US Army Corps
of Engineers
Kansas City District

Engineering and Construction Division
Hydrologic Engineering Branch
Water Management Section

Annual Report of Reservoir Regulation Activities

Summary for 2006 - 2007

December 2007

NORTHWESTERN DIVISION, KANSAS CITY DISTRICT
SUMMARY OF LAKE REGULATION ACTIVITIES
AUGUST 1, 2006 TO JULY 31, 2007

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PURPOSE AND SCOPE.

This report summarizes the past year's regulation activities at storage projects within the boundaries of the Kansas City District (District) that are operated for flood control by the Water Management Section staff. It also summarizes major work items affecting the projects, and it outlines briefly the programs ongoing or proposed for the year ahead. Topics discussed in the report include recent weather patterns, project accomplishments, current project operations; major regulation problems and proposed solutions; lake regulation manuals; data collection programs and procedures; ongoing studies, and personnel of the Water Management Section. The reporting period for Water Management Section activities covers the operating year from August 1, 2006, through July 31, 2007, with additional discussion on proposed operations and studies programmed through calendar year 2008. Preparation of this report is in conformance with paragraph 13b of ER 1110-2-240, dated October 8, 1982.

LAKES IN THE KANSAS CITY DISTRICT.

The Kansas City District includes the watershed of the Missouri River from Rulo, Nebraska, (river mile 498.1 above the mouth) to the junction of the Missouri and Mississippi Rivers near St. Louis, Missouri. During the period covered by this report, 29 storage projects, at which the Corps of Engineers (Corps) has either complete or partial water control responsibilities, were in operation within the District. There are 18 Corps of Engineers lakes and 11 Bureau of Reclamation lakes. The location of each lake and reservoir in the District is shown on ***Plate 1***, and a summary of engineering data outlining the physical characteristics of each project is included as ***Plates 2A through 2E***.

PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include: flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Most functions except flood control are normally provided through the regulation of storage contained in the multipurpose pool. Releases from multipurpose storage are controlled by the manipulation of gates or other means in accordance with plans, schedules, and ratings prepared in advance to meet various conditions of inflow and demand. The general plan for regulation of flood control storage is to evacuate all accumulations in the flood control space as rapidly as downstream channel capacities and flow conditions permit. Should the top of the flood pool be exceeded, criteria have been developed for each project that schedule releases with an aim toward safeguarding the structure. Downstream interests are warned of the possibility of flooding should a surcharge operation appear likely. Although the storage space in the flood control pool is normally evacuated as quickly as downstream conditions allow, release schedules may be modified at times to serve beneficial purposes such as fish and wildlife enhancement.

CLIMATOLOGIC AND HYDROLOGIC CONDITIONS.

August 2006

Heavy rains fell across eastern Nebraska, southern Iowa, northern Missouri, and northeastern Kansas during the month of August. The heaviest amounts (4.0 to 6.5 inches) fell over east-central Nebraska upstream of Rulo into northwestern Missouri. Farther south, only light precipitation fell at best across central and southern Missouri, prompting the eastward expansion of abnormally dry (D0) to severe drought (D2) conditions in these areas. Another round of good rains (2-4 inches) fell over southern Iowa and Rathbun Lake where severe drought conditions (D2) were eliminated. Both long- and short-term climatic indicators agreed in showing large deficits on the year for west-central Missouri, where an area of extreme drought (D3) was introduced. By the end of August, thunderstorms brought moderate to heavy rains to eastern Kansas, northwestern Missouri, and southern Iowa. The heaviest rains (up to 5 inches) fell in west central Missouri, eliminating the extreme drought (D3) and reducing the severe drought (D2) drought areas for Smithville, Longview, and Blue Springs Lakes. However, moderate drought (D1) and severe drought (D2) drought areas continued for eastern Colorado, southwestern Nebraska, and northwestern Kansas. Severe and extreme drought conditions (D2 and D3) continued for central Missouri, including portions of Truman Lake, Lake of the Ozarks, Pomme de Terre Lake, and Stockton Lake. The remainder of Kansas, Iowa, and Missouri were abnormally dry (D0).

September 2006

In September, below normal temperatures prevailed over much of the District. Rainfall was abundant with 2-4 inches falling in eastern Nebraska, northern Kansas, northwestern Missouri, and southern Iowa. These rains helped abnormally dry conditions (D0) around the Rathbun Lake area. However, the central Missouri River basin, and the Osage River basin of Missouri continued in an extreme drought (D3). In eastern Colorado, western Kansas, and western Nebraska, long term drought conditions continued while short term periods of rain occurred.

October 2006

October saw little or no rain in eastern Colorado and western Nebraska. The dry month led to the significant expansion of both an agricultural and hydrologic extreme drought condition (D3) from southeastern Kansas along the Marmaton River basin into western Missouri, including the Stockton Lake, Pomme de Terre Lake, Truman Lake, and Lake of the Ozarks. For this area, precipitation totals for the past year were at least a foot below normal.

November 2006

Dry weather continued into November for the District. However, the extreme drought (D3) in southeastern Kansas, western and central Missouri improved slightly. This area was upgraded to severe drought (D2). The remainder of Missouri, Kansas, western Nebraska, and eastern Colorado continued in abnormally dry conditions (D0) to moderate drought conditions (D1).

December 2006

A major winter storm developed over Missouri in early December bringing ice and significant snow. Snowfall amounts from 7 to 14 inches and greater were common across the Missouri

Osage River and central Missouri River basins as the storm tracked northeastward. This improved conditions to moderate drought (D1) for those areas. Hydrologic abnormally dry conditions (D0) continued just north of the Missouri River near Jefferson City northeastward into the Chariton River basin. Elsewhere, light to moderate precipitation was not sufficient in improving moderate drought conditions (D1) for southwestern Nebraska. Persistent dry weather led to some expansion of abnormally dry (D0) in eastern Nebraska and northeastern Kansas, while D1 edged northward toward central Kansas. Lakes and reservoirs in eastern Colorado remained at low levels even as heavy snow fell across the Colorado plains. However, drought conditions improved to near normal across eastern Colorado.

January 2007

Two winter storms provided improvements to the drought status in southeastern Nebraska, northwestern Missouri, and southern Iowa. These areas were finally near normal. In western Kansas, drought conditions were also back to normal where up to 5 inches of precipitation were recorded. Healy, Kansas, observed 4.70 inches of precipitation, while Leoti, Kansas, recorded 5.37 inches for the week. In the central portion of the state, abnormally dry (D0) and moderate drought (D1) were also improved. By mid-January another winter storm brought devastating freezing rain and sleet in totals of 3-5 inches to southeastern Kansas and southwestern Missouri. This precipitation eased drought conditions in these areas up from a moderate drought (D1) to abnormally dry (D0). At the end of January, snow (2-6 inches generally but up to 10 inches) blanketed much of southern Nebraska, northern Kansas, northern Missouri and southern Iowa. Since mid-December, frequent precipitation produced short-term surpluses in these areas. However, hydrologic abnormally dry conditions (D0) remained in southwest and northeast Missouri where long-term deficits remained. In addition, drought conditions persisted in the upper Midwest and northern Plains, with little or no precipitation, moderating temperatures (weekly departures +4 to +8F), and an increasing shallow snow pack.

February 2007

February began as a very dry month for most of the District. However, rainfall amounts of 1-3 inches ended the hydrologic dry conditions (D0) across most of southwestern Missouri. By Saturday, February 24, a strong low pressure system over Kansas was spreading rain, snow, and ice across the District. This storm eliminated the abnormally dry conditions (D0) in the vicinity of Rathbun and Long Branch Lakes. In northeastern Colorado, although storm amounts were modest, moderate drought (D1) retreated northward based on estimated soil moisture and cumulative precipitation totals. Weekly amounts exceeding 0.5 inches resulted in a slight reduction in the abnormally dry (D0) and moderate drought (D1) area in Kansas. Most of the District ended the month near normal with the exception of abnormally dry conditions (D0) in extreme southwestern Nebraska.

March 2007

Drought conditions continued to improve across the District during March. Abundant rains (2 inches or more) fell across southeastern Kansas, helping to eradicate the lingering pocket of severe drought (D2) and reducing the coverage of abnormal dryness (D0) and moderate drought (D1), which was already west of the Marmaton and Marais des Cygnes Rivers. A major storm tracked into the District March 28-30 and brought severe weather and heavy rains. By March

30th, flood watches and warnings stretched across Kansas and Nebraska. The heavy rains eliminated the lingering dryness in Kansas, which saw up to 5 inches of rain from Wednesday to Saturday.

April 2007

April began dry with colder than normal temperatures across the District. Spring rains began again in mid-April with 1-2 inches of rain in Nebraska and Kansas. With frequent and ample precipitation across most of the central Plains since January, accumulated surpluses of 2 to 6 inches during the past 30-, 60-, and 90-days were noted. This wet weather, in combination with occasional cold outbreaks, shrunk the areal coverage of long-term drought in southwestern Nebraska, and northeastern Colorado. April ended wet over much of the District. Many locations received in excess of 2 inches of rain the last week of April, with some lowland flooding taking place as well. In response to the recent wet pattern, improvements were made to the current drought situation around Harlan County Lake. Drought conditions with D0, D1 and D2 designations were pushed farther to the west. Much of the lingering drought in Nebraska was due to long-term hydrologic impacts in the region.

May 2007

On May 5th, a very moist and unstable air mass dominated the District with an area of very high moisture in the lower atmosphere centered over eastern Kansas / Nebraska and western Missouri / Iowa. A disturbance in the upper atmosphere with a lot of energy was moving northeastern into western Kansas. A surface low pressure center was located over northeastern Colorado with an associated cold front extending southward along the Colorado / Kansas border. A dry line (a boundary between dry and humid air masses) developed ahead of the cold front with dry air moving eastward out of Colorado from the Rocky Mountains. A line of thunderstorms developed along the dry line during the afternoon hours from west of Concordia to near Wilson Lake southward to the Kansas / Oklahoma border. In the meantime another area of storms was moving out of eastern Nebraska into western Iowa with very heavy rain. The morning of May 6th, the low pressure center had weakened and dissipated while the cold front became parallel with the upper level wind flow causing it to become stationary across western Kansas. The line of storms over central Kansas moved eastward, increased in intensity and coverage, and extended from south-central, Iowa to Chillicothe, MO southwestward to Kansas City and to Wichita, KS. With the assistance of upper atmospheric energy this line of storms developed into a Mesoscale Convective Complex (MCC). The MCC produced a "training effect" of waves of excessive rainfall as storms regenerated and moved northeastward across the same areas of western Iowa, eastern Nebraska, eastern Kansas, and western Missouri. In the meantime, another line of thunderstorms developed along the stationary cold front over central Kansas from near Manhattan southward to the Kansas / Oklahoma border. During the early morning hours of May 7th, the stationary front across western Kansas began to move eastward again as a cold front. This allowed the line of storms over central Kansas to finally begin to move eastward with still heavy rainfall. However, the atmosphere began to stabilize behind the MCC. Therefore, rainfall intensity began to decrease very rapidly. By late afternoon, most of the rain had moved through Missouri and east of the Mississippi River.

<u>Rainfall Totals</u>:
Topeka – Forbes Field Airport – 8.78"

Logan, IA – 7.98”
Randolph, IA – 7.87
Omaha, NE – 7.46”
Hiawatha, KS – 6.97”
Perry Lake, KS – 6.81
Maryville, MO – 6.62”
Longview and Blue Springs Lakes, MO – 6.56”
Tuttle Creek Lake, KS – 6.10”

On May 23-24, another round of flooding rains hit the same areas with an additional 2-4 inches of rain with isolated amounts of 6 inches.

June 2007

As the month of June began, drought conditions were near normal with a few of exceptions. Abnormally dry conditions (D0) crept back into extreme eastern Colorado and western Kansas along with the eastern Missouri River basin. However, on Wednesday, June 27th, a north flowing low level jet about 3,000 ft in the atmosphere brought a very moist atmosphere from the Gulf of Mexico due north into eastern Kansas and western Missouri. With this air mass in place, a “cut off” low pressure center at 18,000 ft moved very slowly into extreme southern Oklahoma. A “cut off” low means that there are very little, if any, steering currents above the low to move it. So, the low center is virtually cut off from any steering currents. At the jet stream level of 33,000 ft, wind flow diverged over eastern Kansas setting the stage for a very unstable atmosphere. As moisture flowed northward from the Gulf and westward around the “cut off” low, heavy rain developed over eastern Kansas. With little or no steering currents, this rain continued to develop over the same areas of the Osage basin, but remain nearly stationary. The hardest hit areas were along the Marais des Cygnes river, near Osawatomie and La Cygne, Kansas and then eastward into Bates County, Missouri along the South Grand River. On Thursday, June 28th, moisture continued to flow northward from the Gulf. However, the “cut off” low retrograded, moving back westward from the direction it came. This caused the nearly stationary area of rain to move farther into southeastern Kansas.
On Friday, June 29th, the “cut off” low remained nearly stationary with moisture continuing to flow northward into eastern Kansas and western Missouri. More rounds of heavy rain developed over the Osage basin with rainfall rates reaching 2-3 inches per hour. Finally, Saturday June 30th, winds in the upper atmosphere increased allowing the “cut off” low to begin to move eastward slowly. Thus, heavy rain continued in eastern Kansas and then began to move into western Missouri. As the rain progressed eastward, the low level moisture flow shifted eastward as well. This allowed the heavy rain area to begin to weaken and eventually dissipate as it reached central Missouri.

5 Day Rainfall Totals:

City	County	Rainfall in Inches
Pleasanton	Linn, KS	15.80
Mound City	Linn, KS	15.01
La Cygne	Linn, KS	14.90
Trading Post	Linn, KS	13.28
Butler	Bates, MO	12.11

Drexel	Cass, MO	12.10
Harrisonville	Cass, MO	11.85
Stanley	Johnson, KS	10.62

City	County	Rainfall in Inches
Urich	Henry, MO	10.02
Paola	Miami, KS	9.86
Osawatomie	Miami, KS	8.70
NWS Pt. Hill	Cass, MO	8.19
Clinton	Henry, MO	7.30
Whiteman AFB	Johnson, MO	6.54
Otterville	Cooper, MO	6.29
Higginsville	Lafayette, MO	6.26
Olathe	Johnson, KS	6.14
Lee's Summit	Jackson, MO	5.72

July 2007
Abnormally dry conditions (D0) continued for extreme eastern Colorado and western Kansas. These conditions also developed due to the lack of rain, over southeastern Nebraska, northeastern Kansas, southern Iowa and northern Missouri. By the end of the month, abnormally dry conditions spread southward to include the entire Missouri River basin.

PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Project accomplishments in each of these functional areas, for the period covered by this report, are described briefly in the following subparagraphs.

Flood Control.

Stream flow regulation by storage projects in the Kansas City District began with the closure of Kanopolis Lake in February 1948. By July of that year, Kanopolis also provided the first flood control storage, benefiting downstream damage centers. Since then, stream flow regulation by District projects has produced flood reduction benefits estimated in the

Table 1: Flood Reduction Benefits
(Thousand Dollars)

Project	Fiscal Year 2007	Cumulative
Clinton Lake, KS	$143	$961,955
Harlan County Lake, NE	$27	$177,563
Harry S Truman Resv., MO	$2,021	$1,843,135
Hillsdale Lake, KS	$0	$31,910
Kanopolis Lake, KS	$364	$1,523,908
Little Blue River Lakes, MO	$0	$50,813
Long Branch Lake, MO	$0	$48,299
Melvern Lake, KS	$29	$195,833
Milford Lake, KS	$248	$1,193,610
Perry Lake, KS	$804	$4,986,271
Pomme De Terre Lake, MO	$0	$66,210
Pomona Lake, KS	$34	$197,266
Rathbun Lake, IA	$2	$147,031
Smithville Lake, MO	$318	$846,554
Stockton Lake, MO	$0	$201,347
Tuttle Creek Lake, KS	$1,681	$5,645,346
Wilson Lake, KS	$4	$1,381,079
TOTALS	**$3,656**	**$19,498,130**

millions of dollars annually. In addition to the Corps of Engineers lake projects, local protection projects in the form of levees, floodwalls, and channel improvements also have provided flood reduction benefits amounting to millions of dollars. Federal and private agricultural levees along with temporary storage of flood flows in the main stem reservoir system above Sioux City provide additional benefits within the District. During the reporting period, all of the District lakes except Harlan County and Wilson stored water in the flood control pools. On 1 July 2007 Truman Lake experienced an inflow of 191,000 cfs and on 12 July 2007 crested at 730.22 feet, the sixth highest on record. Flood reduction benefits during Fiscal Year (FY) 2007 credited to all Corps lake projects in the District were $3,655,614,000. During the same period, benefits credited to Section 7 Bureau of Reclamation projects within the District totaled $13,802,000. The accumulated total of flood control benefits for Bureau projects within the District totaled $1,736,836,000. The upstream main-stem projects are responsible for additional flood damage reductions along the Missouri River within the Kansas City District reach. A compilation of flood reduction benefits at Corps Lakes in the District is shown in ***Table 1*** above. The majority of the FY 2007 flood reduction benefits were incurred during the month of July 2007.

Irrigation.

Irrigation data has been obtained from the Bureau of Reclamation (Reclamation) 2006 and 2007 Annual Operating Reports. Harlan County Reservoir released 10,687 ac-ft of irritation water during the May-August period. This was the second year in a row that irrigation releases were made.

ACRES IRRIGATED IN 2006 AND 2007

Irrigation District and Canal	Available	Acres Irrigated in 2006	Acres to be Irrigated in 2007
Mirage Flats Irrigation District	11,662	11,092	11,100
Mirage Flats Canal			
Ainsworth Irrigation District	35,000	34,452	34,500
Ainsworth Canal			
Twin Loups Irrigation District			
Above Davis Creek	34,053	34,040	34,000
Below Davis Creek	20,851	20,861	20,900
Total Twin Loups Irrigation District	54,904	54,901	54,900
Frenchman Valley Irrigation District	9,292	0	2,000
Culbertson Canal			
H & RW Irrigation District	11,915	0	0
Culbertson Extension Canal			
Frenchman-Cambridge Irrigation District			
Meeker-Driftwood Canal	16,855	0	0
Red Willow Canal	4,797	0	0
Bartley Canal	6,353	5,722	0
Cambridge Canal	17,664	15,077	15,500
Total Frenchman-Cambridge Irrigation District	45,669	20,799	15,500

Almena Irrigation District Almena Canal	5,764	0	2,000
Bostwick Irrigation District in Nebraska			
Franklin Canal	10,920	0	0
Naponee Canal	1,650	0	0
Franklin Pump Canal	2,090	0	0
Superior Canal	5,848	0	3,000
Courtland Canal (Nebraska)	1,946	0	0
Total Bostwick Irrigation Dist. in Nebraska	22,454	0	3,000
Kansas-Bostwick Irrigation District			
Courtland Canal above Lovewell	13,378	5,925	1,000
Courtland Canal below Lovewell	29,122	22,655	23,000
Total Kansas-Bostwick Irrigation District	42,500	28,580	24,000
Kirwin Irrigation District Kirwin Canal	11,465	0	8,000
Webster Irrigation District Osborne Canal	8,537	0	0
Glen Elder Irrigation District	10,370	6,693	6,700
TOTAL PROJECT USES	269,532	156,517	161,700
Non-Project Uses Hale Ditch	700	0	700
TOTAL PROJECT AND NON-PROJECT	270,232	156,517	162,400

Precipitation was below normal at 13 of the 16 Bureau of Reclamation dams in Kansas and Nebraska. Glen Elder Dam recorded zero precipitation for the month of January while six project dams recorded zero precipitation for the month of February.

Precipitation during May, June and July was generally below normal throughout the basin. All Reclamation dams recorded below normal precipitation during May and June. August and September precipitation improved considerably. Kirwin Dam recorded the greatest August precipitation total ever for the month. Temperatures in August and September were generally normal throughout the projects area.

October was generally wetter than normal while November was generally drier than normal. Precipitation during November was only 24 percent of normal over the Reclamation projects. Precipitation during December was well above normal at all project dams. December precipitation was the greatest ever recorded for the month at13 of the 16 Reclamation dams.

The State of Colorado makes Bonny Reservoir storage water available to Hale Ditch and other natural flow appropriators under short-term water service contracts. Most of the 700 acres served by Hale Ditch are now owned and operated by the Division of Wildlife. During calendar year 2006 and the first half of calendar year 2007, the Colorado Water Commissioner did not

direct that reservoir inflows from the South Fork of the Republican River and Landsman Creek be passed through Bonny Reservoir into Hale Ditch. Likewise, the Colorado Department of Natural Resources did not request storage releases for irrigation purposes into Hale Ditch.

Municipal and Industrial Water Supply and Water Quality Control.

Three municipalities and one rural water district have executed water service contracts for full or supplemental water supplies from three Reclamation reservoirs. A contract with the city of Norton, Kansas, provides for a maximum annual usage of 1,600 AF from Keith Sebelius Lake (Norton Dam). A contract with Beloit, Kansas, provides for a maximum annual usage of 2,000 AF from Waconda Lake. Waconda Lake also provides up to 1,009 AF of water for a contract with the Mitchell County Rural Water District No. 2. Based on the current State of Kansas Certificate of Appropriation, water usage is not to exceed 737 AF per calendar year. A contract with the City of Russell, Kansas, provides for a maximum annual usage of 2,000 AF from Cedar Bluff Reservoir.

During calendar year 2006, the City of Norton used 456 AF of storage from Keith Sebelius Lake for municipal purposes. Storage releases made from Waconda Lake for the city of Beloit totaled 754 AF, with an additional 5,596 AF bypassed for downstream water quality control as directed by the State Water Commissioner. Releases of 837 AF were made to the Mitchell County Rural Water District No. 2 from Waconda Lake. 1,683 AF was released from Cedar Bluff Reservoir during 2006 for the City of Russell. The State of Kansas took 1 AF of water for the fish hatchery downstream of Cedar Bluff Dam.

Twenty three water supply contracts exist between the Corps of Engineers and the State Agencies at 14 lakes, for lake storage space, annual withdrawals, or surplus water. Contracts exist with eleven other municipalities and rural water districts within Kansas, Missouri, and Iowa. The State of Kansas in turn contracts with a large number of municipalities and industrial sites to supply water from the State's contracted storage space through the water assurance and water marketing programs. To date, assurance districts have been formed for users along the lower Smoky Hill River, lower Kansas River and the State of Kansas portion of the Marais des Cygnes River.

Water is supplied within the limits of each contract through designated lake releases or from intakes located on the lake at the following projects: Kanopolis, Milford, Tuttle Creek, Perry, Clinton, Melvern, Pomona, Hillsdale, Smithville, Longview, Rathbun, Long Branch, Stockton, and Harry S Truman.

Recommendations for minimum stream flows to benefit stream sanitation and for the maintenance of desirable water quality standards were originally established by the U.S. Public Health Service for many river reaches below proposed dams in the District. These recommendations were then utilized to establish minimum release requirements for many of the District lake projects. The minimum release standards set by the Corps water control plans are usually less than the minimum desirable stream flows set by state water authorities. The latter are intended to satisfy water right holders and fish and wildlife flow standards. In some cases, specific water quality storage allocations were included in the project planning to increase the

reliability of the minimum flow releases. Depending on the project, the minimum release quantities may be constant through the year, or they may vary seasonally or vary depending on the amount of current lake storage. Minimum releases for the purposes of downstream quality control and stream sanitation range from 3 cfs during the winter months at Hillsdale Lake to 100 cfs at Tuttle Creek Lake. Seepage is generally considered sufficient to meet minimum flow requirements downstream of the Reclamation dams. Additional releases are made from Tuttle Creek, Milford, and Perry Lakes for water quality and water supply purposes during periods of low flow on the Kansas River. Releases from any lake may be reduced below minimum requirements for brief periods due to construction, periodic inspections, or emergencies.

Navigation.

Releases from the Missouri River main stem reservoir system are designed to provide equitable service to navigation and other project purposes, while at the same time recognizing the important flood control functions of the system. Navigation on the Missouri is limited to the ice-free season, with a full season normally extending from April 1 to December 1 at the mouth. Operating experience plus numerous studies have indicated that flows of 35,000 cfs at Kansas City are the minimum that will permit navigation. Groundings can occur with flows of that magnitude, and dredging may be needed to alleviate local problems. Therefore, an additional flow of 6,000 cfs above the minimum service target has been set as the "full service" level for the navigation function. Thus, a full-service target flow of 41,000 cfs at Kansas City is considered adequate to maintain the designed 9-foot by 300-foot channel with little or no dredging. Milford, Tuttle Creek and Perry lakes are at times called upon to supplement Missouri River flows below Kansas City in order to meet the navigation requirement and to conserve water in the main stem lakes.

On September 26, 2007 the Reservoir Control Center notified the Kansas City District that navigation support would be required, and a Desoto target of 4,000 cfs was established. A navigation supplementation release of 2000 cfs was made from Tuttle Creek for 20 days. No navigation supplementation releases were made from Milford or Perry Reservoirs. A total of 79,339 ac-ft was released for navigation supplementation. On October 15, 2007, the supplemental releases were stopped. The navigation season ended at the Kansas City reach on October 22, 2007.

Hydropower.

Hydropower is generated at two Kansas City District projects. Stockton Dam has one unit with a nameplate rated capacity of 45 megawatts (MW), and an overload generation rate of 52 MW. Harry S Truman Dam has six units with a total nameplate rated capacity of 160 MW, and an overload generation rate of 180 MW. The Southwestern Power Administration markets power from Stockton and Harry S Truman projects.

Stockton’s power operation continues to be restricted by downstream channel capacities that limit tailwater elevations to 777.0 feet above mean sea level (msl) and Highway “J” stages to a maximum reading of 17.5 feet. Generation by the Stockton plant during this report period totaled 37,761 megawatt hours (MWH).

Generation by the Harry S Truman plant totaled 266,754 MWH during the period of this report. Power generation releases at Harry S Truman are restricted to four units during the week and three units on weekends between Memorial Day and Labor Day by the Consensus Plan. During the period December 1 to March 1, five units may be operated during the weekdays (total time limited to 600 hours per year) and three units on weekends. The tailwater elevation measured at the Highway 7 Bridge in Warsaw is limited to 662.5 feet msl, Union Electric datum, during five-unit releases from the power pool. Flood control releases are made through the generation units as much as possible. When Truman pool level is above 710.0 feet msl, a minimum of one unit is operated continuously. The Consensus Plan for Truman was negotiated and approved between the Corps, the State, and the Southwestern Power Administration, and became effective March 1990.

Fish and Wildlife.

Water level management plans, which include the fluctuation of pool levels at various times of the year for the enhancement of fish and migrating waterfowl, were in effect during the report period at the following Kansas City District lakes: Smithville, Clinton, Hillsdale, Kanopolis, Melvern, Wilson, Pomme de Terre, Perry, Pomona, Milford, Rathbun, Stockton, and Long Branch. Truman Lake makes releases for the downstream spring fish spawn when water is available, in accordance with an agreement with Southwest Power Administration and the State of Missouri.

Recreation.

Recreational use of the Corps lakes is a highly visible and important function. Recreational use is enhanced when the lakes are operated close to their normal or multipurpose pool levels. During flood years when large quantities of water are stored in the flood pools and during drought years when the lake levels drop, then access to the lakes and the shoreline facilities, as well as the quality of the experience, is reduced. Park managers at the projects are also concerned about related factors such as facility maintenance and water quality. The fish and wildlife function is closely related to the recreation experience, and coordination with state and county park officials for park management is important. A list by projects of the visitation totals at Corps lakes is shown in ***Table 2***. Park visitation was up 10% over the previous year. Project park facilities at Blue Springs, Hillsdale, Long Branch, Longview, and Smithville are leased to county or state agencies.

Table 2: Visitation Hours
August 1, 2006 through July 31, 2007

Project	Visitation (Visitor Hours)
Clinton Lake, KS	10,049,736
Harlan County Lake, NE	6,635,564
Harry S Truman Resv., MO	14,554,633
Hillsdale Lake, KS	1,230,967
Kanopolis Lake, KS	1,644879
Long Branch Lake, MO	1,691,825
Longview/Blue Springs MO	3,050,553
Melvern Lake, KS	5,352,999
Milford Lake, KS	7,133,197
Perry Lake, KS	4,950,206
Pomme de Terre Lake, MO	14,733,676
Pomona Lake, KS	3,370,304
Rathbun Lake, IA	6,840,446
Smithville Lake, MO	7,641,662
Stockton Lake, MO	6,918,997
Tuttle Creek Lake, KS	1,951,434
Wilson Lake, KS	2,360,218
TOTALS	**104,085,770**

PROJECT OPERATIONS.

Corps of Engineer Lakes - August 1, 2006 through July 31, 2007.

During the last period, prolonged flood-fighting lake regulation activities were required at many of the District Reservoirs. Sixteen of the District's 18 lakes stored water in their flood pools. Those which did not store water in their flood control pools included Harlan County Lake and Wilson Lake. The maximum encroachment into exclusive flood control space was 26.25 feet above multipurpose level at Truman Lake on July 12, 2007.

With the exception of the approved deviation requests noted below, Corps lakes within the Kansas City District were regulated in accordance with normal procedures during the period covered by this report. Details regarding the regulation of all projects are included, along with pool elevation hydrographs, in Appendix A of this report. Approved Northwestern Division (NWD) deviations from the Water Control Manuals are as follows:

Lovewell Reservoir Deviation

- Approved March 2007 through July 2007: Deviation in accordance with an agreement between State of Kansas and NWD to allow storage of water in the lower 1.6 feet of the flood pool at Lovewell Reservoir. The deviation was at the request of the U.S. Bureau of Reclamation and substantially increased the irrigation benefit of the project without adversely affecting the other beneficial purposes.

Navigation Deviation

- Approved June 2007 through October 2007: Deviation in accordance with an agreement between State of Kansas and NWD to allow storage of water in the lower 5% of the Kansas basin reservoirs. The purpose was to reduce draw-downs into the multipurpose pool expected with increased navigation supplementation releases due to drought and restrictions on Gavins Point Dam releases required under the USFWS Missouri River BiOp.

Water Level Management Plan Deviation

- Approved November 2006 through December 2007: Deviation approving water level management plans for District lakes in Kansas and Missouri. Affected Keith Sebelius, Webster, Kirwin, Glen Elder, Kanopolis, Wilson, Clinton, Hillsdale, Melvern, Perry, and Pomona lakes.

Bureau of Reclamation Projects – August 1, 2006 through July 31, 2007.

1. Conservation Operations. The 2006 inflow was below the dry-year forecast at Bonny, Enders, Lovewell, and Webster Reservoirs, and Swanson, Hugh Butler, Harry Strunk, Harlan County, and Waconda Lakes. Cedar Bluff Reservoir and Keith Sebelius Lake had inflows between the dry- and normal-year forecasts. None of the project reservoirs had inflows above the normal-year forecast. All project reservoirs had below average carryover storage from the 2005 water year. Of the 12 project reservoirs in the Kansas River Basin, only Keith Sebelius Lake, and Lovewell and Cedar Bluff reservoirs did not record below average inflows during all 12 months of 2006. Cedar Bluff Reservoir recorded below average inflows during 11 months of 2006, and Keith Sebelius Lake recorded below average inflows during 10 of the months. Just prior to the irrigation season, Enders,

Kirwin, and Webster Reservoirs, along with Keith Sebelius, Swanson, Hugh Butler, Harry Strunk and Harlan County Lakes, did not have sufficient storage to provide water users with a full water supply. Harry Strunk Lake and Lovewell Reservoir had some flood storage occupied prior to the irrigation season. The high irrigation demand months of July and August significantly reduced storage in those project reservoirs that had storage available for irrigation. Precipitation during late July and August was of little help in reducing the demands on project reservoirs. Storage in all the Kansas River Basin project reservoirs was below normal at the end of the irrigation season. The following summarized graph shows a comparison of 2005 and 2006 carry-over storage conditions as compared to the top of conservation storage for all reservoirs in the Niobrara, Lower Platte, and Kansas River Basins as of September 30th.

2. Flood Control Operations. Harry Strunk Lake and Lovewell Reservoir utilized flood pool storage in 2006. Flood releases were not required to reduce or maintain pool levels. The 2006 flood control benefits accrued by the operation of Reclamation's Nebraska-Kansas Projects facilities was $36,000 as determined by the Corps of Engineers. An additional benefit of$7,000 was credited to Harlan County Lake. The accumulative total of flood control benefits for the years 1951 through 2006 by facilities in this report total $1,873,595,000 (see Table 5).

The regulation of flood control storage in Reclamation reservoirs in the Kansas River basin is the responsibility of the Kansas City District Water Management Section. When project inflows are sufficient to produce an encroachment into the flood pool, coordination is immediate between the two Federal agencies, and decisions are made regarding the regulation desired. Water Management staff issues regulation orders to the Reclamation's Water Operations Group at the McCook Field Office in Nebraska. The McCook Field Office is responsible for issuing orders for both flood control and conservation releases to the Reservoir Superintendent. Details on operation of Reclamation's reservoirs, along with pool elevation hydrographs, are included in Appendix B of this report.

Operations – August 1, 2007.

Corps and Reclamation storage lakes in the District contained a total of 6,102,000 AF of storage on August 1, 2007. Of the total volume in storage, 456,000 AF (7 percent) were contained in the Reclamation lakes and 5,646,000 AF (93 percent) were contained in the Corps projects.

Twelve of the eighteen Corps lakes and none of the eleven Reclamation lakes in the District contained storage in their flood control pools on August 1, 2007. The occupied flood control storage amounted to 1,116,000 AF. This volume compares to 8,407 AF of flood control storage space occupied on August 1, 2006.

MAJOR REGULATION PROBLEMS AND PROPOSED SOLUTIONS.

Navigation Support.

The State of Kansas reached a one-year agreement to store water in the flood pools of Milford and Perry Lakes for navigation support during the summer of 2007. A total of 79,339 ac-ft of water was used for navigation supplementation. Discussions between the State of

Kansas and both the Kansas City District and Northwest Division resulted in the one-year plan. Water storage was permitted in the flood pools up to a level equivalent to 5% of the total flood pool storage in each of the lakes. The 5% flood control pool elevations for each lake are:

Perry Lake	893.7 feet msl
Milford Lake	1146.7 feet msl

Endangered Species Act.

Beginning in 1999, releases at Milford and Tuttle Creek Lakes have been affected each summer by special operations required by the Endangered Species Act (ESA). Two listed bird species, the Piping Plover and the Least Tern, were first reported nesting on sandbars in the Kansas River during the mid-1990's. These birds have also affected operations along the Missouri River upstream of Omaha since they were first listed under ESA in 1985. The Terns and Plovers nesting season typically lasts from May through August. During that period, the Corps monitors the bird nests and when possible restricts releases from upstream lakes to protect them to the extent practical from local uncontrolled runoff. The lakes can only control a portion of the basin runoff from spring and summer storms, and many times the runoff from storms closer to the nests are sufficient to destroy them. Since the major nesting areas to date have been in the Manhattan to Topeka reach of the river, these operations have mainly affected Milford and Tuttle Creek Lakes. In previous years, as much as 17 percent of the flood pool at Tuttle Creek Lake has been forced into storage by ESA concerns.

In accordance with a U.S. Fish and Wildlife Service Missouri River Biological Opinion, the District has developed a plan of operation to monitor the nesting areas and coordinate lake releases. Survey crews consisted of a combination of personnel from the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the Kansas Biological Survey, and Westar Energy's Green Team. During the 2007 season, the Corps of Engineers loaned its airboat to the U.S. Fish and Wildlife Service to conduct additional monitoring. An Operations Division biologist assisted in monitoring of bird activity and Kansas River conditions.

Active nesting colonies were documented at Wabaunsee Island and on the Belvue sandbar. The nests at each location were numbered and marked using tongue depressors or survey lath. Nest elevations, number of eggs, stage of incubation, and the fate of the young were determined. There were no known Piping Plover nesting attempts in 2007. A total of 12 Least Tern nests were established and 25 eggs were laid. Four Least Terns were documented to have fledged and one additional Least Tern is assumed to have fledged from the Belvue sandbar nest site. There was no requirement for deviation from the reservoir regulation manuals to satisfy ESA considerations.

Lovewell Deviation Request.

Drought conditions and depleted inflows into Harlan County Lake continued this reporting period. In an effort to retain irrigation water, the Kansas City District and the Bureau of Reclamation prepared a joint deviation request, dated 14 March 2007, to store 1.6 feet of additional water in Lovewell Reservoir for irrigation purposes. Lovewell and Harlan County are operated as a system to provide irrigation support for the Bostwick Irrigation districts. Additional water stored in Lovewell Reservoir would offset the lack of storage in Harlan County Lake and result in improved Harlan County Lake conditions. Documents were prepared in accordance with Draft Guidance provided by Division, showing that storage of 1.6 feet additional water in Lovewell would not severely affect flood control capabilities of the project and would result in substantial benefits to the region.

On 27 March 2007, Northwestern Division approved a deviation for Lovewell Reservoir to store up to 1.6 feet to supplement storage from Harlan County Lake for irrigation purposes.

WATER CONTROL MANUALS.

Manual Status.

This section serves to provide the information requested in paragraph 13c of ER 1110-2-240, dated October 8, 1982, regarding the status of water control manuals.

Water control plans prepared for specific projects and basins within the Kansas City District have been documented in appropriate manuals as directed by paragraph 6c of the above referenced ER. Paragraph 6c also directs that water control plans be revised as necessary to conform with changing requirements resulting from developments in the basin, improvements in technology, new legislation, or other relevant factors, provided such revisions comply with existing Federal regulations and established Corps of Engineers policy.

No water control manuals were submitted to Division for approval during the current reporting period. The schedule and status of manuals for all projects is shown on ***Table 3***.

