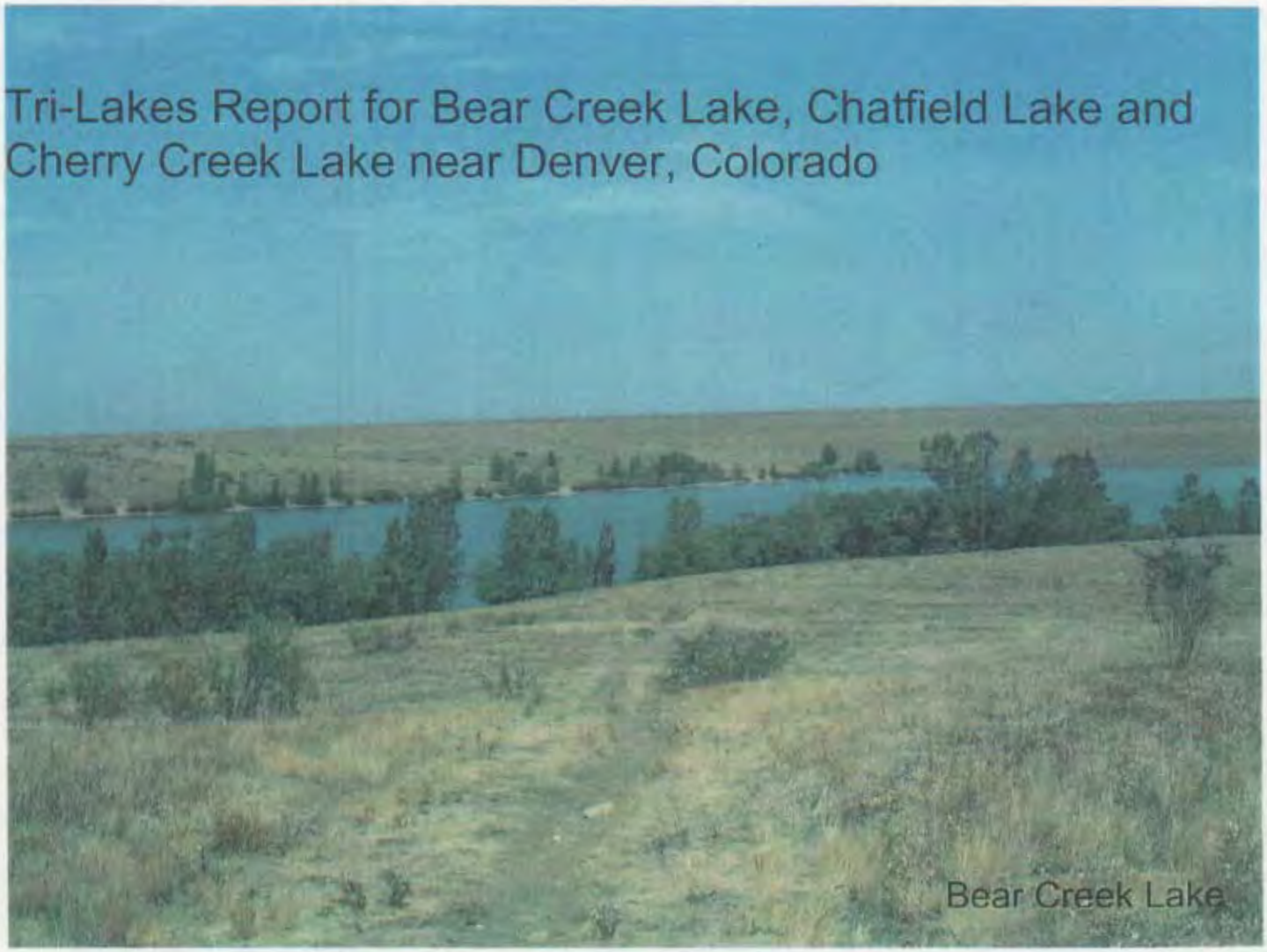
US Army Corps
of Engineers
Omaha District

TRI-LAKES SEDIMENTATION STUDIES AREA-CAPACITY REPORT JULY 2001

Omaha District
Sedimentation and Channel Stabilization Section



July 2001
M.R.B. Sediment Memorandum 23

U.S. ARMY ENGINEER DISTRICTS
OMAHA
KANSAS CITY

The U.S. Army Corps of Engineers Missouri River Basin sediment studies program was established for the development of practical sediment engineering for rational evaluation, regulation, and utilization of fluvial sediment phenomena. It was implemented as a comprehensive, basin-wide program for coordination of studies of sediment problems in the overall basin program for flood control and allied purposes as well as for continuity and perspective in the planning and design of individual projects. The program includes both investigations for the development of sediment transport theory and observation of existent and occurring phenomena for the purpose of developing the applications of theory to practical problems, developing empirical relationships and providing aids to judgement.

ACKNOWLEGEMENTS

This sedimentation conditions report was prepared by Lynnette F. Schaper under the supervision of John I. Remus II, Chief of Sedimentation and Channel Stabilization Section. John W. Garrison and Lawrence J. Morong also contributed to this report.

EXECUTIVE SUMMARY

The purpose of the Tri-Lakes Report is to document changes in the storage capacity of the Tri-Lakes between the original and subsequent surveys. The Tri-Lakes are located in the Denver metro area and consist of Bear Creek Lake, Chatfield Lake, and Cherry Creek Lake.

Gross storage capacity in Bear Creek Lake has decreased from the original capacity of 78,101 acre-feet in 1980 to 77,846 acre-feet in 1997 (the year of the latest hydrographic survey). This amounts to a total storage reduction of 255 acre-feet, or an average of 15.0 acre-feet yearly. Between the two most recent surveys 1987 and 1997, the gross storage was reduced by 198 acre-feet, or an average of 19.8 acre-feet yearly. The original projected storage depletion rate for Bear Creek Lake was approximately 20 acre-feet per year.

For the flood control pool zone, the reduction of storage capacity has decreased from the original capacity of 28,762 acre-feet in 1980 to 28,704 acre-feet in 1997, or an average of 3.4 acre-feet yearly. Between the two most recent surveys, 1987 and 1997, the flood control capacity decreased 8.0 acre-feet, averaging 0.8 acre-feet yearly.

Gross storage capacity in Chatfield Lake has decreased from the original capacity of 351,378 acre-feet in 1977 to 350,676 acre-feet in 1998 (the year of the latest hydrographic survey). This amounts to a total storage reduction of 702 acre-feet, or an average of 33.4 acre-feet yearly. Between the two most recent surveys 1991 and 1998, the gross storage was reduced by 257 acre-feet, or an average of 36.7 acre-feet yearly. The original projected storage depletion rate for Chatfield Lake was approximately 234 acre-feet per year.

For the flood control pool zone, the reduction of storage capacity has decreased from the original capacity of 206,856 acre-feet in 1977 to 206,779 acre-feet in 1998, or an average of 3.7 acre-feet yearly. Between the two most recent surveys, 1991 and 1998, the flood control capacity has been reduced 43 acre-feet, averaging 6.1 acre-feet yearly.

Gross storage capacity in Cherry Creek Lake has decreased from the original capacity of 230,578 acre-feet in 1950 to 226,556 acre-feet in 1988 (the year of the latest hydrographic survey). This amounts to a total storage reduction of 4,022 acre-feet, or an average of 105.8 acre-feet yearly. Between the two most recent surveys 1974 and 1988, the gross storage was reduced by 698 acre-feet, or an average of 49.9 acre-feet yearly. The original projected storage depletion rate for Cherry Creek Lake was approximately 151 acre-feet per year.

For the flood control pool zone, the reduction of storage capacity has decreased from the original capacity of 80,638 acre-feet in 1950 to 79,322 acre-feet in 1988, or an average of 34.6 acre-feet yearly. Between the two most recent surveys, 1974 and 1988, the flood control capacity has been reduced 254 acre-feet, averaging 18.1 acre-feet yearly.

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SECTION I - INTRODUCTION

PURPOSE

The Corps of Engineer's Tri-Lakes Project is made up of three separate reservoirs (Bear Creek Lake, Chatfield Lake and Cherry Creek Lake) located in the metropolitan Denver, Colorado area. The purpose of this report is to document geomorphic conditions and trends for each reservoir. Of specific interest to this report are the nature, extent and quantification of sediment accumulation. Presented in the report are project statistical data, cross section data, pool elevation records, capacity and sediment depletion data, and shoreline erosion information.

The report presents historical data in a format, which may be used in following studies to predict future conditions for the three reservoirs. However, forecasting based on the existing data is not the purpose of this report and is not included in this investigation.

SCOPE OF WORK

The scope of work for this report was to compile, in one document, all pertinent sediment information concerning Bear Creek, Chatfield, and Cherry Creek Lakes. The report is to be used as a reference document that analyzes the data to determine trends in geomorphic changes over the historical record.

AUTHORIZATION

The report was prepared under the requirements of Engineering Manual EM 1110-2-4000; "Sedimentation Investigations of Rivers and Reservoirs" dated 15 December 1989. The funding for this report is through the Omaha District operation and maintenance budget.

DATA RESOURCES AND PRIOR INVESTIGATIONS

Corps of Engineers personnel performed the original surveys of the sediment ranges. Subsequent surveys were performed by the Corps of Engineers and independent survey firms contracted by the Corps of Engineers. Two letters and a number designate the sediment range lines. The first cross-section upstream of the dam is number 1. For example, the first cross section upstream of the dam at Bear Creek Lake is BC-01. Plan view and cross-section locations are provided for each reservoir in Sections III-V.

SEDIMENT RELATED PROBLEMS

The Tri-Lakes are all located in upper reaches of the South Platte River basin when looking at the basin as a whole. Bear Creek Lake and Cherry Creek Lake have experienced normal sediment loading that is less than originally projected; therefore making the projected life expectancy of each reservoir longer than originally projected. Chatfield Lake's projected life expectancy is also greater than

originally projected, although Chatfield Lake has had sedimentation problems with the tributary arm of Plum Creek. In the late 1980's and early 1990's Plum Creek experienced a large influx of sediment, which settled around the Titan Road Bridge and in the Plum Creek delta of Chatfield Lake. This aggradation of the riverbed changed the location of the channel endangering the recreational facilities in the Plum Creek arm of Chatfield Lake. The aggradation of the riverbed decreased the flood conveyance capacity under the Titan Road Bridge. Several studies were conducted around 1990 to determine the future of the Titan Road Bridge. Since 1990, the Titan Road Bridge has been replaced and a grade control structure has been built upstream of the bridge. The Plum Creek arm continues to be the source of the majority of the sediment entering Chatfield Lake. One other source of sediment upstream along Plum Creek is an operating gravel pit.

SECTION II - GENERAL INFORMATION

STUDY AREA

The Corps of Engineer's Tri-Lakes Project is made up of three separate reservoirs, Bear Creek Lake, Chatfield Lake and Cherry Creek Lake, located in the metropolitan Denver, Colorado area. The purpose of the Tri-Lakes Project is to protect the Denver metropolitan area from the ravages of catastrophic South Platte River floodwaters that have plagued the area for more than 100 years. Although the Corps of Engineers built the dams primarily for the purpose of flood control, each project offers multi-purpose features, including outstanding recreational opportunities for those interested in boating, camping, skiing, horseback riding, fishing, hiking, and nature study.

GEOGRAPHY & TOPOGRAPHY

The geography and topography of each of the Tri-lakes basins are similar, due to their proximity to one another. The Bear Creek and Chatfield basins are a mixture of high plain and mountain areas, while the Cherry Creek basin is mostly high plain. More detailed descriptions of each basin follow.

Bear Creek

Bear Creek is a left bank tributary of the South Platte River near Morrison, a suburb of Denver, Colorado. The basin drains a total of 236 square miles, of which 90 percent is made up of the terrain found in the Rocky Mountain foothills located west of Denver. The remaining 10 percent of the basin is characterized by high plains and rolling foothills and is separated from the mountains by a prominent hogback that crosses the basin near the Morrison area. The mountains are heavily forested; the terrain below the hogback is mostly grassland with some urban development.

The basin has a leaf shape, approximately 36 miles long and has a maximum width of about 13 miles. Streamflow originates near Summit Lake on the Mount Evans plateau. As flow moves easterly it picks up contribution from numerous small tributaries along its way through the Arapahoe National Forest. At Morrison, Colorado, the flow breaks out of the confinement of a canyon and spreads through the foothills region.

The 52-square mile Turkey Creek drainage joins Bear Creek approximately two miles downstream from Morrison. It is Bear Creek's only major tributary. The location of Bear Creek Dam is found on Plate II-1.

Chatfield

The South Platte River originates along the eastern slope of the Continental Divide and flows in a southeasterly direction through the South Park Meadow Area to Eleven Mile Canyon Reservoir as shown in Plate II-2. Below Eleven Mile Canyon Dam, the South Platte enters a much narrower valley and the surrounding terrain becomes considerably steeper. This stretch includes Cheesman

Reservoir. Several major tributaries enter the South Platte River between Eleven Mile Canyon and the foothills including Tarryall Creek and the North Fork of the South Platte River.

The drainage area upstream from Chatfield Lake contains 3,018 square miles, most of which is rugged mountainous terrain. The basin has a round shape, approximately 120 miles long and has a maximum width of about 90 miles. The lower section of the basin, elevation 5,500 to 7,000 feet MSL, is a mixture of high plains and rolling foothills vegetated largely by grassland with some forested areas. The bulk of the watershed is comprised of mountainous terrain that begins approximately 10 miles upstream from the project. The terrain includes high mountain peaks ranging up to 13,000 feet MSL and steep mountain valleys. The area is heavily forested and is liberally covered with normal forest duff. The headwaters region of the South Platte River is located along the western edge of the basin; it is comprised of about 270 square miles of extremely steep terrain. Elevations in the headwaters region range from 9,500 feet to over 14,000 feet MSL along the Continental Divide. A map of the South Platte River drainage basin above Chatfield Lake is shown on Plate II-2.

Cherry Creek

Cherry Creek is a right bank tributary of the South Platte River. It enters the South Platte River in the highly developed business and industrial area of downtown Denver. The basin drains a 410-square mile area located south of Denver. Cherry Creek Dam is located about 11.4 miles upstream from the mouth of Cherry Creek and controls 386 square miles of the basin's drainage area. The watershed is oblong in shape with a basin length of approximately 44 miles and an average width of approximately 9 miles. The location of Cherry Creek Dam is found on Plate II-3.

The Cherry Creek basin, upstream from Franktown, has steep to moderately rolling topography. Sharp topographic relief characterizes a narrow belt across the central part of the basin, immediately upstream from Franktown. Canyon walls and mesa fronts, 200 to 400 feet high, are common in this belt. In the reach from near Franktown to near Parker, Cherry Creek courses through a broad valley bordered by steep to rolling ridges and hills. Downstream from Parker, the upland area consists of rolling hills. Vegetation in undeveloped areas is limited to groves of large cottonwoods and low shrubby growth bordering the creek channel. The basin elevation varies from about 7700 feet MSL at the source of Cherry Creek to about 5170 feet MSL at its confluence with the South Platte River. The multipurpose pool elevation of Cherry Creek Lake is 5500.0 feet MSL.

CLIMATE

Due to the topography of the Bear Creek, Cherry Creek, and South Platte River basins remarkable climatic differences occur within each basin area. In describing the climate of these basins it is helpful to make two subdivisions: 1) the high plains and foothills and 2) the mountains and valleys. The climate of the high plains and foothills around the Denver metropolitan area is substantially different than the climate of the mountains and valleys west of the Front Range. Characteristics of these two climates are discussed below.

The climate of the plains is distinctly continental. Situated a long distance from any moisture source and separated from the Pacific Ocean source by a high mountain barrier, the plains area experiences light rainfall, low relative humidity, a large daily range in temperature, high daytime temperatures in summer, a few protracted cold spells in winter, moderately high wind movement, and a high percentage of sunshine. The mean annual temperature in the plains and foothills is about 50 degrees. Temperatures of 100 degrees, or over, have been observed at all stations in the region, and daytime temperatures of 95 degrees, or higher, are common in the summer. In the foothills portion of the area, summer afternoon temperatures are frequently lowered by afternoon cloudiness and thunderstorms over and near the mountains. Cold air masses from the north can be abrupt and severe, intensified by the high altitude. However, many of the cold air masses out of Canada that spread southward over the Northern Great Plains are too shallow to reach the area's altitude and move off over the lower plains to the east. The lowest temperatures observed in the plains and foothills region have ranged from 30 to 40 degrees below zero. The mean annual precipitation averages about 14 to 17 inches, the amounts increasing with proximity to the mountains. Over 70 percent of the annual precipitation falls in the six-month period, April through September, much of it from the intense isolated thunderstorms, which occur during the summer. Winter snowfall averages from 3 to 5 feet on the plains, and from 5 to 7 feet in the foothills.

The climatic variations between mountain weather stations are substantially greater than between plains weather stations. The weather pattern in general is toward lower temperatures and an increase in precipitation and wind movement with an increase in altitude. However, local conditions can change this pattern quite markedly. The diurnal range in temperature is low on the mountain slopes and high in the valleys. At the mountain peaks the average annual temperature is less than 32 degrees. Readings of zero or lower are much more common than on the plains, although minimum temperatures of record are about the same. The daytime temperatures decrease with increasing elevation, while the minimum temperatures are a function of cold air drainage. The rainfall in the mountain areas depends largely on the elevation and exposure to moisture bearing winds. On the eastern slopes of the Front Range the precipitation pattern resembles that of the plains. At the higher elevations west of the Front Range snowfall is more prevalent. Snow survey data collected by the National Resource Conservation Service Office in Fort Collins indicate that there is no general snowpack accumulation in the Bear Creek basin. During the winter, snow normally accumulates to a few inches, drifts considerably, and then melts. This process generally repeats itself several times during the winter season. The variable climatic conditions existing throughout this region are shown in Table II-1, which presents precipitation, snowfall, and temperature data for selected weather stations located near the Tri-Lakes Project dam sites.

Table II-1. Temperature, Precipitation, and Snowfall for Weather Stations Located near the Tri-Lakes Project Dams

	Morrison, CO	Littleton, CO	Cherry Creek Reservoir
Tri-Lakes Project Location	Near Bear Creek	Near Chatfield	Near Cherry Creek
Average Temperature (°F)	--	49.3	49.7
Average Precipitation (in)	16.8	16.4	16.5
Average Snowfall (inches)	--	66.4	55.0
Years of Record	38	15 (1978-1994)	47 (1951-1997)
Elevation (feet)	6000	5360	5650

SURVEYS

Corps of Engineers personnel performed the original surveys of the sediment ranges. Subsequent surveys were performed by the Corps of Engineers and independent survey firms contracted by the Corps of Engineers. Two letters and a number designate the sediment range lines. The first cross-section upstream of the dam is number 1. For example, the first cross section upstream of the dam at Bear Creek Lake is BC-01.

Table II-2 lists the survey years for each lake.

Table II-2. Survey Years for Tri-Lakes Reservoirs

LAKE	SURVEY YEARS
Bear Creek	1980, 1984, 1996-7[a]
Chatfield	1977, 1991, 1998
Cherry Creek	1950, 1961, 1965, 1974, 1988, 1997[b]

[a] The overbanks were surveyed in December 1996 and the underwater portion in 1997.
[b] Erroneous data at ranges CC-01 to CC-04 due to underwater survey.

The survey data collected during 1982 through 1984 at each reservoir is not included in the analysis of this report. The data from these years were deemed to be unreliable due to unresolved survey errors.

The 1997 data for Cherry Creek appears to have questionable data. Plates V-2 through V-4 demonstrate the data's possible problems. Data from 1997 are not included in the analysis of the Section V - Cherry Creek Lake sections entitled Surface Area, Capacity Changes, and Sediment Volume.

SOURCE AND DISTRIBUTION OF DEPOSITS

The primary source of sediment deposited in the project comes from watershed sheet, rill and gully erosion. An additional and non-quantified source of sediment is from shoreline erosion. As a shoreline erodes, the eroded material generally moves to lower elevations. While this erosion increases the capacity at higher reservoir elevations, storage capacity allocated for specific purposes at lower

elevations is reduced. In all the Tri-Lakes, most of the incoming sediment is transported via the inflowing rivers. A delta forms at the junction of the river and the lake where the majority of sediment drops out into the lake. Initially, the delta grows in both the downstream and upstream direction. Most of the growth is in the downstream direction. As the delta matures, a stable slope is established at the headwaters and the delta then progresses into the reservoir. In the reservoir, sediment generally settles in the low spots, filling in the old channel, and smoothing out any roughness in the topography.

AREA - CAPACITY

An investigation of the Tri-Lakes area-capacity is described in Sections III through V for each lake individually. Descriptions of the computational methods follow.

Computations

Procedure: Surface area and capacity computations were performed for all survey data utilizing the Omaha District Reservoir Area-Capacity Analysis (June-August 2000) microcomputer programs. A synopsis of this procedure can be found in Appendix A.

Program Execution: General procedures for executing the area - capacity programs can be found in the manual "Reservoir Area-Capacity Analysis (on the Microcomputer)", August 1992, Omaha District, U. S. Army Corps of Engineers.

Output Filenames: Data output files containing results from the execution of area - capacity programs are a two letter reservoir code (BC for Bear Creek, CH for Chatfield, and CC for Cherry Creek), the year of the survey, and the letters "VO" for volume (i.e. BC80VO, CH77VO). The area-capacity output is labeled with the two letter reservoir code, the year of the survey, and the letters "ALL" for all area-capacity output, (i.e. BC87ALL, CH98ALL). Output files as well as cross section data input files are stored in the River and Reservoir Engineering Section, Omaha District.

Data Accuracy: The accuracy of the data is illustrated by the close similarity of the cross section data plots as shown in cross-section Plates in Sections III through V. However, the 1984 survey data for Bear Creek, Chatfield, and Cherry Creek was determined to be in error, unusable and is not included here.

Area-Capacity Tables

Area - capacity tables computed at 1.0-foot increments are located in Appendices B, C and D for Bear Creek, Chatfield, and Cherry Creek, respectively. The tables computed at 0.01-foot increments are available at the following address:

US Army Corps of Engineers
Omaha District
Attn: CENWO-ED-HF
106 South 15th Street
Omaha, Nebraska 68102-1618

SUMMARY OF ENGINEERING DATA
TRI-LAKES PROJECTS NEAR DENVER, COLORADO

SUBJECT	BEAR CREEK	CHATFIELD	CHERRY CREEK
GENERAL			
Location of dam	3 mi. S.W. of Denver, CO.	8 mi. S. of Denver, CO.	10 mi. S.E. of Denver, CO.
River & river mile	Bear Creek @ R.M. 8	South Platte River @ R.M. 321	Cherry Creek @ R.M. 11.4
Drainage area	236 square miles	3,018 square miles	386 square miles
Reservoir length	0.5 mi. @ elev. 5558	2.0 mi. @ elev. 5430	1.5 mi. @ elev. 5550
Location of Damtender	At Chatfield Dam	On site	At Chatfield Dam
Travel time to Missouri River	2 weeks	2 weeks	Unknown
Max. discharge of record	8,600 cfs July 1896	110,000 cfs June 1965	58,000 cfs June 1965
Project cost (1)	$61,700,000.00	$101,130,000	$14,670,000
DAM AND EMBANKMENT			
Top of dam	5689.5 ft. MSL	5527.0 ft. MSL	5645.0 ft. MSL
Length of dam	5,300 ft.-main/2,100 ft.-South	13,136 ft.	14,300 ft.
Height of dam	179.5 ft.-main/65 ft. South	147 ft.	141 ft.
Stream Bed	5,510 ft. MSL	5,380 ft. MSL	5,504 ft. MSL
Abutment formation	Clay-shale-siltstone-sandstone	Sandy overburden	Sandstone-clay-silt
Type of fill	Rolled earth	Rolled earth	Rolled earth
Fill quantity in cu. Yards	11,346,000-main/770,000 South	14,650,000	13,000,000
Date of closure	Jul-77	Aug-73	Oct-48
Date of initial fill (base F.C.)	May-79	Jun-79	Mar-60
SPILLWAY			
Discharge capacity	153,500 cfs @ elev. 5684.5	188,000 cfs @ elev. 5521.6	38,350 cfs @ elev. 5636.2
Crest elevation	5667.0 ft. MSL	5500.0 ft. MSL	5598.0 ft. MSL
Width	800 ft.	500 ft.	67 ft.
Gates, number, size, type	Ungated earth channel	Ungated convergine chute	Ungated earth channel
RESERVOIR	**ELEVATION. & AREA**		
Maximum pool	5684.5 ft. MSL and 1,235 acres	5521.6 ft. MSL and 5,991 acres	5636.2 ft. MSL and 4,307 acres
Top of flood control pool	5635.5 ft. MSL and 715 acres	5500.0 ft. MSL and 4,779 acres	5598.0 ft. MSL and 2,642 acres
Top of multipurpose pool	5558.0 ft. MSL and 106 acres	5432.0 ft. MSL and 1,429 acres	5550.0 ft. MSL and 847 acres
Top of inactive pool	5528.0 ft. MSL and 17 acres	none	none
STORAGE ZONES	**ELEVATION & CAPACITY**		
Surcharge	5635.5-5684.5 47,260 AF	5500.0-5521.6 116,469 AF	5598.0-5636.2 134,429 AF
Flood control	5558.0-5635.5 28,704 AF	5432.0-5500.0 206,779 AF	5550.0-5598.0 79,322 AF
Multipurpose	5528.0-5558.0 1,824 AF	5385.0-5432.0 27,405 AF	5504.0-5550.0 12,805 AF
Inactive	5510.0-5528.0 58 AF	5377.0-5385.0 23 AF	none
Gross (top of F.C. pool)	77,846 AF	350,676 AF	226,556 AF
OUTLET WORKS			
Number and size - conduits	1 - 7 ft. circular - upstream 1 - 7x10.5 ft. - downstream	2 - 11x16 ft. oval conduit	2 - 8x12 ft. oval conduit 1 - 12 ft. circuar conduit
Conduit length	1690 ft. Ungated drop inlet - elev. 5558	1280 ft.	679.5 ft.
Number - size - type gates	2 - 3x6 ft. hydraulic slide 2 - 1x1 ft. slide - gate on gate	2- 6x13.5 ft. hydraulic slide 2 - 2x2 ft. slide - gate on gate 1 - 72 in. butterfly	5 - 6x9 ft. hydraulic slide
Discharge capacity	2,160 cfs @ elev. 5667	8,400 cfs @ elev. 5500.0	8,100 cfs @ elev. 5598.0
POWER INSTALLATION	none	none	none

(1) 1980 dollars.

Bear Creek Dam:
Tributary Area and Dam Location Map

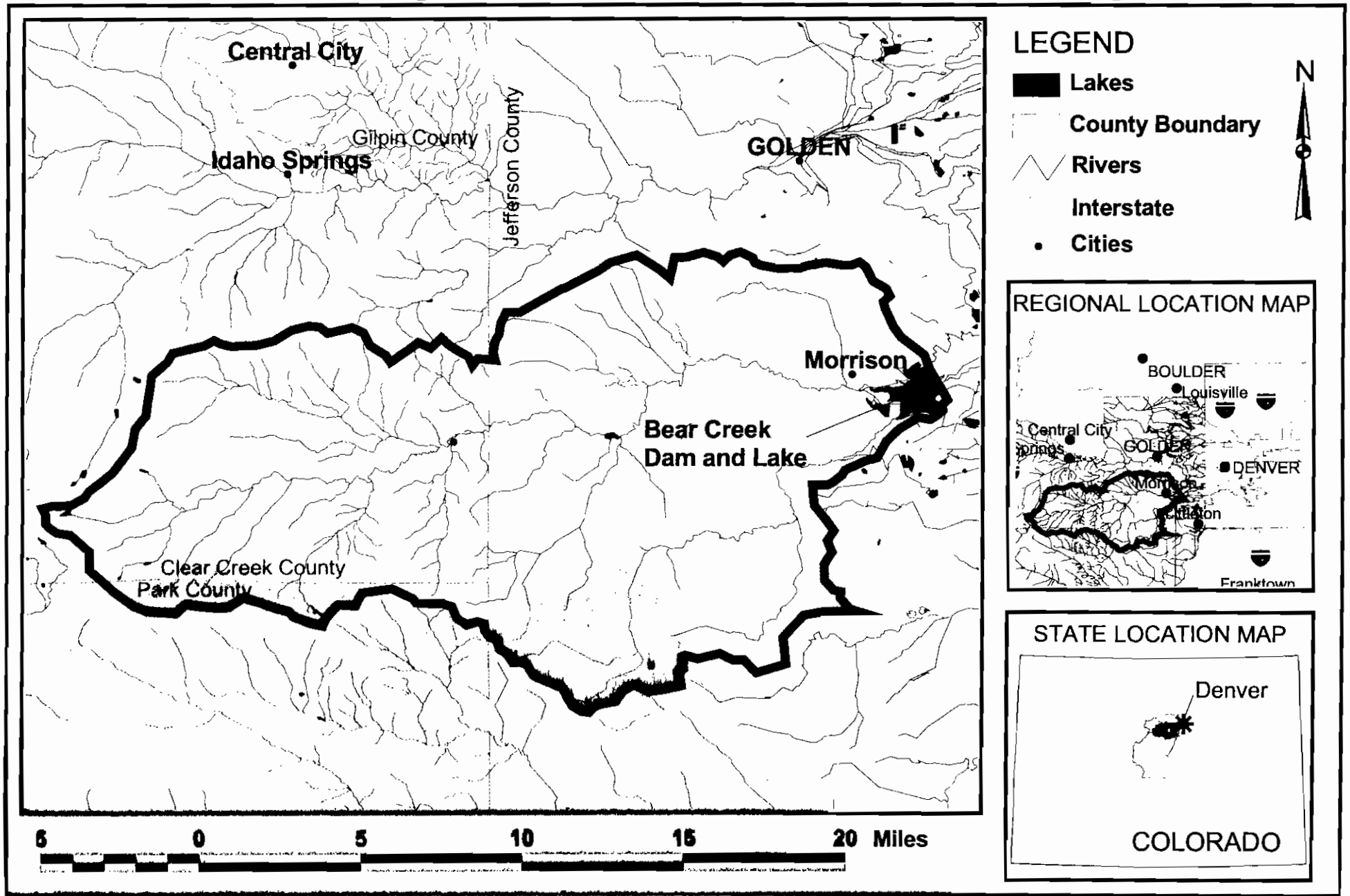


Plate II-1

Chatfield Dam:
Tributary Area and Dam Location Map

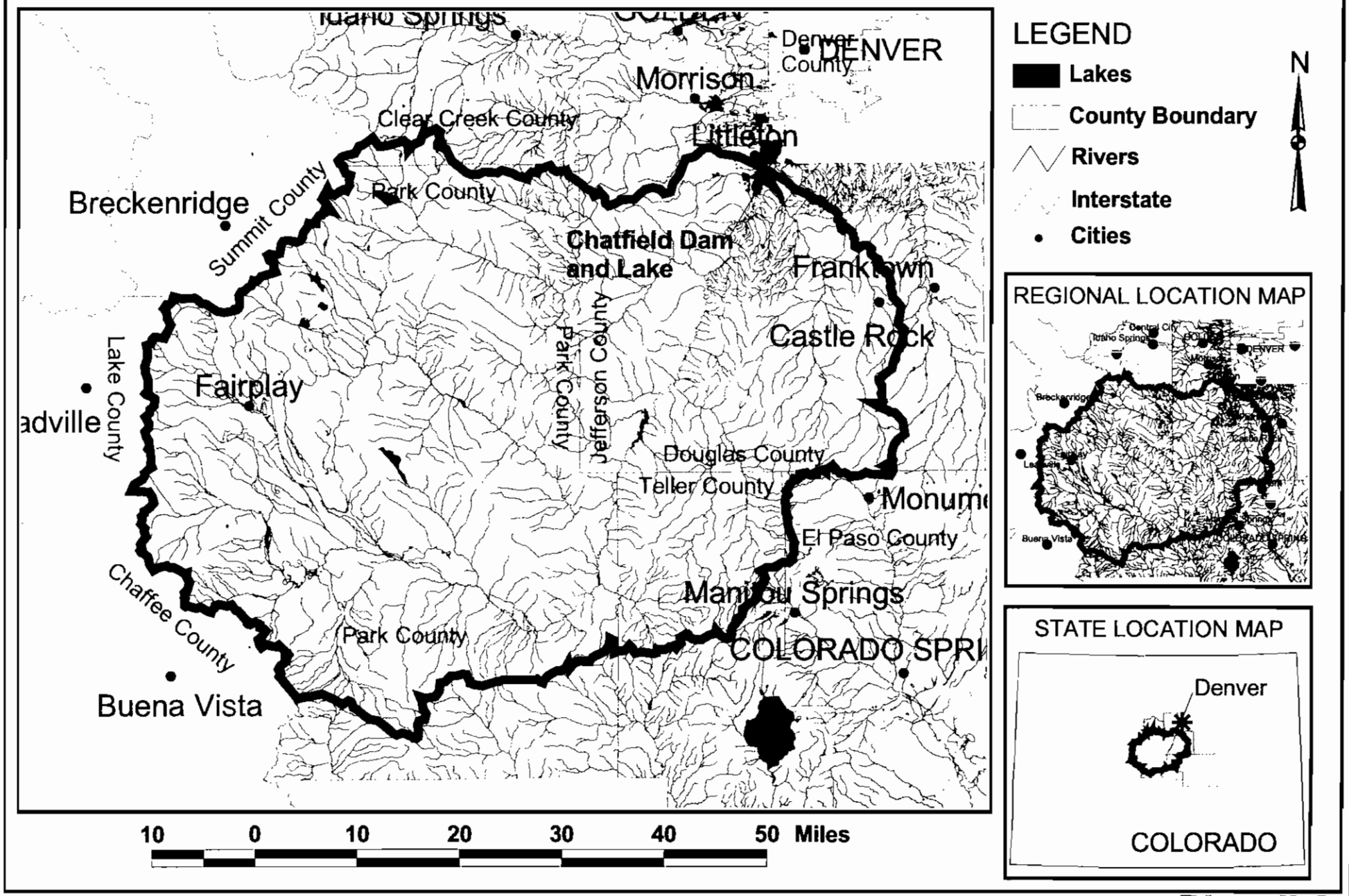


Plate II-2

Cherry Creek Dam:
Tributary Area and Dam Location Map

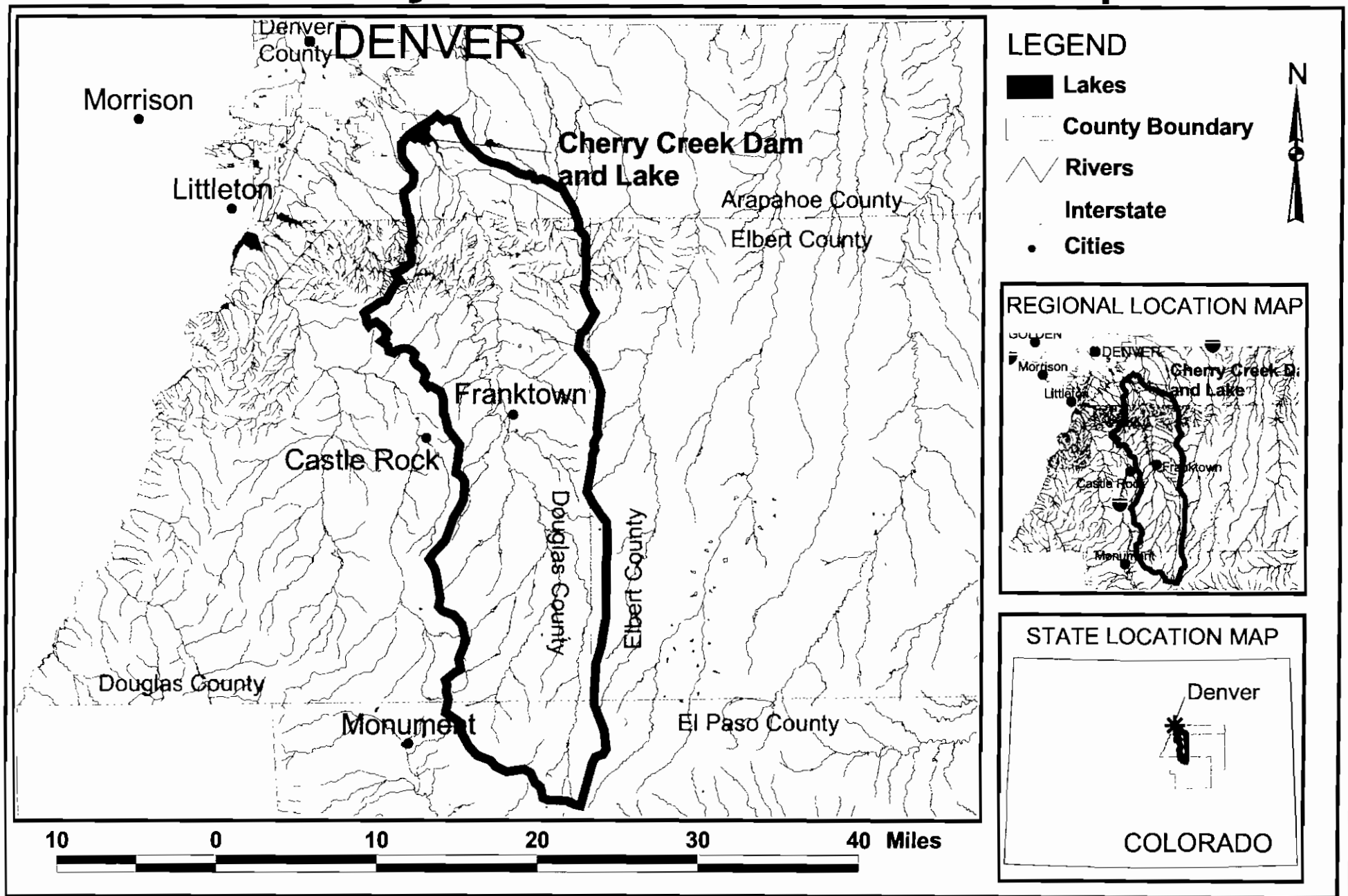


Plate II-3

SECTION III - BEAR CREEK LAKE

BACKGROUND

Bear Creek Lake is located 3 miles southwest of Denver, Colorado. The lake is located in Jefferson County. A map of Bear Creek Lake, including its sediment ranges, is shown in Plate III-1.

Bear Creek Dam is a rolled earthfill structure with the main dam 5,300 feet in length and 179.5 feet in height and the south dam 2,100 feet in length and 65 feet in height. Bear Creek Lake's closure occurred in July 1977 and initial filling was reached in May 1979. The lake covers approximately 106 acres at the multi-purpose pool elevation of 5,558.0 feet MSL. The originally estimated long term average annual depletion rate for the lake was 20 acre-feet.

SURFACE AREA

Plate III-2 is a plot of elevation versus surface area for all survey years.

Table III-1 shows reservoir surface area by elevation. The surface area at the top of the multipurpose pool (5558.0 feet MSL) at Bear Creek decreased by 3 acre(s) between 1980 and 1997. Shoreline erosion increases the surface area while delta growth decreases the surface area of the lake. The decrease in this case is likely due to delta growth at the multipurpose level.

CAPACITY CHANGES

Plate III-3 is a plot of the elevation versus reservoir capacity curve for all survey years. Table III-2 presents reservoir capacity by storage zone. Total storage (elevation 5510.0 – 5684.5 feet MSL) decreased 255 acre-feet (0.3%) between 1980 and 1997. Storage in the flood control zone (elevation 5558.0 – 5635.5 feet MSL) decreased 58 acre-feet (0.2%) between 1980 and 1997. Storage in the multipurpose zone (elevation 5528.0 – 5558.0 feet MSL) decreased 68 acre-feet (3.6%) between 1980 and 1997. Storage in the inactive zone (elevation 5510.0 – 5528.0 feet MSL) decreased 14 acre-feet (19.4%) between 1980 and 1997.

Table III-3 presents the sediment depletion rates up to the multipurpose pool zone (elevation 5510.0 – 5558.0 feet MSL). The total storage depletion rate between survey years 1980 and 1997 is 15.0 acre-feet per year, while the storage depletion rate up to the multipurpose pool level is 4.8 acre-feet per year. The original projected total storage depletion rate was approximately 20 acre-feet per year.

A road was added in the area of range BC-08 between 1987 and 1997. Due to the embankment the 1997 range shows a considerable increase in sediment in this area.

PROFILE PLOTS

Plate III-4 compares the reservoir average bed elevations during each of the survey years. The largest change occurred in the vicinity of range BC-01 and BC-02 where the thalweg increased by over 3.5 feet since 1980.

SEDIMENT VOLUME

Plate III-5 represents the change in sediment volume between 1980 and 1997. The quantity of sediment that entered the reservoir per survey period is shown in Table III-2. The total sediment change and the depletion rate for the range of years is shown below.

Survey Period	Total Volume Depletion (AF)	Depletion Rate (AF/YR)
1980-1987	57	8.1
1987-1997	198	19.8
1980-1997	255	15.0

AREA - CAPACITY TABLES

Area - capacity tables computed at 1.0-foot increments are located in Appendix B.

CROSS SECTION DATA

Cross-sectional plots are shown on Plates III-6 through III-20.

ENG FORM 1787 – RESERVOIR SEDIMENT DATA SUMMARY

ENG FORM 1787, "Reservoir Sedimentation Data Summary" is presented in Appendix E. The purpose of this form is to provide a means for the uniform documentation of pertinent Bear Creek Lake sedimentation data.

