AVG	
Campers	$22.95	$22.61	$22.78	per person
Boat fees	$2.37	$2.37	$2.37	per person
Non-boat day use	$5.98	$5.89	$5.94	per person
Cabins	$45.47	$38.47	$41.97	per person
Boat fees with Rental	$31.00	$31.00	$31.00	per person
Day use hunting fishing	$1.37	$1.28	$1.33	per person

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Appendix B

Kansas Stream Mitigation Debit Calculations

Milford Lake

Stream Type	Feet	Miles
Intermittent	212,384	40.2
Perennial	231,933	43.9
Total	444,317	84.2

Perry Lake

Stream Type	Feet	Miles
Intermittent	213,043	40.3
Perennial	243,942	46.2
Total	456,985	86.6

Tuttle Creek Lake

Stream Type	Feet	Miles
Intermittent	151,644	28.7
Perennial	232,863	44.1
Total	384,507	72.8

Lake	Debits	Approximate Mitigation Costs
Milford	41,103,247	$1,027,581,175
Perry	43,609,850	$1,090,246,250
Tuttle	32,223,747	$805,593,675

Factor	Impact 1 (Perennial - Fill)	Impact 2 (Perennial – Impound)	Impact 3 (Intermittent - Impound)
Stream Type Impacted	0.8 (Perennial)	0.8 (Perennial)	0.4 (Intermittent)
Stream Status	0.8 (Primary)	0.8 (Primary)	0.4 (Secondary)
Existing Condition	0.8 (Moderately Functional)	0.8 (Moderately Functional)	0.8 (Moderately Functional)
Duration	0.3 (Permanent > 3 Yrs)	0.3 (Permanent > 3 Yrs)	0.3 (Permanent > 3 Yrs)
Activity	2.5 (Fill)	2 (Impound)	2 (Impound)
Total Project Impact	0.2 (501'-1000' LF)	=LF/1000*0.4	=LF/1000*0.4
Sum of Factors (M)			
Linear Feet of Stream Impacted (LF)			
MxLF	= Total Debits	= Total Debits	= Total Debits

Appendix C

2009 Final Draft Navigation Study

Kansas Planning Assistance to States
FINAL DRAFT Navigation Study
Milford, Tuttle Creek, Perry Lakes

Edward Parker, P.E.
Water Management Section
Kansas City District

July 13, 2009

I. Purpose:

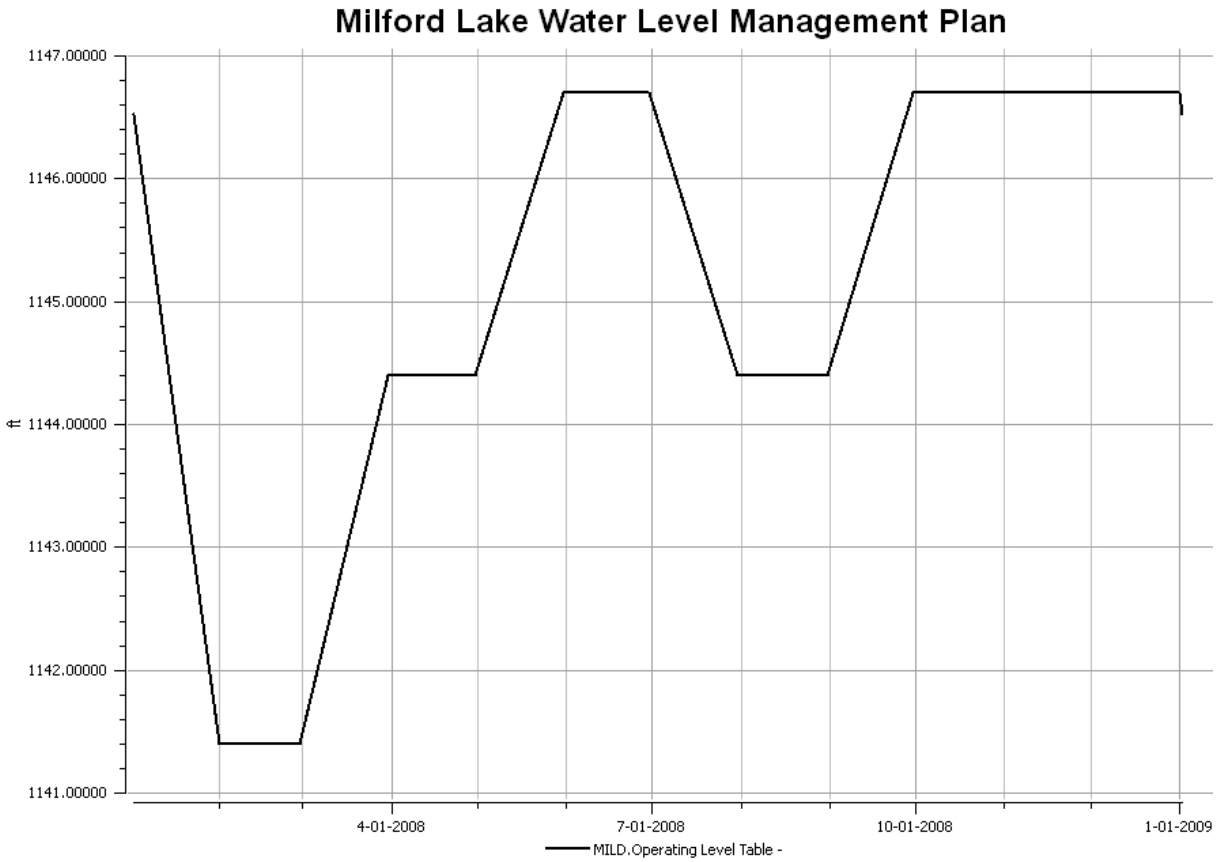
Riverware model runs of the Kansas River Basin lakes have been performed to identify the relative affects of navigation support on the Milford, Tuttle Creek and Perry Lake elevations and downstream flows. The model runs represent historic flows and hydrologic conditions from January 1, 1950 through December 31, 2008. The runs were combinations of hypothetical lake operation methodologies and estimated navigation flow requirements at DeSoto.

Milford, Tuttle Creek and Perry Lakes were authorized to provide supplemental navigation support water for the Missouri River. In 1991 the Water Control Manuals were amended to limit the navigation support to 4,000 cfs flow at DeSoto. The 4,000 cfs flow includes water for water quality purposes, and any uncontrolled flow at the DeSoto gage on the Kansas River. Typically, the Kansas River lakes are operated to maintain 1,000 cfs minimum flow at the DeSoto gage for water quality purposes. The additional 3,000 cfs flow for Missouri River navigation support translates to between six and seven tenths of a foot when the river is near the 41,000 cfs Kansas City navigation target.

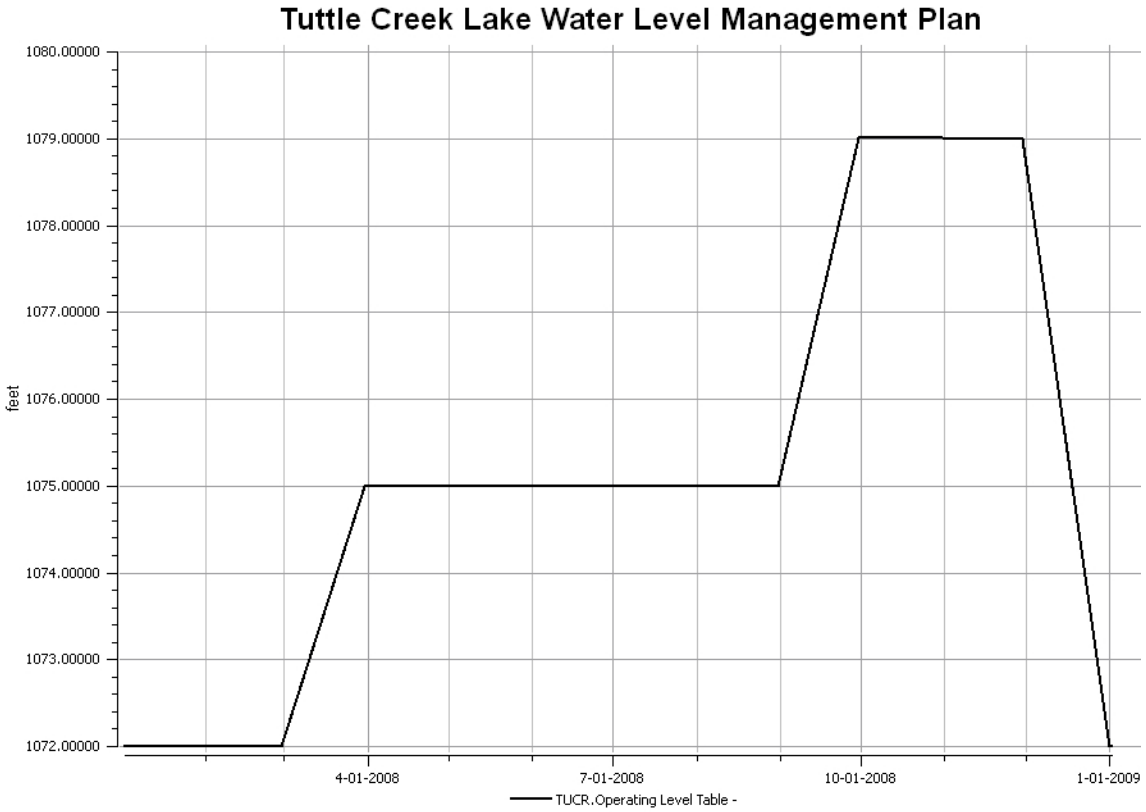
II. Methodologies:

A. Water Level Management Plans

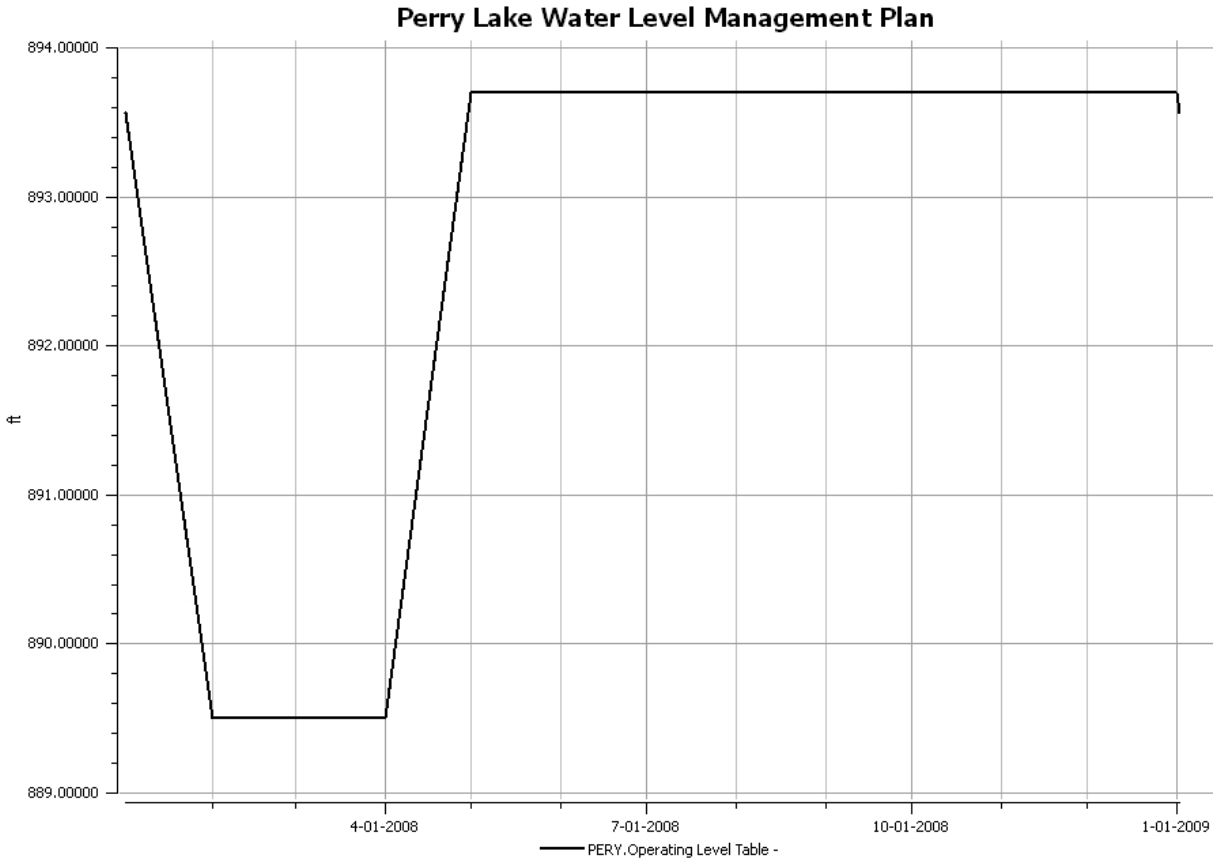
Unless otherwise noted, all runs were performed with the 2008 water level management plans in effect for the entire period. The assumed water level management plan guide curves are illustrated below:



Milford Multipurpose Pool Elevation: 1144.4



Tuttle Creek Lake Multipurpose Pool: 1075.0



Perry Lake Multipurpose Pool Elevation: 891.5

B. Base Model Operation (Water Quality Only)

The model runs represent historic flows and hydrologic conditions from January 1, 1950 through December 31, 2008. A base model run was performed that assumed no navigation support was provided. The runs are titled "Water Quality Only" and are provided on the lake elevation frequency graphs. Assumptions made for these runs were:

1. No navigation support was provided.

2. The model requires input of a maximum release value for downstream lowflow supplementation. Each lake's maximum releases in support of the water quality requirement were:

    - Perry Lake 200 cfs
    - Tuttle Lake 750 cfs
    - Milford Lake 400 cfs

    The maximum release values are percentages of the required DeSoto flow. (Perry – 20%, Tuttle – 75%, Milford – 40%). The percentages are representative of the historic level of support provided by each lake.

Notes:
(a) The model requires that each lake have a maximum release value for lowflow supplementation. The maximum lowflow support releases for each lake was set as a percentage of the required DeSoto flow. By setting the maximum values in this manner, a consistent ratio between each lake's releases was maintained across the different levels of support. The percentages total more then 100% as these are maximum release rates, not necessarily actual release rates.

(b) The maximum values only apply to releases solely for water quality support at DeSoto or Topeka. Flood control release rates are only restricted by the physical limitation of the outlet works, or downstream control points.

3. Water quality support was provided as defined in the water control manuals. Language from the manuals is provided below in Table 1:

Table 1.

Regulation Criteria to
Maintain Water Quality and Supplement
Low Flow on the Kansas River

Tuttle Creek Elevation	Flow Objectives in c.f.s. Topeka	DeSoto
1075-1070	750	1,000
1070-1065 (summer)	750 (summer)	1,000
(winter)	600 (winter)	800
1065-1048	600 (summer)	750
	(winter)	700

Summer = 1 May to 31 October
Winter = 1 November to 30 April

C. Kansas River Navigation Support

Navigation support on the Missouri River is an authorized purpose for Milford, Tuttle Creek and Perry Lakes. The Water Control Manual for each lake specifies a method for balancing the lakes support for navigation and recreation. The manuals specify that three feet of the water can be used to supplement navigation before October 1 of any year, and an additional three feet of storage can be used after October 1 until the navigation season ends. Table 2 and Table 3 provide the water storage volumes available before and after October 1.

Table 2.

Kansas System Lakes
Navigation Support Storage Before October 1

Elevation Multipurpose Storage		
Perry Lake	888.5 -- 891.5 msl	29,500 AF
Milford Lake	1141.4 -- 1144.4 msl	44,600 AF
Tuttle Creek Lake	1072.0 -- 1075.0 msl	35,000 AF
Total Storage Available before October 1		109,100 AF

Table 3.

Kansas System Lakes
Navigation Support Storage After October 1

Elevation Multipurpose Storage		
Perry Lake	885.5 -- 891.5 msl	56,700 AF
Milford Lake	1138.4 -- 1144.4 msl	86,100 AF
Tuttle Creek Lake	1069.0 -- 1075.0 msl	66,000 AF
Total Storage Available after October 1		208,800 AF

The storage values do not represent the actual amount of water that can be released for navigation support. The storage values are simply the amount of space in the three or six feet navigation support zones of the lakes. The yield from that storage is available for navigation support. The yield from these storage zones can be substantially more then the storage amounts alone due to inflow occurring at the same time of the navigation release.. In essence, the bottom elevation of the storage zone is the "shut-off" elevation for navigation support releases. Any water stored above the shut-off elevation, can be released for navigation support, even if the total release exceeds the storage values.

D. Level of Navigation Support Scenarios

Three different navigation support scenarios are studied in this report. The navigation support range from the straight forward "Full Navigation Support" to an approximation of "Typical Navigation Support" and concludes with a review of the "2008 Navigation Support".

1. Full Navigation Support: The Full Navigation Support scenario assumes that the maximum level of support allowed in the water control manuals is provided. A full navigation season extends from April 1 until December 1 each year. The maximum required contribution from the Kansas River is 4,000 c.f.s.

Full Navigation Support Assumptions:

1. Minimum DeSoto flow from April 1 until December 1 is 4,000 cfs.
2. Lowflow support from December 1 until April 1 as defined in the manuals.
3. Maximum releases in support of low flow were:
    - Perry Lake 200 cfs
    - Tuttle Lake 750 cfs
    - Milford Lake 400 cfs
4. Maximum releases in support of navigation flow were:
    - Perry Lake 800 cfs
    - Tuttle Lake 3000 cfs
    - Milford Lake 1600 cfs

The maximum release values are percentages of the required DeSoto flow. (Perry – 20%, Tuttle – 75%, Milford – 40%). The percentages are representative of the historic level of support provided by each lake.

Notes:
(a) The model requires that each lake have a maximum release value for lowflow supplementation. The maximum lowflow support releases for each lake was set as a percentage of the required DeSoto flow. By setting the maximum values in this manner, a consistent ratio between each lake's release was maintained across the different levels of support. The percentages total more then 100% as these are maximum release rates, not necessarily actual release rates.

(b) The maximum values only apply to releases solely for water quality support at DeSoto or Topeka. Flood control release rates are only restricted by the physical limitation of the outlet works, or downstream control points.

2. Typical Support Level: Since 1969, the Reservoir Control Center has requested navigation support from the Kansas Basin in about half of the years. A navigation release was required from the multipurpose pool of at least one of the lakes during: 1969, 1974, 1975, 1977, 1980, 1981, 1985, 1988, 1989, 1990, 1991, 2000, 2001, 2002, 2003, 2005, 2006, and 2007. Minimum navigation flows may have been required during other years, but multipurpose pool releases were not required. Such was the case during 2008 when the navigation requirement was fully met with flood control pool releases. In 2004, water was intentionally stored in the bottom of the flood control pools under a formal operation deviation. In agreement with the Kansas Water Office, the Riverware model assumes navigation support during all study years. In reality, navigation support is not required during many years. However, requiring "typical" navigation support every year allows the potential affect to be reviewed if such a requirement had occurred.

In the spring of 2008, the Kansas City District has performed a data review of navigation support from the multipurpose pools. The study determined the number of days navigation support was required for each of the three lakes from the lakes multipurpose pools. The results from the study are summarized below

Navigation Support Summary Table	MILFORD LAKE		PERRY LAKE		TUTTLE CREEK LAKE	
	Totals	Percent of Total	Totals	Percent of Total	Totals	Percent of Total
First Day to MULTIPURPOSE POOL	14-Jul-67		3-Jun-70		29-Apr-63	
Total Days Dam Operation*	14,719		13,664		16,256	
Total Released (ac-ft) MPP+FC+Surcharge**	23,151,613		18,696,417		68,220,541	
Nav Support Released While Below multipurpose pool (ac-ft) MPP Only	289,591	1.25%	195,204	1.04%	972,453	1.43%
Number of Days of Nav Support Releases	166	1.13%	149	1.09%	429	2.64%
Number of Days of Nav Support Effect	1,578	10.72%	2,225	16.28%	2,001	12.31%
Greatest Max Difference between Actual & Estimated No Nav Support Pool Elev (ft)	7.73		4.57		10.50	

*Days of Dam Operation based on first day to MULTIPURPOSE POOL through 31 Oct 2007.
** Total Released (ac-ft) is calculated from 1 Jan 1969 or first day to multipurpose pool, whichever is later

Support for navigation from the multipurpose pools of the three lakes has occurred between 1.0 and 1.5% of the time since the lakes construction. However, the data from this table only includes navigation releases from the multipurpose pools and not from the flood pools. The Kansas City District has attempted to maximize the level of navigation support by maintaining small amounts of storage in the bottom of the flood control pool when navigation support is expected. For the purpose of modeling, we assume that half of all historic navigation support occurred from the flood control zones. Therefore, we assume the total navigation support from the multipurpose and flood control zones has been required 3% of the time since the lakes' construction

Finally, navigation support has only been requested for about half of the years since the lakes' construction. If the navigation support was necessary 6% of the time since the lakes' construction, it would be required for 12% of the time during those years it was needed and zero percent during the other years. Twelve percent of a year is about 44 days.