Table 3: Project Manual Status and Revision Schedule

Reservoir/Lake	Stream/River	Owner	Report Status	Submission Schedule
Nebraska				
Master Manual	Republican	CE	Updated final submitted to NWD for review July 28, 1977	
Harlan County	Republican	CE	Revision approved by NWD May 10, 2001	
Harry Strunk	Medicine Creek	BR	Approved by NWD July 12, 1974	
Enders	Frenchman Creek	BR	Approved by NWD March 26, 1973	
Swanson	Republican	BR	Flood Control Plan approved by HQUSACE October 6, 1969	
Hugh Butler	Red Willow Creek	BR	Flood Control Plan approved by HQUSACE November 21,1969	
Colorado				
Bonny	S. Fork Republican	BR	Approved by HQUSACE October 6, 1969	
Kansas				
Lovewell	White Rock Creek	BR	Approved by HQUSACE April 9, 1969 subject to comments	
Milford	Republican	CE	Approved December 1984. Minor revision approved Jan 1995	
Norton	Prairie Dog Creek	BR	Approved August 28, 1974	
Master Manual	Smoky Hill	CE	Approved March 28, 1975	
Kanopolis	Smoky Hill	CE	Revision submitted to NWD October 30, 1984	
Cedar Bluff	Smoky Hill	BR	Approved by NWD September 25, 1975	
Kirwin	N. Fork Solomon	BR	Approved by NWD February 6, 1974	
Webster	S. Fork Solomon	BR	Approved by NWD July 16, 1975	
Wilson	Saline	CE	Revision submitted to NWD June 13, 1997	
Waconda	Solomon River	BR	Approved by NWD July 12, 1972	
Master Manual	Kansas	CE	Approved by HQUSACE March 22, 1967 subject to comments	
Tuttle Creek	Big Blue	CE	Approved April 16, 1974. Minor revision approved January 1995	
Perry	Delaware	CE	Approved July 1973. Minor revision approved January 1995	
Clinton	Wakarusa	CE	Approved February 12, 1980	
Master Manual	Osage River	CE	Approved by HQUSACE Sep 21, 1970 subject to comments	
Pomona	110 Mile Creek	CE	Approved February 1973	
Melvern	Marais Des Cygnes	CE	Approved June 27, 1985	
Hillsdale	Big Bull Creek	CE	Submitted to CENWD-PDM for approval on May 20, 2005.	
Missouri				
Pomme De Terre	Pomme De Terre	CE	Submitted to CENWD-PDM for final approval on Sep 11, 2006.	
Harry S Truman	Osage	CE	Interim manual approved by NWD May 12, 1981. Minor revision approved April 1996	
Hillsdale	Big Bull Creek	CE	Submitted to CENWD-PDM for final approval on Sep 11, 2006.	
Stockton	Sac	CE	Approved August 21, 1975	
Smithville	Little Platte	CE	Approved August 12, 1979	
Long Branch	E. Fk Ltl. Chariton	CE	Interim manual approved November 21, 1978	
Longview	Little Blue	CE	Approved February 15, 1994	
Blue Springs	E. Fork Little Blue	CE	Approved January 27, 1994, minor revisions submitted Dec 1994	
Iowa				
Rathbun	Chariton	CE	Submitted to CENWD-PDM for final approval on Apr 20, 2006	

Other Reports

Plates 2A-E list project data showing the date impoundment of storage began, the date the multipurpose pool (the active conservation pool in USBR projects) first filled, and the current status of Standing Instructions for Regulation of Storage in Corps of Engineers Lakes.

As indicated in Engineering Manual 1110-2-3600, it is essential that project operators (dam tenders, operations managers, power plant superintendents) at the various flood control and multiple-purpose reservoirs be supplied with regulation schedules to be followed in case of communication failure. These regulation schedules should be followed in case of communication failure with the headquarters from which instructions are normally issued during flood situations. Standing Instructions have not yet been issued for Harry S Truman Reservoir, Clinton, Hillsdale, Long Branch, Smithville, Longview, and Blue Springs Lakes.

HYDROLOGIC DATA COLLECTION.

The primary objectives of Kansas City District's hydrologic data program is to provide information on precipitation and stream flow characteristics occurring over and within a particular area for a given period of time. These data are used for many purposes, including the design, construction, and maintenance of a wide variety of structures in and along streams; the management of lake releases during floods; the production of hydropower; the design and maintenance of navigation facilities; the control of pollution; the management of flood plains; the development of recreational facilities; the design of highway bridges and culverts; the establishing and administering of water rights and compacts; and the resolving of political, social, and legal water problems. As with any program, however, the restraint on funds and manpower, and the usefulness of the data obtained will determine to what extent the program will, or should, be pursued at any particular point in time. The overall program of observing, monitoring, and collecting hydrologic and meteorological data in the District is quite extensive yet flexible to meet operational and economic needs. Brief descriptions of the various types of data collection now being utilized are presented in the following paragraphs.

Collection and Processing of Water Control Data.

Hydrologic data such as precipitation, stream flow, and lake information are collected in the Kansas City District by: individual observers, Corps project offices, the National Weather Service, the Geological Survey, the Bureau of Reclamation, and certain state agencies. Several different methods of communication are used in the Kansas City District to receive these data including: electronic transfer, e-mail, telephone, and fax. The electronic transfer of data includes FTP between agency computers and data transmitted through a satellite downlink and a Local Readout Ground Station (LRGS). Data received by the District is entered onto the Water Management Section's Unix server database by both automated and manual methods, depending on the data source. Software developed by Water Management Section staff provides a means to view, screen, and process the data for graphical and reporting purposes. The data is then uploaded to the MSC database in Omaha. Daily data and project reports are also available to the public at the Section's web site, http://www.nwk.usace.army.mil/watermanagement/.

The Water Management Section is using a Unix/Linux system. Hardware is available in Omaha for a backup server if needed.

Automatic Remote Sensors.

Data Collection Platforms (DCP's) are the primary means by which Kansas City District obtains remote sensing data on stream stages and lake elevations. The DCP is a sophisticated device that collects the information from a stage/elevation sensor and transmits the data to a GOES satellite for subsequent retrieval by the National Environmental Satellite, Data, and Information Service (NESDIS) at Wallops Island, Virginia. NESDIS then rebroadcasts all data over a single high-speed channel on a Domestic Communications Satellite (DOMSAT). The Water Management Section receives DCP data from NESDIS or directly from the DCP's with a DOMSAT receiver station. Maintenance of the DCP's is performed by the USGS under contract with the Corps of Engineers. In 2007, the District supported 98 permanent DCP's. A breakdown of the total number of DCP's, by states, shows 45 units in Missouri, 38 in Kansas, 9 in Nebraska, and 6 in Iowa.

Cooperative Hydrologic Programs.

Constraints on funds and manpower do not allow the Corps to administer an independent data collection program that satisfies all of its needs. Therefore, assistance is sought from other cooperating agencies. A nationwide program of data collection at selected stream gauging stations has been administered for a number of years by the U.S. Geological Survey (USGS). A similar network of reporting stations has been operated by the National Weather Service (NWS) for their river forecasting services. Arrangements have also been made with the USGS through which they supplement their network of reporting stations, or increase the frequency of reports, to better satisfy Corps needs. The program, designated the "Cooperative Hydrologic Reporting Network," is administered by the USGS and supported by funds transferred from the Corps and by National Streamflow Information Program (NSIP) funds. Arrangements for the services provided are made with USGS data chiefs in each state and submitted annually to the Chief of Engineers, through the Division Commander, for review and approval. A summary of funds expended for data collection purposes during the report period is included in the Personnel and Funding section at the end of this report.

Water Quality Investigations and Monitoring Activities.

The NWK Water Quality (WQ) Program's (PM-PR-W) 2007 activities were highlighted by flood events and bluegreen algal blooms. Once again all 18 NWK reservoirs were sampled to some degree during the year. 'Ambient' monitoring was conducted at twelve lakes (Kanopolis, Harlan County, Wilson, Tuttle Creek, Pomona, Milford, Longview, Rathbun, Smithville, Pomme de Terre, Long Branch and Stockton), which included surface nutrient sampling, chl *a* analyses, secchi depth measurements, and summer in-situ water column profiles (temperature, dissolved oxygen, pH, conductivity, turbidity, and total dissolved solids) from lake sites. 'Intensive' monitoring was conducted at six lakes (Clinton, Hillsdale, Melvern, Perry, Blue Springs and Truman), which involved monthly (April – September) sampling of inflows, lake sites (surface and bottom), and outflow for nutrients, pesticides, metals, chl *a* and in-situ water column

profiles. All lab analyses, including duplicates and blanks, were performed by several labs this past year – Kansas Biological Survey, Test America and Midwest. PM-PR-W staff teamed with lake project personnel to complete the monthly water quality monitoring.

Unlike the past few years, the 2007 sampling season was influenced by spring and summer flood events. A large bluegreen algal bloom occurred in Harlan County Lake during early June, and as a result the state of Nebraska issued a "health alert". The Health Alert designation means that the state believes that the level of toxins in the water make it potentially unsafe for full-body recreational activities, such as swimming. The toxin being measured is microcystin, which is generated from certain strains of blue-green algae. Signs were posted advising the public to use caution and avoid prolonged exposure to the water, particularly avoiding any activity that could lead to drinking the water. Although swimming beaches were closed, boating and other recreational activities were allowed but the public was advised to use caution. The level to trigger a Health Alert declaration is 20 parts per billion of the toxin Microcystin. Lakes under Health Alert will be sampled weekly, and the Health Alert will stay in effect until the level stays below 20 parts per billion for two consecutive weeks.

A minor bluegreen bloom was detected at Perry Lake during June and Rathbun during May. Geosmin and attributed drinking water taste & odor events occurred at Clinton Lake during winter 2007 and again during August. Flood events at Truman Lake required monitoring the tailrace for gas (nitrogen) supersaturation during May and July.

The WQ Program continues to participate with watershed groups for the following lakes: Kanopolis (Smoky Hill), Clinton (Upper Wakarusa), Tuttle Creek, Perry (Delaware River), Pomona, Melvern, Milford, Hillsdale, Smithville, Rathbun (Chariton), and Long Branch. Data has been shared with these watershed partners, as well as with state partners in Nebraska, Missouri, Iowa, and Kansas. Presentations were made at the Delaware River WRAPS and Kansas Water for the Future.

A 2006 final report was completed and delivered during late spring to each of the lakes, watershed coalitions, state partners, and posted on the districts' internet site. Other activities in support of the WQ Program included participation in the MO River Mitigation Project Environmental Sampling of chute projects (ie, Rush Bottom, Tarkio, Barney Bend, Baltimore Bend, and Jameson Island), sponsored a "brown bag" seminar on fecal bacteria (Dr Andy Carson), participated in the NWD's Water Management Functional Review, procured supplies and equipment for 2007/08, performed monthly and annual maintenance and calibration of field and laboratory equipment, and completed paperwork to hire another limnologist.

Sediment Observations.

Pomme de Terre - Degradation Ranges 1 through 3 and 6 were surveyed on 10-11 August 2006. Degradation range 1 is in the outlet channel. Degradation ranges 2 through 8 are in the river channel. Degradation Ranges 4 and 5 and 7 and 8 were not surveyed. Monuments for Ranges 4, 5, and 7 were not found and Range 8 could not be located due to excavation activities occurring during the construction of a new bridge. It is likely that the monument for Range 8 has been destroyed. The surveyed degradation ranges are extremely stable. No channel obstructions were observed. No adverse hydraulic control was observed. It was recommended that monument 8 be reestablished.

Kanopolis - A Periodic General Inspection was conducted 12-14 September 2006. The left bank of the outlet channel immediately downstream of Sand Creek and the drop areas continues

to be of concern. Currently, there is no action being taken to monitor the amount of left bank being lost per year. In the past, the project was asked to measure bank erosion, but that no longer continues. Record-low rainfall and runoff since the previous periodic inspection has had a minimal impact on the area. Trees and vegetation have begun to armor the bank and cover sloughing and erosion. It is estimated that the property line is 100 feet to 300 feet away from different points along high bank. Structural or nonstructural methods will eventually need to be considered to mitigate this problem. One structural method would be to place riprap in problem areas and one nonstructural alternative would be to buy more land and allow the erosion to continue. The right bank grouted riprap immediately downstream of the stilling basin is in good condition. Also, the riprap protecting the right bank is in good condition. It does not appear that substantial degradation has occurred since the previous periodic inspection. Field surveyed degradation ranges in the river channel downstream of the grouted riprap continue to indicate that the river channel is lowering.

Pomona - A Periodic General Inspection was conducted 3-4 April 2007. All six degradation ranges in the downstream river channel were surveyed prior to the inspection, and the condition river channel was observed at these locations during the inspection. Overall, the channel bed appeared to be stable with little or no bank erosion in most areas. Some local bank caving was observed at Degradation Range 1 on the left bank of the river channel. The survey plot for Range 1 does indicate some erosion has occurred at the toe of the banks since the last periodic, but the overall channel bed elevation has remained stable. Exposed bedrock was observed to be providing grade control to the channel bottom at a location between Ranges 1 and 2. Bedrock on the channel bottom will provide excellent protection against channel degradation for the upstream channel. The recent survey plot for Range 2 shows that the channel elevations have remained remarkably stable since 2001. Range 3 was not surveyed in 2001. The survey of Range 3 during this inspection shows some erosion of the right bank during the last 30 years, but the channel bottom elevation has remained within the same one to two foot range since 1962. The plots for Ranges 4 and 5 show very little change in the channel cross section since 2001. The survey for Range 6 indicated no degradation, but if anything, a deposition of material on the left bank and channel bottom. At Degradation Range 5, there is an abandoned old steel truss bridge. During the last periodic inspection, a recommendation was made to determine if any local interest exists in removing and relocating this bridge to a local park for historic purposes. No local interests have stepped forward to inquire about the bridge since that time. The bridge does not pose any threat to operation of the dam; therefore, the Corps has no reason to recommend its removal. A capacity of 28,000 acre-feet was allocated for sediment. The 29 sedimentation ranges on the lake were originally surveyed in September of 1962. They were resurveyed in July of 1975 and 20 of the ranges were resurveyed in July of 1989. The average storage loss was 324 and 206 acre-feet/year from the periods of 1962 to 1979 and 1979 to 1988, respectively. The average annual storage loss for the entire period, 1962 to 1989 is 261 acre-feet. This is very close to the original estimated annual loss of 266 acre-feet. The resurvey of sediment ranges will be scheduled at intervals of 5 to 10 years as required in EM 1110-2-4000.

Through an interagency cooperative agreement with the USGS, the District collects point, depth integrated, and bed sample sediment samples at three Missouri River stations and two inflow stations to Harry S. Truman Reservoir. The Missouri River data at St. Joseph, Kansas City, Boonville, and Hermann include point velocities. Laboratory analyses are performed at the USGS facility at Rolla, Missouri, and the results are stored in their database. The USGS publishes the suspended sediment load data for the Schell City and Clinton stations.

RESEARCH AND STUDIES.

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One of the section's hydraulic engineers assisted with the Missouri River Recovery Shallow Water Habitat program studies during the summer and fall of 2007. He worked with the St. Louis District's River Engineering Center to develop a tabletop moveable bed micromodel of the Jameson Island side channel chute and the adjacent Missouri River mainstem channel. The project is being constructed on the USFWS Big Muddy Refuge north of Boonville in central Missouri. The model was primarily used to demonstrate the changes in flow patterns due to the construction of the chute and the impacts on nearby agricultural levees and dikes. The model was also used to show the disbursal of dredge spoils excavated from the chute and deposited in the river. Demonstrations were provided to Corps personnel, other State and Federal agency representatives, and project stakeholders including local farmers and levee districts, navigators, and public involvement and regulatory groups. The report includes both still and video flow visualizations without the chute, with the chute as constructed with a pilot channel, and after the chute has eventually eroded to its projected full flow carrying capacity. Verification is in progress using a UNET-2D model developed in the Hydrology and Hydraulics Section.

TRAINING AND METHODS.

Training of Water Management Section staff progresses as time and scheduling permit. Technical abilities are enhanced as individuals continue to pursue courses on their own initiative. During the period of this report, Section employees participated in the training courses listed in ***Table 4***. In addition, all staff members attended in-house training on Ethics, Prevention of Sexual Harassment (POSH), Thumb Drive Awareness, G3 Computer Security Training, and Composite Risk Management.

Table 4: Staff Training

Employee	Course or Training
Christopher Purzer	None
Douglas Bennett	None
Alan Bruns	None
Jan Doughman	None
Jerry Holtz	None
Debbie Noble	Introduction to Unix
Edward Parker	None
Steve Spaulding	Statistical Methods in Hydrology

PERSONNEL AND FUNDING.

Personnel.

Authorized positions of the Water Management Section at the close of the fiscal year (September 30, 2007) consisted of one Supervisory Hydraulic Engineer, three Hydraulic Engineers, one Hydrologist, and three Hydrologic Technicians. At the end of this reporting period, the Section had one vacant position. A listing of personnel in the Section at the end of the report period by name and title is shown in ***Table 5***.

Table 5: Water Management Section Personnel

Employee	Grade
Christopher Purzer (1)	GS-13
Douglas Bennett (2)	GS-12
Alan Bruns (3)	GS-12
Jan Doughman (4)	GS-11
Jerry Holtz (4)	GS-11
Debbie Noble (4)	GS-11
Edward Parker (2)	GS-12
Steve Spaulding (2)	GS-12
Vacant (2)	GS-12

Job Title
(1) Supervisory Hydraulic Engineer
(2) Hydraulic Engineer
(3) Hydrologist
(4) Hydrologic Technician

Funding.

Activities of the Water Management Section are funded from the following sources:

Planning

Part of the funds appropriated for survey reports, flood plain information studies, and project planning studies are assigned to the Water Management Section for special studies if water control is included in connection with the planning and design.

Operations and Maintenance

Operation of the existing lakes and reservoirs in the Kansas City District requires stream flow forecasting, water control planning, stream gauging, and other related activities for each authorized function at Corps of Engineers projects, and for the flood control function at Bureau of Reclamation projects. Operation and maintenance funds are used for these purposes.

Technical Services and Flood Emergency

Technical services provided to non-Federal interests, flood emergency operations, post flood reports, and the annual flood report are tasks assigned to the Water Management Section. These activities vary from year to year. Special accounts are provided for these services. Individuals in the Section may also receive special funding from other sources when they participate as a technical resource on Project Development Teams.

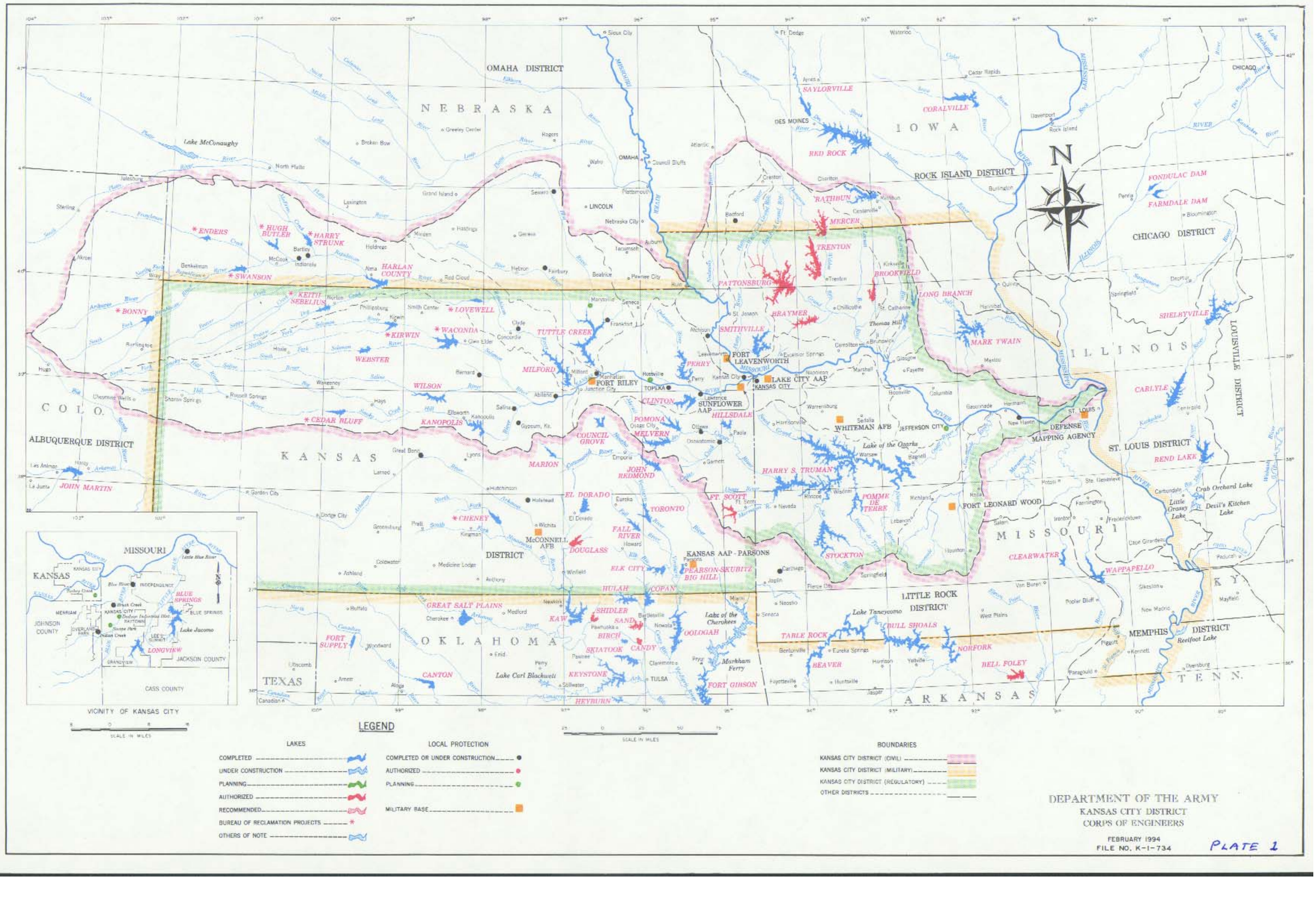
Data Collection Programs

The Cooperative Stream Gauging Program with the four U.S. Geological Survey districts (Kansas, Nebraska, Iowa, and Missouri) includes 98 stations. Kansas City District funding for this program during FY 2008 is $1,158,955, a 1% increase from the FY 2007 program.

Fiscal year expenses for data collected in FY 2006 and FY 2007, and the programmed expenses for FY 2008 are shown in ***Table 6*** below.

Table 6: Data Collection Expenditures

Program	FY 2006	FY 2007	FY 2008
U.S.G.S	$1,298,550	$1,148,465	$1,158,955
Independent Stations	$0	$0	$0
TOTAL	$1,298,550	$1,148,465	$1,158,955


OMAHA DISTRICT
NEBRASKA
IOWA
ROCK ISLAND DISTRICT
CHICAGO DISTRICT
ILLINOIS
LOUISVILLE DISTRICT
ST. LOUIS DISTRICT
MISSOURI
KANSAS
COLO.
OKLAHOMA
TEXAS
ARKANSAS
KY.
TENN.
ALBUQUERQUE DISTRICT
KANSAS CITY DISTRICT
LITTLE ROCK DISTRICT
MEMPHIS DISTRICT
Lake McConaughy
SAYLORVILLE
CORALVILLE
RED ROCK
RATHBUN
MERCER
TRENTON
PATTONSBURG
BRAYMER
SMITHVILLE
BROOKFIELD
LONG BRANCH
MARK TWAIN
FONDULAC DAM
FARMDALE DAM
SHELBYVILLE
CARLYLE
REND LAKE
ENDERS
HUGH BUTLER
HARRY STRUNK
SWANSON
HARLAN COUNTY
KEITH SEBELIUS
BONNY
LOVEWELL
WACONDA
KIRWIN
WEBSTER
TUTTLE CREEK
MILFORD
WILSON
CLINTON
CEDAR BLUFF
KANOPOLIS
POMONA
MELVERN
COUNCIL GROVE
MARION
JOHN REDMOND
HILLSDALE
PERRY
FORT LEAVENWORTH
LAKE CITY AAP
KANSAS CITY
SUNFLOWER AAP
FORT RILEY
TOPEKA
WHITEMAN AFB
JEFFERSON CITY
DEFENSE MAPPING AGENCY
HARRY S. TRUMAN
POMME DE TERRE
STOCKTON
CLEARWATER
WAPPAPELLO
FORT LEONARD WOOD
JOHN MARTIN
CHENEY
EL DORADO
TORONTO
FALL RIVER
DOUGLASS
McCONNELL AFB
ELK CITY
HULAH
COPAN
GREAT SALT PLAINS
KAW
SHIDLER
SAND
BIRCH
SKIATOOK
CANDY
KEYSTONE
FORT SUPPLY
CANTON
Lake Carl Blackwell
Markham Ferry
Lake of the Cherokees
OOLOGAH
FORT GIBSON
KANSAS AAP - PARSONS
PEARSON-SKUBITZ BIG HILL
FT. SCOTT
TABLE ROCK
BULL SHOALS
NORFORK
BEAVER
BELL FOLEY
Lake Tanycomo
Crab Orchard Lake
Little Grassy Lake
Devil's Kitchen Lake
Reelfoot Lake
VICINITY OF KANSAS CITY
MISSOURI
KANSAS
JOHNSON COUNTY
JACKSON COUNTY
CASS COUNTY
BLUE SPRINGS
LONGVIEW
Lake Jacomo
SCALE IN MILES
LEGEND
LAKES
COMPLETED
UNDER CONSTRUCTION
PLANNING
AUTHORIZED
RECOMMENDED
BUREAU OF RECLAMATION PROJECTS
OTHERS OF NOTE
LOCAL PROTECTION
COMPLETED OR UNDER CONSTRUCTION
AUTHORIZED
PLANNING
MILITARY BASE
BOUNDARIES
KANSAS CITY DISTRICT (CIVIL)
KANSAS CITY DISTRICT (MILITARY)
KANSAS CITY DISTRICT (REGULATORY)
OTHER DISTRICTS
DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS
FEBRUARY 1994
FILE NO. K-1-734
PLATE 1

SUBJECT	MELVERN LAKE	POMONA LAKE	HILLSDALE LAKE	STOCKTON LAKE	POMME DE TERRE LAKE	HARRY S. TRUMAN RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose level.
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO	(2) Damming height is from the original riverbed to the top of the flood control pool.
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River	(3) Based on latest available storage data. The revision dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1	Melvern, February 1986 (effective March 1, 1986)
Contributing Drainage Area, square miles	349	322	144	1,160	611	8,914 (4)	Pomona, March 1990 (effective April 1, 1990)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122	Hillsdale, 1969 (initial)
Shoreline, miles (1)	101	52	51	298	113	958	Stockton, February 1988 (effective May 1, 1988)
Maximum Discharge of Record nr Dam Site	68,500 cfs (July 11, 1951)	38,600 cfs (July 11, 1951)	45,200 cfs (July 11, 1951)	120,000 cfs (May 19, 1943)	70,000 cfs (Aug 8, 1927)	259,000 cfs (May 17, 1943)	Pomme de Terre, February 1985 (effective Mar 85)
Date of Closure	October 2, 1970	July 19, 1962	June 15, 1980	September 23, 1968	June 28, 1960	July 21, 1977	Harry S. Truman, April 1993 (effective Mar 94)
Date Storage Began	August 1, 1972	October 18, 1963	September 19, 1981	December 12, 1969	October 29, 1961	February 7, 1979	(4) The total drainage area above Truman Dam is 11,500 square miles. The indicated total is the local drainage area below the upstream dams.
Date Multipurpose Level Reached	April 4, 1975	June 5, 1965	February 23, 1985	December 18, 1971	June 15, 1963	November 29, 1979	(5) In 1994, 1000 AF of flood control storage at Truman Reservoir was reallocated to water supply.
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	The top of the multipurpose pool was adjusted from 706.0 to 706.018
DAM AND EMBANKMENT				911.0 for concrete section			
Top of Dam Elevation, feet msl	1,078.0	1,031.0	952.2	912.0 for embankment	906.0	756.0	
Length of Dam, feet (net)	9,650	7,750	8,700 plus 3,300 dike	5,100 plus 5,600 dike	4,630 plus 2,790 dike	5,000 plus 7,500 dike	
Damming Height, feet (2)	105	83	79	132	124	105	
Type of Fill	Earth	Earth	Earth	Rock Shell	Earth	Earth	
Fill Quantity, cubic yards	9,100,000	5,200,000	6,964,000	7,100,000	5,800,000	8,500,000	
SPILLWAY							
Location	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	
Crest Elevation, feet msl	1,057.0	1,006.0	935.0	861.5	874.0	692.3	
Width, Feet	200	200	50	160	170	160	
Number, Size, and Type of Gates	None	None	None	4 - 40'x30.5' Tainter	None	4 - 40'x47.3' Tainter	
Discharge Capacity, Top of Surcharge Pool	36,000 cfs	50,300 cfs	4,750 cfs	182,500 cfs	73,000 cfs	284,000 cfs	
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation and Area	1,073.0 ft msl 22,673 ac	1,025.4 ft msl 14,584 ac	948.0 ft msl 10,983 ac	906.2 ft msl 48,053 ac	900.2 ft msl 25,456 ac	751.1 ft msl 295,870 ac	417,619 ac
Flood Control Pool Elevation and Area	1,057.0 ft msl 13,935 ac	1,003.0 ft msl 8,522 ac	931.0 ft msl 7,413 ac	892.0 ft msl 38,281 ac	874.0 ft msl 15,999 ac	739.6 ft msl 209,048 ac	293,198 ac
Multipurpose Pool Elevation and Area	1,036.0 ft msl 6,912 ac	974.0 ft msl 3,865 ac	917.0 ft msl 4,575 ac	867.0 ft msl 24,632 ac	839.0 ft msl 7,790 ac	706.02 ft msl (5) 55,406 ac	103,180 ac
Surcharge Storage, AF	1,073.0 - 1,057.0 289,410	1,025.4 - 1,003.0 255,327	948.0 - 931.0 155,799	906.2 - 892.0 608,708	900.2 - 874.0 535,724	751.1 - 739.6 2,910,768	4,755,736 AF
Flood Control Storage, AF	1,057.0 - 1,036.0 208,207	1,003.0 - 974.0 176,123	931.0 - 917.0 83,570	892.0 - 867.0 776,066	874.0 - 839.0 406,821	739.6 - 706.02 4,005,392	5,656,179 AF
Multipurpose Storage, AF	1,036.0 - 965.0 152,051	974.0 - 930.0 64,208	917.0 - 852.5 76,270	867.0 - 765.0 874,887	839.0 - 750.0 237,356	706.02 - 631.0 1,181,640	2,586,412 AF
Gross Storage, AF	1,057.0 - 965.0 360,258	1,003.0 - 930.0 240,331	931.0 - 852.5 159,840	892.0 - 765.0 1,650,953	874.0 - 750.0 644,177	739.6 - 631.0 5,187,032	8,242,591 AF
Design Sediment Reserve Storage	26,000 AF for 100 years	28,000 AF for 100 years	11,000 AF for 100 years	25,000 AF for 100 years	13,000 AF for 50 years	244,000 AF for 100 years	
Measured Sediment Inflow	4,064 AF (1972 to 1985)	7,045 AF (1963 to 1989)	1,928 AF (1981 to 1993)	8,953 AF (1969 to 1987)	4,358 AF (1961 to 1974)	22,321 AF (1979 to 1992)	
OUTLET WORKS							ac = acres
Location	Right Abutment	Right Abutment	Left Abutment		Right Abutment		AF = acre-feet
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None	ft = feet
Number and Size of Conduit	1 - 11.5'	1 - 13.5'	1 - 15.92'x11.67'		1 - 14'		msl = elevation above mean sea level
Length of Conduit, feet	754	720.5	685		560		cfs = cubic feet per second
Entrance Invert Elevation	962.0 ft msl	925.0 ft msl	868.0 ft msl		750.0 ft msl		kw = kilowatts
Discharge Capacity, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs		hp = horsepower
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs		
Discharge Cap, Top of Multipurpose Pool	5,520 cfs	6,400 cfs	6,150 cfs		9,650 cfs		
Service Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	2 - 5.33'x15.92'		2 - 6.5'x14'		
Emergency Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	1 - 5.33'x15.92'		1 - 6.5'x14'		
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 2'x2'	2 - 2'x2'	2 - 24" dia	1 - 24" Butterfly		
Provision for Power	None	None	None	3 - 20'x40'		12 - 17'x26.5'	
POWER FACILITIES							
Generator Turbine Units, Number				1		6	
Generator Name Plate Capacity, kw				45,200		160,000	
Turbine Rating, hp				75,600 (56 ft head)		254,400	
Turbine Type				Kaplan (Vertical Shaft)		Kaplan (Inclined Shaft)	
Maximum (Full Pool) Head and Discharge				112 ft (6,300 cfs)		79.2 ft (31,800 cfs)	
Avg (Power & MP Pool) Head, Discharge				85 ft (7,900 cfs)		42.5 ft (65,000 cfs)	
Minimum Head and Discharge				62 ft (11,000 cfs)		41 ft (68,000 cfs)	
Reversible Pump Turbines				None		6	
Total Dynamic Head, feet						50	
Discharge with 5 Units at Max Head, cfs						27,500	
Maximum Power Required, hp						197,000	
Maximum Drawdown, feet msl				845		704	

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE	REMARKS
GENERAL						(1) With pool at multipurpose level.
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO	(2) Damming height is from original riverbed to top of flood pool.
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River	(3) Based on latest available storage data. The revision dates of the current area capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	13.6	42.9	28.8	142.3	78	Smithville Lake, February 1990 (effective March 1, 1990)
Contributing Drainage Area, square miles	213	50.3	32.8	549	109	Longview Lake, May 1970 (initial)
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9	Blue Springs Lake, September 1974 (initial)
Shoreline, miles (1)	175	24	12	155	24.2	Rathbun Lake, January 2000 (effective December 1, 2000)
Maximum Discharge of Record near Dam Site	76,600 cfs (July 20, 1965)	18,700 cfs (August 13, 1982)	11,000 cfs (August 13, 1982)	21,800 cfs (March 31, 1960)	30,000 cfs (April 21, 1973)	Long Branch Lake, January 1989 (effective October 1, 1989)
Date of Closure	July 13, 1976	June 16, 1983	August 12, 1986	September 29, 1967	September 3, 1976	(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
Date Storage Began	October 19, 1979	September 16, 1985	September 27, 1988	November 21, 1969	August 2, 1978	(5) Flows above 1,800 cfs result in overtopping of the outlet stilling basin walls
Date Multipurpose Level Reached	June 11, 1982	September 23, 1986	March 18, 1990	October 10, 1970	May 19, 1981	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	895.0	926.6	840.0	946.0	826.0	
Length of Dam, feet (net)	4,000	1,900	2,500	10,600	3,550	
Damming Height, feet (2)	80.2	110	70	82	71	
Type of Fill	Rolled Earth	Earth	Earth and Rock	Rolled Earth	Rolled Earth	
Fill Quantity, cubic yards	3,200,000	2,500,000	1,200,000	4,700,000	1,855,000	
SPILLWAY						
Location	Right Abutment	Left Abutment	Left Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	880.2	911.3	823.6	926.0	809.0	
Width, feet	50	200	300	500	50	
Number, Size, and Type of Gates	None	None	None	None	None	
Discharge Capacity, Top of Surcharge Pool	4,800 cfs	22,970 cfs	37,800 cfs	45,600 cfs	9,860 cfs (4)	
RESERVOIR (3)						**TOTALS**
Surcharge Pool Elevation and Area	891.1 ft msl 14,611 ac	922.9 ft msl 3,207 ac	837.7 ft msl 1,200 ac	940.0 ft msl 31,135 ac	821.2 ft msl 6,608 ac (4)	56,761 ac
Flood Control Pool Elevation and Area	876.2 ft msl 9,990 ac	909.0 ft msl 1,964 ac	820.3 ft msl 982 ac	926.0 ft msl 22,452 ac	801.0 ft msl 3,663 ac	39,051 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,115 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,329 ac	791.0 ft msl 2,429 ac	21,522 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac				432 ac
Surcharge Storage	891.1 - 876.2 182,198 AF	922.9 - 909.0 35,370 AF	837.7 - 820.3 19,039 AF	940.0 - 926.0 368,859 AF	821.2 - 801.0 101,880 AF (4)	707,346 AF
Flood Control Storage	876.2 - 864.2 101,777 AF	909.0 - 891.0 24,810 AF	820.3 - 802.0 15,715 AF	926.0 - 904.0 349,173 AF	801.0 - 791.0 30,327 AF	521,802 AF
Multipurpose Storage	864.2 - 810.0 141,666 AF	891.0 - 870.0 13,579 AF	802.0 - 760.0 10,842 AF	904.0 - 857.0 221,360 AF	791.0 - 750.0 34,189 AF	421,636 AF
Recreation Storage		870.0 - 810.0 8,555 AF				8,555 AF
Gross Storage	876.2 - 810.0 243,443 AF	909.0 - 810.0 46,944 AF	820.3 - 760.0 26,557 AF	926.0 - 857.0 570,533 AF	801.0 - 750.0 64,516 AF	951,993 AF
Design Sediment Reserve Storage	52,300 AF for 100 years	2,000 AF for 100 years	300 AF for 100 years	24,000 AF for 100 years	4,000 AF for 100 years	
Measured Sediment Inflow	4,987 AF (1979 to 1993)	20 AF/year (estimated)	3 AF/year (estimated)	240 AF/year (estimated)	483 AF (1978 to 1988)	
OUTLET WORKS						
Location	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
River Outlet Type	Rectangular Conduit	Concrete Arch	Arch Conduit	Horseshoe Conduit	Concrete Arch	
Number and Size of Conduit	1 - 8'x9'	1 - 5.5'x5'	1 - 3.5'x4.75'	1 - 11'	1 - 6'x5.5'	
Length of Conduit, feet	696	916	485	539	450	
Entrance Invert Elevation	805.0 ft msl	816.0 ft msl	768.5 ft msl	855.0 ft msl	760.0 ft msl	
Drop Inlet Crest Elevation		891	802.0 ft msl			
Low Flow Gate Intake Elevation		875 - 861	791.5			
Discharge Cap, Top Flood Control Pool	3,150 cfs	1,200 cfs	570 cfs	5,160 cfs (5)	910 cfs	
Discharge Cap, Top of Multipurpose Pool	2,940 cfs	0 (except low flow outlets)	0 (except low flow outlets)	4,220 cfs (5)	495 cfs	
Service Gates, Number and Size	2 - 4.25'x9.25' Slide			2 - 6'x12' Slide	2 - 24" Slide	
Emergency Gates, Number and Size	2 - 4.25'x9.25' Slide	1 - 6'x7'	1-4.5'x5'	2 - 6'x12' Slide	1 - 6'x6'	
Low Flow Gates, Number, Size, Type		2 - 24" Knife Valves	1-2' Knife Valve			
Low Flow Gates, Number and Size	1 - 2'x2'	2 - 24" Knife Valves	1-2' Knife Valve	2 - 2' x2' Slide	1 - 18" Slide	
Provision for Power	None	None	None	None	None	
Provision for Water Supply	1 - 5.75' Pipe A portion of MP storage pumped from pool	None	None	No pipe outlets, water supply released to river	No pipe outlets, water supply pumped from pool.	