TABLE III-1.
RESERVOIR SURFACE AREA BY ELEVATION
BEAR CREEK LAKE NEAR DENVER, COLORADO

RESERVOIR ZONE & ELEVATION		SURFACE AREA (acres)		
		1980	1987	1997
Flood Control Pool	5635.5 ft. MSL	717	716	715
Multipurpose Pool	5558.0 ft. MSL	109	107	106

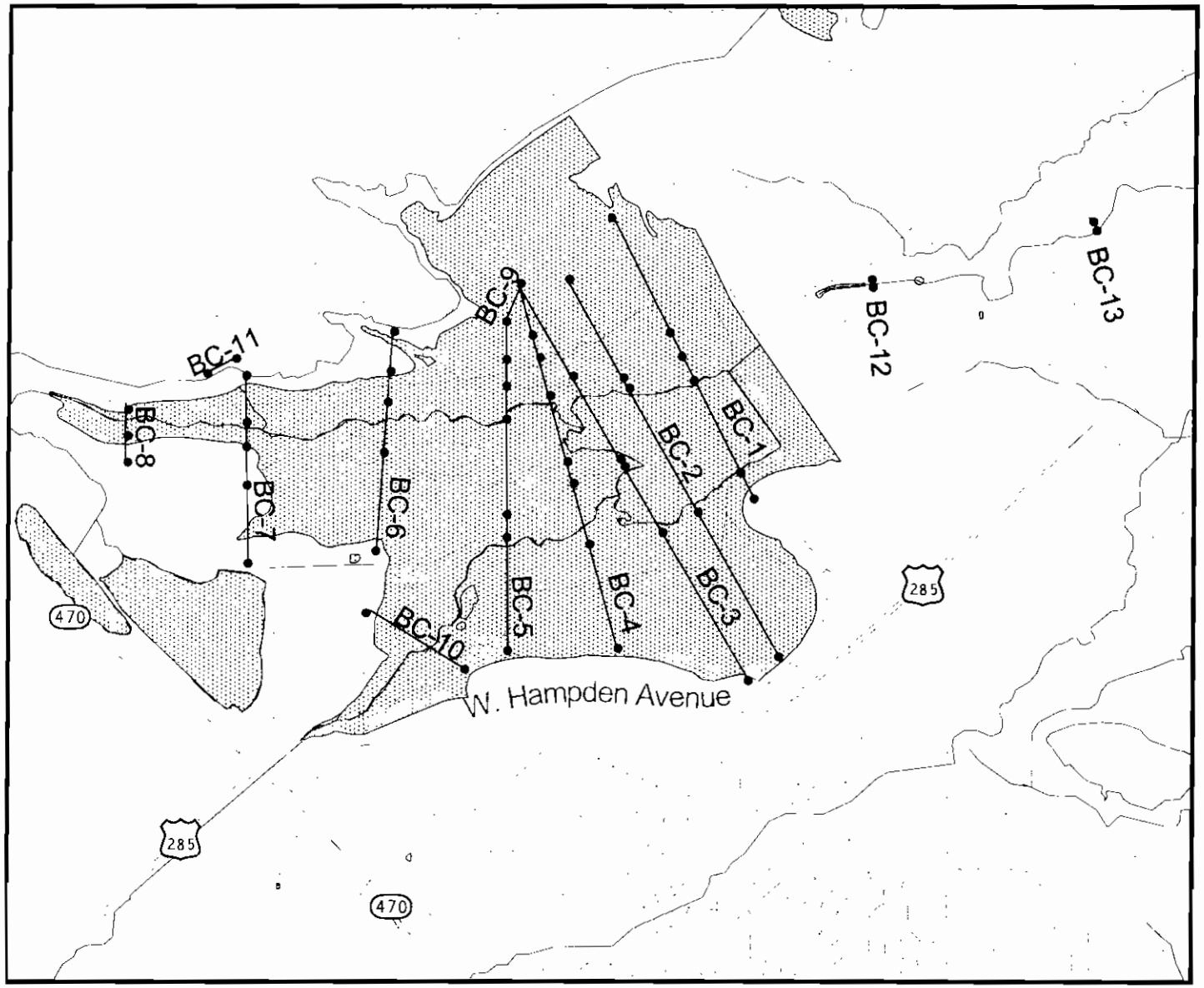
TABLE III-2.
RESERVOIR STORAGE CAPACITY BY STORAGE ZONE FOR BEAR CREEK LAKE

STORAGE ZONE	RESERVOIR CAPACITY acre-feet			CHANGE IN CAPACITY acre-feet			DEPLETION RATE/YEAR acre-feet/yr
	1980	1987	1997	80-87	87-97	80-97	80-97
Surcharge 5635.5 - 5684.5	47375	47358	47260	-17	-98	-115	6.8
Flood Control 5558.0 - 5635.5	28762	28712	28704	-50	-8	-58	3.4
Multipurpose 5528.0 - 5558.0	1892	1909	1824	17	-85	-68	4.0
Inactive 5510.0 - 5528.0	72	65	58	-7	-7	-14	0.8
GROSS STORAGE 5510.0 - 5684.5	78101	78044	77846	-57	-198	-255	15.0

TABLE III-3.
SEDIMENT DEPLETION RATES
UP TO THE MULTIPURPOSE POOL ZONE (EL. 5510.0 - 5558.0 FT. MSL)
BEAR CREEK LAKE NEAR DENVER, COLORADO

Survey Year	No. of Years Between Surveys	Total Capacity (AF)	Capacity Lost (AF)	Depletion Rate Between Surveys (AF/Year)	Depletion Rate Since 1980 (AF/Year)
1980		1964			0.0
	7		-10	-1.43	
1987		1974			-1.4
	10		92	9.20	
1997		1882			4.8

Bear Creek Lake Sedimentation Ranges



N

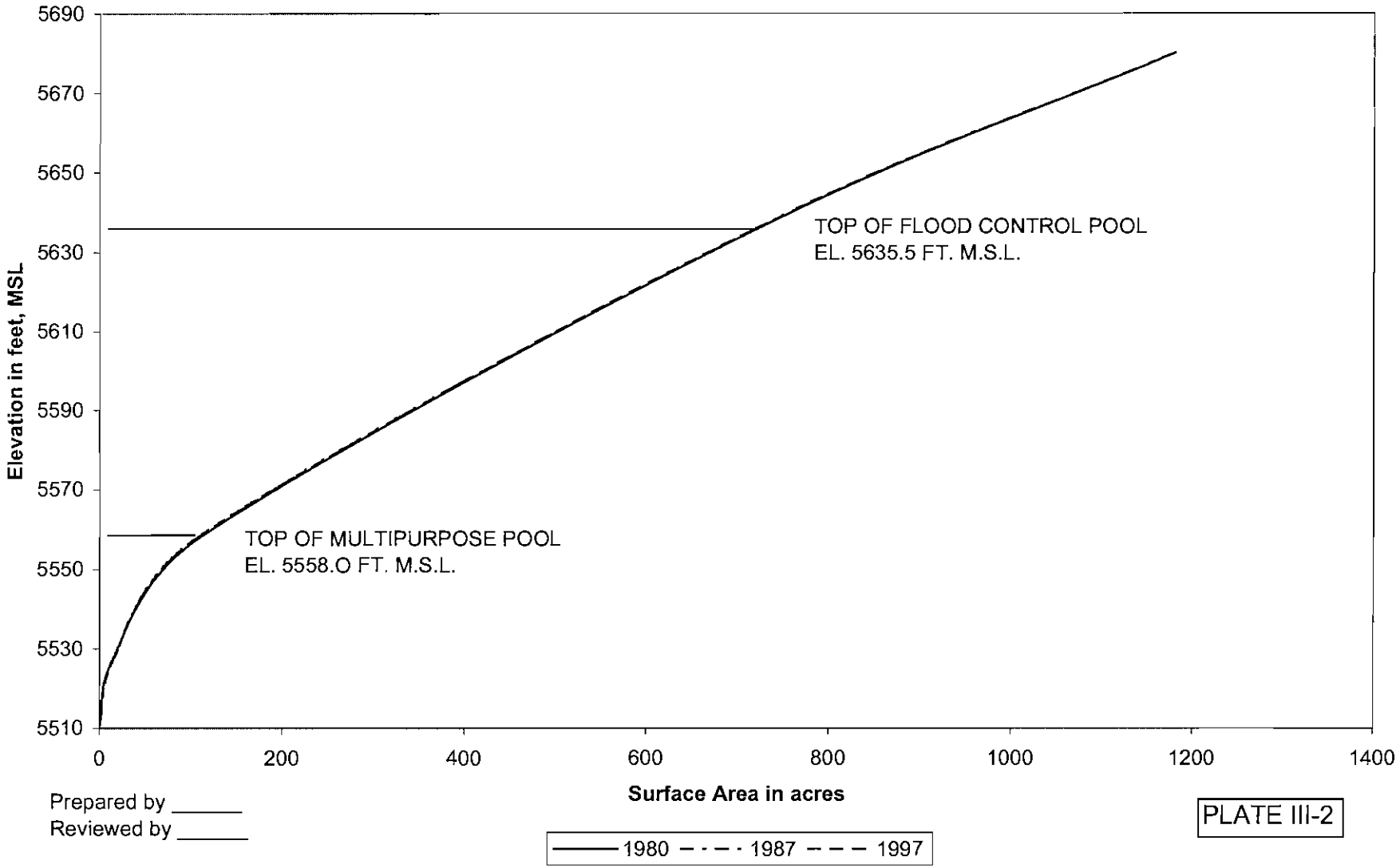
LEGEND

- Range Monuments
- Rivers & Lakes
- Sediment Range Line
- Roads
- Bear Creek Lake

0.2 0 0.2 0.4 0.6 0.8 1 Miles

Plate III-1

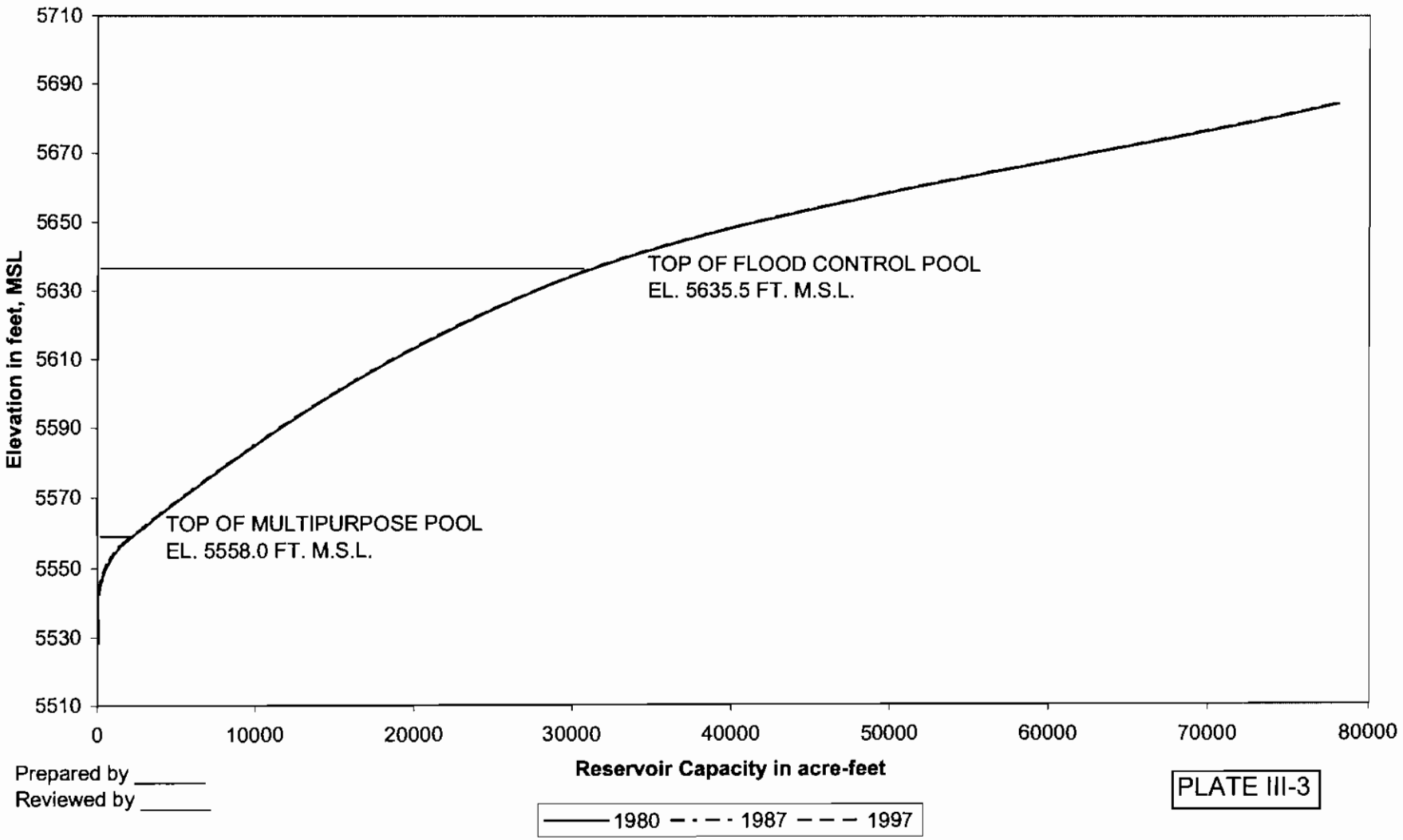
Bear Creek Lake
Elevation vs. Surface Area for All Survey Years



Prepared by _____
Reviewed by _____

PLATE III-2

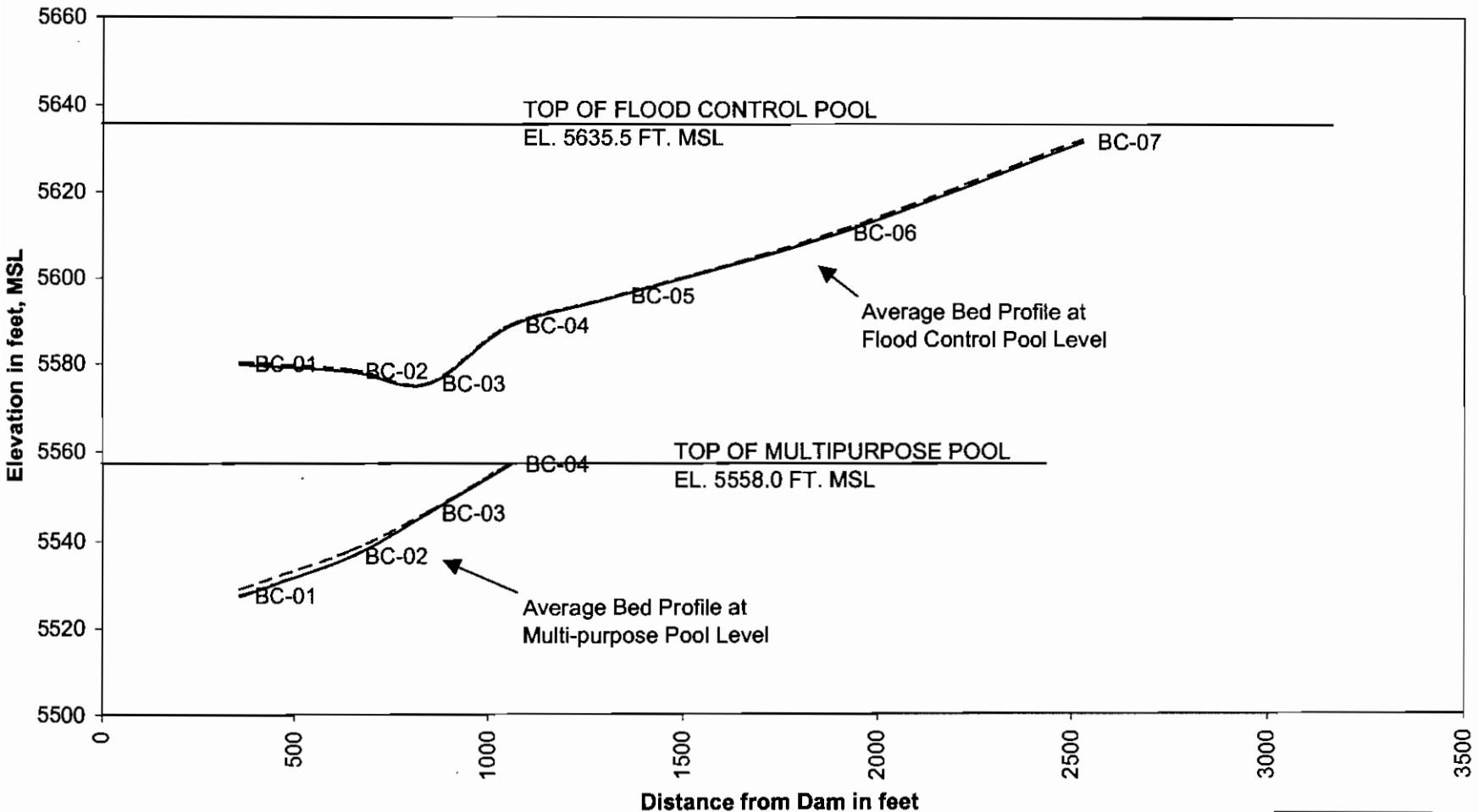
Bear Creek Lake
Elevation vs. Reservoir Capacity for All Survey Years



Prepared by _____
Reviewed by _____

PLATE III-3

Bear Creek Lake
Average Bed Profile for All Survey Years



Prepared by _____
Reviewed by _____

PLATE III-4

Bear Creek Lake Change in Capacity 1980-1997

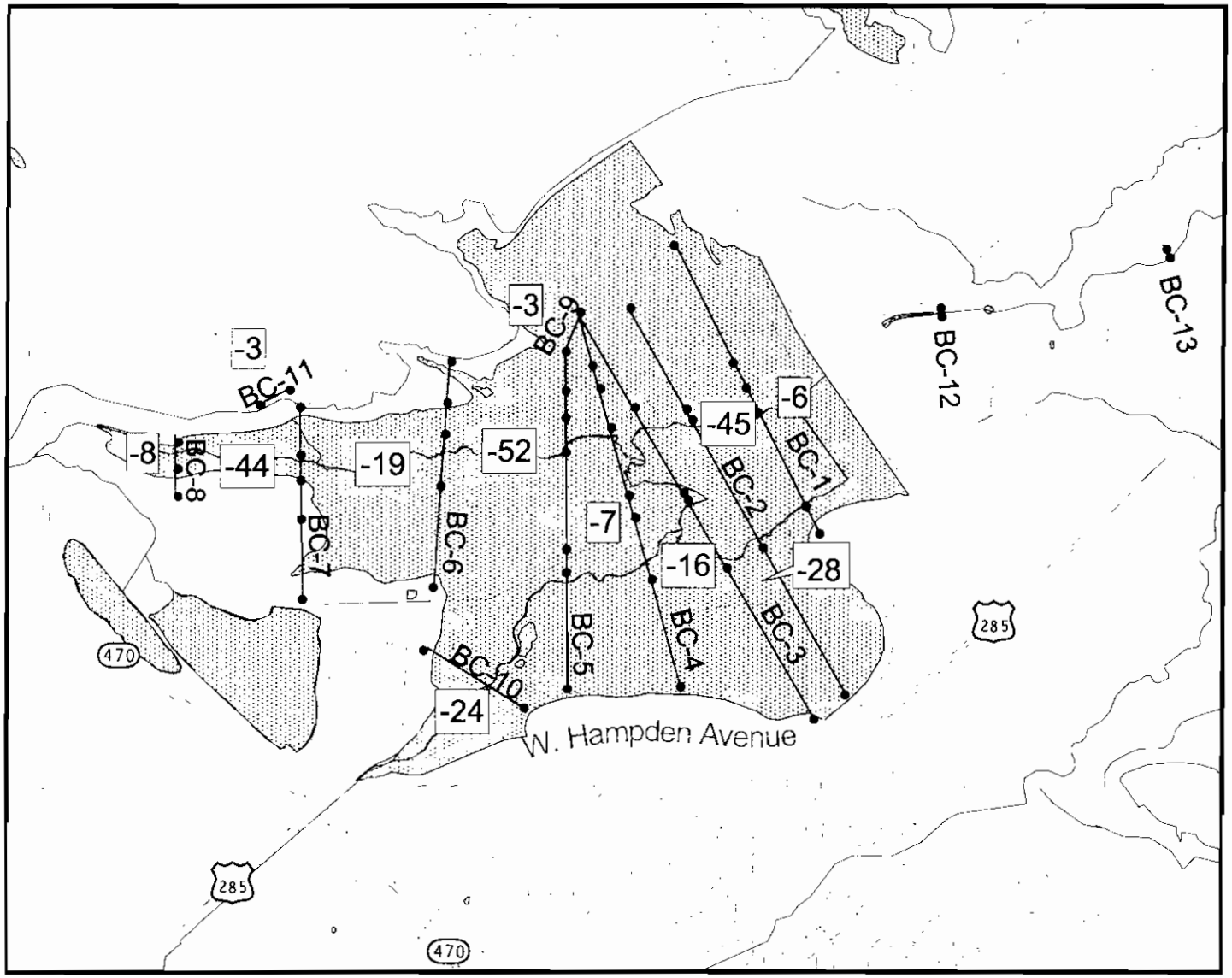


Plate III-5

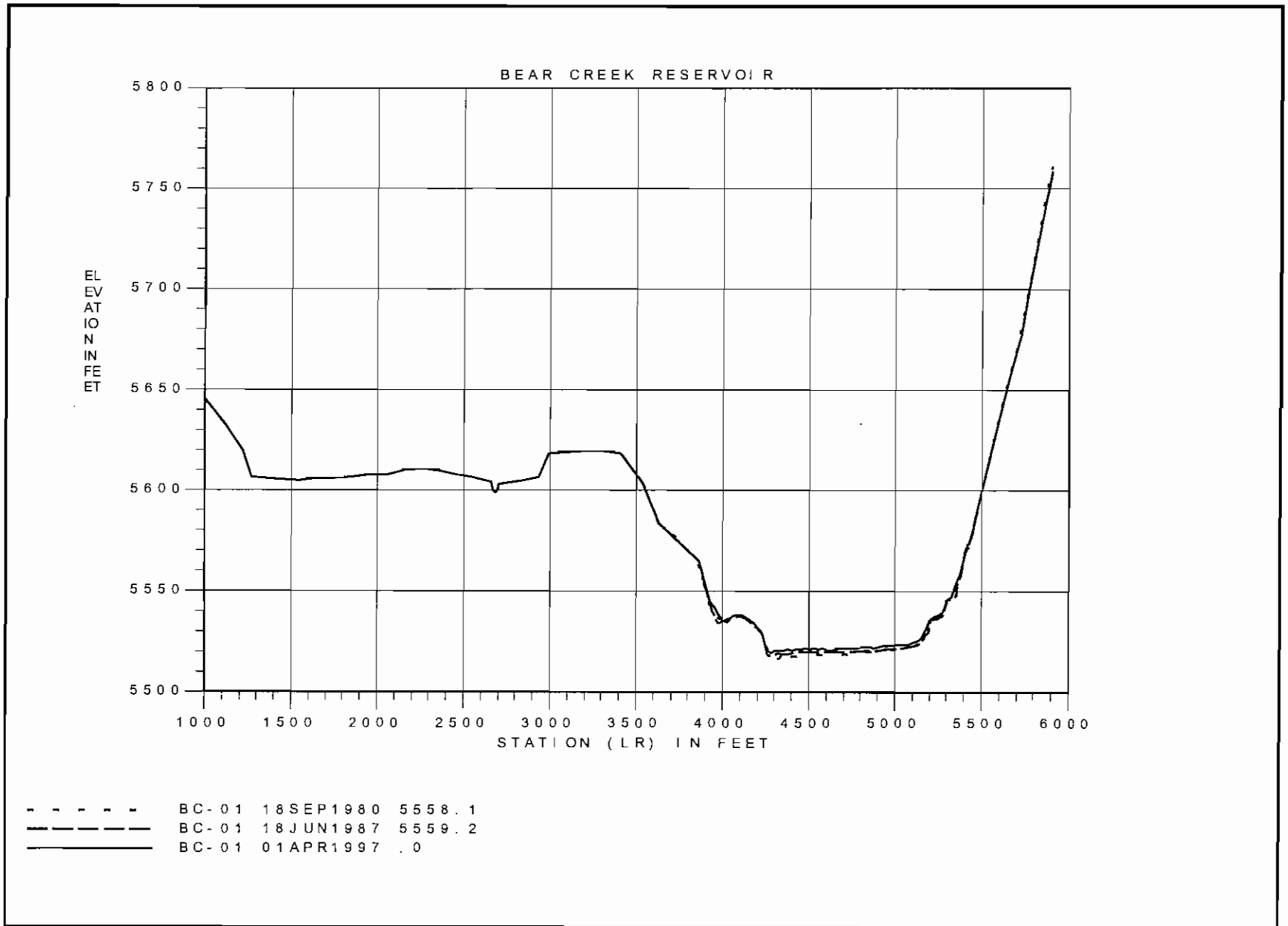

BEAR CREEK RESERVOIR
5800
5750
5700
5650
5600
5550
5500
ELEVATION IN FEET
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
STATION (LR) IN FEET
BC-01 18SEP1980 5558.1
BC-01 18JUN1987 5559.2
BC-01 01APR1997 .0

PLATE III-6

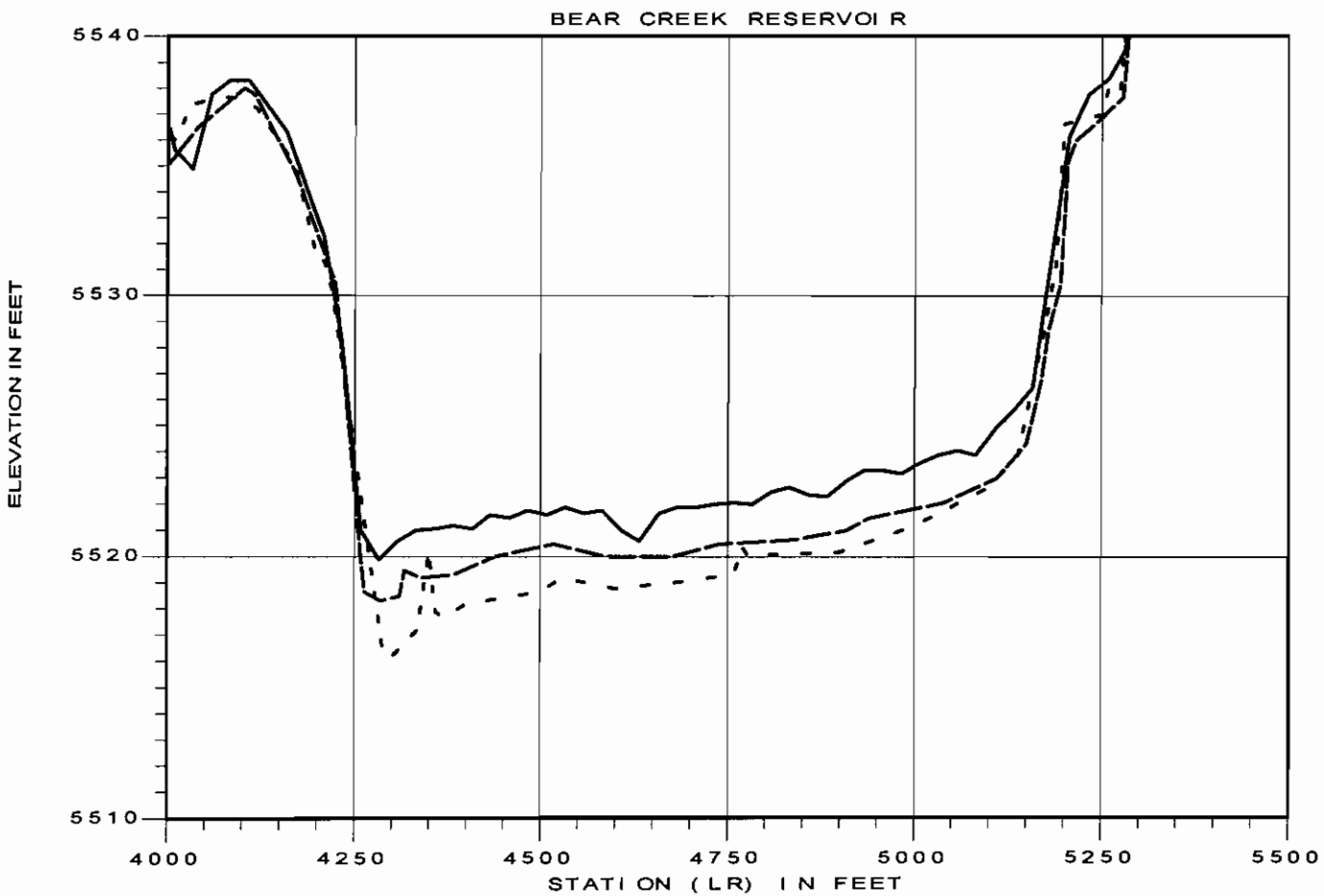

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5540
5530
5520
5510
4000
4250
4500
4750
5000
5250
5500
STATI ON (LR) I N FEET
BC-01 18SEP1980 5558.1
BC-01 18JUN1987 5559.2
BC-01 01APR1997

PLATE III-7

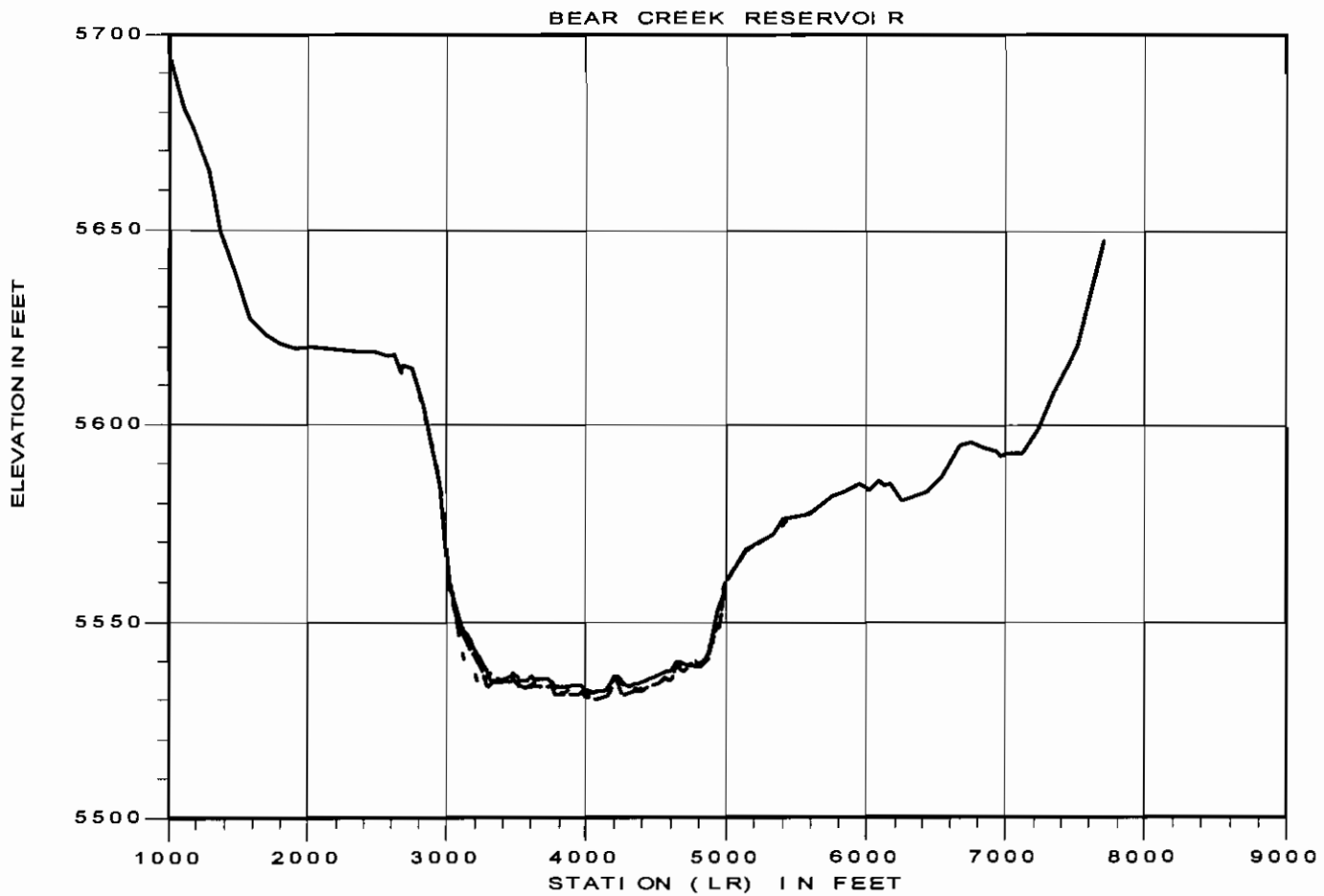

BEAR CREEK RESERVOI R
5700
5650
5600
5550
5500
ELEVATION IN FEET
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATI ON (LR) I N FEET
BC- 02 30OCT1980 5557. 9
BC- 02 17JUN1987 5559. 0
BC- 02 01APR1997 . 0

PLATE III-8

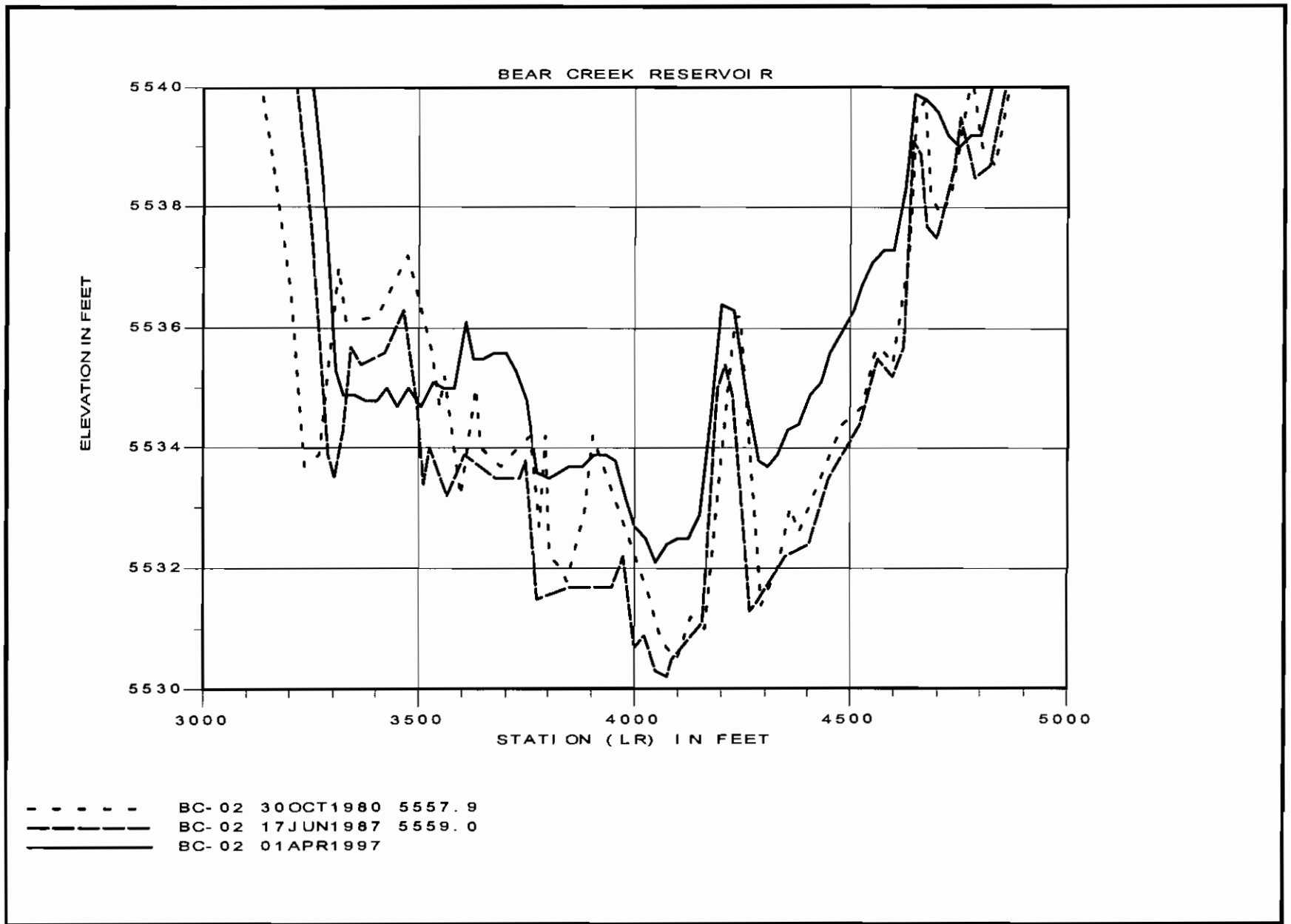

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5540
5538
5536
5534
5532
5530
3000
3500
4000
4500
5000
STATI ON (LR) I N FEET
BC-02 30OCT1980 5557.9
BC-02 17JUN1987 5559.0
BC-02 01APR1997

PLATE III-9

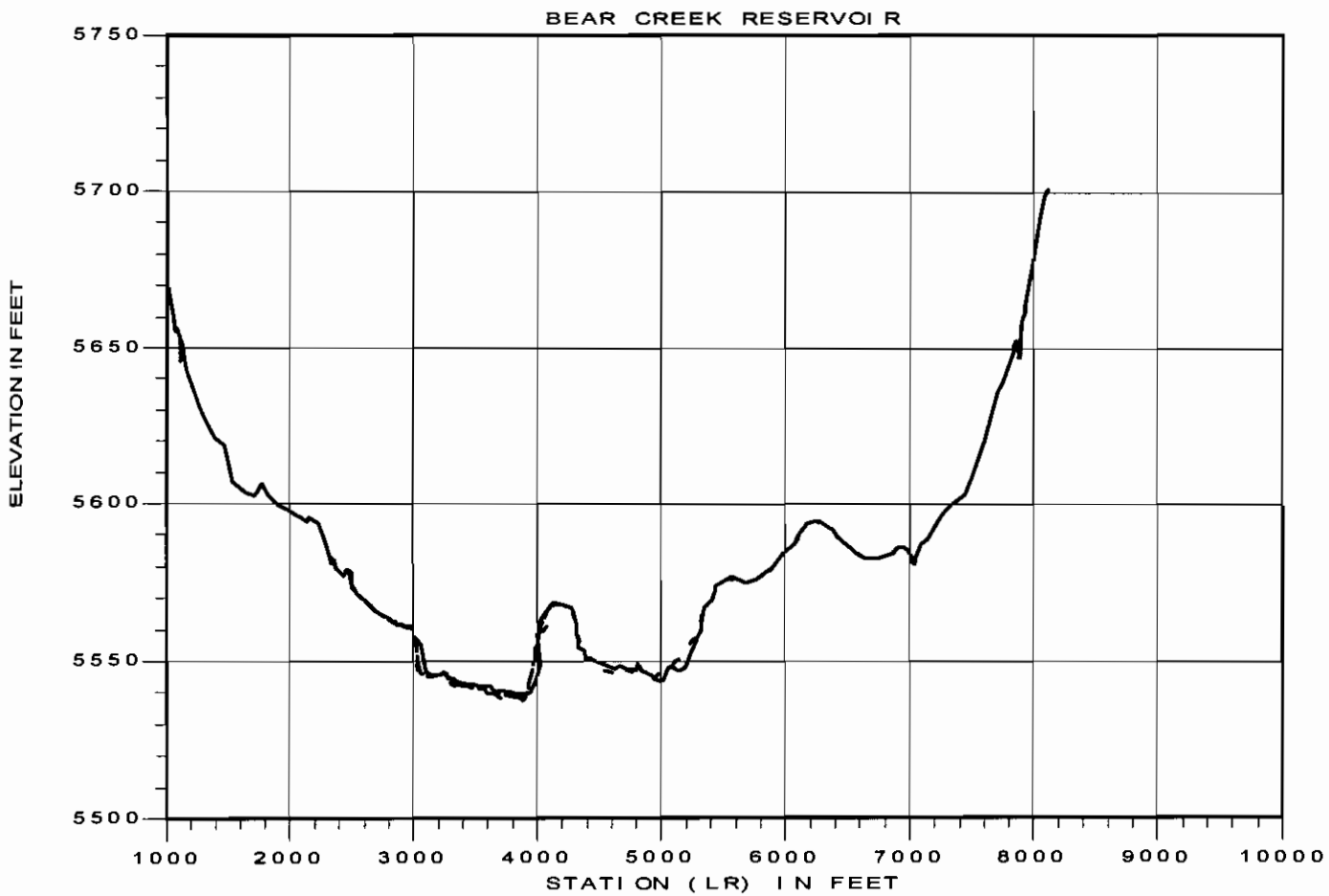

BEAR CREEK RESERVOI R
5750
5700
5650
5600
5550
5500
ELEVATION IN FEET
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
STATI ON (LR) I N FEET
BC- 03 30OCT1980 5558. 0
BC- 03 19JUN1987 5559. 2
BC- 03 01APR1997 . 0

PLATE III-10

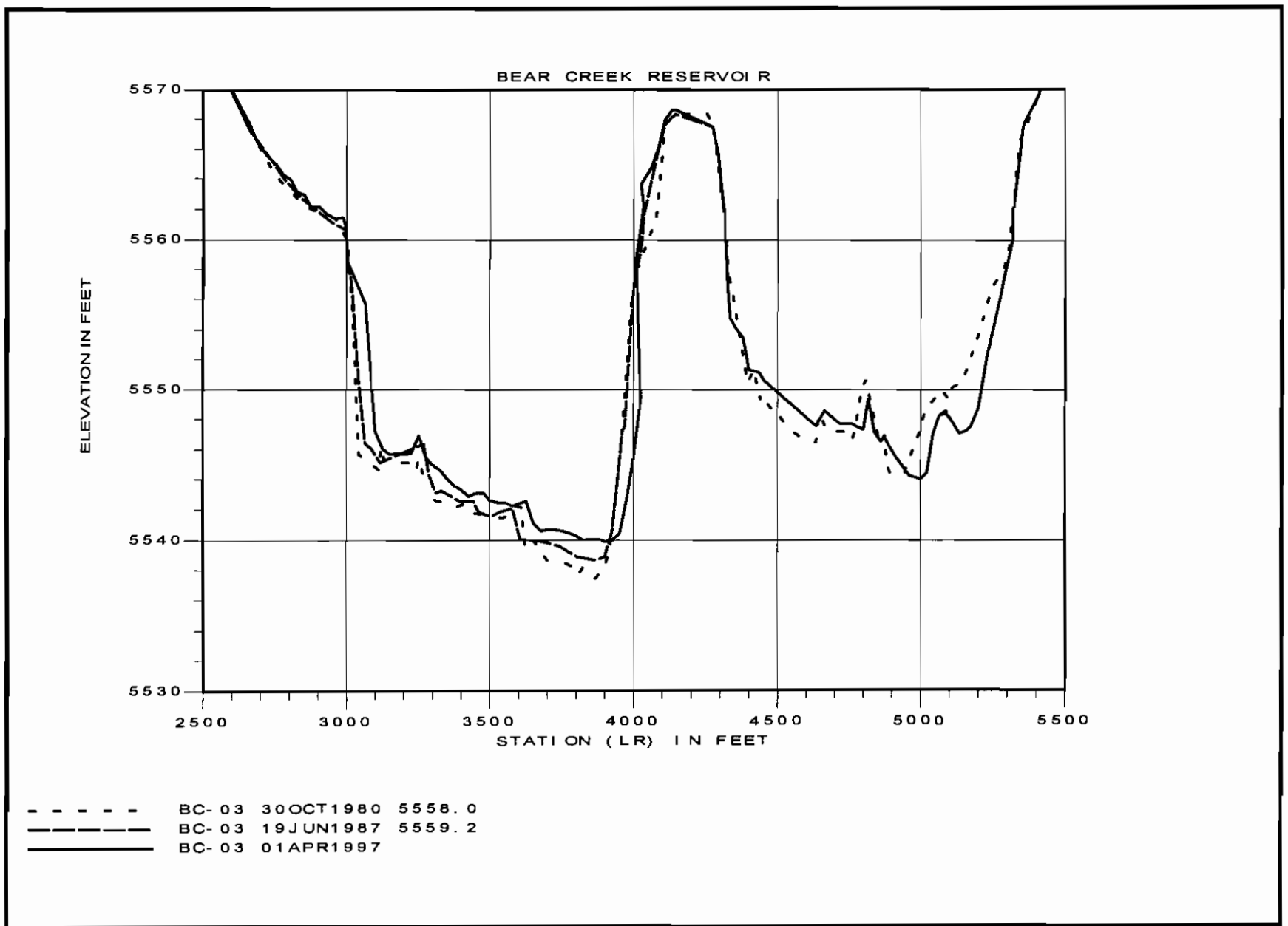

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5570
5560
5550
5540
5530
2500
3000
3500
4000
4500
5000
5500
STATI ON (LR) I N FEET
BC-03 30OCT1980 5558.0
BC-03 19JUN1987 5559.2
BC-03 01APR1997

