CLARENCE CANNON DAM AND MARK TWAIN LAKE
SALT RIVER, MISSOURI

DESIGN MEMORANDUM NO. 9

THE MASTER PLAN

DRAFT

US Army Corps of Engineers
St. Louis District®

(UPDATED 2003)

PREFACE

Construction of Joanna Dam and Lake (later changed to Clarence Cannon Dam and Mark Twain Lake) was authorized in 1962 and work began in 1966. The project was completed in August 1984. The original Master Plan was approved in 1968, revised in 1975 and updated in 1991. The Master Plan has served as a guide for the orderly development and management of the land and water resources of the project.

This updated Master Plan presents a current inventory and assessment of land and water resources and physical improvements, current resource use objectives, discussions of influences on lake operation and management and an evaluation of current and future measures required to protect the value of the resource base. Emphasis has been placed on increasing the efficiency of operations and the rehabilitation of facilities to assure public safety.

Although Mark Twain Lake is managed primarily by the St. Louis District U.S. Army Corps of Engineers, many others play a crucial role in the operation of the project. These important players include the Missouri Department of Natural Resources, Missouri Department of Conservation, marina concessionaires, local organizations and businesses, and youth groups. The objective of the Mark Twain Lake Master Plan is to meet the needs and interest of the various users of the project and outline a 10-year plan of action assuring that all project purposes are addressed.

All aspects of lake operation have been reevaluated due to changes that have taken place since the last update in 1991. All recreation area site plans have been revised to reflect existing development.

The plan will be approved in the St. Louis District; however, this does not assure that all proposed projects will be completed. After approval, funding must be secured to complete the proposed projects.

PREVIOUSLY ISSUED DESIGN MEMORANDA
CLARENCE CANNON DAM & MARK TWAIN LAKE

MEMORANDUM NO.	TITLE	SUBMITTED/ APPROVED	
1	Hydrology and Hydraulic Analysis	Sep	1963
1	Hydrology and Hydraulic Analysis (Revised)	Jan Jul	1967 1967(1st Ind)
2	Hydropower Capacity	Jan	1965
2	Hydropower Capacity (revised)	Feb Jul	1967 1967(3rd Ind)
3	General Design Memorandum	May	1965
3	General Design Memorandum (Revised)	Mar Mar	1967 1968(3rd Ind)
	Low flow Regulation	Apr Sep	1968 1968(5th Ind)
4A	Site Geology	Jun Aug	1966 1966
5	Availability of Construction Materials	Dec Jun	1967 1968(9th Ind)
5	Supplement 1	Oct Aug	1971 1972(6th Ind)
5	Supplement 2	May	1972
6	Real Estate-Main Dam, Reservoir, Public Use Areas	Jun Jan	1966 1967(5th Ind)
6	Supplement 1	Prepared but not submitted	
6	Supplement 2	Oct Nov	1984 1984(1st Ind)
6A	Real Estate-Re-Reg Dam	Aug Nov	1967 1967(3rd Ind)

MEMORANDUM NO.	TITLE	SUBMITTED/ APPROVED	
6A	Supplement 1	Nov Nov	1973 1973 (1st Ind)
6A	Supplement 2	Oct Nov	1979 1979 (1st Ind)
6A	Supplement 3	Aug Dec	1977 1978(lst Ind)
6A	Supplement 4	Jun Oct	1980 1980 (3rd Ind)
7A	Preliminary Master Plan	May Sep	1966 1966(lst Ind)
7A	Supplement 1	Jun Aug	1967 1967 (5th Ind)
8	Relocations-Railroads	May Apr	1968 1969 (7th Ind)
8	Supplement 1	May Aug	1968 1971(llth Ind)
8	Supplement 2	Jul Aug	1971 1971(lst Ind)
8	Supplement 3	Jan Jun	1976 1976(3rd Ind)
9	The Master Plan	Aug May	1968 1969(7th Ind)
9	Supplement 1	Jul Jan	1975 1976 (3rd Ind)
9	Supplement 2	Mar Jun	1976 1976(lst Ind)
9	Supplement 3	Sep Dec	1977 1977(3rd Ind)
9	Supplement 4	Jan Feb	1978 1978 (1st Ind)

MEMORANDUM NO.	TITLE	SUBMITTED/ APPROVED	
9	Supplement 5	Nov Jun	1979 1980(2nd Ind)
9	Supplement 6 – Hunter/Fisherman Access Areas	Mar May	1980 1980 (1st Ind)
9	Supplement 7 – Additional Recreational Facilities	Feb Apr	1982 1982 (1st Ind)
9	Supplement 8	May Jun	1987 1987 (1st Ind)
10	Generator and Generator Motor	Dec Jun	1968 1969(3rd Ind)
11	Administration Building and South Overlook	Apr Dec	1969 1969 (5th Ind)
11	Supplement 1	Nov Apr	1976 1977(5th Ind)
11	Supplement 2	Oct Mar	1977 1978 (5th Ind)
11	Supplement 3	Oct Dec	1979 1979 (3rd Ind)
12	Embankment Design-Main Dam	Nov May	1969 1971 (9th Ind)
13	Phase II - Main Dam	Aug Oct	1970 1972 (8th Ind)
	Main Dam Embankment Phase I (Revised)	Oct	1978
14	Instrumentation and Evaluation Program	Jul Dec	1971 1972 (7th Ind)
15	Re-regulation Dam and Spillway	Jun Feb	1971 1975 (9th Ind)
16	Relocations of State Highways	Oct Nov	1972 1972 (1st Ind)

MEMORANDUM NO.	TITLE	SUBMITTED/ APPROVED	
16	Supplement 1	Sep Oct	1973 1973(5th Ind)
16	Supplement 2	Dec Feb	1973 1975 (3rd Ind)
16	Supplement 3	Apr Apr	1974 1975 (5th Ind)
16	Supplement 4	Oct Feb	1975 1976 (7th Ind)
17	Turbine and Pump Turbine Governors	Sep	1973
18	Relocations Utilities	Aug Mar	1973 1975(7th Ind)
18	Supplement 1	Jun Aug	1976 1976(1st Ind)
18	Supplement 2	May Dec	1978 1978(3rd Ind)
18	Supplement 3	Oct Oct	1980 1980(1st Ind)
18	Supplement 4	Jun Aug	1983 1983 (3rd Ind)
19	Relocations Cemeteries	Jul Mar	1975 1976(4th Ind)
20	Relocations County Roads	May Jun	1975 1975 (1st Ind)
20	Supplement 1	Aug Sep	1980 1980 (1st Ind)
20	Supplement 2	Jul Dec	1982 1982 (4th Ind)
21	Wastewater Land Treatment System	Dec Sep	1976 1977 (9th Ind)

MEMORANDUM NO.	TITLE	SUBMITTED/ APPROVED
21	Supplement 1	Oct 1979 Jan 1980(3rd Ind)
22	Initial Reservoir Filling Plan	Mar 1983 Oct 1983(3rd Ind)
23	Analysis of Hydropower Design	Feb 1986
24	Final Cost Allocation Study	Fiscal Year 1986 Fiscal Year 1987

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SECTION I – INTRODUCTION

1.01 AUTHORIZATION

Federal laws provide that land and water areas of Department of the Army reservoirs, constructed for the primary purposes of flood control, navigation and/or hydropower, shall be administered to encourage and develop all collateral uses such as water supply, public parks and recreation, conservation of fish and wildlife resources, pollution abatement, and other purposes in the public interest.

The Flood Control Act of 28 June 1938 authorized a dam and reservoir on the Salt River near Joanna, Missouri, as part of a general comprehensive plan for flood control in the Upper Mississippi River Basin. A restudy of the project indicated the feasibility of a multi-purpose development, including hydroelectric power. The project was authorized as such by Sec. 203 of the Flood Control Act of 23 October 1962 (PL 87-874), as recommended by the Chief of Engineers in House Document No. 507, 87th Congress, 2nd Session. The reservoir, originally named the Joanna Reservoir was officially renamed Clarence Cannon Dam and Reservoir by Public Law 89-298, 89th Congress, 3rd Session on 27 October 1965. Clarence Cannon Dam and Reservoir was officially renamed Clarence Cannon Dam and Mark Twain Lake by PL 97-128, 97th Congress, 29 December 1981.

This plan has been prepared in accordance with guidance contained in the following:

a. ER 1165-2-400 Water Resource Policies and Authorities: Recreation Planning, Development and Management Policies (chg 1,1988).

b. ER 1110-2-400 Design of Recreation Sites, Areas, and Facilities (1988).

c. ER 1130-2-540 Environmental Stewardship Operations and Maintenance Policies (chg.1, 2002).

d. EP 1130-2-540 Environmental Stewardship Operations and Maintenance Guidance and Procedures (chg.1, 2002).

e. EM 1110-1-400 Recreation Planning and Design Criteria (1987).

f. ER 1130-2-550 Recreation Operations and Maintenance Policies (chg. 3, 2002).

g. EP 1130-2-550 Recreation Operations and Maintenance Guidance and Procedures (chg. 3, 2002).

h. ER 1130-2-406 Shoreline Management at Civil Works Projects (chg. 2, 1999).

i. ER 405-1-12 Real Estate Handbook (1985)

j. ER 1105-2-100 Planning Guidance Notebook (2000)

k. Final Environmental Statement; Mark Twain Lake, Missouri (Operation and Maintenance) 1975

1.02 PROJECT PURPOSES

The authorized purposes of the project are flood control in the Salt River Basin, hydroelectric power generation, water supply, fish and wildlife conservation, recreation, and incidental navigation.

1.03 PURPOSE OF THE MASTER PLAN

The original Master Plan was intended as a guide for the orderly and coordinated development and management of all lands and water areas of the project. It presented data on the scope of development considered adequate for initial public use and an estimate of future requirements. This updated Master Plan presents an inventory and assessment of land and water resources and physical improvements, an analysis of resource use and an evaluation of existing and future needs required to protect and improve the value of the resource base. The provision of quality and relevant services to the public was also evaluated.

1.04 PRIOR PERTINENT DESIGN MEMORANDA

a. The 1991 update of the Master Plan was supplemented eight times. The following is a brief summary of those eight supplements.

(1) Supplement 1, 19 March 1991, requested that the Spillway Recreation Area be renamed the Warren G. See Spillway Area. Total estimated cost was $1500. Approved by CELMV-PD-R on 4 April 1991.

(2) Supplement 2, 29 September 1994, presented the request by the Northeast Missouri Area Vietnam Veterans Inc. to construct a memorial at the M. W. Boudreaux Memorial Visitor Center for Northeast Missouri soldiers who died in the Vietnam war. Total estimated cost of the project was $45,000. Approved by CELMV-PE-R on 28 October 1994

(3) Supplement 3, 8 August 1995, requested approval of a three-year road improvement and maintenance project for paved surfaces with a request for

special funding. The three-year project cost was estimated at $1,586,621. The project without the special funding was approved on 18 October 1995 by CELMV-ET-PR.

(4) Supplement 4, 11 October 1995, proposed a marina development at the North Extension lease area of Mark Twain State Park, fish cleaning stations in several recreation areas, an amphitheater at Frank Russell campground, a vault toilet and multi-purpose shelter in the Warren G. See South Spillway Recreation Area, a wetland restoration project in the North Fork area, and high water accesses at three locations. Total estimated cost was $186,013. CELMV-ET-PR approved the supplement on 12 Jan 1996

(5) Supplement 5, 23 July 1997, proposed a shooting range with a parking lot, road maintenance on an existing unsurfaced access road, and 3 minimum facilities for public health and safety including a 5 car/trailer access lot, and a 20 car gravel access lot. It also reflected a boundary change due to a recent land acquisition. Total estimated cost for all projects with contingencies was $155,250. The St. Louis District Engineer approved the supplement on 23 July 1997.

(6) Supplement 6, 12 February 1999, proposed 6 comfort station shower additions at Ray Behrens and Indian Creek, 2 handicapped fishing accesses in the Spillway, an extension to the Joanna Trail, land acquisition for the Joanna Trail, relocation of the John F. Spalding bathhouse and the Indian Creek comfort station to higher ground, expansion of the Spalding wastewater treatment plant, continuation of special emphasis programs for youth, seniors and physically challenged individuals in various recreation areas, construction of an non-discharge sewage treatment lagoon and upgrade of the vault toilet to waterborne with a shower facility in the South Spillway Recreation Area, and designation of the Joanna Loop in the Frank Russell Campground for equine use. Total cost of proposed items is $1,560,436. The supplement was approved by the St. Louis District Engineer on 16 February 1999.

(7) Supplement 7, 24 August 2001, proposed re-designating the Mark Twain State Park marina site as a beach; adding a swimming facility at Camp Colborn, Mark Twain State Park; upgrading the campsite electrical service at the Indian Creek and Ray Behrens Recreation Areas; adding two shelters and an earthen berm with a concrete retention wall at the special events area of the South Spillway Recreation Area; adding an archery range at the Ray Behrens Recreation Area; and installing full hookups at campsites in the Indian Creek and Ray Behrens Recreation Areas. Total estimated cost was $1,163,750. Supplement was approved by St. Louis District Engineer on 24 August 2001.

(8) Supplement 8, 8 March 2002 proposed renaming the M.W. Boudreaux Group Use Area in recognition and memory of John C. “Jack” Briscoe for his outstanding leadership, contributions and support to Northeast Missouri and to the Clarence Cannon Dam and Mark Twain Lake project. Total estimated cost

was $1300.00. Supplement was approved by St. Louis District Engineer on 12 March 2002.

1.05 APPLICABLE PUBLIC LAWS

Development and management of Federal reservoirs for various purposes is provided under several statutes. These laws cover development of recreation facilities, licensing of project lands for fish and wildlife purposes, protection of natural resources, and leasing of project lands for incidental uses other than recreation. In addition, applicable legislation for cultural resource protection at this project is listed.

a. Recreation. Development and management of recreation facilities by the Corps, other governmental agencies, local groups, or individuals is authorized under the following public laws:

(1) Section 4 of the Flood Control Act, approved 22 December 1944 (PL 78-534), authorizes providing facilities for public use, including recreation, and conservation of fish and wildlife.

(2) The River and Harbors Act, approved 2 March 1945 (PL 79-14), specifies the rights and interests of the states in watershed development and water utilization and control, and the requirements for cooperation with state agencies in planning for flood control and navigation improvements.

(3) Section 209 of the Flood Control Act of 1954 (PL 83-780), approved 3 September 1954, amended the Flood Control Act of 1944. It authorized the Secretary of the Army to grant leases to federal, state or governmental agencies without monetary considerations for use and occupation of land and water areas under the jurisdiction of the Department of the Army for park and recreation purposes when in the public interest.

(4) The Land and Water Conservation Fund Act of 1965 (PL 88-578), approved 1 September 1964 contains provisions by which the Corps may charge for admission and use of its recreation areas under prescribed conditions.

(5) The Federal Water Project Recreation Act (PL 89-72), approved 9 July 1965, contains cost sharing provisions for acquisition of lands and development of recreation facilities for water resources projects authorized after 1965. It also provides for cost sharing development of new areas that were not part of initial project construction.

(6) The Architectural Barriers Act of 1968 (PL 90-480), together with the acts and amendments listed in 7, 8, and 9 below, provides information and guidance regarding universal accessibility for persons with disabilities to the Corps recreation facilities and programs.

(7) The Rehabilitation Act of 1973 (PL 93-112) and the Rehabilitation Act Amendments of 1974 (PL 93-516) (see Architectural Barriers Act above).

(8) The Rehabilitation, Comprehensive Services, and Developmental Disabilities Amendments of 1978 (PL 95-602) (see Architectural Barriers Act above).

(9) The Americans with Disabilities Act of 1990 (PL 101-336) (see Architectural Barriers Act above).

(10) The Water Resources Development Act of 1992, (PL 102-580) approved 31 October 1992 authorized the Challenge Cost Sharing Program (Section 225) that permits the Corps to develop and implement a program to accept contributions of funds, materials and services from non-Federal public and private entities to be used in managing recreation facilities and natural resources.

(11) The Omnibus Budget Act - Day Use Fees, approved 10 August 1993 (PL 103-66), contains provisions by which the Corps may collect fees for the use of developed recreation sites and facilities, including campsites, swimming beaches, and boat launching ramps but excluding a site or facility which includes only a boat launch ramp and a courtesy dock.

(12) The Water Resources Development Act of 1996 was approved 12 October 1996. Section 208 (Recreation Policy and User Fees) directed the Corps to put increased emphasis on recreation opportunities at Corps projects and specifies that recreation fees collected at Corps projects remain for use at the project where they are collected. Section 519 (Recreation Partnership Initiative) directed that, in general, the Corps is to promote federal, non-federal, and private sector cooperation in creating public recreation opportunities at Corps projects.

b. Fish and Wildlife. Fish and wildlife resources are maintained and protected in compliance with the following public laws:

(1) The Fish and Wildlife Coordination Act, enacted 10 March 1934, as amended, 14 August 1946 (PL 79-732), 1958 (PL 85-624), provides authority for making project lands of value for wildlife purposes available for management by interested federal and state wildlife agencies. It further provides for more effective integration of a fish and wildlife conservation program with federal water resources developments.

(2) The National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq), declares a national environmental policy and requires that all federal agencies shall, to the fullest extent possible, use a systematic, interdisciplinary approach which integrates natural and social sciences and environmental design arts in planning and decision making.

(3) The Endangered Species Act of 1973 as amended (16 USC 1531 and 1536) requires that federal agencies shall, in consultation with the U.S. Fish and Wildlife Service (USFWS) (or the National Marine Fisheries Service), use their authorities in furtherance of conserving endangered and threatened species and take such action as necessary to assure that their actions are not likely to jeopardize such species or destroy or modify their critical habitat.

(4) The Water Resource Development Act of 1986, Section 1135, provides for modifications in the structures or operations of a project, consistent with authorized project purposes to improve the quality of the environment, i.e. restoration of fish and wildlife habitat. WRDA 1996 amended Section 103 of WRDA 1986 by specifying that the non-federal share of environmental restoration and protection projects shall be 35 percent.

(5) Executive Order 12962, 7 June 1995, entitled Recreational Fisheries directs Federal agencies to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by means of a number of duties. In addition, it establishes a National Recreational Fisheries Coordination Council consisting of seven members (including one designated by the Secretary of Defense). The “Coordination Council” is charged with developing a comprehensive Recreational Fishery Resources Conservation Plan. This EO also directs all Federal agencies to identify and minimize conflicts between recreational fisheries and their responsibilities under the Endangered Species Act of 1973 and expands the role of the Sport Fishing and Boating Partnership Council.

c. Forest Resources - Protection and Improvement of Natural Resources. The Forest Conservation Act (PL 86-717) approved 6 September 1960, provides for the protection of forest cover in reservoir areas, and specifies that reservoir areas of projects for flood control, navigation, hydroelectric power development, and other related purposes, owned in fee and under the jurisdiction of the Secretary of the Army and the Chief of Engineers, shall be developed and maintained so as to encourage, promote and assure fully adequate and dependable future resources of readily available timber through sustained yield programs, reforestation, and accepted conservation practices, and to increase the value of such areas for conservation, recreation and other beneficial uses; provided, that such development and management shall be accomplished to the extent practicable and compatible with other uses of the project. The law further provides that in order to carry out the national policy declared in the first section of this Act, the Chief of Engineers, under the supervision of the Secretary of the Army, shall provide for the protection and development of forest or other vegetative cover and the establishment and maintenance of other conservation measures on reservoir areas under his jurisdiction, so as to yield the maximum benefit and otherwise improve such areas. Programs and policies developed pursuant to the preceding sentence shall be coordinated

with the Secretary of Agriculture, and with appropriate state conservation agencies.

d. Other Incidental Uses. Title 10, United States Code, Section 2667, authorizes the lease of land at water resource projects for any commercial or private purpose not inconsistent with other authorized purposes, subject to specific restrictions thereupon, as set out in regulations, policy, and Delegations of Authority. Title 16, United States Code, Section 460d, authorizes use of public lands for any public purpose, including fish and wildlife, if it is in the public interest. Such uses are also subject to regulations, policy and Delegations of Authority. The use of project lands for easements and licenses is authorized in various Congressional Acts and codified in Titles 10, 16, 30, 32 and 43 of the United States Code. Lands and rights-of-way will be acquired pursuant to provisions of the Uniform Real Property Acquisition and Relocation Assistance Act of 1970, PL 91-646, as amended.

e. Cultural and Historical Considerations. A number of laws mandating the protection of cultural resources on public lands have been passed during the past 95 years. These laws and Executive Orders are summarized in Appendix A of the St. Louis District Cultural Resource Management Policy (April 1982). The following laws subsume, clarify or supersede all previous cultural resource law:

(1) The Archeological Resources Protection Act of 1979 (16 USC 470 et seq.), PL 96-95, 96th Congress Revision and update of 1906 Antiquities Act protects archaeological resources and sites that are on public lands and Indian land, and fosters increased cooperation and exchange of information between governmental authorities, the professional community, and private individuals.

(2) The 1980 Historic Preservation Amendment to the National Historic Preservation Act of 1966, PL 96-515, states a policy of preserving, restoring and maintaining cultural resources and requires that federal agencies take into account the effect of any undertaking on any site eligible for the National Register of Historic Places.

(3) The Archaeological and Historic Preservation Act (Reservoir Salvage Act, PL 86-523) 27 June 1960, as amended 16 USC 469 et seq., provides for the preservation of historical and archaeological data which might otherwise be lost or destroyed as the result of flooding or any alteration of the terrain caused as a result of any federal construction projects.

(4) Other Cultural/Historical Laws. The Native American Graves Protection and Repatriation Act (PL 101-601) 16 November 1990, requires federal agencies and museums to inventory human remains and associated funerary objects and to provide culturally affiliated tribes with the inventory of collection. The Act requires repatriation, on request, to the culturally affiliated tribes and establishes a grant program within the Department of the Interior to assist tribes

in repatriation and to assist museums in preparing the inventories and collections summaries.

1.06 MISSION STATEMENT

Programs and activities related to environmental stewardship and the Natural Resource Management Program have as their design base the following Corps of Engineers Civil Works mission statement:

> "The Army Corps of Engineers is the steward of lands and waters at Corps water resources projects. Its Natural Resources Management Mission is to manage and conserve those natural resources, consistent with ecosystem management principles, while providing quality public outdoor recreation experiences to serve the needs of present and future generations.
>
> In all aspects of natural and cultural resources management, the Corps promotes awareness of environmental values and adheres to sound environmental stewardship, protection, compliance and restoration practices.
>
> The Corps manages for long-term public access to, and use of, the natural resources in cooperation with other federal, state, and local agencies as well as the private sector.
>
> The Corps integrates the management of diverse natural resource components such as fish, wildlife, forest, wetlands, grasslands, soils, air and water with the provision of public recreation opportunities. The Corps conserves natural resources and provides public recreation opportunities that contribute to the quality of American life."

1.07 SCOPE OF REPORT

This memorandum is the second update of the Clarence Cannon Dam and Mark Twain Lake Master Plan. It is primarily oriented to reflect current conditions and eliminate outdated information concerning the allocation of lake resources. This update reflects the current status of Clarence Cannon Dam and Mark Twain Lake land and water use classifications and the status of proposed and future plans.

SECTION II - PROJECT DESCRIPTION

2.01 LOCATION

Clarence Cannon Dam and Mark Twain Lake is located on the Salt River in northeastern Missouri and lies principally in Monroe and Ralls Counties. The main dam site is located at mile 63.0 on the Salt River and is situated approximately 12 miles southeast of Monroe City, in Ralls County, Missouri. A re-regulation dam is located 9.5 miles downstream from the main dam site. The project area is served on the north by U.S. Highway 24 and on the south by State Highway 154. State Highway 107 runs north and south through the project area and provides a major reservoir crossing near Florida, Missouri. State Highway J crosses the main dam and is a major north-south reservoir route on the east end of the lake.

2.02 LAKE DATA

a. Climatological Data. The climate of the area is considered moderate.

(1) Temperature. The summers are generally mild with occasional temperatures slightly in excess of 100 degrees Fahrenheit. Periods of extreme heat are usually short, if accompanied by sufficient rainfall. Winters are usually moderate, although periods of extremely cold weather are experienced. Weather changes and temperature fluctuations are frequent throughout the year with the extremes varying from 116 to -31 degrees Fahrenheit. Average temperatures by months during the recreation season in counties contiguous to the reservoir in degrees Fahrenheit are as follows: April 54^{o}, May 64^{o}, June 74^{o}, July 78^{o}, August 76^{o}, and September 68^{o}.

(2) Wind. The maximum wind movement occurs in March and the minimum in August. The average wind velocity is about 10.3 miles per hour. The prevailing winds over the basin are generally from the south.

(3) Humidity. The relative humidity varies from about 59 percent to 86 percent in the winter and from 51 percent to 89 percent during the remainder of the year.

(4) Precipitation. The annual average precipitation over the drainage area above the dam site is about 37.1 inches. Two-thirds of the annual rainfall normally occurs during the spring and summer, with local cellular storms occurring generally in July and August. Average annual snowfall amounts to about 21 inches and is usually limited to the period from November to March. The snow cover seldom lasts for more than a few days at a time.

b. Lake Shoreline, Length, and General Character. The topography at Mark Twain Lake reaches a maximum elevation of about 780 feet NGVD[1] in the southwestern portion of the project to a minimum of approximately 520 feet NGVD along the main stream of the Salt River. The North Fork, Middle Fork, Elk Fork and South Fork are the main tributaries of the Salt River within the project boundaries and have a maximum elevation of 675 feet NGVD in the western part of the project. The sides of the major valleys are dissected by short tributaries whose gradients extend from the flat uplands to the valley bottoms, and the divides between these tributaries form a continuous belt of hills along either side of the major valleys. The land adjoining the project is relatively flat farmland. The reservoir covers approximately 18,600 acres and has a shoreline of approximately 285 miles at the normal pool level of 606. The average depth of the pool at the 606 feet NGVD is 29 feet.

c. Project Structures. Project structures include components of the Clarence Cannon Dam and the Re-regulation Dam.

(1) Clarence Cannon Dam. Clarence Cannon Dam consists of a compacted earth embankment, a gated concrete spillway, a concrete hydroelectric power plant and a water temperature control weir. State Highway J crosses the top of the Dam. The total length of the dam is 1,940 feet with the centerline of the dam running in a near north-south direction. The concrete portion of the dam is 845.75 feet in length and it abuts the southern rim of the valley.