Under these assumptions, navigation releases would be required for 44 days (one and a half months) in each of the years that navigation support was requested. The 1.5 months were distributed as one-half month increments in August, September, and October. For the purposes of the Riverware model, the "typical" navigation demand occurs from August 15th until September 15th, and from October 1 until October 15th.

The navigation requirement has occurred near the end of the navigation season for most years, and has generally required a minimum 2,000 c.f.s. flow at DeSoto. However, after discussion with the Kansas Water office, it was decided to provide a combination of 2,000 and 4,000 c.f.s. navigation supports for every year of the study. Therefore, for all years of the "typical navigation support" runs, the model assumes 2,000 c.f.s. navigation

support from August 15th until September 1st, and from October 1st until October 15th. The model also assume 4,000 c.f.s. navigation support from September 1st until September 15th of each year.

Typical Navigation Support assumptions:

1. Minimum DeSoto flow from August 15 until September 1 and from October 1 through October 15 is 2,000 cfs.
2. Minimum DeSoto flow from September 1 through September 15 is 4,000 c.f.s.
3. Lowflow support at other times as defined in the manuals.
4. Maximum releases in support of low flow were:
    - Perry Lake 200 cfs
    - Tuttle Lake 750 cfs
    - Milford Lake 400 cfs
5. Maximum releases in support of 2,000 cfs navigation flow were:
    - Perry Lake 400 cfs
    - Tuttle Lake 1500 cfs
    - Milford Lake 800 cfs
6. Maximum releases in support of 4,000 cfs navigation flow were:
    - Perry Lake 800 cfs
    - Tuttle Lake 3000 cfs
    - Milford Lake 1600 cfs

The maximum release values are percentages of the required DeSoto flow. (Perry – 20%, Tuttle – 75%, Milford – 40%). The percentages are representative of the historic level of support provided by each lake.

Notes:
(a) The model requires that each lake have a maximum release value for lowflow supplementation. The maximum lowflow support releases for each lake was set as a percentage of the required DeSoto flow. By setting the maximum values in this manner, a consistent ratio between each lake's release was maintained across the different levels of support. The percentages total more then 100% as these are maximum release rates, not necessarily actual release rates.
(b) The maximum values only apply to releases solely for water quality support at DeSoto or Topeka. Flood control release rates are only restricted by the physical limitation of the outlet works, or downstream control points.

3. 2008 Navigation Support Level: The hydrologic conditions of 2008 were fairly wet in the Kansas Basin. However, the level of navigation support required by the Reservoir Control Center remained relatively high. While lake inflow and uncontrolled Kansas River flow was significant enough to preclude any multipurpose pool releases for navigation, changes in the Reservoir Control Center's operation of Missouri River nevertheless affected the level of Kansas River support that was required in 2008.

Recently, the Reservoir Control Center discontinued navigation support for the Missouri River upstream of Kansas City if no navigation demand existed. The reduced navigation support conserves water in the Missouri River mainstem projects and helps balance the beneficial purposes of the projects. However, the reduced mainstem support also caused the level of Kansas River support to increase. Insuring that the Missouri River below

Kansas City continued to maintain needed navigation flows, without maintaining the Missouri River flows at Nebraska City, results in a higher need for intervening inflow such as from the Kansas River. While the 2008 support level exceed the historic support level, it may represent a more reasonable estimate of future required navigation requirements for the Kansas River.

On August 29, 2008, the Reservoir Control Center notified the Kansas City District that a minimum 4,000 c.f.s. flow at DeSoto was required. The last day for navigation support at Kansas City was October 27, 2008. The model runs under the "2008 Navigation Support" alternative assume a 4,000 c.f.s. requirement for September and October of every year.

2008 Navigation Support assumptions:

1. Minimum DeSoto flow from September 1 until November 1 is 4,000 cfs.
2. Lowflow support at other times as defined in the manuals.
3. Maximum releases in support of lowflow were:
    - Perry Lake 200 cfs
    - Tuttle Lake 750 cfs
    - Milford Lake 400 cfs
4. Maximum releases in support of 4,000 cfs navigation flow were:
    - Perry Lake 800 cfs
    - Tuttle Lake 3000 cfs
    - Milford Lake 1600 cfs

The maximum release values are percentages of the required DeSoto flow. (Perry – 20%, Tuttle – 75%, Milford – 40%). The percentages are representative of the historic level of support provided by each lake.

Notes:
(a) The model requires that each lake have a maximum release value for lowflow supplementation. The maximum lowflow support releases for each lake was set as a percentage of the required DeSoto flow. By setting the maximum values in this manner, a consistent ratio between each lake's release was maintained across the different levels of support. The percentages total more then 100% as these are maximum release rates, not necessarily actual release rates.
(b) The maximum values only apply to releases solely for water quality support at DeSoto or Topeka. Flood control release rates are only restricted by the physical limitation of the outlet works, or downstream control points.

E. Lake Operation Methods:

For each of the three above assumed levels of navigation support, different lake operation methods were modeled. The lake operation assumptions provide for different methods of restricting the lakes' ability to provide navigation support. The lake operation methods are described below with the assumptions made.

1. Three/Six Feet drawdown limit: Prior to October 1, all three lakes are used to support navigation, providing the lake elevation is no more than three feet below multipurpose pool (MPP). Between October 1 and the end of navigation season, the lakes may be drawn down a maximum of six feet below MPP. Any water stored in the flood control pools of any of the lakes is evacuated in accordance with water control manual requirements without consideration of navigation requirements. The operation will be similar to historic lake operation, except no water is intentional held in the flood pools anticipating a navigation requirement.

2. No Drawdown Limit: Lake storage that has not been called into service as of January 2009 is available for navigation support. The model runs represent the maximum support available, and correspond with the original manual language when the lakes were authorized and constructed. The January 2009 water supply storage amount for each lake is provided below. The shutoff elevations represent the elevation if the water supply storage is the only water in the lake. For the purpose of this exercise, any water above the shutoff elevation is assumed available for navigation support. During non-navigation periods, the water quality requirements at DeSoto and Topeka are met if possible.

Purpose	Perry (acre-feet)	Milford (acre-feet)	Tuttle Creek (acre-feet)
Water Supply in Service	25,000	101,650	50,000
Shutoff Elevation	864.5	1115.2	1044.4

3. Flood Pool Navigation Support Only: All lakes provide support for navigation, but only from the flood control pools of the projects. Essentially, if the navigation requirement provides for a higher release than the water control manual mandated flood evacuation release, the lakes sustain the higher navigation requirement release. If the water control manual mandated flood evacuation rate is higher than the navigation requirement, the water still supplements navigation, but is set at the higher rate and exceeds the minimum navigation requirement.

4. Supplement Navigation with Five Percent Flood Control Pool: The lakes are operated in accordance with the same requirements as "Three/Six Feet Drawdown Limit", but are also able to use the bottom five percent of the flood control pool solely for conservation purposes. Essentially, from June 1 until the end of the navigation support season, the MPP of each lake is raised to the 5% flood control volume elevation. At the end of the navigation support period, the MPP returns to the normal water level management elevation for each lake. The 5% flood control elevation for each lake is:

Lake Project	Normal MPP	5% FP Elevation
Milford	1144.4	1146.7
Tuttle Creek	1075.0	1081.0
Perry	891.5	893.7

Note: This did not result in a change of Perry Lake operation as the 2008 WLMP stipulates a guide curve of 893.7 feet from May 1 until January 1.

5. Credit for Supplement Navigation with Five Percent Flood Control Pool: The operation is the same as number 4 (Supplement Navigation with Five Percent Flood Control Pool) except that credit for extra water stored in the flood pool is provided against the 3 or 6 feet drawdown limit. The navigation shutoff elevation of each lake is adjusted upward based on the maximum lake storage after June 1 of that year. Beginning on June 1, the maximum amount of water stored above the multipurpose pool, and below the five percent limit is determined. The maximum value is recalculated on a daily basis, and added to either the three or six feet drawdown storage. The resulting storage amount provides the new navigation drawdown limit for that navigation season. If a lake is lowered to the new navigation drawdown limit, the releases for that lake are set to lowflow values.

When the navigation support from either Tuttle Creek or Milford Lake is reduced because of the new drawdown limit, the release from the other lake is increased to make up the difference. If both lakes are lowered to the navigation drawdown limit, the model transfers the release requirement to Perry Lake. If all three lakes are below the limit, the model discontinues navigation support, but still attempts to meet water quality requirements.

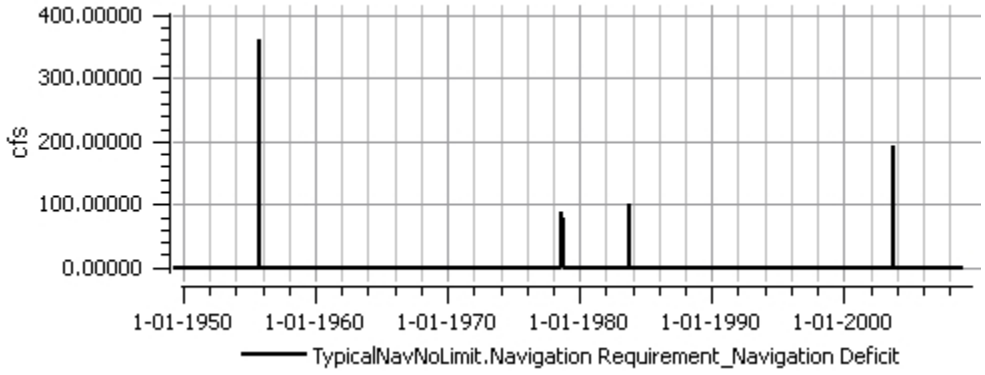
III. Data Output:

Individual minimum elevation frequency graphs have been prepared for each lake and each navigation support level assumption. Each graph represents one navigation support assumption and includes all the operation scenarios for one of the three lakes. The graphs also include the base condition “Water Quality Only” and the “Historic” minimum lake elevation frequency experienced since each lake first filled. The “Water Quality Only” operation provides the minimum elevation frequency if no navigation support is provided,. The “Historic” values provide insight for what has happened at the lakes during past years. However, the historic frequencies are affected by other operation requirements that are not addressed in this report such as construction requirements at the lakes. The historic lake frequency values are provided solely as background information.