PLATE III-11

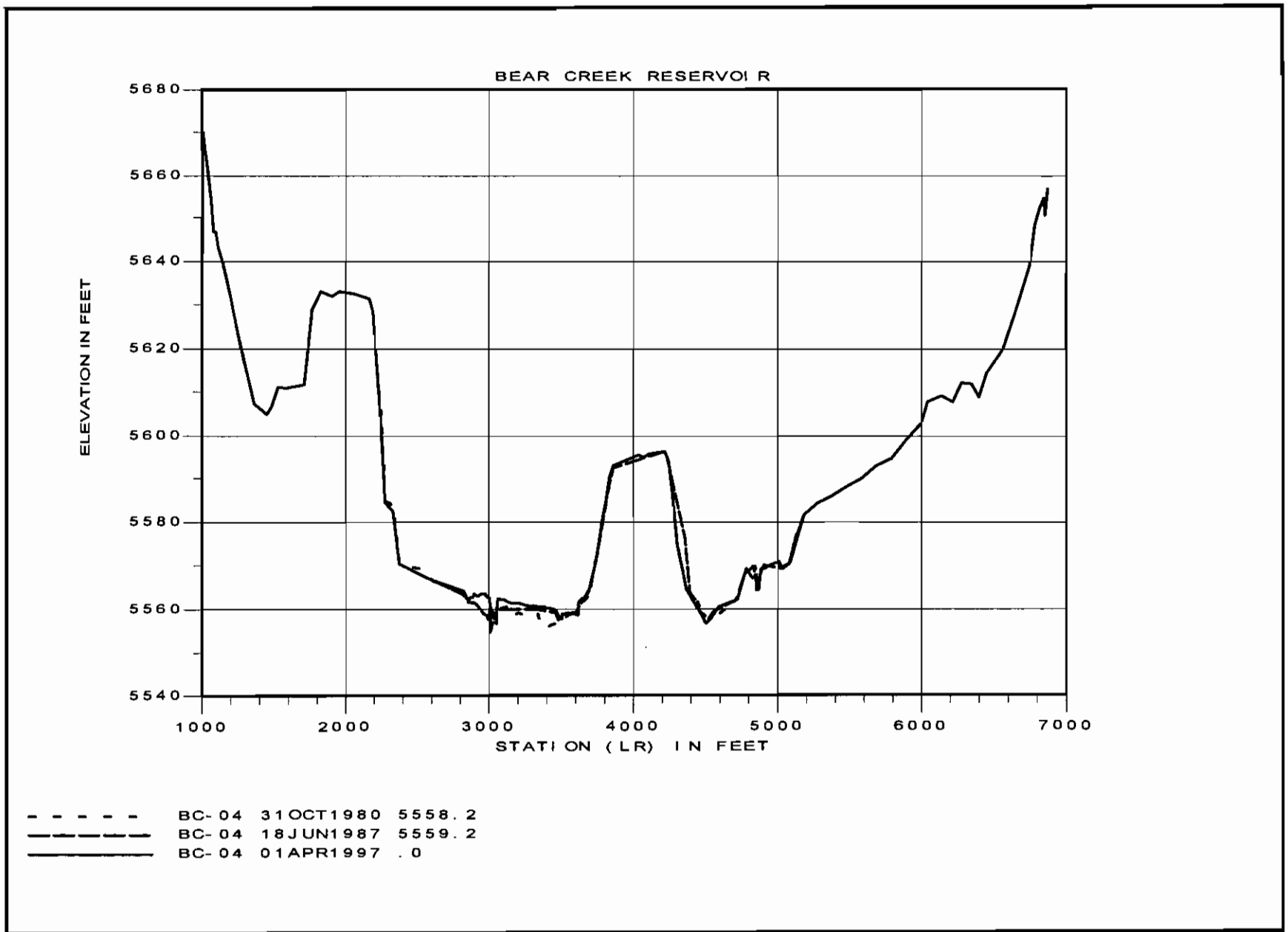

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5680
5660
5640
5620
5600
5580
5560
5540
1000
2000
3000
4000
5000
6000
7000
STATI ON (LR) I N FEET
BC-04 31OCT1980 5558.2
BC-04 18JUN1987 5559.2
BC-04 01APR1997 .0

PLATE III-12

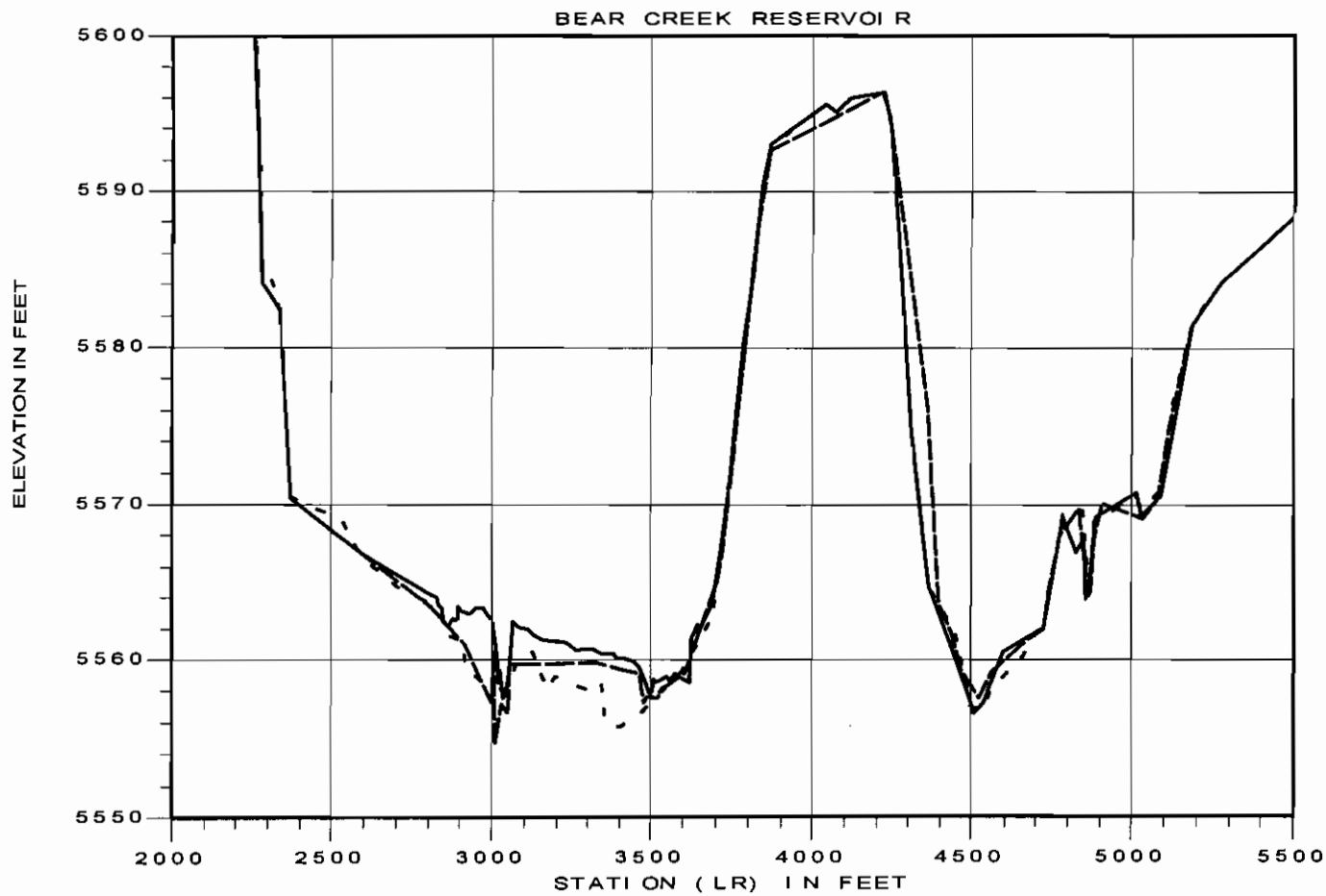

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5600
5590
5580
5570
5560
5550
2000
2500
3000
3500
4000
4500
5000
5500
STATI ON (LR) I N FEET
BC- 04 31OCT1980 5558. 2
BC- 04 18JUN1987 5559. 2
BC- 04 01APR1997

PLATE III-13

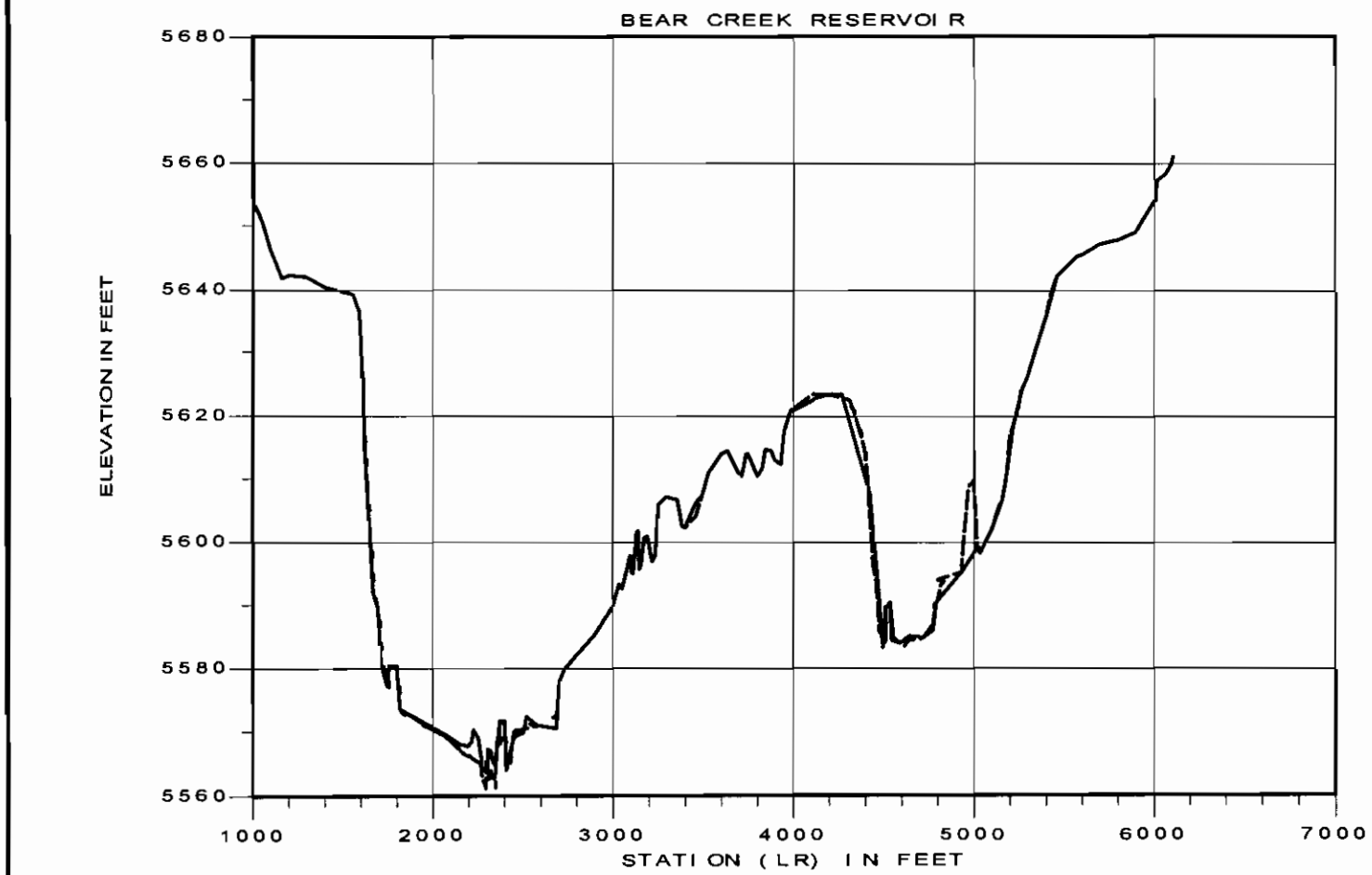

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5680
5660
5640
5620
5600
5580
5560
1000
2000
3000
4000
5000
6000
7000
STATI ON (LR) I N FEET
BC- 05 04NOV1980 5564. 4
BC- 05 19JUN1987 5563. 1
BC- 05 01APR1997 . 0

PLATE III-14

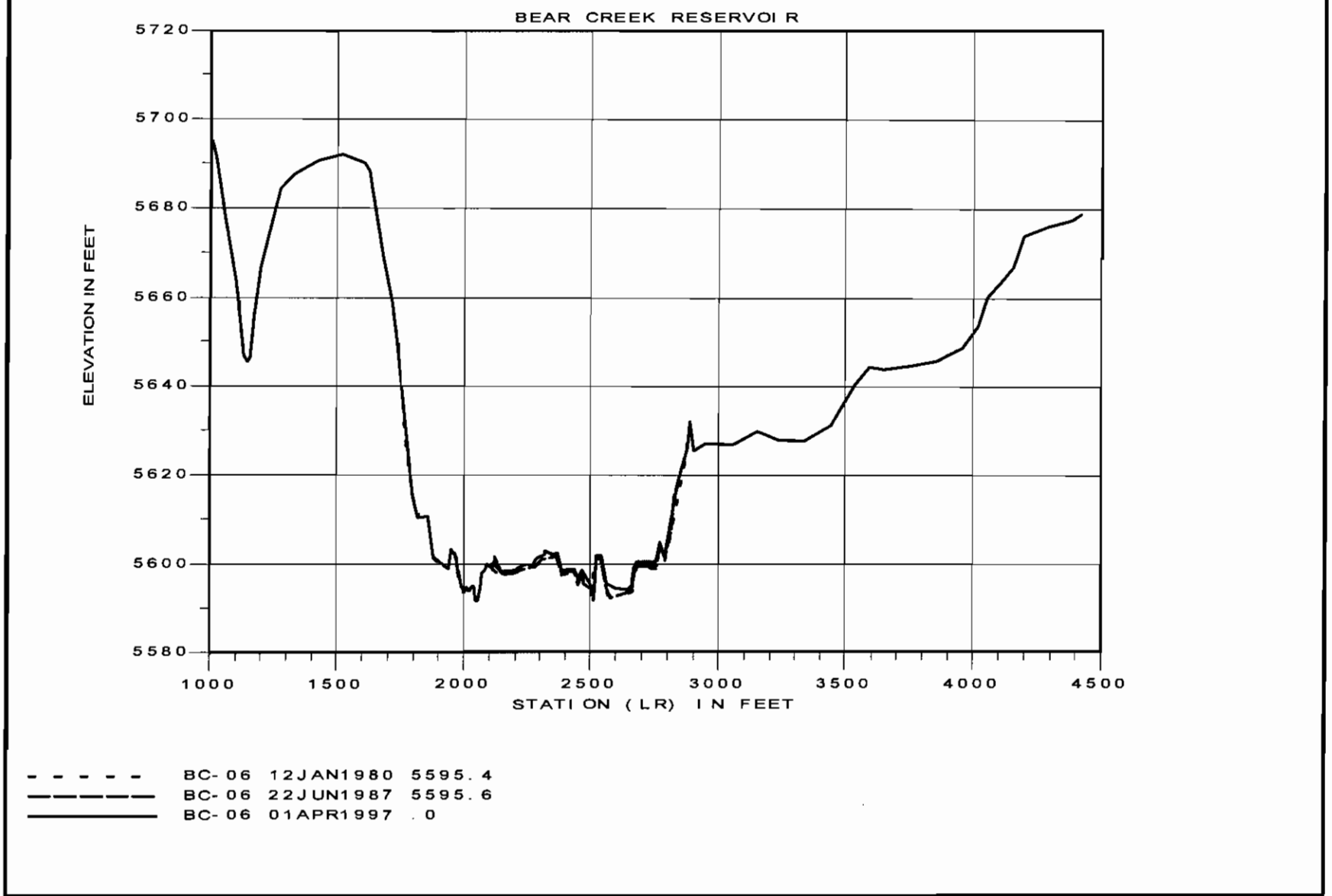

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5720
5700
5680
5660
5640
5620
5600
5580
1000
1500
2000
2500
3000
3500
4000
4500
STATI ON (LR) I N FEET
BC- 06 12JAN1980 5595. 4
BC- 06 22JUN1987 5595. 6
BC- 06 01APR1997 . 0

PLATE III-15

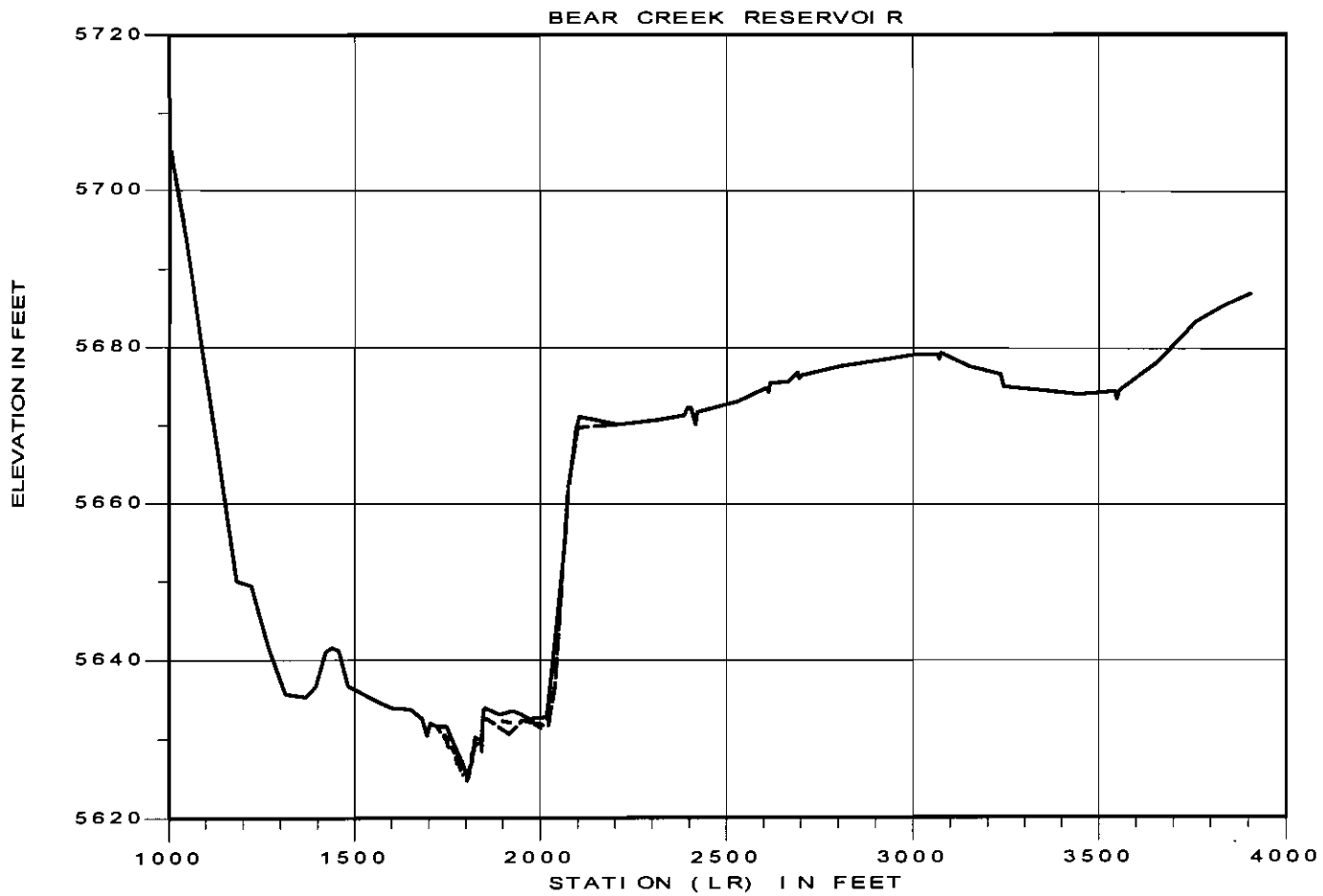

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5720
5700
5680
5660
5640
5620
1000
1500
2000
2500
3000
3500
4000
STATI ON (LR) I N FEET
BC-07 12JAN1980 5625.7
BC-07 23JUN1987 5626.6
BC-07 01APR1997 .0

PLATE III-16

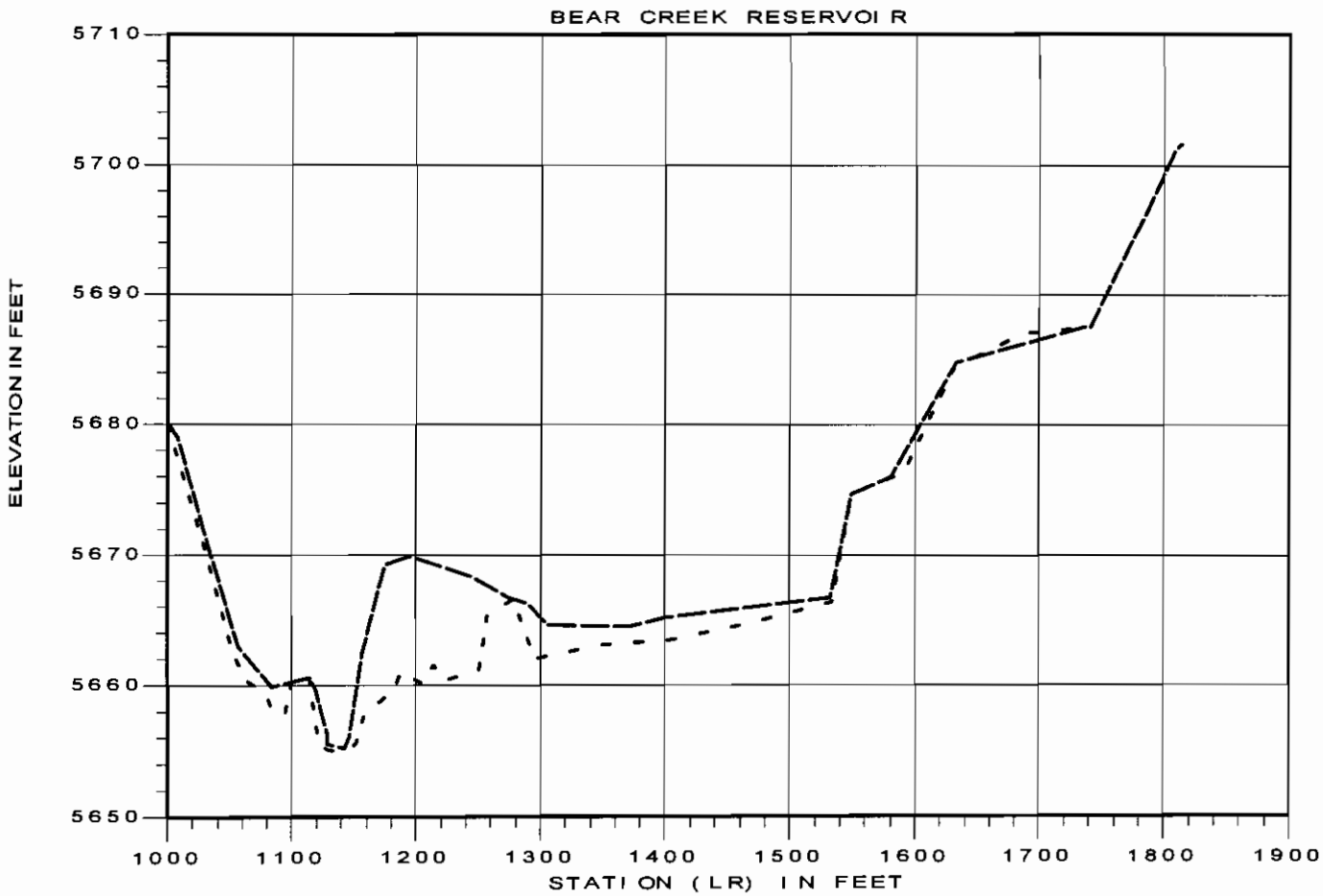

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5710
5700
5690
5680
5670
5660
5650
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
STATI ON (LR) I N FEET
BC- 08 12JAN1980 5655. 6
BC- 08 01APR1997 . 0

PLATE III-17

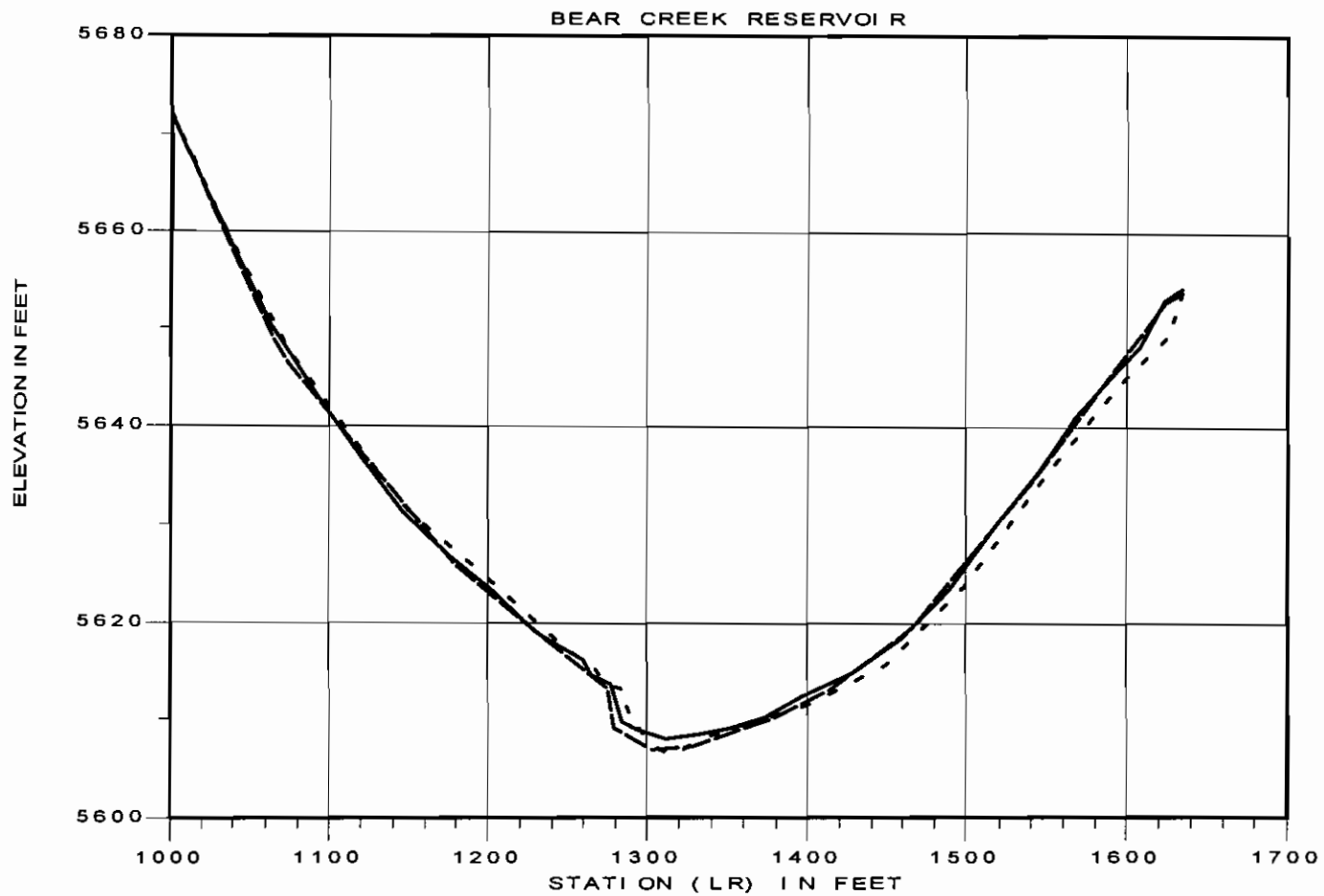

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5680
5660
5640
5620
5600
1000
1100
1200
1300
1400
1500
1600
1700
STATI ON (LR) I N FEET
BC- 09 15SEP1980 DRY
BC- 09 16JUN1987 DRY
BC- 09 01APR1997 . 0

PLATE III-18

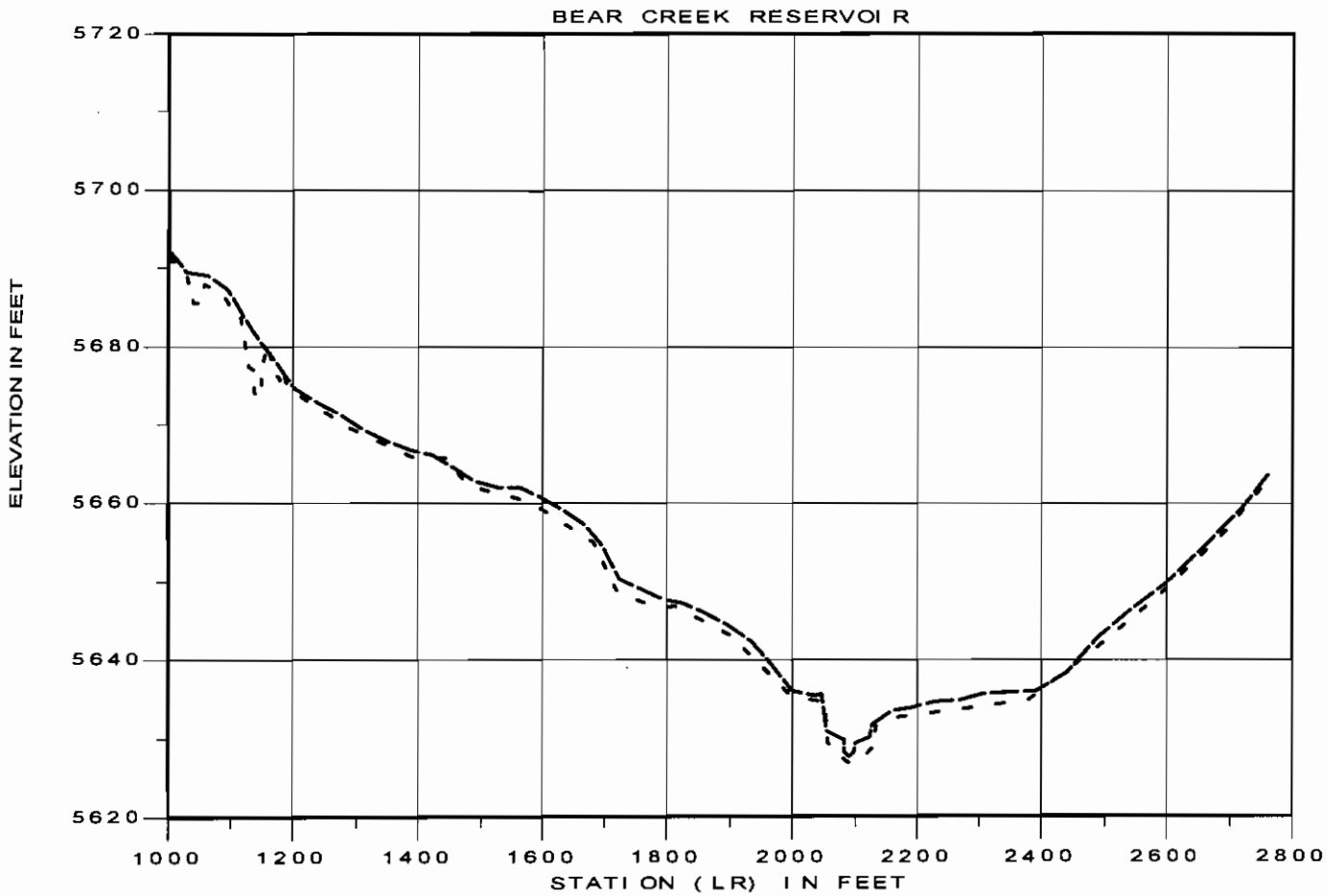

BEAR CREEK RESERVOI R
5720
5700
5680
5660
5640
5620
ELEVATION IN FEET
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
STATI ON (LR) IN FEET
BC-10 12JAN1980 5675.7
BC-10 01APR1997 .0

PLATE III-19

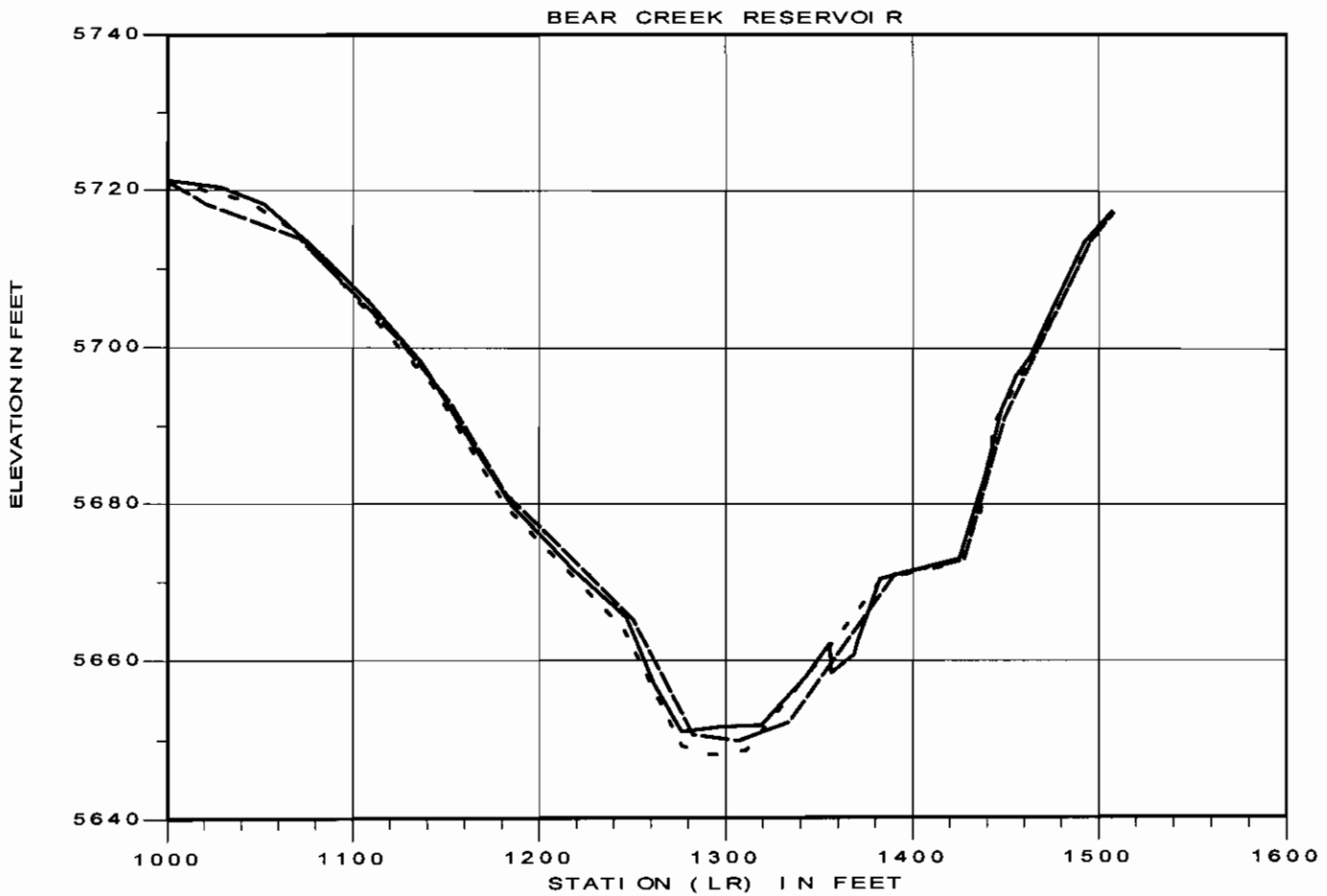

BEAR CREEK RESERVOI R
ELEVATION IN FEET
5740
5720
5700
5680
5660
5640
1000
1100
1200
1300
1400
1500
1600
STATI ON (LR) I N FEET
BC- 11 12JAN1980 DRY
BC- 11 16JUN1987 DRY
BC- 11 01APR1997 . 0

PLATE III-20

SECTION IV – CHATFIELD LAKE

BACKGROUND

Chatfield Lake is located on the South Platte River at the confluence of Plum Creek about eight miles upstream from downtown Denver, Colorado. The lake is located in portions of Arapahoe, Douglas and Jefferson Counties. A map of Chatfield Lake, including its sediment ranges, is shown in Plate IV-1.

Chatfield Dam is a rolled earth structure 13,136 feet long. The lake covers 1,429 acres at the multi-purpose pool elevation of 5,432.0 feet MSL. The originally estimated long term average annual depletion rate for the lake was 234 acre-feet with 59 acre-feet estimated to originate from the Plum Creek drainage basin.

Sedimentation Background

Plum Creek Tributary Arm

Plum Creek flows into the east arm of Chatfield Lake. The Plum Creek basin drains a total of 324 square miles. In the late 1980's and early 1990's Plum Creek experienced a large influx of sediment causing excess aggradation and delta buildup in the Plum Creek tributary arm of Chatfield Lake. This aggradation changed the location of the channel endangering the recreational facilities in the Plum Creek arm of Chatfield Lake. The aggradation has also decreased the flood conveyance capacity of the Titan Road Bridge, located approximately 3 miles upstream of the lake's multipurpose pool elevation. A 1989 internal draft report stated that there was only three (3) feet of clearance at the Titan Road Bridge in 1989. Several studies were conducted around the early 1990's to determine the future of the Titan Road Bridge.

Since 1990 the Titan Road Bridge has been replaced and a grade control structure has been built upstream of the bridge. The Plum Creek arm continues to be the source of the majority of the sediment entering Chatfield Lake. One other source of sediment upstream along Plum Creek is a currently operating gravel pit.

SURFACE AREA

Plate IV-2 is a plot of elevation versus surface area for all survey years. Table IV-1 shows reservoir surface area by elevation. The surface area at the top of the multipurpose pool (5432.0 feet MSL) at Chatfield Lake decreased by 15 acres between 1977 and 1998. Shoreline erosion increases the surface area while delta growth decreases the surface area of the lake. The decrease in this case is likely due to delta growth at the multipurpose level.

CAPACITY CHANGES

Plate IV-3 is a plot of the elevation versus reservoir capacity curve for all survey years. Tables IV-2 and IV-3 present reservoir capacity by storage zone and a summary of capacity changes, respectively. Total storage (elevation 5377.0 – 5521.6 feet MSL) decreased 702 acre-feet (0.2%) between 1977 and 1998. Storage in the flood control zone (elevation 5432.0 – 5550.0 feet MSL) decreased 77 acre-feet (0.04%) between 1977 and 1998. Storage in the multipurpose zone (elevation 5385.0 – 5432.0 feet MSL) decreased 642 acre-feet (2.29%) between 1977 and 1998. Storage in the inactive zone (elevation 5377.0 – 5385.0 feet MSL) decreased 6 acre-feet between 1977 and 1998.

Table IV-3 presents the sediment depletion rates up to the multipurpose pool zone (elevation 5377.0 – 5432.0 feet MSL). The total storage depletion rate between survey years 1977 and 1998 is 33.4 acre-feet per year, while the storage depletion rate up to the multipurpose pool level is 30.9 acre-feet per year. The original projected total storage depletion rate was approximately 234 acre-feet per year.

PROFILE PLOTS

Profile plots listed as Plates IV-4 and IV-5 compare the average reservoir bed elevations during each of the survey years. The largest change occurred in the vicinity of range CH-04 and CH-05 where the thalweg increased by over 7 feet since 1977.

SEDIMENT VOLUME

Plate IV-6 represents the change in sediment volume between 1977 and 1998. The quantity of total sediment that entered the reservoir is shown in Table VI-2. The total sediment change and the depletion rate for the range of years is shown below

Survey Period	Total Volume Depletion (AF)	Depletion Rate (AF/YR)
1977-1991	445	31.8
1991-1998	257	36.7
1977-1998	702	33.4

AREA - CAPACITY TABLES

Area - capacity tables computed at 1.0-foot increments are located in Appendix C.

CROSS SECTION DATA

Cross-sectional plots are shown on Plates IV-7 through IV-43.

ENG FORM 1787 – RESERVOIR SEDIMENT DATA SUMMARY

ENG FORM 1787, "Reservoir Sedimentation Data Summary". Is presented in Appendix E. The purpose of this form is to provide a means for the uniform documentation of pertinent Cherry Creek Lake sedimentation data.