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER MISSOURI RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City Distict
December 2004

Plate 2B

SUBJECT	MILFORD LAKE	TUTTLE CREEK LAKE	PERRY LAKE	CLINTON LAKE	REMARKS
GENERAL					
Location of Dam	Near Junction City, KS	Near Manhatten, KS	Near Perry, KS	Near Lawrence, KS	(1) With pool at multipurpose level.
Stream / River	Republican River	Big Blue River	Delaware River	Wakanusa River	(2) Damming height is from the original riverbed to the top of the flood control pool.
Miles above Mouth	7.7	10	5.3	22.2	(3) Based on latest available storage data. The revision dates of the current
Contributing Drainage Area, square miles	17,388 (4)	9,628	1,117	367	area - capacity tables are indicated below with the effective dates in parentheses:
Approximate Length of Full Reservoir, miles	30	50	20	17	Milford Lake, March 1982 (effective March 10, 1982)
Shoreline, miles (1)	163	112	160	82	Tuttle Creek Lake, October 2000 (effective February 1, 2001)
Maximum Discharge of Record near Dam Site	171,000 cfs (June 3, 1935)	98,000 cfs (June 1951)	94,600 cfs (June 1951)	24,200 cfs (July 1951)	Perry Lake, May 1990 (effective June 1, 1990)
Date of Closure	August 24, 1964	July 20, 1959	August 2, 1966	August 23, 1975	Clinton Lake, December 1991 (effective March 1, 1994)
Date Storage Began	January 16, 1967	March 7, 1962	January 15, 1969	November 30, 1977	(4) Total drainage area above Milford is 38,621 square miles. The indicated total is
Date Multipurpose Level Reached	July 14, 1967	April 29, 1963	June 3, 1970	April 3, 1980	the local drainage area below Harlan County Dam.
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT					ac = acres
Top of Dam Elevation, feet msl	1,213.0	1,159.0	946.0	928.0	AF = acre-feet
Length of Dam, feet (net)	6,300	7,487	7,750	9,250	ft = feet
Damming Height, feet (2)	110.2	134	95	114	msl = elevation above mean sea level
Type of Fill	Earth	Earth, Rock	Earth	Earth	cfs = cubic feet per second
Fill Quantity, cubic yards	15,000,000	21,000,000	8,000,000	10,423,000	
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Left Abutment	
Crest Elevation, feet msl	1,176.2	1,116.0	922.0	907.4	
Width, feet	1,250	1,059	300	500	
Number, Size, and Type of Gates	None	18 - 40’x20’ Tainter	None	None	
Discharge Capacity, Top of Surcharge Pool	560,000 cfs	579,000 cfs	65,000 cfs	44,200 cfs	
RESERVOIR (3)					**TOTALS**
Surcharge Pool Elevation and Area	1,208.2 ft msl 59,886 ac	1,151.4 ft msl 70,030 ac	941.2 ft msl 42,656 ac	921.4 ft msl 18,336 ac	190,908 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 32,979 ac	1,136.0 ft msl 53,050 ac	920.6 ft msl 25,363 ac	903.4 ft msl 12,890 ac	124,282 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,709 ac	1,075.0 ft msl 12,617 ac	891.5 ft msl 11,146 ac	875.5 ft msl 7,120 ac	46,592 ac
Surcharge Storage	1,208.2 - 1,176.2 1,442,049 AF	1,151.4 - 1,136.0 939,272 AF	941.2 - 920.6 692,375 AF	921.4 - 903.4 285,809 AF	3,359,505 AF
Flood Control Storage	1,176.2 - 1,144.4 756,669 AF	1,136.0 - 1,075.0 1,870,735 AF	920.6 - 891.5 515,795 AF	903.4 - 875.5 268,783 AF	3,411,982 AF
Multipurpose Storage	1,144.4 - 1,080.0 388,816 AF	1,075.0 - 1,020.0 280,137 AF	891.5 - 835.0 209,513 AF	875.5 - 828.0 125,334 AF	1,003,800 AF
Gross Storage	1,176.2 - 1,080.0 1,145,485 AF	1,136.0 - 1,020.0 2,150,872 AF	920.6 - 835.0 725,308 AF	903.4 - 828.0 394,117 AF	4,415,782 AF
Design Sediment Reserve Storage	160,000 AF for 100 years	240,312 AF for 50 years	140,000 AF for 100 years	28,500 AF for 100 years	
Measured Sediment Inflow	47,935 AF (1967 to 1994)	216,145 AF (1962 to 2000)	49,057 AF (1969 to 1993)	3,421 AF (1977 to 1991)	
OUTLET WORKS					
Location	Right Abutment	Right Abutment	Near Center of Dam	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	
Number and Size of Conduit	1 - 21’	2 - 20’	1 - 23.5’	1 - 12.5’x13’ Arch	
Length of Conduit, feet	615.5	860	592	710	
Entrance Invert Elevation	1,080.0 ft msl	1,003.0 ft msl	833.0 ft msl	828.0 ft msl	
Gated Sluice, Number and Size	None	None	None	None	
Discharge Cap, Top of Flood Control Pool	23,100 cfs	45,900 cfs	27,500 cfs	7,570 cfs	
Discharge Cap, Top of Multipurpose Pool	18,600 cfs	31,300 cfs	21,200 cfs	5,900 cfs	
Service Gates, Number and Size	2 - 10.5’x21’	4 - 10’x20’	2 - 11.75’x23.5’	2 - 6.33’x12.67’	
Emergency Gates, Number and Size	2 - 10.5’x21’	1 - 10’x20’	2 - 11.75’x23.5’	1 - 6.33’x12.67’	
Low Flow Gates, Number and Size	2 - 2’x2’	2 - 24” Butterfly Valve	2 - 2’x2’	1 - 24” Knife Gate Value	
Water Supply Gate, Number and Size	None	None	None	1 - 54”x54” Slide Gate	
Provision for Irrigation	None	None	None	None	
Provision for Power	None	None	None	None	
Provision for Water Supply	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	36” Steel Pipe	

SUMMARY OF ENGINEERING DATA
LOWER KANSAS RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2C

SUBJECT	BONNY RESERVOIR	SWANSON LAKE	ENDERS RESERVOIR	HUGH BUTLER LAKE	HARRY STRUNK LAKE	KEITH SEBELIUS LAKE (Norton Dam)	HARLAN COUNTY LAKE	LOVEWELL RESERVOIR	REMARKS
GENERAL									(1) With pool at MP level.
Location of Dam	Near Hale, CO	Near Trenten, NE	Near Enders, NE	Near McCook, NE	Near Cambridge, NE	Near Norton, KS	Nr Republican City, NE	Near Lovewell, KS	(2) Damming height is
Stream / River	S. Fk Republican River	Republican River	Frenchman Creek	Red Willow Creek	Medicine Creek	Prairie Dog Creek	Republican River	White Rock Creek	from original riverbed to
Miles above Mouth	60.4	359	81.7	18.7	11.9	74.9	232.3	19.3	top of flood control pool.
Contributing Drainage Area, sq mi	1,435	2,506 below Bonny	786	310	642	688	7,169 below u/s dams (5)	358	(3) Based on latest storage
Approx Length of Full Resv, miles	5.5	9.0	6.0	7.5	8.5	9.5	17	11	data. Date of current area
Shoreline, miles (1)	15.0	30	26	35	29	32	54	44	capacity tables given below
Max. Disch. of Record nr Dam Site	103,000 (May 31, 1935)	200,000 (May 31, 1935)	Insufficient Data	30,000 (June 22, 1947)	120,000 (June 1947)	37,500 (May 28, 1953)	260,000 (June 1, 1935)	23,300 (July 10, 1950)	with effective date in ( ).
Date of Closure	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	January 28, 1964	July 22, 1951	May 29, 1957	Bonny, Mar 51 (initial)
Date Storage Began	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	October 5, 1964	November 14, 1952	October 2, 1957	Swanson, Feb 84 (Jan 84)
Date Multipurpose Level Reached	March 19, 1954	May 15, 1957	January 29, 1952	May 21, 1967	April 2, 1951	June 21, 1967	June 14, 1957	May 20, 1958	Enders, May 97 (Jan 1, 99)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Bureau of Reclamation	Butler, May 97 (Jan 1, 99)
DAM AND EMBANKMENT									Strunk, Oct 82 (Feb 1, 83)
Top of Dam Elevation, feet msl	3,742.0	2,793.0	3,137.5	2,634.0	2,415.0	2,347.0	1,982.0	1,616.0	Sebelius, Sep 00 (Jan 02)
Length of Dam, feet (Less Spillway)	9,141.5	8,600	2,242	3,159	5,665	6,344	11,830	8,392	Harlan, Jan 01 (Jan 1, 01)
Damming Height, feet (2)	93.0	80.0	93.0	About 85	86	85.5	98.5	70.3	Lovewell, Jun 95 (Jan 97)
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Earth	(4) Bartley Div Dam, Rep
Fill Quantity, cubic yards	8,853,000	8,130,000	1,950,000	3,122,000	2,730,000	3,740,000	13,400,000	3,000,000	R. below Red Willow Ck,
SPILLWAY									conc ogee weir w/2-10x16
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	Right Abutment	gates to rivr, 2-10'x3' gates
Crest Elevation, feet msl	3,710.0	2,743.0	3,097.0	2,604.9	2,386.2 (see also below)	2,296.0	1,943.5	1,575.3	to canal, max cap 130 cfs.
Width, feet	121.5	142	361	31.5 (circ morning glory)	229	106	856	53	Franklin pumps on Rep R.
Number, Size, and Type of Gates	None (see notes below)	3 - 42' x 30' Radial	6 - 50' x 30' Radial	None	None	3 - 30'x36.35' Radial	18 - 40'x30' Radial	2 - 25'x20' Radial	blw Harlan Cty, cap 40 cfs.
Disch. Cap. Top of Surcharge Pool	73,300 cfs (with sluice)	126,000 cfs	202,000 cfs (with notch)	4,910 cfs	99,000 cfs (with notch)	96,000 cfs	480,000 cfs	35,000 cfs	Courtland Div Dam, Rep R
RESERVOIR (3)									**TOTALS**
Surcharge Pool Elev (ft msl), Area	3,736.2 8,579 ac	2,785.0 10,035 ac	3,129.5 ft msl 2,557 ac	2,628.0 ft msl 4,079 ac	2,408.9 ft msl 5,784 ac	2,341.0 ft msl 6,713 ac	1,975.5 ft msl 24,339 ac	1,610.3 ft msl 7,635 ac	69,721 ac
Flood Cntrl Pool Elev (ft msl), Area	3,710.0 5,036 ac	2,773.0 7,940 ac	3,127.0 ft msl 2,405 ac	2,604.9 ft msl 2,681 ac	2,386.2 ft msl 3,483 ac	2,331.4 ft msl 5,316 ac	1,973.5 ft msl 23,431 ac	1,595.3 ft msl 5,024 ac	55,316 ac
MP, or Top Cons Pool Elev, Area	3,672.0 2,042 ac	2,752.0 4,922 ac	3,112.3 ft msl 1,707 ac	2,581.8 ft msl 1,621 ac	2,366.1 ft msl 1,840 ac	2,304.3 ft msl 2,181 ac	1,945.73 msl 13,305 ac	1,582.6 ft msl 2,987 ac	30,605 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,411 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 701 ac	2,280.4 ft msl 575 ac	1,932.5 ft msl 9,282 ac	1,571.7 ft msl 1,495 ac	15,137 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 488 ac	3,080.0 ft msl 567 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 481 ac	2,275.0 ft msl 317 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	3,125 ac
Surcharge Storage, AF	3,736.2 - 3,710 178,230	2,785 - 2,773 107,610	3,129.5 - 3,127 6,203	2,628.0 - 2,604.9 76,829	2,408.9 - 2,386.2 105660	2,341.0 - 2,331.4 58,287	1,975.5 - 1,973.5 47,767	1,610.3 - 1,595.3 94,145	674,731 AF
Flood Control Storage, AF	3,710.0 - 3,672 128,820	2,773 - 2,752 134,077	3,127.0 - 3,112.3 30,048	2,604.9 - 2,581.8 48,846	2,386.2-2,366.1 52,715	2,331.4 - 2,304.3 99,230	1,973.5 - 45.73 500,000	1,595.3 - 1,582.6 50,465	1,044,201 AF
MP, or Active Conserv Storage, AF	3,672.0 - 3,638 39,206	2,752 - 2,720 99,784	3,112.3 - 3,082.4 33,962	2,581.8 - 2,558 27,303	2,366.1 - 2,343 26,846	2,304.3 - 2,280.4 30,517	1,945.73 - 32.5 150,000	1,582.6 - 1,571.7 24,022	431,640 AF
Inactive Storage, AF	3,638.0 - 3,635.5 716	2,720 - 2,710 10,312	3,082.4 - 3,080 1,432	2,558.0 - 2,552 3,736	2,343.0 - 2,335 4,699	2,280.4 - 2,275 2,357	1,932.5 - 1,890 164,111	1,571.7 - 1,562.07 9,985	197,348 AF
Dead Storage, AF	3,635.5 - 3,617 1,418	2,710 - 2,701 2,118	3,080.0 - 3,050 7,516	2,552.0 - 2,527 5,185	2,335.0 - 2,318.5 4,160	2,275.0 - 2,262 1,636	Sluice crest at 1,885 0	1,562.07 - 1,550.0 1,659	23,692 AF
Gross Storage, AF	3,710.0 - 3,617 170,160	2,773 - 2,701 246,291	3,127.0 - 3,050 72,958	2,604.9 - 2,527 85,070	2,386.2 - 2,318.5 88,420	2,331.4 - 2,262 133,740	1,973.5 - 1,890 814,111	1,595.3 - 1,550.0 86,131	1,696,881 AF
Design Sediment Reserve Storage	8,000 AF for 50 years	51,000 AF for 50 years	4,000 AF for 100 years	10,000 AF for 50 years	15,000 AF for 50 years	6,000 AF for 50 years	200,000 AF for 100 yrs	8,000 AF for 50 years	
Measured Sediment Inflow	160 AF/year (estimated)	7,659 AF (1953 to 1982)	1,572 AF (1950 to 1997)	1,616AF (1961 to 1997)	4,397 AF (1949 to 1981)	1,617 AF (1964 to 2000)	38,548 AF (1952 - 00)	6,021 AF (1957 to 1995)	
OUTLET WORKS									at Guide Rock, conc ogee
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	Left Abutment	Center of Dam	Right Abutment	w/2-20'x12' gates to river
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Sluices	Spillway gates used for	5-10'x6'gates to Courtland
Number and Size of Conduit	1 – 56" Cond to 26" Pipe	2 - 6' x 7.5'	1 - 84" Cond to 84"Pipe	1 - 82"	1 – 84" Cond to 44" Pipe	1 – 48" Cond to 38" Pipe	9 - 5'x8' thru Spillway	river releases. Gated	canal (cap 751 cfs), 1-10x6
Length of Conduit, feet	831.5	86.74	516	553.5	553	495 to Gate, 145 to Basin		wasteway with 1-10'x9'	gate to Superior (cap 139).
Entrance Crest Elevation	3,635.5 ft msl	2,710.0 ft msl	3,080.0 ft msl	2,552.0 ft msl	2,335.0 ft msl	2,275.0 ft msl	1,885.0 ft msl	radial gate from outlet	Other private diversion
Disch Cap, Top of Flood Cntrl Pool	140 cfs (approx)	4,300 cfs	1,430 cfs	1,170 cfs	398 cfs (max elev 2,379)	312 cfs	20,700 cfs	canal to stilling basin.	weirs exist on some creeks
Disch Cap, Top of MP (Consv) Pool	103 cfs	3,500 cfs	1,300 cfs	990 cfs	361 cfs	257 cfs	17,370 cfs	Wasteway is not used.	like Riverside blw Enders
Service Gates, Number, Size, Type	1 - 24" Hollow Jet Valve	2 - 6' x 7.5' Slide Gates	2-60" Hollow Jet Valves	2 - 42" Slide Gates	1 – 39" Slide Gate	1 - 33" Slide Gate	9 - 5' x 8' Slide Gates	None	but div capacity minimal.
Provision for Irrigation	1 - 32" Pipe to 24" Valve	1 - 56" Pipe to 4' Gate	None	None	None	None	1-5.5'; 1-2.83' Conduits	1 - 8'x10' Gated Outlet	(5) 13,536 sq mi total
Provision for Power	None	None	None	None	None	None	12'x12' Plug for 9' Cond	None	contributing with u/s dams.
Provision for Municipal Supply	None	None	None	None	None	1 - 16" Pipe to 16" Gate	None	None	ac = acres ft = feet
Other Outlet	1 - 40" Capped Conduit	None	None	None	None	None	1-18" outlet for low flow regulation in mono 20.	Note: Inflow to lake also provided from gated	AF = acre-feet
	Notes: Spillway also has 16.5'x21.5' sluice, with 1 - 16.5' x 10.75'gate, crest elev 3,672.0. The 56" gated outlet conduit feeds all three gated sub outlets. Capacity of irrig pipe outlet limited to 34.5 cfs by canal cap.	Notes: Irrigation outlet in right abutment.	Notes: Spillway has an uncontrolled notch w/ crest elevation at 3112.3. Concrete ogee weir diversion dam 52 miles d/s, w/ 2-14' x 9.5' gates plus 30" gated condut to river, and 2- 10'x6' gates to canal (cap 400 cfs).	Note: Concrete ogee weir diversion dam 13 miles downstream, w/ 1-6'x18' radial gate to river, and 2 - 5'x4' regulating gates to canal (max cap 90 cfs) Bartley Diversion Dam located below Rep. R. confluence. See note (4)	Notes: Spillway also has an uncontrolled notch w/ crest elevation at 2366.1. Concrete ogee weir div-ersion dam at mile 301.6 on Rep. R. blw Med Ck. 2-10'x14'gates to river and 4-10'x14' gates to canal (max cap 325 cfs).	Notes: Concrete ogee weir diversion dam 17.6 miles downstream, with 1 – 6'x18' radial gate to river, 2 – 6'x5' gates to Main Canal (cap 100 cfs) and 2 – 5'x4' gates to South Canal (capacity 36 cfs).	Franklin Canal conduit to 2-36" gates, cap 520 cfs. Naponee Canal conduit to 1-24" valve, cap 40 cfs. See also note (4)	Courtland Canal outlet.	cfs = cubic feet per sec msl = elev abv mean sea lvl

SUMMARY OF ENGINEERING DATA
REPUBLICAN RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2D

SUBJECT	WACONDA LAKE	KIRWIN RESERVOIR	WEBSTER RESERVOIR	WILSON LAKE	KANOPOLIS LAKE	CEDAR BLUFF RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose or full conservation level. (2) Damming height is height from original river bed to top of flood control pool. (3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below along with the effective dates in parenthesis: Waconda, July 2001 (effective January 1, 2003) Kirwin, May 1996 (effective January 1, 1998) Webster, May 1996 (effective January 1, 1998) Wilson, December 1984 (effective January 1, 1985) Kanopolis, February 1983 (effective March 1, 1983) Cedar Bluff, March 2001 (effective January 1, 2002) (4) Total DA with Kirwin and Webster = 5,076 sq miles (5) 7' conduit from intake tower to gate chamber. 4'x5' emergency gate to 60" pipe. Entrance to stilling well controlled by 4'x5' slide gate. From stilling well, 42" river outlet pipe controlled by 36" gate. River outlet capacity at top of MP pool and flood control pool about 220 cfs. Length of combined pipes from intake to stilling well about 500'. About 200' more to stilling basin. Canal releases from two openings at top of stilling well. Canal capacity is about 175 cfs, but combined capacity with river outlet about 395 cfs. (6) Total contrib. DA with Cedar Bluff = 7,695 sq miles
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS	
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River	
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4	
Contributing Drainage Area, sq miles	2,559 below u/s dams (4)	1,367	1,150	1,917	2,330 blw Cedar Bluff (6)	5,365	
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9	
Shoreline, miles (1)	100	37	27	100	41	50	
Maximum Discharge of Record nr Dam Site	125,000 cfs (July 1951)	24,000 cfs (Sep 1919)	55,200 cfs (July 1951)	25,700 cfs (Jul-Aug 1928)	61,000 cfs (June 1938)	98,000 cfs (May 1938)	
Date of Closure	October 18, 1967	March 7, 1955	May 3, 1956	September 3, 1963	July 26, 1946	November 13, 1950	
Date Storage Began	July 24, 1968	October 5, 1955	May 3, 1956	December 29, 1964	February 17, 1948	November 13, 1950	
Date Multipurpose Level Reached	May 16, 1973	July 2, 1957	June 18, 1957	March 12, 1973	July 19, 1948	June 21, 1951	
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation	
DAM AND EMBANKMENT							
Top of Dam Elevation, feet msl	1,500.0	1,779.0	1,944.0	1,592.0	1,537.0	2,198.0	
Length of Dam, feet (Less Spillway)	14,631	12,246	10,604	5,600	15,360	12,409.5	
Damming Height, feet (2)	107.9	95	84.7	114	102	102	
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	
Fill Quantity, cubic yards	8,050,000	9,537,000	8,145,000	8,500,000	15,200,000	8,490,000	
SPILLWAY							
Location	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	1,467.4	1,757.3	1,884.6	1,582.0	1,507.0	2,166.0	
Width, feet	644	400 (uncontrolled)	116	450 (uncontrolled)	500 (uncontrolled)	150.5 (uncontrolled length)	
Number, Size, and Type of Gates	12 - 50'x21.76' Radial	None, but see note below	3 – 33.33'x39.51' Radial	None	None	Gated orifice, see note blw	
Discharge Capacity at Top of Surcharge Pool	278,000 cfs	96,000 cfs (sluices closed)	138,000 cfs	15,700 cfs	172,000 cfs	84,000 cfs (with orifice)	
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,178 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,882 ac	1,531.8 ft msl 23,408 ac	2,192.0 ft msl 16,510 ac	137,908 ac
Flood Control Pool Elevation (ft msl), Area	1,488.3 ft msl 33,682 ac	1,757.3 ft msl 10,639 ac	1,923.7 ft msl 8,478 ac	1,554.0 ft msl 20,027 ac	1,508.0 ft msl 13,958 ac	2,166.0 ft msl 10,790 ac	97,574 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,071 ac	1,892.45 ft msl 3,767 ac	1,516.0 ft msl 9,045 ac	1,463.0 ft msl 3,406 ac	2,144.0 ft msl 6,869 ac	40,760 ac
Inactive Pool Elevation (ft msl), Area	1,428.0 ft msl 3,020 ac	1,697.0 ft msl 1,006 ac	1,860.0 ft msl 904 ac			2,107.8 ft msl 1,907 ac	
Dead Storage Pool Elevation (ft msl), Area	1,407.8 ft msl 248 ac	1,693.0 ft msl 765 ac	1,855.5 ft msl 440 ac			2,090.0 ft msl 755 ac	
Surcharge Storage, AF	1,492.9 - 1,488.3 203,798	1,773.0 - 1,757.3 198,467	1,938.0 - 1,923.7 140,912	1,587.5 - 1,554.0 894,263	1,531.8 - 1,508.0 438,655	2,192.0 - 2,166.0 353,250	2,229,345 AF
Flood Control Storage, AF	1,488.3 - 1,455.6 722,988	1,757.3 - 1,729.25 215,136	1,923.7 - 1,892.45 183,353	1,554.0 - 1,516.0 530,204	1,508.0 - 1,463.0 369,278	2,166.0 - 2,144.0 191,890	2,212,849 AF
MP, or Active Conservation Storage, AF	1,455.6 - 1,428.0 193,183	1,729.25 - 1,697.0 89,639	1,892.45-1,860.0 71,926	1,516.0 - 1,435.0 242,528	1,463.0 - 1,430.0 49,474	2,144.0 - 2,107.8 143,878	790,628 AF
Inactive Storage, AF	1,428.0 - 1,407.8 25,989	1,697.0 - 1,693.0 3,546	1,860.0 - 1,855.5 2,975			2,107.8 - 2,090.0 24,172	56,682 AF
Dead Storage, AF	1,407.8 - 1,395.0 248	1,693.0 - 1,680.0 4,969	1,855.5 - 1,849.0 1,256			2,090.0 - 2,078.0 4,402	10,875 AF
Gross Storage, AF	1,488.3 - 1,395.0 942,408	1,757.3 - 1,680.0 313,290	1,923.7 - 1,849.0 259,510	1,554.0 - 1,435.0 772,732	1,508.0 - 1,430.0 418,752	2,166.0 - 2,078.0 364,342	3,071,034 AF
Design Sediment Reserve Storage	23,750 AF for 50 years	14,950 AF for 100 years	18,600 AF for 100 years	40,000 AF for 100 years	51,500 AF for 50 years	26,000 AF for 100 years	
Measured Sediment Inflow	22,597 AF (1968 to 2001)	1,278 AF (1955 to 1996)	1,267 AF (1956 to 1996)	15,066 AF (1964 to 1995)	28,704 AF (1948 to 1993)	13,044 AF (1950 to 2000)	
OUTLET WORKS							(7) In addition to the gated conduit, Kanopolis has an uncontrolled port opening 3.5'x13.75' in the 10' pier separating the two service gate openings. Crest elevation of the port is 1,463 ft msl. The max discharges given for the outlet is the combined total of the port and gates. (8) River outlet crest elev is 2,090 ft msl. Crest elev of sluices under spillway is 2,134.82 ft msl. River outlet capacity at MP is 804 cfs, at top of flood pool is 909 cfs. Cedar Bluff also has an irrig canal outlet on Y junction from river outlet, 5.5' pipe to control house, canal flow controlled by 4'x5' gate (not used since 1978, irrigation district disbanded in 1994). Also a hatchery supply line from 18" valve on canal outlet, capacity 10 cfs. Lake storage owned by KS, for benefit of recreation and F&W. All releases coordinated with Kansas KDWP. (9) 2,000 AF annual storage supply contract for Russell.
Location	Left Abutment	Center of Dam	Right Abutment	Right Abutment	Right Abutment	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit (7)	Gated Conduit to River	
Number and Size of Conduit	1 - 12.5'	7' Cond to 60" pipe (5)	4.5' Conduit to 48" pipe	1 - 12'	1 - 14'	1 - 5.5'	
Length of Conduit, feet	575	(5)	538	1,097	2,443	863.5	
Entrance Crest Elevation	1,407.8 ft msl	1,693 ft msl	1,855.5 ft msl	1,450.0 ft msl	1,415.0 ft msl	2,090.0 ft msl	
Gated Sluice, Number and Size	None	See note below	None	None	None	8 - 5'x5', gated (8)	
Discharge Cap, Top of Flood Control Pool	5,200 cfs	220 cfs (5)	480 cfs	6,500 cfs	6,400 cfs (7)	3,520 cfs (outlet, sluices) (8)	
Disch Cap, Top of MP (Conservation) Pool	4,000 cfs	220 cfs (5)	385 cfs	5,300 cfs	4,500 cfs (7)	7,949 cfs (outlet, sluices) (8)	
Service Gates, Number, Size, Type	2 - 6.5'x8' Slide Gates	1 - 4'x5' to stilling well (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Service Gates	2 - 6'x12'	1 - 4'x5'	
Emergency Gates, Number and Size	1 - 9'x12' Slide Gates	1 - 4'x5' (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Slide Gates	1 - 6'x12'	1 - 4'x5'	
Low Flow Gates, Number and Size	None	None	None	2 - 2'x2' Slide Gates	None	None	
Provision for Irrigation	None	2 - 5.5'x8' openings (5)	None	None	None	1 - 4'x5' (8)	
Provision for Power	None	None	None	None	Provision future penstock	None	
Provision for Municipal Supply	No pipe outlets, water supply released to river	None	None	None	Pump outlet near tower	See (9), supplied by release to river, pump to Big Ck.	
		Note: 15 - 5' x 5' gated sluices located in concrete ogee section below spillway crest. Crest elevation at sluice entrance = 1,720.0. Discharge capacity at top of conserv pool = 4,800 cfs, top, flood pool = 15,350 cfs.	Note: When reservoir elevation is below 1,860, the outlet gate openings must be reduced to prevent air entrainment in conduit.	Note: Low flow gates are mounted in the service gates		Note: Spillway also has a gated orifice section at center with 1 - 14.5' x 9.58' radial gate, crest elev 2,144. Spillway cap includes ogee and orifice. Sluices located in ogee section below crest.	

Abbreviations
ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
MP = multipurpose pool elevation

SUMMARY OF ENGINEERING DATA
SMOKY HILL RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2E

APPENDIX A
CORPS OF ENGINEERS PROJECTS

BLUE SPRINGS LAKE

CLINTON LAKE

HARLAN COUNTY LAKE

HARRY S TRUMAN RESERVOIR

HILLSDALE LAKE

KANOPOLIS LAKE

LONG BRANCH LAKE

LONGVIEW LAKE

MELVERN LAKE

MILFORD LAKE

PERRY LAKE

POMME DE TERRE LAKE

POMONA LAKE

RATHBUN LAKE

SMITHVILLE LAKE

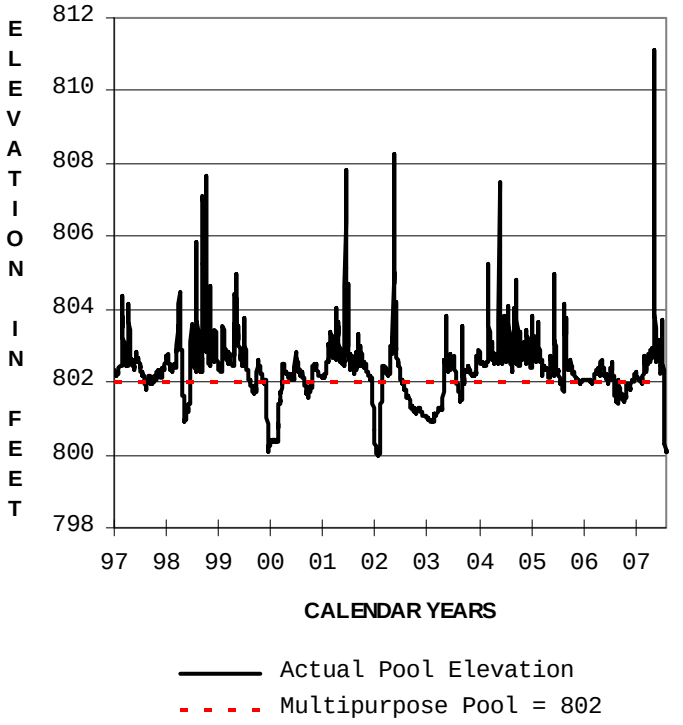
STOCKTON LAKE

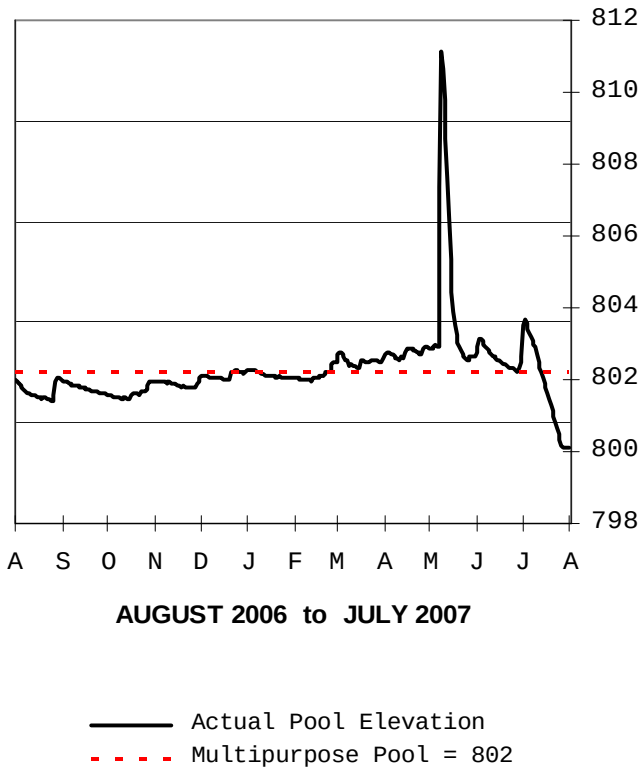
TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



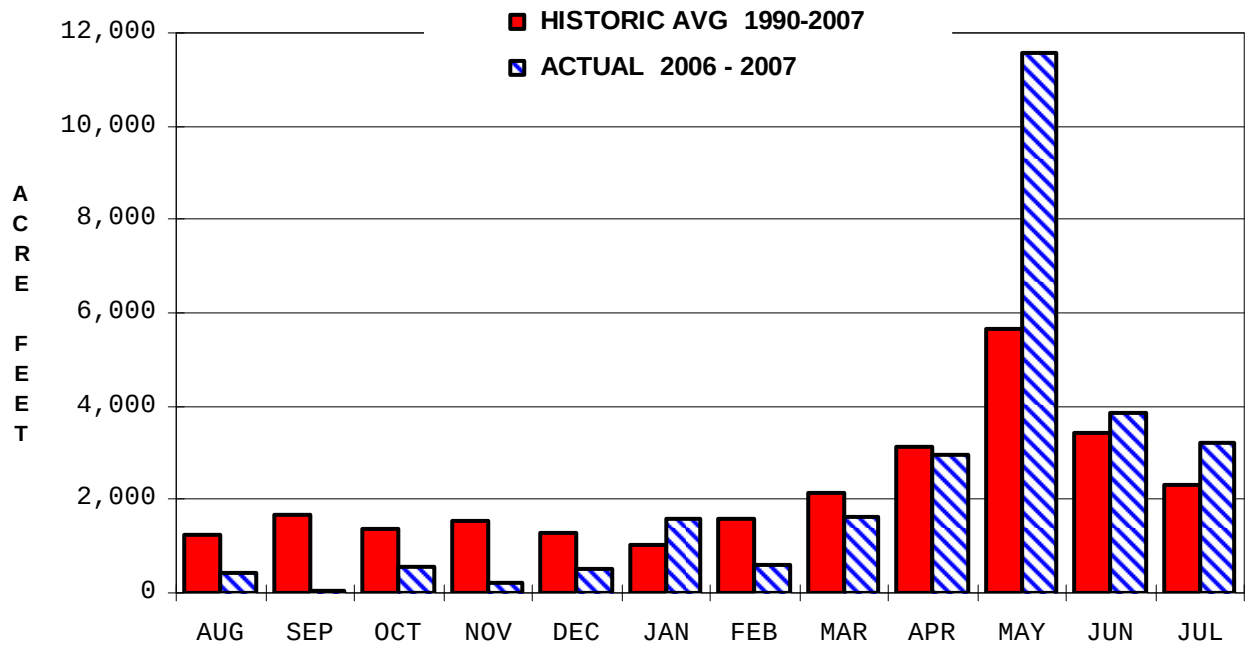


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
801.97 1 Aug 06	**800.12 31 Jul 07**	**811.12 8 May 07**	**800.11 27 July 07**	**816.37 16-17 May 90**	**800.00 17-18 Jan 02**

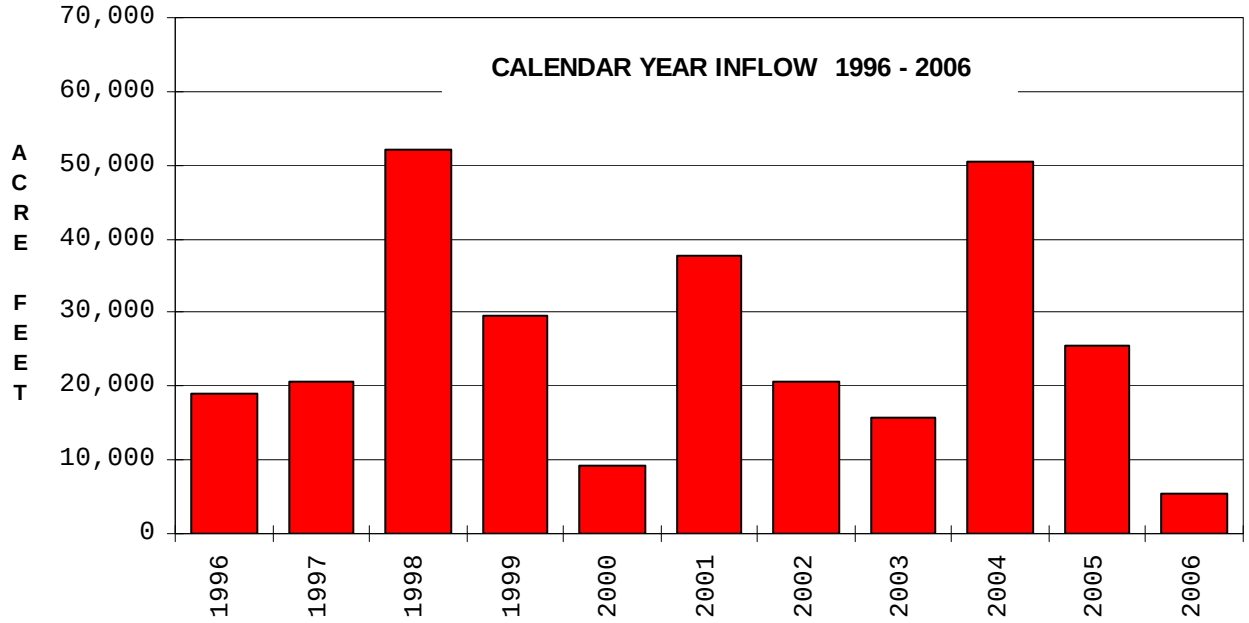
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2100 8 May 07	**26,230**	**529 9 May 07**	**0 Many days**

All releases are to the river. No minimum release requirement. No release when lake below notch elevation 802.0