(a) Earth Embankment. The compacted earth embankment, which is topped by State Highway J, has a crest elevation of 653.0 NGVD. The embankment is about 1,094 feet in length.

(b) Spillway. The spillway is part of the concrete portion of the dam and is 230 feet in length. It begins 360 feet from the southern rim of the valley. The spillway is topped by four 50-foot wide by 39-foot high tainter gates separated by 10-foot wide piers. The spillway crest elevation is 600.0 feet NGVD. A 230-foot wide by 198.86-foot long stilling basin, with two rows of baffle piers and an end sill, is provided for the purpose of energy dissipation. The stilling basin floor is at elevation 508 feet NGVD.

(c) Power Plant. The power plant is part of the concrete portion of the dam and is located immediately north of the spillway. The power plant is 222.75 feet in length. The power plant contains a Kaplan 27,000-KW turbine generator and a Francis 31,000-KW pump turbine generator. The invert elevation of the intake structure is 520.0 feet NGVD. The invert elevation of the outlet structure is 483.0 feet NGVD.

[1] Note: All elevations cited are in terms of the National Geodetic Vertical Datum (NGVD)

(d) Water Temperature Control Weir. A water temperature control weir constructed of rolled earth is located 400 feet upstream of the centerline of the concrete portion of the dam. The crest elevation of the weir is 580.0 feet NGVD and is approximately 780 feet in length.

(2) Re-regulation Dam. The Re-regulation dam is located 9.5 miles downstream from the main dam and consists of a compacted earth embankment, a gated concrete spillway, a sluice and an operating house. The total length of the dam is 1,550 feet.

(a) Earth Embankment. The crest elevation of the compacted earth embankment is 537.0 feet NGVD. The embankment is 1430 feet in length.

(b) Spillway. The concrete spillway is 119.5 feet in length. The spillway is topped by two 32 by 31 foot-high tainter gates separated by an 8 foot wide pier. The spillway crest elevation is 499.0 feet NGVD. A 68 foot by 40 foot stilling basin with an end wall is provided for the purpose of energy dissipation. The stilling basin floor is at elevation 494.0 feet NGVD. The operating house is located at the west end of the spillway.

(3) Saddle Dams. Two small saddle dams are located just north of the entrance to the Frank Russell Recreation Area.

2.03 LAKE REGULATION

a. General Objective. The objective for regulating the Clarence Cannon Dam is to provide flood control, hydroelectric power generation, water supply, minimum releases for downstream water quality control, water temperature control for fish and wildlife, and recreation. There are also incidental benefits to Mississippi River navigation. The pool at elevation 606.0 feet NGVD retains one hundred percent of the joint-use storage for the other project purposes, namely hydroelectric power generation, water supply, water quality, recreation, and fish and wildlife enhancement and has one hundred percent of the flood-control pool for floodwater storage available. Figure 2-1 shows the duration of the pool elevation for the period of record, while Figure 2-2 shows the frequency curve using the annual peak lake elevations. The curve was created using Weibull plotting positions.

b. Reservoir Regulation and Hydroelectric Power Generation. Normal drawdown of the conservation pool resulting from power production will be limited throughout the year, with a more significant limitation during the crop season. The Southwestern Power Administration (SWPA), Department of Energy, schedules hydropower generation in cooperation with water control managers in the St. Louis District. The various levels of pool storage within Mark Twain Lake are defined below . Figure 2-3 shows the water control regulation diagram for different pool elevations.

(1) The controlling release (i.e. maximum) release rate from the Re-regulation Pool is 12,000 cfs (cubic feet per second) during the dormant season (i.e. October through March), while the minimum release, at all times, is 50 cfs.

(2) During the crop season, the release rate from the Re-regulation Pool will normally vary between 50 cfs and 6,000 cfs. However, the release rate from the Main Dam may be as high as 12,000 cfs if the Mark Twain pool elevation is at or above 615.0 feet NGVD. The nature of hydroelectric power generation is such that the release rate from Cannon Dam will normally vary between 0 cfs and 12,000 cfs.

Figure 2-1

FREQUENCY AND DURATION OF DAILY OBSERVED STAGE
SALT RIVER AT MARK TWAIN LAKE
COMPUTED OVER YEARS 1984 TO 2001 BETWEEN DAYS 01JAN AND 31DEC

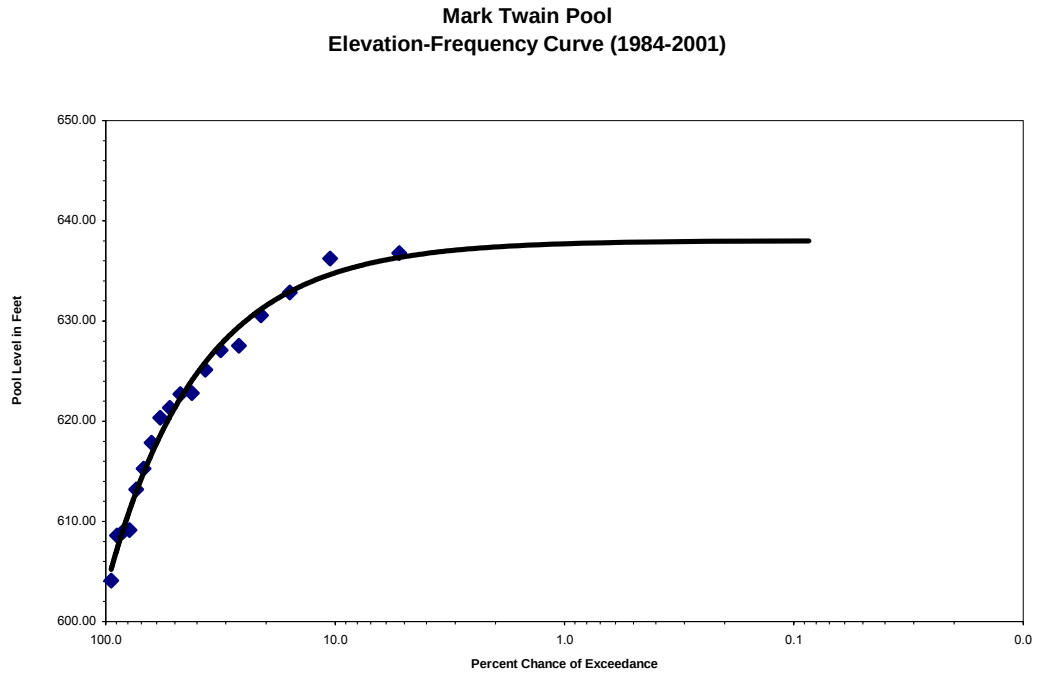
Level	Duration	Percent	Level	Duration	Percent
637	0	0.00	615	742	11.30
636	7	0.10	614	875	13.30
635	12	0.20	613	1008	15.30
634	24	0.40	612	1142	17.40
633	43	0.70	611	1287	19.60
632	55	0.80	610	1462	22.20
631	68	1.00	609	1671	25.40
630	90	1.40	608	1954	29.70
629	113	1.70	607	2447	37.20
628	129	2.00	606	3085	46.90
627	149	2.30	605	3584	54.50
626	174	2.60	604	4018	61.10
625	206	3.10	603	4400	66.90
624	252	3.80	602	4832	73.50
623	306	4.70	601	5396	82.10
622	348	5.30	600	5757	87.60
621	387	5.90	599	6029	91.70
620	421	6.40	598	6384	97.10
619	461	7.00	597	6474	98.50
618	514	7.80	596	6555	99.70
617	568	8.60		6573	100.00
616	629	9.60			

NOTE: 2 values (0.0%) missing from 6575 values in time interval

(a) The maximum release will be restricted to 2,000 cfs if the stage of the Mississippi River at Louisiana or at St. Louis is forecast to be at flood stage and the Mississippi River hydrograph is not on its recession side.

(b) In an attempt to prevent the Mark Twain Lake pool elevation from reaching 615.0 feet NGVD, which would automatically require a change in the maximum release to 12,000 cfs, the maximum release may be increased to 10,000 cfs under either of the conditions given below.

FIGURE 2-2



1. If the pool elevation is forecast to rise to 615.0 feet NGVD, it may be determined to increase the release up to 10,000 cfs after consultation with local downstream interests.

2. If the flood event is over and if favorable weather and river forecast conditions exist, the decision may be made to increase the release to 10,000 cfs after consultation with local downstream interests.

3. Every year, the Missouri Department of Conservation notifies the Corps of Engineers when the fish spawn begins. The pool elevation of the lake will be monitored and controlled to minimize the amount of fluctuation. The pool is normally stabilized from 1 May to 15 June annually. See Figure 2-4.

FIGURE 2-3

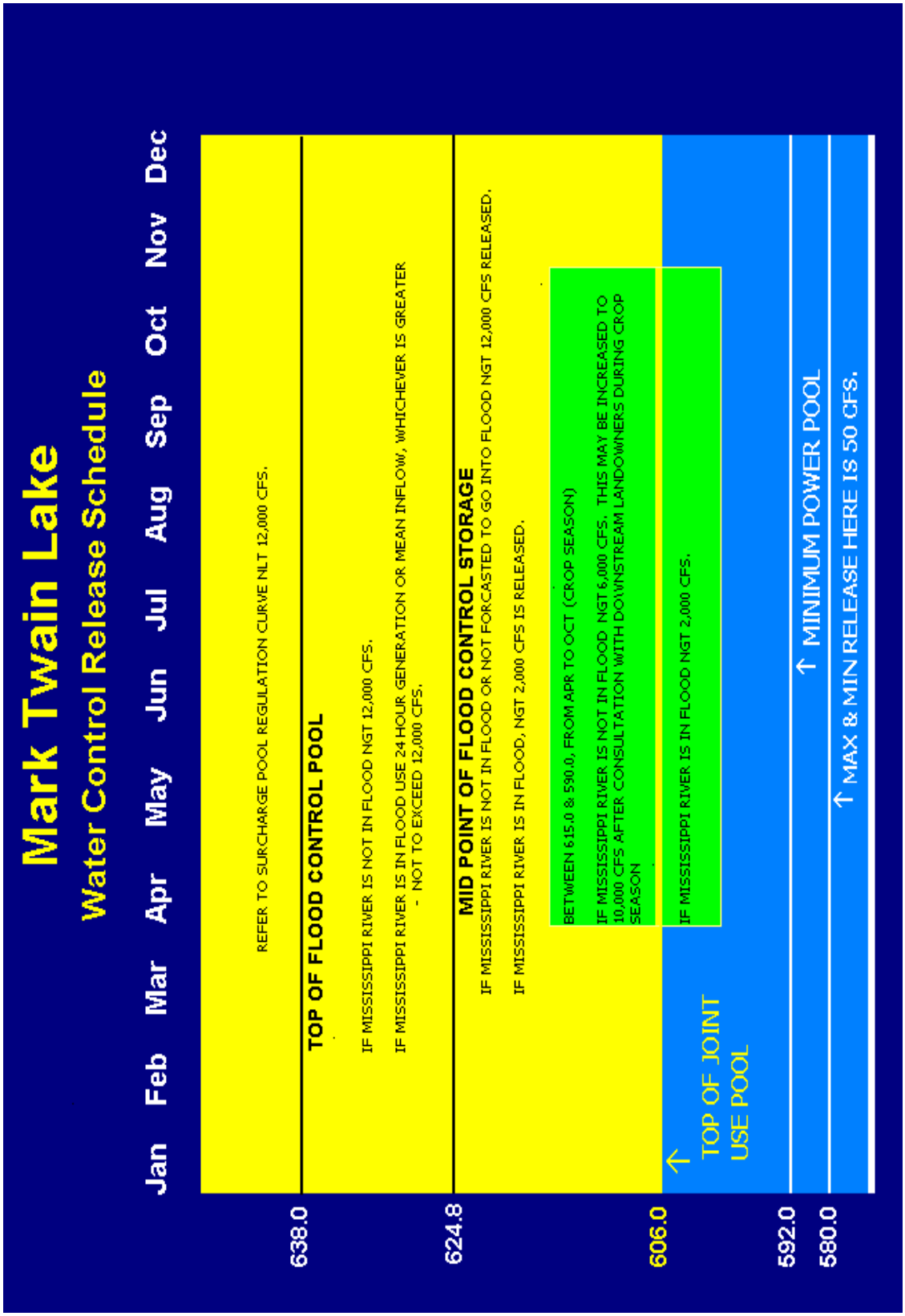
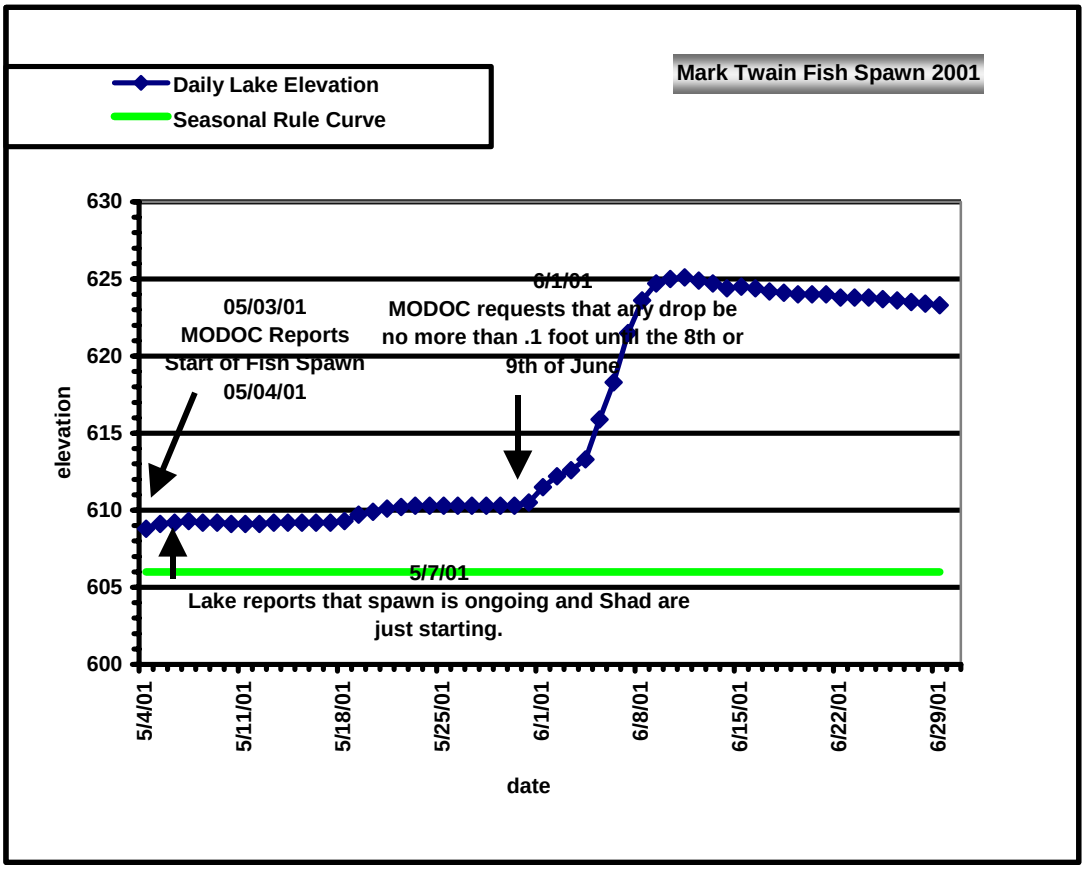

Mark Twain Lake
Water Control Release Schedule
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
638.0
624.8
606.0
592.0
580.0
REFER TO SURCHARGE POOL REGULATION CURVE NLT 12,000 CFS.
TOP OF FLOOD CONTROL POOL
IF MISSISSIPPI RIVER IS NOT IN FLOOD NGT 12,000 CFS.
IF MISSISSIPPI RIVER IS IN FLOOD USE 24 HOUR GENERATION OR MEAN INFLOW, WHICHEVER IS GREATER - NOT TO EXCEED 12,000 CFS.
MID POINT OF FLOOD CONTROL STORAGE
IF MISSISSIPPI RIVER IS NOT IN FLOOD OR NOT FORCASTED TO GO INTO FLOOD NGT 12,000 CFS RELEASED.
IF MISSISSIPPI RIVER IS IN FLOOD, NGT 2,000 CFS IS RELEASED.
BETWEEN 615.0 & 590.0, FROM APR TO OCT (CROP SEASON)
IF MISSISSIPPI RIVER IS NOT IN FLOOD NGT 6,000 CFS. THIS MAY BE INCREASED TO 10,000 CFS AFTER CONSULTATION WITH DOWNSTREAM LANDOWNERS DURING CROP SEASON
IF MISSISSIPPI RIVER IS IN FLOOD NGT 2,000 CFS.
↑ TOP OF JOINT USE POOL
↑ MINIMUM POWER POOL
↑ MAX & MIN RELEASE HERE IS 50 CFS.

FIGURE 2-4



MARK TWAIN LAKE WATER CONTROL VARIOUS POOLS DEFINITION

Inactive Pool (520-567.2): 87,000 Acre-ft. Storage used to accommodate the effect of sedimentation in the lake.

Conservation Pool (567.2 – 606.0): 457,000 Acre-ft. Used to provide for hydropower, water supply (20,000 Acre-ft, average 16MGD), fish and wildlife conservation, recreation, water quality enhancement, and incidental navigation on the Mississippi River.

Hydroelectric Pool (592.0-606.0): No set storage allocation. This is a subset of the conservation pool.

Flood Control Pool (lower) (606.0 – 624.8): 442,000 acre-ft (3.58 inches of runoff). Storage set aside to provide flood damage reduction on the lower Salt River and the Upper Mississippi River.

Flood Control Pool (upper) (624.8 – 638.0): 442,000 acre-ft (3.58 inches of runoff). Storage set aside to provide flood damage reduction on the lower Salt River and the Upper Mississippi River.

Induced Surcharge Pool (638.0 –642.0): 164,700 acre-ft (1.33 inches of runoff). Subset of the entire surcharge pool. Storage set aside to allow discharge to increase up to inflow or spillway capacity (gates out of the water).

Surcharge Pool (638.0 – 648.0): 433,800 acre-ft (3.51 inches of runoff). After the induced surcharge pool has been used this storage passes the spillway design flood (Peak inflow = 476,000 cfs, peak outflow 276,500 cfs).

Freeboard (648.0 –653.0): 257,120 acre-ft (2.08 inches of runoff). The storage needed to prevent wave wash from overtopping the dam.

c. Water Quality Regulation. A minimum release of approximately 50 cfs will be maintained at all times through the Re-regulation Dam, regardless of the Mark Twain Lake pool elevation, to ensure satisfactory downstream water quality conditions.

d. Flood Control and Hydropower Interface.

Flood Control. The objective is to provide a high degree of protection for areas along the Salt River and the Mississippi River downstream of the project. The two components of this project (Cannon Dam and the Re-regulation Dam) will be regulated as one project. The releases from the flood control pool will normally vary between 2,000 and 12,000 cfs. The release depends upon the pool elevation of Mark Twain Lake, the inflow rate, the downstream runoff, the stages on the Lower Salt River and on Spencer Creek, and the stages on the Mississippi River at Louisiana and at St. Louis. However, the release may be temporarily reduced to 50 cfs in the event of an emergency or other unusual conditions. These conditions include threats to the safety of human life or to the integrity of the project, inspection and maintenance of the project, or maintaining a constant pool elevation during fish spawning season. When the pool elevation is above 606.0 feet, the portion of the flood release that can be used for power generation will be passed through the penstocks and the remainder of the release will be passed through the spillway.

During the growing season (i.e., April through October), the flood release will normally be 6,000 cfs or less until elevation 615.0 is exceeded. When practical, the growing season shall be considered to be in effect when a significant amount of crops are in the field as determined by consultation with local farming interests. Releases may be restricted because of the flooding on the Lower Salt River or on the Mississippi River at Louisiana or at St. Louis.

A limited amount of storage, approximately 1510 dsf (day-second-feet or daily average of cfs (cubic feet per second)), is provided in the Re-regulation Pool between elevations 521.0 feet and 528.0 feet. This storage is used to attenuate releases from Mark Twain Lake, to store releases from Mark Twain

Lake for pumpback operations, and to provide water quality releases. Operation of the Re-regulation Dam must be coordinated closely with Mark Twain Lake releases and with local inflow to the Re-regulation Pool. The outflow from the Re-regulation Pool does not need to be maintained at a constant rate.

Hydroelectric power. The objective is to obtain the maximum amount of power generation revenue the project is capable of producing without conflicting with the achievement of other project purposes. When within the conservation pool, hydroelectric power will be scheduled so as to meet the needs of SWPA. Normal lake drawdown within the conservation pool as the result of power production will be limited to 2.0 feet per calendar week (i.e., Sunday through Saturday) or 4.0 feet per month (i.e., any consecutive four calendar week period) during May through October. During the remainder of the year, normal lake drawdown will be limited to 2.0 feet per week with no monthly maximum. Care will be taken to meet the power needs of SWPA everyday, but final control always rests with the Regulating Office. Cannon Dam Power Plant was designed to produce 58,000 KW of electrical power (installed capacity) as a peaking plant.

2.04 VISITATION DATA.

a. General. Visitation at the Clarence Cannon Dam and Mark Twain Lake project has been estimated since 1984 by the use of traffic counters and statistical analysis based on visitor use surveys. The visitation unit used to estimate recreation use until 1991 was the Recreation Day. In 1991, the Visitor Estimation Reporting System (VERS) was installed at the lake project to administer visitation reporting. Two of the units of measurement in VERS are visitor hours and visits.

Visitor hours represent the presence of one of more persons recreating on land or water for periods of time aggregating to sixty minutes. It takes into consideration the number of participants and duration of stay and provides a good estimate of the amount of use.

Visits are simply a ‘head count’ of visitors to a project but do not reflect the amount of use or length of stay. It represents the entry of one person into a recreation area or site to carry on one or more recreation activities.

A Recreation Day is similar to a Visit but reflects the duration of the visit in days. It is the unit of measure for determining recreation benefits at water resource development projects.

b. Past and Current Visitation. Visitation to Clarence Cannon Dam and Mark Twain Lake increased dramatically until the late 1980’s, when it began to level off around 2 million recreation use days. Visitation increased from 665,000 in 1984 to over 2 million in 1988. The lowest visitation years of 1993 and 1998 for

Mark Twain Lake reflect the impacts of high water events. Visitation has rebounded since 1998 to set a new record in 2002 with over 2,500,000 visitors, which is reflective of favorable recreation seasons.

TABLE 2-1

CLARENCE CANNON DAM AND MARK TWAIN LAKE ACTUAL VISITATION DATA, 1976 - 2002

Year	Visits	Rec-Use Days	Visitor Hours
1976		220,536	
1977		146,023	
1978		295,021	
1979		229,300	
1980		215,171	
1981		139,741	
1982		258,057	
1983		424,339	
1984		□ 665,577	
1985		850,700	
1986		1,684,372	
1987		1,863,104	
1988		2,030,000	
1989		1,865,980	
1990	1,834,157	1,738,052	
1991	1,849,844	1,814,947	
1992	1,648,429	1,638,246	19,586,956
1993	1,423,489	1,352,581	◊16,230,968
1994	1,696,376	1,567,938	18,815,259
1995	1,685,983	1,602,029	19,224,351
1996	1,636,607	1,516,801	18,201,614
1997	1,664,087	1,466,293	17,595,516
1998	1,218,199	1,111,057	13,332,681
1999	1,794,386	2,200,366	26,404,389
2000	1,836,028	1,877,135	22,525,623
2001	1,806,966	2,116,511	25,398,112
2002	2,594,626	2,306,286	27,675,436

□ Note: Clarence Cannon Dam was completed in 1983 and Mark Twain Lake reached recreational pool in March of 1984. The 1984 visitation data represents the first full year of lake recreational use at the project

◊ Missing September visitation

Yearly visitation totals are affected by a number of factors including changes in weather conditions, fluctuations in lake levels, cost and supply of gasoline, general economic conditions, and the availability of recreational facilities at the lake. TABLE 2-1 presents a summary of actual visitation from 1976 -2002. TABLE 2-2 presents the percentage of users traveling from various mileage distances to the major recreation areas at Mark Twain Lake. This information is from a 1988 recreation area users survey. The project zone of influence is considered to extend 125 miles from the lake.

TABLE 2-2
DISTANCE OF VISITOR TRAVELS TO MAJOR RECREATION AREAS AT MARK TWAIN LAKE

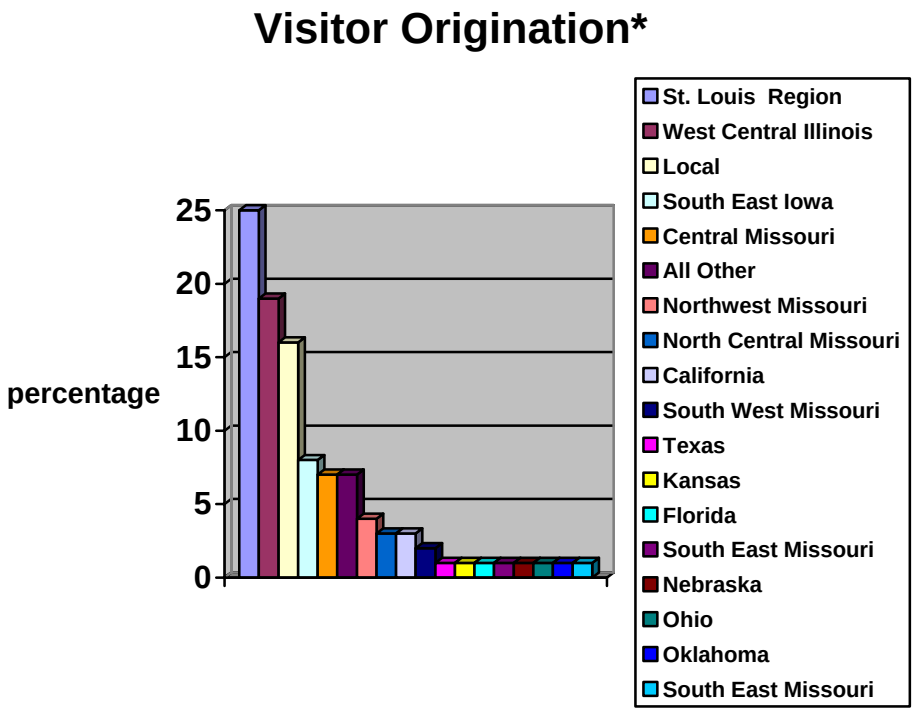
Area	Within 50 Miles	51-125 Miles w/o St. Louis	St. Louis Area	Other
M.W. Boudreaux	14.60%	13.30%	38.60%	33.50%
Ray Behrens	23.20%	6.30%	48.20%	22.30%
Robert Allen	45.50%	0	36.40%	18.10%
South Fork	71.50%	7.10%	14.30%	7.10%
Stoutsville	11.10%	22.20%	50%	16.70%
Indian Creek	28.60%	7.10%	29.40%	34.90%
John Spalding Day Use Boat Ramp	33.80%	8%	30.80%	27.40%
Spillway North & Overlook	28.20%	13%	22.60%	36.20%
Bluff View	57.10%	4.80%	9.50%	28.60%

c. Projected visitation. A discussion of projected visitation at Mark Twain Lake is presented in Section 6.12.