TABLE IV-1.
RESERVOIR SURFACE AREA BY ELEVATION
CHATFIELD LAKE NEAR DENVER, COLORADO

RESERVOIR ZONE & ELEVATION		SURFACE AREA (acres)		
		1977	1991	1998
Flood Control Pool	5500.0 ft. MSL	4774	4778	4779
Multipurpose Pool	5432.0 ft. MSL	1444	1438	1429

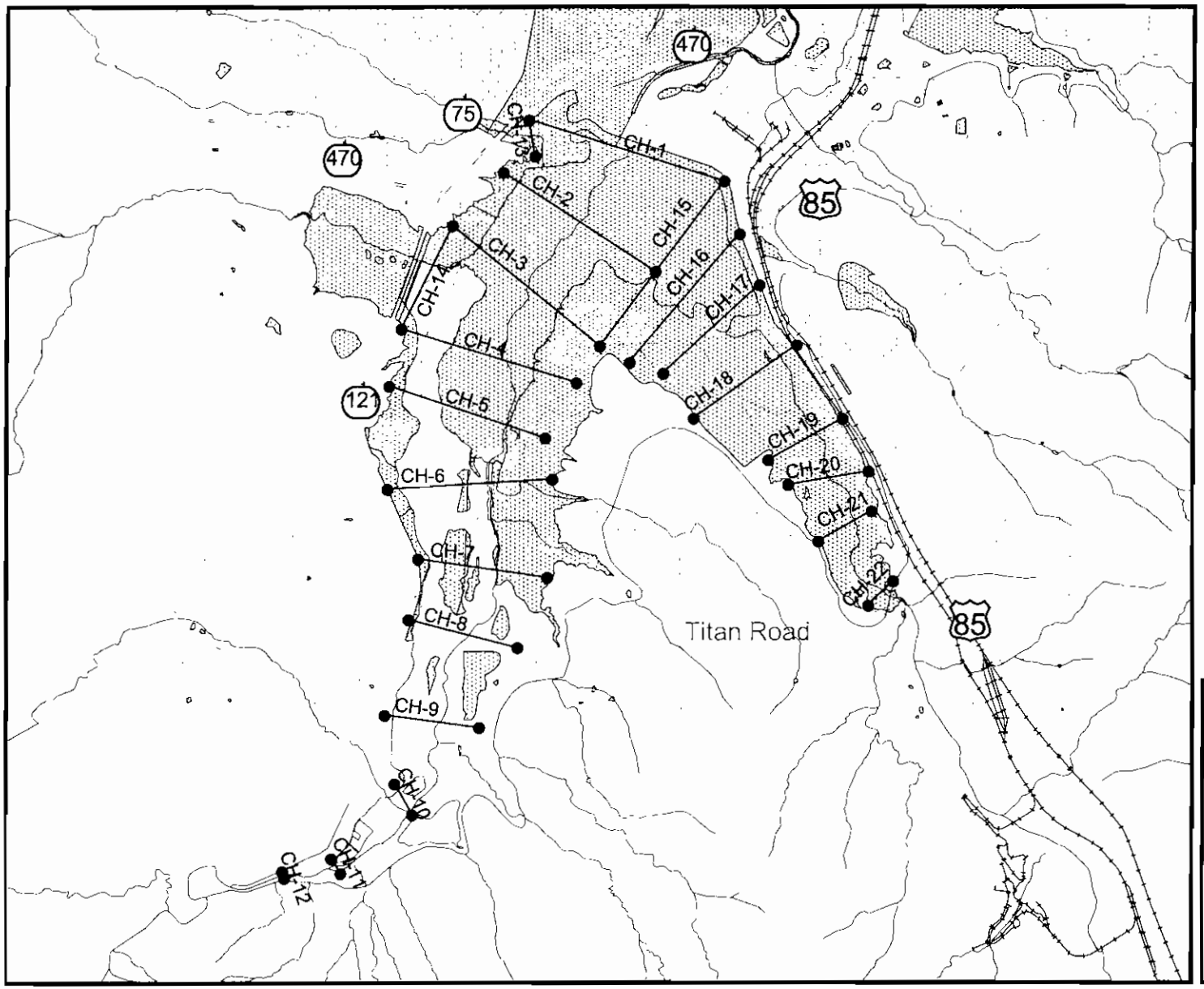
TABLE VI-2.
RESERVOIR STORAGE CAPACITY BY STORAGE ZONE FOR CHATFIELD LAKE

STORAGE ZONE	RESERVOIR CAPACITY acre-feet			CHANGE IN CAPACITY acre-feet			DEPLETION RATE/YEAR acre-feet/yr
	1977	1991	1998	77-91	91-98	77-98	77-98
Surcharge 5500.0-5521.6	116446	116487	116469	41	-18	23	-1.1
Flood Control 5432.0-5500.0	206856	206822	206779	-34	-43	-77	3.7
Multipurpose 5385.0-5432.0	28047	27596	27405	-451	-191	-642	30.6
Inactive 5377.0-5385.0	29	28	23	-1	-5	-6	0.3
GROSS STORAGE 5377.0-5521.6	351378	350933	350676	-445	-257	-702	33.4

TABLE IV-3.
SEDIMENT DEPLETION RATES
UP TO THE MULTIPURPOSE POOL ZONE (EL. 5377.0-5432.0 FT. MSL)
CHATFIELD LAKE NEAR DENVER, COLORADO

Survey Year	No. of Years Between Surveys	Total Capacity (AF)	Capacity Lost (AF)	Depletion Rate Between Surveys (AF/Year)	Depletion Rate Since 1977 (AF/Year)
1977		28076			0.0
	14		452	32.3	
1991		27624			32.3
	7		196	28.0	
1998		27428			30.9

Chatfield Lake Sedimentation Ranges



N

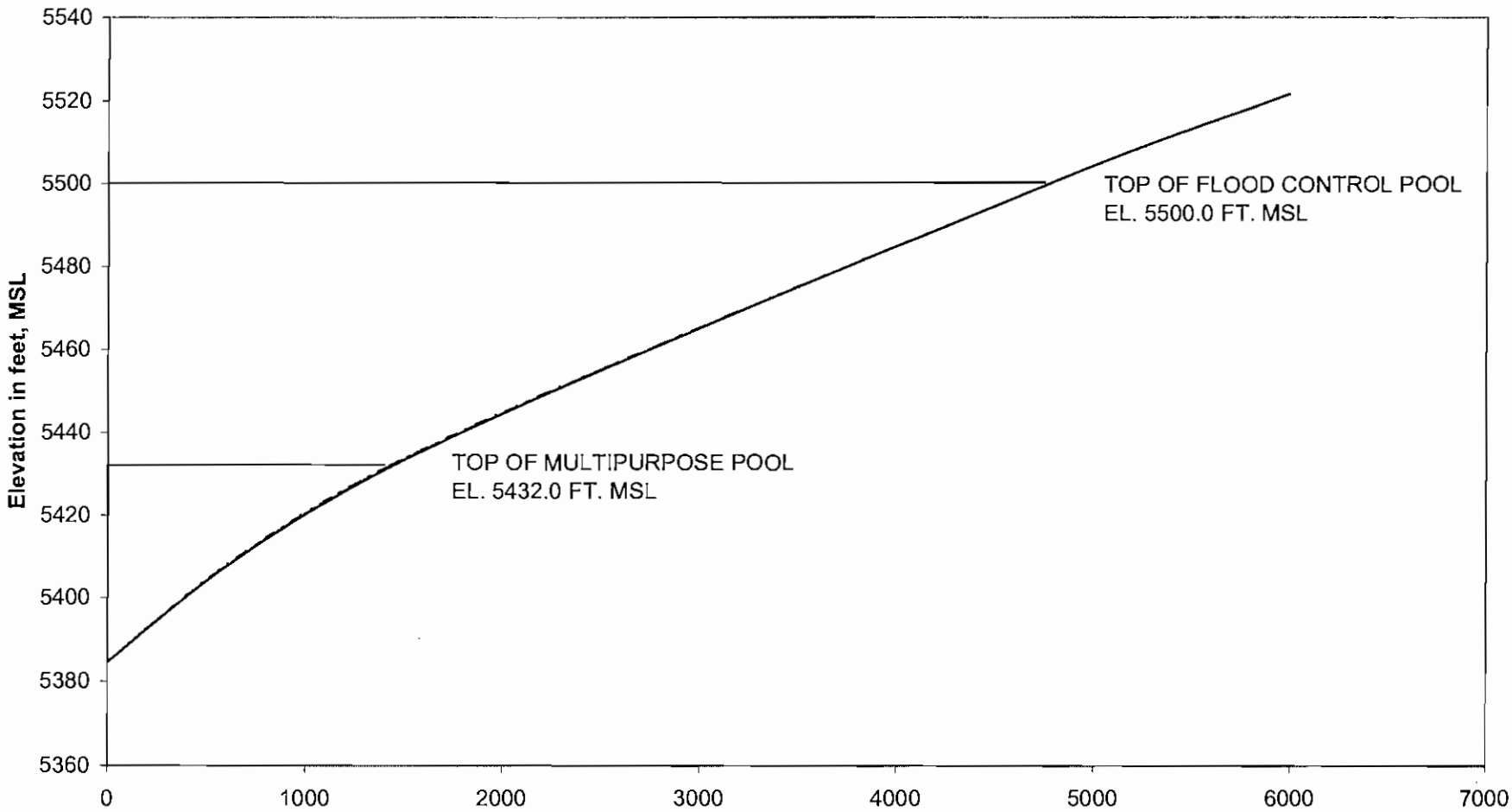
LEGEND

- Range Monuments
- Rivers & Lakes
- Sediment Range Line
- Railroads
- Roads
- Chatfield Lake

1 0 1 2 3 4 5 Miles

Plate IV-1

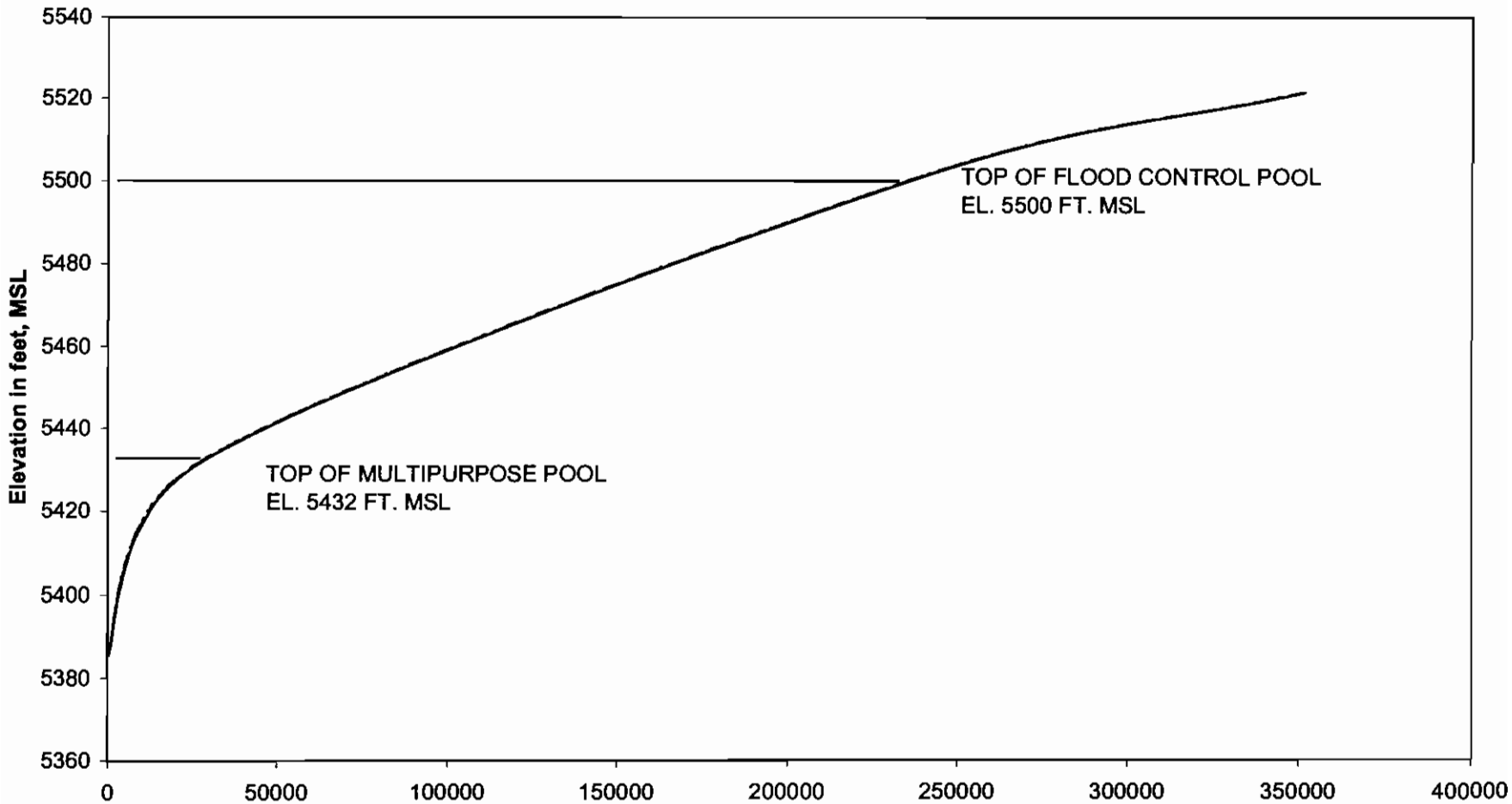
Chatfield Lake
Elevation vs. Surface Area for All Survey Years



Prepared by _____
Reviewed by _____

PLATE IV-2

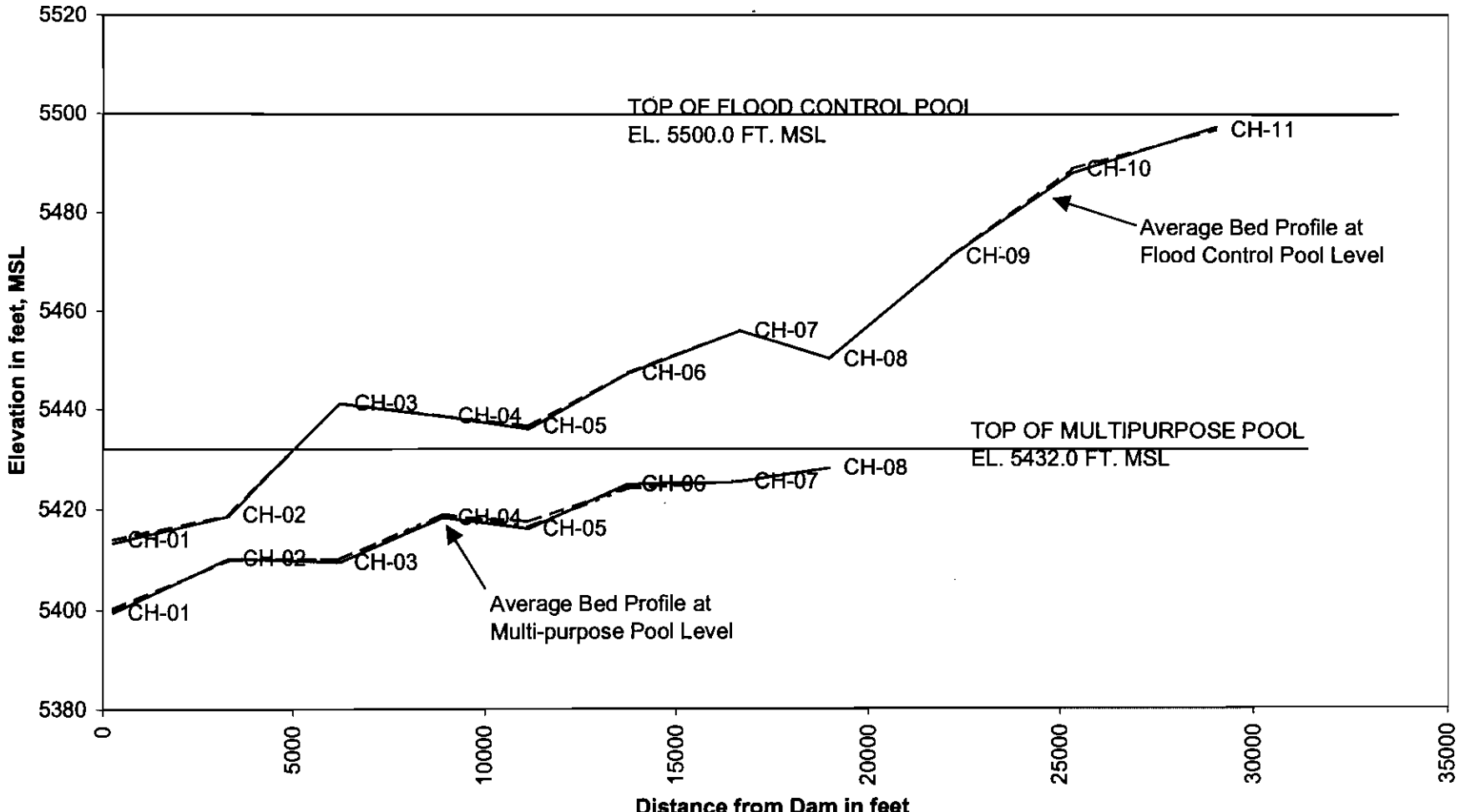
Chatfield Lake
Elevation vs. Reservoir Capacity for All Survey Years



Prepared by _____
Reviewed by _____

PLATE IV-3

Chatfield Lake-South Platte River Arm
Average Bed Profile for All Survey Years



Prepared by _____
Reviewed by _____

PLATE IV-4

Chatfield Lake Change in Capacity 1977-1998

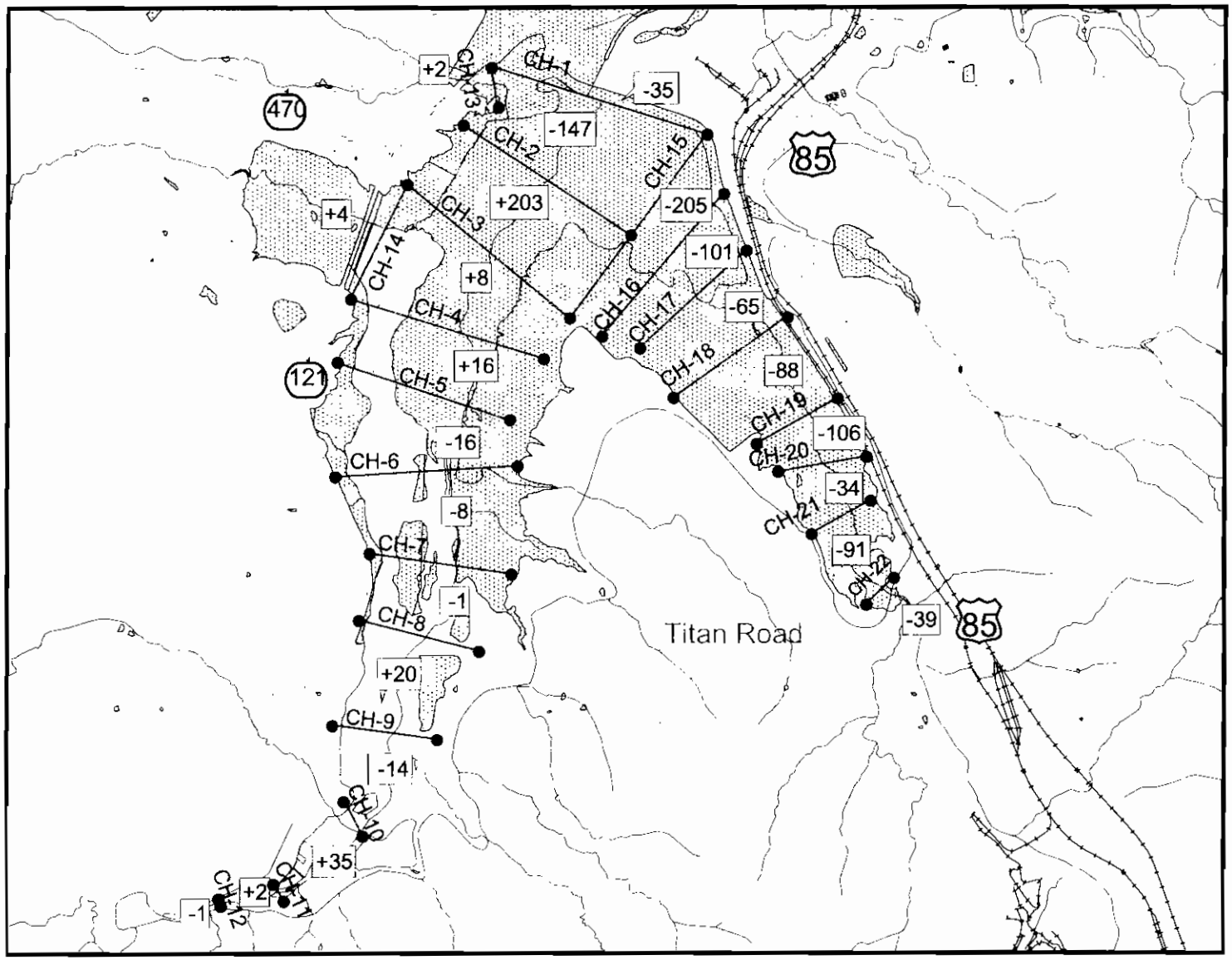
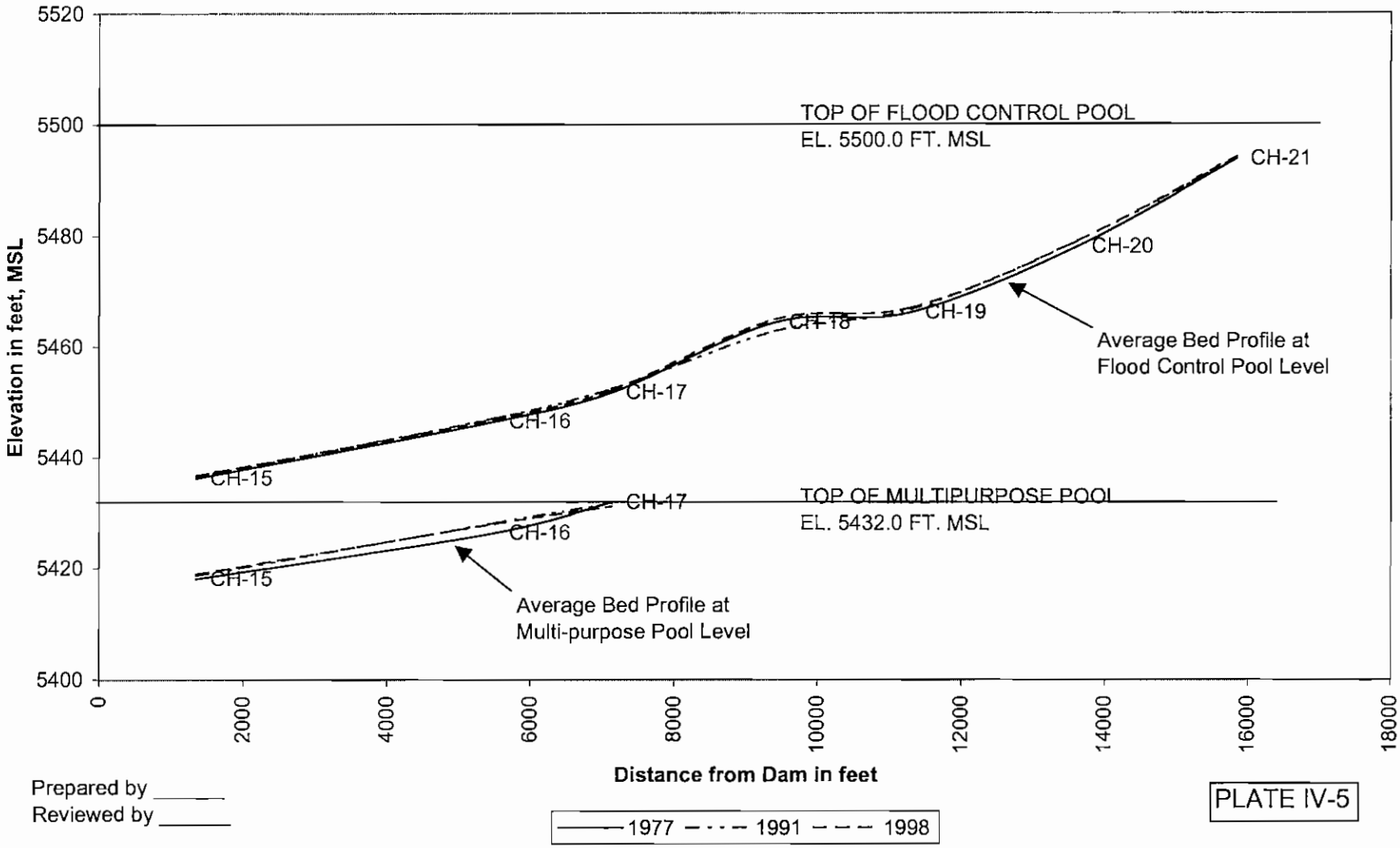


Plate IV-6

Chatfield Lake-Plum Creek Arm
Average Bed Profile for All Survey Years



Prepared by _____
Reviewed by _____

PLATE IV-5

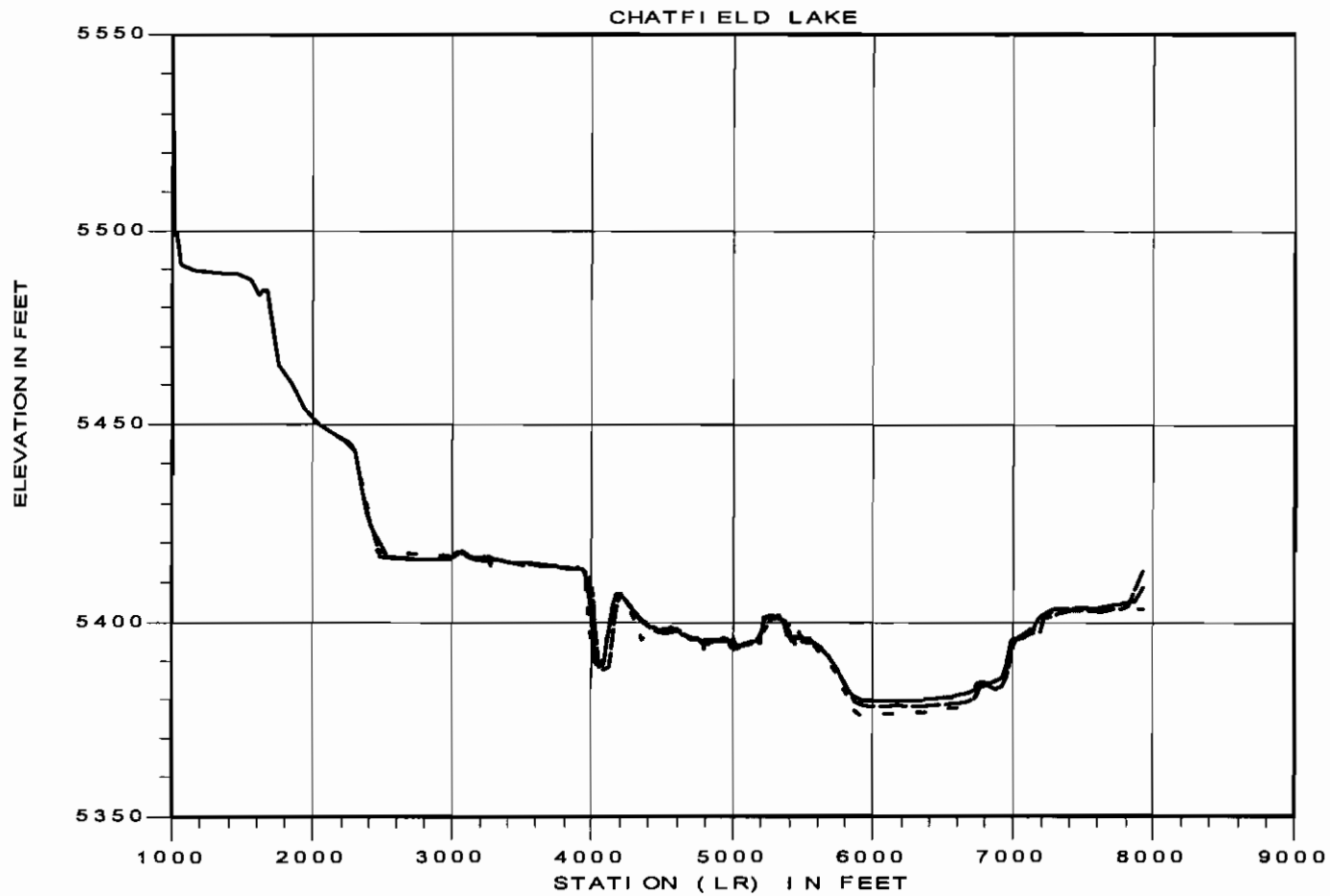

CHATFIELD LAKE
5550
5500
5450
5400
5350
ELEVATION IN FEET
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATION (LR) IN FEET
CH-01 05MAY1977 5418.0
CH-01 22MAY1991 5427.3
CH-01 06NOV1998 5424.3

PLATE IV-7

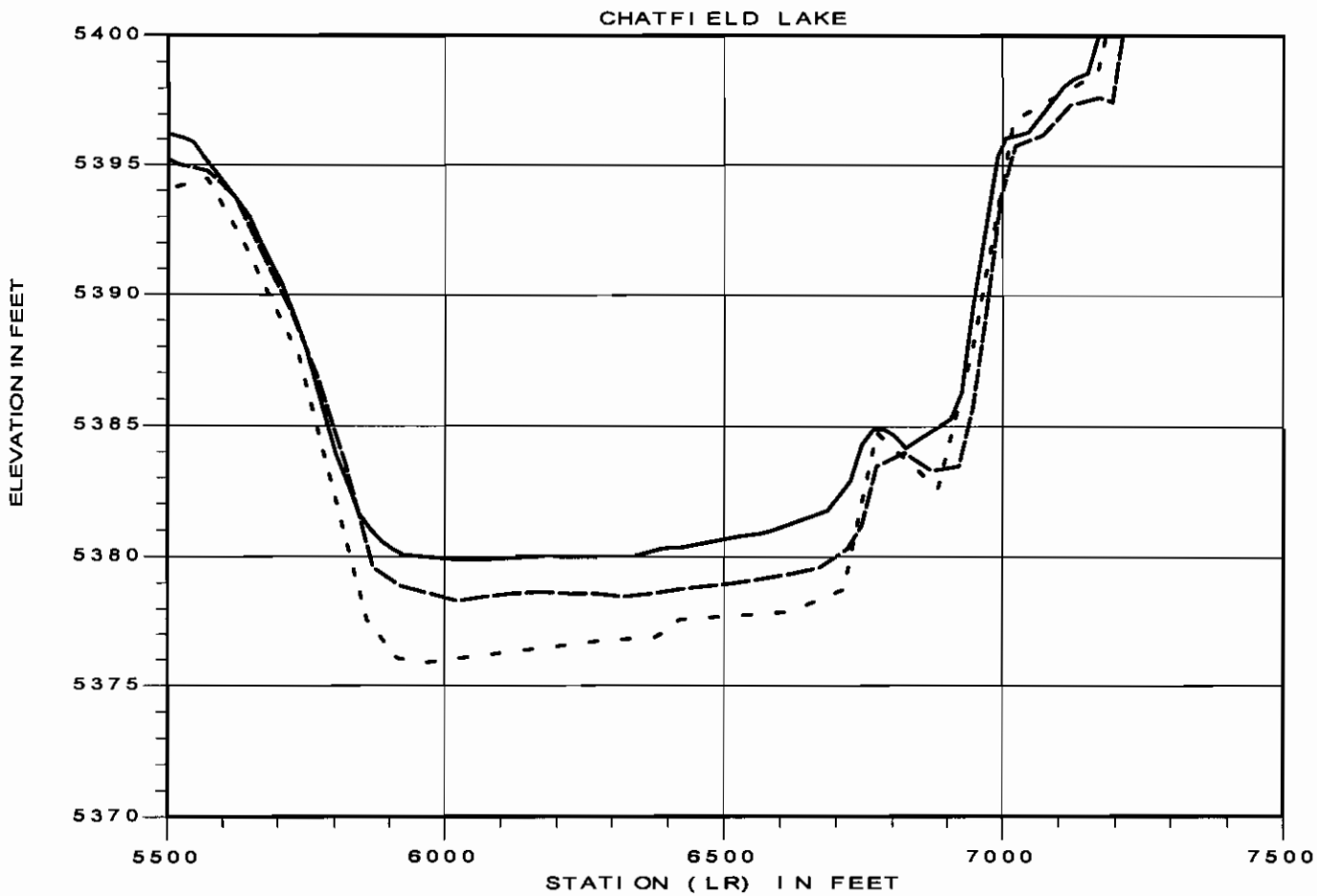

CHATFIELD LAKE
5400
5395
5390
5385
5380
5375
5370
ELEVATION IN FEET
5500
6000
6500
7000
7500
STATION (LR) IN FEET
CH-01 05MAY1977 5418.0
CH-01 22MAY1991 5427.3
CH-01 06NOV1998 5424.3

PLATE IV-8

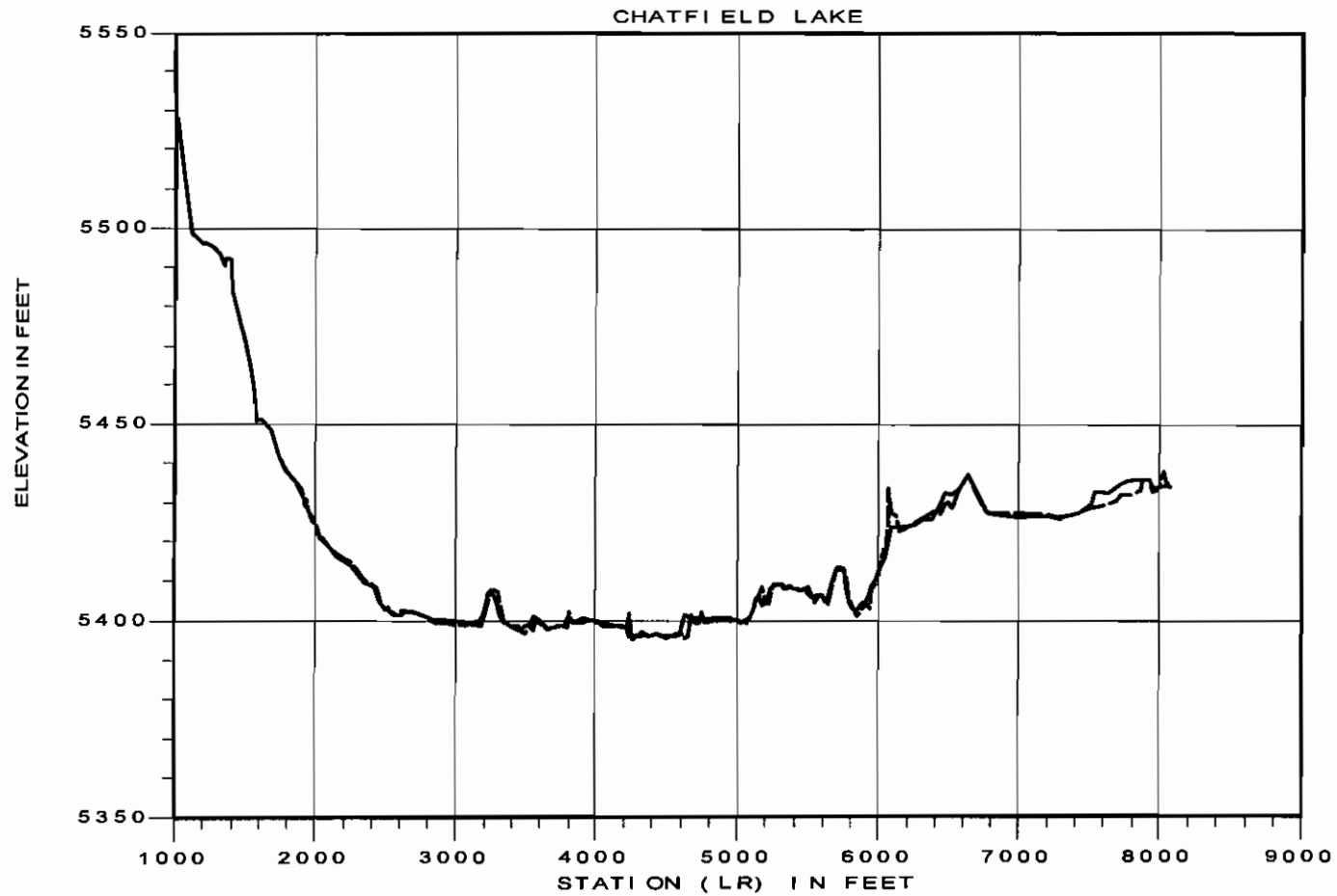

CHATFIELD LAKE
ELEVATION IN FEET
5550
5500
5450
5400
5350
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATION (LR) IN FEET
CH-02 04MAY1977 5416.3
CH-02 04MAY1991 5416.3
CH-02 06NOV1998 5424.4

PLATE IV-9

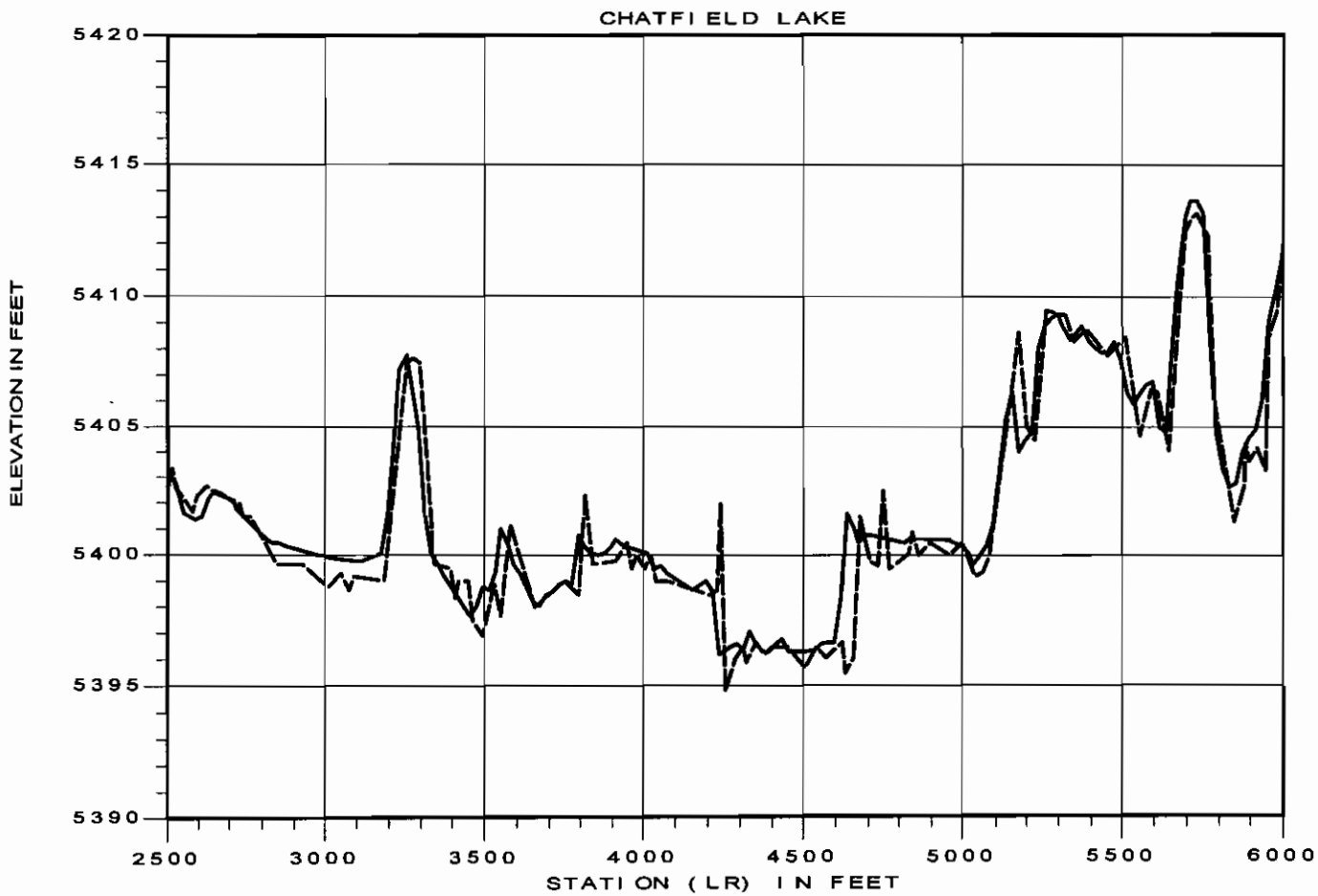

CHATFI ELD LAKE
5420
5415
5410
5405
5400
5395
5390
ELEVATION IN FEET
2500
3000
3500
4000
4500
5000
5500
6000
STATI ON (LR) I N FEET
CH- 02 04MAY1977 5416. 3
CH- 02 04MAY1991 5416. 3
CH- 02 06NOV1998 5424. 4

PLATE IV-10

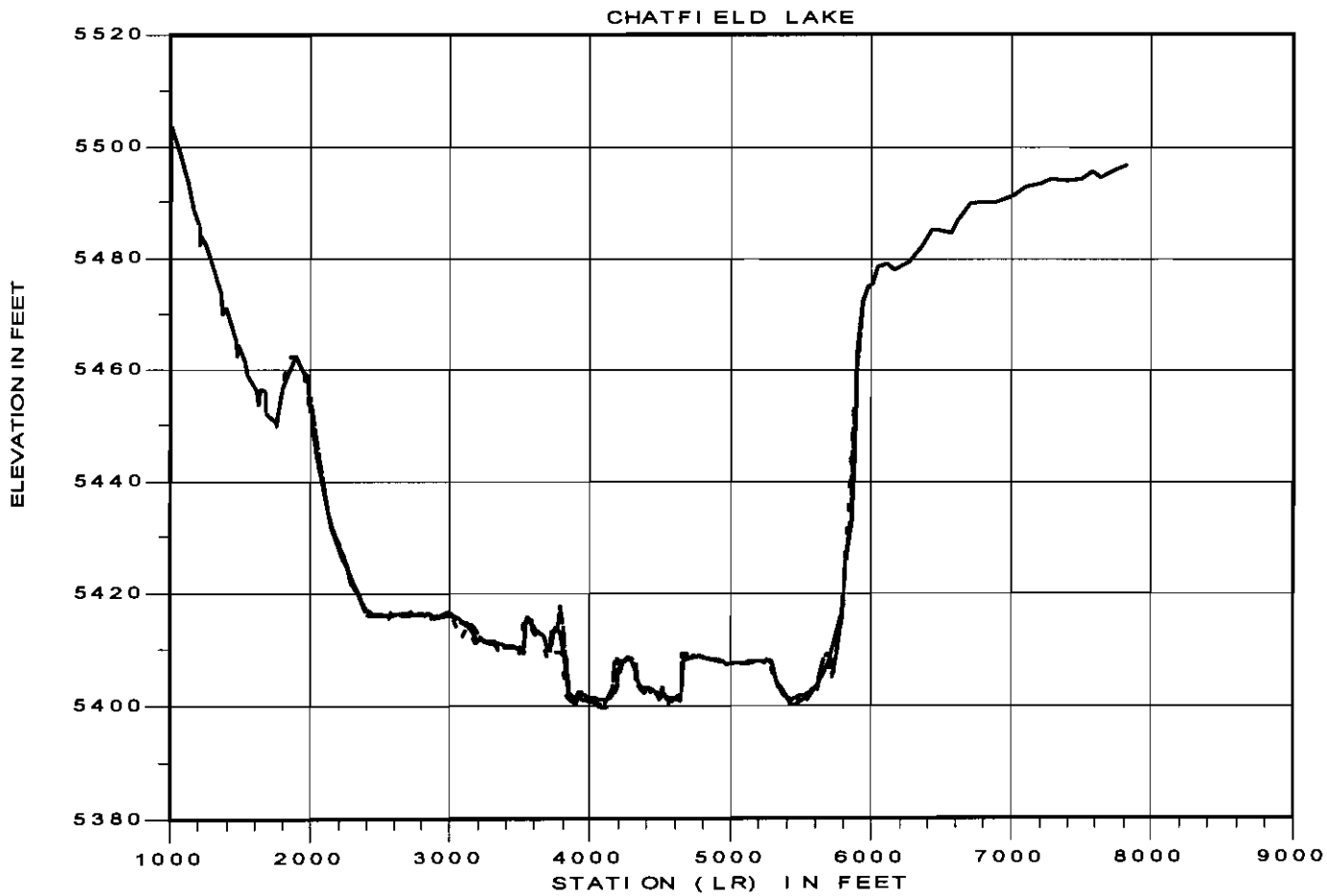

CHATFIELD LAKE
ELEVATION IN FEET
5520
5500
5480
5460
5440
5420
5400
5380
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATION (LR) IN FEET
CH-03 04MAY1977 5417.8
CH-03 22MAY1991 5427.3
CH-03 05NOV1998 5424.3