BLUE SPRINGS LAKE MONTHLY INFLOW

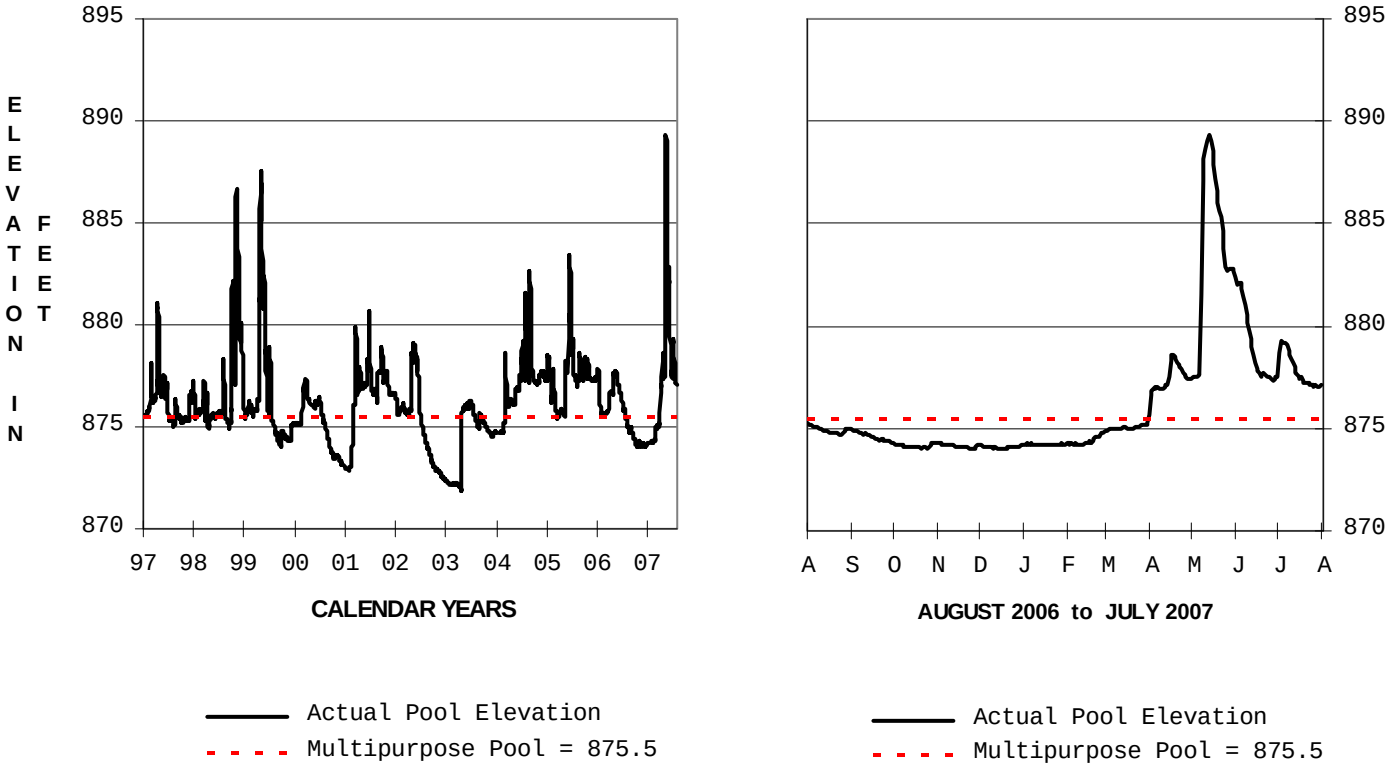


BLUE SPRINGS LAKE ANNUAL INFLOW



CLINTON LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

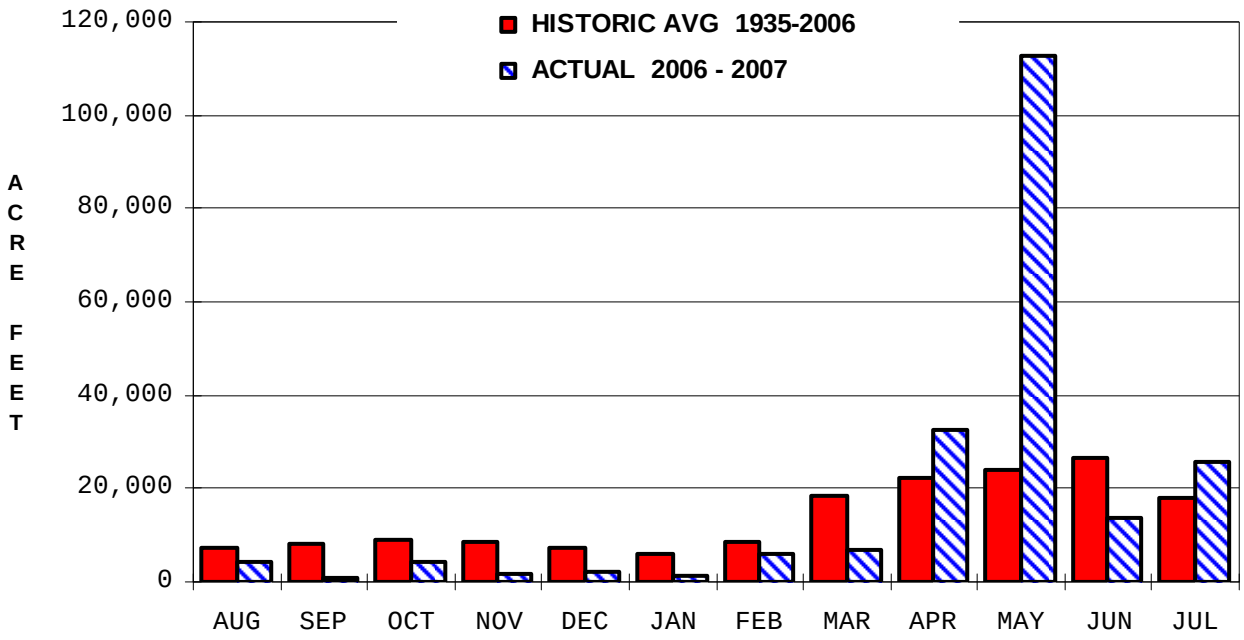


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
875.17 1 Aug 06	**877.54 31 Jul 07**	**889.34 12 May 07**	**874.00 20 Dec 06**	**892.48 29 May 95**	**871.60 18-19 Aug 89**

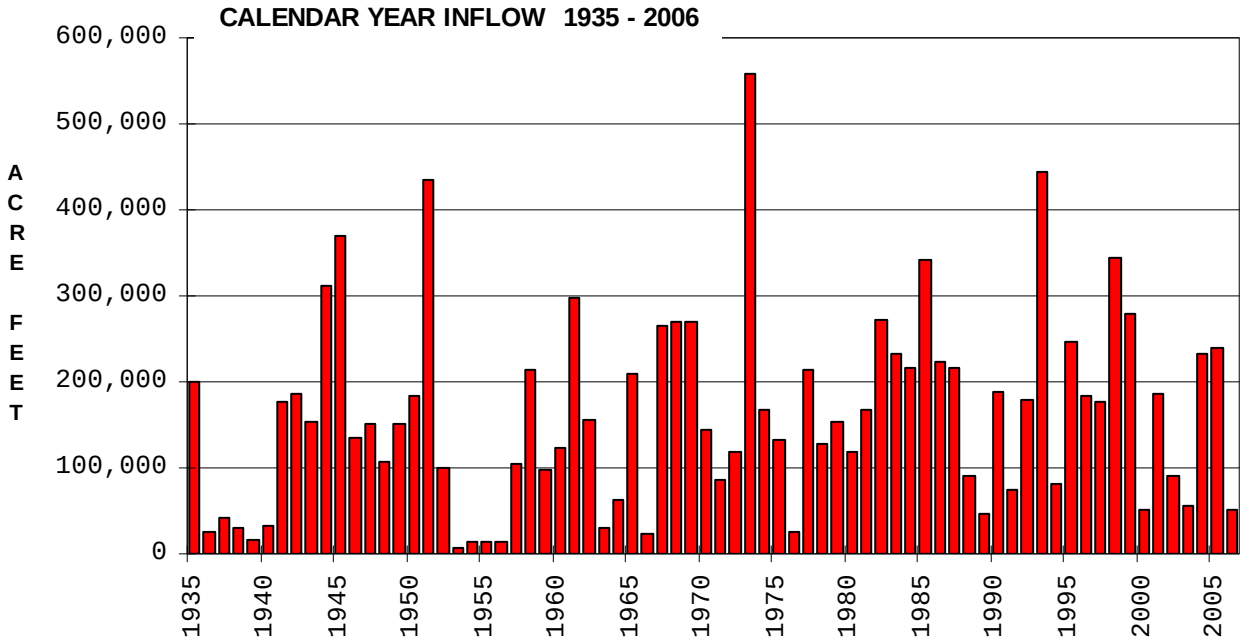
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
24,000 8 May 07	**497,395**	**3,500 18 May 07**	**0 8 May 07**

Outflows are those to river only. Minimum release is 7 to 21 cfs. Releases cut to 0 for maintenance, inspections.

CLINTON LAKE MONTHLY INFLOW

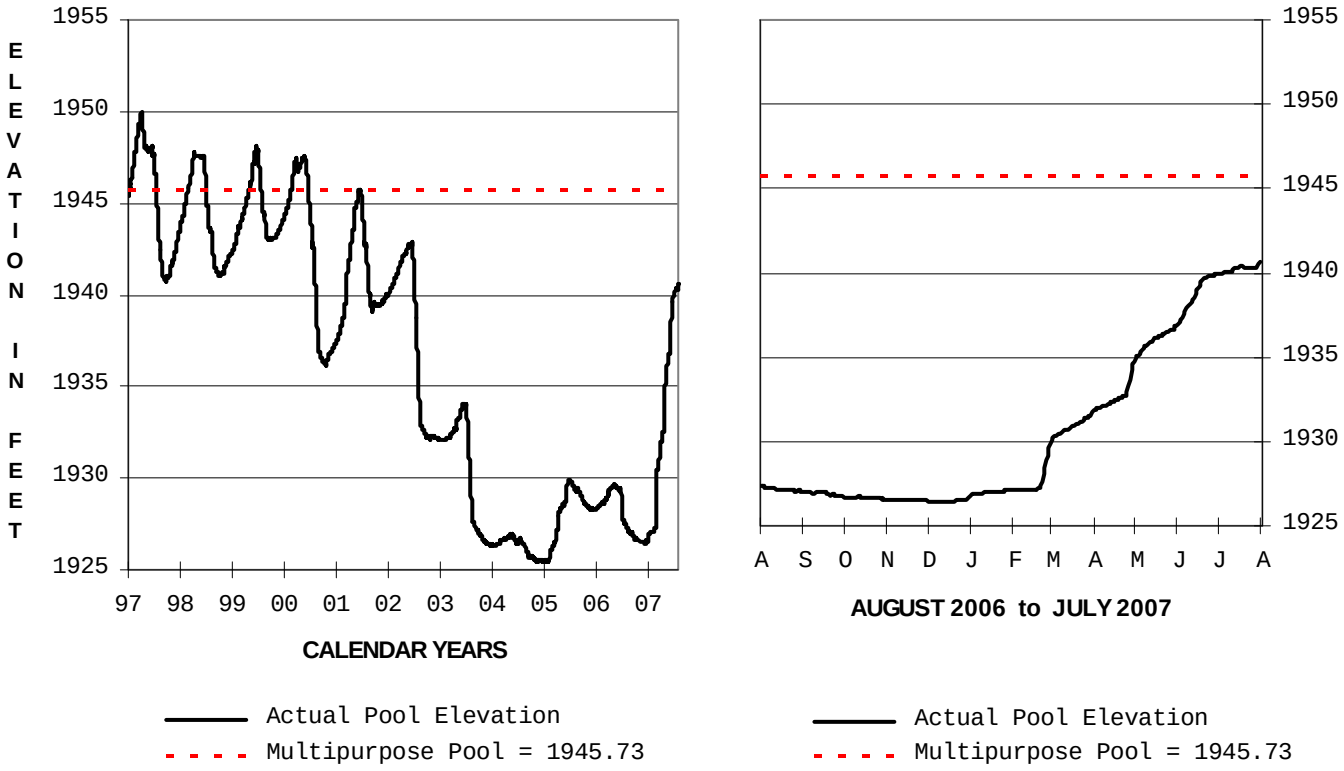


CLINTON LAKE ANNUAL INFLOW



HARLAN COUNTY LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

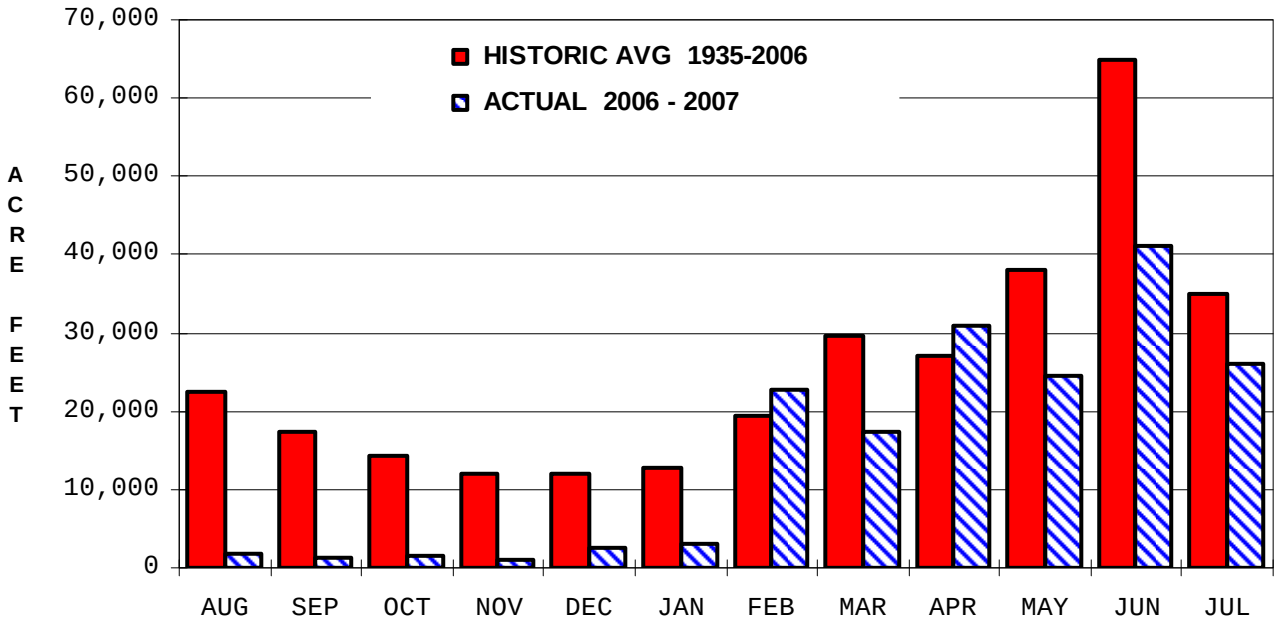


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1927.33 1 Aug 06	**1940.66 31 Jul 07**	**1940.66 31 May 07**	**1926.45 7 Dec 06**	**1955.66 5 Apr 60**	**1925.38 31 Dec 04**

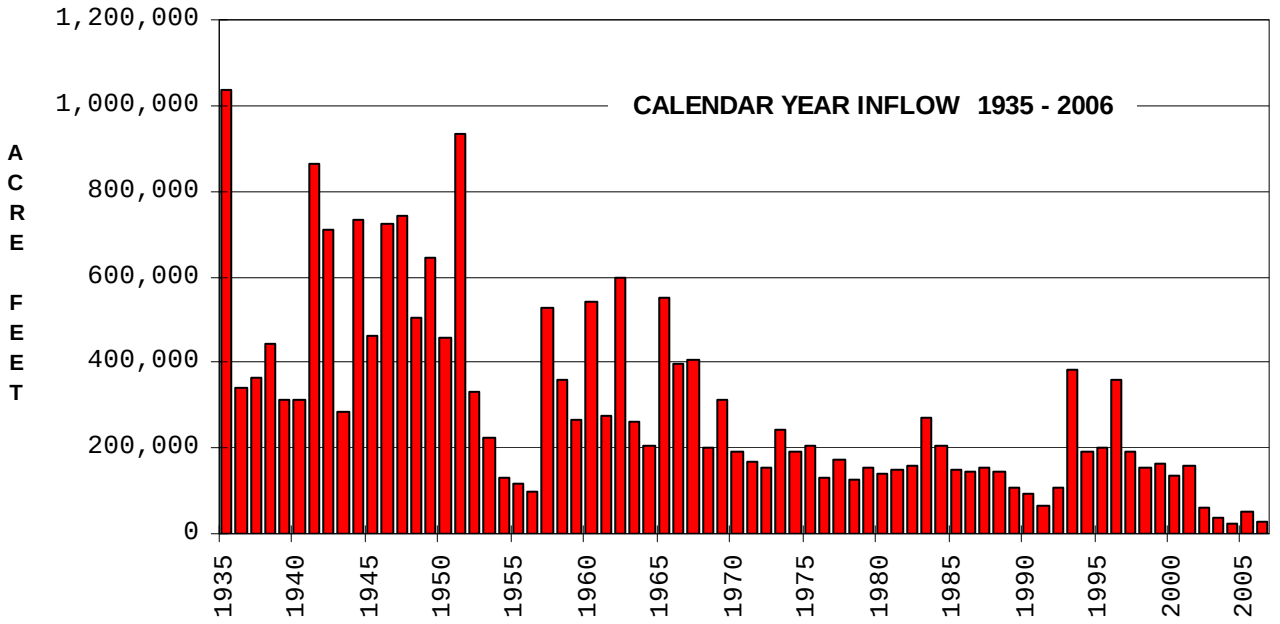
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,500 28 Apr 07	**181,693**	**290 3 July 07**	**0 Many Days**

Max daily outflow to river normally occurs as part of normal releases for irrigation. No minimum release requirement.

HARLAN COUNTY LAKE MONTHLY INFLOW

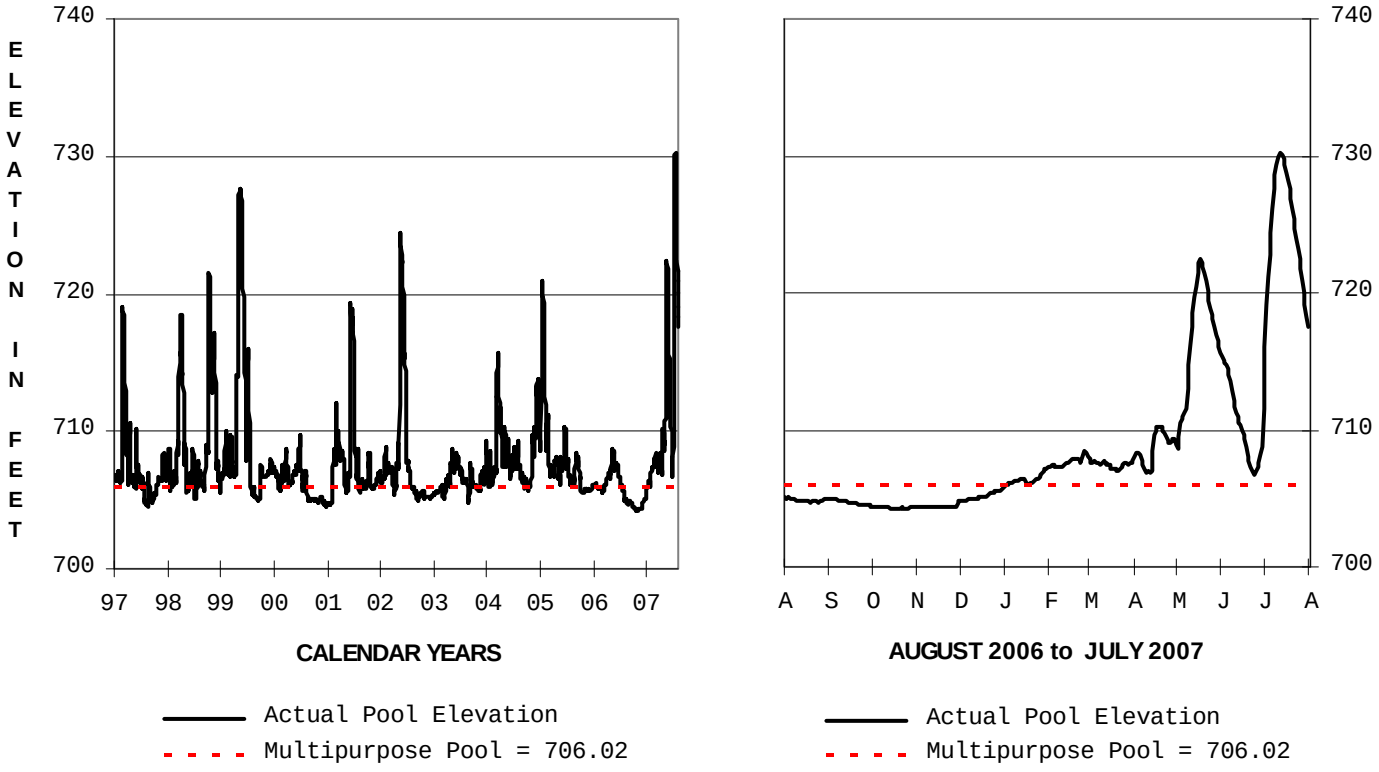


HARLAN COUNTY LAKE ANNUAL INFLOW



HARRY S TRUMAN RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

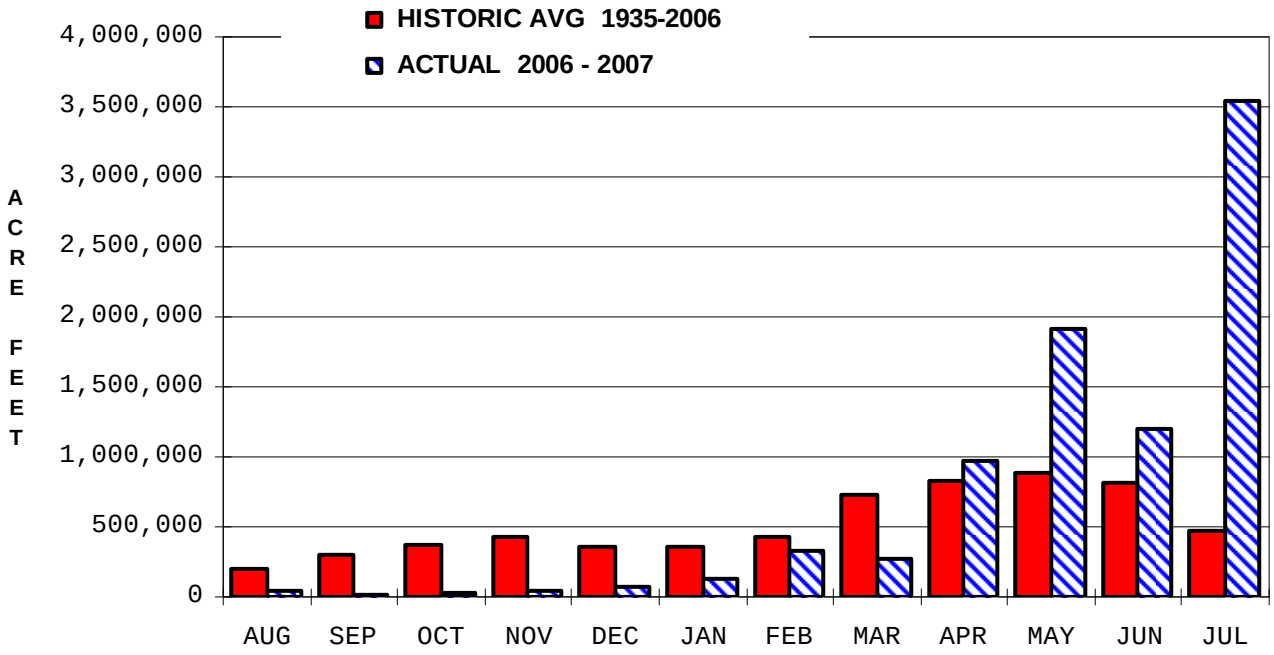


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
705.00 1 Aug 06	**716.94 31 Jul 07**	**730.25 12 Jul 07**	**704.22 24 Oct 06**	**738.72 12 Oct 86**	**703.42 10 Apr 81**

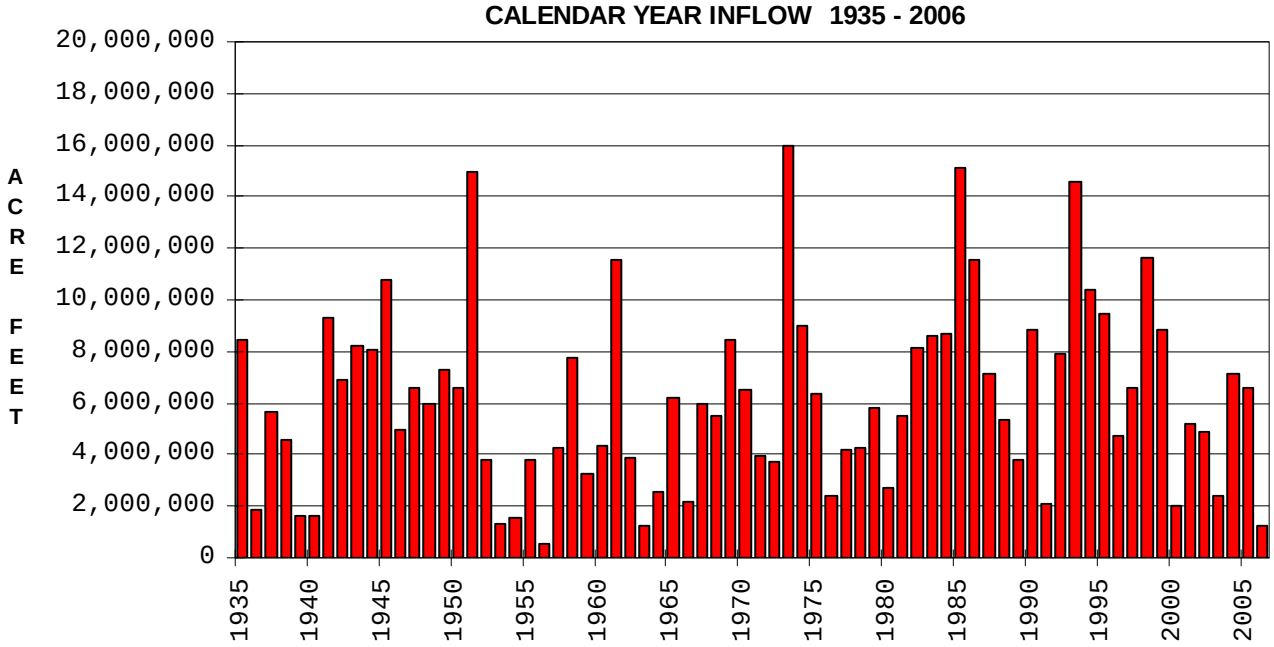
Report Period Inflow and Outflow			
Max Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
190,000 1 Jul 07	**8,084,319**	**53,000 27 Jul 07**	**0 Many days**

No minimum release requirement.

HARRY S. TRUMAN RESERVOIR MONTHLY INFLOW

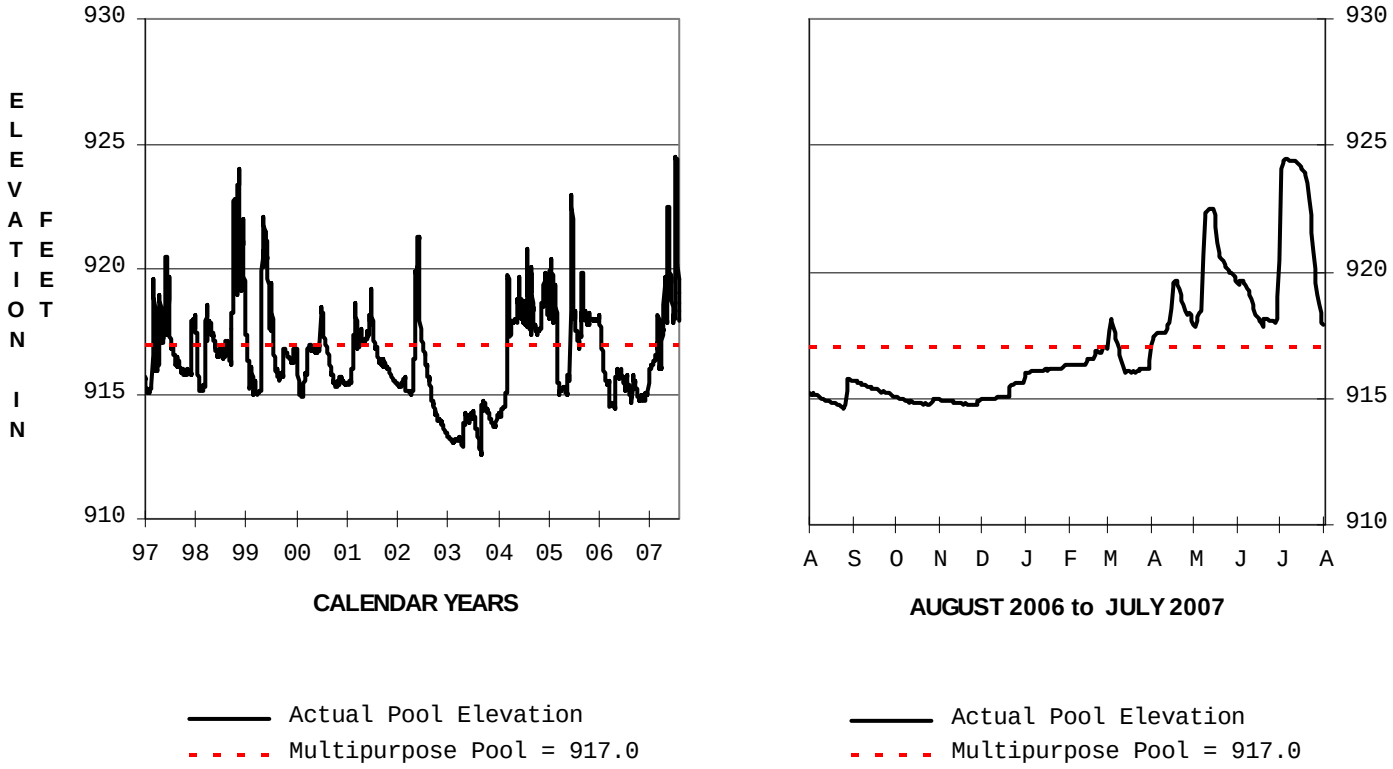


HARRY S. TRUMAN RESERVOIR ANNUAL INFLOW



HILLSDALE LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

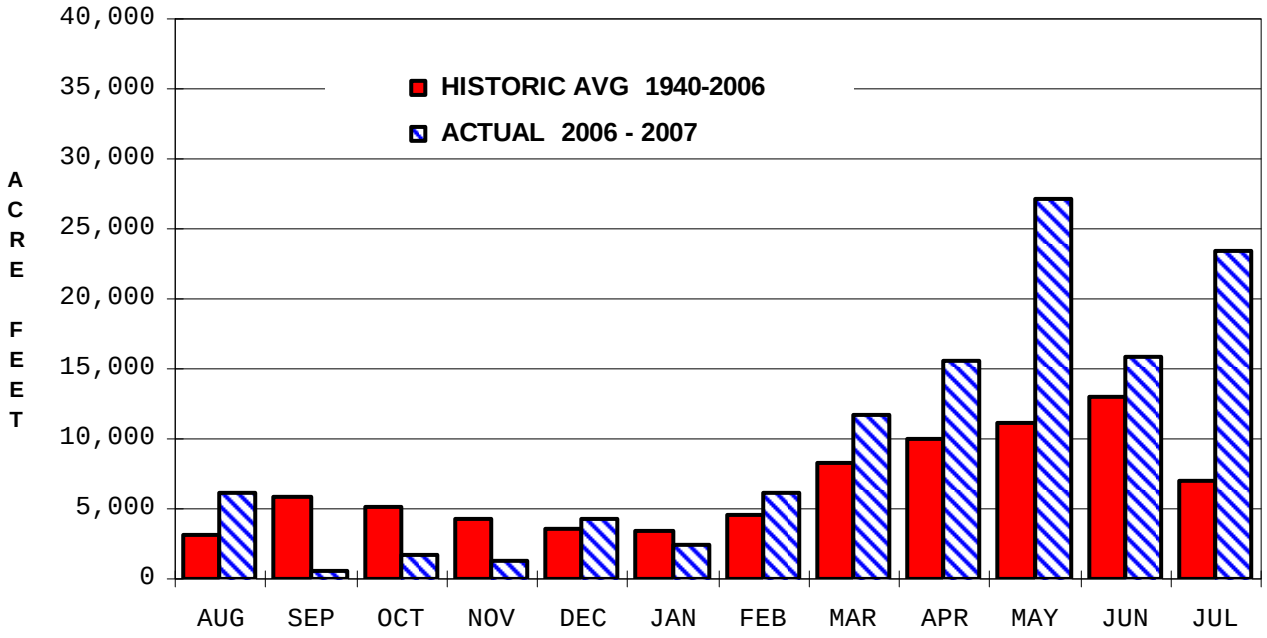


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
915.17 1 Aug 06	**917.86 31 Jul 07**	**924.44 5 Jul 07**	**914.61 25 Aug 06**	**928.51 21 Oct 86**	**904.97 14-15 Nov 87**

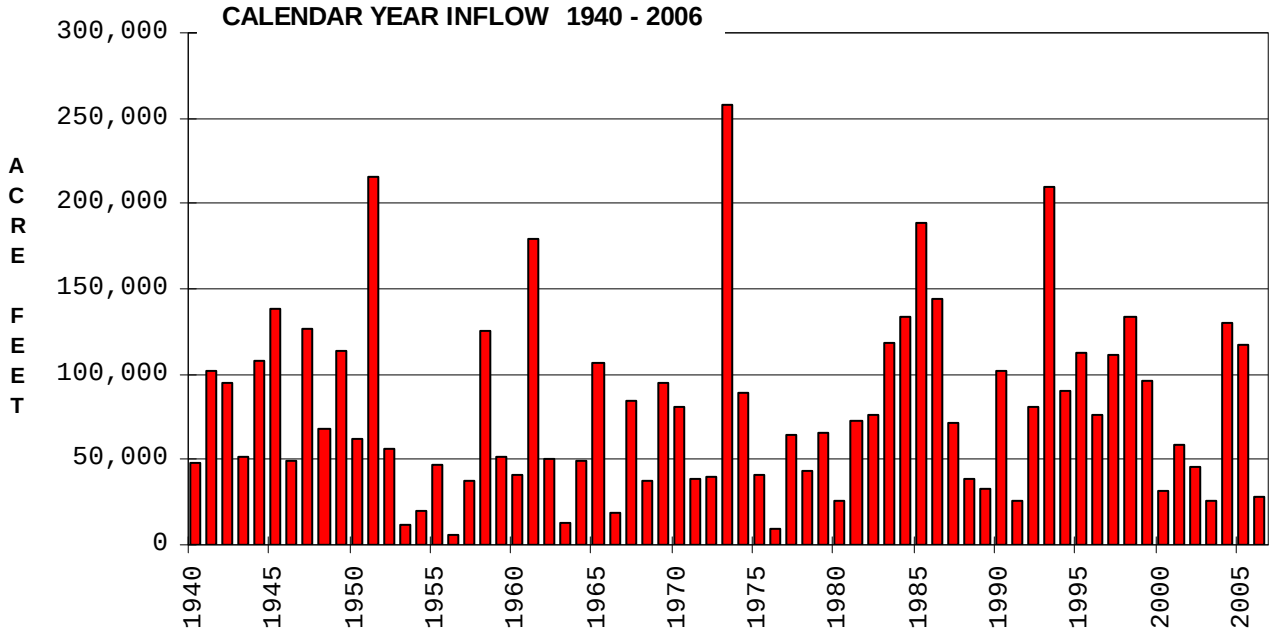
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
10,000 1 Jul 07	**103,903**	**1820 22-25 Jul 07**	**3 Many days**

Minimum required release varies seasonally 3 to 24 cfs. Releases cut to 0 for maintenance and inspections.