Figures 2-5 to 2-7 below were created by sampling visitor logs and camper registrations. Additional information was obtained from a study performed by the University of Missouri for the Northeast region of Missouri. Visitors originate from the St. Louis area, West Central Illinois, and Southeast

Iowa. By state, Missouri (78 percent) and Illinois (13 percent) are the points of origin for most campers.

Figure 2-5



*Based on informal sampling of Boudreaux Visitor Center 2001 visitor logs.

Figure 2-6

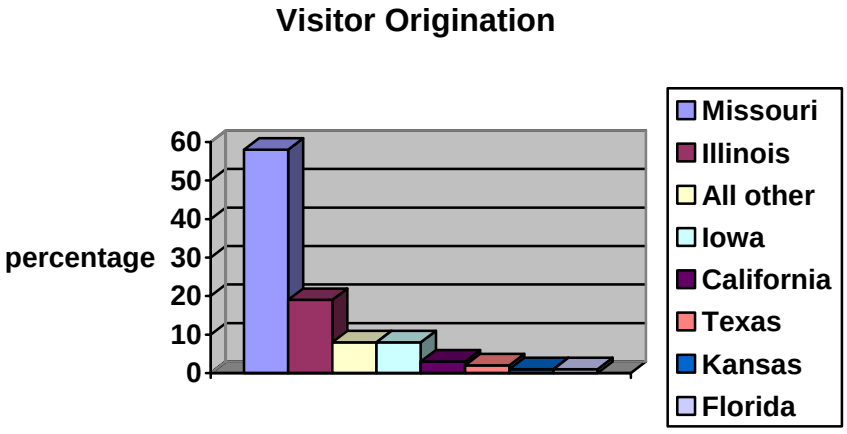
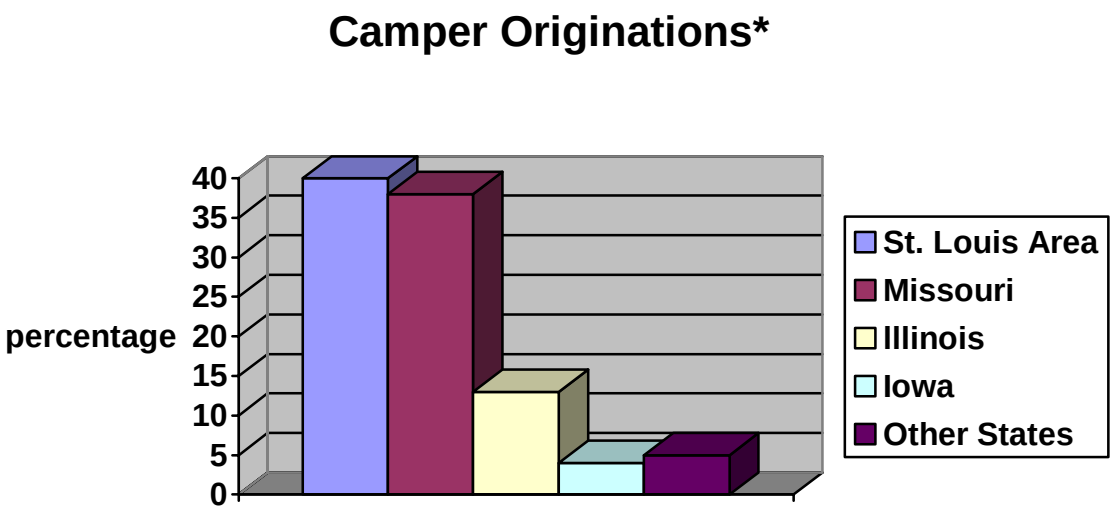


FIGURE 2-7



*Based on informal sampling of 2001 camper registrations.

SECTION III - OPERATING PROJECTS: STATUS

3.01 PROJECT DEVELOPMENT AND OPERATION CHRONOLOGY

Clarence Cannon Dam and Mark Twain Lake were authorized by the Flood Control Act of 23 October 1962, Public Law 87-874. Construction began in 1966 and the lake was impounded in the spring of 1984. The hydropower plant in the main dam began online generation in the late fall of 1984.

3.02 CHRONOLOGY OF EXPENDITURES FOR PUBLIC USE AND ENVIRONMENTAL RESOURCE DEVELOPMENT

a. Federal Government.

(1) Recreation Area Development

Thirteen public recreation areas have been developed by the St. Louis District Corps of Engineers. Ten of these areas have been developed for intensive recreation and are named as follows; M.W. Boudreaux Recreation Area, Ray Behrens Recreation Area, Robert Allen Recreation Area, South Fork Recreation Area, Stoutsville Recreation Area, Indian Creek Recreation Area, John F. Spalding Recreation Area, Frank Russell Recreation Area, Warren G. See Spillway Recreation Area and Bluffview Recreation Area. Three additional areas, North Fork, Sandy Creek and Shell Branch Recreation Areas have limited facility development, with large portions of each reserved for future recreational development. In addition, the St. Louis District has partially developed two other areas that were included in the Mark Twain State Park lease issued to the Missouri Department of Natural Resources in 1986.

The scope of development varies with each respective area. Some areas provide basic facilities such as access roads, picnic tables, and comfort stations and launch ramps with related parking, while other areas provide a swimming beach, campsites with electrical hookups, showerhouses, playgrounds, amphitheaters, and nature trails. The total cost of recreational and environmental developments for the recreational areas was $21,916,515. This total was spent for initial development and construction of three major camping areas, eight major picnic areas, fourteen boat ramps, and approximately 34 miles of paved roadways. These facilities were opened for public use during the period 1979 through 1986.

The St. Louis District will provide additional facilities as proposed in this master plan subject to public demand and availability of funds. Table 3-1 summarizes existing recreational facilities at areas managed by the Corps of Engineers, those leased to the state of Missouri at Clarence Cannon Dam and Mark Twain Lake, and those operated on State Park lands adjacent to Corps property.

(2) Operation and Maintenance Cost

Operations expenditures for the period 1 October 2000 through 30 September 2001 (Fiscal year 2001) amounted to $2,906,047. Maintenance expenditures for the same period were $2,646,945 for a total operation and maintenance cost of $5,552,992.

b. Non-Federal Public Agencies

An area comprising 1,559 acres of land is outgranted to the Missouri Department of Natural Resources (MDNR). A 25-year lease (DACW43-1-86-6) ending 28 February 2010, authorizes the MDNR use and occupancy of 1,559 acres of land along the north and south shorelines of the main pool and along the south shore of the South Fork of the Salt River. The MDNR, formerly the Missouri State Park Board, had a large land holding along the Salt River before acquisition began. Six hundred and seven acres (607) of Government land were exchanged for 617 acres of MDNR's fee land and 17 acres of flowage easements. The 617 acres of land acquired by the Government from MDNR lie mainly in the pool area with some portions lying above 606.0 NGVD being included in the park lease. The land area of the lease is 1,559 acres; the premises was surveyed using a 606.0 NGVD elevation line, which is the top of the conservation pool. The terms of the lease allow for access to the water's edge if the pool should fall below the 606.0 elevation. Developed areas of the Mark Twain State Park lie both on MDNR fee land and on the leased premises. Access to the park is by Missouri State Highway 107, which crosses portions of the park on a northwest southeast axis, and State Route U, which crosses parts of the park on an east/west axis. Existing development on leased land consists of an arterial road system, a swimming beach, a bathhouse, 10 picnic sites, two 4-lane boat ramps, one single-lane boat ramp, an overlook, 235-car parking spaces, 165-car/trailer parking spaces, 2 vault comfort stations, a group camp facility with swimming facility, and a land irrigation sewage treatment plant (STP).

c. Private Recreational Investment

(1) Concession Leases. There are two commercial concession leases at Clarence Cannon Dam and Mark Twain Lake. The leases occupy portions of two Corps developed public recreation areas. A summary of a feasibility study entitled *“Market Potential and Feasibility Analysis of Commercial Concession Development at Mark Twain Lake, Missouri”* , completed in January 2001 that addressed marina capacities, expansion possibilities and a potential third marina, is located in Appendix B.

Descriptions of the commercial concession lease areas are provided below:

(a) Blackjack Marina (Blackjack Marina, Inc., Lessee) comprises approximately 24.0 acres of land. The total leased area is 37.5 acres, which includes approximately 13.5 acres of water in the conservation pool. The area is located in the southern portion of the Ray Behrens Recreation Area approximately two miles southwest of the main dam. The concession lies entirely on Government land and includes a total of 275 boat slips (total includes every slip including courtesy boat slips); a sales and service building, and a floating gas dock/store. Services, boat rentals and hunting and fishing licenses are available for sale to the public. The facility began operation in 1985. Proposed additional facilities include overnight accommodations, dock and slip expansion and supplemental parking when the present facilities approach capacity. Lease No. DACW43-1-84-6 covering the site expires on 31 October 2008.

(b) Indian Creek Marina (Indian Creek Development Corporation Lessee) comprises approximately 97.4 acres of land. The total leased area is 154.64 acres, which includes approximately 57.2 acres of water in the conservation pool. The area is located in the southwestern portion of the Indian Creek peninsula and lies entirely on Government land. The marina began operation in 1986. Existing facilities include a total of 221 boat slips (total includes rental slips, courtesy slips, etc), primary electrical service, storage building, general store, restaurant, and gas pumps. Access roads and 200 parking spaces exist on the site. Proposed facilities may include overnight accommodations. Lease No. DACW43-1-84-63 covering the site expires 29 May 2014.

(c) Mark Twain State Park Although the State has indicated that a “third commercial concession area” is no longer an element in their short-term or long-term planning, this is an excellent location for a third commercial concession area at the Mark Twain State Park. A January 2001 study entitled “Market Potential and Feasibility Analysis of Commercial Concession Development at Mark Twain Lake, Missouri” prepared by Parsons HBA for the Corps stated that under the present circumstances, development of a quality resort lodge/hotel with a restaurant and ancillary facilities is a higher priority than developing a third marina. The potential at this location is excellent because of compatible existing facilities and good access from major highways as stated in Appendix D, page D-16 of the market feasibility report. A summary of the study is included in Appendix B of this Master Plan.

d. Summary of Recreation Facilities

Table 3-1 presents a listing of all existing recreational facilities that have been provided at Clarence Cannon Dam and Mark Twain Lake by the Corps of Engineers, the state of Missouri, and private concessionaires.

TABLE 3-1
OPERATING PROJECTS: MARK TWAIN LAKE
STATUS: EXISTING PUBLIC RECREATIONAL DEVELOPMENT

AREA	Campsite Full Hookup	Camp Sites W/Elec.	Camp Sites Primitive	Group Camp Sites	Trailer Dump Station	Shower Building	Comfort Station	Comfort Vault	Picnic Sites	Picnic Shelter	Swim Beach	Fish Cleaning Stations	Fountains/ Hydrants	Boat Ramp Launch Lanes	Play Ground	Bath House	Amphi-theater	Corral	High Water Ramp	Multi-Purpose Building	Visitor Center Interpretive Exhibits	Marina	Shooting Range	Change House
M.W. Boudreaux Recreation Area							1		14												1			
John C. "Jack" Briscoe				20		1				1			2		1									
Ray Behrens	7	165			1	4	5		15	1		1	10	4	4		1					1		
Robert Allen								1	3					4					1					
South Fork								1	3					4										
Stoutsville								1	3			1		4					1					
North Fork														4										
Shell Branch														4										
Sandy Creek																								
Indian Creek	13	190	20	*37	2	6	7	3	13	2	1	2	19	5	4		1		1			1		
John Spalding							3		33	3	1	1	4	4	1	1			1					
Frank Russell		65			1	1		3					3		2		1	1						
Spillway								4		2			7	2	2					1	1		1	
Bluff View								2	4	1				1	1									
Hunter/ Fisherman Lots (36)			6					1	2					9										
Corps Total	20	420	26	57	4	12	16	16	90	10	2	5	45	45	15	1	3	1	4	1	2	2	1	
State Park Facilities **		63	40	4****	1	2	0	7	30	1	2***	1	13	9	1		1			1	1			1
Grand Total	20	483	66	61	5	14	16	23	120	11	4	6	58	54	16	1	4	1	4	2	3	2	1	1

* Twelve of these sites are tent only sites. Twenty-five of these sites are trailer sites with electric.

** State Park facilities listing are for both State Park owned lands and leased properties.

*** Facilities include 1 Swim Beach and 1 Swimming Facility

**** Four cabins and a dining hall

SECTION IV - COORDINATION WITH OTHER AGENCIES AND THE PUBLIC

4.01 GENERAL

A high degree of coordination was maintained with all appropriate Federal and State agencies during preparation of the original Master Plan and in the preparation of subsequent updates to the Master Plan. For this reason, a summary of agency coordination during project development and the ensuing 19 years of agency and public coordination and cooperation is contained in the following paragraphs. Detailed coordination activities are presented in the Operational Management Plan (OMP) under separate cover.

4.02 FEDERAL AGENCIES

a. National Park Service

The National Park Service reviewed the proposals for development contained in the original Master Plan. Their comments were coordinated with the Missouri State Park Board (now MDNR) and were given full consideration in the development of the Master Plan and recreation facilities.

b. U.S. Fish and Wildlife Service

During the early stages of project planning, the USFWS and the Corps were in frequent contact to coordinate their respective programs for fish and wildlife resources at Mark Twain Lake. Initial coordination called for a license agreement between the Corps and the MDC for wildlife management on approximately 14,000 acres of land. In 1978 the MDC declined to enter into a cooperative agreement at Mark Twain Lake. The Corps of Engineers has assumed responsibility for the wildlife management of these and other lands. Cooperation between the Corps and the USFWS is continuing with the recent North American Waterfowl Cooperative Agreement between the Department of Interior and Department of the Army.

c. Public Health Service

The Public Health Service prepared a report and recommendations concerning vector-borne diseases. Many of the recommendations are obsolete under current environmental concerns and knowledge.

In Missouri, diseases such as St. Louis and eastern equine encephalitis are a potential threat each year, but the much-publicized West Nile encephalitis has overshadowed them recently. West Nile virus was first discovered in the United States in New York City in 1999 and spread to other states in the Northeast and along the Atlantic seaboard during 2000. West Nile virus invaded

the Midwest in 2001, and by the fall of that year had been identified in eight crows in eastern Missouri. One positive West Nile Virus case was reported for Monroe Co. in 2002.

The Centers for Disease Control and Prevention is working with the U.S. Geological Survey, U.S. Department of Agriculture Animal and Plant Health Inspection Service, state wildlife agencies, and state and local health and vector control agencies to track the occurrence of West Nile virus (WNV). Organizations in the lower 48 States and localities are actively participating in a West Nile Virus Surveillance System.

The West Nile Virus Surveillance System is intended to monitor the geographic and temporal spread of WNV over the contiguous United States, to further develop national public health strategies for WNV surveillance, prevention, and control, to develop a more complete regional picture of the geographic distribution and incidence of similar viruses, and to provide national and regional information to public health officials, elected government officials, and the public.

d. Natural Resources Conservation Service (NRCS)

The Corps maintains continuing coordination with the NRCS concerning agricultural management programs on public land. The NRCS also provides information regarding cooperative plans, tillage techniques, agricultural leases and pond construction, design, and location. This information is used as a basis for planning purposes by the NRCS for proposed projects in the upper watershed and by the Corps for water quality concerns.

The NRCS in association with the MDC sponsor Wetland Reserve Program projects on flowage easement lands. Both agencies have a vested interest in management and identification of wetlands. The NRCS has an interest in the policies and procedures used by the Corps to interpret and administer Section 404 of the Clean Water Act of 1972. The Corps has an interest in how the NRCS administers wetlands through the 1985 Food Security Act. Both agencies work together to effectively meet their goals.

e. Federal Power Commission

The study to determine the feasibility of generating hydroelectric power as one of the multiple purposes of Mark Twain Lake was coordinated with the Chicago Regional Engineer of the Federal Power Commission.

f. Southwestern Power Administration (SWPA)

The Southwestern Power Administration was originally consulted regarding the financial feasibility of power generation at Mark Twain Lake. They later became the contracted buyer of the generated electricity. Contractual and

administrative coordination is on going and will continue with Southwestern Power Administration.

g. Advisory Council on Historic Preservation

The Advisory Council on Historic Preservation is a division of the Executive Office and serves in an advisory capacity to the President. The Advisory Council reviews and comments upon federal agencies' finding of "adverse effect" and "no adverse effect" to cultural properties, which may result from construction, operation, and maintenance projects. The Advisory Council also comments and provides guidance on federal agencies' proposals to avoid or mitigate adverse effects.

4.03 STATE OF MISSOURI

Close liaison with the MDC, Missouri Department of Natural Resources and Missouri Department of Transportation was maintained through the planning and early development phases of Clarence Cannon Dam and Mark Twain Lake.

a. Missouri Department of Natural Resources (MDNR)

The MDNR includes the following divisions; State Parks; Outreach and Assistance; Water Protection and Soil Conservation; Air and Land Protection; and Geologic Survey and Resource Assessment. The Corps of Engineers has a 25-year lease with Missouri State Parks for approximately 1,559 acres of outgranted State Park lands near Florida, Missouri. The Corps works closely with the Mark Twain State Park in future planning, maintenance and monitoring visitation.

(1) State Historic Preservation Office (SHPO) Coordination is also maintained through this agency and the MDNR. The SHPO provides information and guidance regarding the protection and preservation of cultural resources and assists in making determinations of eligibility for inclusion in the National Register of Historic Places.

(2) The Corps coordinates with the MDNR regarding the construction and operation of wastewater treatment facilities, the maintenance of effluents (NPDES and Operating permits), drinking water and clean water quality standards.

(3) The Corps of Engineers also works with the MDNR concerning lake and watershed water quality, monitoring of sewage and solid waste disposal and coordination of raw water for municipal use.

b. Missouri Department of Conservation (MDC)

This agency has the formal responsibility of fisheries management for Mark Twain Lake and the re-regulation pool. Informally the Corps of Engineers coordinates management objectives with the MDC concerning enforcement, fisheries management, endangered species, raptor reintroduction programs, forestry, and prairie restoration and management.

(1) An Agreement between the U.S. Army Corps of Engineers and the MDC allows the Corps to conduct authorized deer and turkey hunts within Corps recreation areas during established hunting seasons. These hunts are conducted for physically challenged hunters.

(2) MDC has a cooperative effort with the Corps to develop littoral zone structures in Mark Twain Lake.

(3) Hunter Education Programs

The Education Program, sponsored by the MDC is to provide hunter education instruction to all citizens. Corps Rangers and MDC personnel cooperatively provide hunter safety and ethics training to the general public. The Corps provides a classroom, shooting facilities, and teachers to work cooperatively with MDC personnel in providing training and live firing to the general public.

(4) Shooting Range Inspections

MDC personnel inspect the shooting range in the Warren G. See South Spillway area and prepare an annual report evaluating the safety conditions of the range.

(5) Archery Range

MDC and Corps personnel will develop the plans for an archery range in the Ray Behrens Day Use Area. These plans will be used for the construction of the range.

c. Missouri Department of Transportation

Coordination is on-going concerning signs, right-of-way maintenance, encroachments and potential future transportation system upgrades for the area.

d. Missouri Highway Patrol

This agency provides support that includes traffic control, law enforcement, accident investigation and reporting, and emergency response. A Memorandum of Agreement is in place with these agencies and the Missouri

Division of Highway Safety, St. Louis, Little Rock, Memphis, Rock Island, and Kansas City Districts of the Corps of Engineers. This partnership provides a mutually beneficial opportunity for each agency to improve the effectiveness of their safety education/awareness programs through such initiatives as the safety billboards across Missouri. These collaborative safety campaigns are designed to address visitor inquiry and accidents. Examples include highway billboard and driver check points.

e. Missouri Water Patrol

This agency provides support that includes boat inspections, enforcement of state laws, boat safety courses, and search and rescue operations. The Missouri Water Patrol also participates in the Memorandum of Agreement with the Missouri Highway Patrol to improve effectiveness of safety education/awareness programs.

f. Missouri Department of Public Safety/Motorcycle Safety Foundation

The Motorcycle Safety Foundation is administered through the Missouri Department of Public Safety, Division of Highway Safety. The Foundation is planning to provide motorcycle safety and operation training programs beginning in 2003 at Mark Twain Lake for the public and employees.

g. Challenge Cost-Share Agreement with the MDC, National Rifle Association Foundation Inc.

This agreement provided for the construction of a shooting range at the Warren G. See South Spillway Area. This facility is provided for hunter education training and enjoyment of visitors. The agreement met the need to ensure that safe multi-use opportunities are available on public lands.

4.04 LOCAL AGENCIES

There has been and continues to be a great deal of coordination between the Corps of Engineers and local agencies. Coordination includes information on future plans, advisement of changes in policies and regulations, exchange of information and cooperation on special events, recreation and volunteer programs.

Primary agencies dealt with locally include: Ralls and Monroe County Courts and Sheriff's Departments; Clarence Cannon Wholesale Water District; Ralls County Electric Cooperative; Northeast Power Cooperative; Tri-Cities Chamber of Commerce; Mark Twain Lake Chamber of Commerce.

a. Challenge Cost-Sharing Agreements

Challenge Cost-Sharing Agreement with Tri-City Commission

The purpose of this agreement is to install a non-discharge wastewater infiltrator system in the Warren G. See South Spillway Recreation Area. The Commission is interested in promoting and assisting the Government in providing this sanitation system for the public's benefit and use during Special Events.

Challenge Cost-Share with the Tri-City Commission

The purpose of this agreement was to construct a picnic shelter in the Warren G. See South Spillway Recreation Area. This facility provides support and safety features for events held in this area.

Challenge Cost-Share Partnership with the Missouri Equine Council

This partnership resulted in construction and maintenance of multi-use trails and a trail extension at Mark Twain Lake.

Challenge Cost-Share Agreement with the Missouri Department of Conservation, National Rifle Association Foundation Inc.

Provided for the construction of a shooting range at the Warren G. See South Spillway Area. This facility provides a safe and convenient place for public firearm enthusiasts and serves as a training facility for hunter education classes, area law enforcement and new shooters. The group agreement met the need to ensure that multi-use opportunities are available on public lands.

b. Memoranda of Agreement

Memorandum of Agreement with Greenlawn Saddle Club, Missouri Long Riders, Monroe County Saddle Club, N.E. Missouri Long Ears Association, and Trails Committee Missouri Equine Council (MEC)

This MOA is for the purchase of land which is proposed to be ultimately donated to the government. The purpose of this agreement is to promote responsible stewardship of natural resources. These donations will be used to reroute difficult to traverse sections of the Joanna and Lick Creek multi use trails. This will result in a safer trail for visitors utilizing the facilities.

Memorandum of Agreement with the NEMO Chapter of the National Wild Turkey Federation, Inc. and Hannibal Vo-Tech

This agreement strives to produce an integrated approach to the management of public lands. This approach will maximize the benefits to wildlife by promoting stewardship of the natural and cultural resources at Mark Twain Lake while promoting community service and involvement.

Memorandum of Agreement with the Northeast Missouri Vietnam Veterans, Inc

This agreement permits a memorial that honors area citizens who participated in the Vietnam conflict. The Northeast Missouri Vietnam Memorial was constructed at the M.W. Boudreaux Visitor Center.

Memorandum of Agreement with the Mark Twain Lake Chamber of Commerce

This agreement establishes a relationship of cooperation regarding issues of common interest. Furthermore, it will enable the parties to the agreement to jointly plan and carry out mutually beneficial programs, projects and activities relating to responsible enjoyment, visitor safety and environmental stewardship of Mark Twain Lake and associated public lands.

Memorandum of Agreement Customer Funding with the Jonesboro, Arkansas City Water and Light and the Southwestern Power Administration (Southwestern)

This MOA is for the Rehabilitation of the Power Plant Intake Gates, Bridge Crane Controls, Service Air Compressors, Gantry Crane and Generator Coolers.

Cooperative Agreement with the University of Missouri

The University of Missouri will house, manage, stabilize, preserve, and provide access to archaeological collections and records generated in conjunction with Corps of Engineers' activities in the state of Missouri.

Cooperative Agreement with the North American Waterfowl Management Plan

A task force will be formed to explore potential opportunities for waterfowl habitat on corps projects.

MO Partners for Safety (MOPS)

The MO Partners for Safety (MOPS) is a partnership that began with an MOA in 1998 between all five U.S. Army Corps of Engineers Districts in Missouri, the Missouri State Water Patrol, and the Missouri State Highway Patrol. Initially, MOPS was involved in promoting a statewide "buckle-up seatbelts and life jackets" billboard campaign. Since then, cooperation has continued to expand with these and other agencies becoming involved in discovering ways to work together to improve their education and safety awareness efforts.

c. Memoranda of Understanding

Memorandum of Understanding with the Mark Twain Water Quality Initiative
This project will show the benefits of holistic land management to improve the various environmental aspects of the Mark Twain Lake Watershed. The

results of this study will benefit Mark Twain Lake, the local communities, and result in improved water quality.

Memorandum of Understanding with the Bass Anglers Sportsman Society (B.A.S.S.)