PLATE IV-11

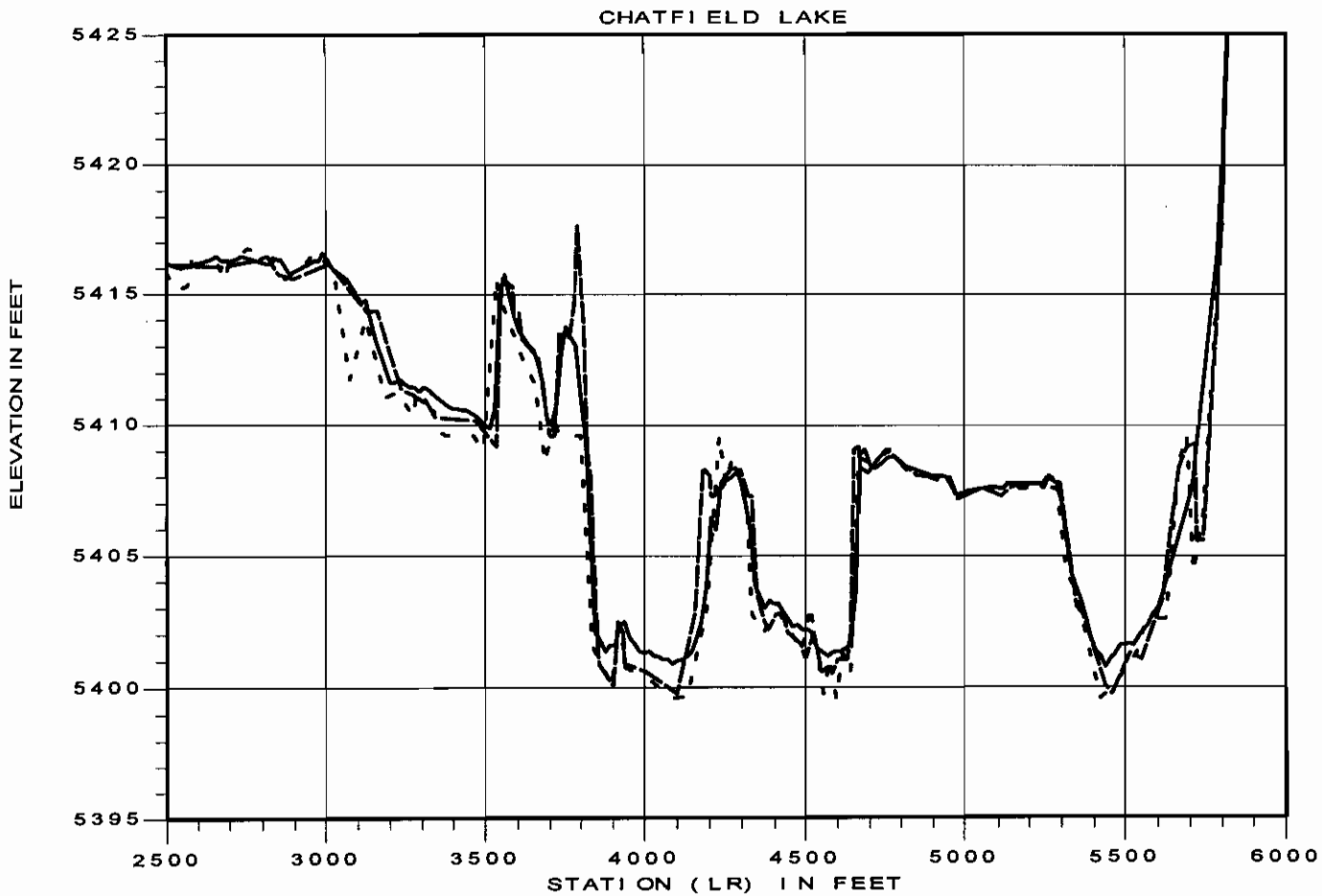

CHATFI ELD LAKE
5425
5420
5415
5410
5405
5400
5395
ELEVATION IN FEET
2500
3000
3500
4000
4500
5000
5500
6000
STATI ON (LR) I N FEET
CH- 03 04MAY1977 5417. 8
CH- 03 22MAY1991 5427. 3
CH- 03 05NOV1998 5424. 3

PLATE IV-12

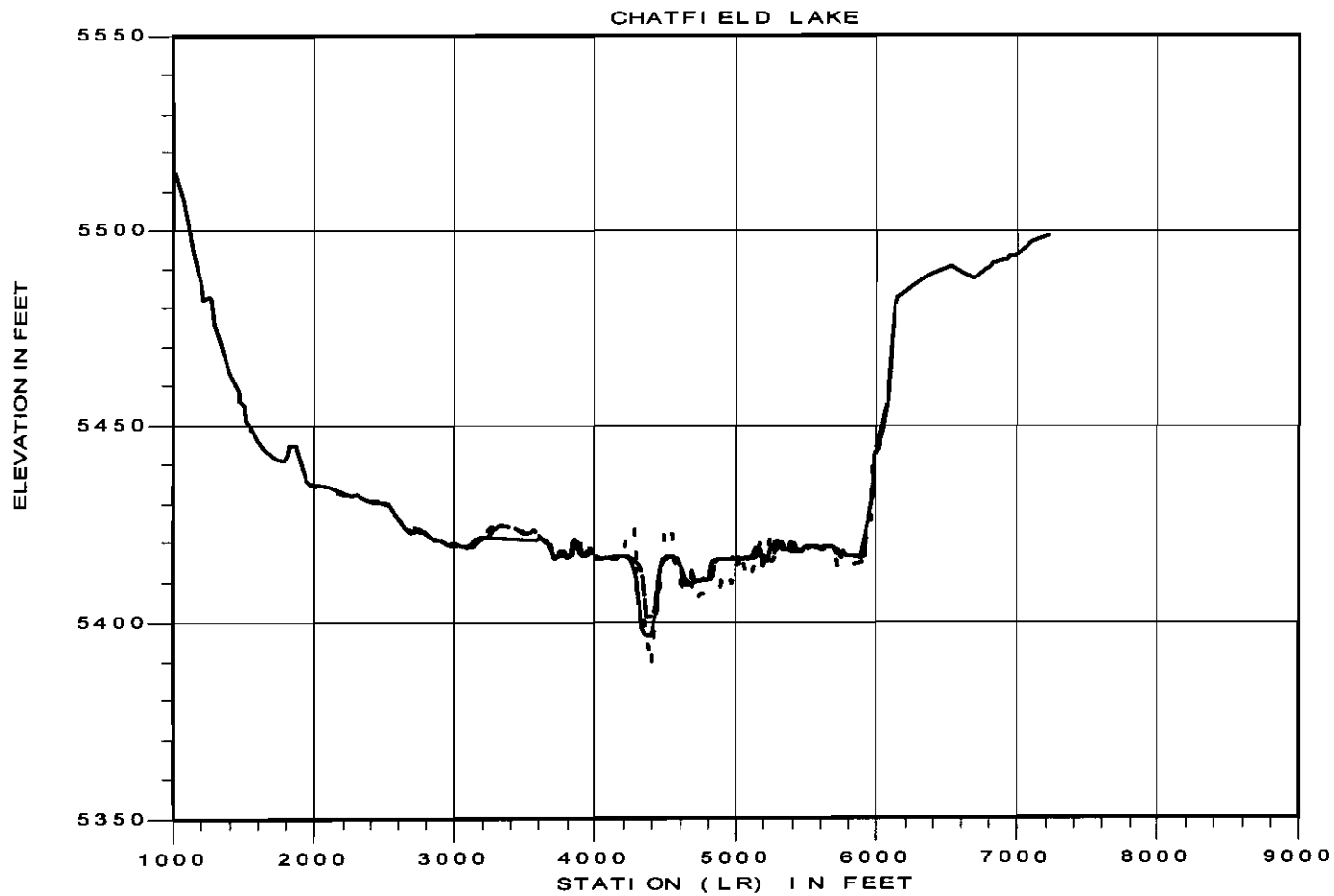

CHATFIELD LAKE
5550
5500
5450
5400
5350
ELEVATION IN FEET
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATION (LR) IN FEET
CH-04 03MAY1977 5431.1
CH-04 22MAY1991 5427.3
CH-04 05NOV1998 5424.1

PLATE IV-13

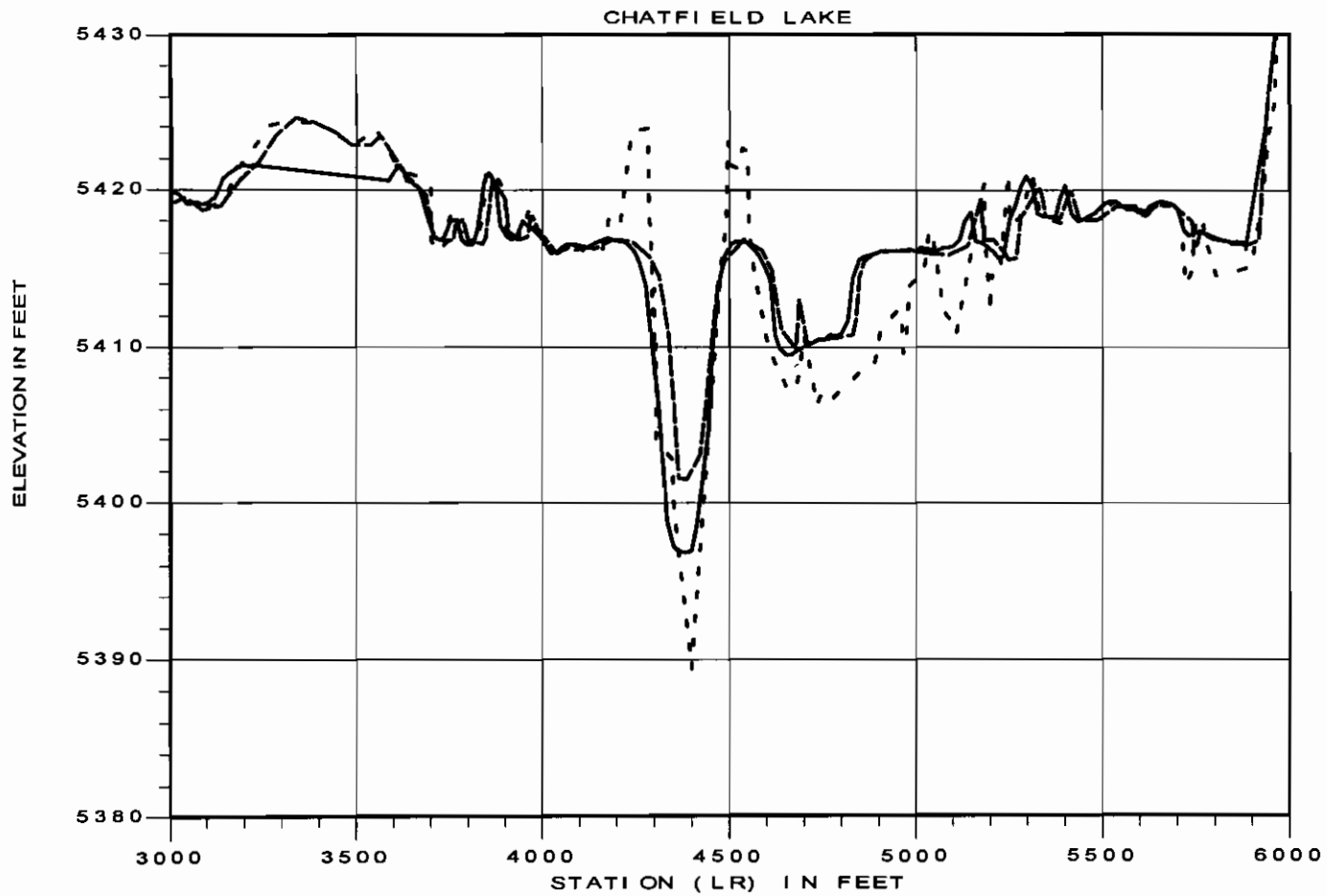

CHATFIELD LAKE
5430
5420
5410
5400
5390
5380
ELEVATION IN FEET
3000
3500
4000
4500
5000
5500
6000
STATION (LR) IN FEET
CH-04 03MAY1977 5431.1
CH-04 22MAY1991 5427.3
CH-04 05NOV1998 5424.1

PLATE IV-14

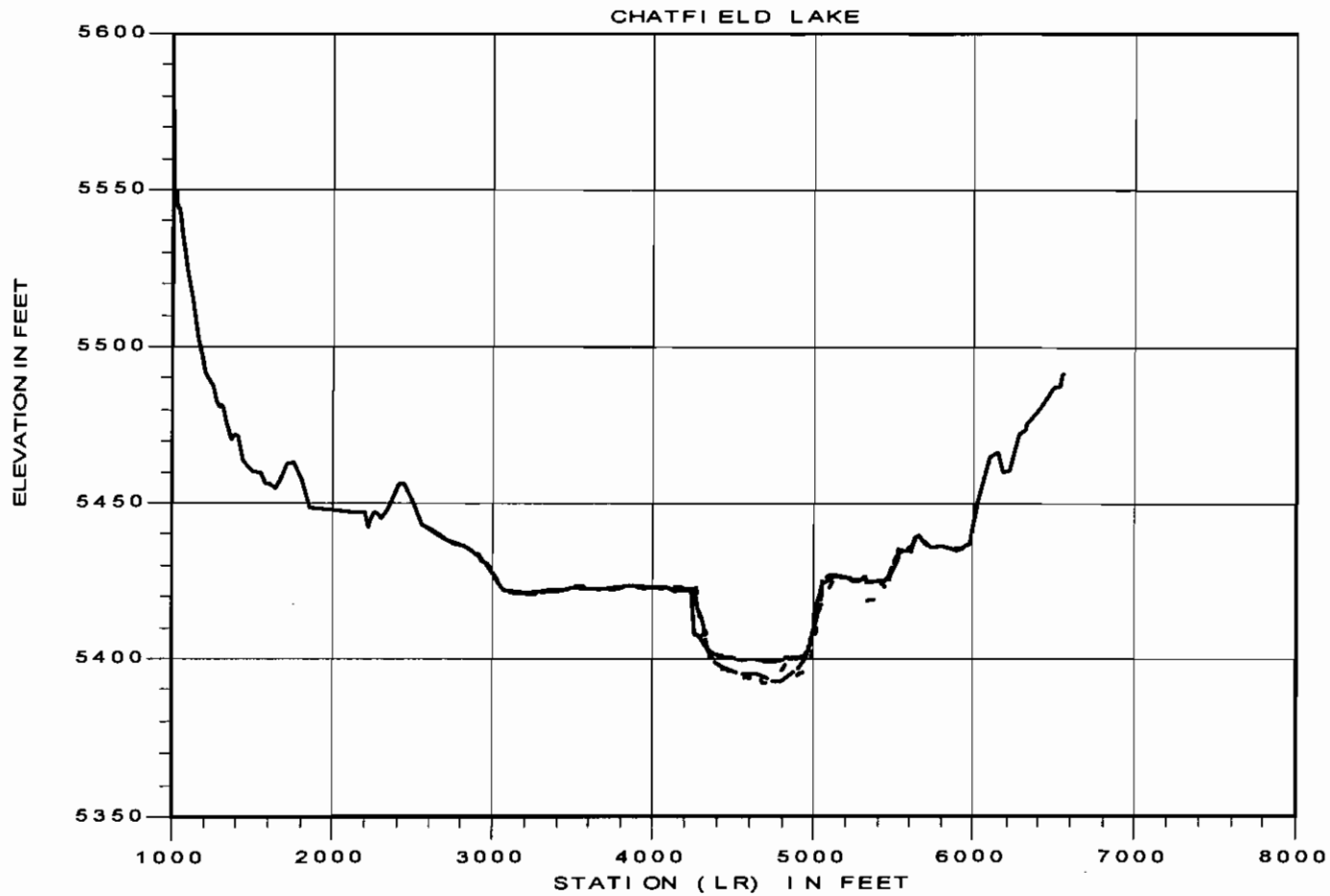

CHATFIELD LAKE
ELEVATION IN FEET
5600
5550
5500
5450
5400
5350
1000
2000
3000
4000
5000
6000
7000
8000
STATION (LR) IN FEET
CH-05 03MAY1977 5417.6
CH-05 22MAY1991 5427.3
CH-05 05NOV1998 5424.1

PLATE IV-15

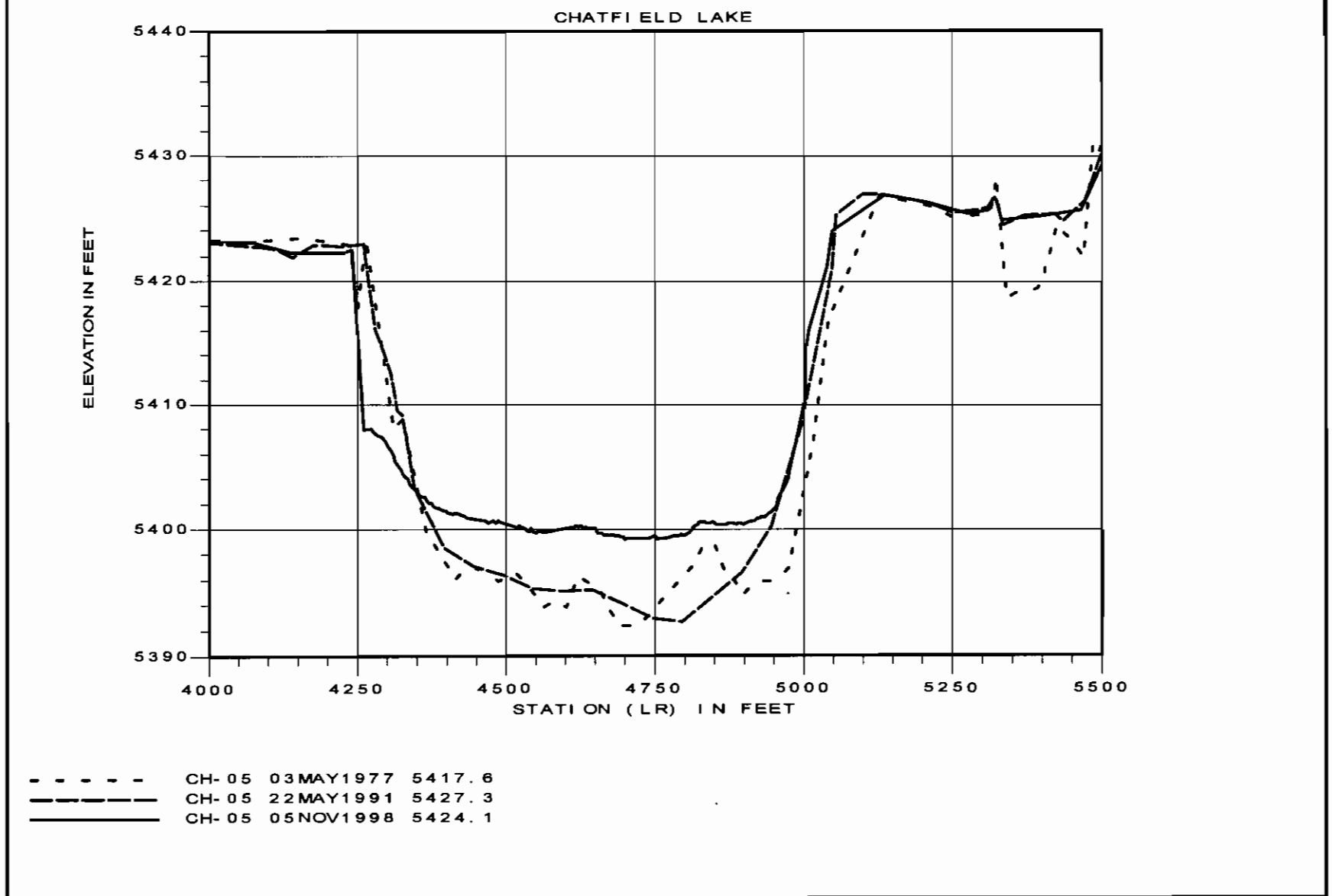

CHATFIELD LAKE
5440
5430
5420
5410
5400
5390
ELEVATION IN FEET
4000
4250
4500
4750
5000
5250
5500
STATION (LR) IN FEET
CH-05 03MAY1977 5417.6
CH-05 22MAY1991 5427.3
CH-05 05NOV1998 5424.1

PLATE IV-16

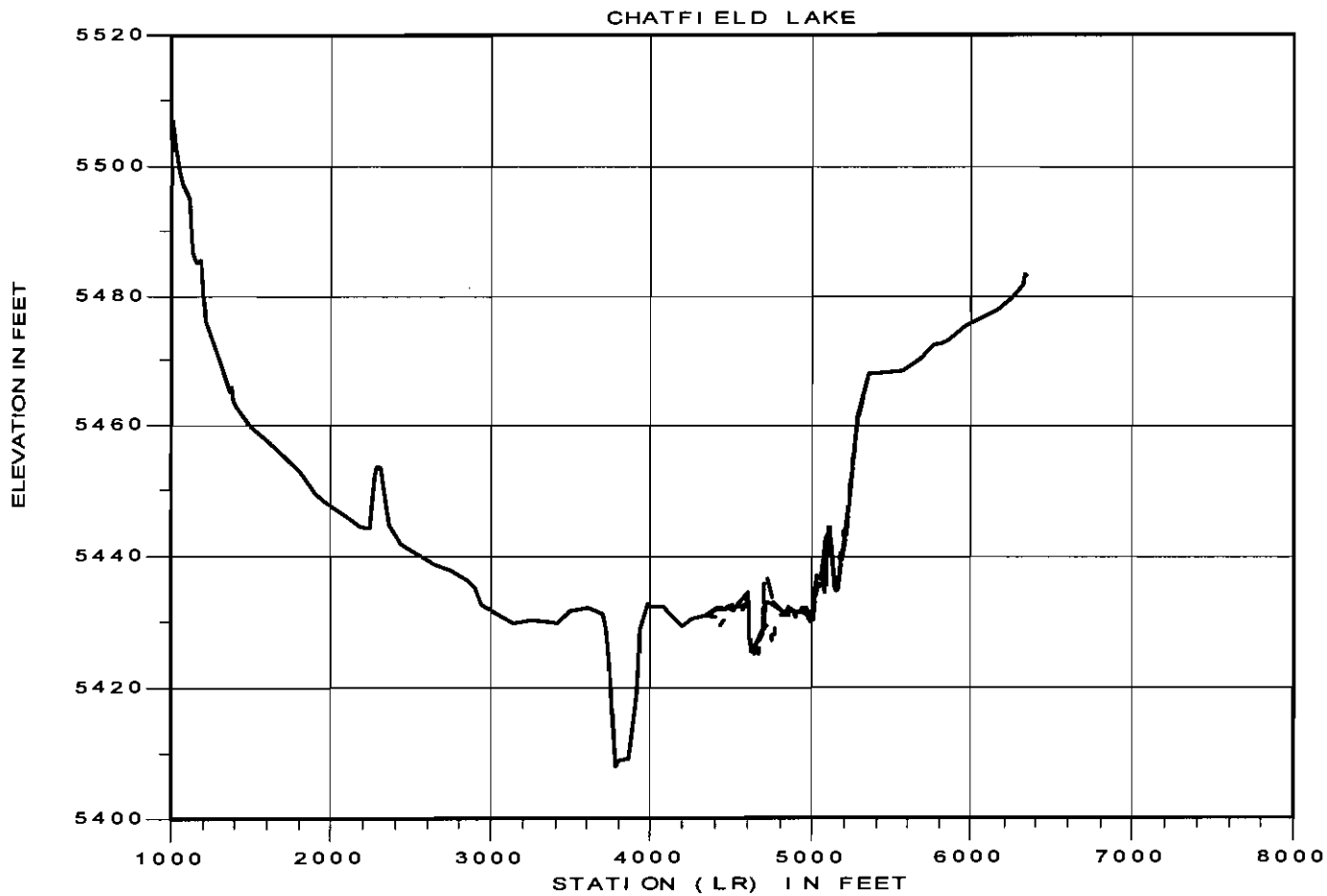

CHATFI ELD LAKE
ELEVATION IN FEET
5520
5500
5480
5460
5440
5420
5400
1000
2000
3000
4000
5000
6000
7000
8000
STATI ON (LR) I N FEET
CH- 06 03MAY1977 5425. 0
CH- 06 23MAY1991
CH- 06 31OCT1998 5427. 4

PLATE IV-17

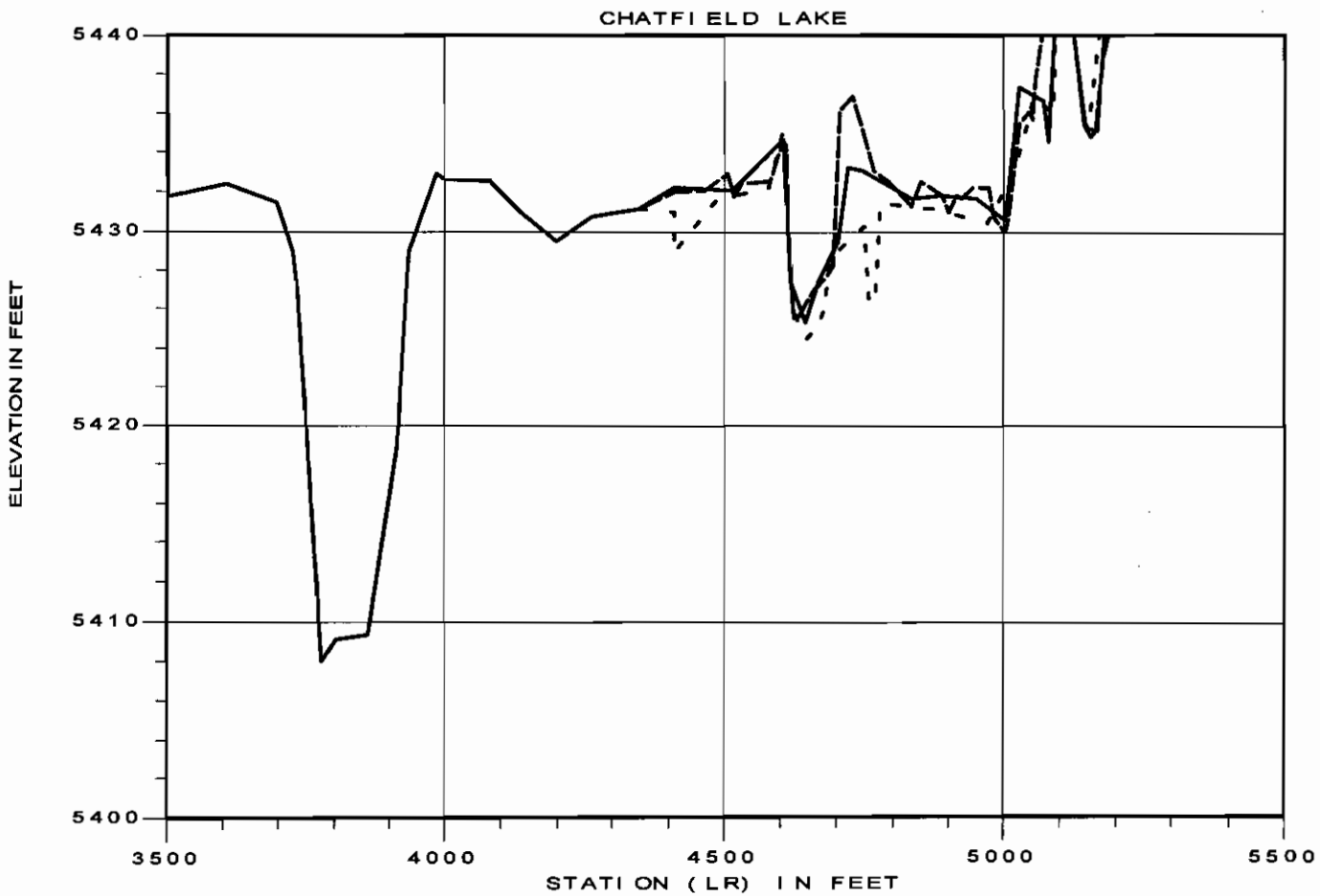

CHATFI ELD LAKE
5440
5430
5420
5410
5400
ELEVATION IN FEET
3500
4000
4500
5000
5500
STATI ON (LR) I N FEET
CH- 06 03MAY1977 5425. 0
CH- 06 23MAY1991
CH- 06 31OCT1998 5427. 4

PLATE IV-18

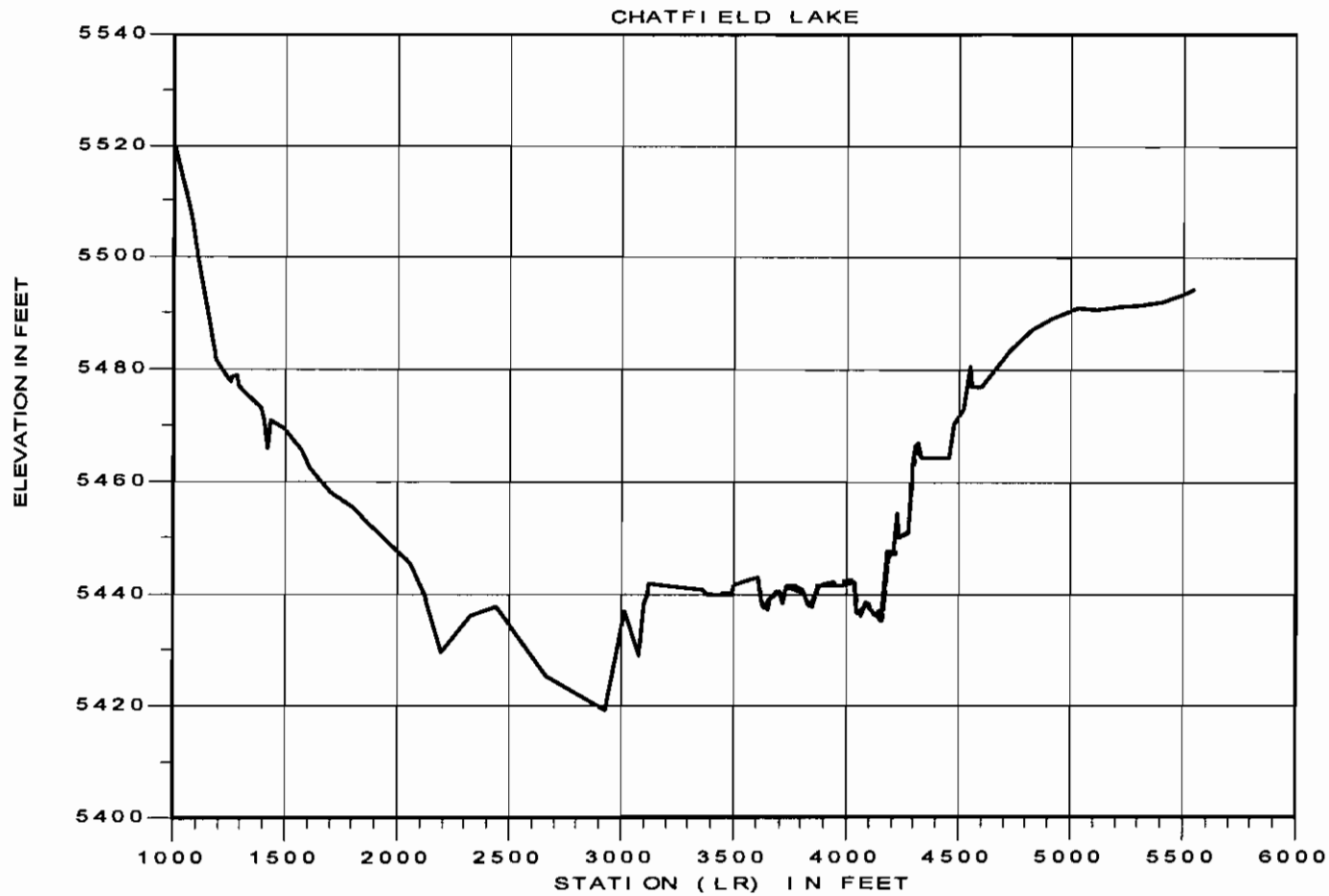

CHATFIELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
5420
5400
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
STATION (LR) IN FEET
CH-07 02MAY1977 5437.8
CH-07 14MAY1991
CH-07 30OCT1998 5437.1

PLATE IV-19

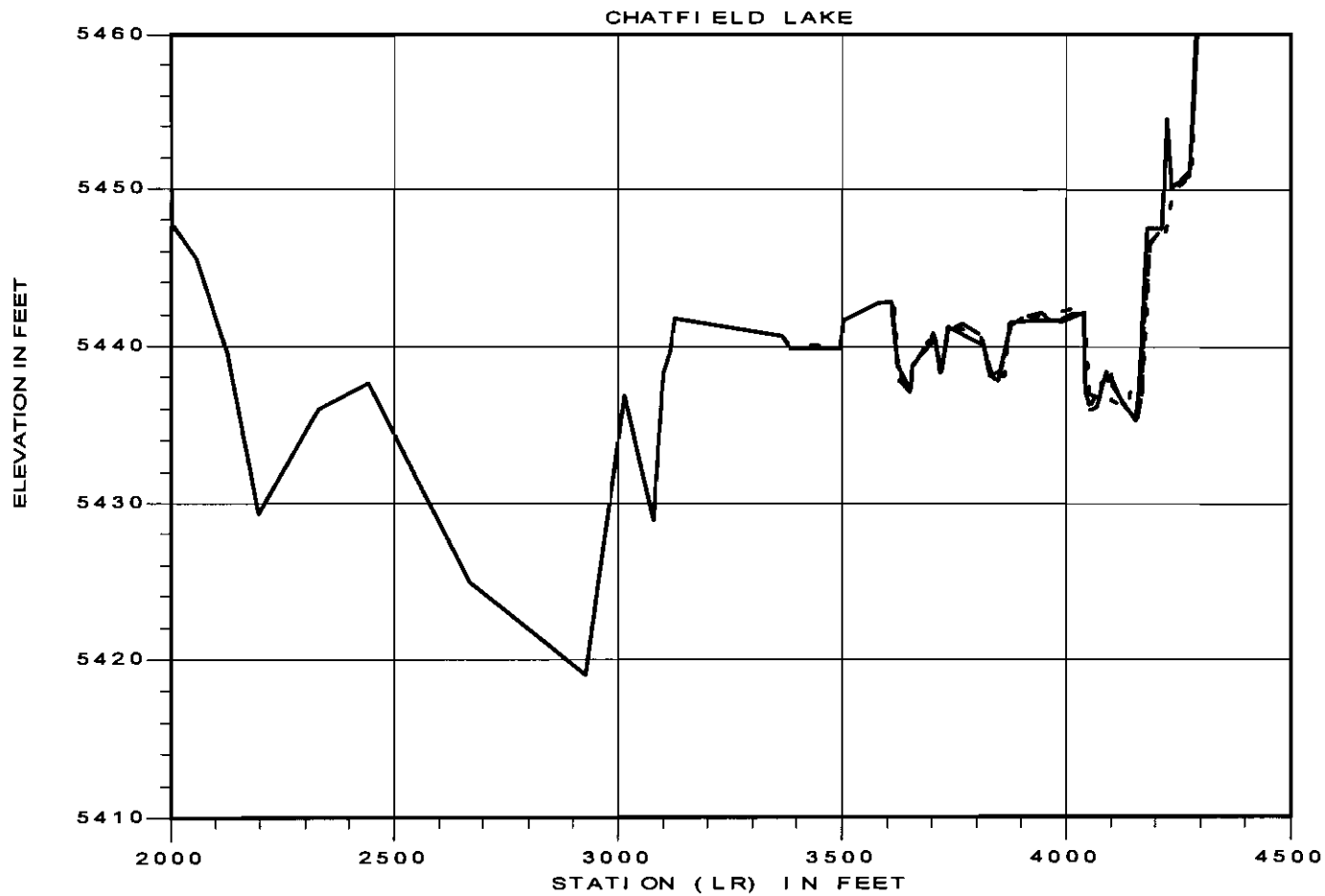

CHATFI ELD LAKE
5460
5450
5440
5430
5420
5410
ELEVATION IN FEET
2000
2500
3000
3500
4000
4500
STATI ON (LR) I N FEET
CH- 07 02MAY1977 5437. 8
CH- 07 14MAY1991
CH- 07 30OCT1998 5437. 1

PLATE IV-20

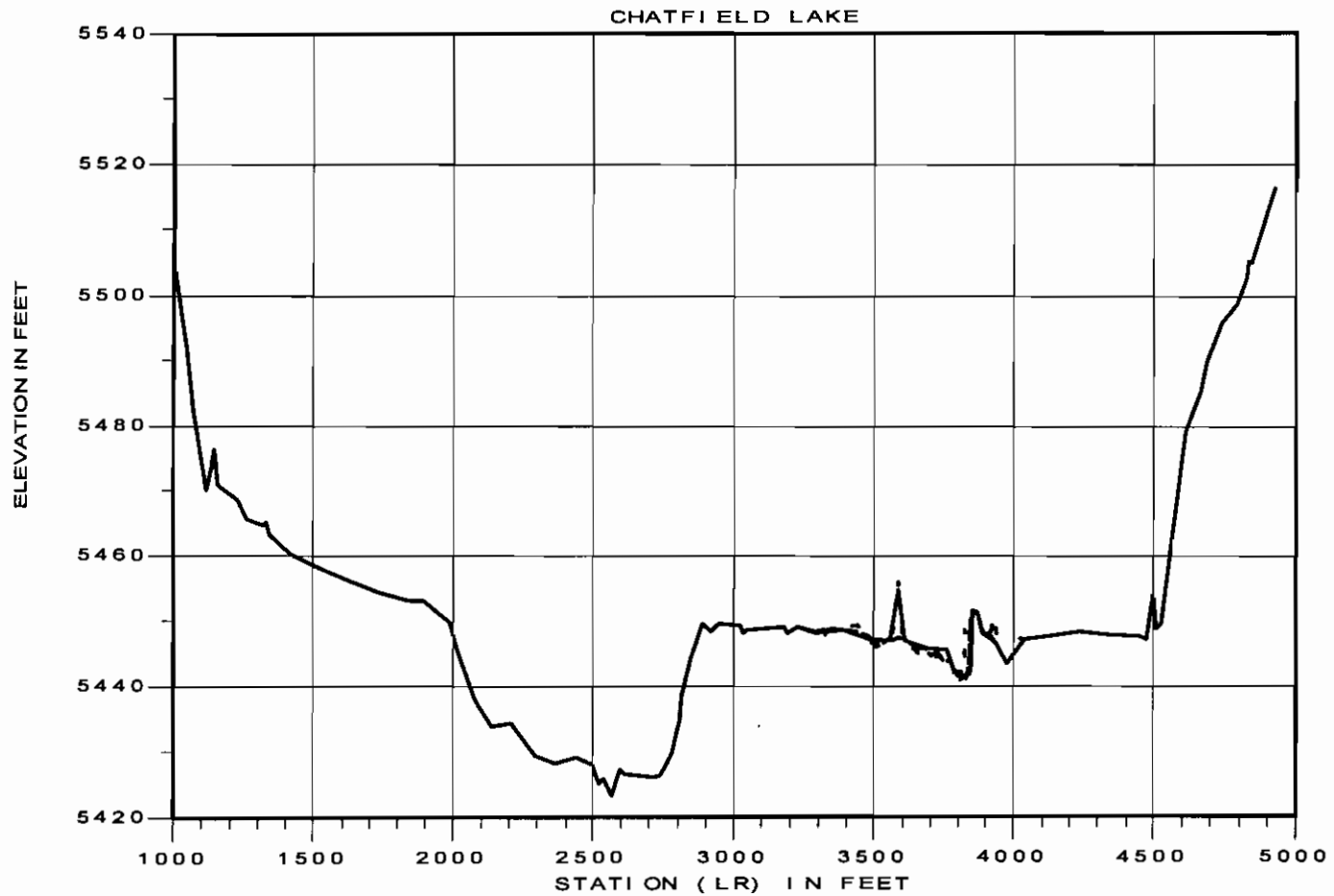

CHATFIELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
5420
1000
1500
2000
2500
3000
3500
4000
4500
5000
STATION (LR) IN FEET
CH-08 02MAY1977 5443.8
CH-08 14APR1991
CH-08 30OCT1998 5443.4