HILLSDALE LAKE MONTHLY INFLOW

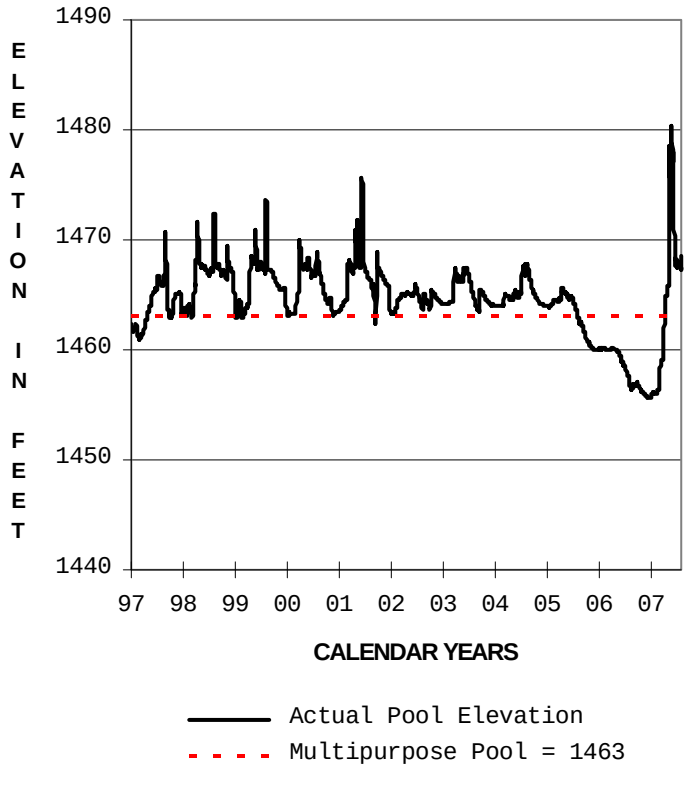


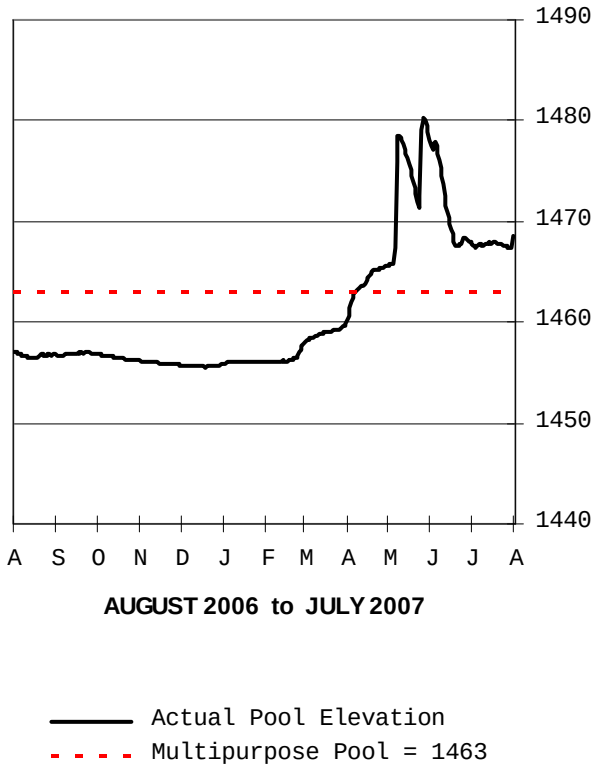
HILLSDALE LAKE ANNUAL INFLOW



KANOPOLIS LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



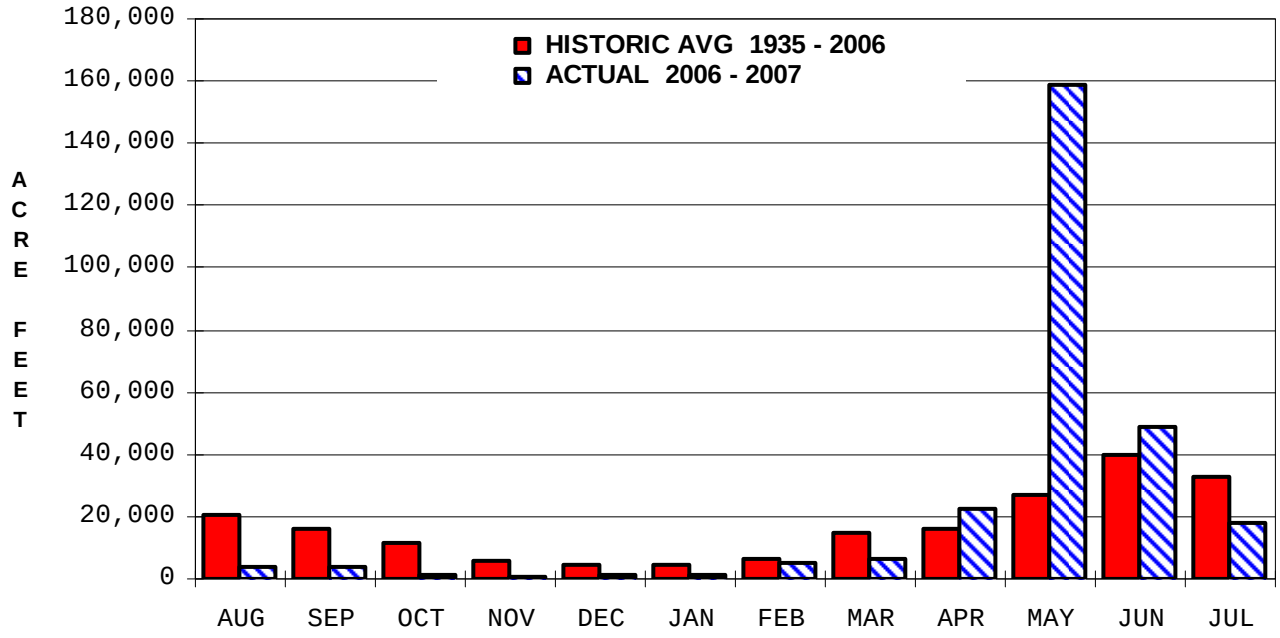


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1456.97 1 Aug 06	**1468.98 31 Jul 07**	**1468.98 31 Jul 07**	**1455.55 18 Dec 06**	**1506.98 14 Jul 51**	**1452.55 11 Dec 88**

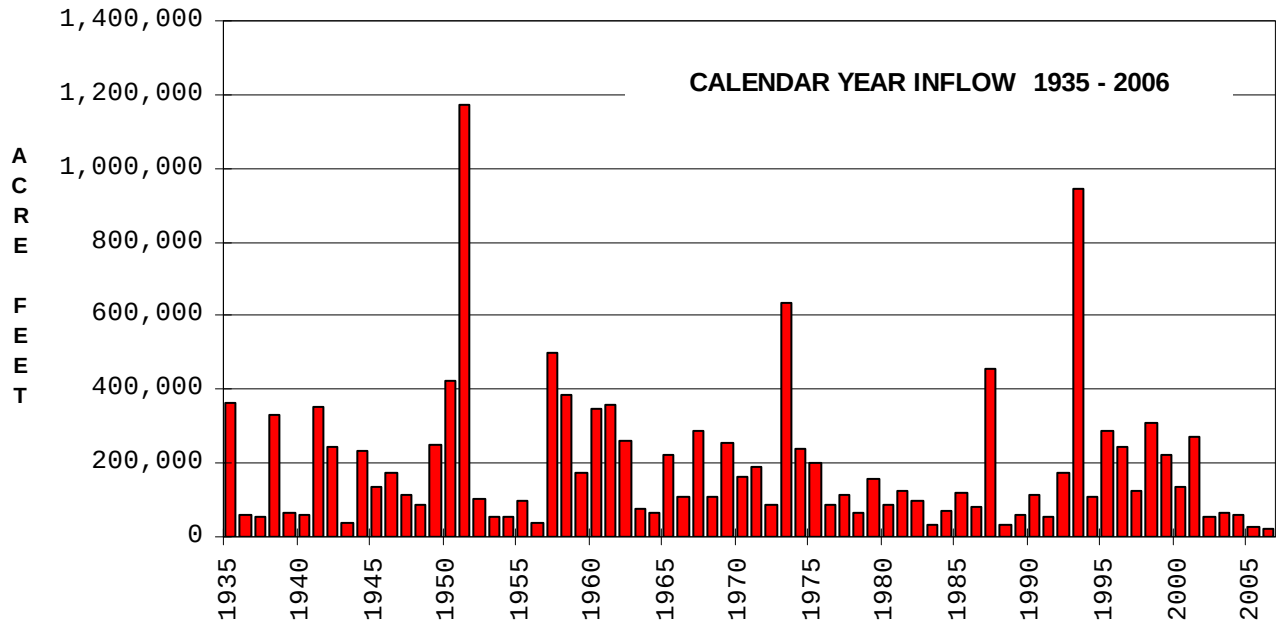
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
23,600 7 May 07	**271,844**	**3072 4 Jun 07**	**0 18 Jun 07**

Outflows are total from the gates and the uncontrolled notch. Minimum release varies seasonally 10 to 50 cfs.

KANOPOLIS LAKE MONTHLY INFLOW

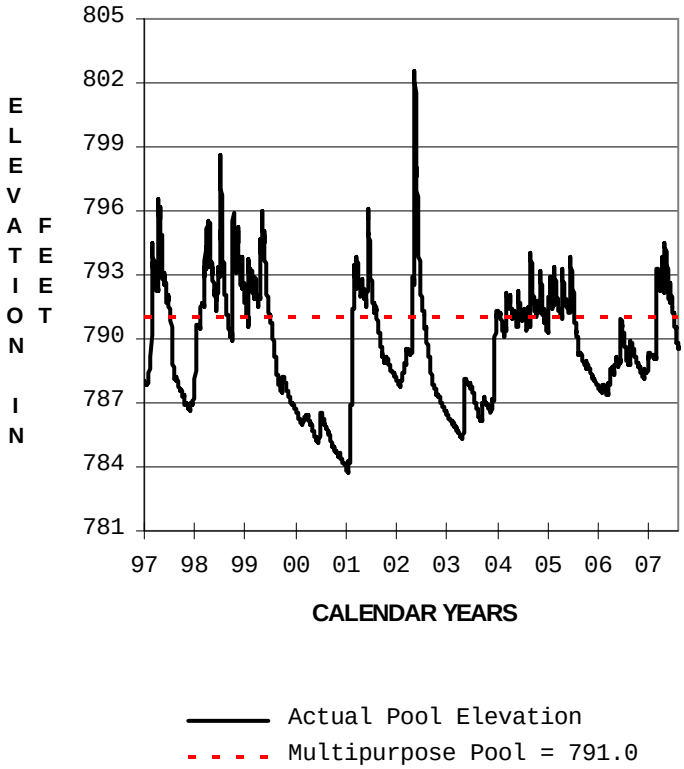


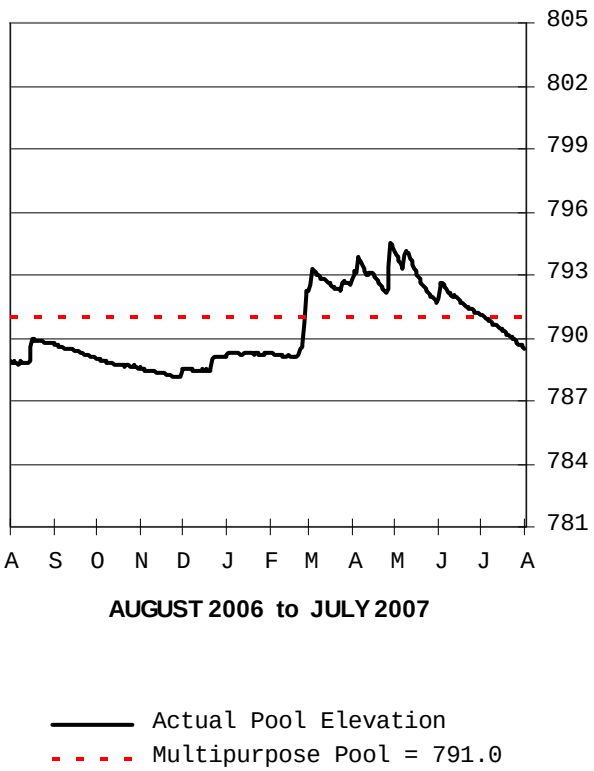
KANOPOLIS LAKE ANNUAL INFLOW



LONG BRANCH LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



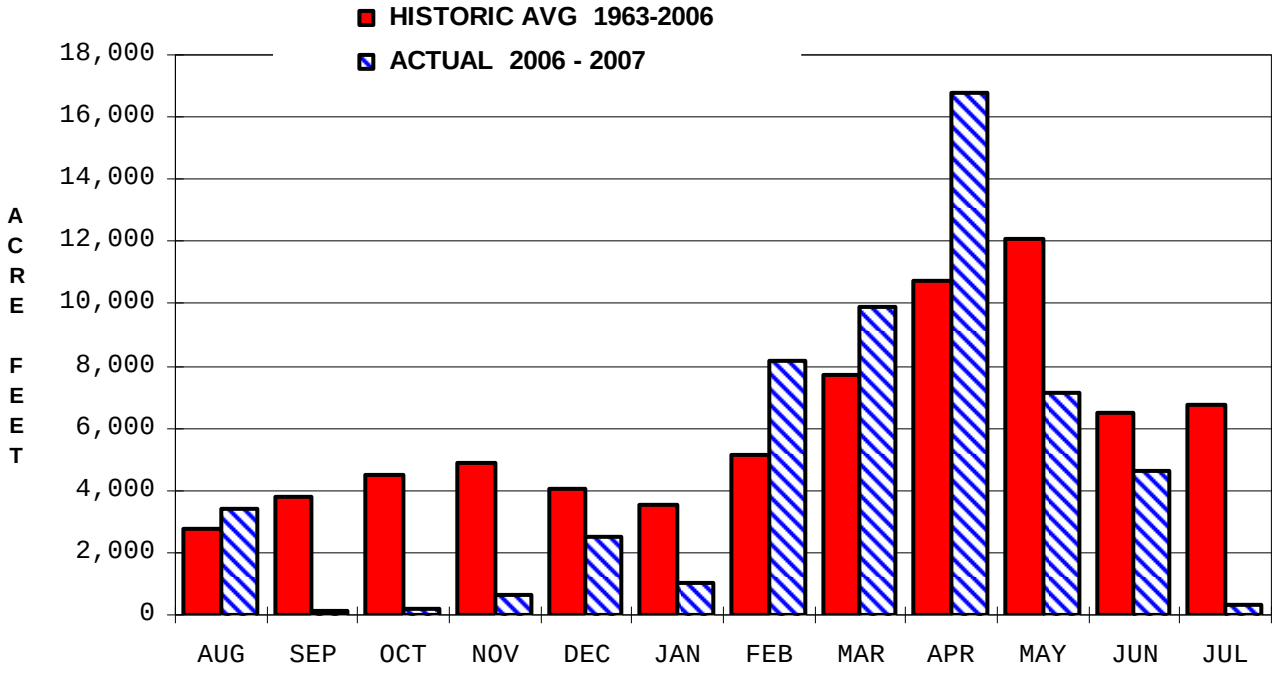


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
788.84 1 Aug 06	**789.72 31 Jul 07**	**794.52 27 Apr 07**	**788.12 27 Nov 06**	**802.74 13 May 02**	**783.70 12 Jan 01**

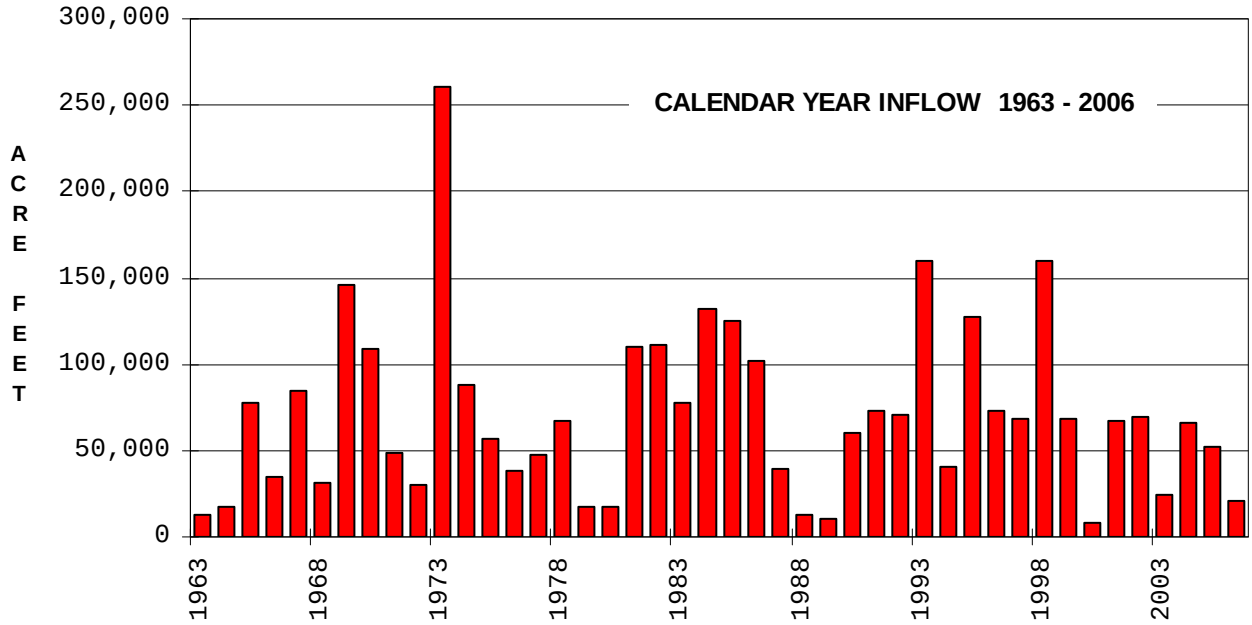
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,900 27 Apr 07	**54,809**	**301 28 Apr 07**	**7 Many days**

Listed outflows are total to the river from the gates and the uncontrolled notch. Min req release is normally 7 cfs.

LONG BRANCH LAKE MONTHLY INFLOW

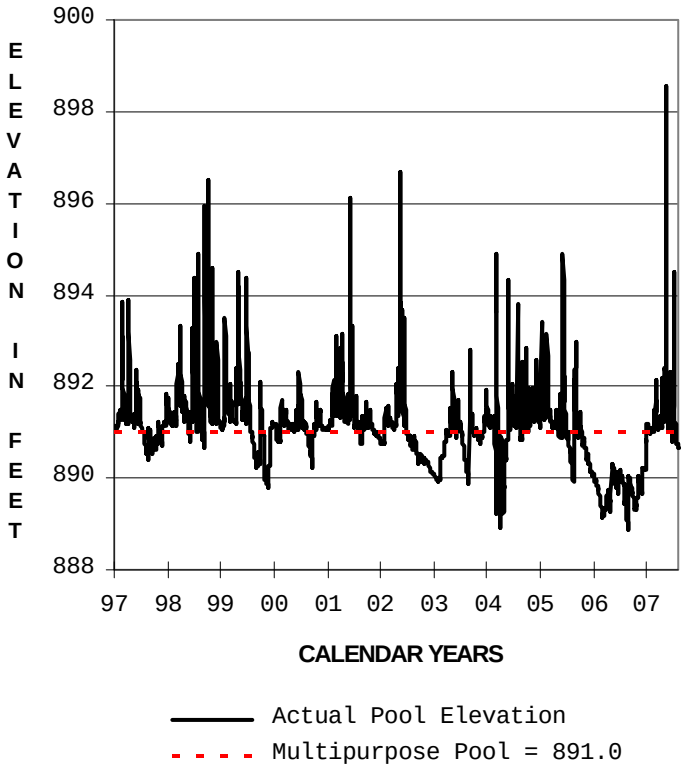


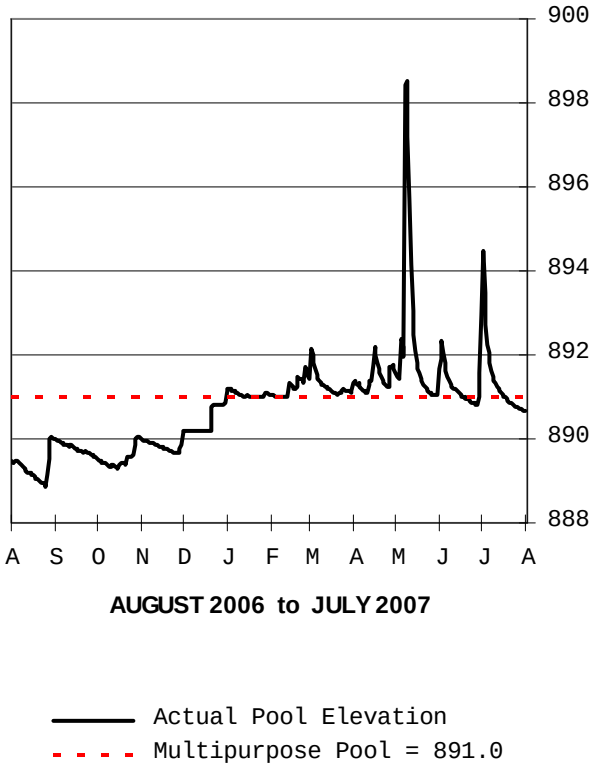
LONG BRANCH LAKE ANNUAL INFLOW



LONGVIEW LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



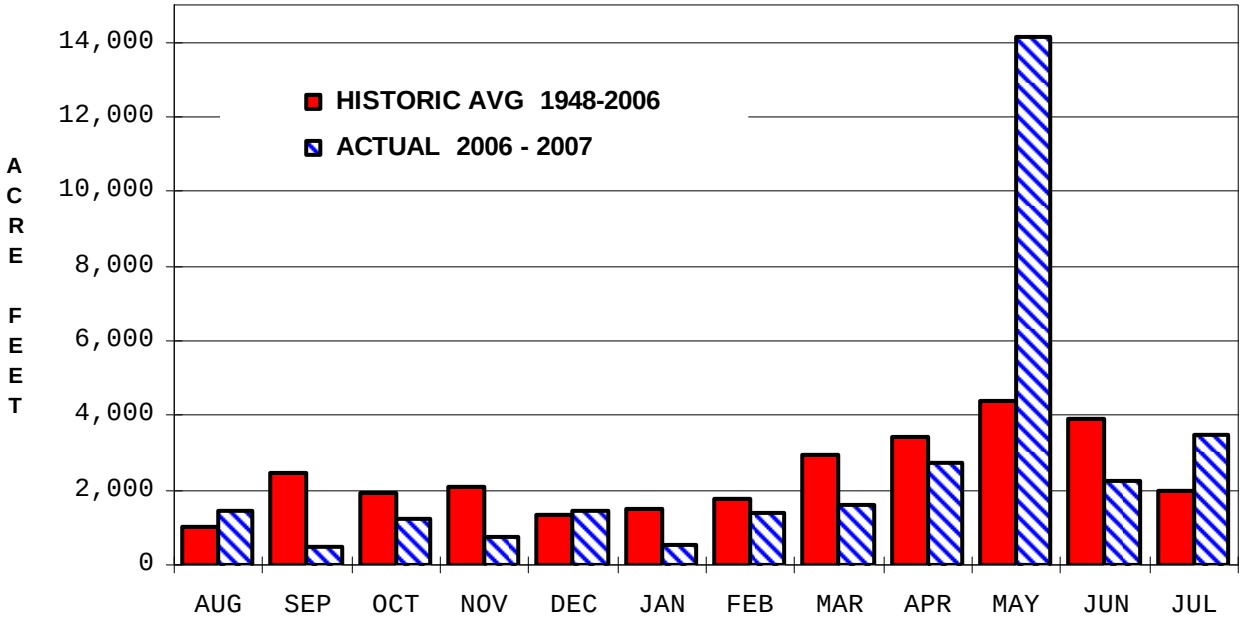


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
889.48 1 Aug 06	**890.66 31 Jul 07**	**898.54 8 May 07**	**888.86 25 Aug 06**	**903.37 16 May 90**	**888.08 14 Sep 88**

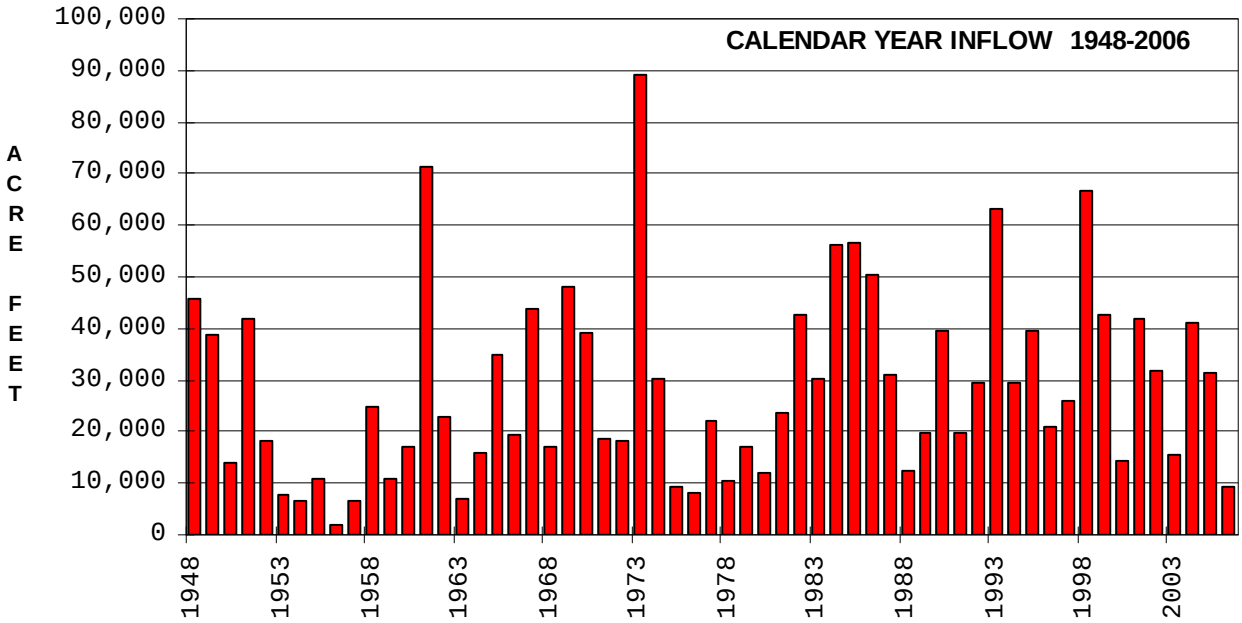
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
4250 7 May 07	**29,577**	**1104 8 May 07**	**8 Many Days**

Listed outflows are total to the river from the gate and the uncontrolled notch. Minimum required release is 8 cfs.

LONGVIEW LAKE MONTHLY INFLOW

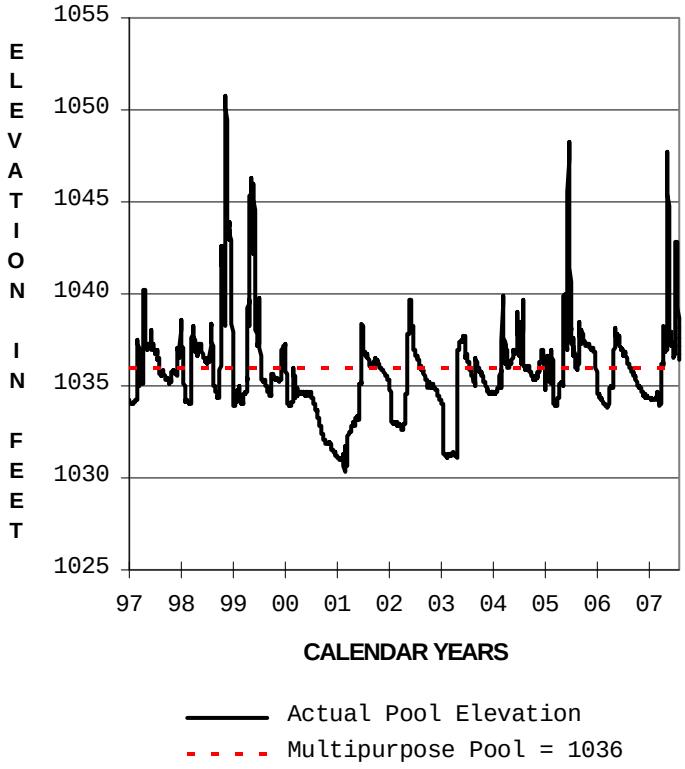


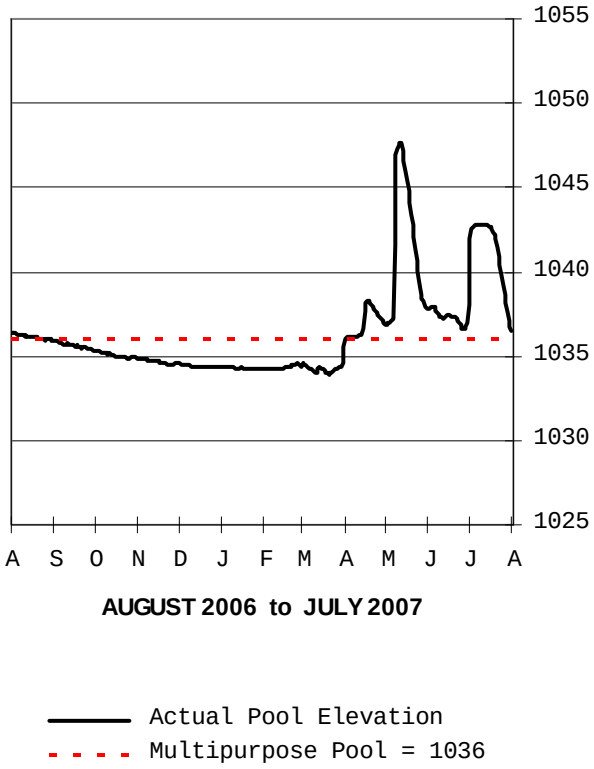
LONGVIEW LAKE ANNUAL INFLOW



MELVERN LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



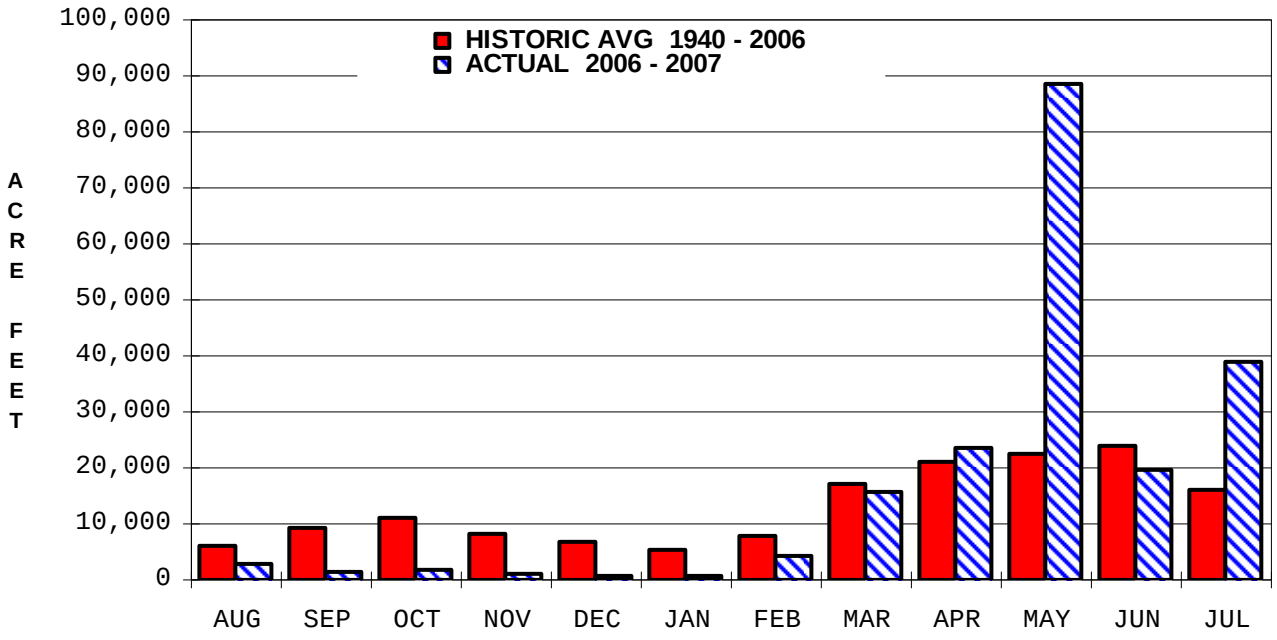


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1036.36 1 Aug 06	**1036.51 31 Jul 07**	**1046.56 14 May 07**	**1033.95 20 Mar 07**	**1053.45 13 Jun 95**	**1029.87 11 Feb 92**

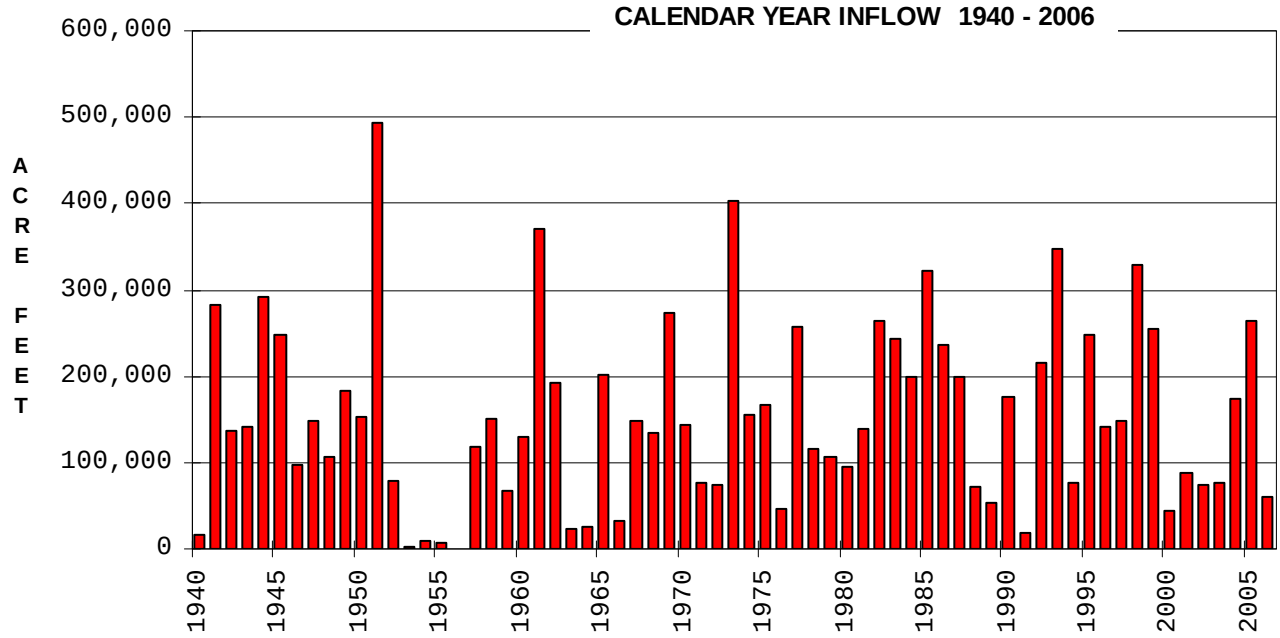
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
21,000 8 May 07	**215,527**	**2500 14-25 May 07**	**20 Many days**

Minimum required release is 20 cfs. Releases reduced to 0 for maintenance and inspection periods.

MELVERN LAKE MONTHLY INFLOW

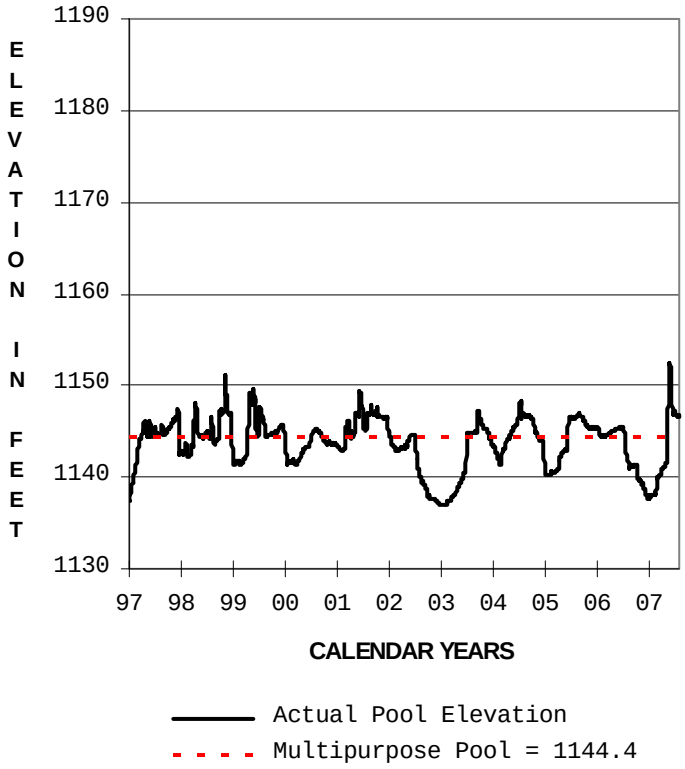


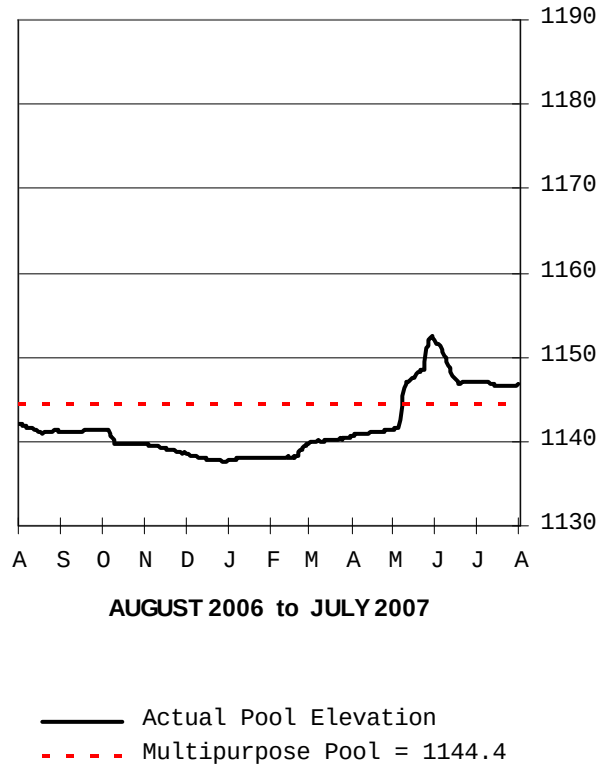
MELVERN LAKE ANNUAL INFLOW



MILFORD LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

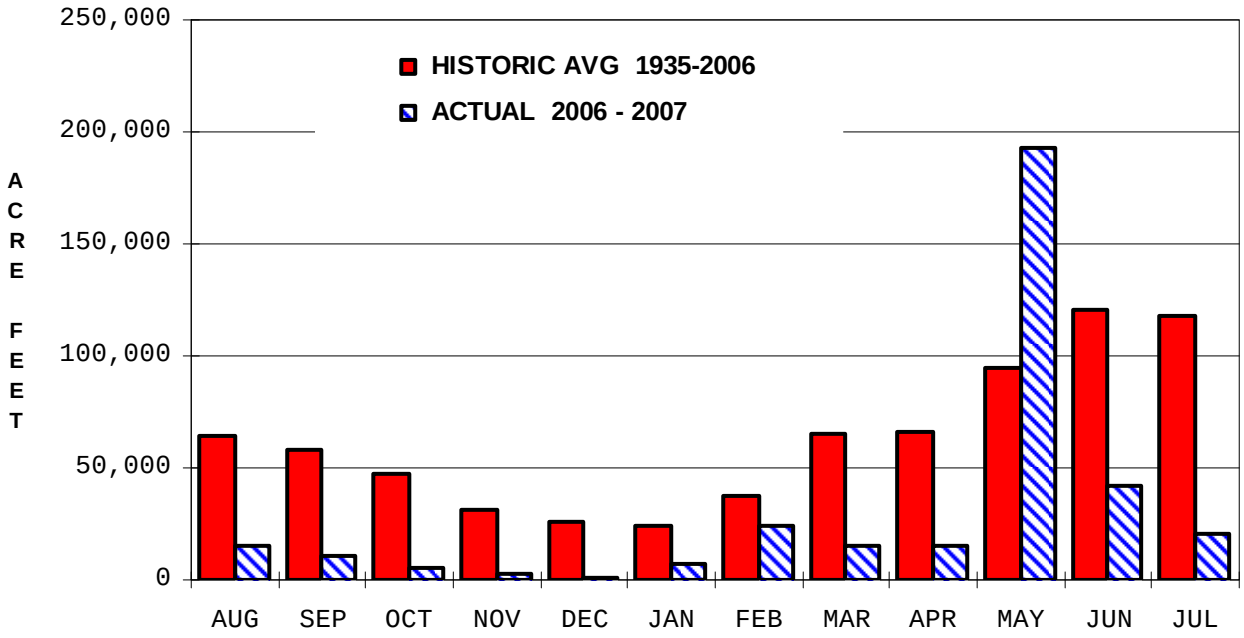




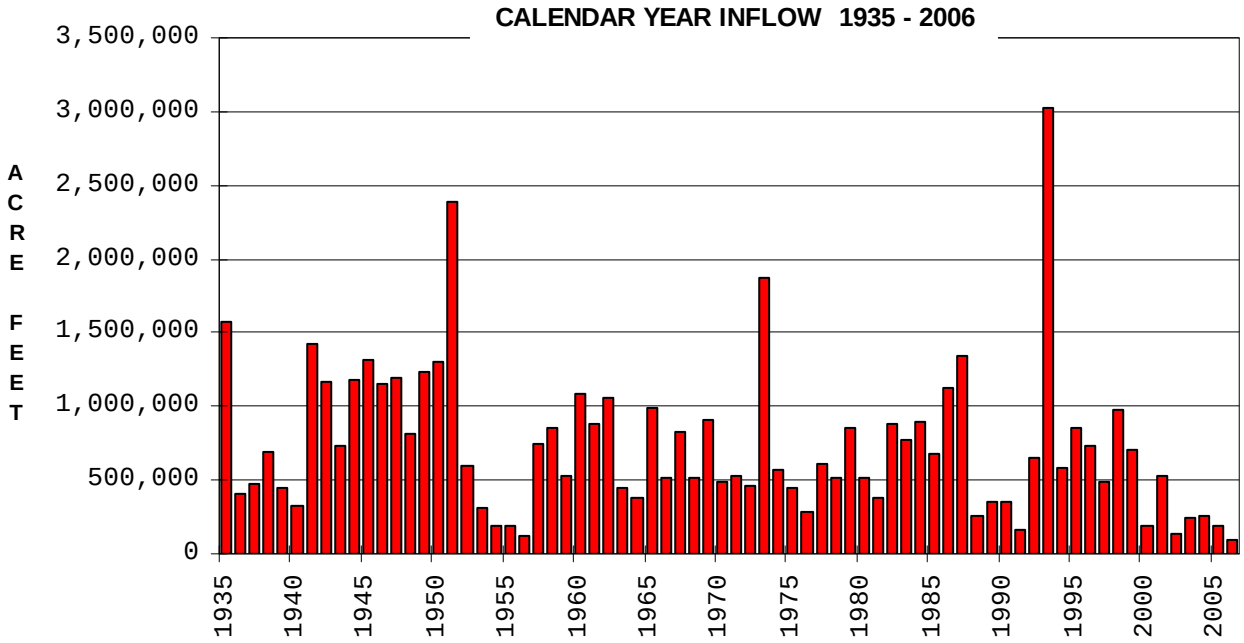
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1142.04 1 Aug 06	**1146.83 31 Jul 07**	**1152.42 29 May 07**	**1137.65 29 Dec 06**	**1181.94 25 Jul 93**	**1136.89 12-13 Jan 03**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
13,800 25 May 07	**1,063,061**	**4,000 1 Jun 07**	**15 Many Days**
Minimum required release is 25 cfs.			