The purpose of this agreement is to establish a framework of cooperation to work together to maintain and enhance the productivity of sport fishery resources and public fishing opportunities at U.S. Army Corps of Engineers water resource projects.

Memorandum of Understanding with the Nature Conservancy.

Provides for the Nature Conservancy to provide management and monitoring recommendations, review natural resource management plans, and monitor conditions on public lands to maximize environmental stewardship efforts.

Clarence Cannon Wholesale Water Commission

This agreement allows for the use of up to five million gallons of water per day by the commission. This water provides service for local communities in Northeast Missouri.

Memorandum of Understanding with the American Canoe Association

This agreement will allow the use of our finite resources in the protection of resources, promotion of recreation, enhancement of visitor safety, improvement of accessibility, and attraction of additional volunteers to Corps projects.

Mark Twain Lake Water Safety Program Partnering

This program is a key element in the success of the water safety program at Mark Twain Lake and has received national recognition at the National Water Safety Congress. This effort has been successful in part due to the cooperation of the many local partners. These local partners include: Hardees of Monroe City, Pizza Hut, Kentucky Fried Chicken, Refreshment Services Pepsi of Quincy, C&R Markets of Monroe City, Wal-Mart Inc., and Lamar Advertising. Water safety will continue to be an integral part of all programs at Mark Twain Lake.

d. Other local partners contributing to Special Events.

Adventure in Astronomy

This program is offered with the academic support from local educators at Hannibal-LaGrange College. Additional contributions from high school teachers and Corps personnel has afforded local visitors the opportunity to pursue topics of interest in space and astronomy fields.

Kids Fishing Day

This program, introducing young visitors to the art of fishing, is partnered with the MDC.

MSWP Safe Boating Course

This partnership with the Corps and the Missouri State Water Patrol provides boat safety courses for the general public.

Primitive Artifacts

This special event explores the cultural heritage of the Mark Twain Lake region. Partners include: Ralls, Marion, and Northeast Missouri Archeological Society and the University of Missouri.

Water Safety Bulletin Board Contest

This water safety contest is partnered with Lamar Advertising to provide water safety campaign messages for the Mark Twain Lake area.

Salt River Folk Life Festival

This Special Event is partnered with the Corps, Missouri Department of Natural Resources, and the Friends of Florida. This event educates and promotes historical living skills, entertainment and crafts of 1800's northeast Missouri.

Mule Days

This Special Event is partnered with North East Missouri Long Ears Association and the Mark Twain Lake Area Chamber of Commerce.

C.A.S.T for Kids Event

A partnership with the C.A.S.T. for Kids Organization, the Corps of Engineers, the Mark Twain Lake Bass Masters and area businesses provide physically challenged and under privileged kids the opportunity to learn about and enjoy fishing.

Environmental Education Day

This informal agreement is a joint effort by a variety of organizations to promote environmental education to area students. Partners in this event include: BASF Corporation, Continental Cement, The Pillsbury Co., Al's Rental Plus, Northeast Missouri Power, MDC, C&R Supermarkets, Pace Industries, U.S. Army Corps of Engineers branches, Missouri Department of Natural Resources, Kan-Man Recycling, Northeast MO Electric Power

Coop, JC Auto & Truck, MO Watershed Information Network, USFWS, NEMO National Turkey Federation, McLeod, Ralls County Electric Coop, Ralls, Monroe & Marion Co. Soil and Water Conservation District, St. Louis Science Center, and Missouri Pork Producers.

4.05 OTHER AGENCIES AND ORGANIZATIONS

Ralls and Monroe Counties

Coordination with these local governmental bodies continues to be conducted as action/plans of mutual interest and/or impacts are identified at Mark Twain Lake. A Memorandum of Understanding was developed in 1986 with the identification of county roads within the project. Cooperative agreements are also maintained with the Ralls County Sheriff's Department and the Monroe County Sheriff's Department for the provision of additional law enforcement services on Corps administered public lands. These agreements have proven to be highly successful and will be continued as funding permits. These agreements would provide a contractual mechanism to meet Homeland Security requirements for the project.

Perry Volunteer Fire Department

The Mark Twain Lake Project Office is a dues paying member of the Perry Volunteer Fire Department. The department helps to suppress fires at Corps owned structures, visitor property and to assist in the suppression of forest and/or brush fires that immediately threaten Corps owned structures within their jurisdiction. Continued coordination will be maintained as required.

Monroe City Area Fire Protection District.

The Mark Twain Lake Project Office has a cooperative agreement with this agency to suppress fires in Corps owned structures, visitor property and to assist in the suppression of forest and/or brush fires that immediately threaten Corps owned structures within their jurisdiction. Continued coordination will be maintained as required.

Paris Rural Fire Protection District.

The Mark Twain Lake Project Office has a cooperative agreement with this agency to suppress fires in Corps owned structures and visitor property and to assist in the suppression of forest and/or brush fires that immediately threaten Corps owned structures within their jurisdiction.

Two Marinas on Mark Twain Lake.

Indian Creek and Blackjack Marinas operate and provide services to the public that may not otherwise be provided by the federal, state, and local governments.

4.06 COORDINATION

The update of the Mark Twain Lake Master Plan was coordinated with elected officials, partner agencies and organizations and the public. A public meeting was held in the fall of 2001 to discuss issues of concern regarding Mark Twain Lake's operation prior to initiating the update the Master Plan. This draft plan will be circulated for public review and comment in early 2003. A Market Potential and Feasibility Analysis of Commercial Concession Development at Mark Twain Lake was completed in January 2001. Information developed in that study was incorporated in the Master Plan where appropriate. Agencies and concessionaires submitted revisions for those sections of the Master Plan relevant to their operations. The input received at the public meeting was considered in the development of this plan and is included as Appendix C to this plan.

SECTION V – RECREATIONAL AND ENVIRONMENTAL RESOURCES OF THE PROJECT

5.01 GEOLOGIC

a. Geologic Setting. The predominant geologic structure controlling the local dip of rock strata at the project is the Lincoln Fold, a complex plunging asymmetrical anticline located in northeast Missouri. The axis of this structure trends structure results in the slight (1 to 3 degrees) northwesterly dip present in the rock strata of the project area. The project area is located in the Dissected Till Plains Section of the Central Lowlands Physiographic Province. The geologic formations occurring at the surface within the project area include Paleozoic sedimentary rocks (primarily limestones and shales) Pleistocene glacial drift, and recent alluvium. The area is characterized by low to moderate relief in the uplands with locally high relief (up to 200 feet) occurring in the bluffs along the Salt River and its tributaries. Some karst features are present in the project area, most notably, solution cavities in the limestone bluffs.

b. Geologic Formations. The stratigraphy in the area consists essentially of nearly flat-lying sedimentary strata of Mississippian and Pennsylvanian formations on the uplands. These in turn, are overlain by Pleistocene deposits of glacial till, residuum, or on the floodplains, by recent alluvium.

(1) Hannibal Formation. The oldest exposed unit is the Hannibal Formation of Early Mississippian (Kinderhookian) age. It is a bluish-green, moderately hard, sublimated shale and siltstone. The shale contains some pyritized fossils, irregular tubular markings (probably worm borings) and “Rooster Tail” markings (Taonurus causagalli) that are common throughout the formation. The Hannibal outcrops in the eastern portion of the project area, from approximately elevation 535 to 590 feet NGVD. The Hannibal Formation is overlain by the Chouteau Formation.

(2) Chouteau Formation. The Chouteau is a gray to “mouse-gray”, Lower Mississippian (Kinderhookian) limestone. On weathered outcrops, it generally has a light to dark brown color and earthy texture. It is generally an argillaceaus dolomitic thin-bedded limestone, but occurs as a medium to coarsely crystalline, competent limestone in portions of the project area. It is a cliff-forming unit with a well developed joint and fracture system. The Chouteau contains some calsite, pyrite, marcasite, and sphalerite-lined vugs. The Chouteau outcrops in the eastern portion of the project area, from approximately elevation 590 to 620 feet NGVD. The Chouteau is overlain by the Burlington Formation.

(3) Burlington-Keokuk Formations. The Burlington and Keokuk formations are similar lithologically and are assumed to contact conformably. The contact between the Burlington and the overlying Keokuk is not characterized by any significant change in the physical properties of the rock, and they are therefore treated here as one unit. The Burlington-Keokuk Formation is a light gray, coarse to fine crystalline, middle-Mississippian (Osagean) limestone. The upper section of the unit is a cherty limestone with chert occurring in nodular form throughout. Geodes are common locally in the upper portions of the formation, and are sometimes found in the weathered residuum of the formation. Bedding planes in the upper unit are generally separated by paper-thin shale partings. The lower unit consists of approximately 20 feet of massive bedded very coarsely crystalline limestone that is practically chert free. The Burlington is extremely fossiliferous, containing an abundance of crinoids. The unit is the primary cliff-former in the project area. The thickness of the Burlington-Keokuk Formation varies depending upon the extent of surface weathering. The unit occurs from approximately elevation 590 to 710 feet NGVD, having an irregularly weathered upper contact with Pennsylvanian deposits and residuum.

(4) Warsaw Formation. The Warsaw Formation is a shaley argillaceous, Middle Mississippian limestone, occurring in limited exposures overlying the Burlington Limestone in several creek valleys in the extreme western portions of the project area. It occurs between elevations 650 and 680 feet NGVD, and unconformable contacts with overlying Pennsylvanian age strata. Chert nodules and some geodes are common in the unit.

(5) Pennsylvanian Age Strata. Several formations of Pennsylvanian age occur, primarily in the western portions of the project area. These strata have been deposited unconformable upon the eroded surface of the Burlington-Keokuk and Warsaw Formations. Their thickness, lithology and areal extent vary greatly. The mapping of these units has not been detailed, as their impact upon the reservoir is negligible, because they occur above the maximum pool elevation. The most persistent and well defined of these units is the Cheltenham, which contains shales, clays, and a basal conglomerate. The clays of the Cheltenham locally contain economic grade fire clay, which has been mined in the past near the towns of Stoutsville and Goss. Also occurring in the western portions of the project area is the cyclothem of the Cabannis Subgroup, which includes the Tebo, Weir, and Scammon Formations. Some minor amounts of low-sulfur coal have been mined from the Cabannis Subgroup near Perry, but no significant reserves are presumed present within the project area.

(6) Pleistocene and Recent Deposits. Overlying the irregularly weathered bedrock surfaces are unconsolidated materials of Pleistocene and Recent age. These include pre-Illinoian glacial till and subsequent loessal deposits, residuum from the weathered sedimentary formations, and recent alluvium in the floodplains. The unconsolidated materials present in the uplands consist of

weathered residuum from the late Mississippian and Pennsylvanian formations, glacial till, and loess. The residuum is characteristically clayey with chert remnants throughout. The glacial till occurs as a more granular soil, and it, as well as the overlying loess deposits, is not as thick in the uplands as in the lowlands and valleys. The flood plain deposits consist of Pleistocene glacial outwash in the deeper pre-glacial river valleys, overlain by finer recent alluvium. The glacial outwash is primarily gravely sand, whereas the recent alluvium consists mostly of silts and clays.

c. Summary of Geology, The nature of significant economic mineral deposits within the project area makes any protective measures beyond slope or erosion protection unnecessary. Sufficient reserves of fire clay, coal, and other geologic resources are present outside the project area to preclude the exploitation of any deposits within Government property lines. Geologic items of a collectible nature such as the geodes present in the Keokuk Limestone and its weathered residuum, and the rather unique pyritized fossils of the Hannibal Shale may be deemed significant enough to consider them a resource that warrants management.

5.02 ARCHAEOLOGICAL/HISTORICAL

a. The St. Louis District Historic Properties Management Report No. 47, Historic Properties Data Synthesis, Mark Twain Lake, Missouri, September 1995 provides site information to project personnel on the subject of identified archaeological sites, material and remains. The Historic Properties Management Report documents archaeological investigations in the Mark Twain Lake region, prior to impoundment. The pre-impoundment archaeological research in the project region is divided into four phases:

1. 1959-64, the University of Missouri surveyed and excavated archaeological sites under a cooperative agreement with the National Park Service.
2. 1967-68, University of Missouri, under contract with the National Park Service, excavated nine archaeological sites.
3. 1974-May 1977, University of Nebraska, under contract with the U.S. Army Corps of Engineers, St. Louis District, conducted further survey and testing.
4. May 1977 - August 1980, the Cannon Reservoir Human Ecology Project (CRHEP) was executed.

The combined archaeological research efforts performed in the Mark Twain Lake Project area identified over 1500 prehistoric sites and 300 historic sites ranging in age from 12,500 to 100+ years old.

b. In addition to the subsurface remains, a total of 225 historic buildings were evaluated prior to impoundment. Of these, a total of 25, were recorded to standards established by the Historic American Building Survey (H.A.B.S.)

standards. Prior to impoundment, and following completion of the H.A.B.S. documentation, all historic structures were raised and removed from the project area.

c. It is the policy of the St. Louis District to manage historic properties at the same level as other programs (i.e. recreation, wildlife, flood control, etc.). The St. Louis District Historic Properties Management Plan, Mark Twain Lake, September 1994 serves as a reference to assist lake personnel in managing identified cultural resources and meeting federal regulations concerning cultural resource management.

5.03 ECOLOGICAL CONDITIONS

a. Wildlife Resources. The wildlife species known or expected to occur on the Mark Twain Lake area are those common to the region in general. The land and its plant association support an upland game population, predators and a variety of non-game mammals and birds. Although the project is located in the Mississippi Flyway, the major flights of waterfowl normally pass down the Mississippi to the east and the Grand River to the west. There are; however, sufficient numbers of waterfowl using the lake to have a huntable population. Some "threatened" or "rare and endangered" species do occur in the area; these are discussed in Section 6.13.

Wildlife population limiting factors at Mark Twain Lake appear to be minimal. The project lands surrounding the lake encompass some of the best upland habitat in northeastern Missouri. The ratio of open land to forest cover creates the desirable edge effect. Food and cover are both abundant and well-interspersed. Woodlots, lake shore, timber and brushy field borders furnish all the requirements necessary to support viable wildlife populations. The presence of the lake benefits some species. For example, flooded timber in the tributary streams furnishes nesting and brood rearing sites for wood ducks. Many more shorebirds and waterfowl utilize this area than ever before.

The Corps has designated and manages 14,536 acres of land exclusively for fish and wildlife purposes at Clarence Cannon Dam and Mark Twain Lake, Missouri. In 1978, the MDC notified the St. Louis District that they could not accept a license at the project for fish and wildlife management. Accordingly, the St. Louis District has accepted the responsibility to implement and manage the program with its personnel and resources. Land management procedures on public lands benefit many of the species present and attract other species to the area. Such procedures are beneficial to songbirds, game birds, and mammals. Trees and shrubs have been and will continue to be planted to provide nesting cover and food for all wildlife species. Wildlife food plots varying in shape, size and species composition are planted in areas to increase available foods for wildlife. Succession control in the form of mowing, disking, and prescribed fire eliminates woody plants while providing diversity

among herbaceous plants, in contrast to adjacent untreated areas. Nest boxes provide additional nesting spaces for wood ducks, purple martins, house wrens, tree swallows, bluebirds, and squirrels. Together, the private farms and the public wildlife areas provide a proper balance of food and cover for wildlife over much of the project. Nine wetland sub-impoundments have also been developed to provide for waterfowl management. These areas are managed by periodically manipulating water levels to provide resting and feeding areas for migratory waterfowl. Areas that are in the agricultural lease program provide additional food and cover for waterfowl and other wildlife species. Civic and private organizations in partnership with the Corps of Engineers assist in the development of structures beneficial to all wildlife on public lands.

b. Aquatic Resources. The impoundment of Mark Twain Lake has caused a decrease in fast-water adapted fish species, and has caused an increase in slow-water adapted fish species. Species found in the lake pool include: black bass, white bass, crappie, bluegill, some species of catfish, most species of sunfish, some species of minnows and shiners, some suckers, gars, drum, gizzard shad and carp. The tailwater downstream of the re-regulation dam yields sizable concentrations of crappie, white bass, channel catfish, walleye and bluegill.

The Mark Twain Lake Project Office coordinates with the MDC on the management of the fisheries resource at the project area. Water regulation aspects at the project having a potential effect on fish include (1) water level fluctuations governed by annual precipitation patterns and power generation demands (2) a weir at the front of the dam that keeps the water released through the turbines close to the natural river temperatures, (3) tainter gates used during high water periods and a concrete apron with force diffusers, and (4) a re-regulation dam that impounds a 9.5 mile pool downstream from the main dam to provide storage for pump-back power generation. The re-regulation pool has a potential fluctuation of 7 feet.

To support fisheries habitat, standing timber was left in coves, along some shorelines, and portions of the main lake basin. The lake's fish population is periodically sampled and evaluated by MDC, with age and growth rates of key species determined annually. Periodic checks of reproductive success are made with a comprehensive sample being taken in the fall. In the future, if large numbers of commercial fish species reach a marketable size, a limited commercial fishing program may be considered. However, such a program would utilize that portion of the fisheries not highly desirable or susceptible to sport fishing. Predator species not showing adequate survival or contribution to the creel will not be considered for future supplemental stockings. Species important to the creel in early years and subsequently diminishing will be stocked as fry or fingerlings on a regular basis. As the lake ages, it is expected that the lake's predators will establish an equilibrium between themselves and the prey species. The more prolific predators will expand to their reproductive

potential and become the dominant species. Other predators that are limited by lower reproductive potential or food availability will have a lower standing crop. The white bass can be expected to expand slowly at first, but will probably become a close competitor with the black bass and crappie as a co-dominant species in later years. The catfish species that are stocked will be native species that can be expected to sustain their populations as the lake ages.

The Corps of Engineers developed and operates a brood pond in the Sandy Creek Area of Mark Twain Lake. It is a 3.5 acre nursery pond, supported by two minnow ponds. The purpose of the pond is to raise game fish, such as large-mouth bass, to a size where they are less vulnerable to predation. The water level within the brood pond is controlled by a spin-gate structure, which when opened, allows water to pass through the impoundment structure and into a catch basin.

c. Vegetative Resources. Prior to construction of the lake, about half of the present fee-owned project land was forested. The majority of this land was located above the lake pool elevation. The white oak-black oak-northern red oak (Forest Cover Type No. 52) is the most common association on upland sites. The white oak association (Forest Cover Type No. 53) also occurs frequently. Shagbark hickory comprises a substantial stocking on most upland sites. Dominant trees include white oak, northern red oak, and black oak. Hickory spp. and Ash spp. usually occupy the co-dominant or intermediate class. Sugar maple, elm, black cherry, red bud, flowering dogwood, and serviceberry are the predominant understory species. Understory shrub species include fragrant sumac, corralberry, greenbriar, and various forms of shade tolerant grasses.

Successional or invasional species that occur in the openlands include eastern red cedar, elm, sassafras, shingle oak, autumn olive, and honey locust. Herbaceous or woody shrub invasional species include blackberry, multi-flora rose, and sumac.

Flood plain forests of the Salt River basin are predominately silver maple and American elm (Forest Cover Type No. 62); however, local variations do occur in the area with such species as eastern cottonwood, sycamore, river birch, pin oak, green ash, persimmon, hackberry and black willow being common.

Although about half of the fee lands are forested, there is a significant portion in grassland or openlands. Openlands are comprised of cool season/forb grasslands, warm season native prairies, agricultural lands, and early to mid-successional fields. Openlands are managed through various means to provide diverse wildlife habitat. Mechanical manipulations (mowing, successional disking, supplemental food resource development), agricultural lease, and prescribed burning are employed to manage and maintain open

lands. Even with these practices, portions of open land have reverted to natural succession with the invasion of such species as hawthorn, blackberry, elm, oaks and sassafras.

d. Insect and Vector Problems. For the most part, insects and other vectors are kept in ecological balance. At certain times of the year, mosquito problems arise when the area receives a combination of wet, warm weather. In Missouri, diseases such as St. Louis and eastern equine encephalitis are a potential threat each year, but the much-publicized West Nile encephalitis has overshadowed them recently. West Nile virus was first discovered in the United States in New York City in 1999 and spread to other states in the Northeast and along the Atlantic seaboard during 2000. West Nile virus invaded the Midwest in 2001, and by the fall of that year had been identified in eight crows in eastern Missouri.

The life cycle of these mosquito-borne viruses is complex. Reservoirs include wild and domestic birds, small rodents and other mammals, and perhaps even reptiles and amphibians. Vectors for these viruses include mosquitoes that feed on both birds and mammals. Horses and humans are accidentally infected when the level of virus activity in normal hosts becomes so great that it begins to "spill over" into other species.

Ticks can potentially transmit Rocky Mountain spotted fever, tularemia and lyme disease. In the past, none of these diseases have been a major health problem in the area. Other pests found in the Salt River Basin are chiggers, horseflies, leeches, and yellow jackets. Occasionally, rats present a minor problem in recreation areas where litter or food is overly abundant. Periodic checks of levees and dams on the project are conducted to survey for damage caused by ground hogs and other burrowing rodents that can weaken these structures. Pigeons roosting on the dam can create a health hazard and maintenance problems on the metal portions. There are no known significant adverse effects of any pest control programs now being carried out. Pest control programs are closely coordinated with appropriate-agencies to insure that the environmental effects are adequately considered. Pest control programs are discussed in detail in the OPERATIONAL MANAGEMENT PLAN.

5.04 ENVIRONMENTAL AND SCENIC QUALITIES

a. Geologic Qualities, The site of the Clarence Cannon Dam is on the Salt River in northeastern Missouri, 63 river miles west of the Mississippi River. Mark Twain Lake is principally located in Ralls and Monroe Counties, and at normal pool extends 34 miles upstream on the North Fork of the Salt River, which is the main stem. The highest altitudes in the project area are on the flat upland divides, which reach a maximum altitude of about 780 feet. The local relief is about 100 feet along the major tributaries and increases to about 200 feet along the main stem. The sides of the major valleys are dissected by short tributaries

whose gradients extend from the flat upland to the valley bottoms; and the divides between these tributaries form a continuous belt of hills along either side of the major valleys. The Salt River and its major tributaries flow through meandering valleys bordered by steep rocky walls. Nearly all the valley meanders occur where the valleys are incised into limestone strata of the Mississippian age, or, near the Clarence Cannon Dam, into limestone above and below shale. An unusual feature of the valley bottoms along the Salt River is their great variability in width that is now reflected in the variable width of Mark Twain Lake.

b. Vegetative Qualities. The vegetative types are discussed in paragraph 5-03c. These different vegetative types combine to form moderate scenic qualities.

c. Land-Uses. Land management on project lands is, for the most part, complementary to scenic qualities. The majority of the adjacent lands are forested, but there is also a significant portion in open land.

d. Water Quality. The current water quality monitoring program is conducted every six weeks between the months of March and October. There are a total of ten samples collected, four lake sites, four tributary sites, one just below the dam and one below the re-regulation dam. These samples are taken to provide information on the following water quality parameters: alkalinity, total organic carbon (TOC), metals, ammonia-nitrogen, nitrate-nitrogen, ortho-phosphate, total phosphate, total suspended solids (TSS), total volatile suspended solids (TVSS), fecal coliform, pH, dissolved oxygen, specific conductance, oxidation-reduction potential (ORP), chlorophyll, pheophytin-a, sulfur bacteria, atrazine and alachlor. Data evaluated for the period from 1984 through 2000 indicate an improving to stable trend of water quality within Mark Twain Lake. Of the seventeen parameters measured, six indicate improved water quality, four are stable and seven suggest a possible degrading trend. The parameters that indicated improvement or remained stable are alkalinity, ammonia, nitrate, total suspended solids, volatile suspended solids, alachlor, and orthophosphate, phosphate, chlorophyll and atrazine. The parameters that suggest a degradation of water quality are: total organic carbon (TOC), iron, manganese, silica, pheophytin, dissolved oxygen and pH. The degrading water quality parameters of iron, manganese, TOC and silica are minor and may have been impacted by the 1993 and 1995 flood events. Pheophytin is increasing with the age of the lake, but is not at levels that would be considered excessive for good water quality. Data of the above degrading parameters over the past 3 years indicate a return to a more stable condition. Dissolved oxygen and pH both have decreasing trends in the lake system. The trends are minor, but should not be disregarded. Wastewater from industry or the general population could be impacting the oxygen demand and pH of the lake. The current trends do not pose an immediate threat to water quality, but should be monitored to determine if conditions continue to degrade.

In previous years this lake was considered impaired based on the criteria that it exceeded Missouri Water Quality Standards for atrazine. In the past few years atrazine levels have decreased and the lake is scheduled for removal from the state's 2002 303(d) list.

Water quality reports are written and submitted to each Corps lake on a five-year cycle. An annual division water quality management report is also submitted.

The Missouri Department of Natural Resources has established water quality standards for designated uses to adhere to the Missouri Clean Water Law and the federal Clean Water Act. The water quality sampling conducted reflects the minimal parameters needed to indicate if the water quality can sustain adequate plant and animal life and to ensure safety for human recreation.

e. Visual Qualities. The combination of features listed in the above paragraphs form the overall visual qualities of lake area. For Mark Twain Lake, the overall esthetic qualities are moderate. The primary reasons for this are the moderate relief topography, exposed rock, the interspersion of forest and open land constituting the majority of adjacent land, and moderately turbid waters.

5.05 RECREATION

a. Recreation Development Description. Several areas have been developed at Mark Twain Lake for the visiting public to enjoy a variety of outdoor recreational experiences. The most common activities engaged in are fishing, boating, and water skiing, sailing, camping, picnicking, swimming and hunting. Developed facilities available at the lake include a visitor center, four campgrounds, three group camping areas, five picnic areas, twenty-one boat launching areas, five nature trails, two marinas, and three beaches. Hunting and fishing opportunities are available on all Corps of Engineers lands and water except where restricted due to recreational development or safety. (Section VIII presents a complete description of all recreational facilities.)

b. Effects of Recreation on the Environment. The development of recreational facilities and associated accesses has provided visitors with quality outdoors recreational opportunities with minimal effect on the environment. Campgrounds, picnic areas, boat ramps, etc. have been designed and developed in order to retain the outstanding esthetic quality on the lake and surrounding area. Waste collection and treatment is stringently regulated in compliance with state and local regulations. Recreation management including regulating visitor use has kept site deterioration to a minimum. Vegetative and landscape management practices have controlled erosion and prevented potential environmental degradation. Developed roads and hunter fisherman

parking areas have controlled off-road vehicle use while providing visitors with access to trails and underdeveloped wooded areas with minimal environmental impact.