PLATE IV-21

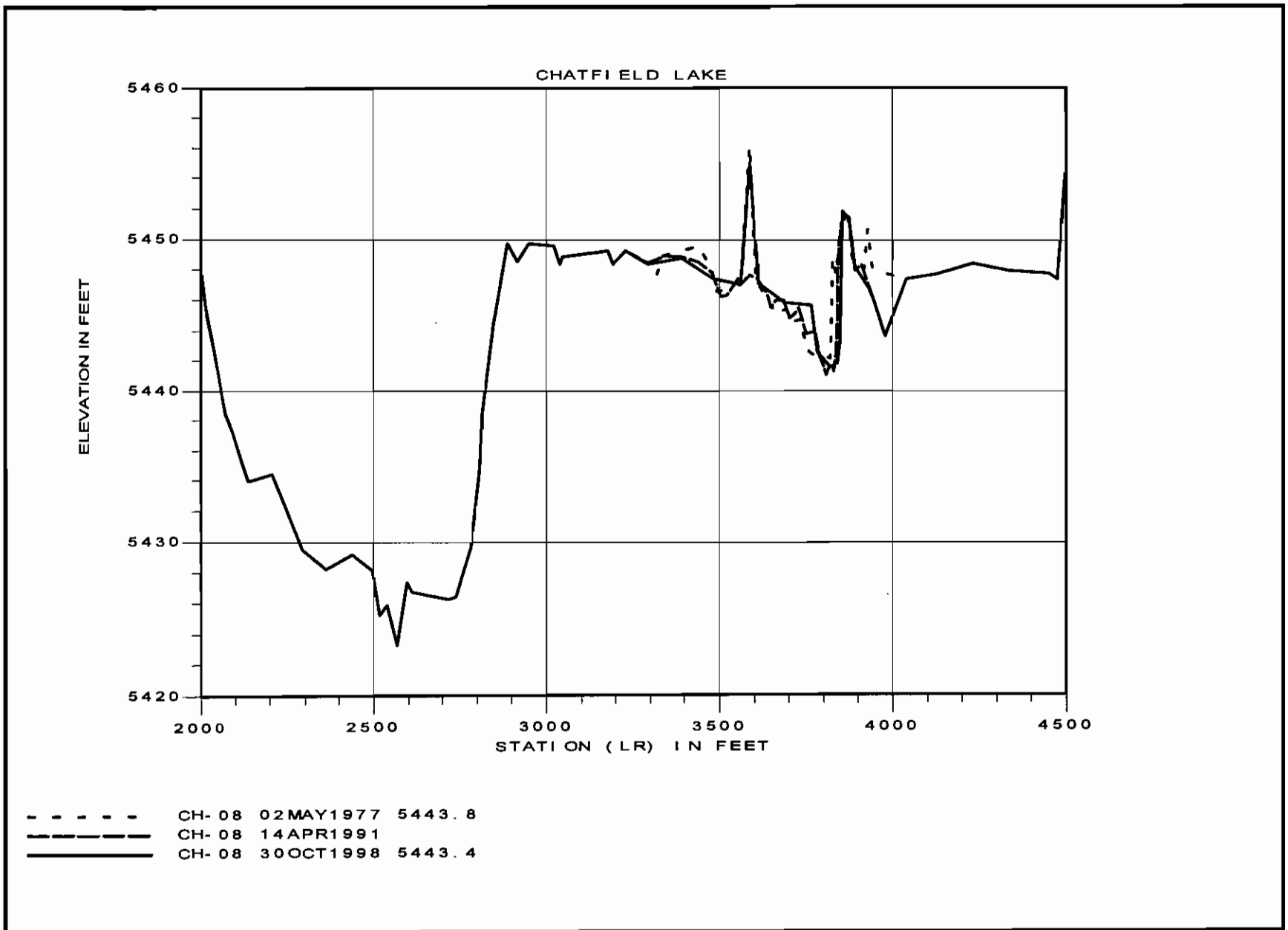

CHATFI ELD LAKE
5460
5450
5440
5430
5420
ELEVATION IN FEET
2000
2500
3000
3500
4000
4500
STATI ON (LR) I N FEET
CH- 08 02MAY1977 5443. 8
CH- 08 14APR1991
CH- 08 30OCT1998 5443. 4

PLATE IV-22

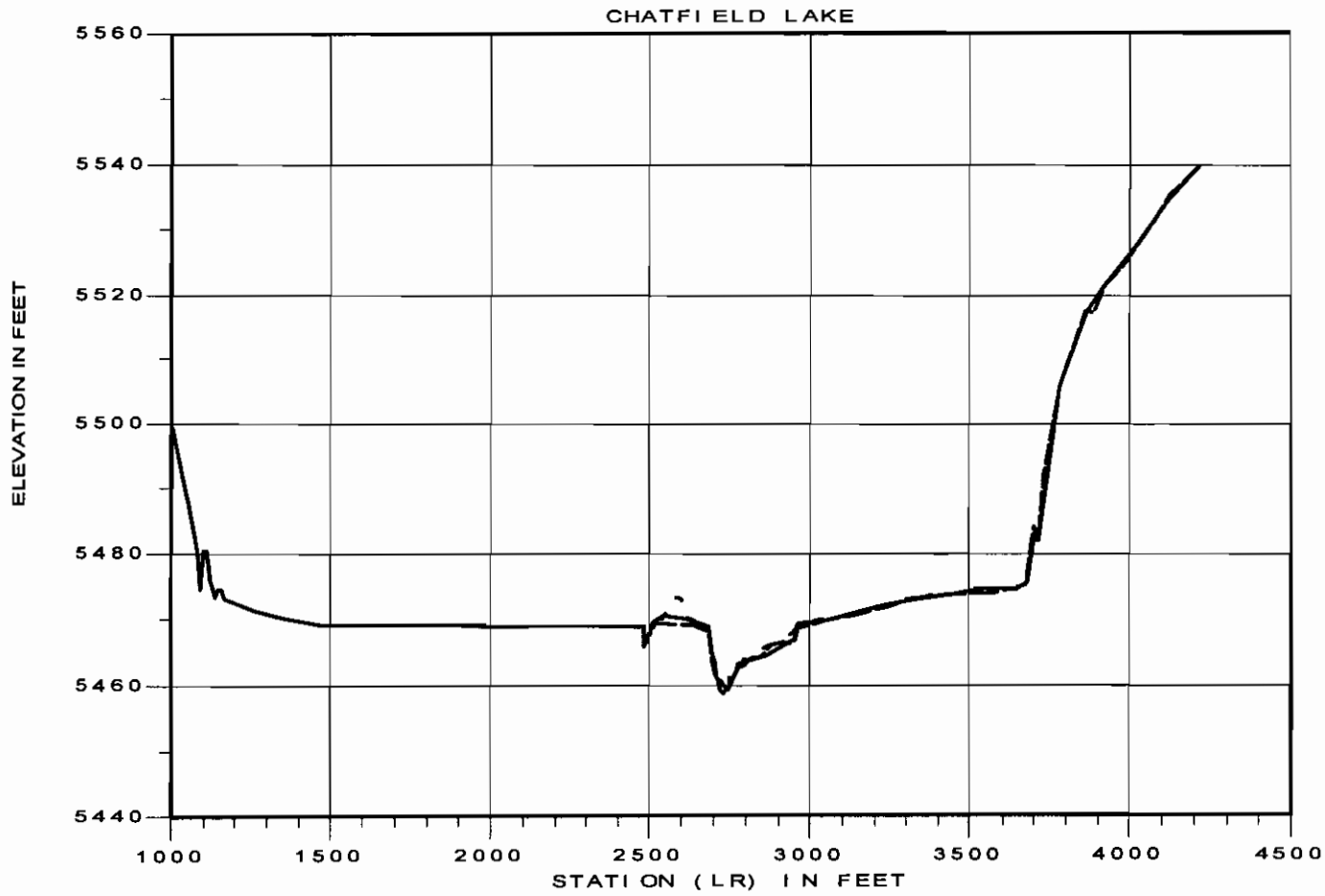

CHATFIELD LAKE
5560
5540
5520
5500
5480
5460
5440
ELEVATION IN FEET
1000
1500
2000
2500
3000
3500
4000
4500
STATION (LR) IN FEET
CH-09 02MAY1977 5463.0
CH-09 14APR1991
CH-09 30OCT1998

PLATE IV-23

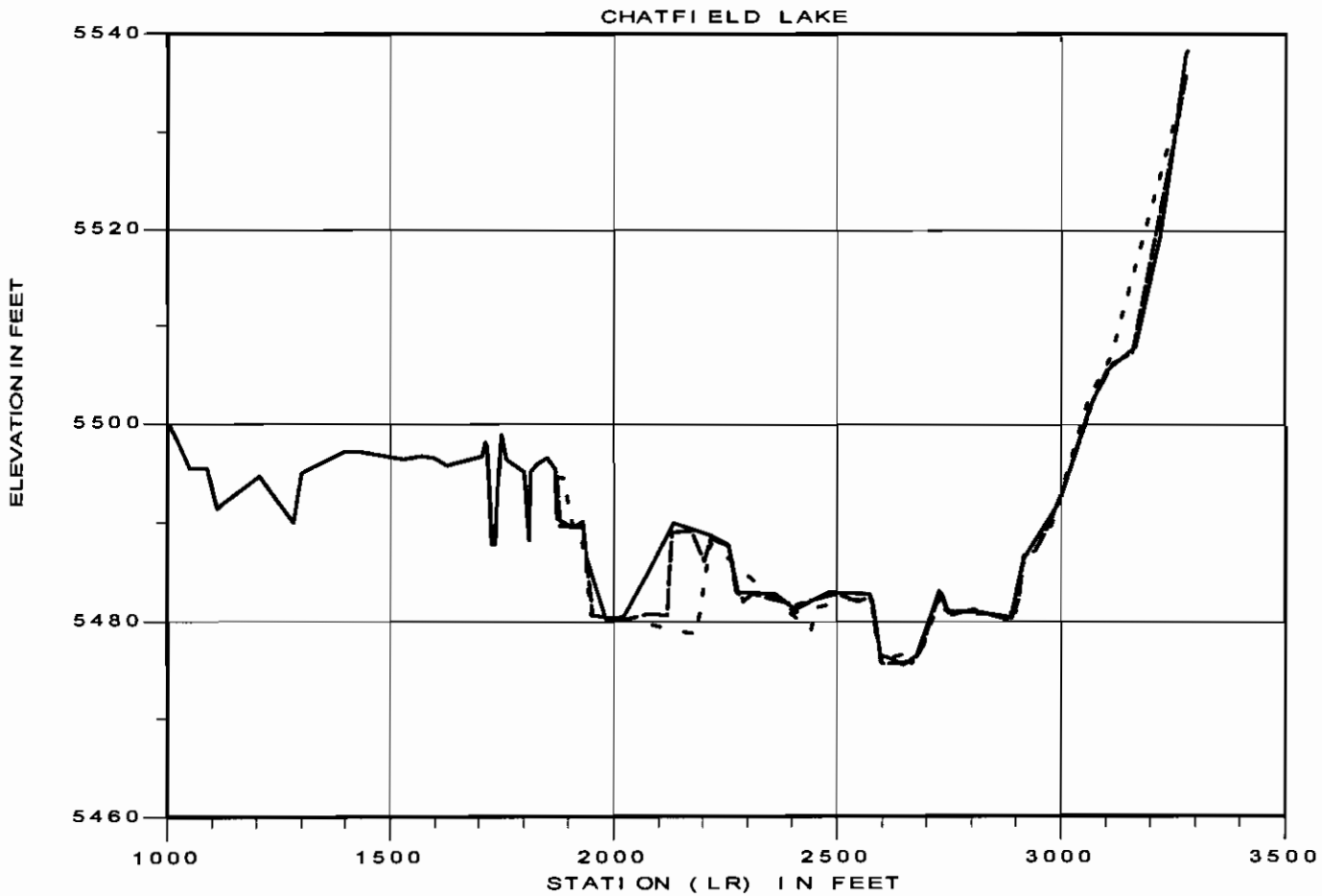

CHATFI ELD LAKE
5540
5520
5500
5480
5460
ELEVATION IN FEET
1000
1500
2000
2500
3000
3500
STATI ON (LR) I N FEET
CH- 10 26APR1977 5477. 5
CH- 10 10MAY1991
CH- 10 30OCT1998

PLATE IV-24

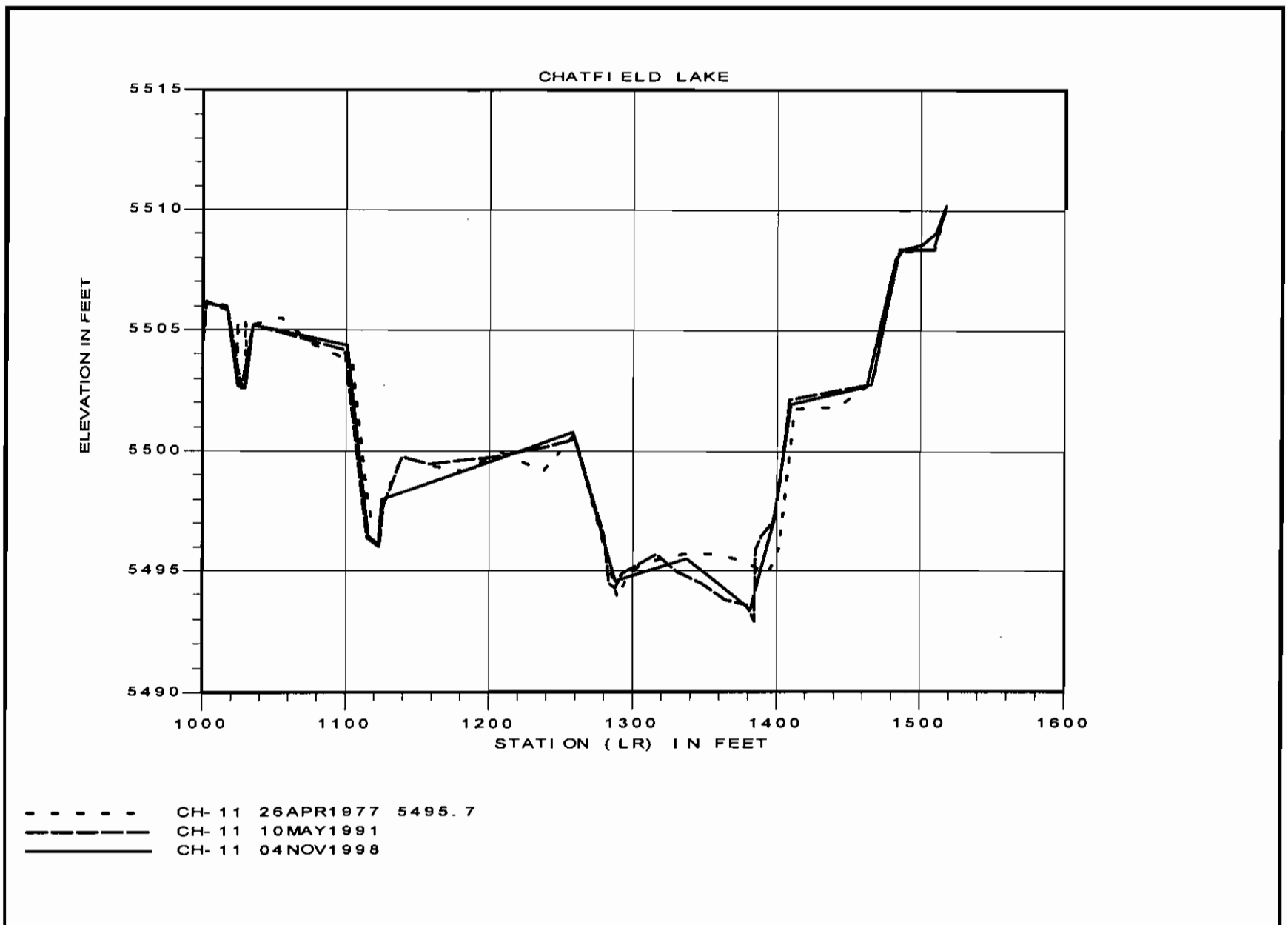

CHATFIELD LAKE
5515
5510
5505
5500
5495
5490
ELEVATION IN FEET
1000
1100
1200
1300
1400
1500
1600
STATION (LR) IN FEET
CH-11 26APR1977 5495.7
CH-11 10MAY1991
CH-11 04NOV1998

PLATE IV-25

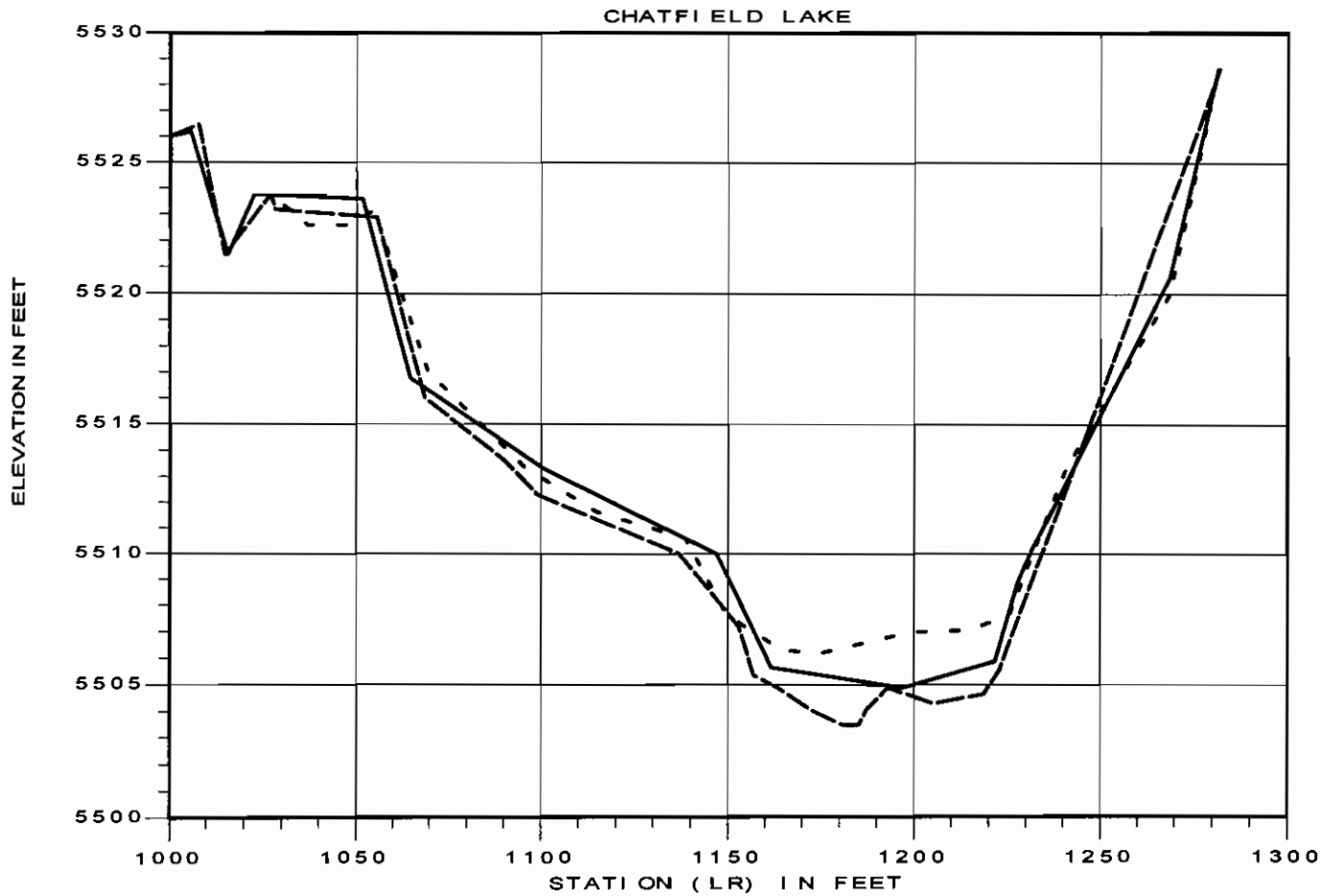

CHATFI ELD LAKE
5530
5525
5520
5515
5510
5505
5500
ELEVATION IN FEET
1000
1050
1100
1150
1200
1250
1300
STATI ON (LR) I N FEET
CH- 12 26APR1977 5507. 6
CH- 12 15MAY1991
CH- 12 04NOV1998

PLATE IV-26

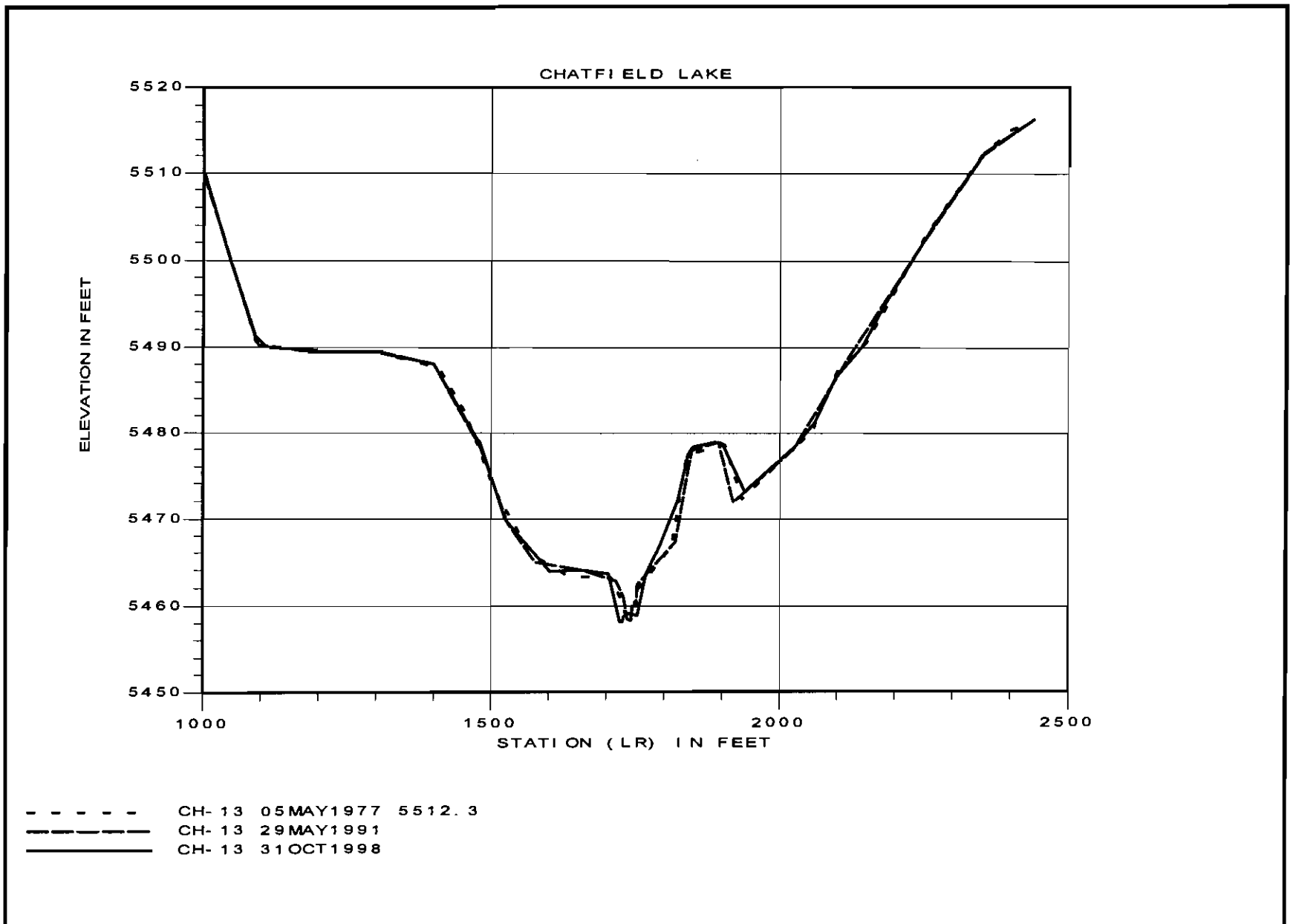

CHATFIELD LAKE
5520
5510
5500
5490
5480
5470
5460
5450
ELEVATION IN FEET
1000
1500
2000
2500
STATION (LR) IN FEET
CH-13 05MAY1977 5512.3
CH-13 29MAY1991
CH-13 31OCT1998

PLATE IV-27

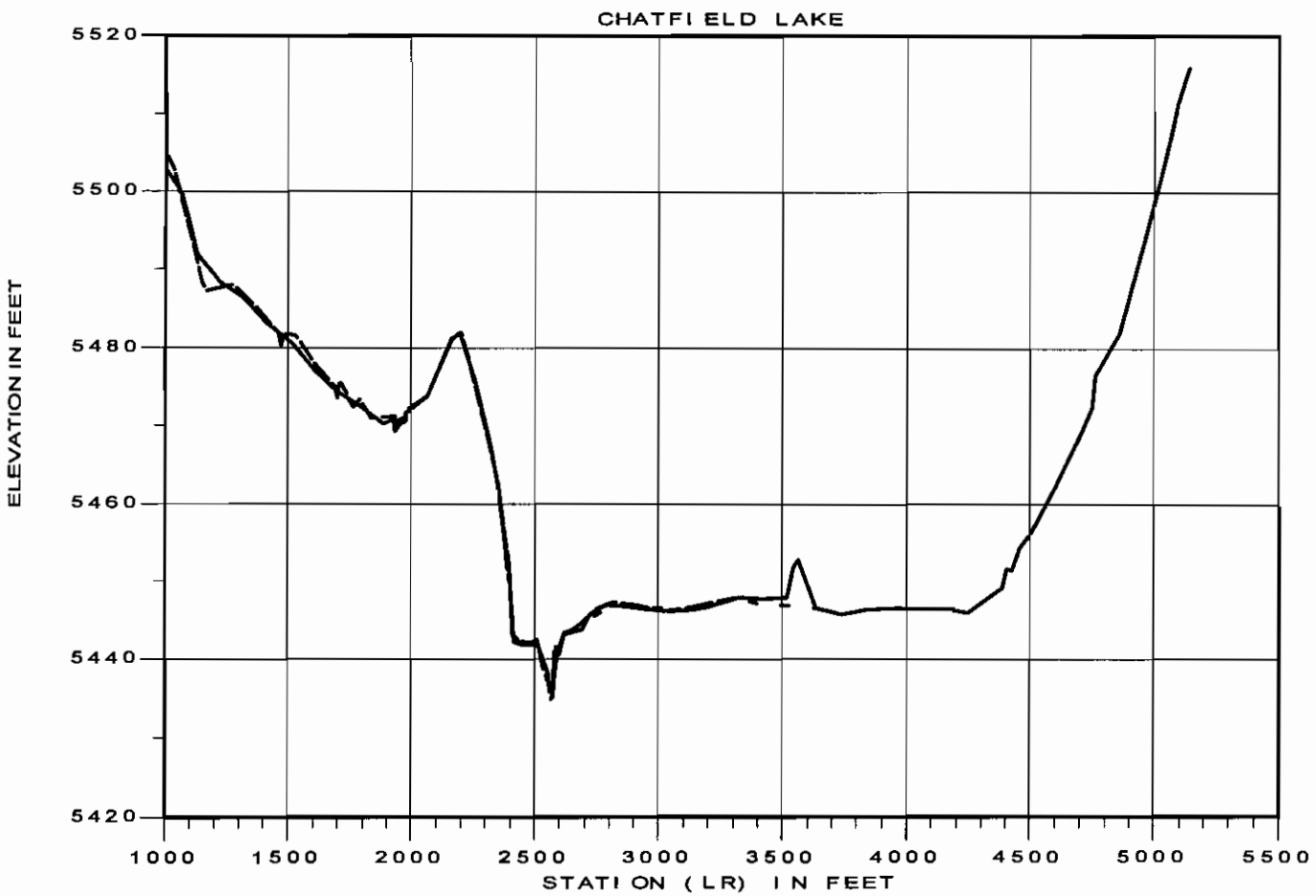

CHATFI ELD LAKE
ELEVATION IN FEET
5520
5500
5480
5460
5440
5420
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
STATI ON (LR) I N FEET
CH- 14 05MAY1977 5435. 7
CH- 14 03JUN1991
CH- 14 31OCT1998

PLATE IV-28

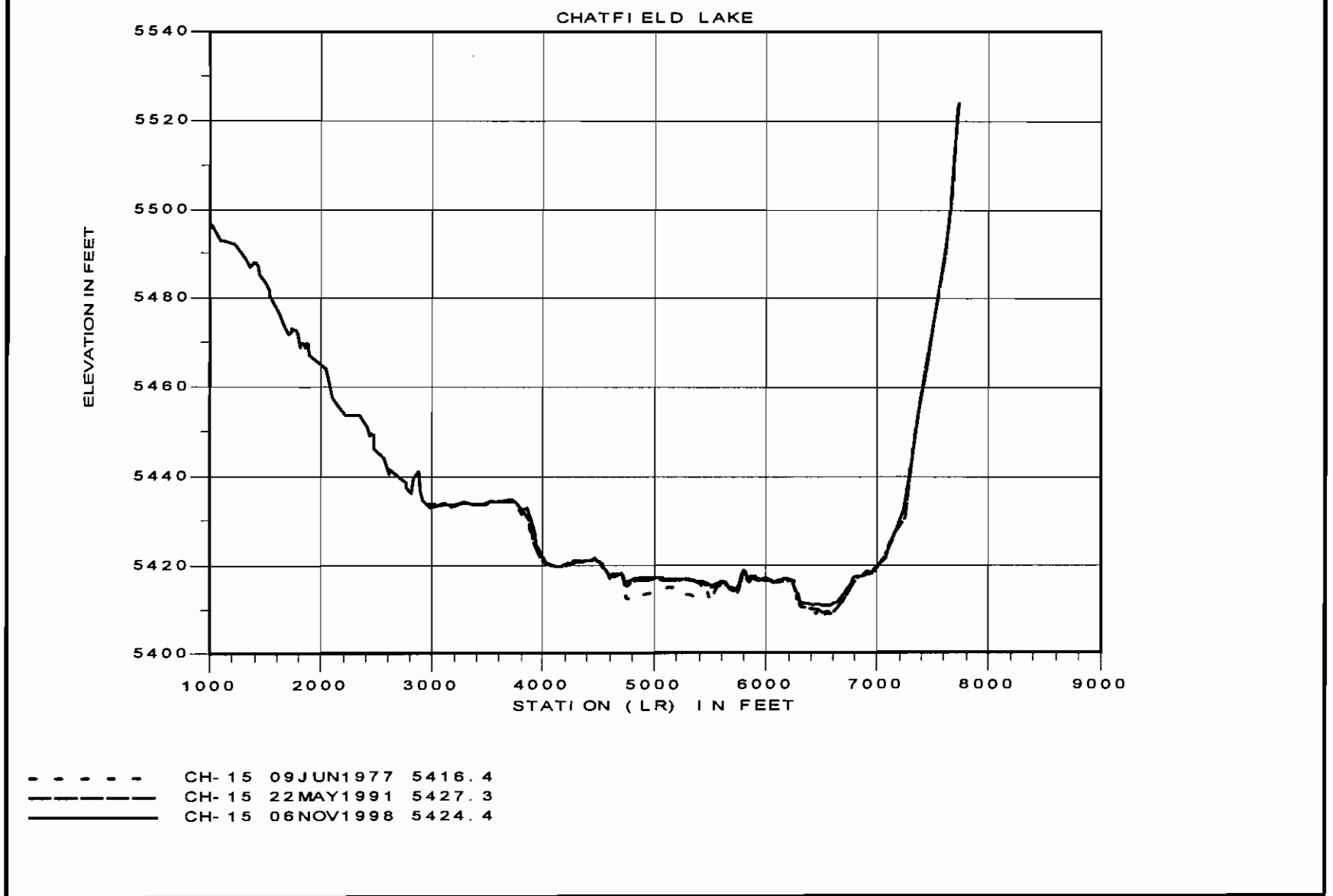

CHATFI ELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
5420
5400
1000
2000
3000
4000
5000
6000
7000
8000
9000
STATI ON (LR) I N FEET
CH- 15 09JUN1977 5416. 4
CH- 15 22MAY1991 5427. 3
CH- 15 06NOV1998 5424. 4

PLATE IV-29

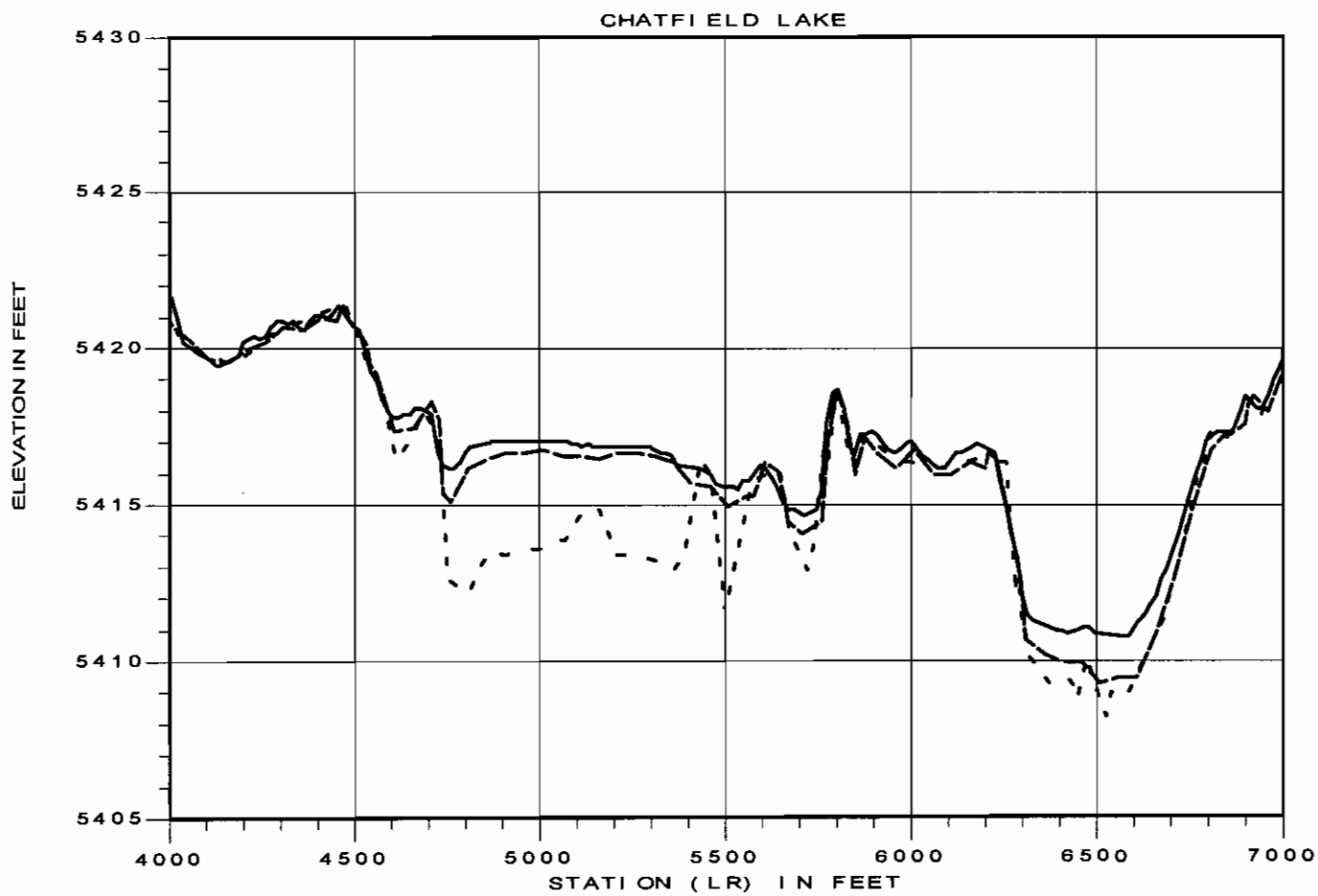

CHATFIELD LAKE
5430
5425
5420
5415
5410
5405
ELEVATION IN FEET
4000
4500
5000
5500
6000
6500
7000
STATION (LR) IN FEET
CH-15 09JUN1977 5416.4
CH-15 22MAY1991 5427.3
CH-15 06NOV1998 5424.4

PLATE IV-30

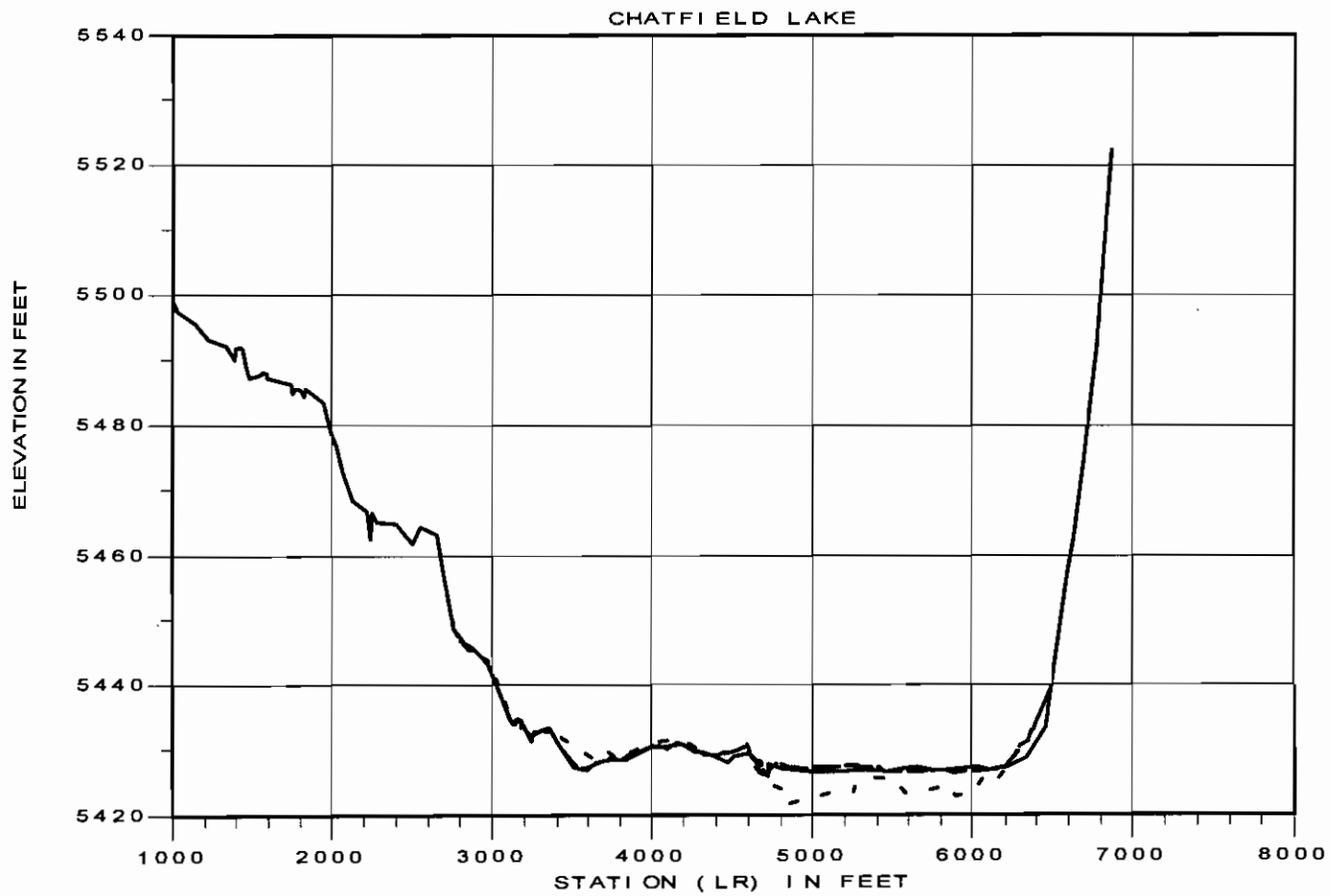

CHATFIELD LAKE
5540
5520
5500
5480
5460
5440
5420
ELEVATION IN FEET
1000
2000
3000
4000
5000
6000
7000
8000
STATION (LR) IN FEET
CH-16 13JUN1977 5423.3
CH-16 23MAY1991 5427.3
CH-16 04NOV1998

PLATE IV-31

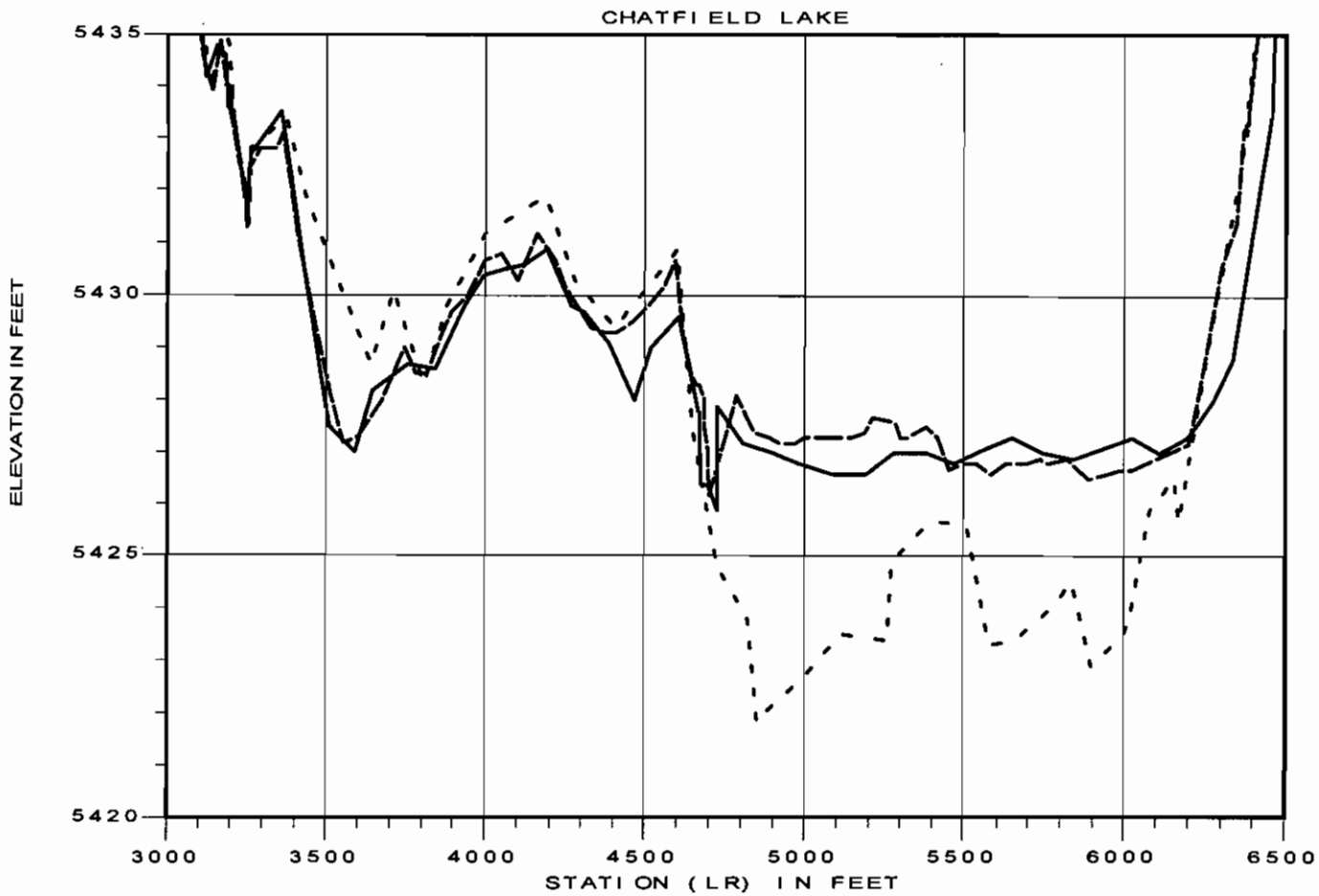

CHATFIELD LAKE
5435
5430
5425
5420
ELEVATION IN FEET
3000
3500
4000
4500
5000
5500
6000
6500
STATION (LR) IN FEET
CH-16 13JUN1977 5423.3
CH-16 23MAY1991 5427.3
CH-16 04NOV1998