The reader can use the elevation frequency graphs to see the relative affects of changing the lake operation method, assuming a navigation support requirement. The Y-axis is each lakes minimum annual pool elevation. The frequencies on the X-axis represent the probability of the annual elevation being less than the value on the curve.

Graphs have also been prepared to provide insight to the lakes ability to maintain the navigation requirement at the DeSoto gage. A duration curve was prepared for each navigation support scenario and lake operation method. The duration curves represent the percent of time that the navigation requirement exceeded the DeSoto flow during times that navigation support was required. The amount that the DeSoto flow was below the requirement is provided on the Y axis.

It is noted that on some occasions the navigation requirement is not met, even though the lake condition indicates that navigation support water is available. For example, the model output for Typical Navigation Support and No Drawdown Limit has four occasions when the support was not met.



The deficiency is due to RiverWare recalculating flows multiple times until all conditions are resolved. The rules for lowflow support calculations are set to only be determined once. After determining the amount of navigation support needed from Tuttle, Milford and Perry the RiverWare model may recalculate the DeSoto flow and determine a lower value. As the RiverWare model does not then recalculate the lowflow release requirement, the output would show deficient support for that time period. The amounts of the flow deficiencies are small, infrequent, and not deemed to significantly affect the results.

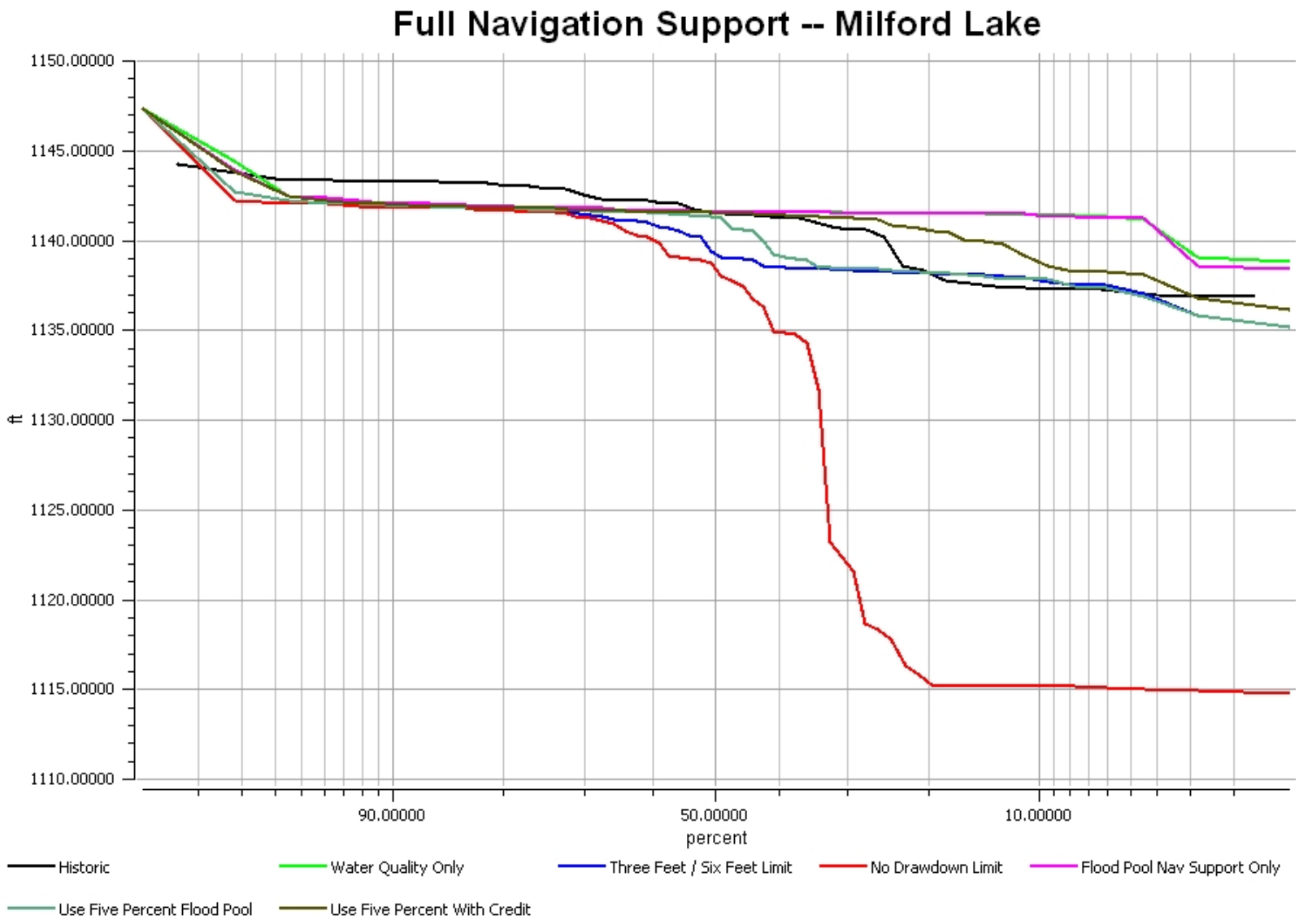
Finally, graphs have also been prepared of the daily lake elevations and amount of navigation support deficiency for the entire period of the model run. The daily RiverWare output has been loaded into a number of Excel workbooks. Each operation scenario and navigation support assumption pair has been loaded into one workbook file. Within each file, charts have been prepared for each decade that includes the Milford, Tuttle Creek and Perry Lake elevations, and the amount of flow deficit at DeSoto. These Excel workbooks are included with this report. Due to the large number of charts, they have not been reproduced within this document.

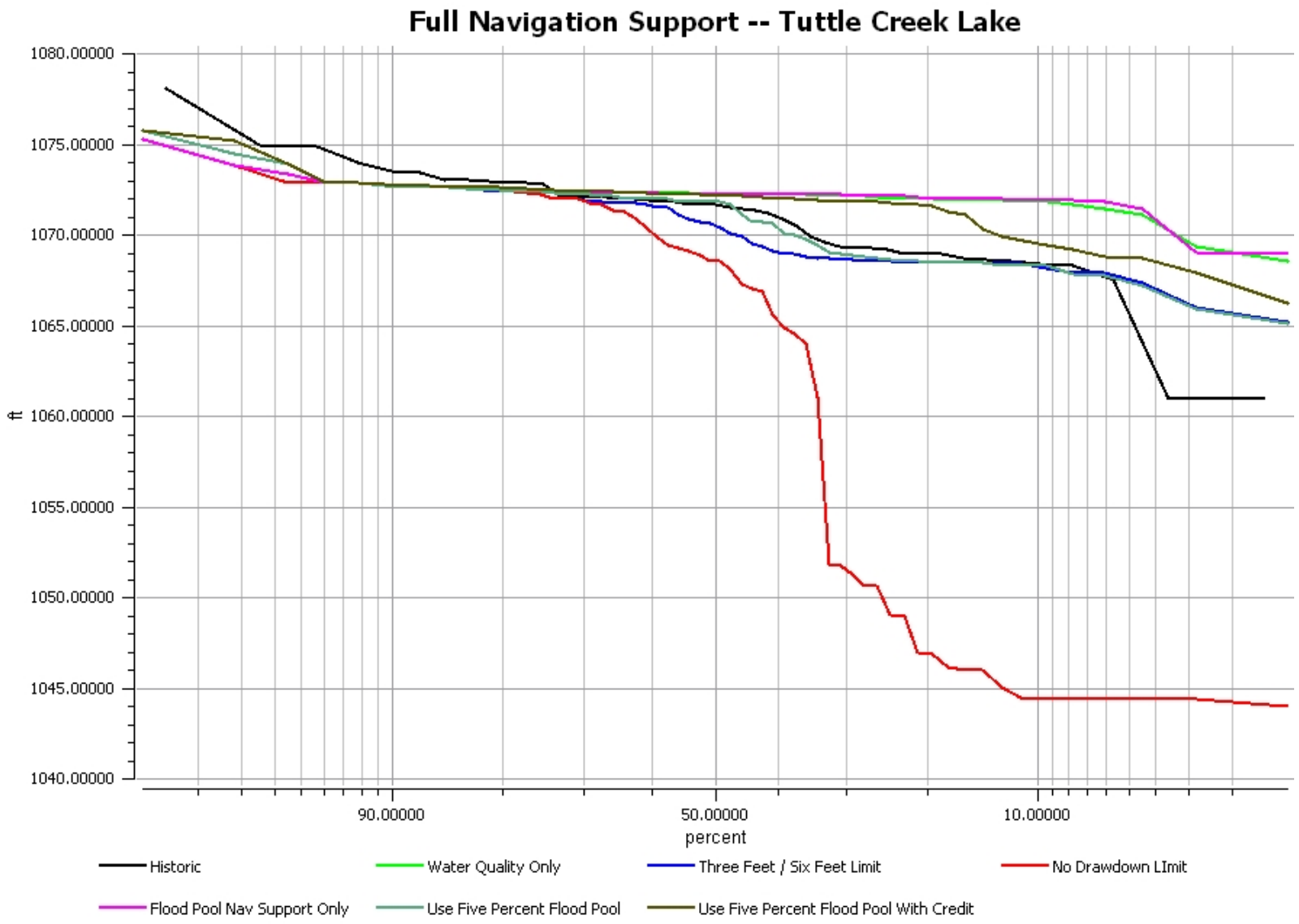
The first part of the file name corresponds with the navigation support scenario:

- **TypicalNav** -- Typical Support Level
- **FullNav** – Full Navigation Support
- **2008** – 2008 Navigation Support Level

The second part of the file name corresponds with the lake operation method:

- **ThreeSixlimit** – Three/Six Feet drawdown limit
- **NoLimit** -- No Drawdown Limit
- **FPonly** -- Flood Pool Navigation Support Only
- **5Percent** -- Supplement Navigation with Five Percent Flood Control Pool
- **5PercentCredit** -- Credit for Supplement Navigation with Five Percent Flood Control Pool