SECTION VI - FACTORS INFLUENCING AND CONSTRAINING RESOURCE DEVELOPMENT AND MANAGEMENT

6.01 GENERAL LAND AND WATER CONSTRAINTS

a. The topography at Mark Twain Lake reaches a maximum elevation of about 780 feet NGVD in the southwestern portion of the project to a minimum of approximately 520 feet NGVD along the main stream of the Salt River. The North Fork, Middle Fork, Elk Fork and South Fork are the main tributaries of the Salt River within the project boundaries and have a maximum elevation of 675 feet NGVD in the western part of the project. The sides of the major valleys are dissected by short tributaries whose gradients extend from the flat uplands to the valley bottoms. The divides between these tributaries form a continuous belt of hills along either side of the major valleys. The land adjoining the project is relatively flat farmland.

Soil surveys have been prepared by the United States Department of Agriculture – Natural Resources Conservation Service (NRCS) for the counties encompassing Mark Twain Lake (Ralls and Monroe, Mo. Counties). Engineering as well as other land use interpretations for each soil unit encountered in the respective counties are included in these soil surveys.

The predominant soil units within the project area are the Armstrong-Leonard Association and the Goss-Gorin-Lindley Association. The Armstrong-Leonard Association is composed of the Armstrong and Leonard soils. The Armstrong soils are moderately to strongly sloping. They are well-drained dark gray to dark brown mottled lean and fat clays. The Leonard soils are moderately sloping, poorly drained gray lean clays. Minor soils in the Association are the well-drained, moderately steep Lindley soils and the well-drained, steep, Cherty Goss soils. These soils are on narrow ridge tops and steep side slopes. The Goss-Gorin-Lindley Association is composed of the Goss, Gorin and Lindley soils. The Goss soils are steep, well-drained, cherty clays and silts. The upper portion is typically very dark gray and brown. The subsoils are usually reddish to yellowish brown. The Gorin soils are moderately sloping and are on ridge tops above the Lindley soils. The Gorin soils are poorly drained gray to brown silty clays. The Lindley soils are steep well-drained soils on narrow ridge tops. The surface layer is dark gray to brown clay and the subsoils are yellowish brown clays. The minor soils in this association are the well-drained, nearly level Cedargap soils; the moderately well-drained, moderately sloping to strongly sloping Armstrong soils; the poorly drained, sloping Calwoods soils; and the moderately well drained, strongly sloping and moderately steep Gosport soils. The Cedargap soils are on narrow ridge tops and on side slopes

in positions higher than those of the Goss and Lindley soils. Gosport soils are in positions similar to those of the Goss soils.

The soils of the area present several problems. They are erosive particularly when the shoreline of the lake is subjected to periods of high water combined with windy conditions. Bank erosion and caving can occur. Many of the soil deposits are in an area of glacial origin, and include rocks and boulders of large to moderate size at or immediately beneath the ground surface. These conditions can complicate foundation and utility trench design and placement, thus requiring additional expense.

b. Water Constraints The lake level may rise or fall depending upon the natural factors of flood and drought. During flood control operations, the level of the lake is allowed to rise so that the adverse effect of flooding to downstream areas can be minimized.

6.02 DEMOGRAPHIC DATA

The following is a brief economic and demographic analysis of Monroe and Ralls Counties, Missouri. The combined area is located northwest of the St. Louis, Missouri - Illinois Standard Metropolitan Statistical Area (SMSA). This investigation will focus on a statistical analysis of past, present and future trends of counties mentioned above. TABLE 6-1 and FIGURE 6-I reveal a 4.2 percent decrease in population for Monroe County and an 8.0 percent increase for Ralls County from 1980 to 2000. Both counties exhibited a downward trend at the time of the 1990 Census. The study area as a whole experienced a decrease in population of about 2.0 percent for this period.

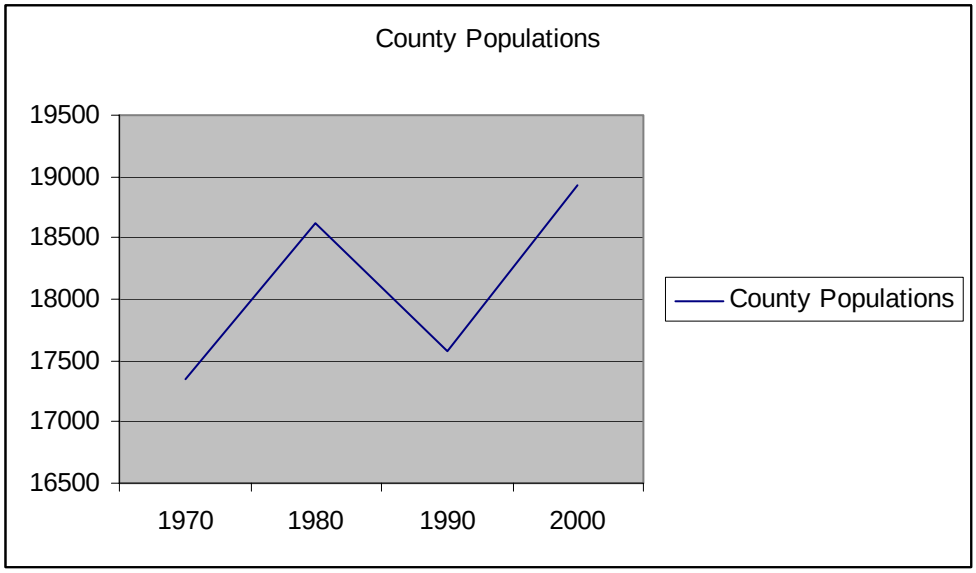
TABLE 6-1 COUNTY POPULATIONS BY DECADE

	2000[1]	1990[1]	1980[2]	1970[2]
Monroe County	9,311	9,104	9,716	9,499
Ralls County	9,626	8,476	8,911	7,846
TOTAL	18,937	17,580	18,627	17,345

[1] Missouri Census Data Center; Missouri (Counties, Places Metropolitan Areas); May 2001.

[2] U.S. Department of Commerce, Bureau of the Census; 1980 Census of Population; General and Social Economic Characteristics – Missouri; April 1980.

FIGURE 6-1 - COUNTY POPULATIONS - COMBINED POPULATION TRENDS OF RALLS AND MONROE COUNTIES

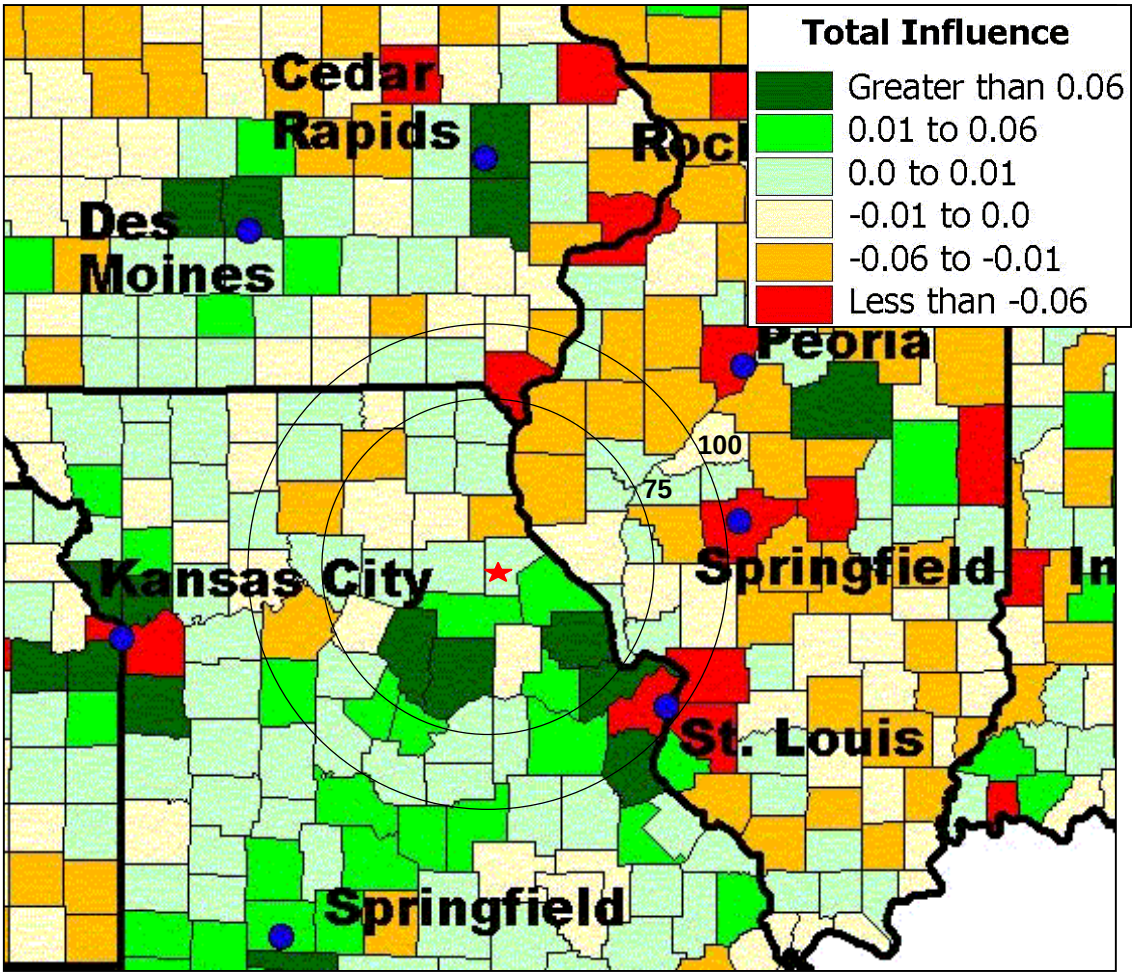


6.03 AREA OF INFLUENCE

a. General. A 100-mile radius of influence, centered on the dam site, has been adopted for purposes of this Master Plan. The area of influence shown in Figure 6-2 encompasses 37 northeast Missouri counties, 19 western Illinois counties and 8 southeastern Iowa counties. The St. Louis SMSA is located in this zone of influence and represents the majority of population and industrial concentration. The remainder of the area is substantially agriculture. Excluding St. Louis City and County, 79.7 percent of all land in 1980 was designated as farmland. This land use percentage attributed to farmland decreased to 77.2 percent in 1990.

The economic influence of counties in the Midwest Region of the U.S. between 1995-2001 was presented in reports developed by the Missouri Economic Research and Information Center, Missouri Department of Economic Development. A county's economic influence is a composite of changes in employment, population and income, and the percentage of a region's economy held by a county. Two very strong areas of economic influence are located in the Columbia, Missouri area and the St. Charles, Missouri area. See Figure 6-2 below for a map showing economic influence by county. Future efforts at marketing the lake may be directed to these areas.

FIGURE 6-2 Zones of Influence and Economic Influence of Counties



b. Industries. Although the manufacturing sector of the economy employs the greatest percentage of people in the area, manufacturing employment decreased 12.0 percent between 1980 and 1990. The service industry, on the other hand significantly increased employment by 14.6 percent for the same period. This trend mirrors the national trend towards increased employment opportunities in the service sector. The predominant manufacturing industries in the area of influence involve the manufacture of air and spacecraft, metal and metal products, chemicals, and refining and distributing petroleum products.

c. Transportation and Road Network[3]. FIGURE 6-3 portrays the location of Mark Twain Lake with respect to the major highways within the area. U.S. Highway

[3] Market Potential and Feasibility Analysis for Commercial Concession Development at Mark Twain Lake, Parsons Harland Bartholomew & Associates with Fact Finders, Inc., January 2001

24 and State Highway 154 parallel the northern and southern sides of Mark Twain Lake respectively, with State Highway 107 bisecting the Lake and connecting the two highways. Route J parallels the eastern side of the Lake, and crosses over the Clarence Cannon Dam. The Corps of Engineers Operations Center and Visitor Center are located on Route J. U.S. Highway 61, a four-lane divided highway that provides the primary access from the St. Louis Metropolitan Area, is located approximately 15 miles east of the Lake. U.S. Highway 24/36 and State Highways 19 and 154 provide the primary access to Mark Twain Lake from U.S. Highway 61.

FIGURE 6-3 Regional Location Map

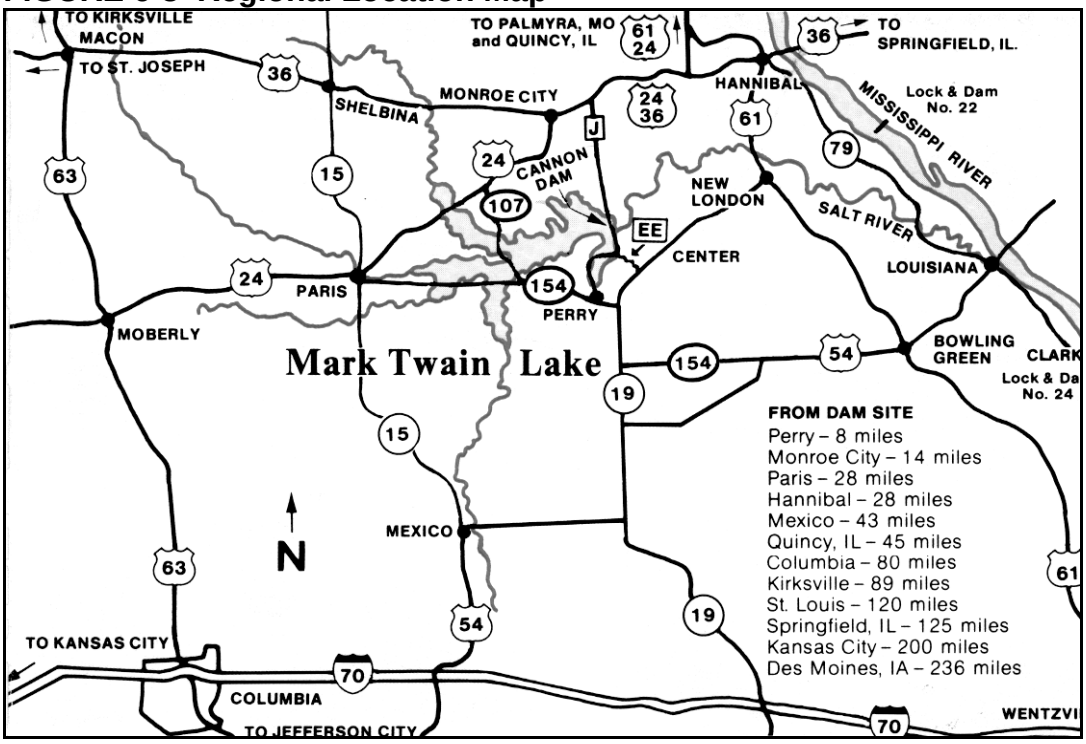


TABLE 6-2 Daily Traffic Count (ADT) Trends, 1990-1999[1]			
Highway Segment/Location	1999	1995	1990
U.S. Highway 61 @ State Highway 19	11,075	7,985	6,888
State Highway 19 @ Highway H-P	3,826	3,008	2,450
State Highway 154 @ Routes J-B	2,305	2,604	1,814
State Highway 154 @ State Highway 107	982	1,000	850
U.S. Highway 24 @ Route J	5,971	5,418	4,463
Route J @ U.S. Highway 24-36	1,182	1,370	1,076
Route J @ Route A	1,535	1,782	1,398
State Highway 107 @ U.S. Highway 24	452	258	294
State Highway 107 @ Route U	836	418	412

[1] Includes bi-directional traffic.
Source: Missouri Department of Transportation, Office of Transportation Management Systems.

TABLE 6-2 provides a summary of the daily traffic count trends on the above highways in the immediate vicinity of Mark Twain Lake during the 1990-1999 period. Major traffic movement within the area is on U.S. Highway 61 on which traffic increased by 60 percent during the 1990-1999 period. Traffic on the major feeder highways from U.S. 61 to Mark Twain Lake has also increased during this period, with increases of 56 percent on State Highway 19 and 33 percent on U.S. Highway 24. However, as indicated in TABLE 6-2, daily traffic volume on the roads immediately adjacent to Mark Twain Lake has not increased substantially during this period. For example, daily traffic volume on Route J – a major center of activity on Mark Twain Lake – increased by only 10 percent during this same period. Overall daily traffic volume on State Highway 107 at Route U – the central point of Mark Twain Lake State Park – is approximately equal to one-half the daily volume on Route J, with about twice as much traffic coming from the south as from the north.

There are no short-range major highway improvement projects funded or planned for the immediate Mark Twain Lake area. State Highways 19 and 54 were on the Missouri Department of Transportation's 15-Year Plan for a 4-lane improvement, but the lack of funding has resulted in this plan being modified or postponed.

6.04 ECONOMIC CHARACTERISTICS

Manufacturing, services, retail trade and agriculture comprise the major employment sectors in Northeast Missouri. Total full-and part-time employment in the more immediate area of Monroe and Ralls counties totaled 9,481 in 1998, of which 22 percent were engaged in manufacturing; 19 percent in agriculture or farming; and 17 percent each in retail trade and services. Employment within Monroe and Ralls counties has increased 17 percent since 1990, approximately equivalent to the relative employment increase for Northeast Missouri, and exceeding the 14 percent statewide employment increase.

Employment directly associated with Mark Twain Lake and Mark Twain State Park includes employees of the U.S. Army Corps of Engineers, State Department of Natural Resources, Missouri Water Patrol, and the commercial concessionaires. The Corps of Engineers has 26 full-time employees with additional part-time summer employees, while the State Department of Natural Resources has seven full-time employees with additional part-time summer employees. The Missouri Water Patrol usually employs three/four seasonal employees for lake patrol. In addition, the Blackjack and Indian Creek marinas together have approximately 55 employees during the boating season (April–October), with a skeleton staff the remainder of the year.

6.05 ACCESSIBILITY

a. Major Highways. Major highways providing access to Mark Twain Lake are U.S. Highway 24 to the north and west, State Highway 154 to the south and

State Highway 19 to the east. State Highway 107 runs north from Highway 154 bisecting the lake and ending at Highway 24. These highways provide the public with safe and adequate access to all areas of the project.

b. County Roads. Local county authorities are responsible for the maintenance of several off-project roads that provide the public with access from major highways to recreation areas. The condition of these roads varies, however, most can be considered as adequately maintained. The following roads with access descriptions are the primary routes of travel used by the visiting public.

(1) State Route J from Highway 154. This road provides access to the Ray Behrens, South Spillway, John C. “Jack” Briscoe, North Spillway, Frank Russell, and John Spalding Recreation Areas, as well as the Mark Twain Lake Project Office. Ralls County.

(2) State Route EE from Highway 19. This road leads from Highway 19 west to Route J. Ralls County.

(3) State Route BB from Route J. This road leads to Route BB boat ramp; Hunter Fisherman Access 60. Ralls County.

(4) John F. Spalding Access Road (Old State Route J) from Route J. Leads to John F. Spalding Recreation Area. Ralls County.

(5) State Route N from Highway 24. Leads to Route N Boat Ramp, Hunter Fisherman Access 11. Monroe County.

(6) State Route HH from Highway 24. Leads to Indian Creek Access Road and Shell Branch Recreation Area, Hunter Fisherman Access 15. Monroe County.

(7) Indian Creek Access Road (County) from State Route HH. Leads to Indian Creek Recreation Area. Monroe County.

(8) State Route U from Highway 107. Leads to Mark Twain State Park and Historic Area. Monroe County.

(9) Robert C. Allen Access Road (County) from Highway 154. Leads to Robert E. Allen Recreation Area. Monroe County.

6.06 RELATED RECREATIONAL AND HISTORICAL AREAS.

The Mark Twain Lake Project is the primary source of outdoor recreational activities for the area. Hunnewell Lake administered by the Missouri Department of Conservation and the Route J Reservoir run by Monroe City are the two closest lakes to Mark Twain Lake and both lakes are very small. Although these have camping, picnicking and boating opportunities, they do not compete nor compare to the opportunities offered at Mark Twain Lake. The Mississippi River is approximately 30 miles from Clarence Cannon Dam and provides the public with numerous outdoor recreational opportunities on a large river environment. Hannibal, Missouri, located 28 miles northeast of Clarence Cannon Dam, is the site of Mark Twain's Boyhood Home. A shrine commemorating the birthplace of Mark Twain is located on Mark Twain State Park lands near Florida, Missouri. These two historical areas provide visitors to the lake with supplementary points of interest.

6.07 RESERVOIR PLAN OF REGULATION

Operational concepts and plan of operation for Mark Twain Lake are explained in Paragraph 2.03.

6.08 RELOCATIONS OF ROADS, CEMETERIES, RAILROADS, AND UTILITIES

a. Highways.

By authority of a one time approval by OCE, the top of pier elevations for State Highways were set relative to the flood of record at 640.0 feet NGVD. Elevations for County roads were determined by the classification of the particular road and minimum elevations vary between 626.0 feet NGVD and 636.0 feet NGVD. The general policy used in the plan of relocation was to maintain the continuity of the existing road network on each side on the reservoir and to provide access to remaining properties and residences adjacent to the reservoir substantially equivalent to that which they previously had.

b. Railroads.

Operations on the Mark Twain Lake project affected the Norfolk and Western Railroad system at two locations. It was required that the track be relocated in the general vicinity of Stoutsville, Mo. One section of track was relocated to the north of the old alignment beginning at a point approximately 1,900 feet west of the North Fork Salt River crossing and extending eastward through Stoutsville, MO and northward to a point approximately 100 feet north of U.S. Route 24. Another section of track was relocated to the south of the old alignment extending 3,400 feet west and 2,400 feet east of the Otter Creek crossing. These sections of track were relocated with base of rail at minimum elevation 644.5 feet NGVD. The relocation involved the reconstruction of the bridges over the North Fork of the Salt River and Otter Creek to a low steel elevation of 638.5 + and 642.0 feet NGVD respectively. In addition to the above relocations, the end cones of the embankments at each abutment of the Burlington Northern Railroad Bridge at the North Fork River crossing were protected from pool effects by the addition of riprap on the end cone slopes.

c. Utility Lines.

(1) All major power and telephone facilities within the limits of the conservation pool have either been relocated or removed except for two large power lines. A 69 KV transmission line, owned by Northeast Missouri Electric Cooperative, crosses the project limits immediately downstream of the main dam. A second 69 KV transmission line, owned by Central Electric Power Cooperative, crosses the project just below the South Fork Recreation Area.

(2) In general, clearances are not less than those outlined in the National Electrical Safety Code for all affected by the reservoir.

(3) Two 12-inch diameter Amoco pipelines and a 6-inch diameter Monroe City natural gas pipeline cross the Salt River downstream of the Main Dam and

spillway. All three pipelines were relocated to allow the channel to be widened for hydropower operation. Relocation consisted of new pipe materials and concrete weights below elevation 530.0 feet NGVD that was equivalent to existing facilities. The original pipes and weights were removed from the site.

d. Cemeteries.

Thirty-four cemeteries were affected by the development of the Clarence Cannon Dam and Mark Twain Lake project. Of this total, thirty-three were located within project limits while one was located immediately outside project limits. Twenty-three cemeteries required relocation, seven cemeteries were provided with protective fencing, and four cemeteries were left in their existing condition. Cemeteries that required relocation involved approximately 500 burials. All cemeteries where the ground surface was below elevation 642 feet NGVD were relocated to put them above the lake level that would result from a standard project flood. Cemeteries located within the vicinity of limited recreation development above the 642 feet NGVD elevation were left in place and fenced. Cemeteries located at or above elevation 642.0 feet NGVD, but on Government lands planned for extensive recreational development were also relocated.

6.09 EARTH BORROW AND DISPOSAL AREAS

The project has four major disposal areas within its boundaries. One of the areas is inundated by the lake. Two of the sites are immediately downstream of the dam along the exit channel. These sites are now recreation areas with roads, parking and boat launching facilities. Two other sites have been re-vegetated. One of these sites is located near a water tower just off County Road J where it crosses the lake and the other location is downstream of the exit channel. These sites can be developed, however, subsurface conditions can have extreme variations (boulders, rocks, debris, etc.) and cause additional design and construction costs. Any development such as parking lots, roads and buildings should consider the past use of the land, loads, potential settlements, and excavation techniques required (boulders, rocks, etc.). Disposal areas should be investigated thoroughly before development.

6.10 WATER QUALITY

The affect of coal strip mines, soils of high clay content, and non-point source runoff causes the watershed to have elevated levels of sulfur, iron, nutrients, and colloidal suspended solids. The reservoir has a shallow photic zone, very shallow epilimnetic zone, high algal productivity, and extremely stable stratification. This causes the lake to be eutrophic with an extreme oxygen deficiency within the hypolimnetic waters. The water temperature control weir appears to function as designed during periods of power generation. However, evacuation of the forebay upon start-up of turbines causes water of poor quality to be released into the re-regulation pool.

Releases from the re-regulation dam had caused downstream problems in the past. Stop logs placed in one gate to act as a skimming weir were used as a temporary cure for downstream problems. A fluctuating intake that changes in conjunction with pool elevation to allow upper level water of good quality to be released downstream was installed in November 1988. This structural modification has provided adequate downstream water quality.

The lake water met state standards applying to primary and secondary contact recreation for the purposes of swimming, boating, fishing and water skiing. The lake appears to be a suitable source for drinking water, both presently and in the future, with the possible exception of taste and odor problems associated with algae. The project area has several pollution potentials, but now no major form of degradation to the lake or streams is apparent. In accordance with an agreement with the Missouri Dept. of Conservation, the pool elevation will be maintained at a constant to slowly rising level during the time of shad and bass spawns if possible, to avoid desiccating the eggs. Water quality monitoring will continue at various locations throughout the watershed to protect human health, public safety, and economic welfare of those at Corps projects, to insure downstream water quality, and to protect the district from litigation and adverse public reaction. Annual Water Quality Reports are written in accordance with ER 1110-2-8154 (Water Quality and Environmental Management for Corps Civil Works Projects) 31 May 1995 and submitted to Division.