MILFORD LAKE MONTHLY INFLOW

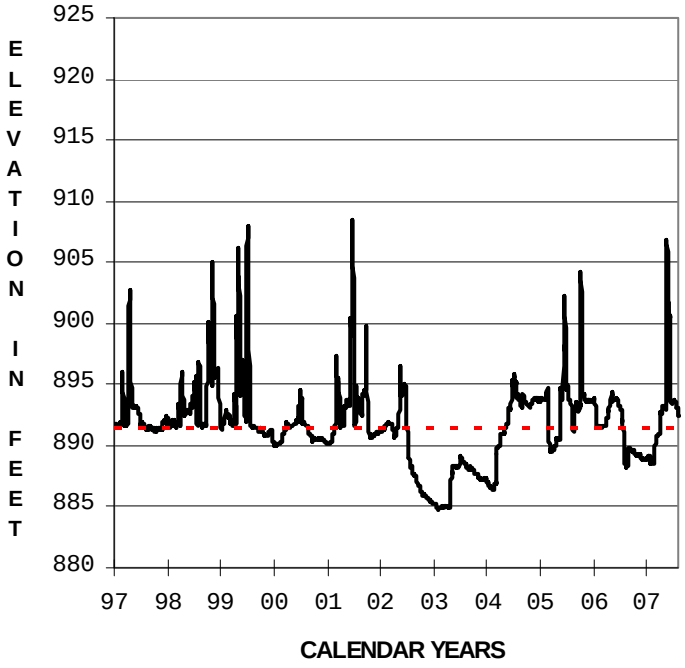


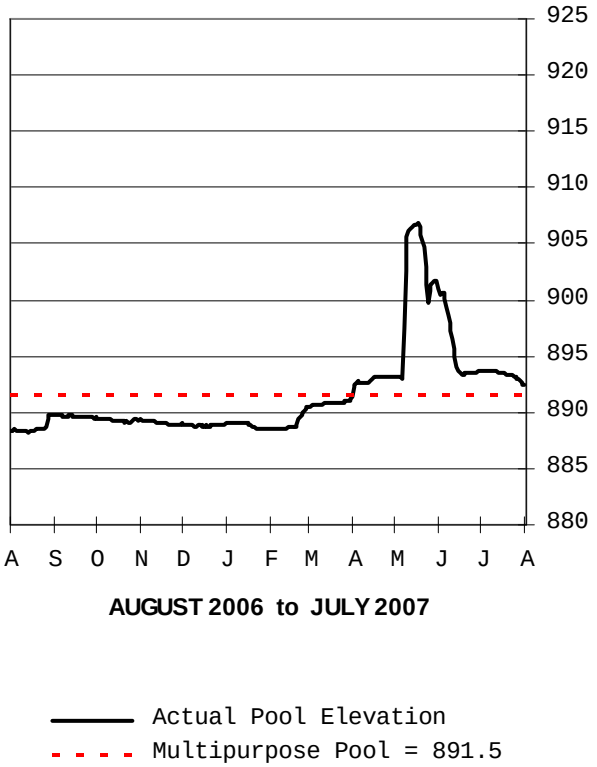
MILFORD LAKE ANNUAL INFLOW



PERRY LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



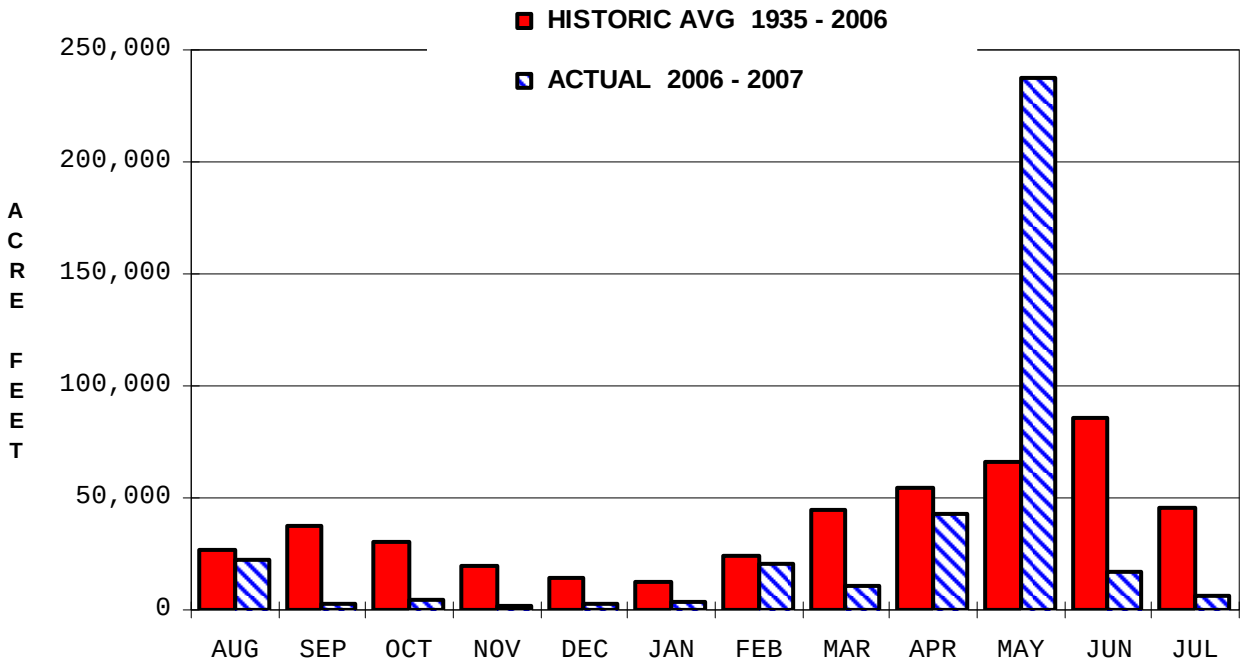


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
888.43 1 Aug 06	**892.33 31 Jul 07**	**906.77 17 May 07**	**888.24 13 Aug 06**	**920.85 25 Jul 93**	**884.77 30 Jan 03**

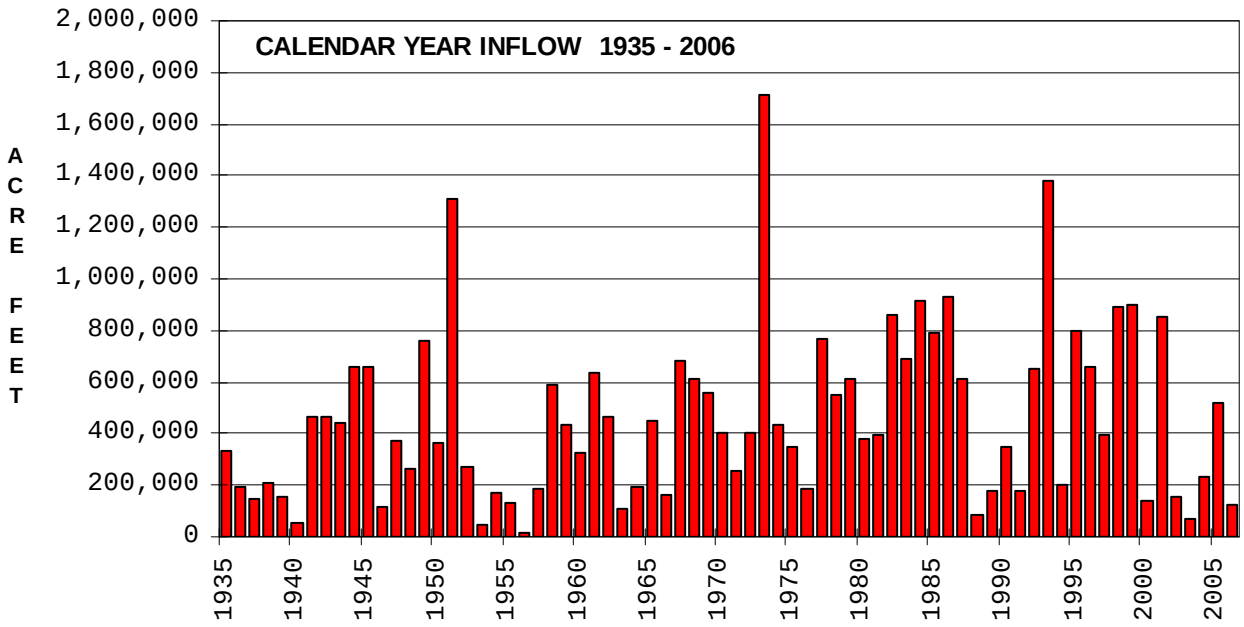
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
37,000 8 May 07	**1,376,796**	**12,000 23 May 07**	**25 Many days**

Minimum required release is 25 cfs. Releases reduced to 0 for maintenance and inspection periods.

PERRY LAKE MONTHLY INFLOW

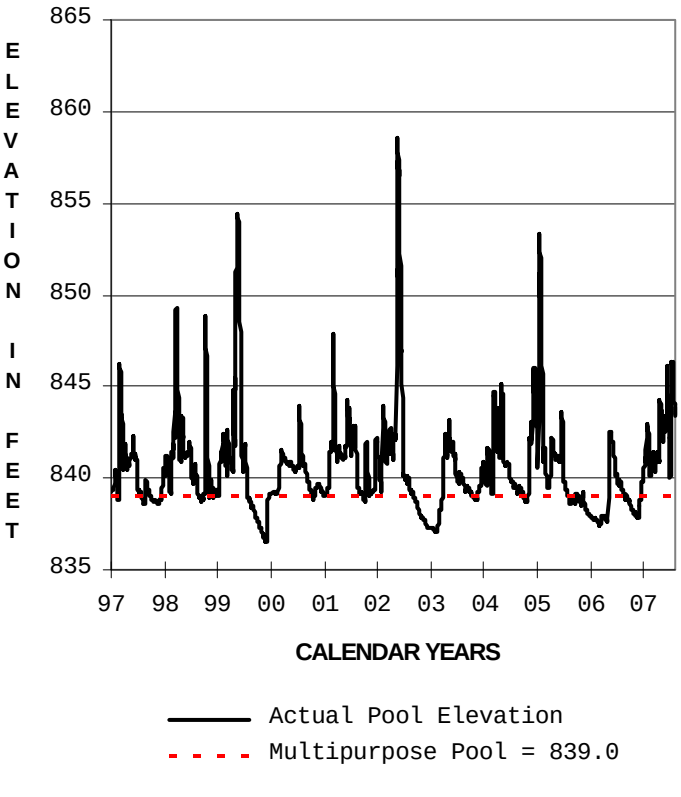


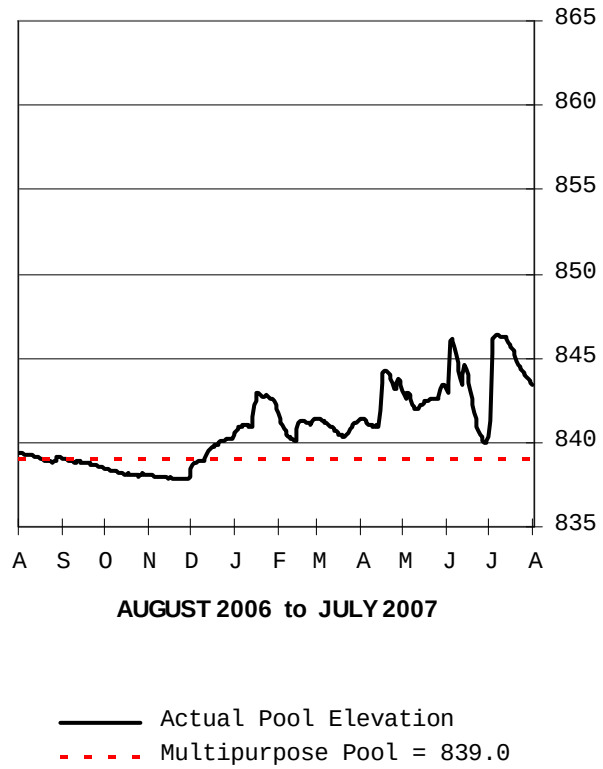
PERRY LAKE ANNUAL INFLOW



POMME DE TERRE LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



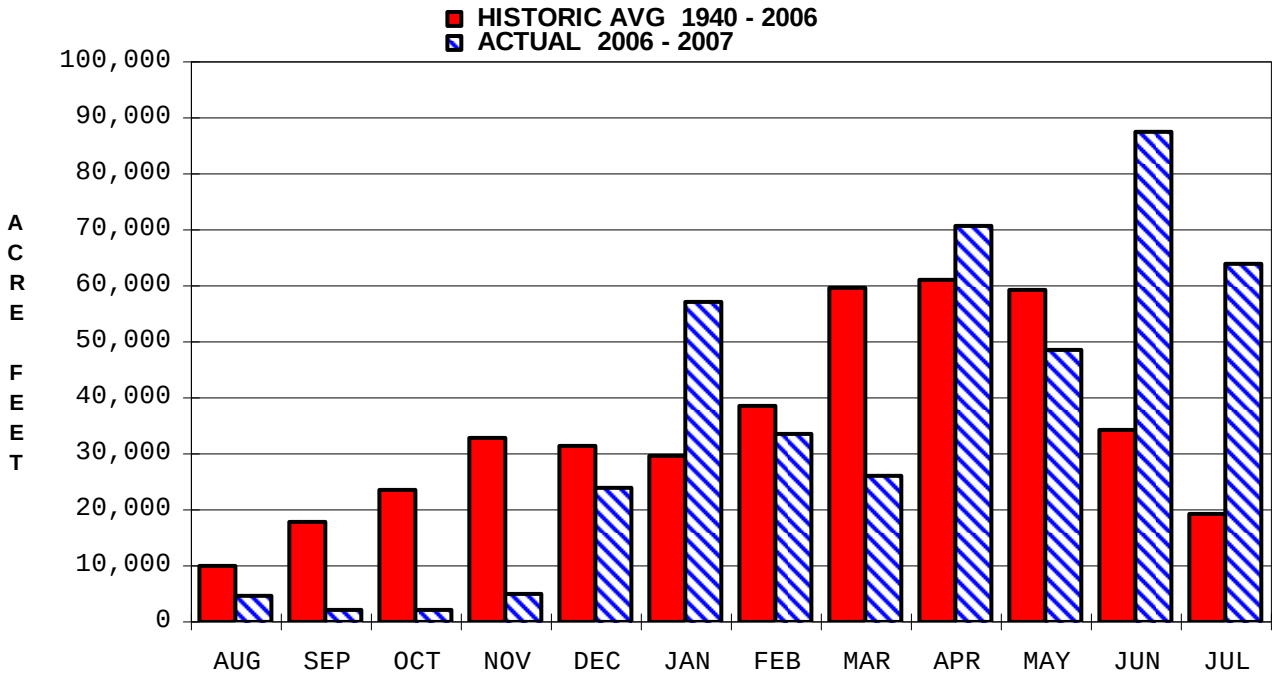


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
839.40 1 Aug 06	**843.18 31 Jul 07**	**846.39 6 Jul 07**	**837.79 27 Nov 06**	**864.58 27 Sep 93**	**835.61 3 Mar 64**

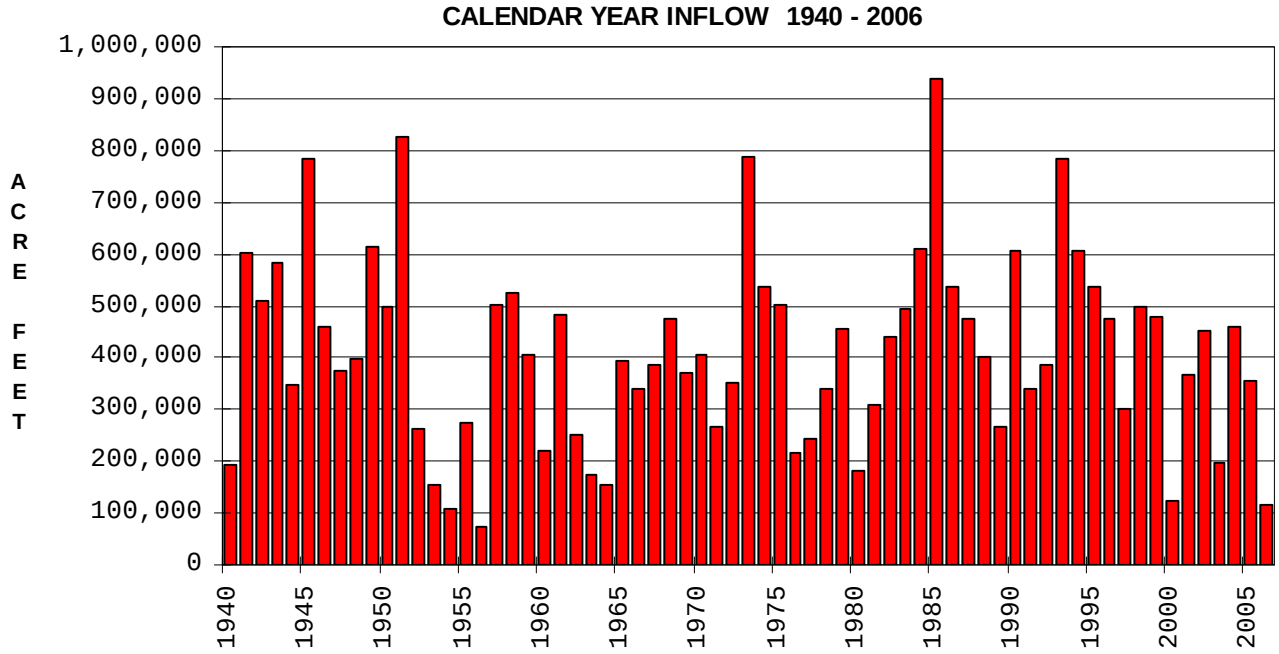
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
17,000 2 Jul 07	**437,308**	**2500 7-18 Jun 07**	**0 14-20 Oct 06**

Minimum required release is 50 to 100 cfs, varying by season and pool level.

POMME DE TERRE LAKE MONTHLY INFLOW

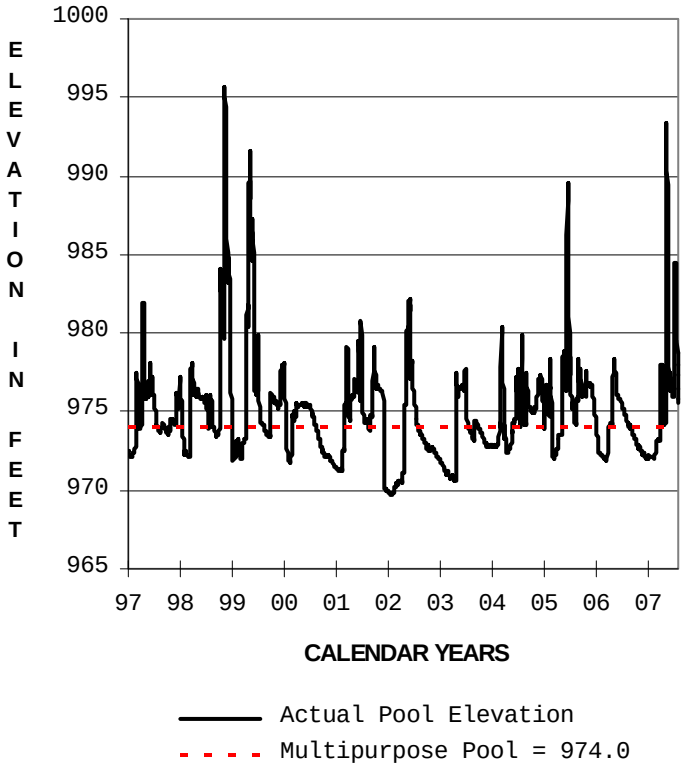


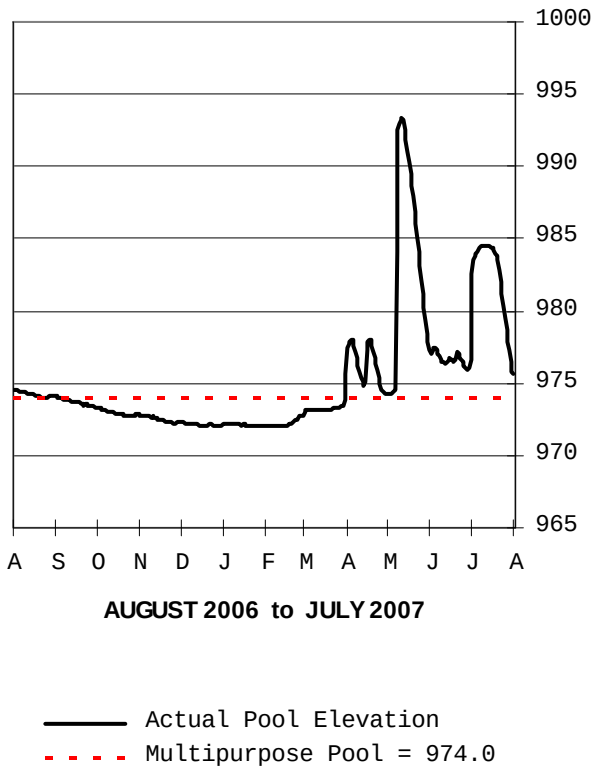
POMME DE TERRE LAKE ANNUAL INFLOW



POMONA LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW



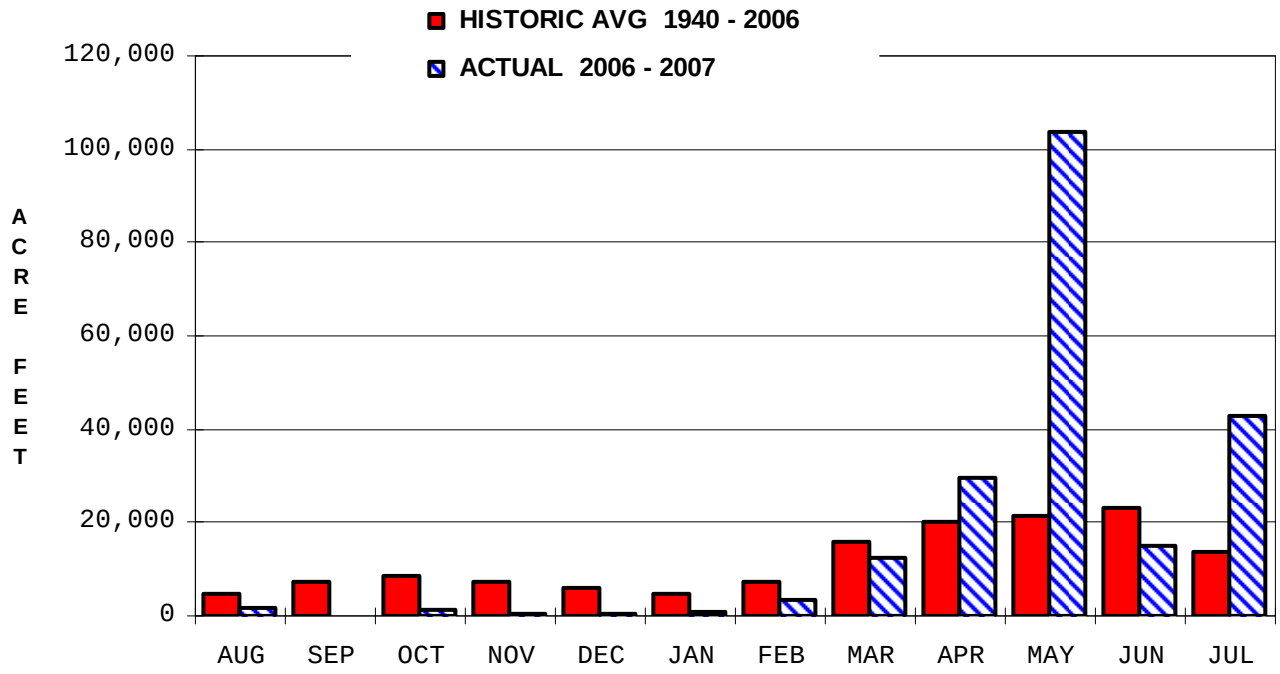


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
974.55 1 Aug 06	**976.25 31 Jul 07**	**993.40 11 May 07**	**972.02 12 Feb 07**	**998.40 12-13 Jun 95**	**969.62 30 Mar 67**

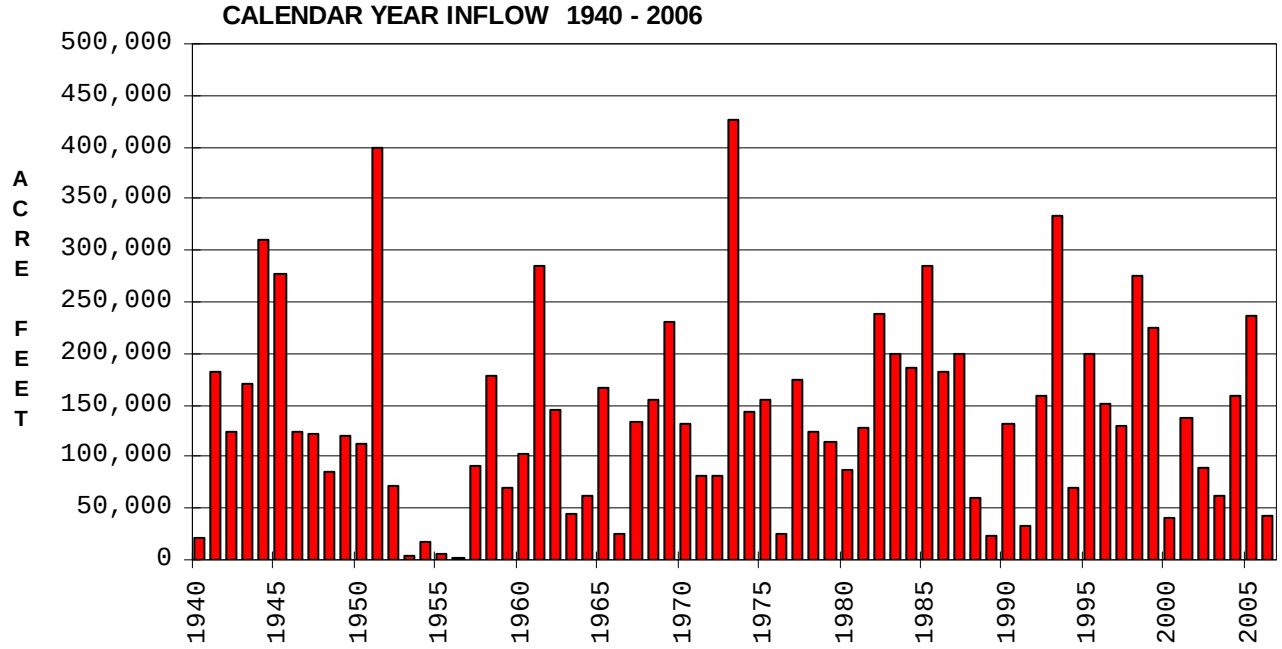
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
25,000 8 May 07	**219,029**	**2,500 14 May 07**	**0 4-5 April 07**

Minimum required release is 15 cfs.

POMONA LAKE MONTHLY INFLOW

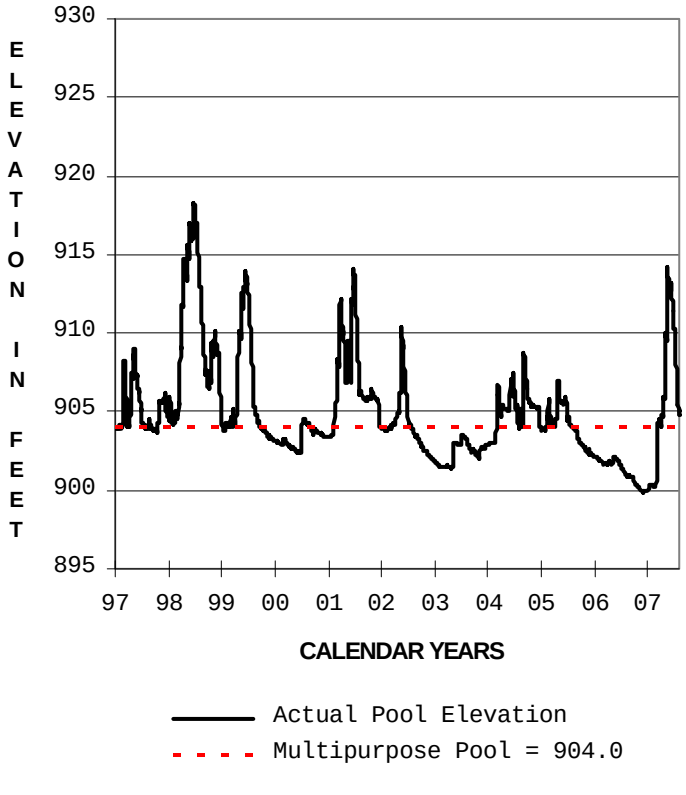


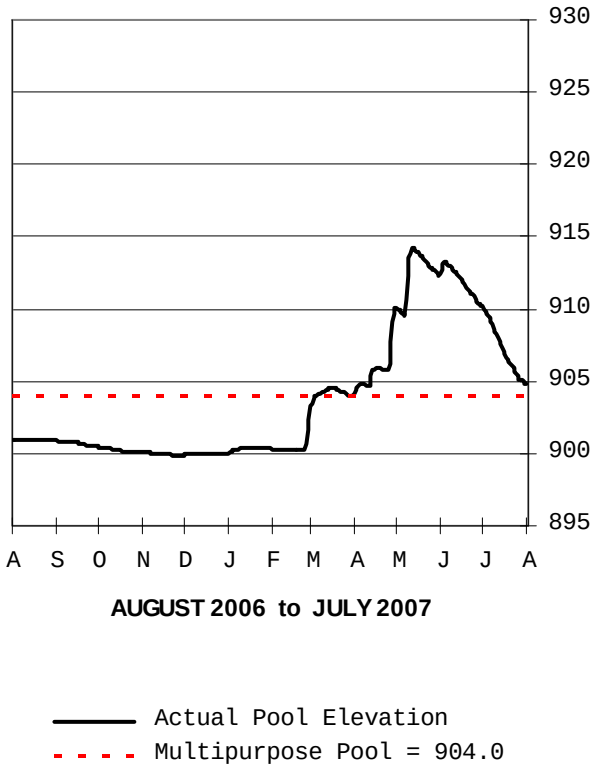
POMOMA LAKE ANNUAL INFLOW



RATHBUN LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



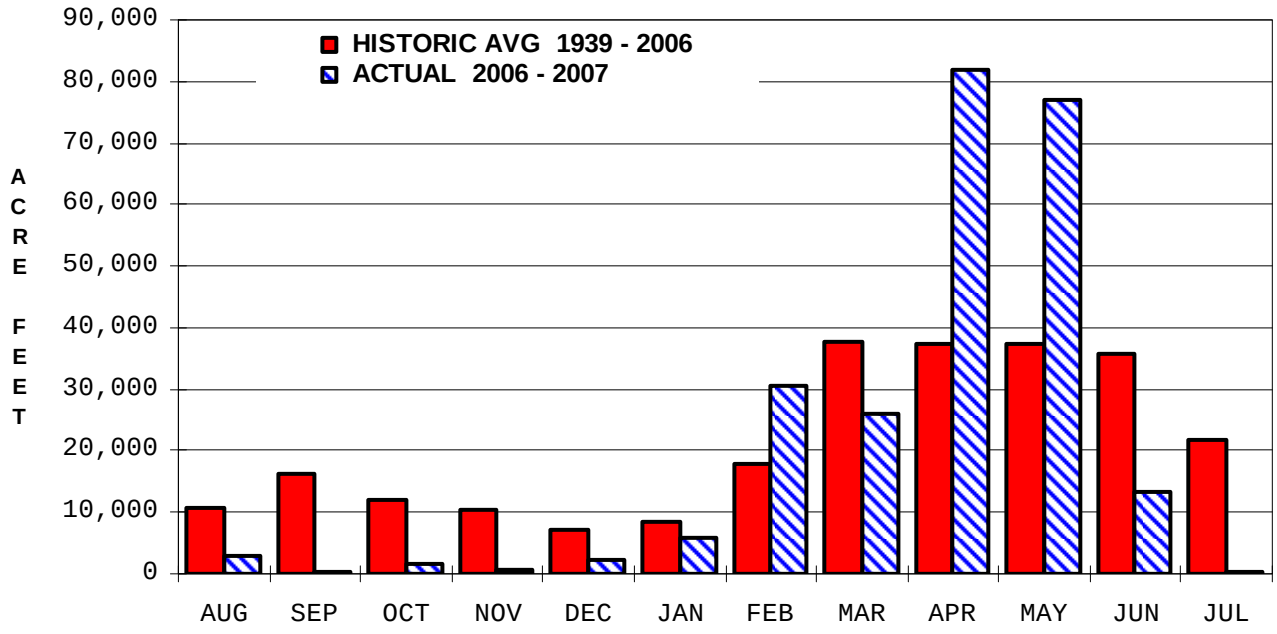


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
900.96 1 Aug 06	**904.79 31 Jul 07**	**914.18 11 May 07**	**899.85 28 Nov 06**	**927.16 28 Jul 93**	**898.38 26-27 Jan 95**

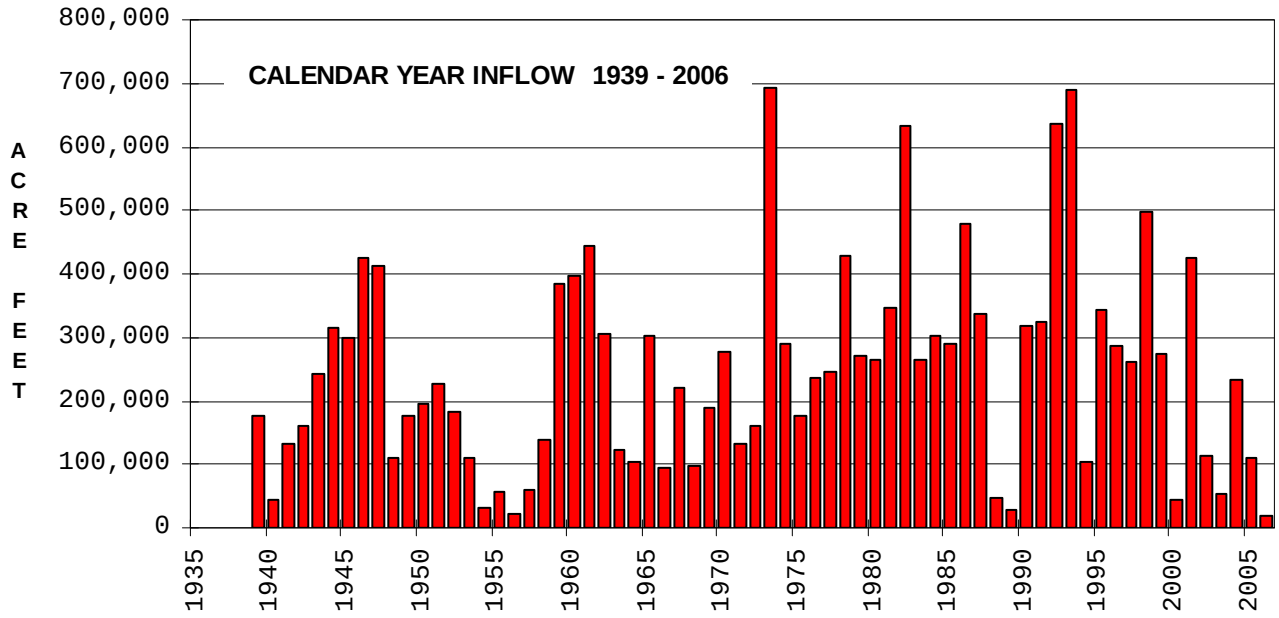
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
12,000 8 May 07	**242,723**	**1200 4 July 07**	**21 Many Days**

Outlets include a fish hatchery pipe and service gate. Minimum required release varies with downstream needs.