Full Navigation Support -- Milford Lake
1150.00000
1145.00000
1140.00000
1135.00000
1130.00000
1125.00000
1120.00000
1115.00000
1110.00000
ft
90.00000
50.00000
10.00000
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit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1075.00000
1070.00000
1065.00000
1060.00000
1055.00000
1050.00000
1045.00000
1040.00000
ft
90.00000
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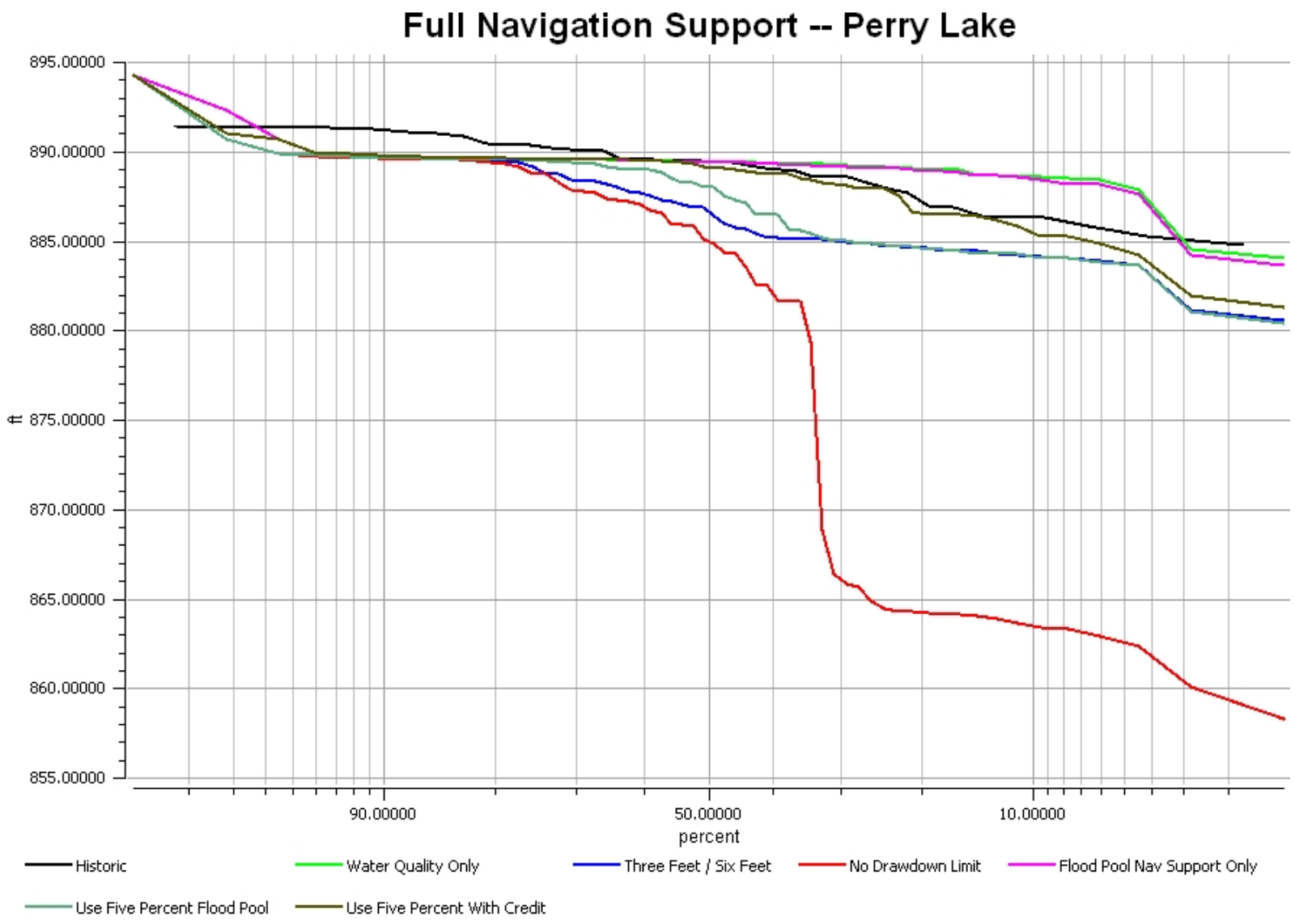
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown LImit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool With Credit


Full Navigation Support -- Perry Lake
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890.00000
885.00000
880.00000
875.00000
870.00000
865.00000
860.00000
855.00000
ft
90.00000
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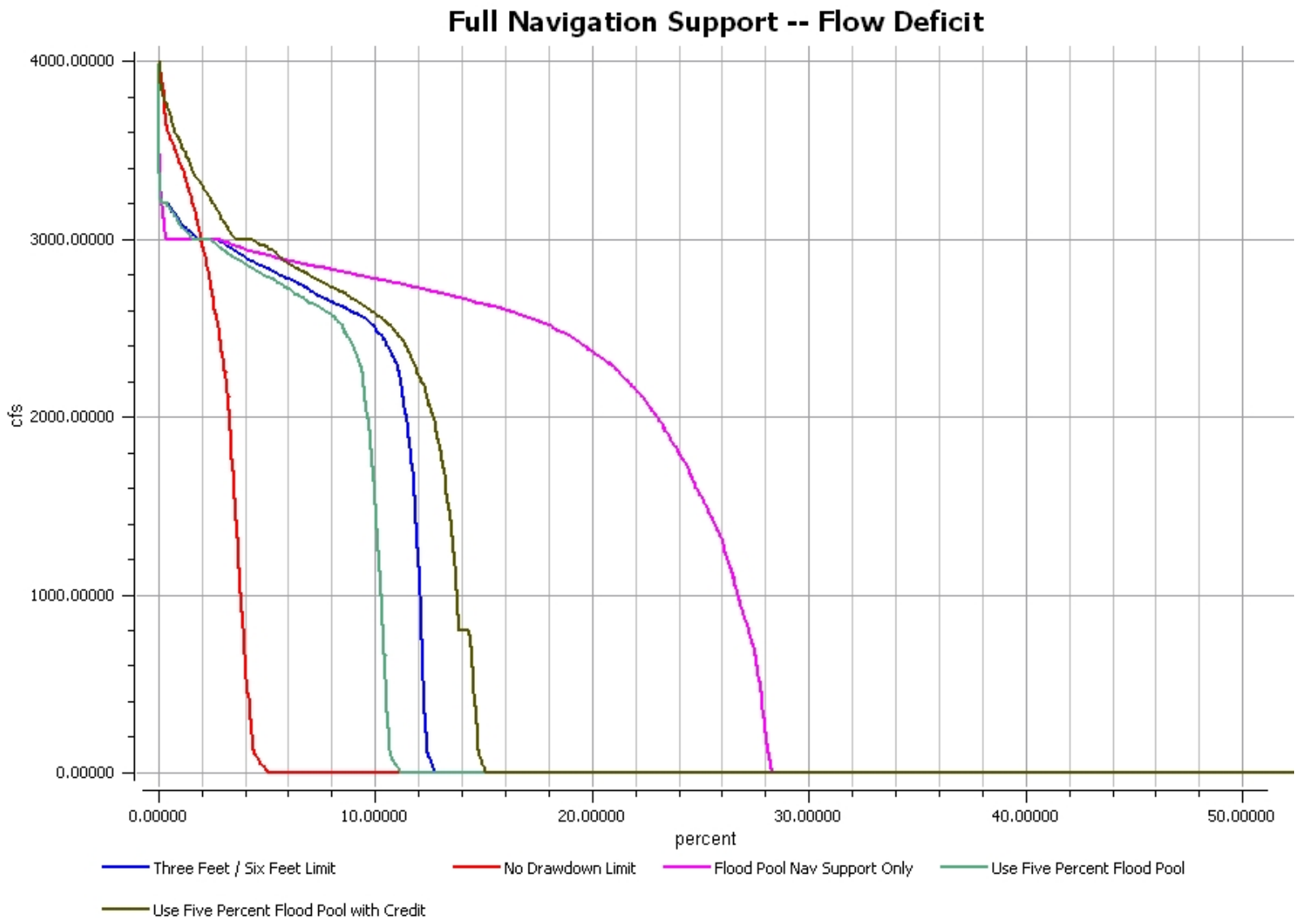
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit


Full Navigation Support -- Flow Deficit
4000.00000
3000.00000
2000.00000
1000.00000
0.00000
cfs
0.00000
10.00000
20.00000
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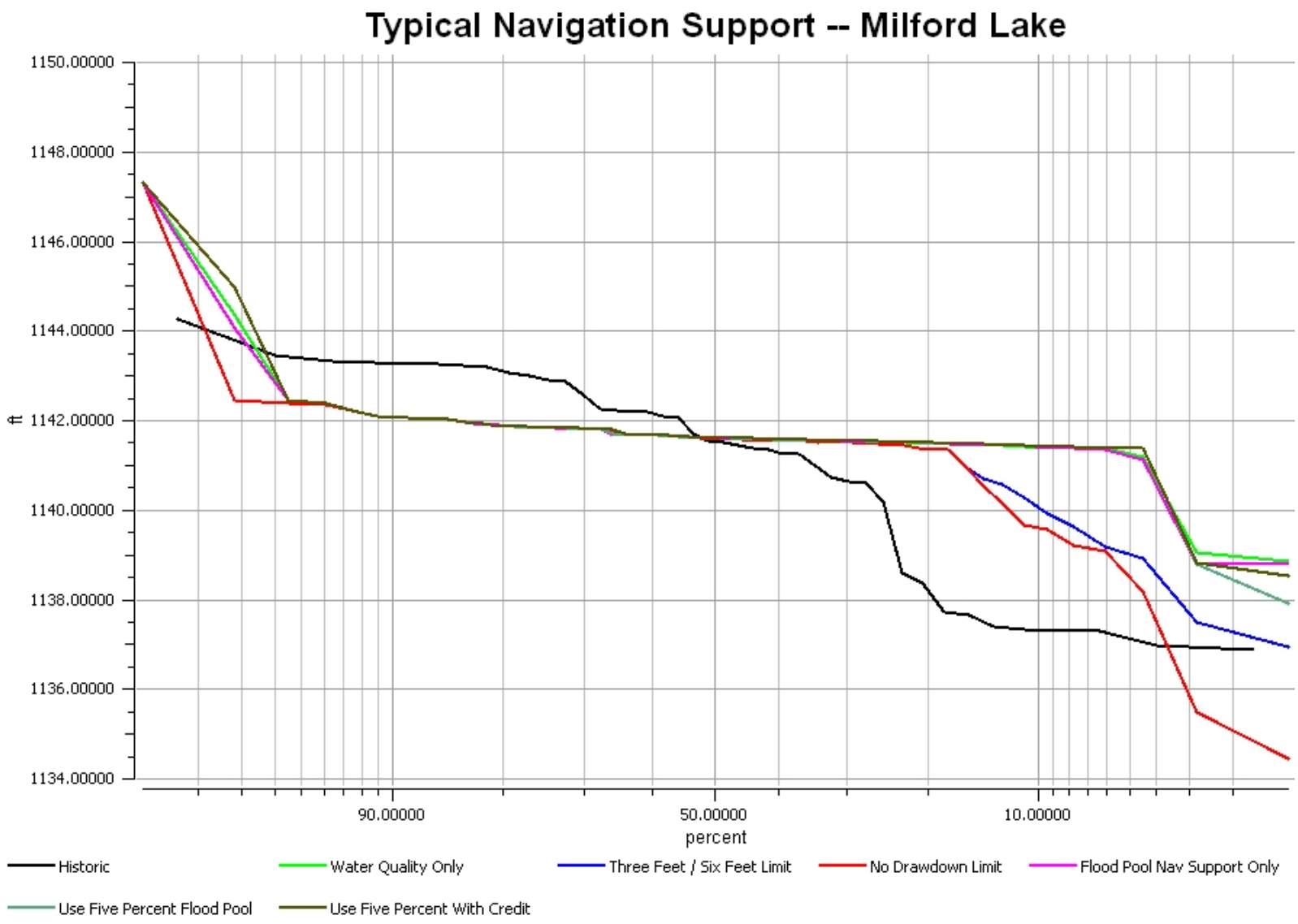
40.00000
50.00000
percent
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool with Credit