6.11 FOREST, MINERAL, AND WATER RESOURCES

The pre-project exploitation of mineral and timber resources near the project area was not considered detrimental to public use and enjoyment of the resource base, nor does it constrain or influence resource development and management.

a. Timber Resources. Major forest types of commercial value found within the project area are oak-hickory, and bottomland hardwoods. At present the timber resources can be classified as poletimber or immature sawtimber. The existing timber quality is a direct result of past land management practices prior to purchase. There is, however, the potential to support local mills with limited intermediate cutting practices, establishing a solid timber base for future planning.

(1) The Oak-Hickory Forest Type. The white oak-black oak-northern red oak (Forest Cover Type No. 52) is the most common association on upland sites. The white oak association (Forest Cover Type No. 53) also occurs frequently. Shagbark hickory comprises a substantial stocking on most upland sites. Dominant trees include white oak, northern red oak, and black oak. Hickory spp. and Ash spp. usually occupy the co-dominant or intermediate class. Sugar maple, elm, black cherry, red bud, flowering dogwood, and serviceberry are the

predominant understory species. Understory shrub species include fragrant sumac, corralberry, greenbriar, and various forms of shade tolerant grasses

(2) The Bottomland Hardwoods Forest Type. Flood plain forests of the Salt River Basin are predominately silver maple and American elm (Forest Cover Type No. 62); however, local variations do occur in the area with such species as eastern cottonwood, sycamore, river birch, pin oak, green ash, persimmon, hackberry and black willow being common.

b. Mineral Resources. No economic deposits of metallic minerals occur within the project area; however, there are other deposits of economic or potentially economic grade resources within the reservoir area. These include fire-clay, limestone, sand and gravel, and coal.

(1) Fire-Clay. The Cheltenham Clay is the chief source of high-grade ceramic clay in the region, and is known to occur within the project area, and adjacent uplands. At present, clay is only being produced locally in the Goss area, approximately 14 miles west of the dam site. These deposits generally occur at elevations above maximum flood pool; however, it is possible that some of the clay pits may be deep enough to be impacted by prolonged periods of high pool. Sump pits in some of the excavations are below maximum flood pool, but it is believed that seepage into these pits from the reservoir will be minimal due to the short periods of high water and natural topographic boundaries between the pits and the reservoir.

(2) Limestone and Gravel. Limestone is suitable for use as flagstone. Crushed stone is common in the reservoir area and outcrops are numerous. To be commercially useful limestone should be chert free with relatively shallow overburden, accessible to transportation, and relatively free of impurities. The potentially economic limestone units within the project area are the Chouteau and the lowest portion of the Burlington Formations. There are a few limestone quarries in the area, but no known active quarry will be impacted by even extended periods of maximum pool. The quarry previously operated by the State of Missouri for resurfacing Highway J is now inundated by the reservoir.

(3) Sand and Gravel. There were, at the time the dam was under construction, several producers of sand and gravel operating in the project area. Production of sand and gravel is generally accomplished by locating a suitable bar or deposit in the riverbed, and removing the material by dragline or similar procedure. After depletion of the deposit, or location of more economically exploitable deposits elsewhere, the operation is moved. The worked sites are sometimes replenished during seasonal periods of high water, and may be reworked following sufficient re-deposition. The completion of the dam and reservoir has virtually eliminated this cycle of replenishment, to the extent that production will be limited to existing deposits downstream of the dam without significant renewal. Because of the method of operation, all of the areas upstream of the dam have been impacted by the reservoir. Those areas inundated by the pool are no longer accessible to exploitation.

(4) Coal. There are no economic coal deposits known to exist within the reservoir area; however, there have been small coal strip mining operations on lands near the project area southeast of the reservoir. The mining has been of low sulfur coals in the discontinuous Pennsylvanian Cabannis Subgroup. Minor discontinuous coal seams exist within the reservoir area in the Tebo, Scammon, and Weir cyclothems of the Cabannis Subgroup. These deposits outcrop along some of the tributaries of the Salt River in the southern and western portions of the reservoir area west of Highway 107, along Highway 154. These deposits are found at elevations from 640 to 690 feet NGVD, generally above the maximum flood pool.

c. Groundwater. Groundwater near the reservoir is obtained from several sources. Shallow sources of groundwater include the glacial till and recent alluvium in the valleys of the Salt River and some of the tributaries. Deep sources are the Burlington and other early Mississippian limestones, and the St. Peter Sandstone (Ordovician.) The majority of producing wells on farms in the vicinity are in the Burlington Limestone. Water quality varies with the degree of mineralization. The wells producing from the alluvium generally yield water containing lower mineral content, and consequently better quality water. Many of the wells on farms in the vicinity produce water that is mineralized to the extent that farmers haul water or have cisterns for domestic use. There appear to be three groundwater levels present in the reservoir area, and not all three are necessarily present everywhere.

Well capacity, although not completely a function of well depth, is generally greater in the deeper wells. Shallow-dug wells produce varying amounts of water generally in the range of 1 to 5 gpm. Wells drilled to depths from 70 to 300 feet produce from 5 to 13 gpm, and wells deeper than 300 feet may produce anywhere from 5 to 50 gpm. No negative impact on water quality or well production is anticipated as a result of lake management policy. The impact on groundwater resources from wells and waste treatment facilities associated with recreation areas should be addressed on a site-specific basis.

6.12 RECREATION ATTENDANCE AND FACILITY REQUIREMENTS

a. Existing User Demand. Existing user demand is reflected using 2001 visitation as a basis for computations. Facility requirements are based on current visitation, design criteria, and guidelines detailed in the Institute for Water Resources' Research Report 74-RI (Estimating Recreational Facility Requirements, Volume IV of V). These requirements are oriented toward key facilities that include campsites, picnic units, boat launching lanes and beach area. This planning methodology estimates the number of facilities necessary to satisfy recreation use on an average weekend day during the peak month of visitation.

(1) Facility Design Day Load. This determination represents the anticipated number of users visiting the project on an average weekend day during the

peak month of use. Based on 2001 visitation, the present facility day load is estimated at 26,904. (See TABLE 6-3, Actual and Projected Annual Visitation).

(2) Summary of Existing User Demand. Utilizing the facility design day load, participation rates for each activity requiring facilities, and the appropriate activity turnover rates, the principal recreation facility requirements were estimated. The existing facility user demand estimate is presented in TABLE 6-4.

(3) Summary of Existing Facility Supply. The existing supply of key park and recreation facilities is presented in TABLE 3-1 in Section III. The principal agencies developing facilities at Mark Twain Lake are the Corps of Engineers and the Missouri Department of Natural Resources. The state contributes to the supply of campsites, picnic sites, boat launching ramps, and beaches. Appendix A discusses recreation facility development (existing, proposed, future) by the Missouri Department of Natural Resources.

TABLE 6-3
ACTUAL AND PROJECTED ANNUAL VISITATION IN RECREATION USE DAYS[4] MARK TWAIN LAKE, MISSOURI

Year	Actual
1976	220,536
1977	146,023
1978	295,021
1979	229,300
1980	215,171
1981	139,741
1982	258,057
1983	424,339
1984	665,577
1985	850,700
1986	1,684,372
1987	1,863,104
1988	2,030,000
1989	1,865,980
1990	1,834,157
1991	1,849,844
1992	1,648,429
1993	1,423,489
1994	1,696,376
1995	1,685,983
1996	1,636,607
1997	1,664,087
1998	1,218,199
1999	1,794,386
2000	1,836,028
2001	1,806,966
2002	2,306,286
PROJECTED[5]	
2010	2,282,683
2015	2,485,063
2020	2,687,443

[4] See Table 2-1 for visits and visitor hour data.

[5] Computed using FORECAST equation in EXCEL for the years 1990 – 2002.

TABLE 6-4 PRINCIPAL RECREATION FACILITIES: EXISTING SUPPLY AND DEMAND SUMMARY

Facility	Corps	State**	Total	Existing Demand	Existing Excess(+) /Shortage(-)
Camp Units* (trailer or tent)	465	103	568	740	-172
Picnic Units	90	30	120	112	+8
Boat Ramp Lanes	45	9	54	52	+2
Swimming Beach (Linear feet of shoreline)	1016	300	1316	1345	-29

*Number includes sites able to accommodate trailer and/or tent camping. The hike-in tent camping area at Indian Creek, the tent only area at the Indian Creek Group Use Area, the Hunter/Fisherman Lot sites and the John C. "Jack" Briscoe Group Use Area are not included in this total.
**Number of facilities located on State Park fee title lands.

(4) Evaluation of Existing Supply and Demand

(a) Camp Units - The most critical need for new facilities is for additional camping facilities. Existing supply falls short of demand by 172 campsites as shown in TABLE 6-4. Campsite utilization percentages for Saturday nights averaged by month for the years 2000 through 2002, shown in TABLE 6-5, indicates that camping is on the rise at all three campgrounds.

Plans for additional sites in the Indian Creek Campground were proposed and approved in Supplement No. 7, Additional Recreational Facilities, Design Memorandum, No. 9, the Master Plan, 1982. However, based on current visitor use patterns and trends, the Ray Behrens Campground would be the preferred location to meet this demand.

While these additional campsites would help meet the current demand, growth in visitation is expected, based upon recent visitor use trends. According to these trends and calculations for existing demand for camping units (See Table 6-4), there is a need for planning for facilities in the lake area.

A campsite reservation system was initiated in 1990 to alleviate some of the problems caused by the lack of campsite availability. In 1990, the reservation system was limited to 75 sites in the Indian Creek Campground.

TABLE 6-5

CAMPSITE UTILIZATION PERCENTAGES				
RAY BEHRENS		2000	2001	2002
	MAY	74%	76%	63%
	JUNE	74%	86%	93%
	JULY	83%	72%	92%
	AUGUST	71%	80%	84%
	AVERAGE	**76%**	**79%**	**83%**
INDIAN CREEK		2000	2001	2002
	MAY	58%	51%	46%
	JUNE	55%	60%	62%
	JULY	66%	65%	68%
	AUGUST	53%	60%	64%
	AVERAGE	**58%**	**59%**	**60%**
FRANK RUSSELL		2000	2001	2002
	MAY	49%	44%	40%
	JUNE	35%	53%	72%
	JULY	45%	50%	60%
	AUGUST	38%	52%	54%
	AVERAGE	**42%**	**50%**	**57%**

Because of the popularity of the reservation system, the program has been expanded to include various loops in all three campgrounds.

(b) Picnic Units – Picnic units have been reduced from a total of 310 in the previous Master Plan update to 120 in this plan. The public is not using this type of facility in large numbers except at beach areas where picnicking occurs frequently. The other recreation areas only require a smaller number of tables to meet demand. TABLE 6-4 shows a very small oversupply in picnic units provided as compared to estimated demand.

(c) Boat Launch Lanes - TABLE 6-4 shows an oversupply in the number of boat launch lanes available compared to estimated demand. However, because some of the lanes are located in very remote areas, use is not evenly distributed at all of the ramps and some experience periods of overcrowding.

(d) Swimming Beach Area - TABLE 6-4 shows a small deficit in linear feet of beach available to visitors. However, a large portion of the beach frontage is concentrated in only one public beach area that has already experienced periods of overcrowding. One of the three beaches at the lake is open only to visitors of the Indian Creek campground. Availability of swimming beach area is considered adequate for now.

b. Projected User Demand. Utilizing projected visitation, current planning and design criteria, and the procedures and guidelines outlined in the Institute for Water Resources' Research Report 74-RI (Estimating Recreational Facility

Requirements, Volume IV), the projected recreation facility requirements through the year 2020 were computed and are presented in TABLE 6-6. According to the procedures noted above, deficiencies in the number of camping units and linear swimming beach are indicated. Only minor deficiencies are indicated for picnic units and boat ramp lanes. Further detailed evaluations will be required to substantiate the key facility demand levels identified by this planning methodology.

TABLE 6-6
SUMMARY: PROJECTED RECREATION FACILITY REQUIREMENTS

Facility	2010	2015	2020
Camp Units	829	879	930
Picnic Units	125	133	140
Boat Ramp Lanes	63	67	71
Swimming Beach (Linear feet of shoreline)	1507	1599	1691

6.13 ENVIRONMENTAL AND ECOLOGIC CONCERNS

The need for the continued protection of the project's natural areas is a key concern. Potentially incompatible uses of these areas shall be prohibited.

Project management practices will be used to maximize the support value of the project for fish and wildlife production, while at the same time maximizing recreational opportunities for hunters and fishermen. Waterfowl management objectives will be fully coordinated with other agencies and should be consistent with the North American Waterfowl Management Plan. The lake's future potential for commercial fishing activity should not be over-looked. The Corps needs to continually monitor the lake's water quality, and to alert regulatory authorities of identified sources of contamination and of the need for implementing rectifying measures to control such pollution.

Specific management practices formulated for the project's operations and maintenance will take into account the need to protect and enhance conditions for Federally-listed and state-listed endangered species provided in TABLE 6-7. Additional observations and field study are needed to determine the presence or absence of endangered species. Management practices will also take into account carrying capacities for developed recreation areas. Management and maintenance practices will include regulating visitor numbers and erosion/site deterioration repairs.

TABLE 6-7

FEDERAL AND/OR STATE THREATENED AND ENDANGERED PLANT AND ANIMAL SPECIES KNOWN TO OCCUR OR THAT MAY POTENTIALLY OCCUR WITHIN THE MARK TWAIN LAKE AREA*

Common Name	Scientific Name	State Status	Federal Status
Bald Eagle	Haliaeetus leucocephalus	Endangered	Threatened
Indiana Bat	Myotis sodalis	Endangered	Endangered
Henslow's Sparrow	Ammodramus		Species of Concern
Greater Prairie Chicken	Tympanuchus cupido	Endangered	
Gray Bat	Myotis grisescens	Endangered	Endangered
Wild Sarsaparilla	Aralia nudicaulis	Rare	
Rock Pocketbook	Arcidens confagosus	Rare	
Prairie Dandelion	Microseris cuspidate	Rare	
Ghost Shiner	Notropis buchanani	Watch List	
Hickorynut	Obovaria olivaria	Watch List	
Wartyback	Quadrula nodulata	Rare	
Ditch Grass	Ruppia maritime var rostrata	Extinct	
Meadow Willow	Salix petiolaris	Endangered	
Fat Pocketbook	Potamilus capax	Endangered	Endangered

*Based upon information provided in the Missouri Heritage Database

SECTION VII - RESOURCE USE OBJECTIVES

7.01 GENERAL

The purpose of this section is to define and prescribe a series of resource use objectives for Clarence Cannon Dam and Mark Twain Lake.

Resource use objectives are statements specific to Mark Twain Lake that provide general guidance and direction for the use, development, and management of project resources. The objectives listed below have been determined through study and analysis of regional needs, public input, and resource capabilities and potentials.

As stated in Section I, the authorized purposes for Clarence Cannon Dam and Mark Twain Lake are flood control, hydropower generation, recreation, fish and wildlife conservation, water supply, and incidental navigation. Certain project purposes, by their nature, can be conflicting. For example, under certain conditions, the flood control purpose of the lake can conflict with the other project purposes of recreation and fish and wildlife conservation. The development of sound resource use objectives increases user satisfaction and minimizes conflicts between project purposes through compromises that do not seriously detract from the achievement of any or all project purposes.

Resource use objectives based on project purposes at Clarence Cannon Dam and Mark Twain Lake are identified and discussed in the following paragraphs.

7.02 RESOURCE USE OBJECTIVES

Seventeen resource use objectives, applicable to the project, are presented below. They are formulated to provide general guidance and direction to the overall management and development of Clarence Cannon Dam and Mark Twain Lake resources. The objectives are grouped into three categories: General, Recreation, and Environmental Stewardship.

a. General

(1) Administration and Management. Ensure that quality administration and management of all project lands, waters and other associated man-made and natural resources are consistent and thorough. Seek to continually increase

efficiency, cost effectiveness, and innovation in projects while keeping public use and enjoyment as a goal as well.

(Discussion) All project administrative and management decisions/actions will adhere to all applicable laws, regulations, policies, and agreements. Consistent coordination, both internally and with other applicable federal, state, and local government agencies, private organizations and individuals, will be maintained.

All actions and/or plans will be implemented in a manner compatible with authorized project purposes and all applicable social and environmental factors to insure maximum benefits. Compromise will be used to minimize conflicts in project uses and development.

(2) Regional Economic Growth. Contribute to and develop partnerships with communities, agencies, groups, and individuals with the common goal of lake and regional tourism and economic development in the tri-state area.

(Discussion) The region around Mark Twain Lake is nationally known for being the birthplace and boyhood home of author Mark Twain. An effort to promote and develop upon both the historical significance of the area and recreational opportunities available can be most efficiently accomplished through the joint effort of the Corps and other groups, local communities, and individuals. The continued development of joint projects designed to inform and attract visitors to the region will benefit the entire area. Current associations with interested parties have proven to be very successful. The expansion of these partnerships will continue to increase area tourism and economic growth.

The use of partners to assist with the operation and management of the project will be fully employed. When feasible, donations and the challenge cost-share program will be utilized to accomplish work. Section 225 of Public Law 102-580 grants authorization to the Corps to enter into cooperative agreements with non-federal public and private entities to provide for operation and management of recreation facilities and natural resources at civil works projects. The Corps may accept contributions of funds, materials and services from non-federal public and private entities. The services of volunteers are accepted under PL 98-63 to carry out any activity of the Corps except policymaking or law or regulatory enforcement. Partnerships with the Tri-City Commission, the Missouri Department of Conservation, National Rifle Association, Missouri Equine Council, Mark Twain Lake Chamber of Commerce, Paris Lions Club, and other groups have provided great benefits to the public through additional facilities and special events.

Relationships with our partner agencies and local constituent groups will be maintained and strengthened; volunteers will be utilized maximally and our use of cooperating associations will be continued. If feasible, agreements will

be formed with local cooperating associations to assist with operations related to natural resource management, interpretive and visitor service activities.

b. Recreation

(1) Quality Recreational Experiences. Seek to increase the quality of visitor experiences by maintaining and developing purposeful, functional recreation areas that meet the needs of visitors while maintaining the aesthetic integrity of the environment.

(Discussion) Opportunities to improve the quality of recreation experiences are influenced by carrying capacity, compatibility of activities, and site-specific design factors. An aggressive maintenance program will continue to be used in order to maintain the quality of all recreational areas. Rehabilitation efforts designed to stop environmental degradation and facility deterioration will continue to be a top priority. A management goal will be to provide visitors with diverse and cost-effective recreation opportunities. Efforts will continue to be made to reduce the impacts of pool fluctuations on facilities and public use.

(2) Facility Management. Provide facilities that meet the needs of the visitors to the region. Maintain, develop and alter facilities in order to meet the changing and diverse use patterns of the visitors to the park. As funds become available, renovate and upgrade recreation areas to improve available facilities and reduce maintenance costs.

(Discussion) There is a need for providing visitors with a diverse range of day and overnight recreational opportunities. Four campgrounds, three group camp areas, two tent camping areas and a backpacking area provide accommodations for overnight visitors seeking a diverse range of camping needs. Current efforts are directed to upgrading electrical service to 50 amps and adding full service hookups in the campgrounds to accommodate visitor demand and stimulate visitation to the area. Numerous day use facilities managed by the Corps of Engineers and the Missouri Department of Natural Resources provide visitors with opportunities in boating, picnicking, swimming, and fishing. Two marina concessions provide visitors with additional opportunities. The need for additional concession services including resort and marina developments have been identified through market feasibility studies and efforts will be made to meet this critical demand.

All developed recreation areas designated for recreation use are regularly evaluated for the presence of safety hazards and environmental compliance with the Environmental Review Guide for Operations (ERGO) guidelines. As any detrimental conditions are identified, they will be given priority for evaluating and implementing feasible corrective actions.

(3) Barrier-Free Access. Increase outdoor recreational opportunities for the elderly, disabled, and other disadvantaged groups by providing barrier-free access and special programs to accommodate their needs. Continue to identify, build, modify, and redesign areas/facilities as mandated by Uniform Federal Accessibility Standards (UFAS) and Americans with Disabilities Act Design Guidelines (ADADG).

(Discussion) All persons must be given access to a wide range of outdoor recreation activities through careful and appropriate planning, design and program implementation. Accordingly, consideration is given to accessible facilities and services for disabled persons in the planning, design, and operations of existing recreation areas, and the development of future public use areas at the project. Shoreline fishing access for the physically challenged and the elderly continues to be a need that warrants attention. Efforts are underway to meet this need through the development of a small accessible lake in the Frank Russell Recreation Area and the construction of accessible fishing piers in the North and South Spillway Recreation Areas. Special hunts for the physically challenged are offered to enhance recreational opportunities for these needs.

(4) Visitor Awareness. Continue to expand upon the effective and efficient distribution of project related information detailing availability of facilities, rule and regulation considerations, awareness of land and water safety, and the diversity of recreational opportunities available. Expand upon the range of contact to include locations in Missouri, Illinois, and Iowa where public information contacts have been minimal and the potential exists for market growth.

(Discussion) An Interpretive Services and Outreach Program has been in effect at Mark Twain Lake since the mid 1970's. A project Interpretive plan has been prepared and implemented, and has facilitated the successful operation of the program. The Interpretive Services and Outreach program should play a vital role in enhancing public knowledge and understanding of the Corps, the natural and cultural features of the lake and the surrounding areas, and should promote visitor safety on both land and water areas of the project. The M.W. Boudreaux Visitor Center and an Exhibit Area at the Clarence Cannon Power Plant feature a variety of exhibits highlighting the project and its purposes. The project also features interpretive nature trails, multi-use trails, and bulletin boards posted with information about the project. Interpretive activities held at the project include special events, campground programs, water safety programs, and tours of the power plant and visitor center.

Education is the key factor to increased public knowledge and awareness of natural and cultural features. Education is also the key factor in the reduction of accidents on public lands and waters. Public knowledge is enhanced through programs both on and off site, news releases, a 24-hour lake

information hotline, internet website, information handouts, posters, billboards and various other public service announcements done on radio and television. Also, by cooperating with other agencies, public awareness of Corps programs is increased.

(5) Environmental Protection. Continue to provide a rewarding experience for visitors by monitoring, maintaining, and improving the aesthetic and environmental quality of the area. Sites will be monitored and steps taken to prevent damage or rehabilitate areas before site impacts have any negative effects on visitors' experiences or the environment. Use of all areas for public enjoyment will be encouraged while minimizing any environmental degradation.

(Discussion) The development of recreational facilities and opportunities will not only satisfy the technical requirements of the effort but also incorporate environmental protection and enhancement techniques. Site designs, site hardening, impact deterrence, and natural landscaping will be used to accomplish this goal. Water quality in the lake is monitored at least four times per year. Boat and land patrols and reports from concerned citizens enable us to locate point and non-point source contamination areas.

(6) Special Events. Continue to support special events to serve the mission of the Corps and to promote economic benefits received by the region. This will be accomplished by continuing to provide special events annually as funding permits and through partnerships with other agencies and groups.

(Discussion) To promote public safety, the Corps will provide events such as "Mark Twain Lake Waterfest" and the "Women in the Outdoors" event as well as continuing to speak on safety issues on and off-site at all public contacts. Other events are staged to promote economical benefits to local businesses and improve tourism. The "Mark Twain Lake Rodeo" and the "North American Bullriding Association World Championship Finals" each attract approximately 20,000 visitors to the area each year. Events such as the "Primitive Artifacts Weekend", "An Adventure in Astronomy", the "Salt River Folklife Festival", "Missouri Mule Days" and the "Environmental Education Day" promote public awareness about environmental, scientific, cultural, and historical messages for the Corps and the local area. The following events may be pursued with interested partners to promote visitation and economic benefits to the region: farmers markets, car shows, and fishing tournaments.

c. Environmental Stewardship

(1) Conservation of the Resource. Continue to monitor project resources to ensure protection against fire, overuse, abuse, off road vehicle activity, insect and disease infestation, encroachments, and trespasses. Corrective actions will be implemented to resolve problems.

(Discussion) We will strive to achieve environmental sustainability and recognize the interdependence of life and the physical environment. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems. Seek ways and means to assess and mitigate cumulative impacts to the environment. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work. Respect the views of individuals and groups interested in Corps activities and our projects. Listen to them actively and learn from their perspective in the search to find innovative solutions to the problems that also protect and enhance the environment. The partnership with the North Fork Watershed Group and the Clarence Cannon Wholesale Water Commission will continue with direction towards resolving water quality and erosion problems in the North Fork watershed and the entire Salt River watershed.

(2) Wildlife. Public land will be managed to encourage optimal utilization by the greatest number and diversity of wildlife species through the manipulation, management, and protection of habitats and ecosystems.

(Discussion) Management activities to provide food, nesting, and escape cover will include succession control through mowing, prescribed burns and agricultural practices, native grass, food plot, and tree plantings, and selective forest and wetland management practices. All management activities will be accomplished using applicable scientific and professional standards and practices. Habitat manipulation techniques and ecosystem approaches will be implemented to maximize the carrying capacity of various vegetative conditions. Erosion control and soil conservation practices will be utilized to improve water quality and watershed characteristics.

(3) Forest. Forestlands will be managed for multiple use to enhance their ecological, scenic, recreational, and wildlife values.

(Discussion) Sustained yield management will provide for diversity in all age groups and species composition. Inventories and prescriptions will be used to monitor and maintain forest cover for its scenic, recreational, water quality, fishery, and wildlife values. Silvicultural practices may be used for disease and pest control, fire hazard reduction, habitat manipulation, and improvements to species composition.

(4) Cultural Resources. Identify, evaluate, and preserve significant archaeological and historical sites. Implement established procedures for inadvertent discoveries of Native American burials.

(Discussion) Continue to preserve and protect the “Crigler Mounds” National Register of Historic Places site and consult with the Missouri State Historic Preservation Officer as necessary. Numerous archaeological and historical sites were identified on Corps lands during various surveys. The implementation of the Historic Properties Management Plan will provide for these sites to be identified, evaluated, mitigated or managed for the benefit of future generations. Archaeological resources recovered prior to construction have been inventoried and are preserved at the University of Missouri-Columbia.

(5) Soils. All land management activities will be based on suitable soil types, soil characteristics and land use capabilities.