PLATE IV-32

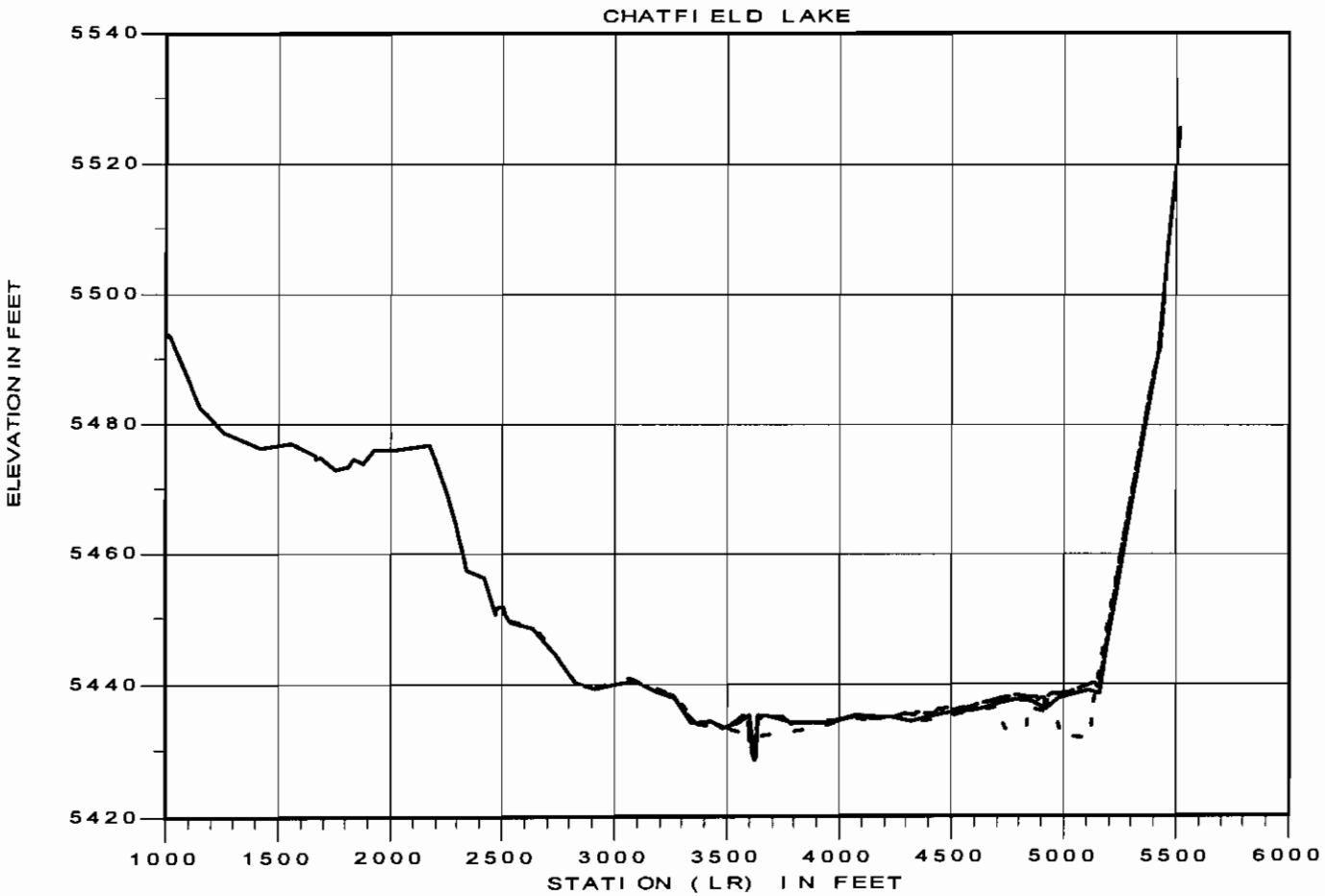

CHATFI ELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
5420
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
STATI ON (LR) I N FEET
CH- 17 13JUN1977 5433. 3
CH- 17 23APR1991
CH- 17 03NOV1998

PLATE IV-33

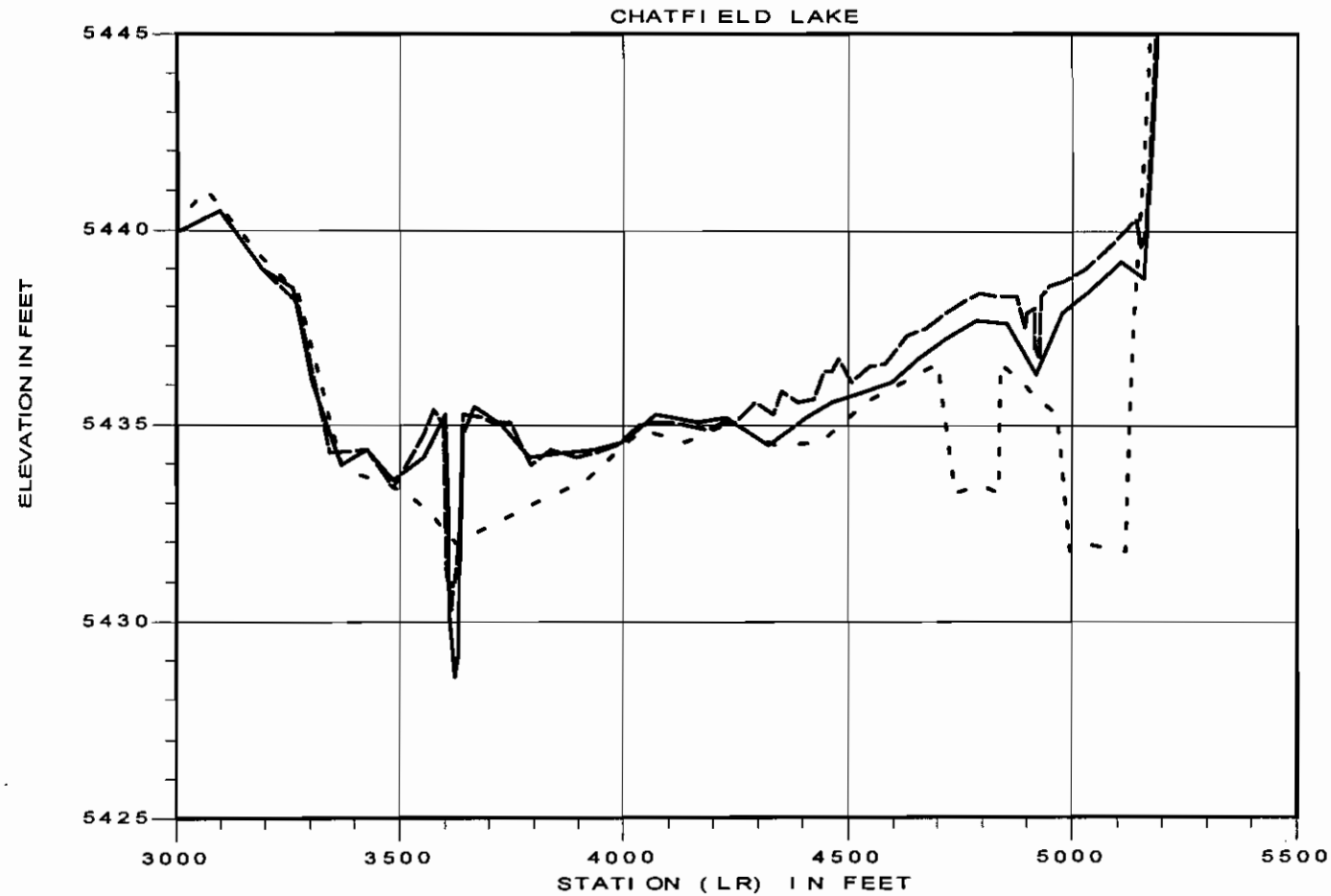

CHATFI ELD LAKE
5445
5440
5435
5430
5425
ELEVATION IN FEET
3000
3500
4000
4500
5000
5500
STATI ON (LR) I N FEET
CH- 17 13JUN1977 5433. 3
CH- 17 23APR1991
CH- 17 03NOV1998

PLATE IV-34

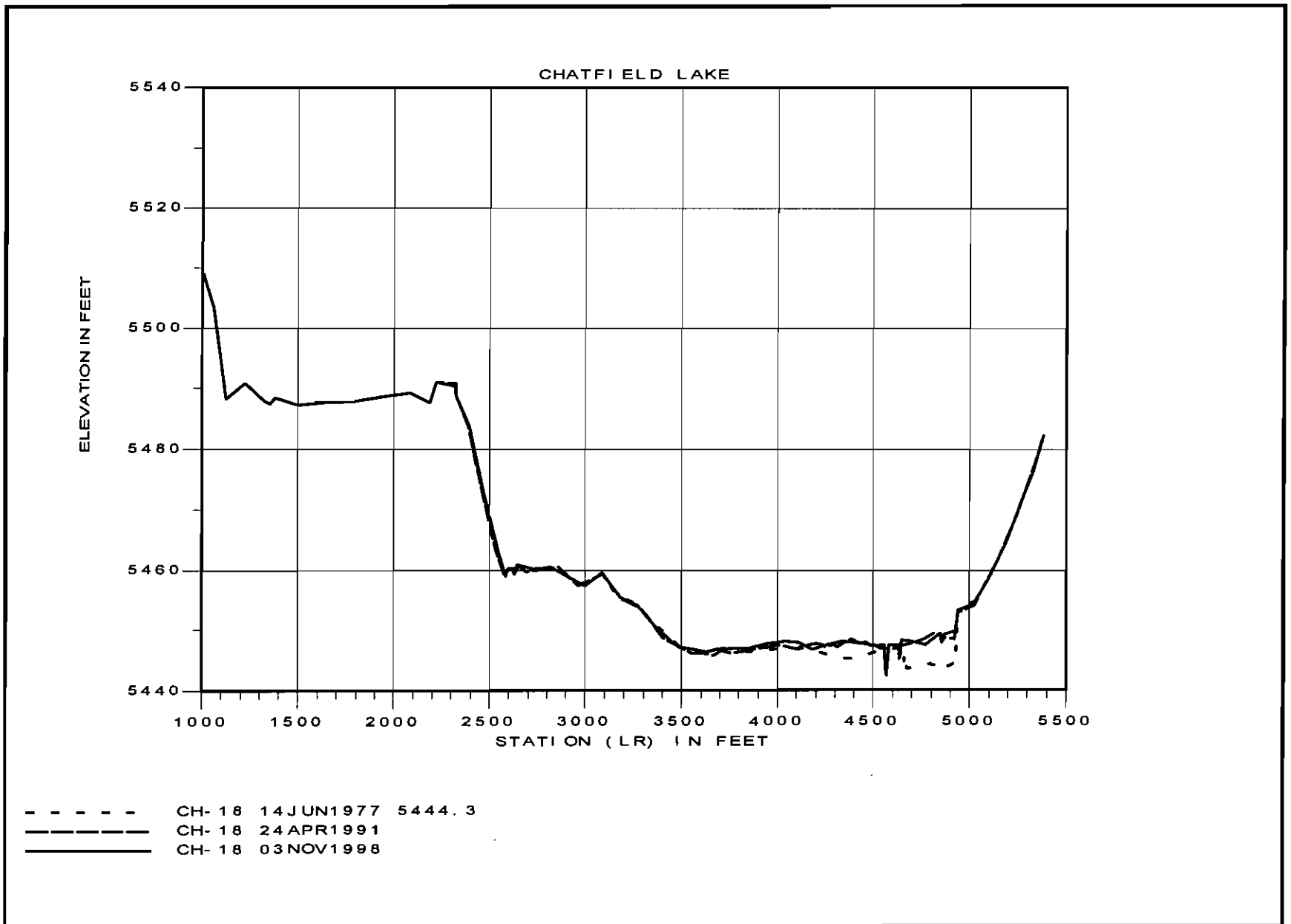

CHATFIELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
STATION (LR) IN FEET
CH-18 14JUN1977 5444.3
CH-18 24APR1991
CH-18 03NOV1998

PLATE IV-35

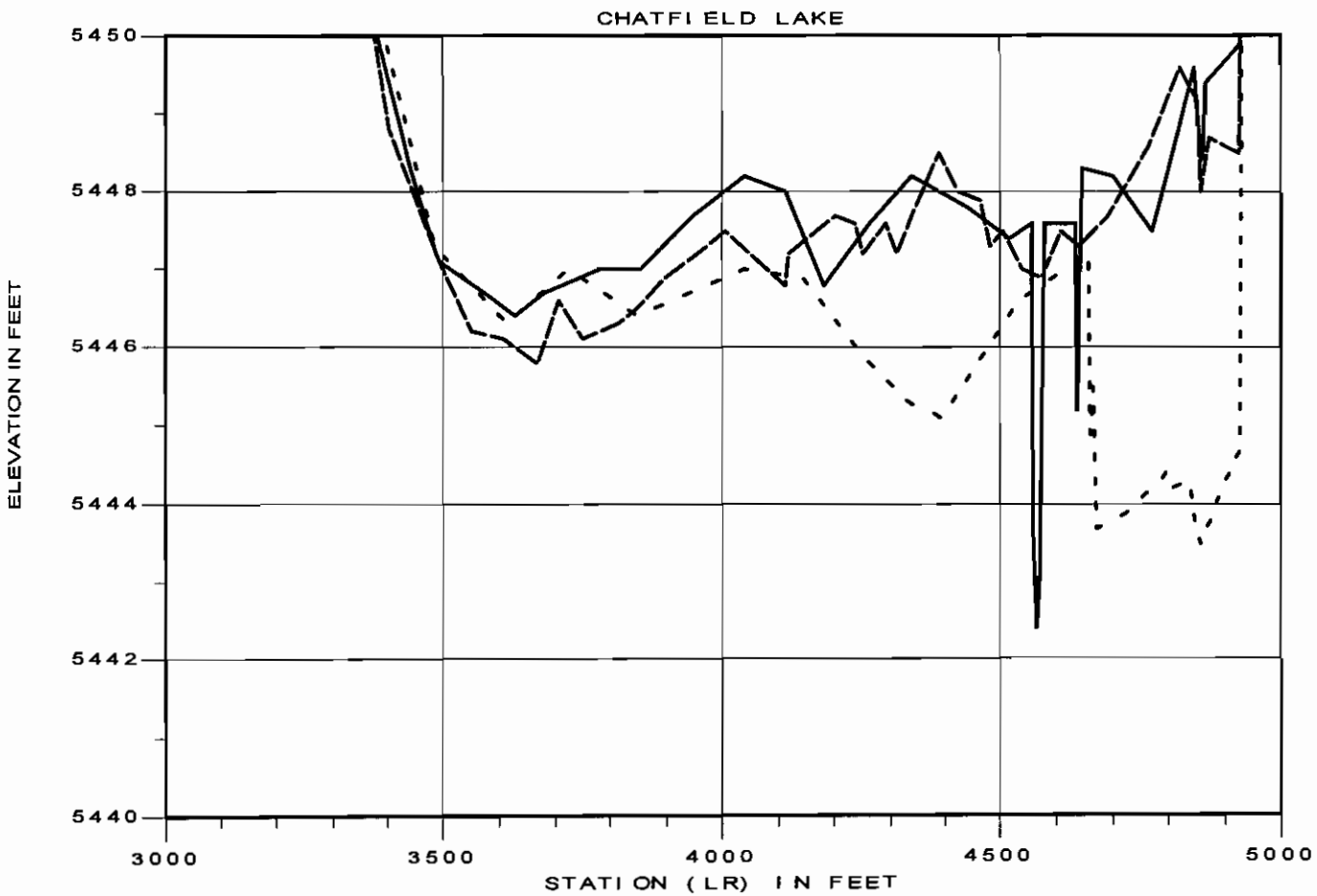

CHATFIELD LAKE
5450
5448
5446
5444
5442
5440
ELEVATION IN FEET
3000
3500
4000
4500
5000
STATION (LR) IN FEET
CH-18 14JUN1977 5444.3
CH-18 24APR1991
CH-18 03NOV1998

PLATE IV-36

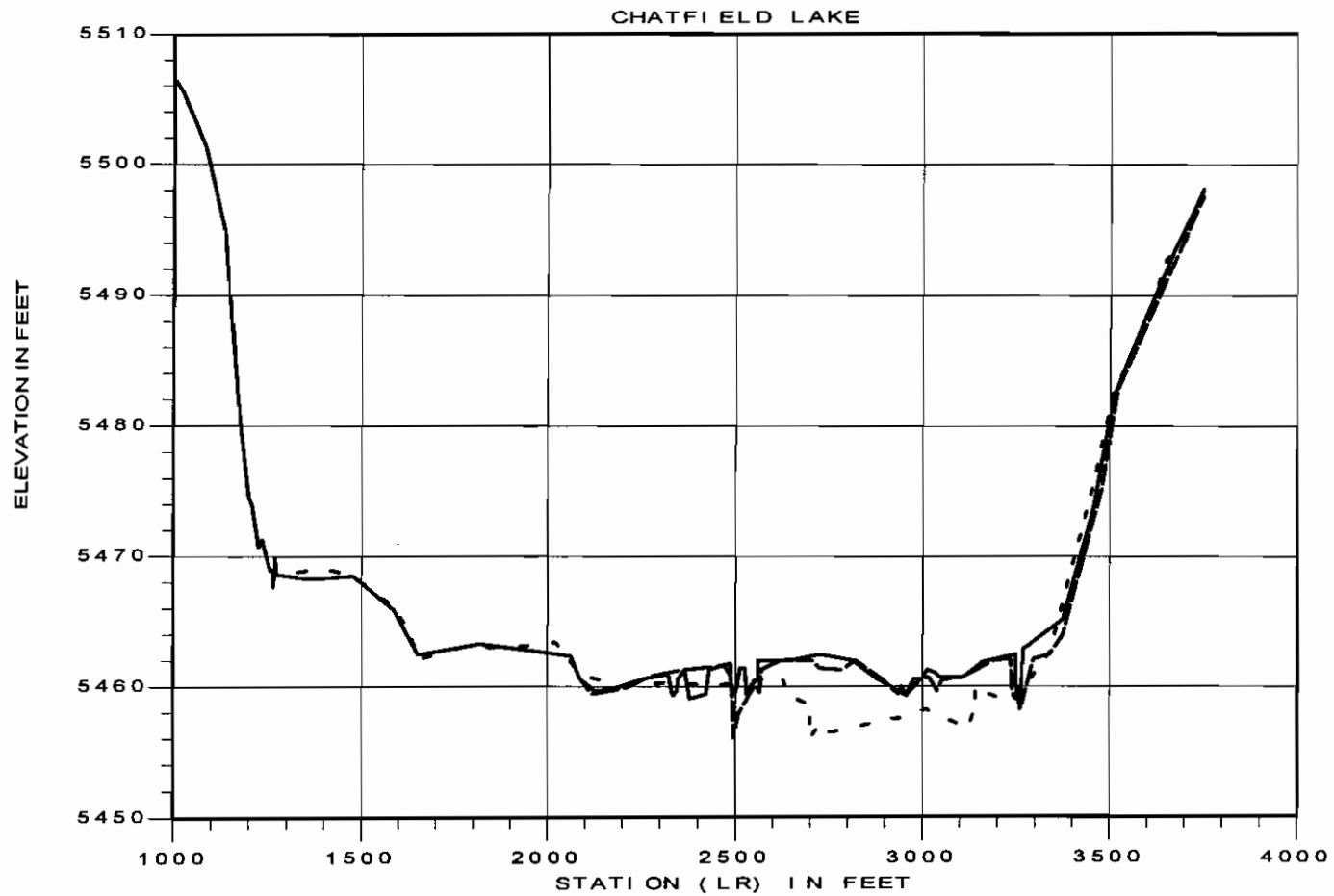

CHATFIELD LAKE
ELEVATION IN FEET
5510
5500
5490
5480
5470
5460
5450
1000
1500
2000
2500
3000
3500
4000
STATION (LR) IN FEET
CH-19 14JUN1977 5456.8
CH-19 24APR1991
CH-19 03NOV1998

PLATE IV-37

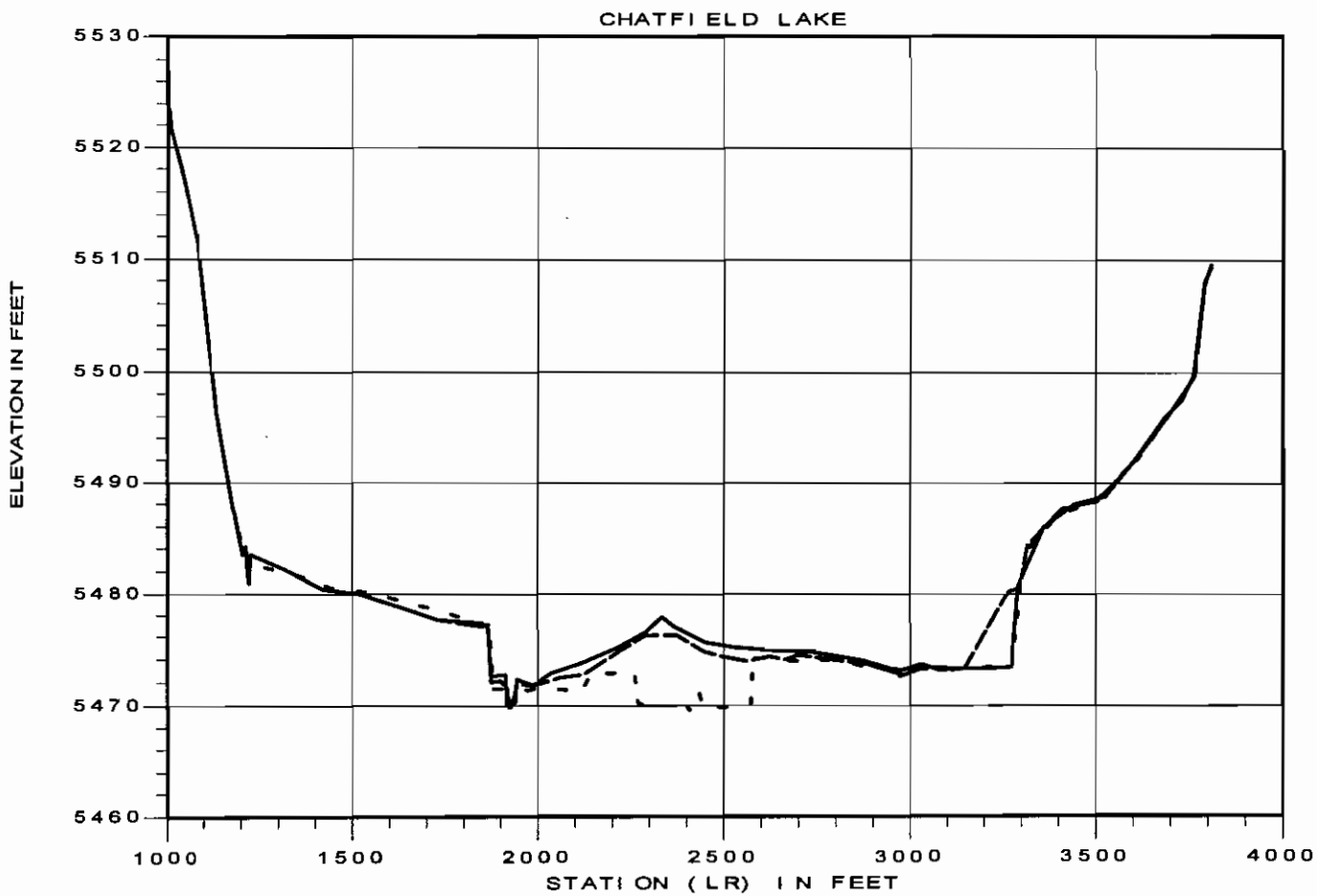

CHATFIELD LAKE
ELEVATION IN FEET
5530
5520
5510
5500
5490
5480
5470
5460
1000
1500
2000
2500
3000
3500
4000
STATION (LR) IN FEET
CH-20 15JUN1977 5470.0
CH-20 23APR1991
CH-20 02NOV1998

PLATE IV-38

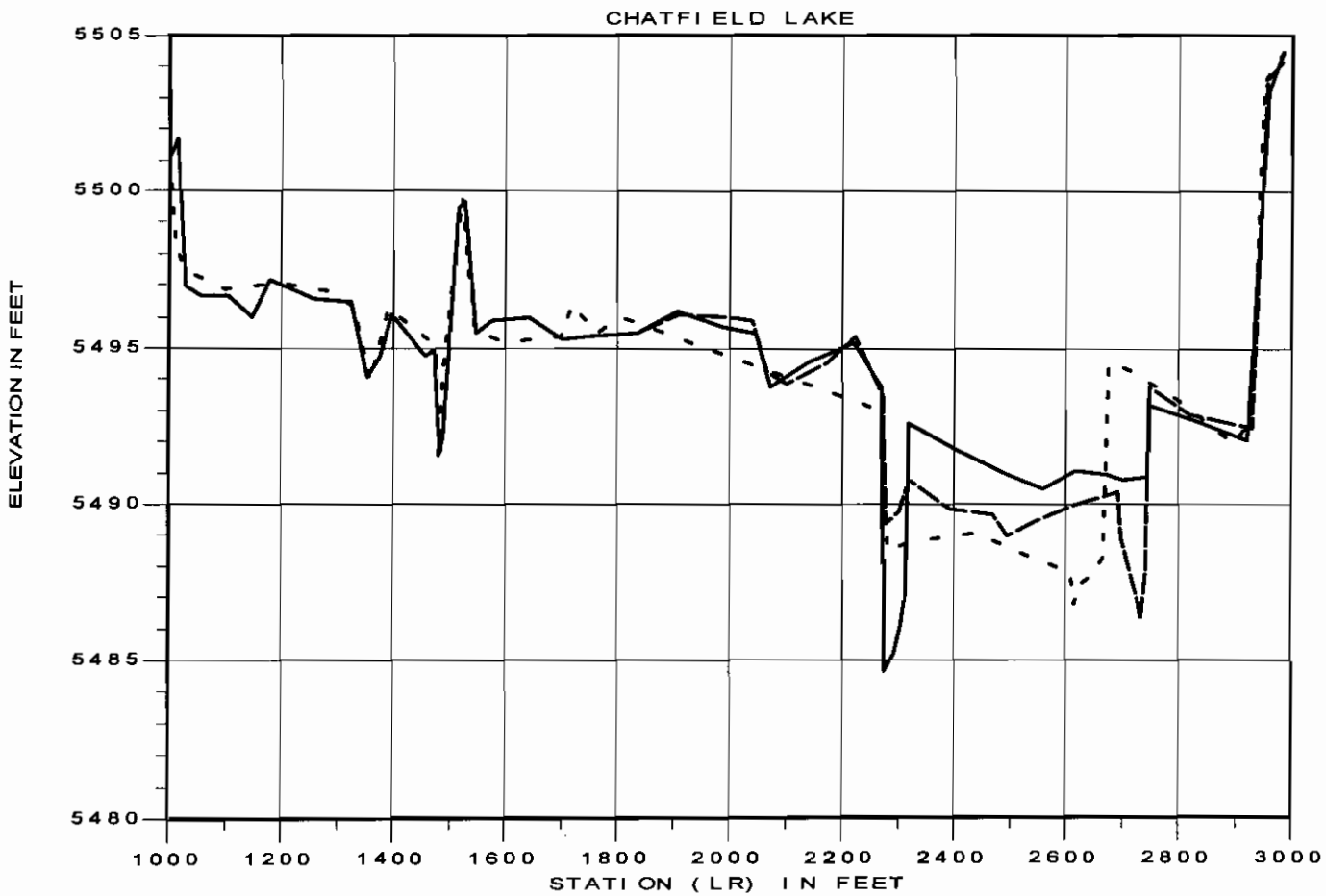

CHATFIELD LAKE
5505
5500
5495
5490
5485
5480
ELEVATION IN FEET
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
STATION (LR) IN FEET
CH-21 01977 DRY
CH-21 23APR1991
CH-21 01NOV1998

PLATE IV-39

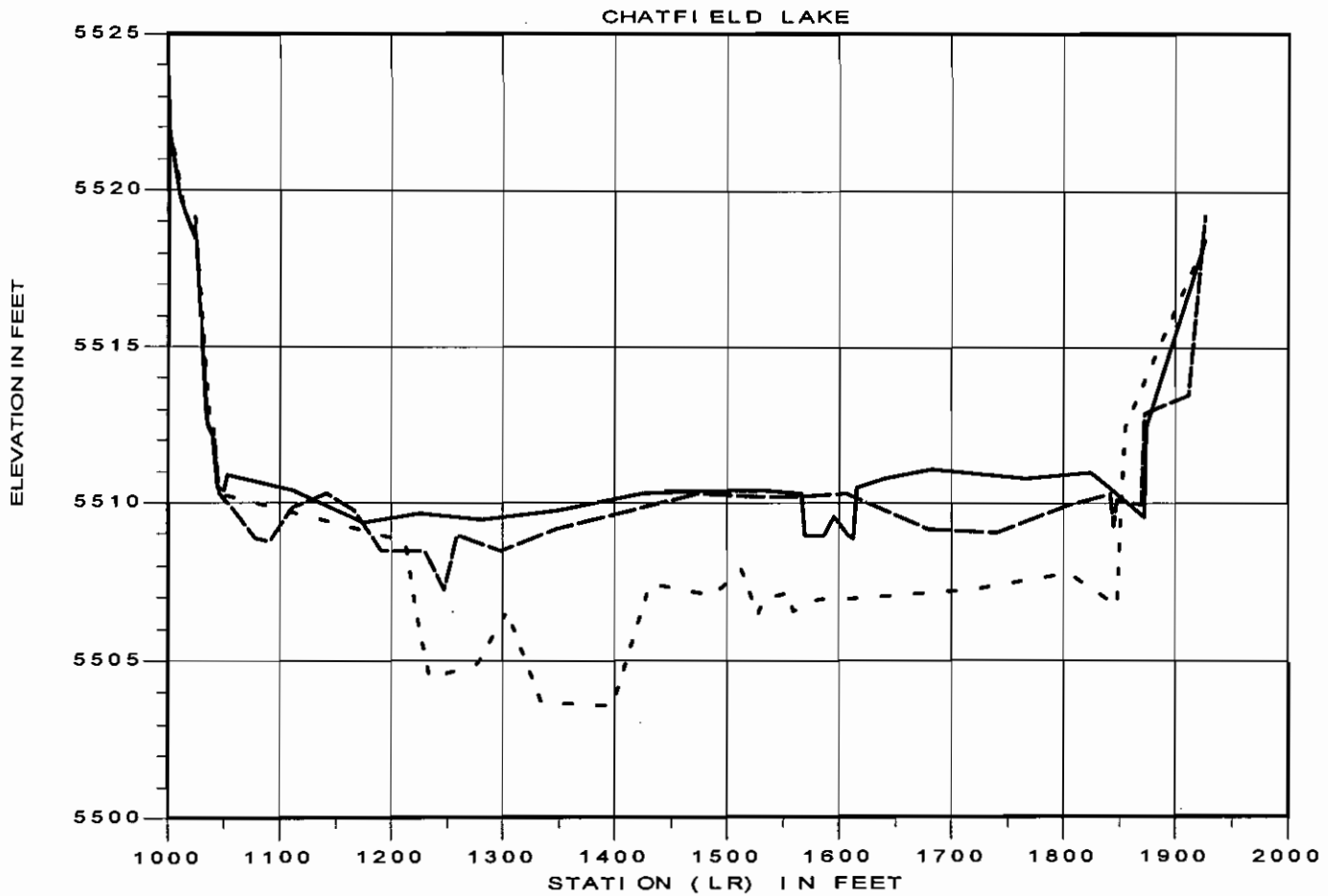

CHATFIELD LAKE
5525
5520
5515
5510
5505
5500
ELEVATION IN FEET
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
STATION (LR) IN FEET
CH-22 01977 DRY
CH-22 23APR1991
CH-22 01NOV1998

PLATE IV-40

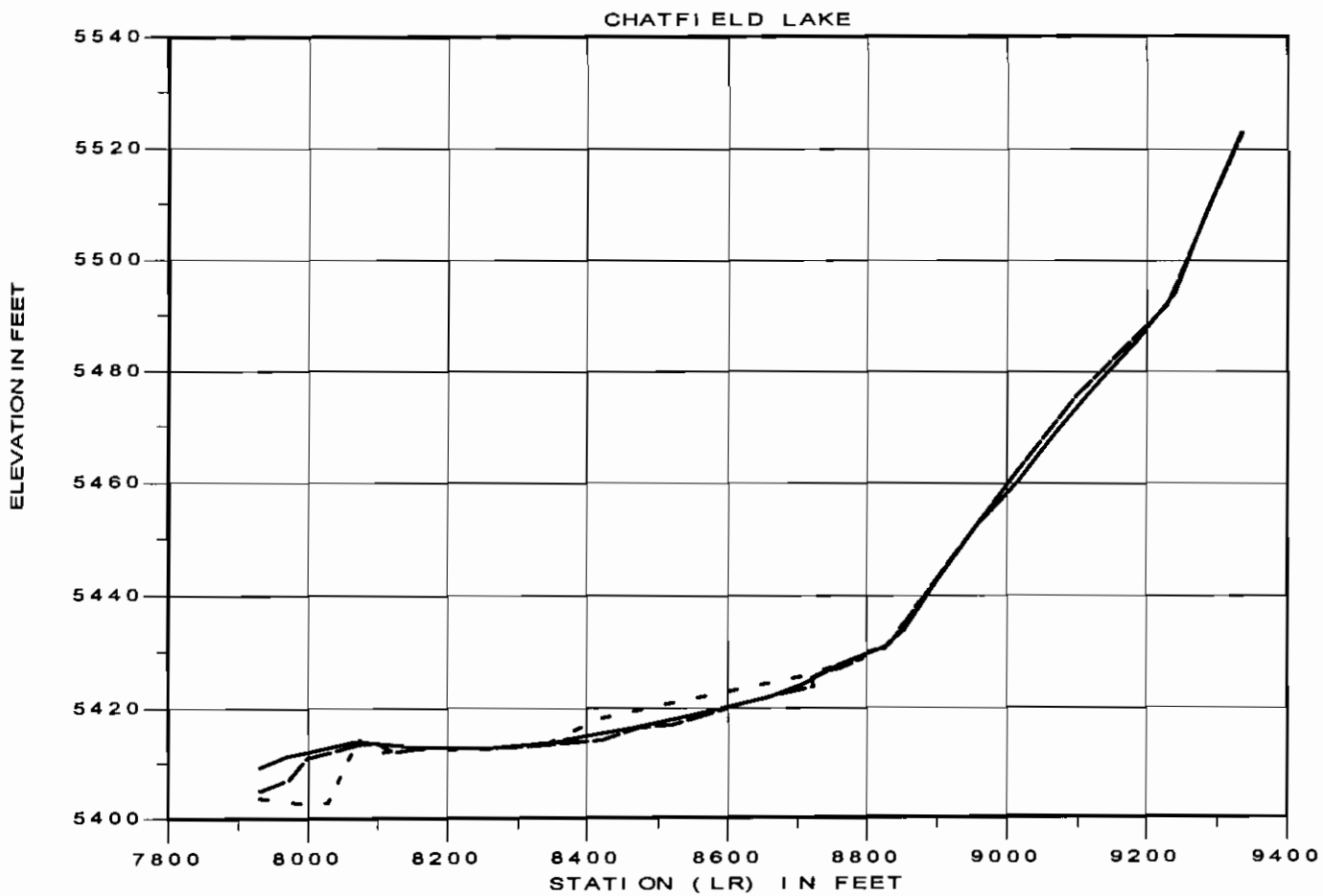

CHATFI ELD LAKE
ELEVATION IN FEET
5540
5520
5500
5480
5460
5440
5420
5400
7800
8000
8200
8400
8600
8800
9000
9200
9400
STATI ON (LR) I N FEET
CH- 101 05MAY1977 5418. 0
CH- 101 22MAY1991 5427. 3
CH- 101 06NOV1998

PLATE IV-41

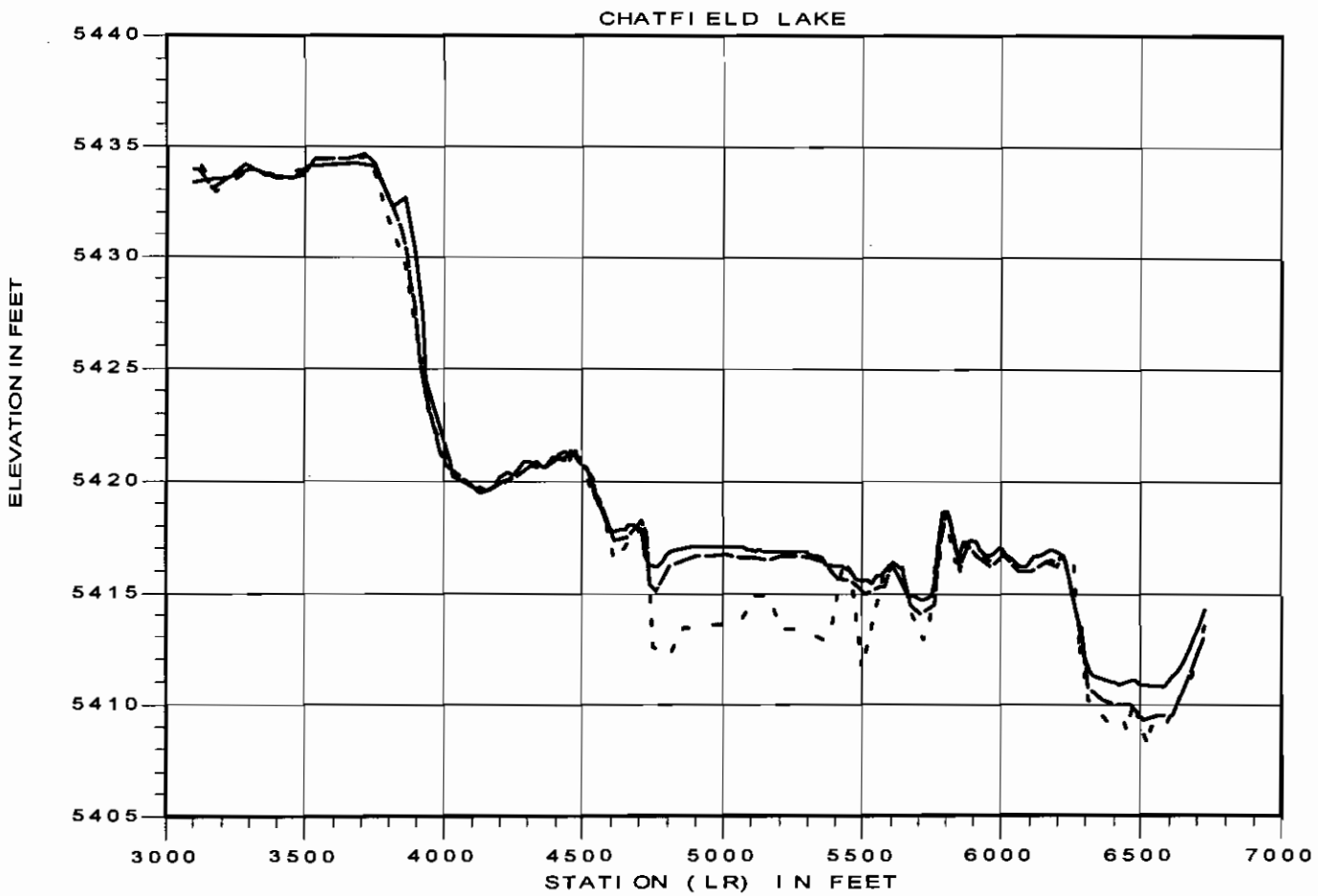

CHATFIELD LAKE
ELEVATION IN FEET
5440
5435
5430
5425
5420
5415
5410
5405
3000
3500
4000
4500
5000
5500
6000
6500
7000
STATION (LR) IN FEET
CH-115 09JUN1977 5416.4
CH-115 22MAY1991 5427.3
CH-115 06NOV1998 5424.4

PLATE IV-42

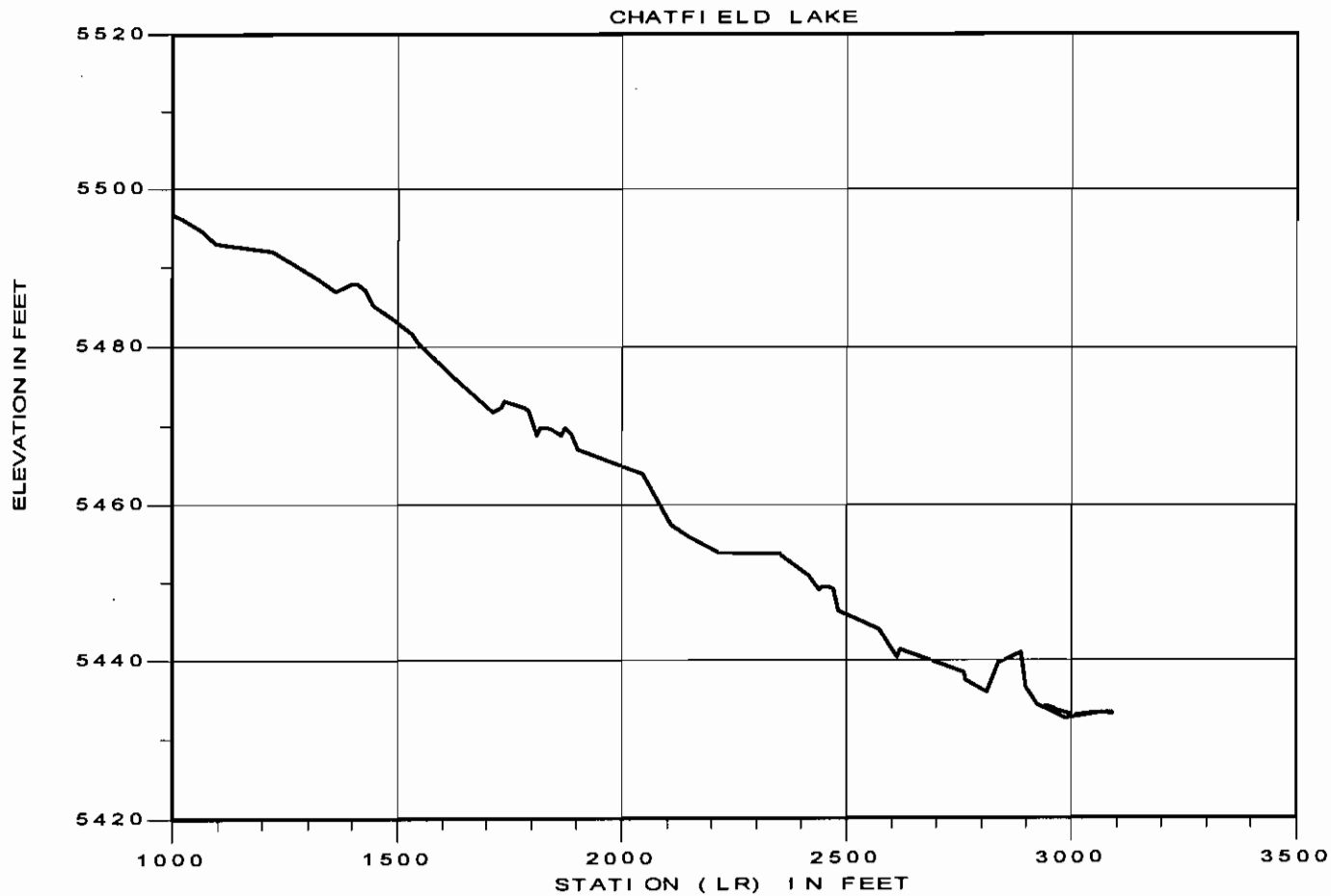

CHATFI ELD LAKE
5520
5500
5480
5460
5440
5420
ELEVATION IN FEET
1000
1500
2000
2500
3000
3500
STATI ON (LR) I N FEET
CH- 215 09JUN1977 5416. 4
CH- 215 22MAY1991 5427. 3
CH- 215 06NOV1998 5424. 4

PLATE IV-43

SECTION V – CHERRY CREEK LAKE

BACKGROUND

Cherry Creek Lake is located approximately 10 miles southeast of Denver, Colorado. The lake is located in Arapahoe County, Colorado. A map of Cherry Creek Lake, including its sediment ranges, is shown in Plate V-1.