RATHBUN LAKE MONTHLY INFLOW

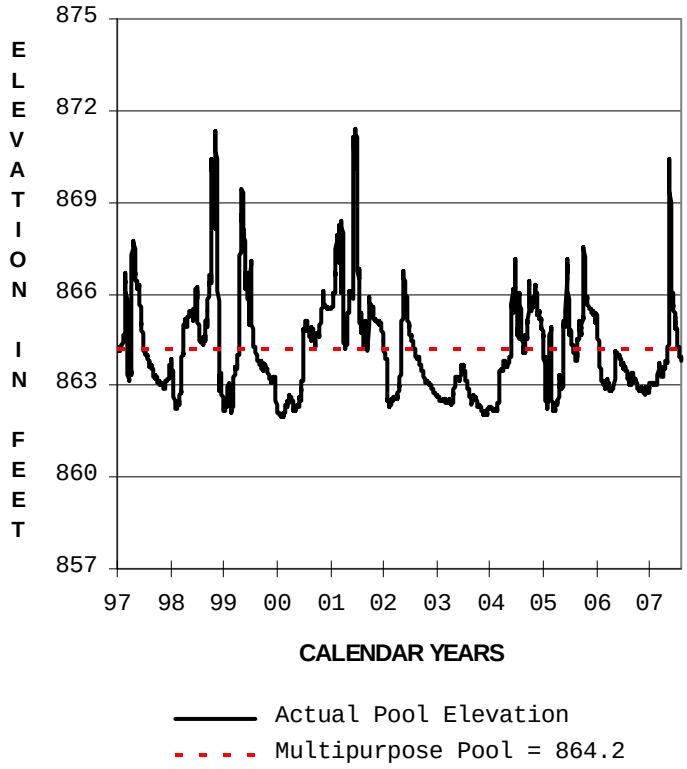


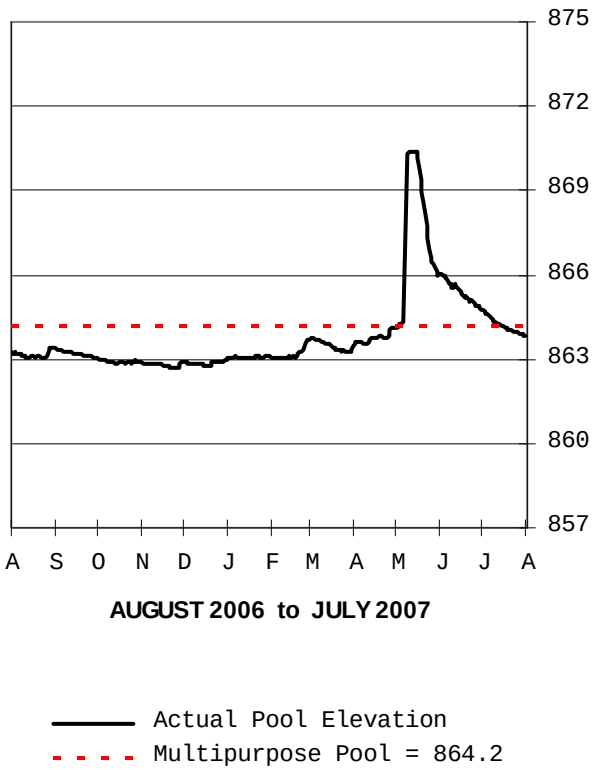
RATHBUN LAKE ANNUAL INFLOW



SMITHVILLE LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



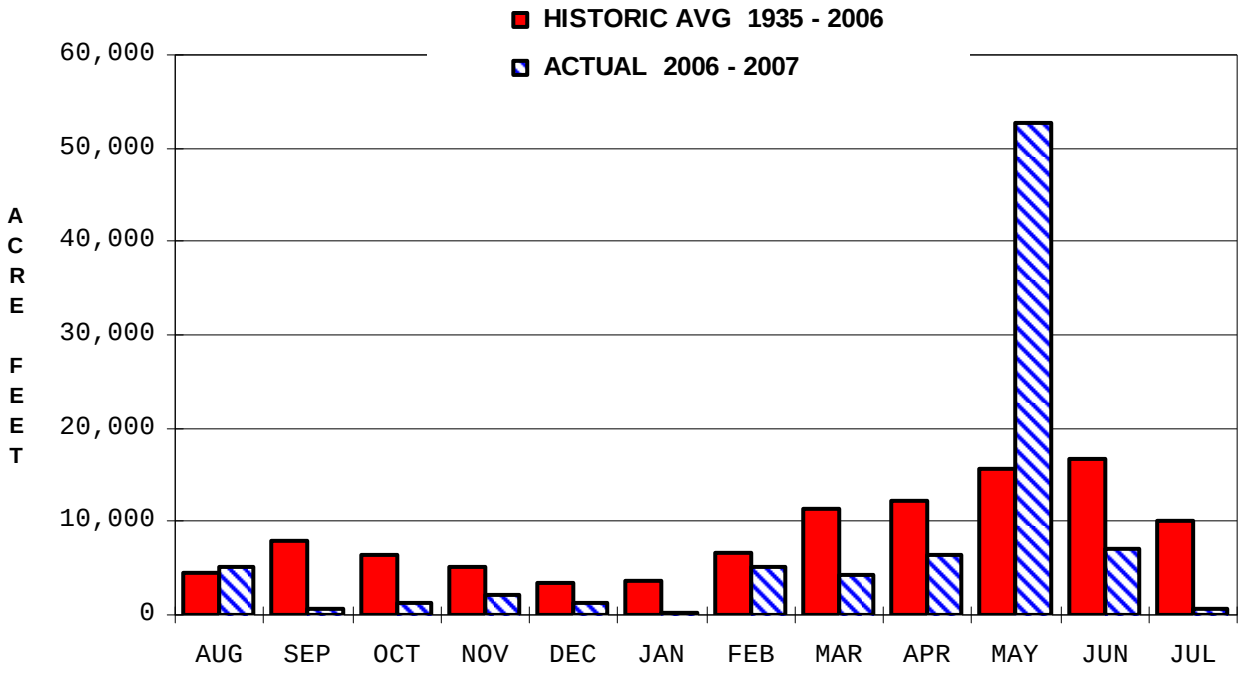


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
863.20 1 Aug 06	**863.81 31 Jul 07**	**870.41 12 May 07**	**862.70 25 Nov 06**	**874.31 27-28 Jul 93**	**858.86 19 Jan 93**

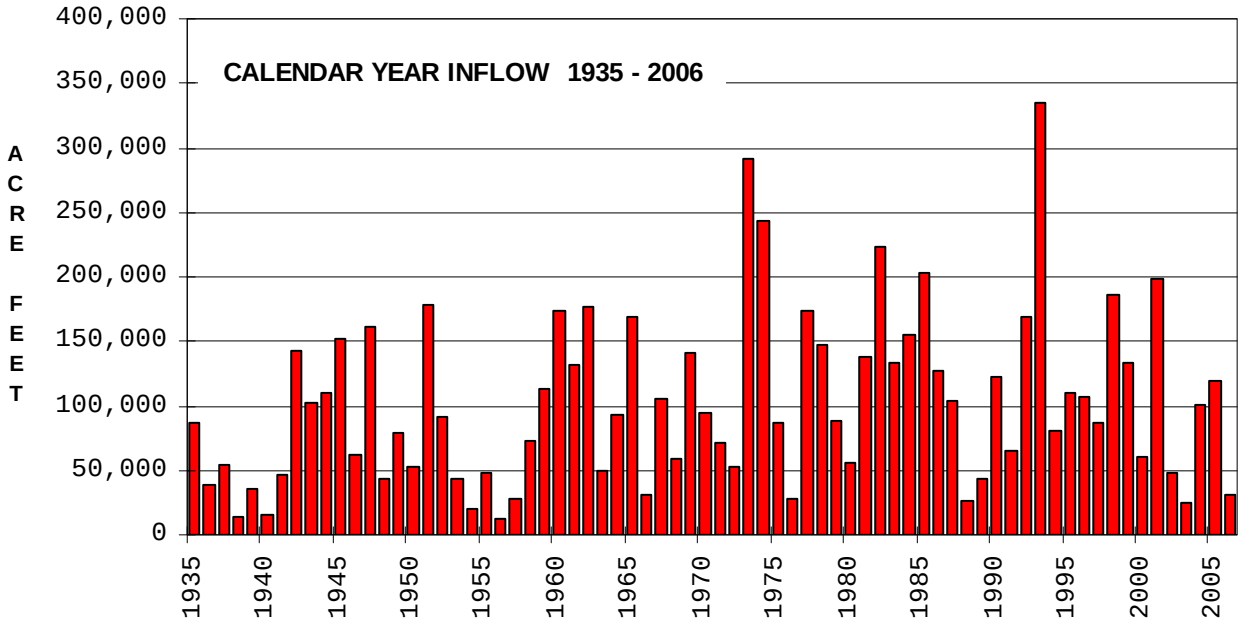
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
12,000 8 May 07	**80,477**	**1,750 18 May 07**	**8 Many Days**

Minimum required release is 8 cfs. Releases cut to 0 during flooding and for maintenance and inspections.

SMITHVILLE LAKE MONTHLY INFLOW

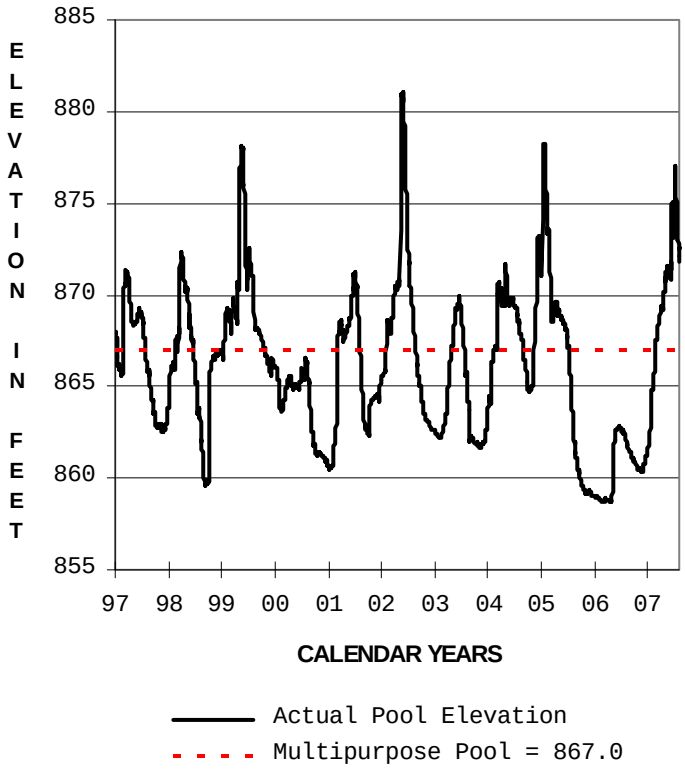


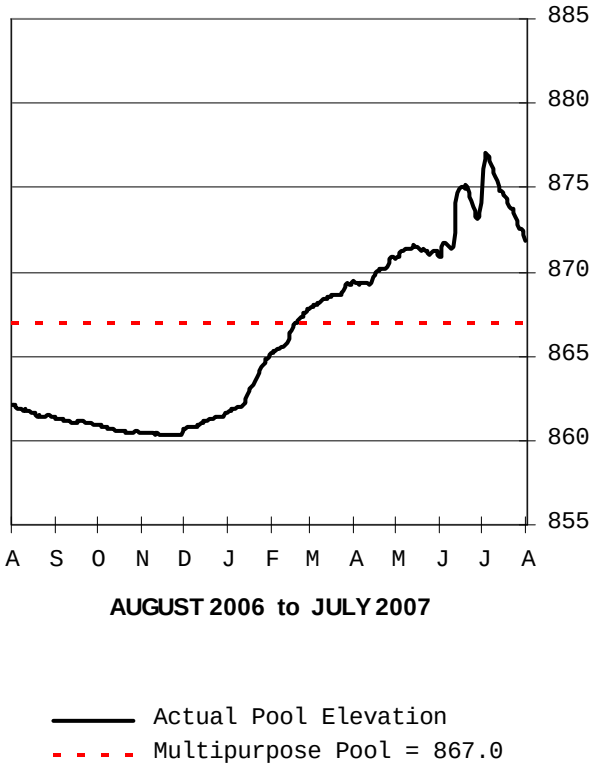
SMITHVILLE LAKE ANNUAL INFLOW



STOCKTON LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



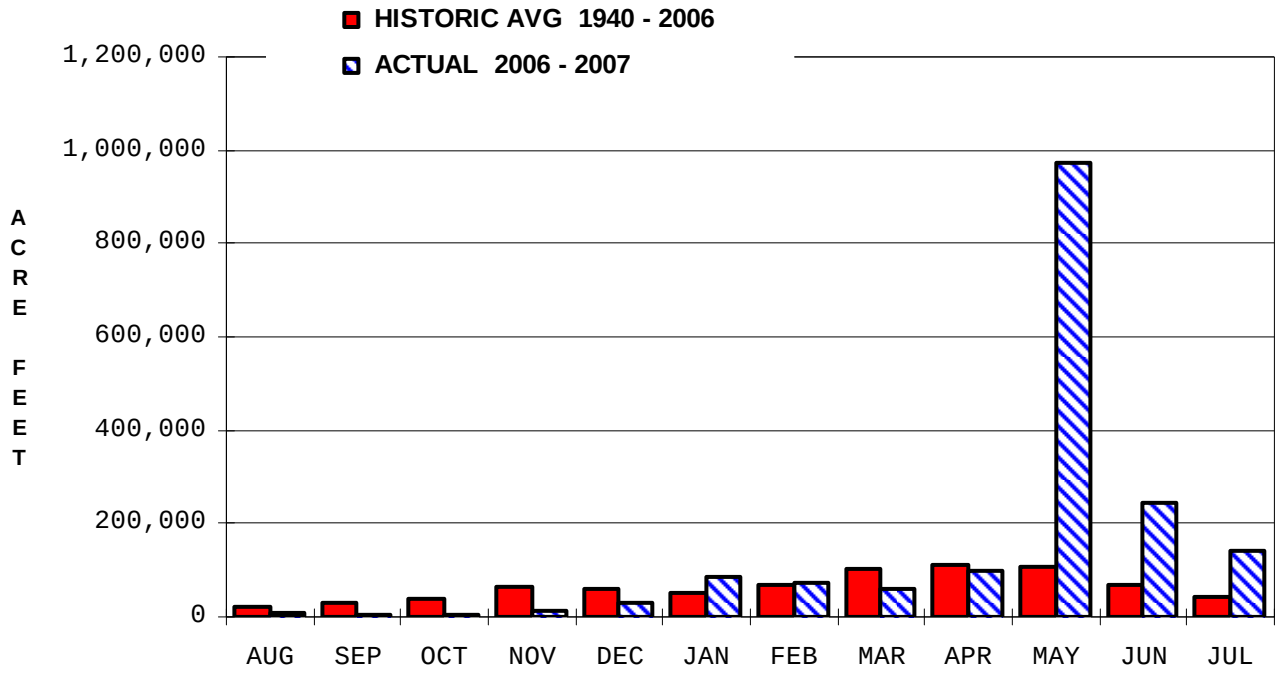


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
862.07 1 Aug 06	**871.45 31 Jul 07**	**877.01 3 Jul 07**	**860.31 25 Nov 06**	**885.94 28 Apr 73**	**851.86 2 Feb 77**

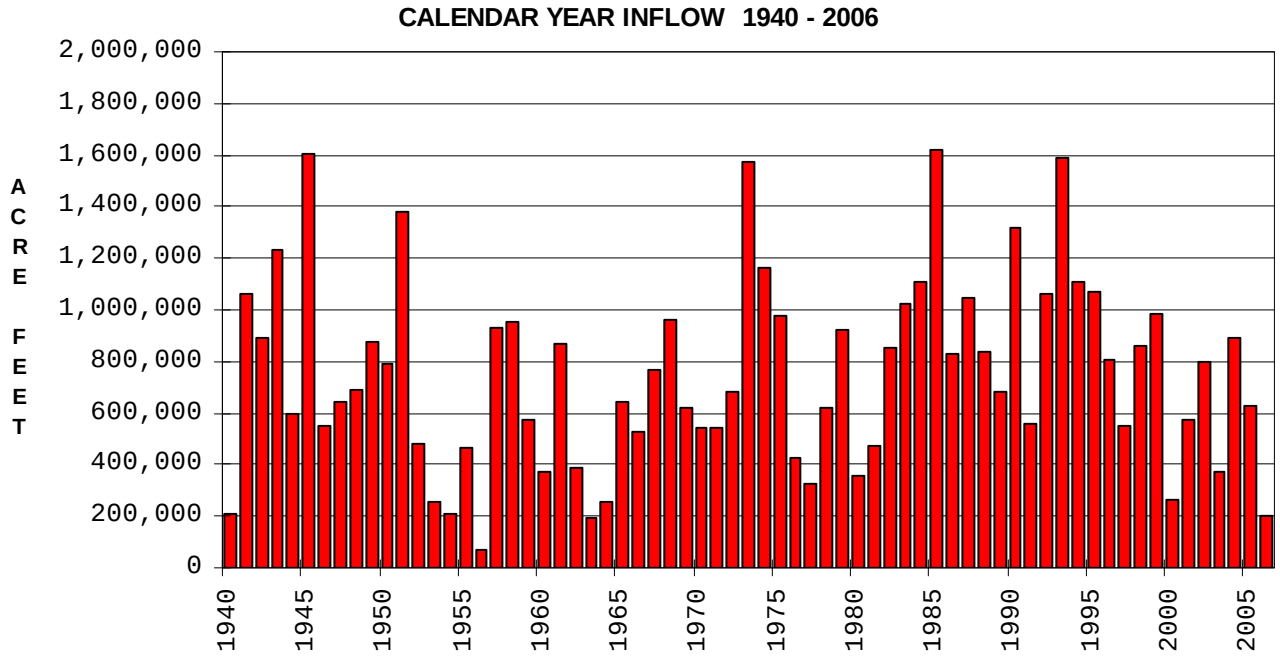
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
30,000 1 Jul 07	**1,787,015**	**5438 26 Jun 07**	**40 Many Days**

Listed outflows include turbine releases and spill to the river. Minimum required release is 40 cfs.

STOCKTON LAKE MONTHLY INFLOW

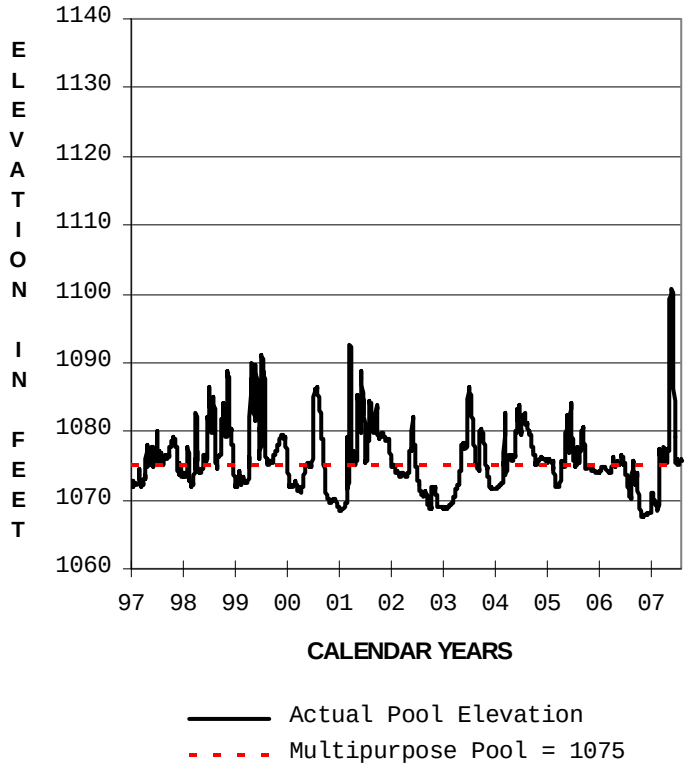


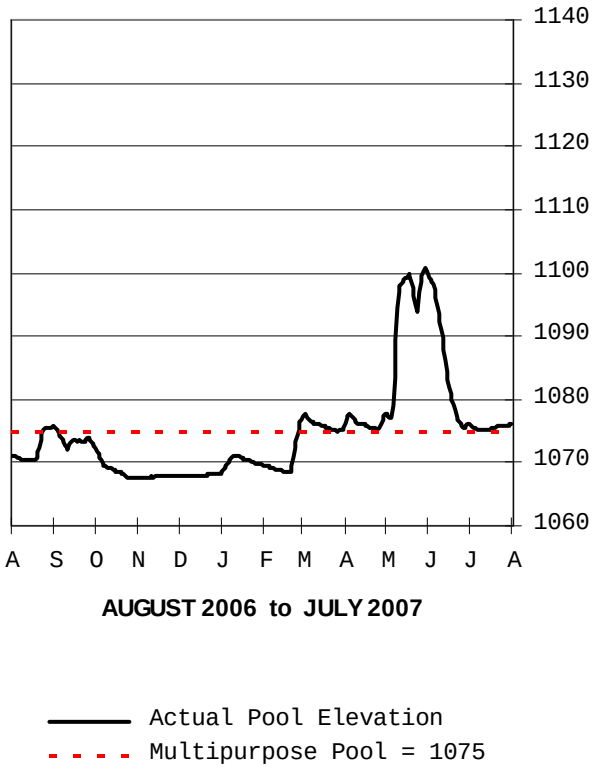
STOCKTON LAKE ANNUAL INFLOW



TUTTLE CREEK LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



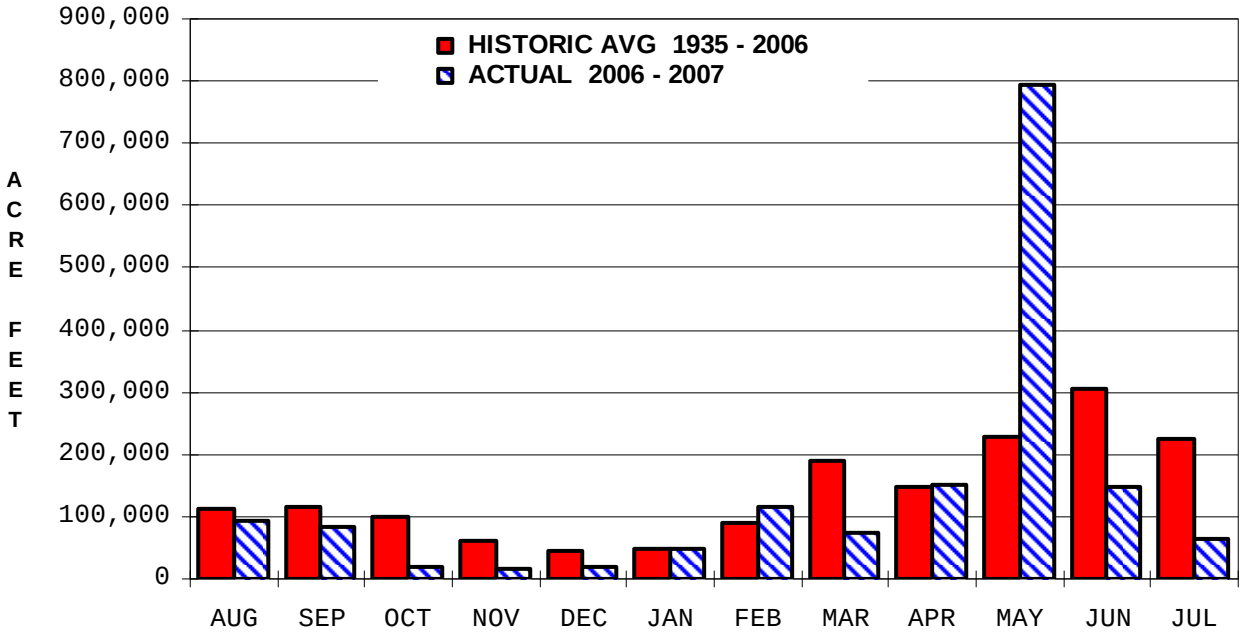


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1071.10 1 Aug 06	**1076.34 31 Jul 07**	**1100.73 30 May 07**	**1067.56 3 Nov 06**	**1137.77 22 Jul 93**	**1060.82 4 Jan 67**

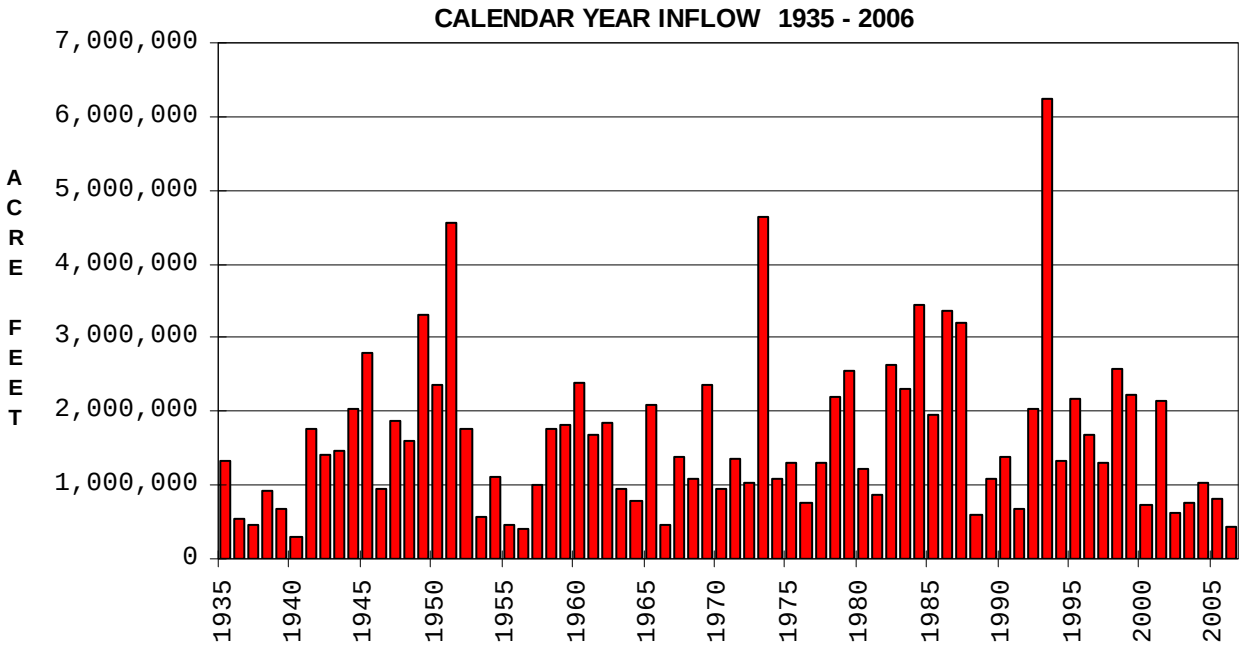
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
61,000 8 May 07	**2,850,226**	**20,000 13 Jun 07**	**100 5 Nov 06**

Minimum required release is 50 to 100 cfs. Releases may be cut to 0 for maintenance and inspection periods.

TUTTLE CREEK LAKE MONTHLY INFLOW

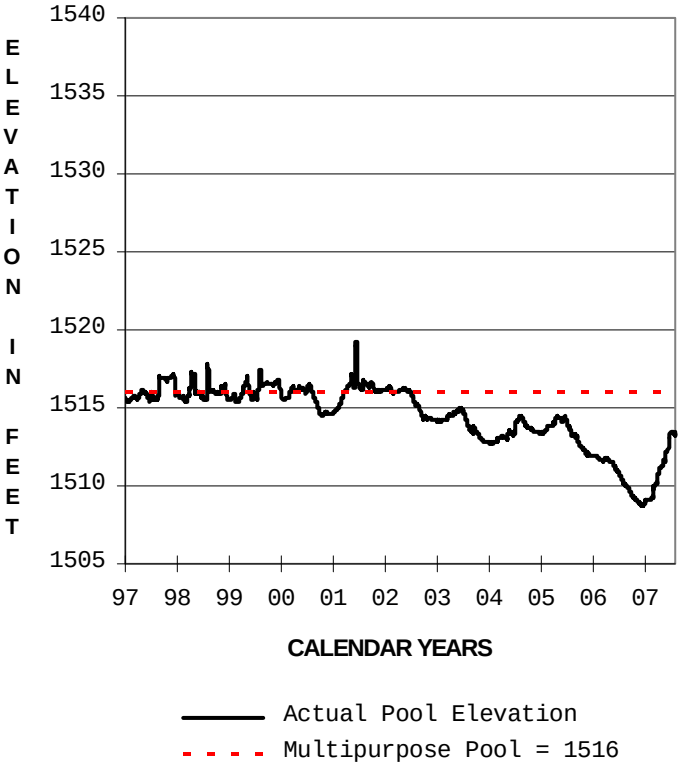


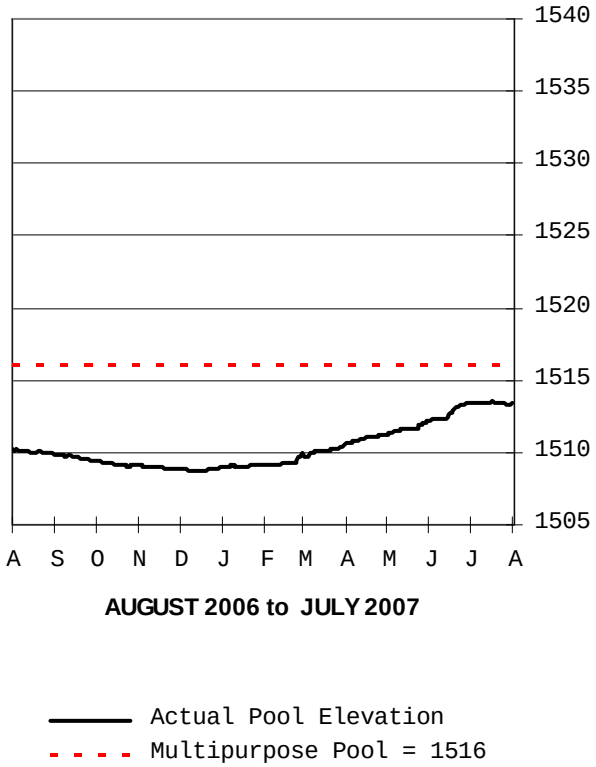
TUTTLE CREEK LAKE ANNUAL INFLOW



WILSON LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



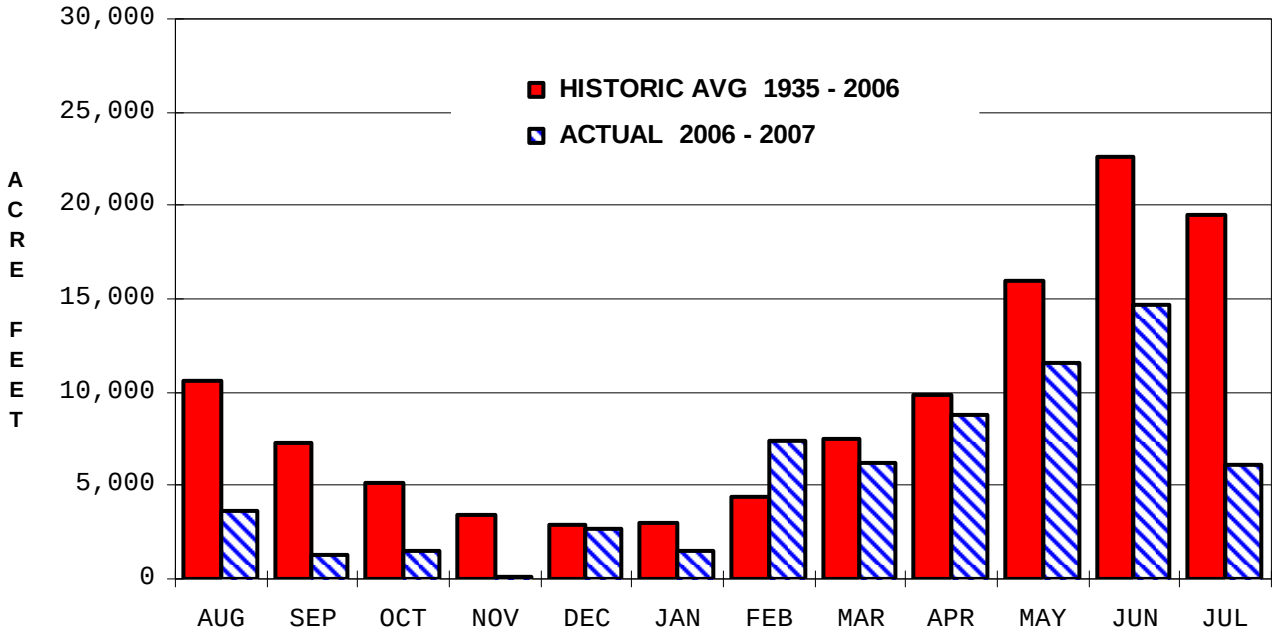


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1510.13 1 Aug 06	**1513.38 31 Jul 07**	**1513.51 16 Jul 07**	**1508.73 19 Dec 06**	**1548.27 13 Aug 93**	**1508.73 19 Dec 06**

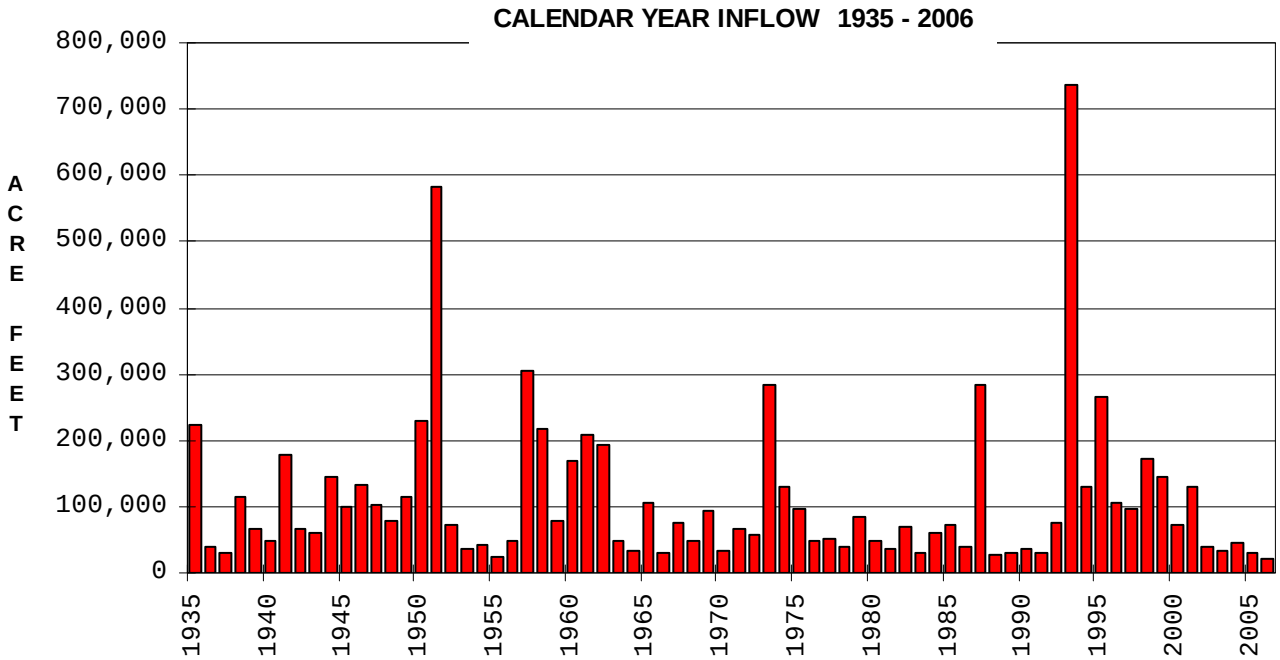
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,100 25 Feb 07	**65,501**	**26 12 July 07**	**5 All winter**

Minimum required release of 5-15 cfs varies seasonally. Releases cut to 0 for maintenance and inspections.