(Discussion) Use soil conservation practices that minimize the effects of wind, water, and mechanical erosion. Consult with the Natural Resources Conservation Service in the respective counties to evaluate and implement suitable management practices. Develop strategies that demonstrate sound public land stewardship in all Corps decisions. Conservation measures designed to prevent soil loss such as maintaining riparian corridors and grass waterways, stream bank stabilization, terraces, fertilization and turf renovation will be implemented on project lands.

(6) Wetlands. Establish, maintain, and protect high quality wetlands to improve water quality and provide habitat for wetland flora and fauna.

(Discussion) Development and maintenance of wetlands using moist soil units, the creation of opportunistic wetlands, strip cropping in suitable areas, and establishment of wetland plants will continue in support of applicable parts of the North American Waterfowl Management Plan and the project “Environmental Action Plan”. Management of the 3000-acre waterfowl refuge will continue in the Middle and Elk Fork branches of the lake. Wetland units in the re-regulation area will continue to be managed and maintained to demonstrate the additional benefits obtained from hydropower generation. Additional opportunities will be pursued with potential partners to derive benefits from projects such as wetland mitigation banking on project lands sponsored through the Missouri Department of Transportation highway improvements program.

(7) Fisheries. Maintain a viable fishery resource through monitoring and protecting water quality, enhancing fish cover/habitat, managing brood ponds, stocking, and coordinating with SWPA to maintain stable pool elevations during critical spawning periods.

(Discussion) Fisheries management efforts will be coordinated with the Missouri Department of Conservation. Fishing is the single most important recreation activity that influences visitation. Coordination efforts and

management strategies will focus on optimizing a quality fishery and fishing success. Largemouth bass and crappie are the primary species that benefit the majority of visitors. Cooperative relationships with the power industry and the SWPA continue to provide opportunities to maintain stable pool elevations during the spring. Opportunities to fund research to determine the most beneficial way to obtain optimum population dynamics for target species will be explored with Cooperative Fisheries Research Laboratories, the Waterways Experiment Station, and other research institutions.

(8) Prairies. Manage native grasses and forbs to closely reflect remnant prairie ecosystems. Establish native grass and forbs plantings where necessary to maintain diversity of habitat and improve soil characteristics.

(Discussion) Prescribed burning with additional grass and forbs plantings will be used to maintain this remnant example of tall grass prairies that existed prior to early pioneer settlement. Existing native grass areas will be maintained through a schedule that includes periodic burns in order to halt woody invasion of the area. Emphasis will be placed on managing current acreage with minimal additional plantings where benefits are documented in habitat appraisal and evaluation techniques.

(9) Aesthetics. Plan and design all management actions and activities with consideration to visual enhancement, impacts, and aesthetics.

(Discussion) In order to provide the opportunity for a quality recreational experience, it is essential to consider the aesthetic impact of planned improvements as well as the economic and functional requirements. Each design, construction or maintenance action will be considered according to its visual impact to the environment.

Tree, shrub, forbs, and grass species used for landscape plantings and habitat improvements will be evaluated and selected based on aesthetics, food value for wildlife, cover and other qualitative vegetative factors. Native plant species with the greatest aesthetic appeal and wildlife value should be emphasized in plantings.

SECTION VIII – RESOURCE PLAN

8.01 ZONING OF LAKE LANDS AND WATERS – LAND AND WATER USE

Recreational development at Clarence Cannon Dam and Mark Twain Lake has generally proceeded as planned in Supplement No. 1 of the original Master Plan for the lake. All project lands have been allocated for the authorized purposes for which they were acquired. Plate 1 depicts land allocations for all project lands. Allocated project lands have been further classified to provide for development and resource management consistent with authorized project purposes and the provisions of NEPA and other Federal laws. The land classification process refines land allocations to fully utilize project lands and takes into consideration public needs, legislative authority, regional and project-specific resource requirements and classification categories. Plate 2 depicts land classification categories for all project lands. Each classification category and the lands that are assigned to each category are described in the following narrative sections.

a. Project Operations. The objective of this resource allocation is to provide adequate land for safe and efficient operation and management of the project land and water resources for all authorized purposes. Lands zoned in this category include the main dam, the powerhouse, the outlet channel, the re-regulation pool and dam, and lands required for administrative and maintenance needs. Agricultural use of these lands will be permitted on an interim basis when it does not conflict with use for authorized purposes. The OPERATIONAL MANAGEMENT PLAN (OMP) contains further details on this land resource allocation and use. Seven areas are classified in this allocation and are depicted on Plate 2 and described in Section 8.02.

b. Recreational Lands The objective of this zoning classification is to allocate lands, by virtue of location and natural resources, to intensive recreational use. Park and recreation lands are developed to provide for the intensive recreational activities of the visiting public. Factors such as road access, natural resources, recreational facility design, and management practices make these lands conducive to accommodating public use. Lands in this classification include areas for existing, proposed and future commercial concessions, recreational development, and group use. Natural resources management objectives and techniques may be implemented within intensive use recreation areas to sustain and enhance biological communities and ecosystems, to prevent vector and disease problems, and to promote the scenic qualities of the area. Any agricultural use must comply with applicable soil conservation practices. Section 8.03 further details the development and use of lands in this zoning category.

c. Environmental Sensitive Areas (ESA) Lands classified as environmental sensitive areas contain significant scientific, ecological, cultural or esthetic features. These areas are normally located within one of the other classification categories and must be taken into consideration by management to insure the sensitive areas are not impacted by excessive activity or conflicting management objectives. Natural resource management objectives and techniques may be implemented within environmental sensitive areas with full consideration for protecting the ecological or cultural aspect of these areas. Limited or no development of public use is generally contemplated on land in this classification. Eight areas are classified as environmental sensitive areas. Of these, four are considered ecological areas (ES-1, etc.) and four areas considered cultural areas (CS-1, etc.). These areas are described in Section 8.04 of this Plan.

d. Multiple Resource Management The objective of this zoning classification is to allocate lands to one or more of the following uses based on their location and their natural resources: (a) recreation-low density, (b) wildlife management general, (c) vegetative management and (d) inactive and/or future recreation areas. Nine areas are classified as recreation-low density, and one area is classified wildlife management. These are described in Section 8.05. No lands were classified as vegetative management or future recreation.

e. Flowage Easement Lands Flowage easement interest was purchased for 9,740 acres to obtain the right to periodically flood these lands to achieve the project flood control benefits. These lands begin at elevation 620 feet NGVD and terminate at 642 feet NGVD.

8.02 PROJECT OPERATIONAL LANDS

The following paragraphs provide a brief description of all lands classified as Project Operations: Areas are depicted on Plate 2 and are described in a clockwise progression around the lake beginning at the main dam.

(1) 0-1. Main Dam/Saddle Dams and Outlet Works/Corps Management/Maintenance Complex. The Clarence Cannon Dam, powerhouse and outlet works are located in this area of approximately 260 acres. The Clarence Cannon Dam was built in two sections consisting of an earthen embankment approximately 1,100 feet long and a concrete monolith structure measuring approximately 845 feet in length. The concrete section includes the powerhouse substructure and a gated spillway section with four 50 feet by 39 feet tainter gates used for flood control. To the extent practical, all releases are directed through the hydroelectric generator turbines rather than the tainter gates. The crest of the dam embankment is at elevation 653 feet NGVD.

The project administrative area is located just north of the main dam. Facilities include the project office, a maintenance complex, a fenced vehicle

compound, material storage, fuel tanks, weather station, and employee/visitor parking areas.

Located downstream of the main dam in the Warren G. See North Spillway Recreation Area is the electrical switchyard. The switchyard is owned and maintained by Northeast Power Cooperative in Palmyra, Missouri on lands leased from the Corps. The switchyard directs electrical power generated by the Clarence Cannon Power Plant to Northeast Power Cooperative transmission lines located east of the dam.

Two small earthen saddle dams with a total area of approximately four acres are located north of the Frank Russell Recreation Area.

(2) 0-2. Water Treatment Plant, Clarence Cannon Wholesale Water Commission . This regional water treatment plant is located four miles west of Florida, Missouri off of state highway Rt. U. This facility was constructed in 1991-1992. The production and sale of water to members began on June 16,1992

The Clarence Cannon Wholesale Water Commission (CCWWC) entered into a three party contract with the US Army Corps of Engineers and the State of Missouri to purchase water storage space in Mark Twain Lake. The contract allows for removal of a maximum of 16 million gallons of raw water per day with an allowance for a failure rate of 2 years out of every 100 years for not being able to supply the full 16 million gallons. The CCWWC owns the rights to 5.0 million gallons of storage space, while the remaining 11.0 million gallons of water are available to them through contract with the State of Missouri.

The CCWWC facilities consist of a 4.5 million gallon per day surface water treatment plant, which uses flocculation, sedimentation, and filtration to purify raw water to acceptable standards for drinking purposes. In addition to the main facilities, the infrastructure consists of 236 miles of transmission mains, four booster- pumping stations, a raw water intake structure located on the North Fork Branch of Mark Twain Lake, and daily storage space for 4.5 million gallons of drinking water.

The CCWWC currently serves the following cities and water districts: City of Paris, City of Perry, City of Shelbyville, City of Madison, City of Huntsville, City of New London, City of Farber, City of Vandalia, City of Curryville, PWSD #1 of Shelby County, PWSD #1 of Knox County, PWSD #1 of Marion County, Thomas Hill PWSD #1, PWSD #2 of Monroe County, Cannon PWSD #1, PWSD #1 of Audrain County, PWSD #1 of Pike County, City of Edina, City of Lewistown, City of La Belle, PWSD #1 of Lewis County. Associate members include; City of Clark, City of Baring, and PWSD #1 of Macon County. Expansion is underway to serve additional customers.

(3) 0-3. Land Irrigation Type Sewage Treatment Facilities, North Extension of Mark Twain State Park. Operated by the Missouri Department of Natural Resources, the acreage comprised by the facility is included in the

acreage figures for the state park lease with the Corps of Engineers for recreational purposes.

(4) 0-4. Land Irrigation Type Sewage Treatment Facilities, Indian Creek Recreation Area. - These sewage treatment facilities comprise approximately 26 acres and serve the Indian Creek campground, picnic area, group use area, and Indian Creek Marina. This facility is a no-discharge storage and irrigation system comprised of a two-cell aerated lagoon with an aerated vault waste tank and a 16.9-acre irrigation area.

(5) 0-5. Land Irrigation Type Sewage Treatment Facilities, John F. Spalding Recreation Area. - These sewage treatment facilities comprise approximately 20 acres and serve the facilities located at the Ray Behrens Recreation Area, Blackjack Marina, M.W. Boudreaux Visitor Center, John C. "Jack" Briscoe Group Use Area, Frank Russell Recreation Area, Mark Twain Lake Project Office, Clarence Cannon Dam, and the John F. Spalding Recreation Area. This facility is a no-discharge storage and irrigation system comprised of a two-cell aerated storage lagoon with a fourteen-acre irrigation area.

(6) 0-6. Re-regulation Pool. A total of approximately 1,766 acres of land and water located downstream from the dam are designated for project operations. These lands lie along both sides of the re-regulation pool over most of its 9.5-mile length. This area, downstream of the dam, is in the historic floodplain of the Salt River and was primarily acquired to enable operation of the re-regulation pool for hydropower operations. The re-regulation pool is used to store and regulate large releases of water from the generation of hydroelectric power and to store water for the potential use of the pump-back feature of the hydropower plant. This area was evaluated for wetland development as part of the North American Waterfowl Management Plan and contains developed wetlands constructed through the authorities of this plan and project resource use objectives.

The area along the re-regulation pool is also used for low-density recreational activities including fishing, boating, hunting, hiking, and nature study. Gravel roads, hunter/fisherman lots and two boat ramps provide visitors access to the area. A paved two-lane boat-launching ramp with an associated paved parking area is located just below the main dam in the Warren G. See South Spillway Recreation Area and provides visitor access to the western portion of the pool. A second one-lane paved ramp and associated Hunter/Fisherman Lot # 70 is located upstream of the Re-regulation Dam provides access to the eastern portion of the pool. Hunter/Fisherman Lot #71 is also upstream of the Re-regulation Dam and provides walk-in access to the pool and several wetlands and offers a wildlife viewing tower.

(7) 0-7 Re-regulation Dam The Re-regulation dam is located 9.5 miles from the main dam and is in the Bluff View Recreation Area. It consists of a compacted earth embankment, a gated concrete spillway, a sluice, and an operating house. The dam and its associated structures comprise approximately 10 acres. The total length of the dam is 1,550 feet.

8.03 RECREATION AREA PLANS - FACILITIES DEVELOPMENT

A description of all recreational development at Clarence Cannon Dam and Mark Twain Lake is presented in this section. A total of fifteen areas are classified and zoned as intensive recreational areas. A summarization of development at these areas, both existing and future, is presented below. The following subparagraphs describe recreation areas in a clockwise order around the lake as shown on Plate 2, "Land Classification Map."

Proposed facilities are those facilities that may be completed within a ten-year period following the update and approval of this Master Plan. New proposed facilities are accompanied by a general cost estimate in Section XIII. A benefit/cost analysis is completed for new proposed facilities to justify their development.

The future plans provided in the area descriptions describe what may occur in the area beyond the ten-year time frame.

The following 15 areas have been classified as recreation lands:

1. M. W. Boudreaux Recreation Area – Plate 3
2. Ray Behrens Recreation Area – Plate 4
3. Robert Allen Recreation Area – Plate 5
4. South Fork Recreation Area – Plate 6
5. Mark Twain State Park – Plate 7
6. Stoutsville Recreation Area – Plate 8
7. North Fork Recreation Area – Plate 9
8. Mark Twain State Park – North Extension – Plate 10
9. Shell Branch Recreation Area – Plate 11
10. Sandy Creek Recreation Area – Plate 12
11. Indian Creek Recreation Area – Plate 13 and 14
12. John F. Spalding Recreation Area – Plate 15
13. Frank Russell Recreation Area – Plate 16
14. Warren G. See Spillway Recreation Area – Plate 17
15. Bluff View Recreation Area – Plate 18

(1) M. W. Boudreaux Recreation Area. This 268-acre multi-use area is located on the east shore of the lake, just south of the main dam on Missouri State Highway J. The area is divided into two distinct sub-areas, one featuring the M. W. Boudreaux Visitor Center and the other a group use development.

The northern portion of this area contains the M. W. Boudreaux Visitor Center, which is a Class B Visitor Center with 2 overlooks; exhibit rooms and a 49-seat theater/conference room. Development in the area includes the Northeast Missouri Vietnam War Memorial, 14 picnic sites, 2 overlooks, a universally accessible waterborne comfort station, a nature trail, an amphitheater and a paved parking area.

There are no proposed or future plans for the Visitor Center area.

The southern portion of this area was renamed the John C. "Jack" Briscoe Group Use Area and is developed for group use activities. Facilities in the group use area include 20 campsites with electric hookups, a shower building, a group picnic shelter, a nature trail, a playground, 2 combination fountain/hydrants, and a group fire ring.

There are no proposed plans for the group use area, but future plans include the addition of group campsites and a playfield.

A site plan that illustrates all development at the M. W. Boudreaux Recreation Area is presented on Plate 3.

(2) Ray Behrens Recreation Area. This 858-acre multi-use recreation area is the most highly visited area on the lake and provides a diverse range of facilities for boaters, picnickers, hikers and campers. The area is located on the south shore of the lake approximately eight miles north of Perry. The area features 165 campsites with electric hookups, a full service marina, a four lane boat launching ramp with an associated fish cleaning station and parking area, a courtesy boat loading dock, a 15-site picnic area that includes a group picnic shelter and the Lick Creek Trail Head with parking for trailers. Support facilities include 4 playgrounds, a potable water supply distribution system consisting of fountain/hydrant units, 2 overlooks/trilateration stations, an outdoor amphitheater, a fire ring, 4 shower buildings, 4 waterborne comfort stations, one waterborne comfort/changing station, a trailer dumping station, a fee booth, 3 nature trails, and a paved parking area for 156 cars and 170 car-trailers. An additional 240 car parking spaces are located adjacent to the full-service marina in this area.

Development approved in previous supplements but not yet constructed includes conversion of three campground comfort stations to shower buildings, conversion of 50 existing camp sites to full service hookup sites, upgrade of 30 amp to 50 amp electrical service at individual sites, and an archery range in the day use area.

Proposed facilities include a 2-lane high-water boat ramp, a replacement fee booth equipped with a restroom and a floating breakwater for Black Jack Marina. Other proposed development plans include expanding the campground by 65 campsites with electric hookups and providing support facilities, i.e., 3 shower buildings, a playground, fountain/hydrants and 30 parking spaces. Due to current visitor use and trends this area was selected over the Indian Creek Campground as the preferred location for additional camping development.

Future plans for the area include the development of additional campsites and associated support facilities. Approximately 160 acres located in

the northwest portion of this area is held in reserve for the development of additional concession facilities.

A site plan that illustrates all development at the Ray Behrens Recreation Area is presented on Plate 4.

(3) Robert Allen Recreation Area. This 1,083-acre area located on the south side of the lake about midway along the main body of the pool area has been developed as a multi-use area. Recreational developments include a 4-lane boat-launching ramp, 2 courtesy boat loading docks, a 2-lane high-water boat launching ramp for use at 625 feet NGVD and above, 3 picnic sites, a vault toilet, and parking spaces for 160 car-trailers and 10 cars. Included in the parking space total are 60 car-trailer spaces located in an overflow parking lot.

Proposed plans for this area include relocating the existing vault toilet above the flood pool at the next scheduled major repair and a fish cleaning station.

Future plans include the addition of group facilities and a vault toilet.

Approximately 207 acres located on the western most peninsula of the Robert Allen area north of Missouri State Highway 154, is being held in reserve for the development of a resort concession.

A site plan that illustrates all development at the Robert Allen Recreation Area is presented on Plate 5.

(4) South Fork Recreation Area. This 176 acre multi-use recreation area is located at the northeastern point of the South Fork of the Salt River as it joins the main body of the lake. Facilities located here include a 4-lane boat launching ramp, two courtesy loading docks, 3 picnic sites, a vault toilet, and a 120 car-trailer and 15-car spaces parking lot.

Proposed development includes a fish cleaning station, enlarging the parking lot by 30 spaces and relocating the existing vault toilet above the flood pool at the next scheduled major repair.

The area also has the potential to accommodate an additional marina.

A site plan that illustrates all development at the South Fork Recreation Area is presented on Plate 6.

(5) Mark Twain State Park. Recreation Area 5, an area of approximately 1,073 acres, comprises the central portion of the 2,700-acre Mark Twain State Park and is leased to the Missouri Department of Natural Resources. The State Park contains 1,559 acres leased from the Corps of Engineers, while the remaining acreage is owned in fee title by the State of Missouri. Recreation

Area 8 (Mark Twain State Park – North Extension) forms the northern portion of the park, while an area owned by the State of Missouri forms the southern boundary of the park. Existing development in Recreation Area 5 is shown on Plate 7, which includes a paved access road, a four-lane boat launching ramp, a 100-car and 145-car/trailer parking area, and a vault toilet. A visitor contact station is also proposed for development on state park property at the intersection of Highway 107 and Route U.

An area of land south of Recreation Area 5 is owned in fee title by the State of Missouri and is operated as a portion of the Mark Twain State Park. This portion of the park contains a 103-site campground, a one-lane boat ramp, an overlook, 20 picnic sites, one playground, six miles of hiking trails, two picnic shelters, two washhouses, five vault toilets, one amphitheater, a scout camping area, fish cleaning station and a boat ramp parking lot.

Development proposed for this area includes four to six cabins in the existing campground, construction of a fee booth, development of 50 additional campsites, an additional washhouse, installation of electric service to campsites that currently do not have electric service and development of mountain bike trails in open areas and hiking trails in wooded areas just south of State Route U.

(6) Stoutsville Recreation Area. This 486-acre multi-use recreation area has been developed for day-use recreational activities. The area is located on the North Fork Branch of Mark Twain Lake. A portion of the area has been developed for intensive recreational use while the remainder of the area is held in reserve for future development. Facilities located here include a 4-lane boat launching ramp, 2 courtesy boat loading docks, a high water boat launching ramp for use at 625 feet NGVD and above, 3 picnic sites, 1 vault toilet, 1 fish cleaning station, and 35 car and 145-car/trailer parking spaces. This area is periodically utilized as a training site for local National Guard and Reserve units.

Proposed plans for this area include relocating the existing vault toilet above the flood pool at the next scheduled major repair..

Future development planned for this area includes a picnic area and support facilities. The area also contains a potential marina-concession site and a site suitable for future development as a beach.

A site plan that illustrates all development at the Stoutsville Recreation Area is presented on Plate 8.

(7) North Fork Recreation Area. This 703-acre area is located on the North Fork Branch of the Salt River adjacent to the southeastern portion of the Stoutsville Recreation Area. The area is zoned for recreational use with most of the site reserved for future development. Existing development is limited to a

gravel access road, a 20 car-trailer parking lot, and a 4-lane boat-launching ramp.

Development previously approved for this area includes a vault toilet.

There is no proposed development for this area.

Future development planned for this area includes a paved access road, group picnic shelter, picnic sites, vault comfort station, and additional car and car/trailer parking spaces.

A site plan that illustrates all development at the North Fork Recreation Area is presented on Plate 9.

(8) Mark Twain State Park - North Extension. There are 486 acres of land in this area that is leased to the Missouri Department of Natural Resources which comprises the northernmost portion of the Mark Twain State Park. Existing recreational facilities are shown on Plate 10, and include a 4-lane boat launching ramp, with an associated 10-car and 120-car/trailer space parking area, two vault toilets, 13 picnic sites and a swimming beach with an associated changing house and parking area for 75 cars. Other facilities include the “Si” Colborn Group Camp with four barracks-style cabins, a washhouse, a kitchen and dining hall, an office/infirmary, swimming facility, play areas, and land irrigation sewage treatment plant.

This location was approved for marina development in 1995 at the request of the MDNR, but no marina development occurred. The MDNR requested in 1998 that the area be re-designated as a swimming beach and it was re-opened in 2000.

Proposed development includes an equestrian trailhead and parking area to tie into the Corps of Engineers Joanna Multi-use Trail, an equestrian campground, restroom facilities, and a fish cleaning station and associated parking near the Rt. 107 boat ramp.

There are no future developments planned for this area.

(9) Shell Branch Recreation Area. The developed portion of this 377-acre area features a 4-lane concrete boat launching ramp, a 15 car-trailer parking lot and a courtesy boat dock.

There is no proposed development.

Future development includes a day use area with picnic sites, a picnic shelter, vault toilet, a large car/trailer parking area and a paved access road.

A site plan that illustrates all development at the Shell Branch Recreation Area is presented on Plate 11.

(10) Sandy Creek Recreation Area Current recreational development in this 594 acre area includes an access road, hunter/fisherman parking lot, recreational fishing pond and a nursery pond.

A number of undisturbed Indian burial mounds were discovered in this area by a University of Missouri archaeological survey team and are now known as the Crigler Mound Group Archeological Site. The site is listed in the National Register of Historic Places as provided by the Historic Preservation Act of 1966, Public Law 89-665.

There is no proposed or future development planned for this area.

A site plan that illustrates all development at the Sandy Creek Recreation Area is presented on Plate 12.

(11) Indian Creek Recreation Area. This 2,775-acre multi-use area is the largest recreational area on the lake. Located on a large peninsula in the east central portion of the north shore of the lake, the area is accessed from Missouri State Highway HH and an off-project county connector road. Several day use areas, a full service marina, a major campground, boat ramp, amphitheater/day use area, and a group camping facility are all located within this recreation area.

The main campground at Indian Creek features 190 campsites with electrical hookups, 20 hike-in tent camping sites, a single lane boat-launching ramp, and a beach. Support facilities include 5 shower buildings, 4 waterborne comfort stations, 2 playgrounds, a campground fee booth, 3 vault toilets, a system of hydrant/fountains, fish cleaning station, and 2 trailer dumping stations.

A group camping area located outside of the main campground provides 25 trailer camping sites, 12 tent sites without electrical hookups, 1 shower building, 1 waterborne comfort station, a group picnic shelter, combination hydrant/fountains, and a playground.

Day use areas located within Indian Creek Recreation Area feature a 4-lane boat launching ramp with an associated fish cleaning station, two courtesy boat loading docks, a high water boat launching ramp for use at 625 feet NGVD and above, a waterborne comfort/changing station, a waterborne comfort station, a playground, a nature trail, 13 picnic sites, a full service marina, a group picnic shelter, an outdoor amphitheater with an associated fire ring, combination fountain/hydrants and a recreational fishing pond. A land irrigation sewage treatment plant and 370 car and 207 car-trailer parking spaces support

the entire Indian Creek Recreation Area. The marina area also features a 150-car parking lot and a 2-lane boat-launching ramp.

Development plans previously approved for the Indian Creek Recreation Area include conversion of 3 campground comfort stations to shower buildings, conversion of 50 existing sites to full service hook ups, upgrading electrical service to individual campsites from 30 to 50 ampere, a primitive equestrian camping area at the day use area and relocation of the west boat ramp comfort station out of the flood pool.

The expansion of the Indian Creek Campground by 75 trailer sites was proposed and approved in Supplement No. 7, Additional Recreational Facilities Design Memorandum No. 9, The Master Plan, 1982. Support facilities for the campsite development will include 2 shower buildings, one waterborne comfort station, 9 combination hydrant/fountains, a playground, and an additional campground fee booth. However, due to visitor trends and use, priority will be given to developing the 65 campsites proposed for the Ray Behrens Campground first.

Proposed development in this plan includes the development of a vault comfort/changing station near the existing Indian Creek beach, a playground, relocation of the east ramp vault toilet out of the flood pool, and a universally accessible fishing pier at Henderson Lake.

Future development plans for the area include the expansion of the concession area with overnight accommodations and an additional expansion of the campground.

A site plan that illustrates all development in the Indian Creek Recreation Area is included on Plates 13 and 14.

(12) John F. Spalding Recreation Area. This 506-acre multi-use recreation area is located eight miles north of the main dam on the northeastern end of the lake. Missouri State Highway J provides the primary access to the area. The area has been subdivided into two use categories. One area features a boat ramp and parking area and the second provides picnic facilities and a swimming beach. A project operations area, O-5, that includes a wastewater land treatment site and saddle dam is located in the easternmost portion of the Spalding area. The wastewater land treatment site provides services to all facilities on the eastern end of the lake.