Typical Navigation Support -- Milford Lake
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1146.00000
1144.00000
1142.00000
1140.00000
1138.00000
1136.00000
1134.00000
ft
90.00000
50.00000
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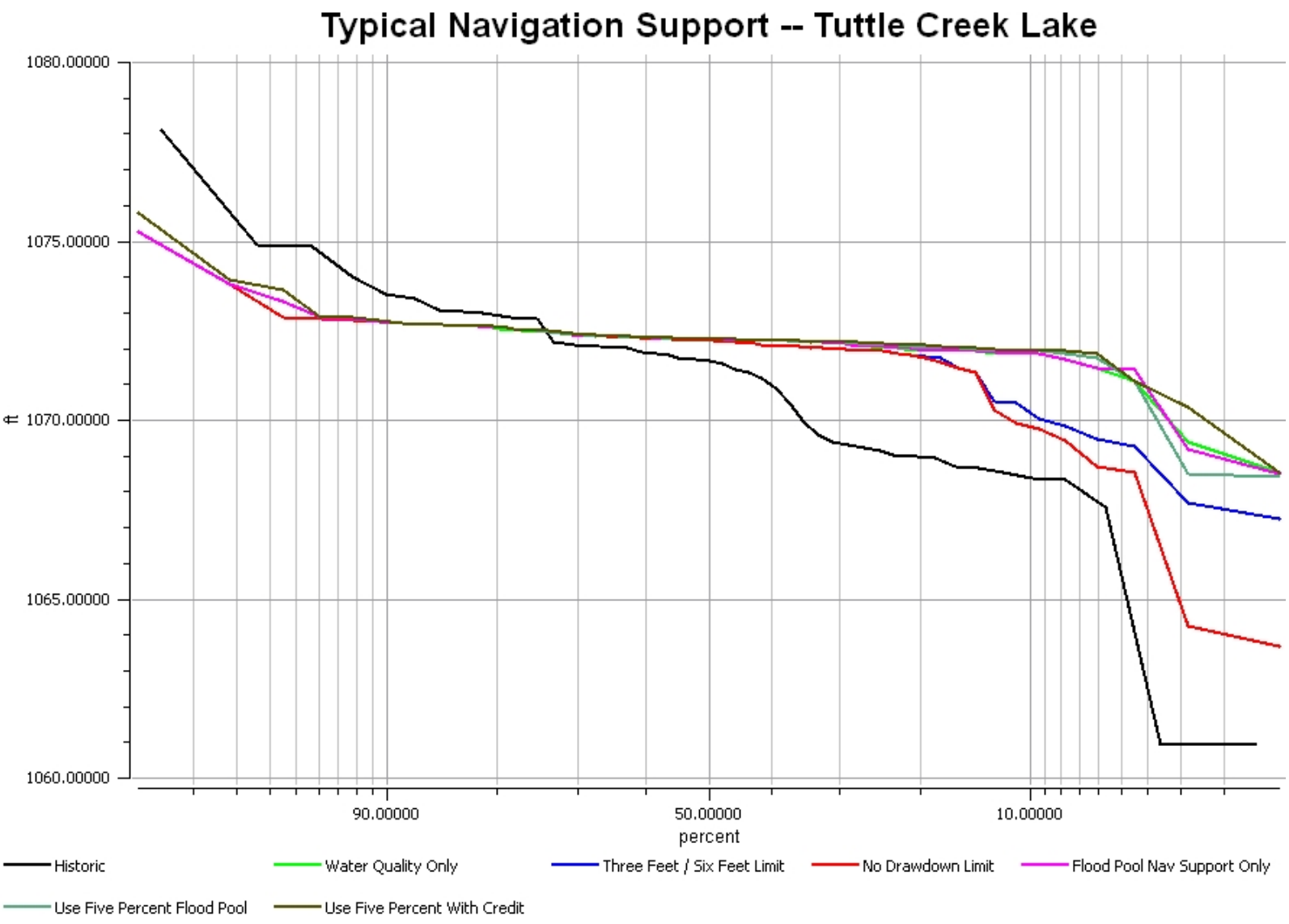
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit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1075.00000
1070.00000
1065.00000
1060.00000
ft
90.00000
50.00000
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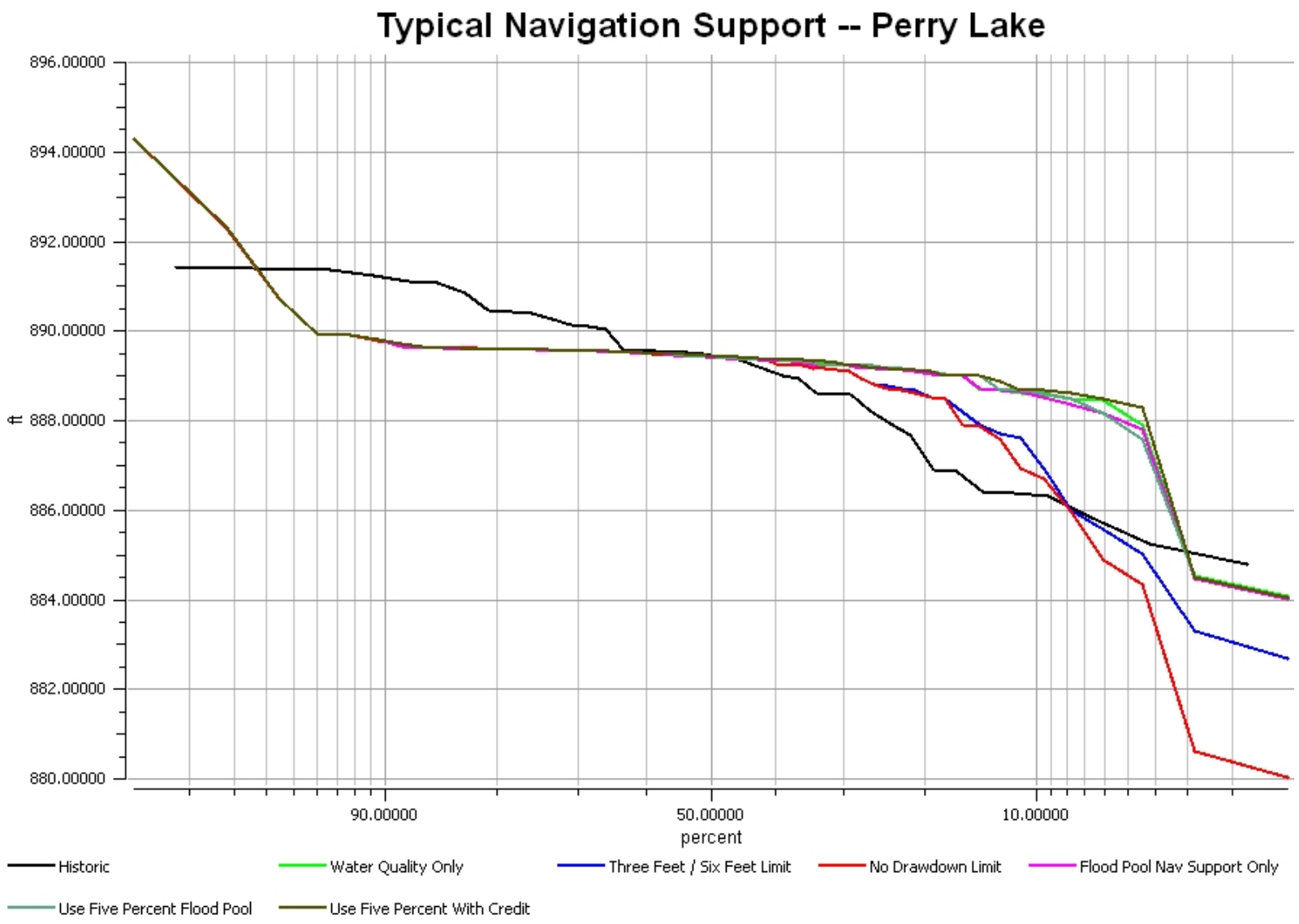
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit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894.00000
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890.00000
888.00000
886.00000
884.00000
882.00000
880.00000
ft
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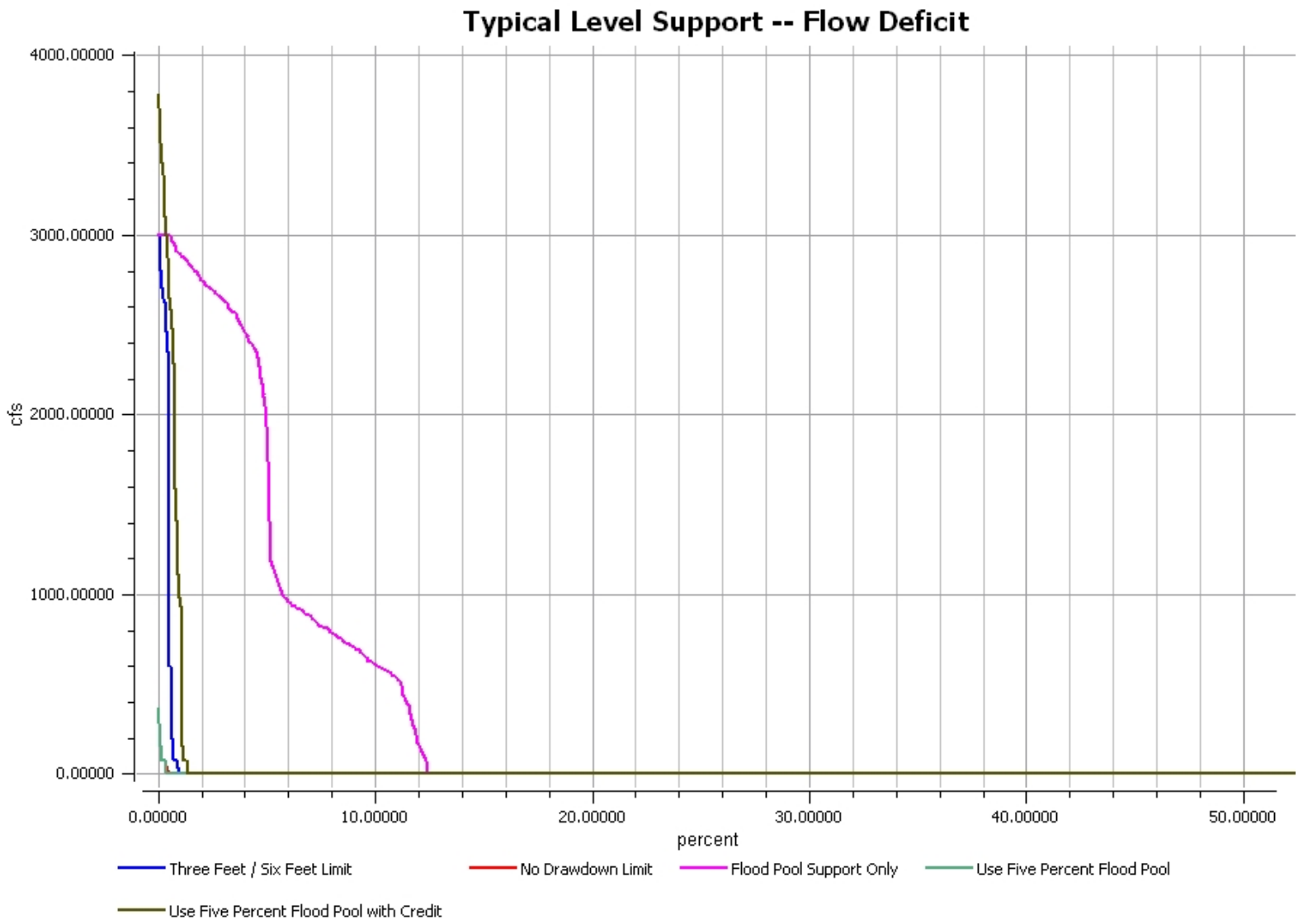
50.00000
10.00000
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit


Typical Level Support -- Flow Deficit
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cfs
0.00000
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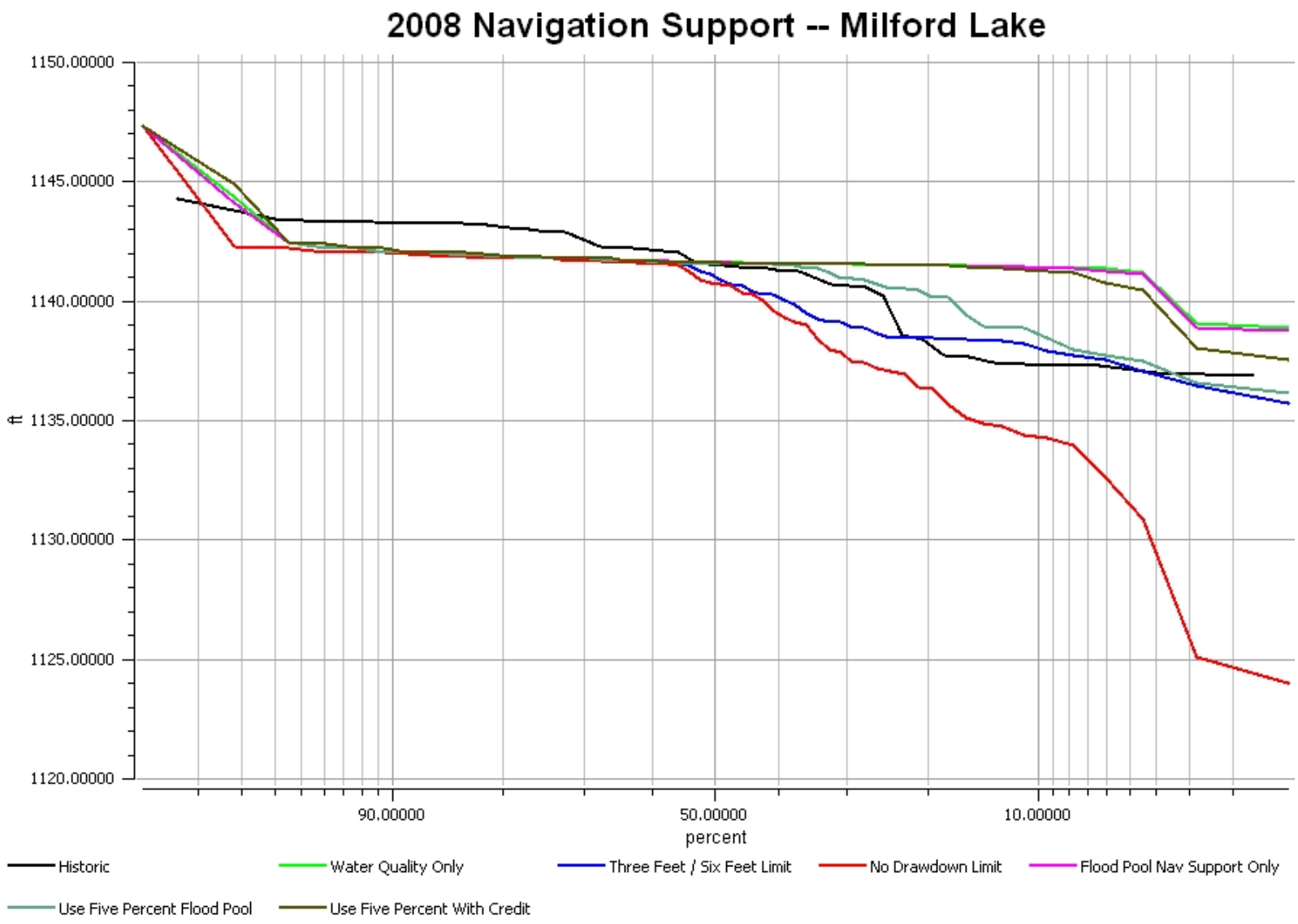
percent
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool with Credit


2008 Navigation Support -- Milford Lake
1150.00000
1145.00000
1140.00000
1135.00000
1130.00000
1125.00000
1120.00000
ft
90.00000
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percent
Historic
Water Quality Only
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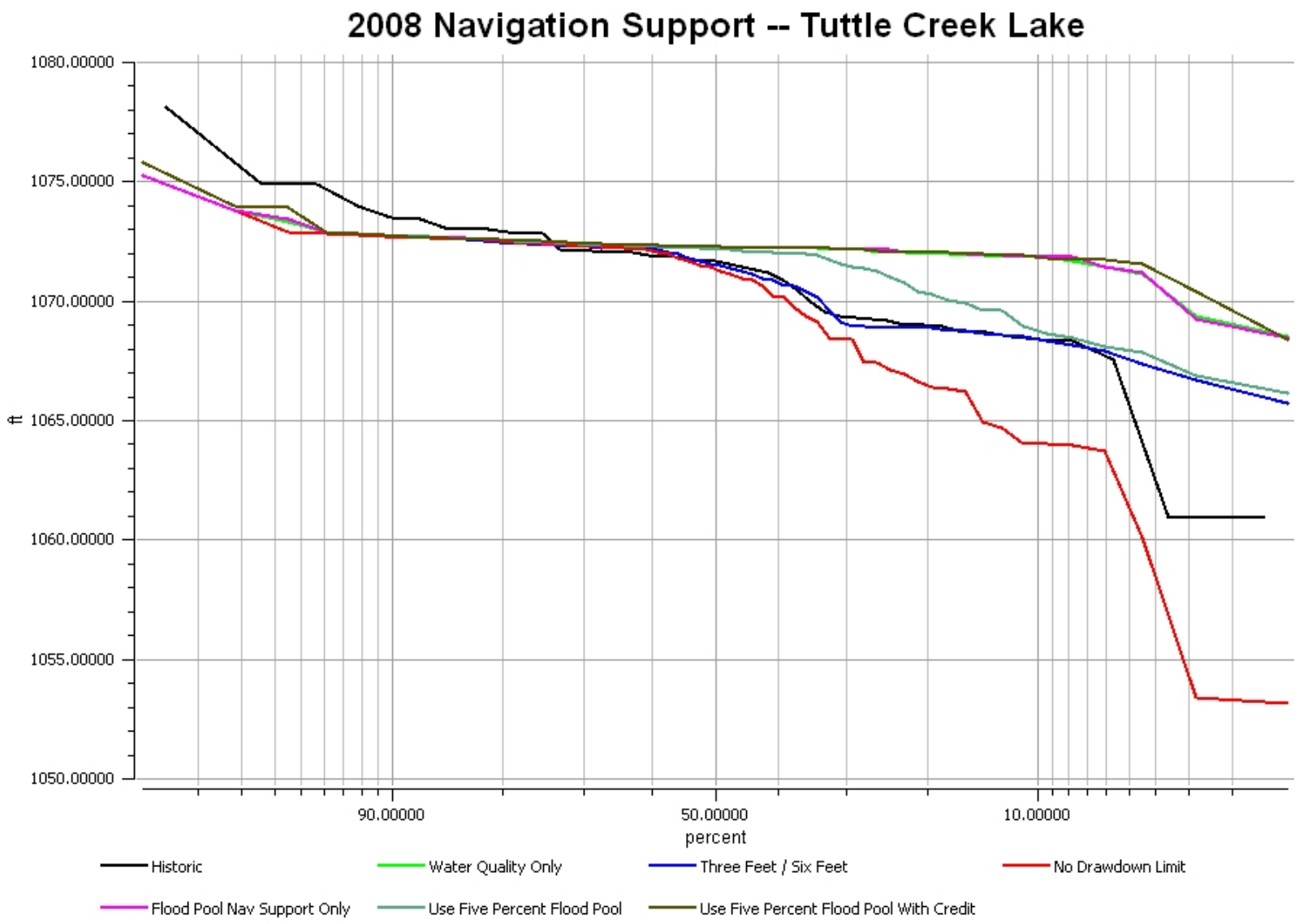
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent With Credit