WILSON LAKE MONTHLY INFLOW



WILSON LAKE ANNUAL INFLOW



APPENDIX B
BUREAU OF RECLAMATION PROJECTS

BONNY RESERVOIR

CEDAR BLUFF RESERVOIR

ENDERS RESERVOIR

HARRY STRUNK LAKE
(Medicine Creek Dam)

HUGH BUTLER LAKE
(Red Willow Dam)

KEITH SEBELIUS LAKE
(Norton Dam)

KIRWIN RESERVOIR

LOVEWELL RESERVOIR

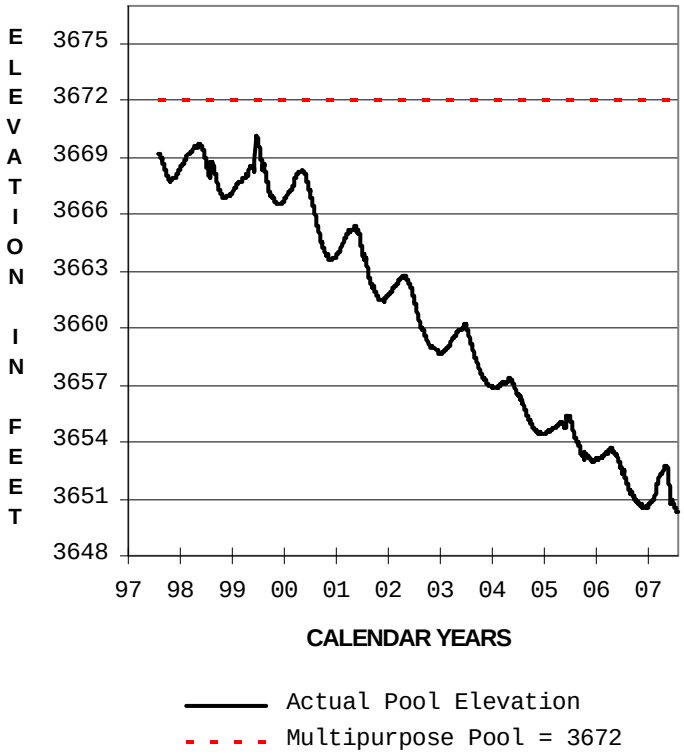
SWANSON LAKE
(Trenton Dam)

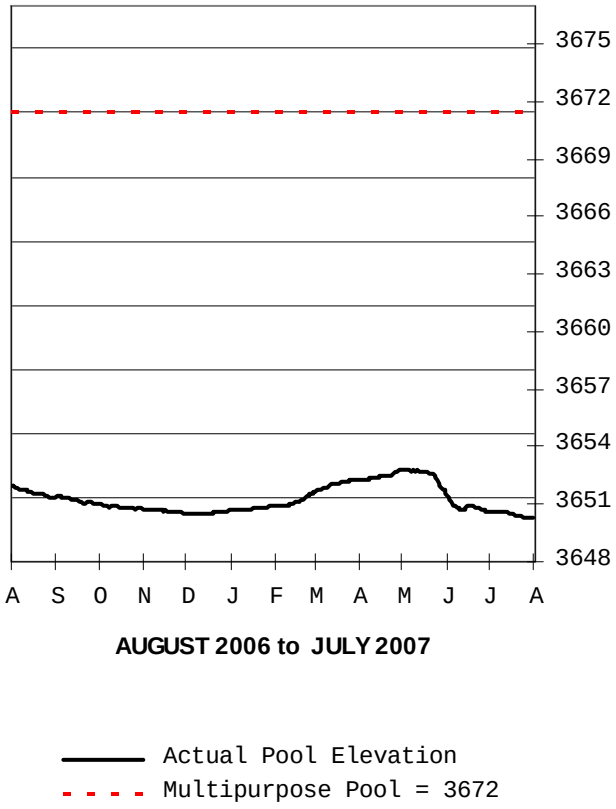
WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





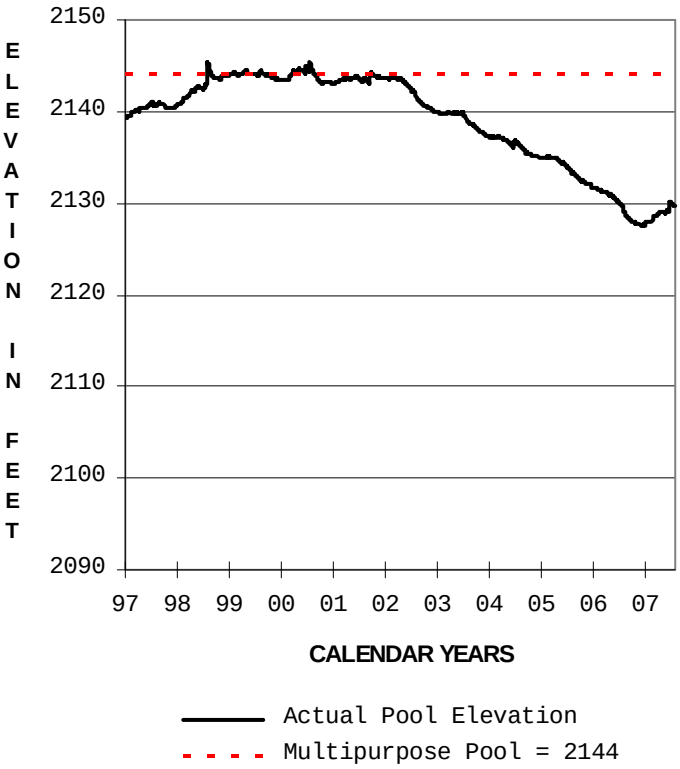
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3651.93 1 Aug 06	**3650.25 31 Jul 07**	**3652.78 2 May 07**	**3650.27 31 Jul 07**	**3678.10 17 May 57**	**3650.27 31 Jul 07**

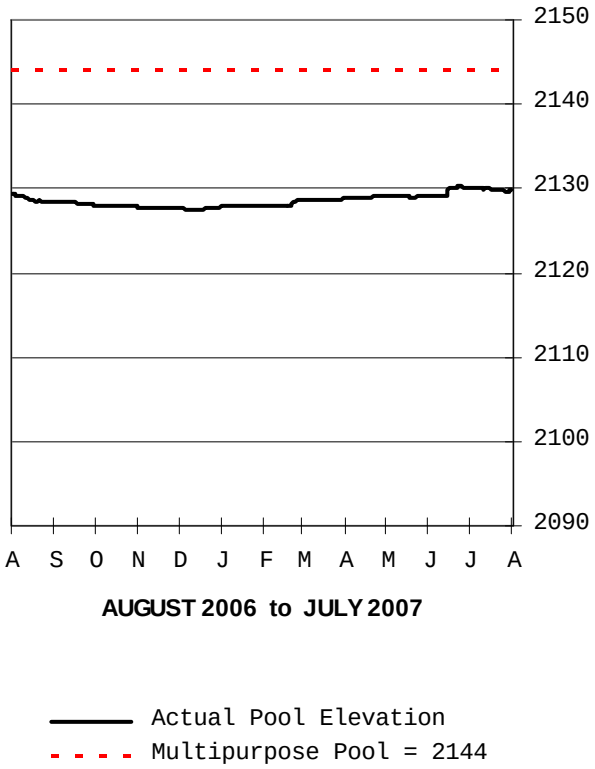
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
70 14 Jun 07	**8,494**	**58 26 May 07**	**5 Many days**

Maximum daily outflow is river release only. Minimum required release is 5 cfs.

CEDAR BLUFF RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





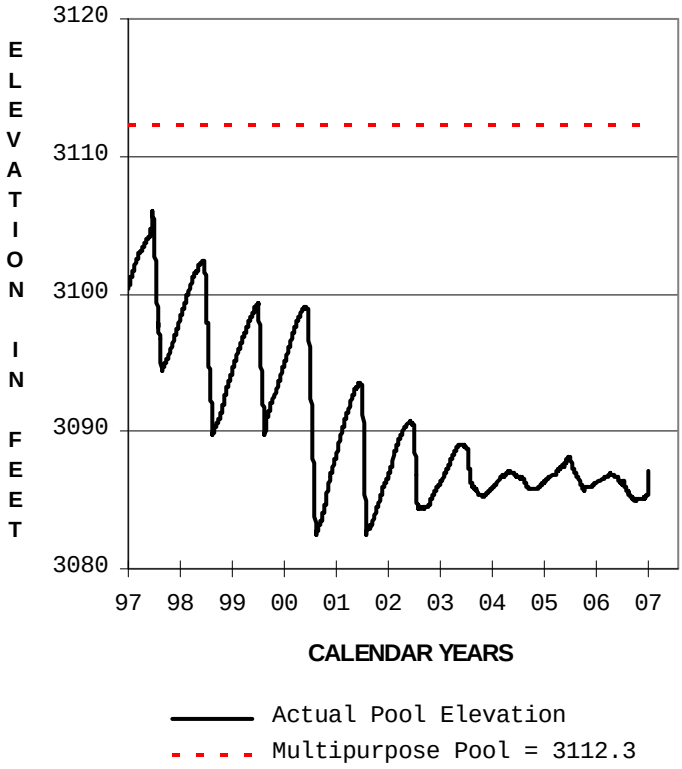
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2129.30 1 Aug 06	**2129.81 31 Jul 07**	**2130.23 22Jun 07**	**2127.52 18 Dec 06**	**2154.90, 2 Jul 51 4-5 Jul 57**	**2091.78 9-19 Nov 92**

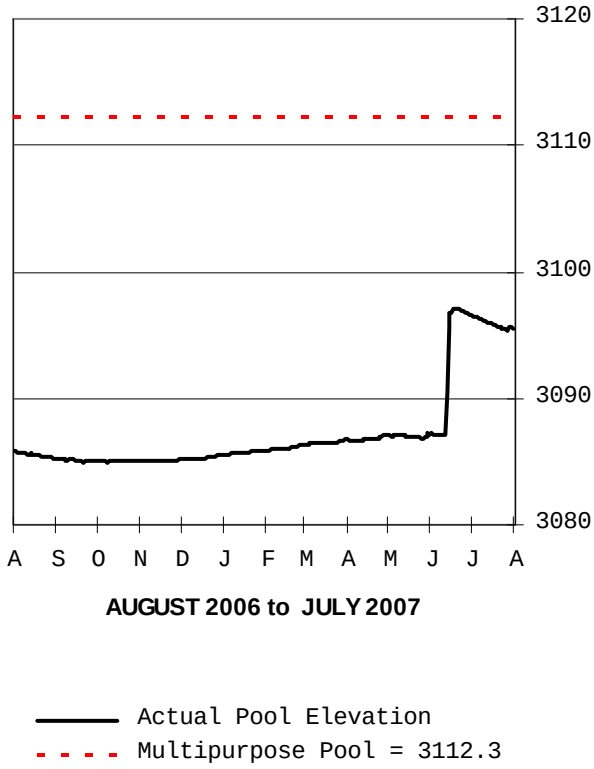
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1375 15 Jun 07	**21,558**	**0 All Year**	**0 All Year**

No minimum required release. Minor releases to the fish hatchery are not reported on a daily basis.

ENDERS RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





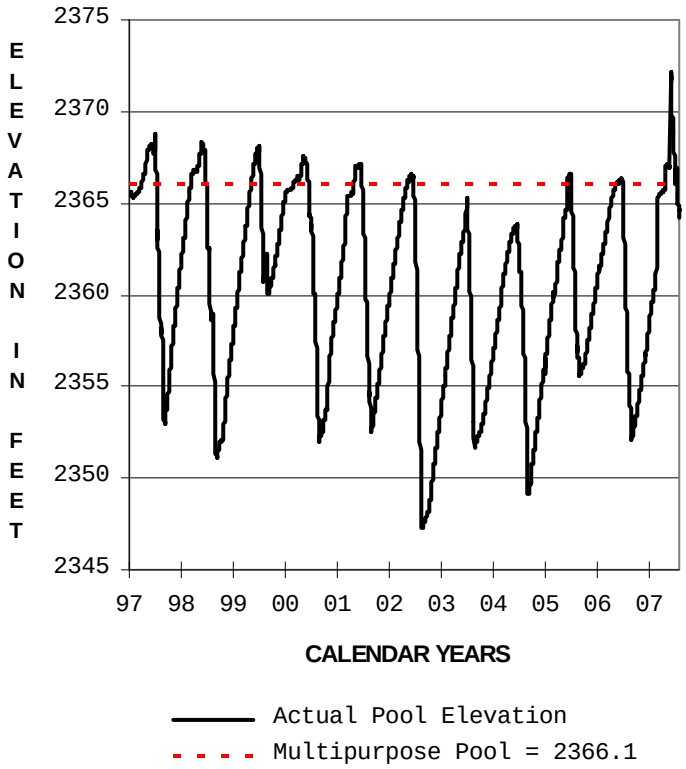
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3085.80 1 Aug 06	**3095.51 31 Jul 07**	**3097.11 18 Jun 07**	**3084.96 21 Sep 06**	**3118.20 25 Mar 60**	**3080.67 28 Aug 78**

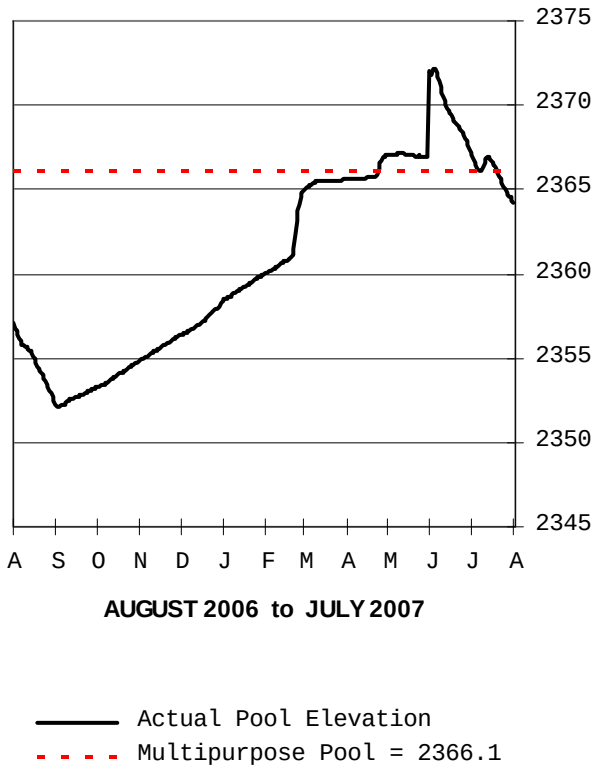
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2500 14 Jun 07	**14,319**	**3 All Year**	**3 All Year**

No minimum required release. The outflow is mostly seepage.

HARRY STRUNK LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



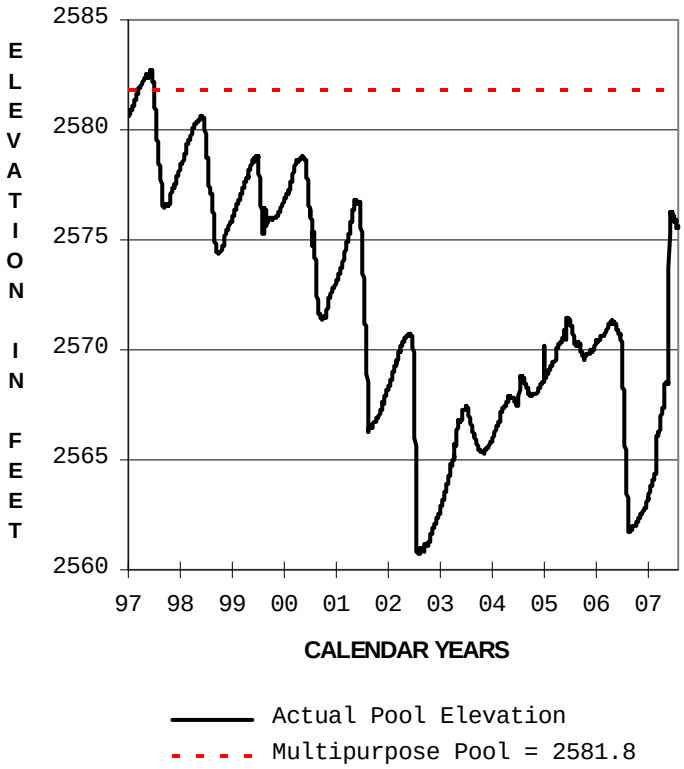


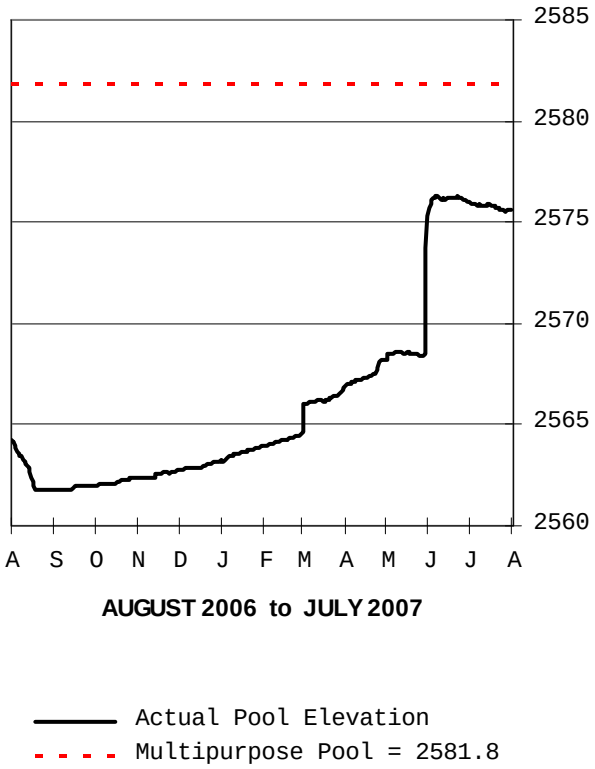
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2357.05 1 Aug 05	**2364.17 31 Jul 07**	**2372.19 3 Jun 07**	**2352.07 1 Sep 06**	**2374.10 23 Mar 60**	**2340.42 8 Sep 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
5108 31 May 07	**63,010**	**750 3 Jun 07**	**0 Many days**
Max daily outflow occurred as part of normal irrigation releases. All releases to the river. No min required release.			

HUGH BUTLER LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



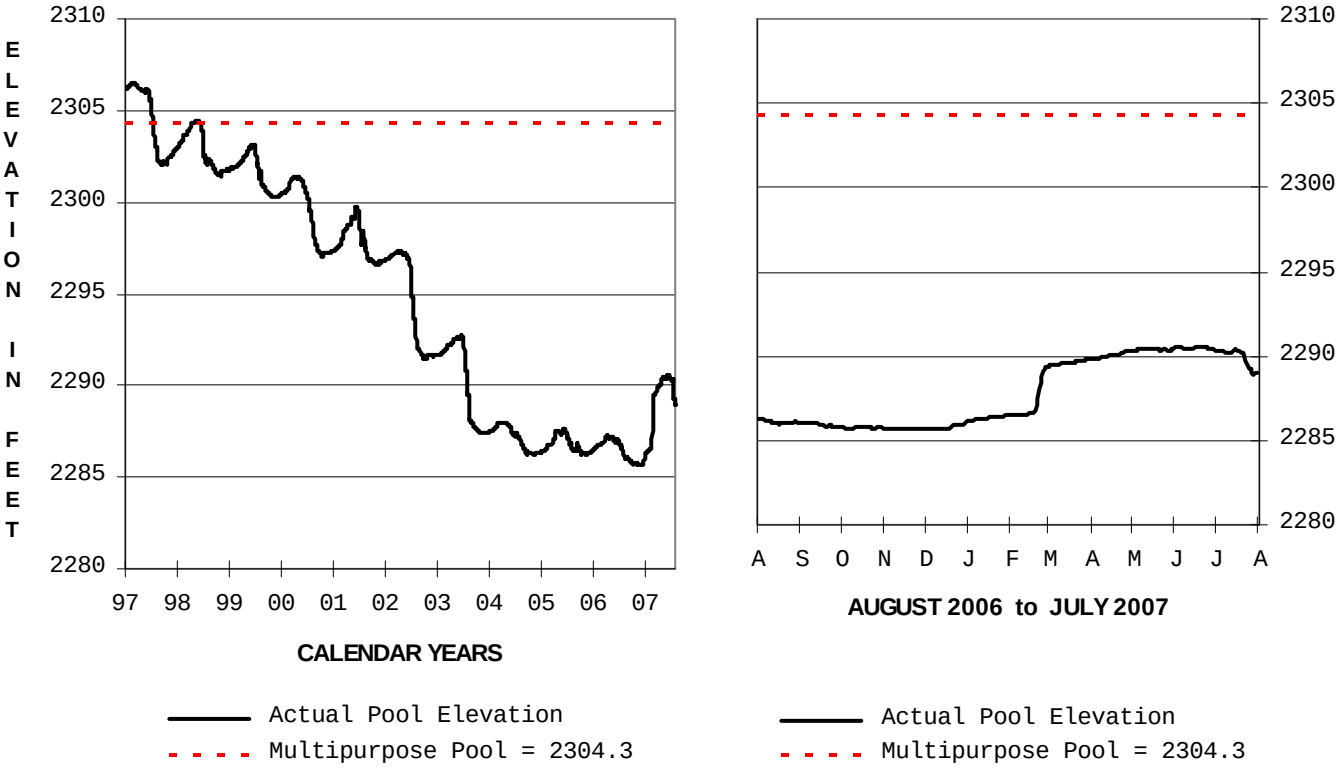


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2564.14 1 Aug 06	**2575.57 31 Jul 07**	**2576.26 6 Jun 07**	**2561.75 19 Aug 06**	**2584.11 16 Jul 67**	**2560.72 8 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
3,000 30 May 07	**22,006**	**103 1 Aug 06**	**4 Many Days**
No minimum required release. The outflow is mostly seepage.			

KEITH SEBELIUS LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD E XPANDED FOR READING EASE.



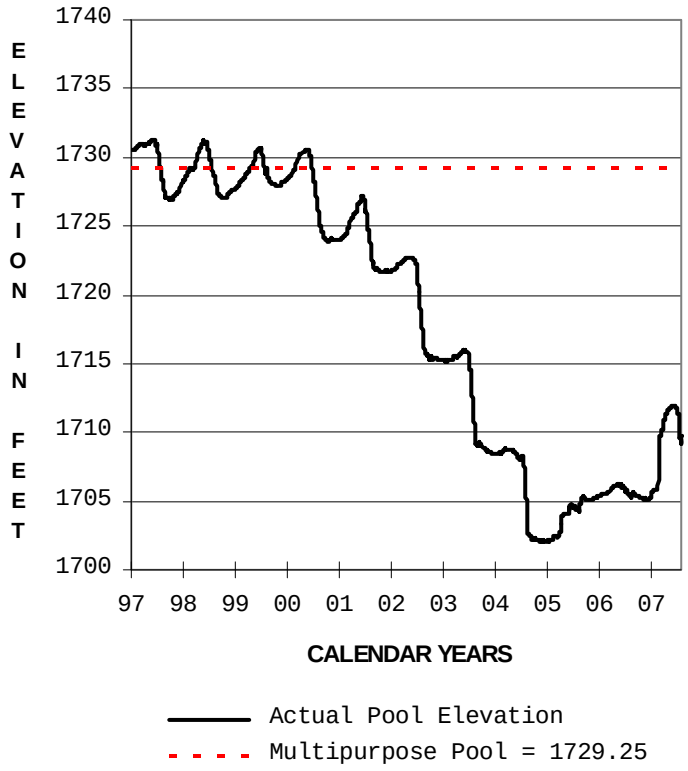
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2286.30 1 Aug 06	**2289.04 31 Jul 07**	**2290.56 19 Jun 07**	**2285.57 3 Dec 06**	**2306.47 15 Feb to 4 Mar 97**	**2275.82 1 Feb 82**

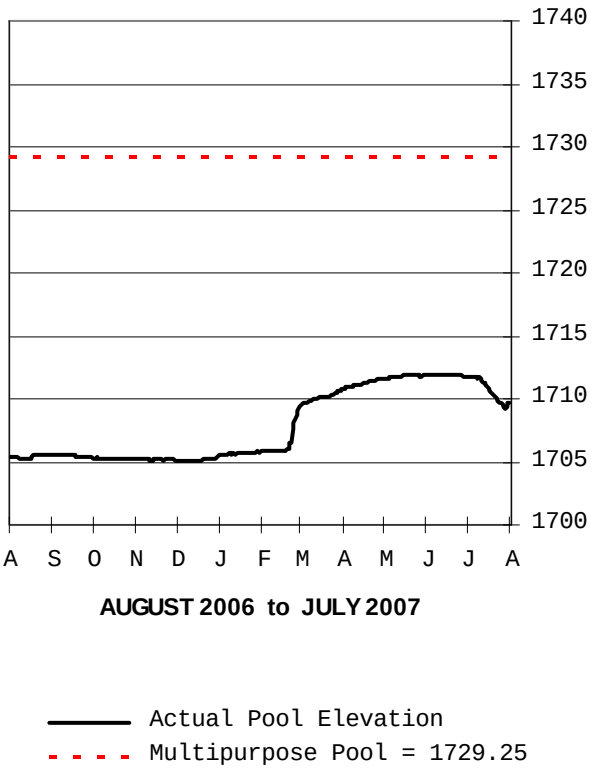
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
230 22 Feb 07	**8,292**	**1 All Year**	**1 All Year**

No minimum required release. The normal outflow is mostly seepage.
Historic Minimum Pool Elevation of 2275.82 occurred on many days 28-29 Nov 81 and 20 Jan to 1 Feb 82.

KIRWIN RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





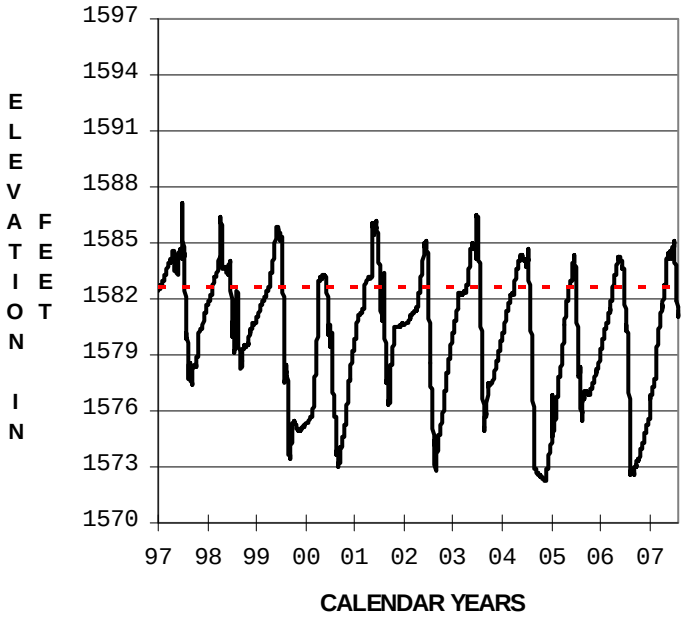
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1705.36 1 Aug 06	**1709.67 31 Jul 07**	**1711.96 4 Jun 07**	**1705.11 5 Dec 06**	**1737.07 2 Jun 95**	**1695.45 11 Feb 81**

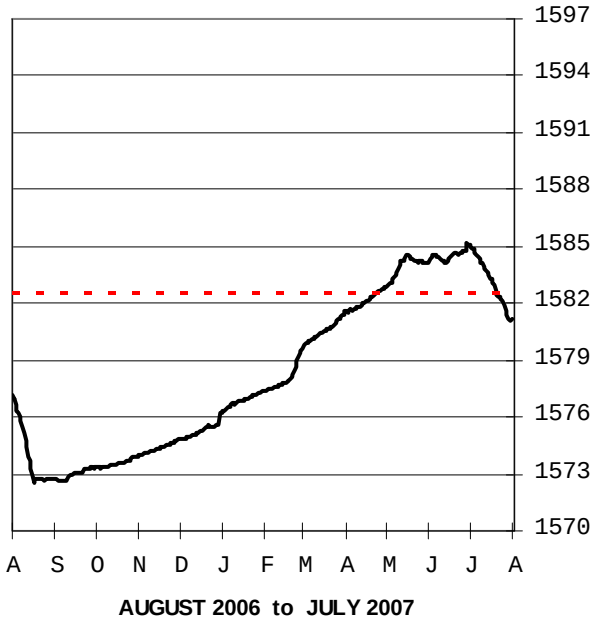
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
450 30 Jun 07	**20,384**	**140 29 Jul 07**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 150 cfs on 7 Aug 04. No min required release.

LOVEWELL RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





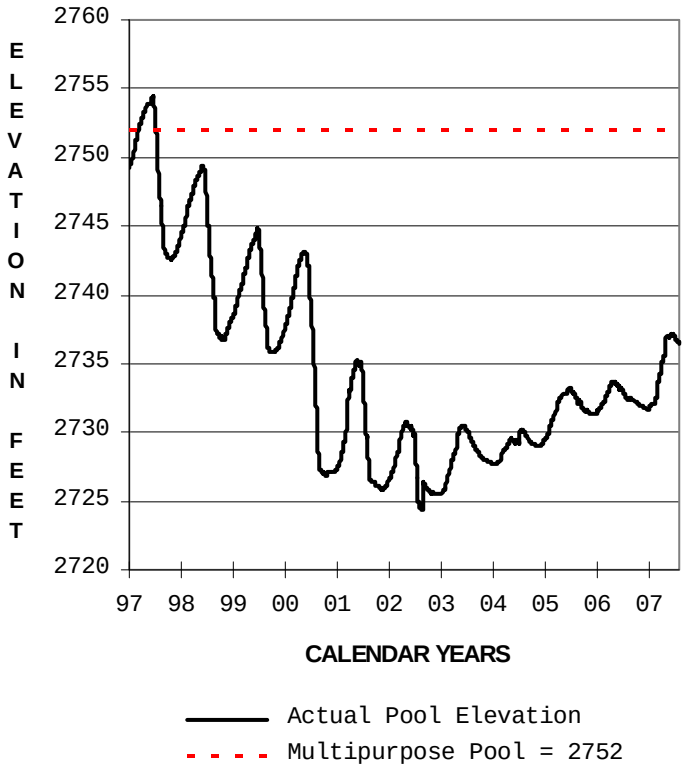
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1577.19 1 Aug 06	**1581.23 31 Jul 07**	**1585.16 28 Jun 07**	**1572.56 16 Aug 06**	**1595.34 22 Jul 93**	**1570.20 22 Aug 91**

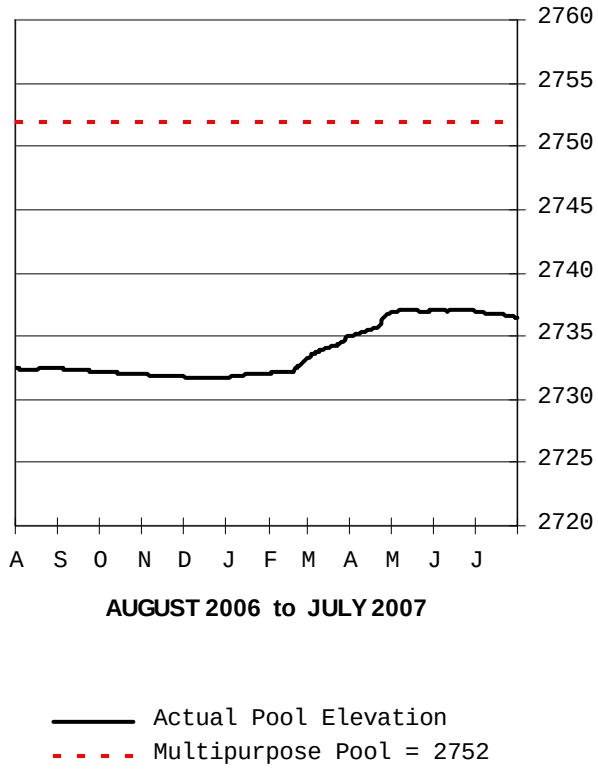
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
836 28 Jun 07	**18,846**	**398 19 July 07**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 425 cfs on 6 Aug 04. No min required release.

SWANSON LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





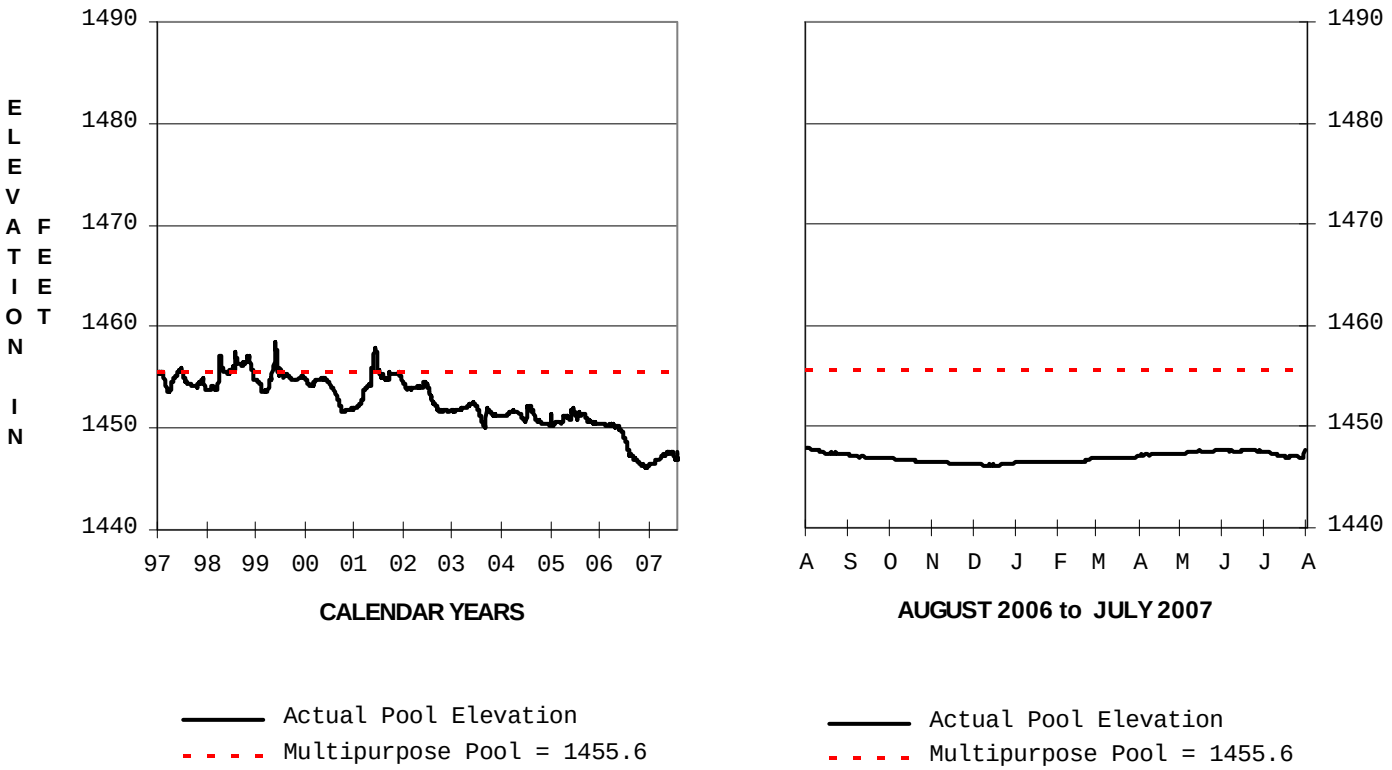
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2732.46 1 Aug 06	**2736.50 31 Jul 07**	**2737.14 22 Jun 07**	**2731.64 29 Dec 06**	**2757.40 3-4 Aug 62**	**2724.30 26 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
400 25 Apr 07	**22,515**	**1 All year**	**1 All year**

Maximum daily outflow is river release only (mostly seepage). No releases from canal. No min required release.

WACONDA LAKE
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



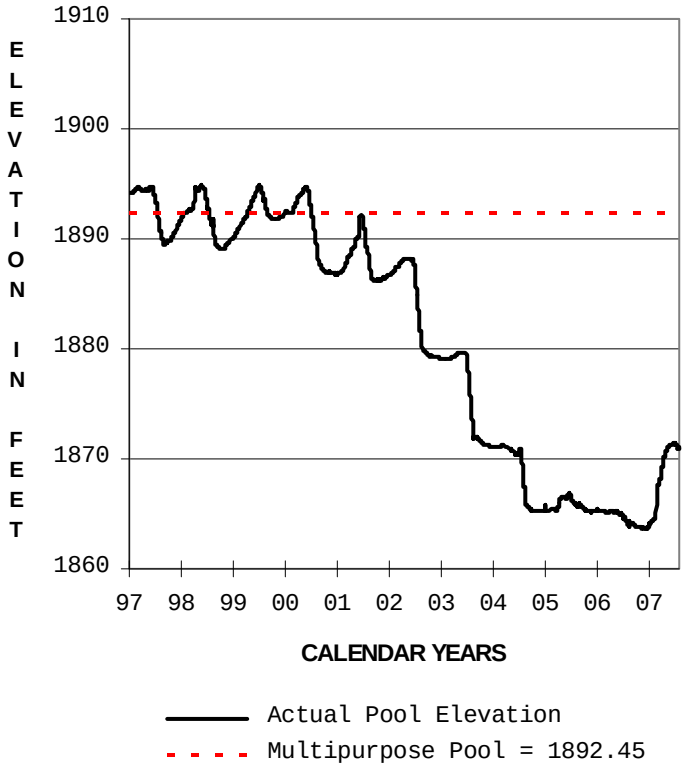
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1447.87 1 Aug 06	**1447.82 31 Jul 07**	**1447.72 18 Jun 06**	**1446.18 19 Dec 06**	**1487.02 29 Jul 93**	**1446.18 19 Dec 06**

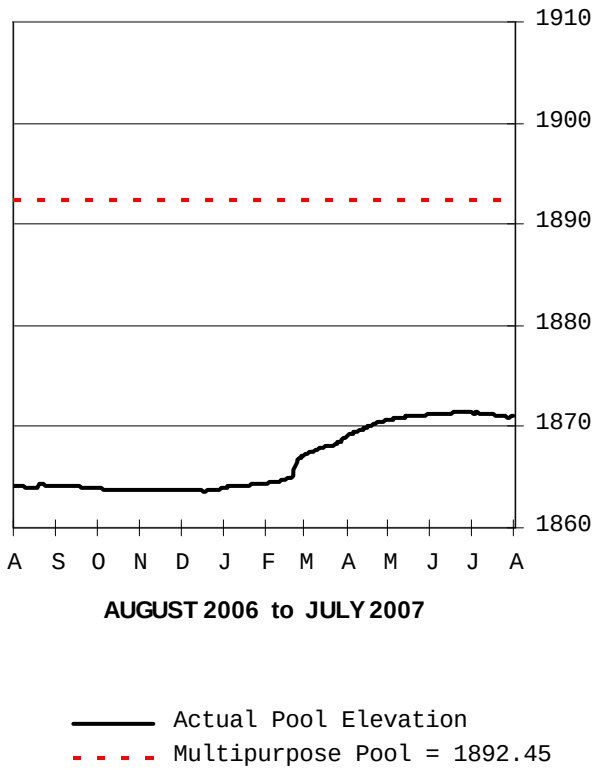
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
500 12 Apr 07	**54,492**	**121 19 Jul 07**	**6 29 Nov 06**

Max daily outflow is river release only. No min required release, but min mean monthly flow of 24 cfs is desirable.

WEBSTER RESERVOIR
2006 - 2007 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1864.13 1 Aug 06	**1871.13 31 Jul 07**	**1871.45 21 Jun 07**	**1864.17 31 Jul 06**	**1907.04 5 Jun 95**	**1857.35 22-29 Oct 71**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
490 21 Feb 07	**1,570**	**0 All Year**	**0 All Year**

All releases to river. Max daily outflow occurred as part of normal irrigation releases. No minimum required release.