A four lane concrete boat-launching ramp with paved parking area for 40 cars and 155 car-trailers is featured in a portion of this area. A gravel parking lot with a 20 car-equestrian trailer capacity and an associated universally accessible loading ramp provides access to the Joanna Multi-purpose trail that meanders through the western portion of the area. Support facilities at the boat ramp include two courtesy boat loading docks, a fish cleaning station, a 2-lane

high water boat launching ramp for use at 625 feet NGVD and above, a combination fountain/hydrant, and a waterborne comfort/changing station.

Facilities for the swimming beach and picnic area include 2 picnic shelters, 1 picnic shelter with waterborne comfort station, 1 waterborne comfort station, 1 waterborne bathhouse, 1 playground, combination fountain/hydrants, 33 picnic sites, and parking for 430 cars and 30 car-trailers.

Development plans previously approved for this area include relocation of the bathhouse out of the flood plain.

There are no proposed plans for this area.

Future plans include setting aside a portion of the recreation area, approximately 200 acres in size, as a lodging concession site.

A site plan that illustrates all development at the John F. Spalding Area is located on Plate 15.

(13) Frank Russell Recreation Area. This 578-acre recreation area lies adjacent to the northern abutment of the dam and has been developed primarily for camping. Currently the area contains 65 campsites with electrical hook-ups, a campground fee booth, one centrally located shower building, 3 vault toilets, 2 playgrounds, an amphitheater, several combination fountain/hydrants units, a fishing pier, a trailer dumping station, and parking for 10 vehicles. Other development within the recreation area includes a horse corral/shelter with access to the Joanna Trail, a universally accessible loading ramp, and a universally accessible fishing pond.

Proposed actions include the replacement of existing vault-toilets with water borne comfort stations, upgrading of electrical service to 50 amperes at individual sites and water and sewer hookups for 20 campsites.

Future development plans for the area include additional campsites with electrical service, a shower building and comfort stations. A portion of the Frank Russell Recreation Area has been set aside for a future concession area with overnight accommodations.

A site plan that illustrates all development at the Frank Russell Recreation Area is presented on Plate 16.

(14) Warren G. See Spillway Recreation Area This 226-acre recreation area lies contiguous to Clarence Cannon Dam along the north and south sides of the re-regulation pool and is accessed by Highway J. The Corps administration and maintenance compound form the northern border of the area. The area features opportunities for many day use recreational activities including fishing, picnicking, boating, shooting and special event activities.

Facilities on the north side of the re-regulation pool are in the Warren G. See North Spillway Recreation Area and include 1 vault toilet, 1 vault comfort station, several combination fountain/hydrants, 57 parking spaces, 5 handicapped parking spaces and a playground. Also provided is a parking area for visitors to the Cannon Dam Power Plant Exhibit Area.

Recreational facilities on the south side of the re-regulation pool are in the Warren G. See South Spillway Recreation Area and include a 2-lane boat launching ramp, a vault toilet, a vault comfort station, an overlook, several combination fountain/hydrants, a playground, 45 parking spaces, 7 handicapped parking spaces, 104 car/trailer parking spaces, a shooting range, and 2 group picnic shelters and a multi-purpose building with a no-discharge waste water infiltration system. This area is utilized as a special event activities area by a variety of groups and organizations.

Development plans previously approved for this area include disabled accessible fishing piers, a waterborne comfort station/shower facility, a picnic shelter and an earthen berm with a concrete retention wall to support bleachers for the community activity area.

There are no proposed plans for this area.

Future plans for the area include development of a clay target shooting area and picnic sites.

A site plan that illustrates all development at the Warren G. See Spillway Recreation Area is presented on Plate 17.

(15) Bluff View Recreation Area. This 45 acre recreation area is located downstream of the Re-regulation Dam on the downstream side and is developed for a variety of day use activities. Improvements in the area include a one-lane boat launching ramp, a group picnic shelter, 2 vault toilets, a playground, 4 picnic sites, and 83 car and 20 car-trailer parking spaces.

Proposed development plans for this area include a fish cleaning station.

There are no future development plans for this area.

A site plan that illustrates this development is presented on Plate 18.

8.04 ENVIRONMENTAL SENSITIVE AREAS

The following paragraphs describe the areas classified as environmental sensitive areas (ESA). These areas are depicted on Plate 2, and are described in clockwise progression around the lake beginning at the main dam. The zoning of cultural sites as environmental sensitive areas insures their protection and allows their use as an interpretive resource.

. Eight areas are classified as environmental sensitive areas. Of these, four are considered ecological sensitive areas (ES-1, etc.) and four areas are considered cultural sensitive areas (CS-1, etc.):

1. ES-1 Lick Creek Ecological Sensitive Area – Plate 2
2. ES-2 Quarry Lake Ecological Sensitive Area – Plates 2 and 6
3. ES-3 Indian Creek Ecological Sensitive Area – Plates 2 and 13
4. ES-4 Little Indian Creek Drainage Area (Joanna Ridge) – Plates 2 and 15
5. CS-1 Hatten Mounds Cultural Sensitive Area – Plate 2
6. CS-2 Pollard Cemetery Cultural Sensitive Area – Plates 2 and 7
7. CS-3 Shell Branch Village Sites Cultural Sensitive Area – Plates 2 and 10
8. CS-4 Crigler Mounds Cultural Sensitive Area - Plates 2 and 12

(1) ES-1 Lick Creek Ecological Sensitive Area. The 1,404-acre Lick Creek Ecological Sensitive Area features a variety of natural attributes that make it a unique area in the Salt River basin. Vegetative and scenic qualities of the area make it an ideal location for ecological study. Extending southward along both sides of Lick Creek, on the east from the John C. “Jack” Briscoe Group Use Area and on the west from the Ray Behrens Recreation Area, the area is easily accessed by hikers and equestrian users. The 7 ½-mile Lick Creek Trail currently extends through a portion of the area. The diverse Lick Creek drainage area contains a broad cross section of the plant types found in the Salt River Basin. Of particular note is the Western Wall-Flower (Erysimum capitatum), found in 1974 on limestone outcroppings in this area. Many of the limestone bluffs provide scenic vistas of the lake. The area is managed to provide diverse vegetative structure for wildlife.

(2) ES-2 Quarry Lake Ecological Sensitive Area, South Fork Salt River. Located at the northern tip of the South Fork Recreation Area, the Quarry Lake Ecological Sensitive Area comprises 10 acres and features an abandoned quarry that forms a small clear lake. Vertical walls of limestone surround the lake 30-40 feet high, which reflect in very clear water, and permit viewing of many forms of aquatic life. Although the lake is man-made, the overall scenic effect is of great interest and charm. Protection of this site will preserve an area of striking beauty. The area is managed to provide diverse vegetative structure for wildlife.

(3) ES-3 Indian Creek Ecological Sensitive Area. The 987-acre Indian Creek Ecological Sensitive Area lies along both sides of the Indian Creek Branch of Mark Twain Lake. Ecological features of the area are noteworthy and will be preserved under this designation. The bluffs located in the area are largely wooded and feature good representative cross section of the flora of this region of Missouri. Another feature of this ecological zone is an unnamed cave, which will be protected under this classification.

The Indian Creek Ecological Sensitive Area contains some of the largest expanses of native prairie grassland on the Mark Twain Lake Project. Prescribed burns are implemented to maintain the vegetative structure within the area. The area is managed to provide diverse vegetative structure for wildlife.

The area lies adjacent to the highly developed Indian Creek Recreation Area and will afford visitors excellent opportunities for hiking and ecological study.

(4) ES-4 Little Indian Creek Drainage Area (Joanna Ridge). The Little Indian Creek Drainage Area comprises 1,232 acres and lines the eastern shoreline of the Little Indian Creek Branch that is composed of diverse ecosystems. Scenic limestone bluffs rim the area, while the plateau areas above the bluff feature a glade type ecosystem with post oak, white oak, and red cedar as the dominant species. Ground cover species include patches of prairie grass, lichens and mosses. The southeastern portion of the area (S 1/2 Sec. 15, Section 16 T 55 N, R &W) provides an extremely interesting prairie remnant ecosystem of which Big Bluestem and Little Bluestem prairie plants are typical.

ES-4 consists of large tracts of warm season grass prairies, which are managed through a prescribed burn program. The area is managed to preserve its diverse vegetative habitat structure for wildlife.

Previously approved facilities for this area , but not constructed, are a self-composting vault toilet, signs and bulletin boards.

(5) CS-1 Hatten Mounds. These mounds are located on the South Fork of the Salt River 1 ½ miles south of State Highway 154. Excavation has been done on both sites and identification indicates occupation since Archaic times (CA. 3,500 years ago). These salvage excavations were done in 1960-1962 and conducted by Dr. Dale R. Henning, under the auspices of the University of Missouri. The mounds were used by Archaic and Late Woodland peoples.

Although the principal mound may be eventually restored, the hillside is expected to yield further burial sites and evidence of habitation. The location is beautiful, and provides a vista over the South Fork area.

(6) CS-2 Pollard Cemetery. This site is located east of State Highway 107 and north of the town of Florida. Three identified mounds make up the site. Members of the Pollard family are buried in the larger mound. These mounds are of interest to the archaeologist because of their proximity to numerous prehistoric villages. The vista is admirably located for viewing the lake and provides an opportunity for interpretation of the significance of Native American occupancy.

(7) CS-3 Shell Branch Village Sites. The Shell Branch Village Sites are located on the southernmost side of Shell Branch Creek where it enters Mark Twain Lake. Mr. R. Henning tested these two sites in 1961. Both sites were extensively occupied, judging from the amount of surface material recovered. Although Archaic (CA 3,500 years ago) materials are found on both, the principal occupations appear to have been by Late Woodland Peoples. Evidence of funerary practices, food resource development and house form and use has come from these sites. The site yielded valuable archeological information and also is of great interest to the general public.

(8) CS-4 Crigler Mounds. These Native American burial mounds are known as the Crigler Mound Group Archaeological Site. The site is listed in the Federal Register, Vol. 29, No. 108, June 4, 1974 and is located in Monroe County, Missouri, 2 miles east of the town of Florida in the undeveloped portion of the Sandy Creek Recreation Area.

The Crigler Mound Group Archeological Site is composed of seven mounds that were investigated by a University of Missouri survey team in 1960. Dr. Dale R. Henning was the field archaeologist in charge of the investigation. The mound group, known locally as “Crigler Cemetery”, is possibly the largest and best-preserved group within the Mark Twain Lake project.

The zoning of these mounds as an cultural sensitive area ensures their protection and allows their use as an interpretive resource.

8.05 MULTIPLE RESOURCE MANAGEMENT LANDS AREA DESCRIPTIONS

The following ten areas have been classified as Multiple Resource Management Lands with primary classifications as listed below. These areas are depicted on Plate 2 of this plan.

(a) Recreation - Low Density

(1) ML-1 Lick Creek Multiple Resource Area.
(2) ML-2 Pigeon Roost Multiple Resource Area.
(3) ML-3 Allen Multiple Resource Area
(4) ML-4 North Fork Multiple Resource Area
(5) ML-5 Shell Branch Multiple Resource Area
(6) ML-6 Crigler Multiple Resource Area
(7) ML-7 Sandy Creek Multiple Resource Area
(8) ML-8 Indian Creek - Upper Drainage Multiple Resource Area.
(9) ML-9 Little Indian Creek Multiple Resource Area

(b) Wildlife Management General

(10) MW-1 Upper End - Multiple Resource Area.

Recreation - Low Density

(1) ML-1 Lick Creek Multiple Resource Area (MRA). The 560-acre Lick Creek MRA forms the southern boundary of public lands lying on Lick Creek east of State Route J, approximately one mile north of the town of Perry, MO. The area is characterized by a small area of bottomlands with steep bluffs or steep banks on the opposing side of the creek. Pool elevations lie within the confines of the historic creek channel. Included within the area is a hunter/fisherman parking lot and a one-lane boat ramp.

The original vegetation in the area was oak-hickory forest on the uplands with bottomland hardwoods in the lower area and along drainages. Most of the lands were cleared and were either in pasture or in row crop prior to the formation of the lake, but now is being allowed to revegetate. The slopes and drainages have remained forested and are in need of management due to the effects of previous poor land management practices.

The area is being managed to produce diverse vegetative habitat structure for wildlife. Hunting, fishing, and nature study are popular pursuits in this area.

(2) ML-2 Pigeon Roost Multiple Resource Area. The 1,609-acre Pigeon Roost MRA lies between the Ray Behrens and Robert Allen Recreation Areas and acts as a buffer zone between these two areas that have been developed for intensive recreational use. The area embraces the Pigeon Roost and Ely Branch, which flow into the lake from the south.

These lands were originally in oak-hickory forest and approximately 1,100 acres of this area are still classified as forest. However, most of this forest is second growth timber, occupying lands that at one time had been cleared for agricultural uses. The remaining areas are in various stages of succession and grasses.

The area is managed to produce diverse vegetative habitat structure for wildlife.

The area contains a gravel access road and a hunter/fisherman parking lot with a boat-launching ramp designed for small fishing boats. The lot and boat-launching ramp provide access for low-density recreational activities such as hunting, fishing, hiking, and nature study.

(3) ML-3 Allen Multiple Resource Area The 345-acre Allen MRA lies between Robert Allen Recreation Area and Mark Twain State Park and acts

as a buffer zone between these two areas that have been developed for intensive recreational use. Ground elevations range from the top of the conservation pool (El. 606 feet NVGD) to over 690 feet NVGD. The original vegetative cover in the area was forest. The tops of the ridges were cleared and farmed prior to the formation of the lake. The ridge tops are now in various grasses, and successional stages. The slopes and drainages are currently forested. Hunting, fishing, boating, and nature study are popular recreational pursuits in the area. The area is also being managed to produce diverse vegetative habitat structure for wildlife.

(4) ML-4 North Fork Multiple Resource Area The North Fork MRA comprises 643 acres and lies between the North Fork Recreation Area and the North Extension of the Mark Twain State Park. The area was covered with oak-hickory forest before the arrival of Euro-American settlers. The area was mainly cleared for agricultural purposes with the settlement of the area and now is generally open except for forested drainages and small-forested tracts. Portions of the area were reforested after acquisition by the government. Other areas are managed under the agricultural lease program, as warm season grasslands or succession fields. The area is available for low-density recreation activities.

(5) ML-5 Shell Branch Multiple Resource Area. This 614-acre area lies between the North Extension of the Mark Twain State Park and the Shell Branch Recreation Area. The area acts as a buffer between the eastern edge of the state park and between private lands and the lakeshore. Gravel access roads provide continuous access for hunting, hiking, fishing, boating, and nature study. The Shell Branch MRA also features a cultural resource site consisting of two Indian Village sites. (See Description of CS-3) These sites contain material from the Archaic period through the Woodland period with the principal occupation being in the Woodland Period. A prairie grass restoration area and a wildlife food plot are also located within this area. The area is also being managed to produce diverse vegetative habitat structure for wildlife.

(6) ML-6 Crigler Multiple Resource Area. The approximately 242-acre Crigler MRA lies between the Sandy Creek Recreation Area and the Shell Branch Recreation Area. The area is mostly forested and consists of a series of ridges with a southern aspect terminating in Mark Twain Lake. The area contains a minor access site with a gravel road and parking lot, and a trail to the lake. The area is used for hunting, fishing, hiking, and other low-density recreational pursuits.

(7) ML-7 Sandy Creek Multiple Resource Area. The 259-acre Sandy Creek MRA serves as a buffer between private lands and the Indian Creek Recreation Area. The area consists of a series of old agricultural fields interspersed with forested ridges. Originally, these lands were all oak-hickory forest. With the advent of the Euro-American settler, the areas suitable for agricultural purposes were cleared and cultivated. These areas now lie above the top of the conservation pool (El. 606 feet NVGD) but are well within the

flood pool (El. 638 feet NVGD.) and are maintained as openings for the purpose of wildlife management. The entire area is available for the low-density recreation activities.

(8) ML-8 Indian Creek - Upper Drainage Multiple Resource Area. The approximately 517-acre Indian Creek Multiple Resource area comprises the upper limits of public land on the Indian Creek tributary to the lake. The area is comprised of an area of bottomlands with the lake being confined to its ancestral channel in all but flood stages.

The original vegetation in the area was Oak-Hickory forest on the uplands with bottomland hardwoods in the lower areas and along stream courses. The lands have been cleared and converted to agricultural purposes with the bottomlands being converted to pasture lands. The management to correct past poor management practices is allowing a portion to naturally revegetate to more beneficial habitat.

The area is currently being managed for low-density recreation use.

An access lot was previously approved for this area.

(9) ML-9 Little Indian Creek Multiple Resource Area. The Little Indian Creek MRA lies along the Indian and Little Indian Creek branches of Mark Twain Lake and serves as a buffer zone between the public and private lands. Comprising 867 acres, the area features plateaus, and limestone bluffs. The plateau above the bluff consists of an upland hardwood forest with post oak, white oak, and hickory dominant. The ground cover includes patches of prairie grass, forbs and a variety of secondary succession species. The area is currently being used for low-density recreation. The area is managed to produce diverse vegetative habitat structure for wildlife. A portion of the Joanna Multi-use Trail is located within ML-9.

(10) MW-1 Upper End Multiple Resource Area. An area encompassing a total of 14,536 acres, the Upper End MRA encompasses project lands west of the Stoutsville and South Fork recreation areas. The area includes all project lands found along the upper reaches of the North Fork, Middle Fork, Elk Fork, South Fork and Long Branch tributaries of the Salt River and thus contains a large amount of riparian lands as well as lands along the lakeshore. To facilitate a description of this diverse area, it will be divided into three sub-areas as follows: 1) South Fork and Long Branch sub-area, 2) Elk Fork and Middle Fork sub-area, and 3) North Fork sub-area.

1) South Fork and Long Branch Sub-area – The South Fork and Long Branch Sub-area extends southward on both sides of South Fork Branch from the South Fork Recreation Area (Rt. 154) to near the community of Santa Fe, Missouri. It includes the South Fork, Long Branch, and Brush Creek tributaries to Mark Twain Lake. The original vegetative cover in this area was generally forest; however, the tops of

the ridges and areas with gentler slopes were cleared and farmed after settlement of the area. The marginal farmlands are now in various successional stages with some areas being managed for native warm season grasses. The flatter areas, which are not susceptible to flooding, are being managed under the agricultural lease program. The slopes and drainages remain timbered. The area is used for low-density recreation with hunting, fishing, hiking, and nature study being popular pursuits.

2) Elk Fork and Middle Fork Sub-area – The Elk and Middle Fork Sub-area includes the lands along the South and Middle Forks westward of the juncture of the South and Middle Fork branches. Originally, these lands were covered by forest; however, with the coming of Euro-American settlers, the flatter portions were cleared and used as farmlands or for hay and pasturelands. Now the marginal farmlands are in various grasses and successional stages with some areas being managed for native warm season grasses. The flatter lands, which are not susceptible to flooding, are being managed under the agricultural lease program. The steeper slopes and drainages are still forested.

A portion of this area is designated as a seasonal waterfowl refuge. The refuge is comprised of approximately 3,000 acres of land and water that have been set-aside as a resting area for the migrating waterfowl. Waterfowl hunting and boating is prohibited in the area from October 15 through December 31. The area remains open for other recreation pursuits.

3) North Fork Sub-area – The North Fork Sub-area includes lands along the North Fork west of the Stoutsville Recreation Area and Mark Twain State Park. It includes the Otter Creek, Crooked Creek, and Buck Creek tributaries to Mark Twain Lake. The North Fork Wetland Restoration Area is located in this area.

These lands were originally covered in oak-hickory forest; however, with the arrival of Euro-American pioneers, the areas suitable for agricultural use were cleared. After the construction of Mark Twain Lake, the more deteriorated areas are covered in grasses or woody growth. The steeper slopes and drainages are forested.

A tract of land (O-2) in the southern most section of this area near Mark Twain State Park is leased to the Clarence Cannon Wholesale Water Commission for operation of a water treatment plant. This area will be used for the plant maintenance corridor, road, and utility corridors.

The remainder of the area is available for low-density recreation activities.

8.06 IMPLEMENTATION

a. Introduction

The means of accomplishing a development program is equally as important as the plan itself. Current national priorities limit development and renovation options more than in the past. At the same time, recreation visitation to Mark Twain Lake is no longer increasing at the annual rate of the 1980's, 1990's. Nevertheless, a need exists for the proposals contained in this Master Plan; and this need is expected to become greater in the future. It should also be recognized that changing priorities could drastically affect the manner and schedule for implementing this Master Plan. Hopefully, this Master Plan will have continuing utility despite any changing priorities that may affect its implementation.

b. Implementation Methods

There are five basic implementation methods currently available for development at Mark Twain Lake:

(1.) Cost Sharing

Funding for cost sharing may well be more difficult to secure than in the past. In addition to providing at least 50 percent of the development cost of a proposal up front, the cooperating local governmental entity must also agree to operate, maintain, and provide major replacements for the new development.

Requirements for cost sharing recreational development with non-Federal public interests will be considered when the need for such facilities can be sufficiently demonstrated.

The current Corps regulation, ER 1165-2-400 requires that all recreational developments be cost shared 50 percent by non-Federal public agencies. The non-Federal sponsor is required to enter into a cost sharing contract with the Corps prior to construction and agree to assume operation and maintenance responsibilities for the completed recreation facility. In addition, the non-Federal sponsor must agree to more than offset the annualized federal investment by assuming the responsibility for operation and maintenance of existing recreation areas operated by the Corps. There is one exception to this policy that permits the construction, operation and maintenance of new facilities without cost sharing. The one exception is the authority for upgrading sanitary facilities in existing Corps managed recreation areas to meet urgent sanitation needs in accordance with provisions of applicable state and federal laws.

This Master Plan does not contain any cost sharing proposals, but may in the future serve as a basis for initiating such actions. Any program proposals will be based on a letter of intent provided by the non-Federal sponsor and shall include: (1) estimated cost of the proposed development; (2) cost to be borne by the cost sharing sponsor; (3) method of repayment the cost sharing sponsor will use to match Federal funds; and (4) understanding of the cost sharing sponsor regarding assumption of operation and maintenance.

(2.) Development Solely by Local Interests Under an Outgrant.

As in the past, local governmental entities with all or part of a project in their jurisdiction, may obtain use, under a lease or license. All costs are the sole responsibility of the local sponsor and operation, maintenance, and major replacement costs must be borne by them also.

(3.) Regular O&M General Funds.

The use of Operation and Maintenance funds is restricted to normal O&M activities and when facilities are in need of total rehabilitation, consolidation, relocation or replacement. Changes or upgrades to facilities is restricted to current O&M funding levels for replacement or rebuilding of existing facilities.

(4.) Development by Concessionaire.

Another development method that could be used at Mark Twain Lake involves the implementation of some of the plans proposed in this Master Plan by a concessionaire. Only activities for which there is a viable commercial market are eligible. For developments undertaken in this manner; operation, maintenance, and major replacements are also provided by the concessionaire.

(5.) Challenge Cost-Share

The challenge cost-sharing program provides opportunities for public and non-Federal groups and individuals to contribute to and participate in the operation and/or management of recreation facilities and natural resources at Corps water resource development projects. Partnering with others provides a way to stretch the Corps of Engineers budget by sharing the cost of developing, operating and managing recreation facilities and natural resources.

8.07 Summary of Water and Land Use Classification

Table 8-1

Plate No.	Area No.	Location Name		Acres
Intensive Recreational Areas				
3	1	M. W. Boudreaux Recreation Area		268
4	2	Ray Behrens		858
5	3	Robert Allen Recreation Area		1083
6	4	South Fork Recreation Area		176
7	5	Mark Twain State Park		1073
8	6	Stoutsville Recreation Area		486
9	7	North Fork Recreation Area		703
10	8	Mark Twain State Park - North Extension		486
11	9	Shell Branch Recreation Area		377
12	10	Sandy Creek Recreation Area		594
13,14	11	Indian Creek Recreation Area		2775
15	12	John F. Spalding Recreation Area		506
16	13	Frank Russell Recreation Area		578
17	14	Warren G. See Spillway Recreation Area		226
18	15	Bluff View Recreation Area		45
			Total	10234
Environmental and Culturally Sensitive Areas				
2	ES-1	Lick Creek		1404
2, 6	ES-2	Quarry Lake, South Fork Salt River		10
2, 13	ES-3	Indian Creek Environmental Sensitive Area		987
2, 15	ES-4	Little Indian Creek Drainage Area (Joanna Ridge)		1232
2	CS-1	Hatten Mounds		*
2, 7	CS-2	Pollard Cemetery		*
2	CS-3	Shell Branch Village Sites		*
2, 12	CS-4	Crigler Mounds		*
			Total	3633
Multiple Resource Management Areas - Low Density Recreation				
2	ML-1	Lick Creek		560
2	ML-2	Pigeon Roost		1609
2	ML-3	Allen		345
2	ML-4	North Fork		643
2	ML-5	Shell Branch		614
2	ML-6	Crigler		242
2	ML-7	Sandy Creek		259
2	ML-8	Indian Creek Upper Drainage		517
2	ML-9	Little Indian		867
			Total	5656
Multiple Resource Management Areas - Wildlife Management				
2	MW-1	Upper End		14536
			Total	14536
Project Operations				
2	O-1	Main Dam/Saddle Dams and Outlet Works/Corps Management/Maintenance Complex		260
2	O-2	Water Treatment Plant, Clarence Cannon Wholesale Water Commission		*
2	O-3	Land Irrigation Type Sewage Treatment Facilities, North Extension of Mark Twain Lake State Park		* *
2	O-4	Land Irrigation Type Sewage Treatment Facilities, Indian Creek Recreation Area		26
2	O-5	Land Irrigation Type Sewage Treatment Facilities, John F. Spalding Recreation Area		20
2	O-6	Re-Regulation Pool		1766
2	O-7	Re-Regulation Dam		10
			Total	2082
Land Use Classification Acreage				36141
General Recreation Waters				18600
All Project Fee Lands and Waters				54741

* Acreage for these areas is included in other areas

* * Acreage for this area is included in acreage for Mark Twain State Park