2008 Navigation Support -- Tuttle Creek Lake
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1070.00000
1065.00000
1060.00000
1055.00000
1050.00000
ft
90.00000
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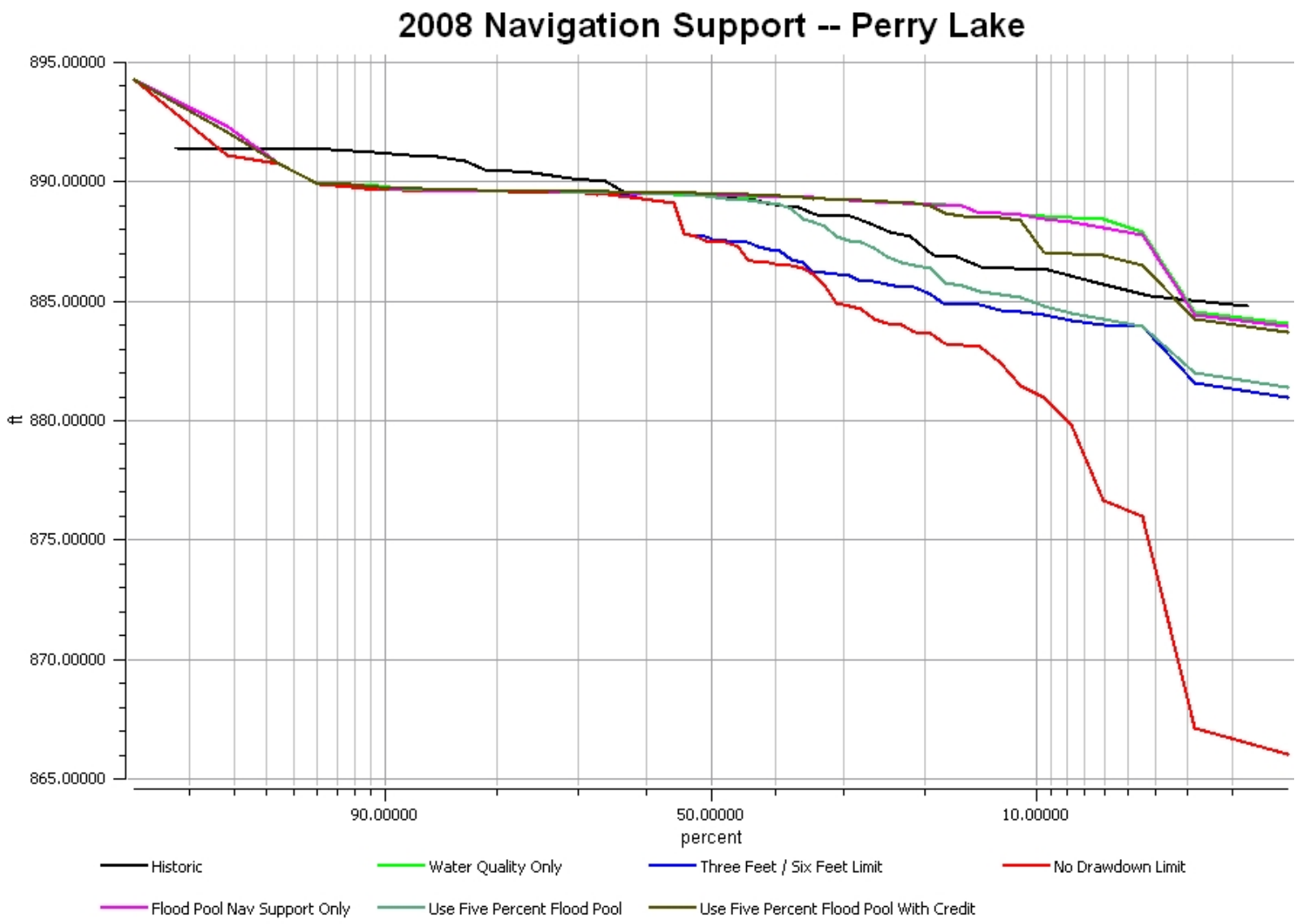
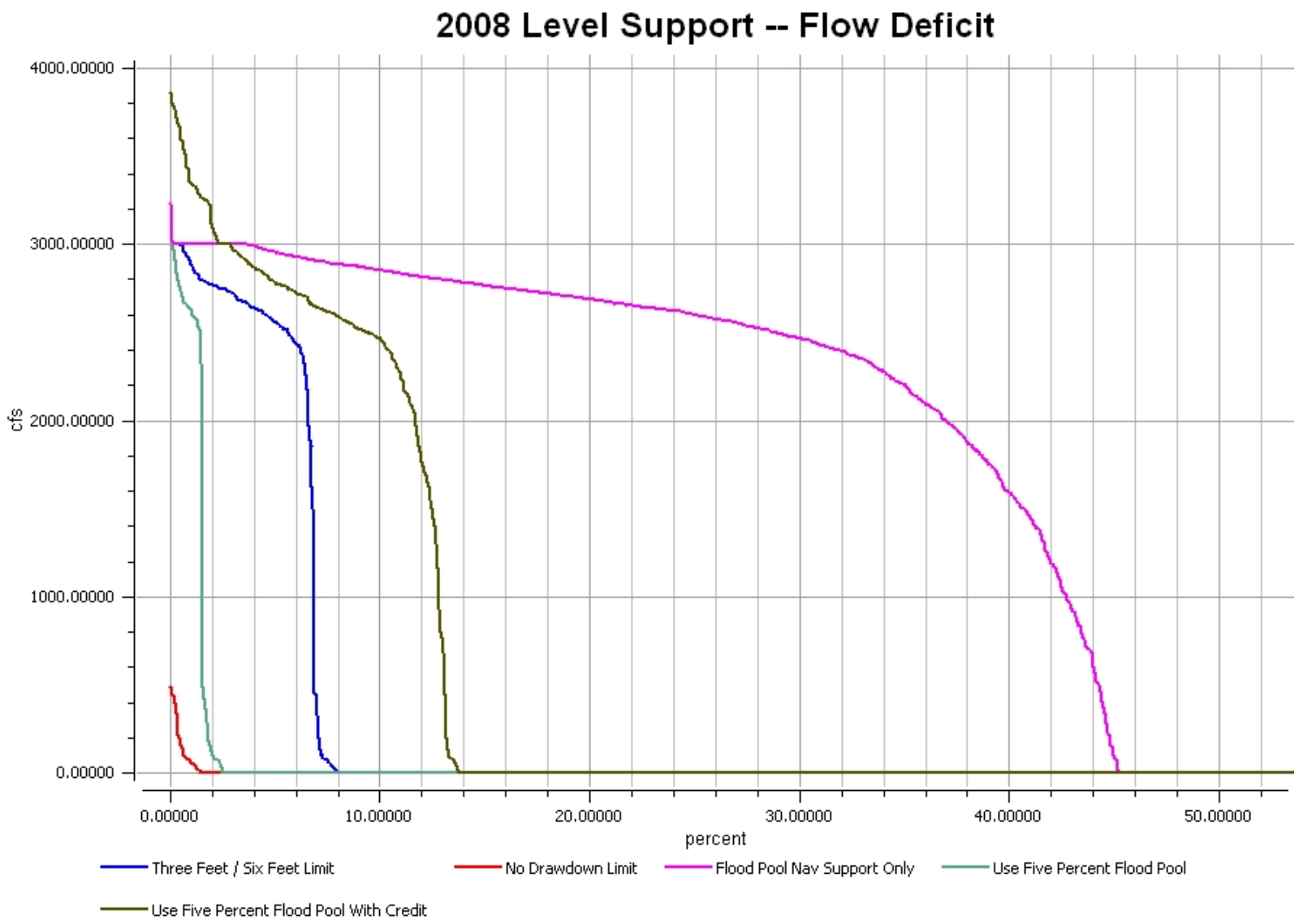
percent
Historic
Water Quality Only
Three Feet / Six Feet
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool With Credit


2008 Navigation Support -- Perry Lake
895.00000
890.00000
885.00000
880.00000
875.00000
870.00000
865.00000
ft
90.00000
50.00000
10.00000
percent
Historic
Water Quality Only
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool With Credit


2008 Level Support -- Flow Deficit
4000.00000
3000.00000
2000.00000
1000.00000
0.00000
cfs
0.00000
10.00000
20.00000
30.00000
40.00000
50.00000
percent
Three Feet / Six Feet Limit
No Drawdown Limit
Flood Pool Nav Support Only
Use Five Percent Flood Pool
Use Five Percent Flood Pool With Credit

IV Analysis:

1. Using 5% of the flood pool zone to support navigation results in an appreciable reduction of lake drawdown. This is even true at Perry Lake, even though the Perry water level management plan already allowed for the 5% storage. The improvement at Perry is the result of more navigation support being shifted to the other lake projects. It should be noted that Milford and Tuttle Creek, even with an increased navigation support load, also show high lake pool frequency curves with the 5% flood pool option. In fact, under the "typical navigation" scenario, the 5% frequency curve compares favorable with the "water quality only" curve for all of the lakes.

2. Restricting navigation support to the flood pool results in frequency curves very similar to those that do not provide any navigation support (water quality only). This illustrates that unless a portion of the flood pool is specifically operated to support navigation, very little benefit is gained.

3. The restrictions on the amount of multipurpose pool available for navigation support provide significantly higher pool frequency curves (Three Feet/Six Feet Limit). During the early nineties, the Kansas City District agreed with the Kansas Water Office to restrict the navigation support from the each lake to no more than three feet of storage prior to October 1 of each year. After October 1, each lake provides a maximum of six feet storage for navigation support. The purpose of the agreement was to balance the navigation support and recreational usage of the lakes.

4. Providing the maximum level of navigation support, even with no restriction on pool usage, results in near normal pool elevations about 30 to 40% of the time.

5. Applying "typical" navigation demand on the lakes every year affects the lake pools significantly 20 to 30% of the time.

6. The navigation demand of 2008 has a significantly greater impact on pool elevations than a "typical" navigation demand year.

7. It should be noted that the historic pool frequency curves do not cover the entire study period, but only reflect the lake elevations since the specific project first filled. For example, the drought period of the mid-fifties is not included in the historic frequency curves. The historic frequency curves have also not been adjusted to account for special lake operations such as construction drawdowns or variable water level management plans.

8. The "Flow Deficit" curves indicate that the 2008 Navigation Support scenario was more strenuous than the Full Navigation Support scenario. This is due to the 2008 support being at the same flow level as full support (4,000 cfs), but only during a period of relative low base flow in the Kansas River (September and October). The flow deficit curves are for partial durations, with the data screened to only include periods when navigation support was required.