Cherry Creek Dam is a rolled earth dam 14,300 feet long and 141 feet high containing 13,000,000 cubic yards of fill material. Cherry Creek Lake's closure occurred in October 1948. The lake is 1.5 miles long with 5 miles of shoreline at the multipurpose pool elevation of 5550.0 feet MSL and covers approximately 850 acres. The originally estimated long term average annual depletion rate for the lake was 151 acre-feet.

The 1997 data for Cherry Creek has been included in Plates V-2 through V-4. From the results and graphing of the cross-sectional data, there appears to be problems with the accuracy of the data. The 1997 data is not included in the discussion in the following sections.

SURFACE AREA

Plate V-2 is a plot of elevation versus surface area for all survey years.

Table V-1 shows reservoir surface area by elevation. The surface area at the top of the multipurpose pool (5550.0 feet MSL) at Cherry Creek decreased by 39 acres between 1950 and 1988. Shoreline erosion increases the surface area while delta growth decreases the surface area of the lake. The decrease in this case is likely due to delta growth at the multipurpose level.

CAPACITY CHANGES

Plate V-3 is a plot of the elevation versus reservoir capacity curve for all survey years.

Tables V-2 and V-3 present reservoir capacity by storage zone and a summary of capacity changes. Total storage (elevation 5504.0 – 5636.2 feet MSL) decreased 4022 acre-feet (1.74%) between 1950 and 1988. Storage in the flood control zone (elevation 5550.0 – 5598.0 feet MSL) decreased 1316 acre-feet (1.63%) between 1950 and 1988. Storage in the multipurpose zone (elevation 5504.0 – 5550.0 feet MSL) decreased 2350 acre-feet (15.5%) between 1950 and 1988. There is not a designated inactive zone for Cherry Creek Lake.

Table III-3 presents the sediment depletion rates up to the multipurpose pool zone (elevation 5504.0 – 5550.0 feet MSL). The total storage depletion rate between survey years 1950 and 1988 is 105.8 acre-feet per year, while the storage depletion rate in the multipurpose zone is 61.8 acre-feet per year. The original projected depletion rate was 151 acre-feet per year. The original projected depletion rate was made with a limited amount of data at the time the dam was constructed. Lower than predicted deposition is most likely attributable to the amount of data to make the original prediction and

lower sediment inflow rates during the late 1970's and early 1980's. Better sediment control throughout the watershed will likely occur as the development continues upstream of Cherry Creek Dam.

PROFILE PLOTS

Profile plots listed as Plate V-4 compares the average reservoir bed elevations during each of the survey years. The largest change in thalweg elevation is in the lake, as expected, showing almost 19 feet of build up between 1950 and 1988.

SEDIMENT VOLUME

Plate V-5 represents the change in sediment volume between 1950 and 1988. The quantity of sediment that entered the reservoir per survey period is shown in Table V-2. The total sediment change and the depletion rate for the range of years is shown below.

Survey Period	Total Volume Depletion (AF)	Depletion Rate (AF/YR)
1950-1961	862	78.4
1961-1965	1406	351.5
1965-1974	1056	117.3
1974-1988	698	49.9
1950-1988	4022	105.8

AREA AND CAPACITY TABLES

Area and capacity tables computed at 1-foot increments are located in Appendix D.

CROSS SECTION DATA

Cross-sectional plots are shown on Plates V-6 through V-24.

ENG FORM 1787 – RESERVOIR SEDIMENT DATA SUMMARY

ENG FORM 1787, "Reservoir Sedimentation Data Summary". Is presented in Appendix E. The purpose of this form is to provide a means for the uniform documentation of pertinent Cherry Creek Lake sedimentation data.

TABLE V-1.
RESERVOIR SURFACE AREA BY ELEVATION
CHERRY CREEK LAKE NEAR DENVER, COLORADO

RESERVOIR ZONE & ELEVATION		SURFACE AREA (acres)				
		1950	1961	1965	1974	1988
Flood Control Pool	5598.0 ft. MSL	2640	2641	2636	2636	2642
Multipurpose Pool	5550.0 ft. MSL	886	872	856	851	847

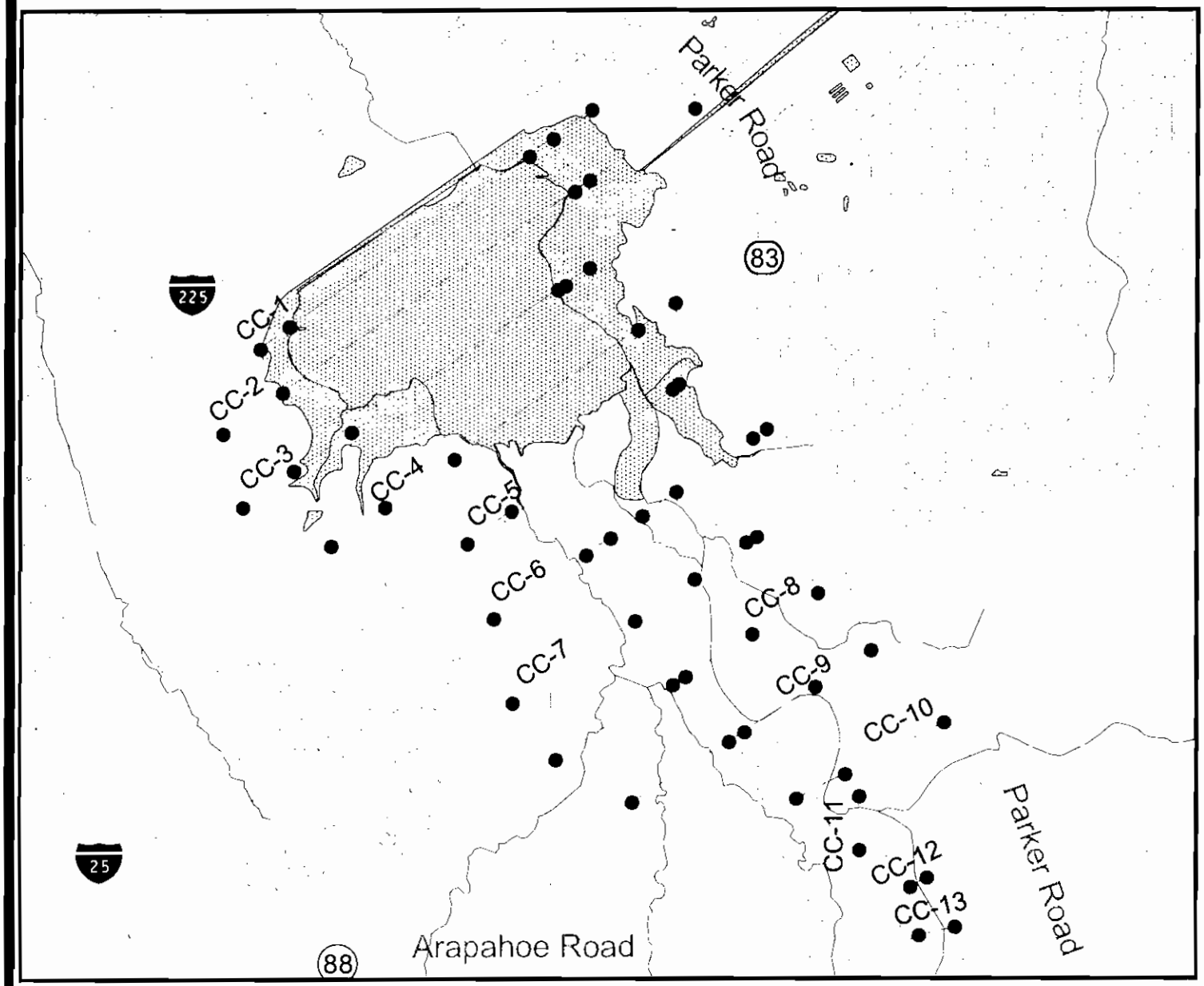
TABLE V-2.
RESERVOIR STORAGE CAPACITY BY STORAGE ZONE FOR CHERRY CREEK LAKE

STORAGE ZONE	RESERVOIR CAPACITY acre-feet					CHANGE IN CAPACITY acre-feet					DEPLETION RATE/YEAR acre-feet/yr
	1950	1961	1965	1974	1988	50-61	61-65	65-74	74-88	50-88	50-88
Surcharge 5598.0-5636.2	134785	134629	134453	134458	134429	-156	-176	5	-29	-356	9.4
Flood Control 5550.0-5598.0	80638	80502	79916	79576	79322	-136	-586	-340	-254	-1316	34.6
Multipurpose 5504.0-5550.0	15155	14585	13941	13220	12805	-570	-644	-721	-415	-2350	61.8
GROSS STORAGE 5504.0 - 5636.2	230578	229716	228310	227254	226556	-862	-1406	-1056	-698	-4022	105.8

TABLE V-3.
SEDIMENT DEPLETION RATES
UP TO THE MULTIPURPOSE POOL ZONE (EL. 5504.0 - 5550.0 FT. MSL)
CHERRY CREEK LAKE

Survey Year	No. of Years Between Surveys	Total Capacity (AF)	Capacity Lost (AF)	Depletion Rate Between Surveys (AF/Year)	Depletion Rate Since 1950 (AF/Year)
1950		15155			0.0
	11		570	51.8	
1961		14585			51.8
	4		644	161.0	
1965		13941			80.9
	9		721	80.1	
1974		13220			80.6
	14		415	29.6	
1988		12805			61.8

Cherry Creek Sedimentation Ranges



N

LEGEND

- Range Monuments
- Rivers & Lakes
- Sediment Range Line
- Roads
- Cherry Creek Lake

1 0 1 2 3 4 5 Miles

Plate V-1

Cherry Creek Lake
Elevation vs. Surface Area for All Survey Years

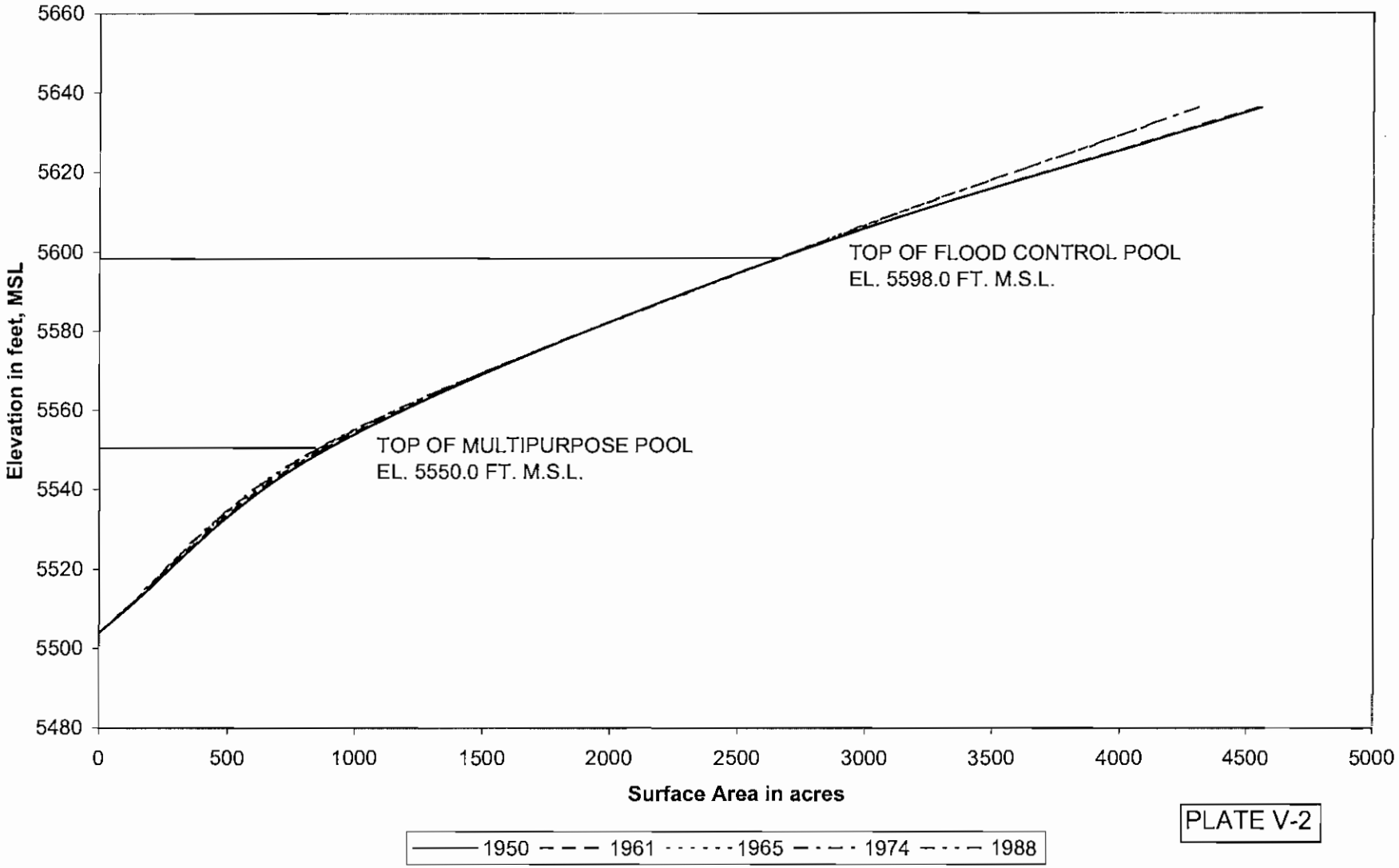


PLATE V-2

Cherry Creek Lake
Elevation vs. Storage Capacity for All Survey Years

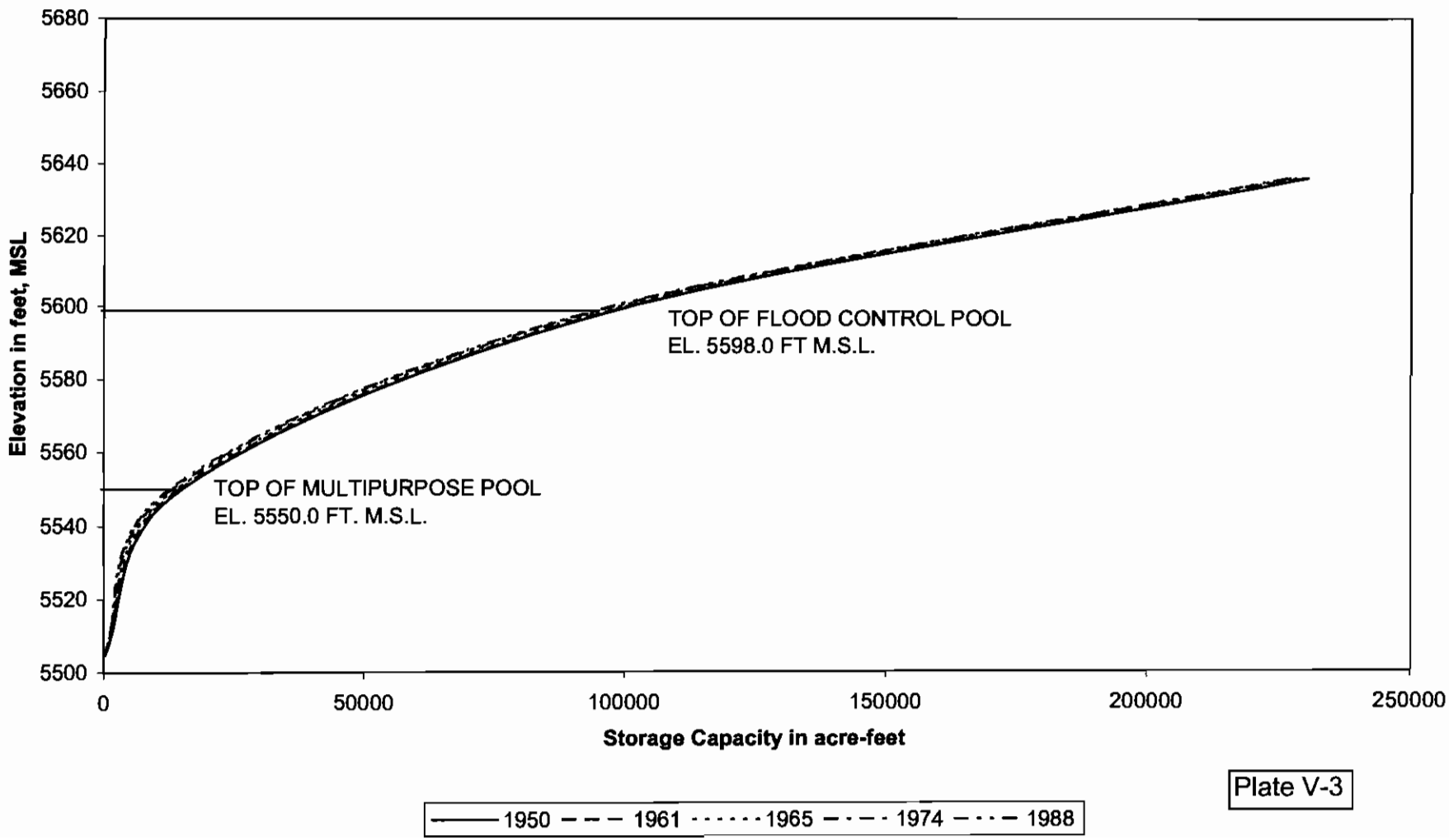


Plate V-3

Cherry Creek Lake
Average Bed Profile for All Survey Years

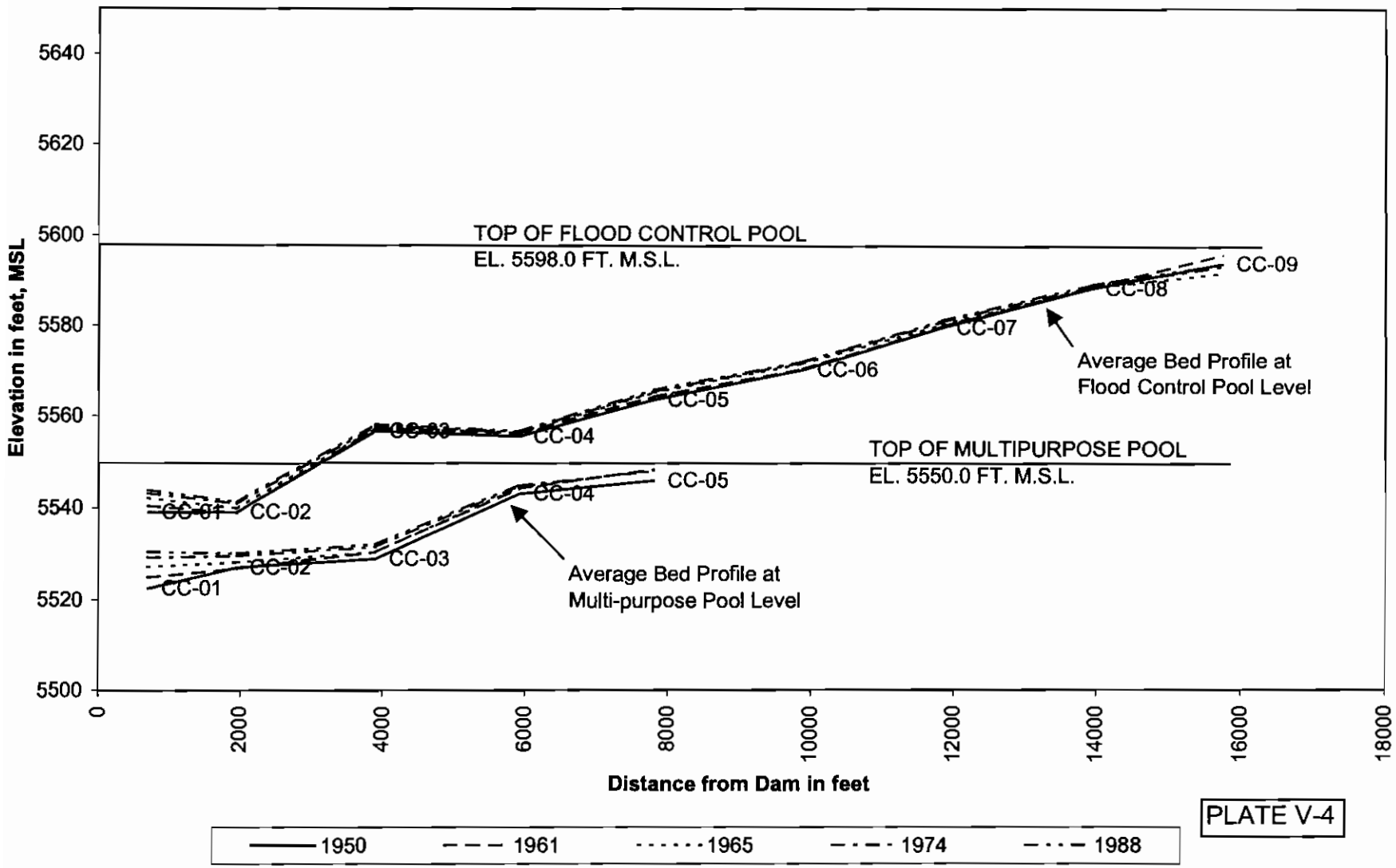
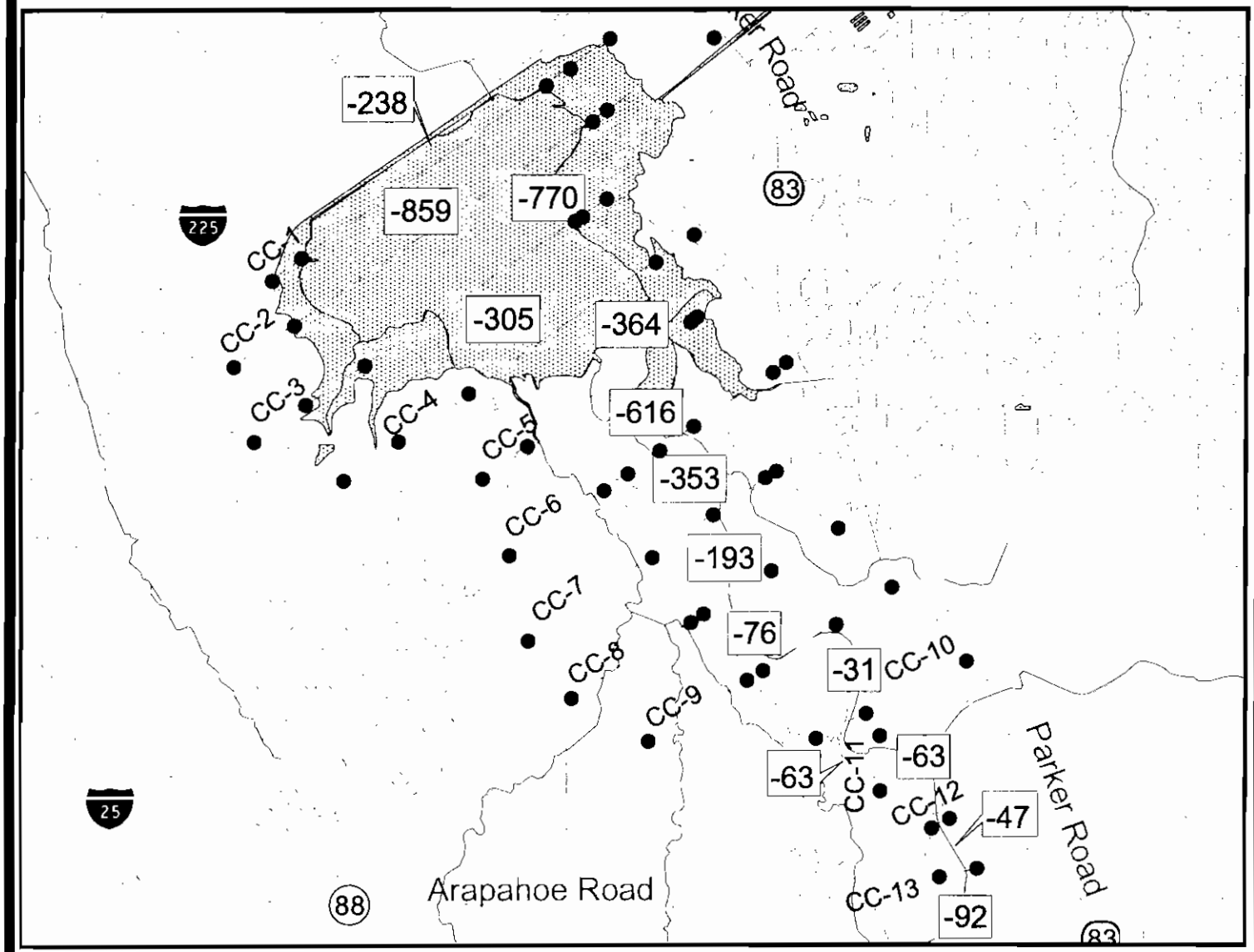


PLATE V-4

Cherry Creek Lake Change in Capacity 1950-1988



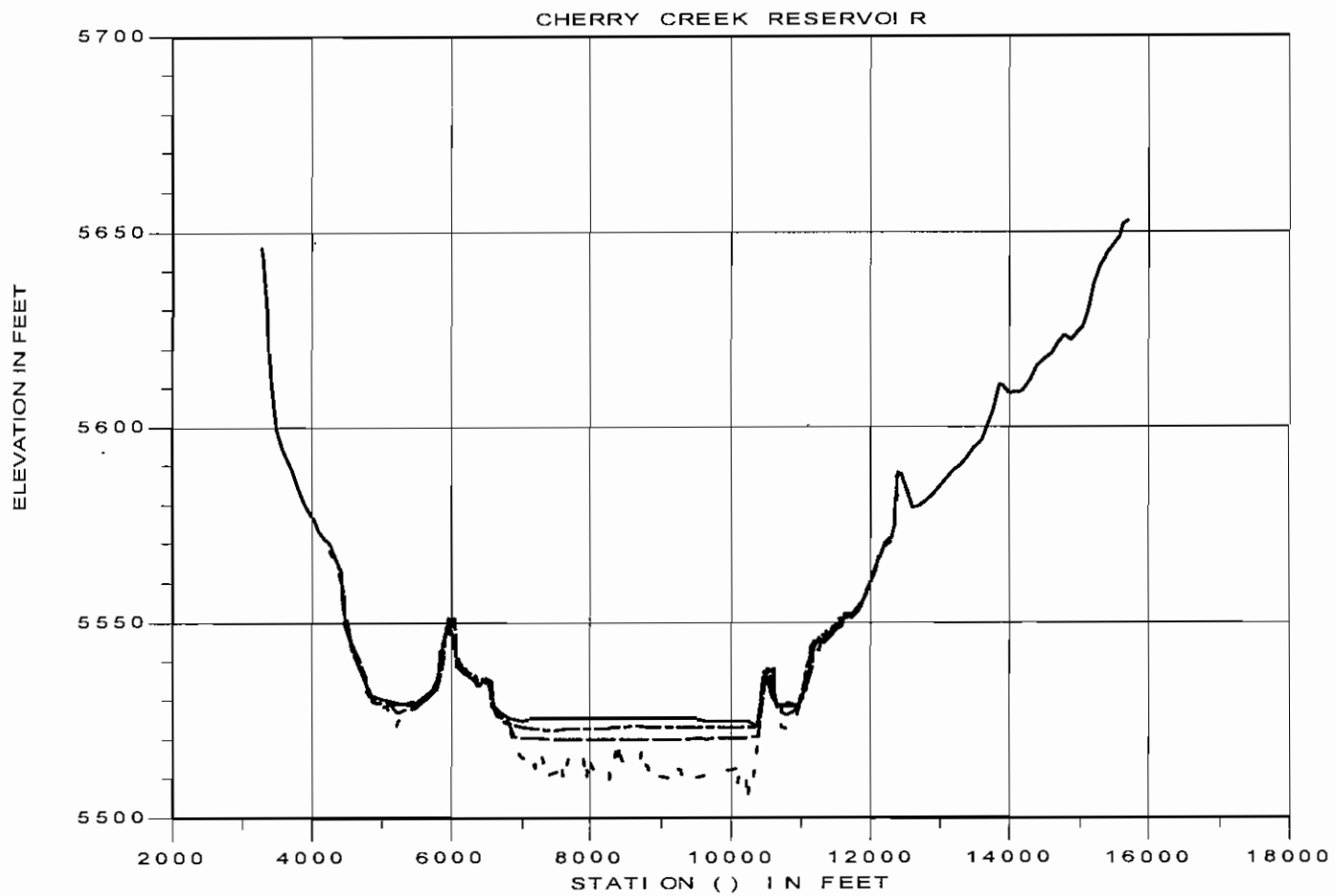
N

LEGEND

- Range Monuments
- Rivers & Lakes
- Sediment Range Line
- Roads
- Cherry Creek Lake
- -305 Capacity Change in Acre-Feet

1 0 1 2 3 4 5 Miles

Plate V-5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5650
5600
5550
5500
2000
4000
6000
8000
10000
12000
14000
16000
18000
STATI ON ( ) I N FEET
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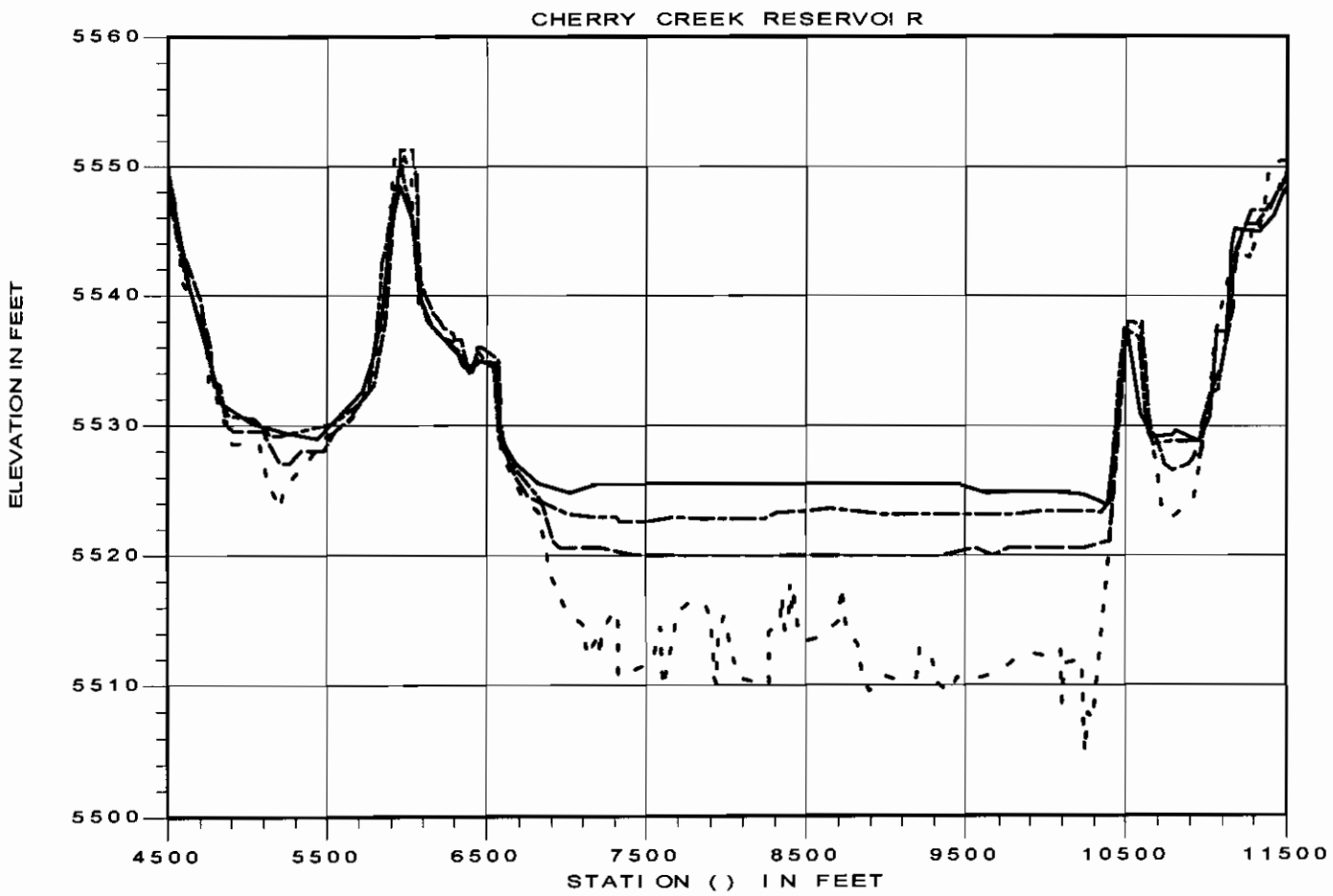
CC- 01 17AUG1965
CC- 01 11JUL1974
CC- 01 15JUN1988 5550. 9

PLATE V-6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ELEVATION IN FEET
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5520
5510
5500
4500
5500
6500
7500
8500
9500
10500
11500
STATI ON () I N FEET
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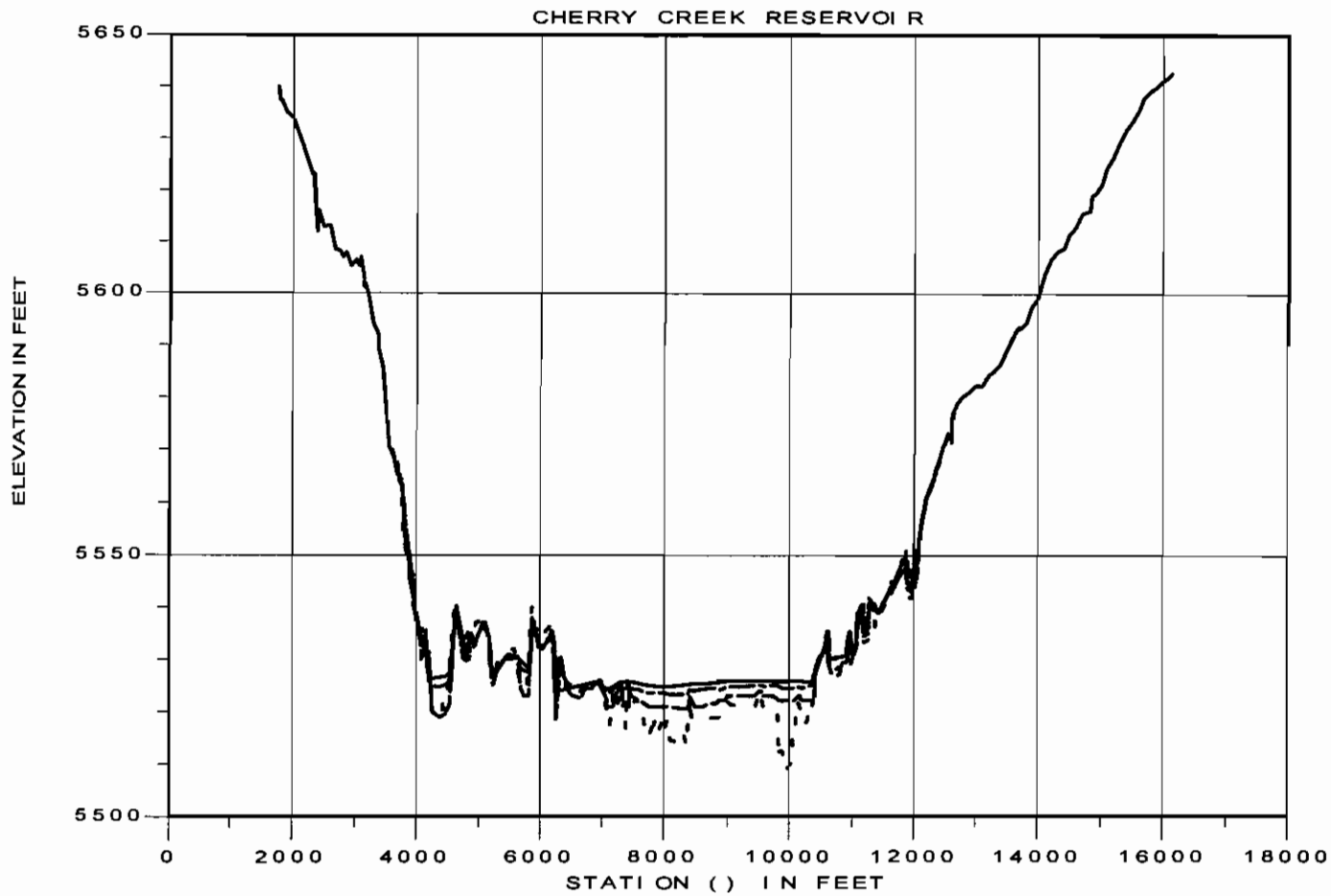
CC- 01 17AUG1965
CC- 01 11JUL1974
CC- 01 15JUN1988 5550. 9

PLATE V-7


CHERRY CREEK RESERVOI R
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5600
5550
5500
ELEVATION IN FEET
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
STATI ON ( ) I N FEET
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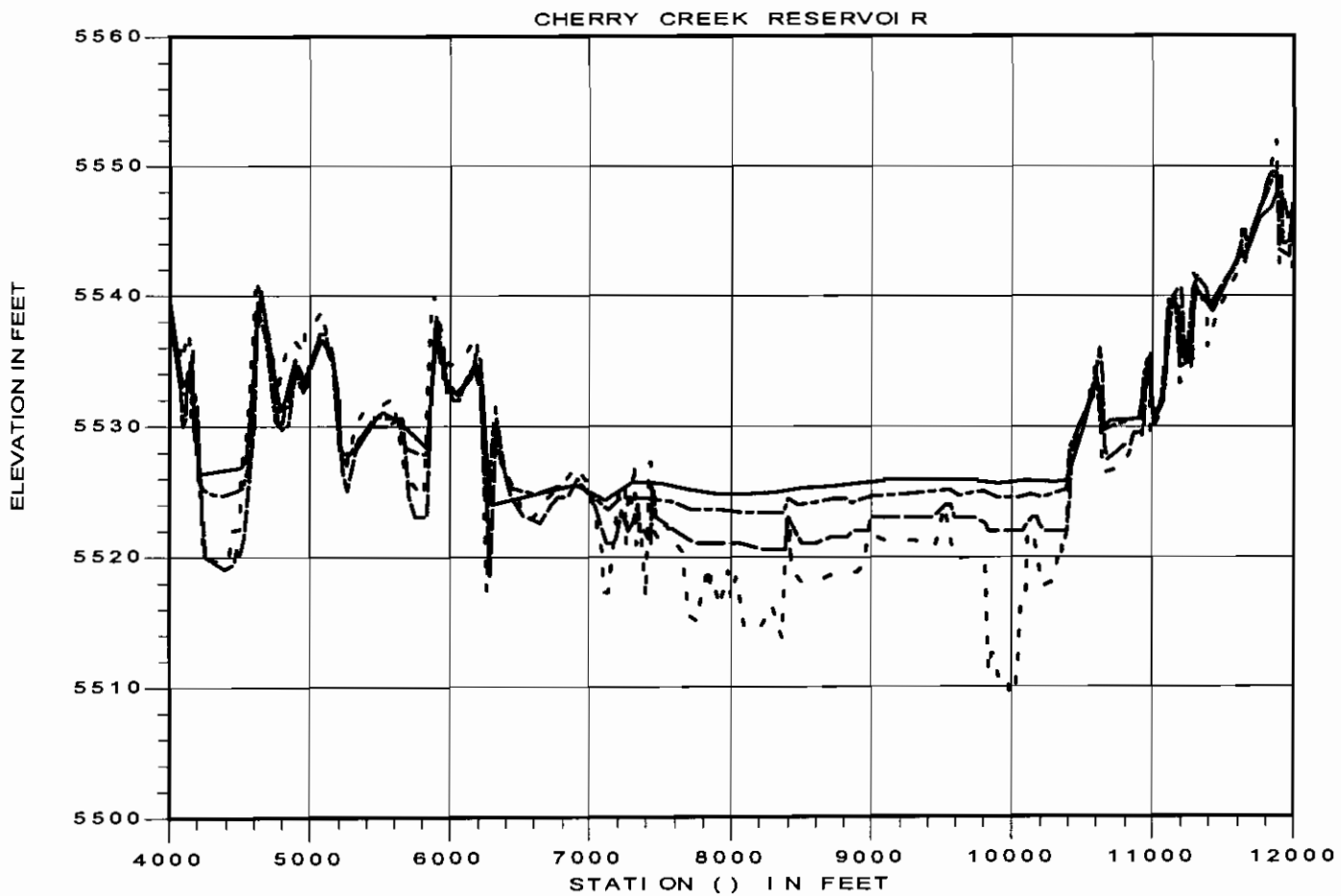
CC- 02 17AUG1965
CC- 02 11JUL1974
CC- 02 15JUN1988 5550. 9

PLATE V-8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ELEVATION IN FEET
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5550
5540
5530
5520
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5500
4000
5000
6000
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9000
10000
11000
12000
STATI ON ( ) I N FEET
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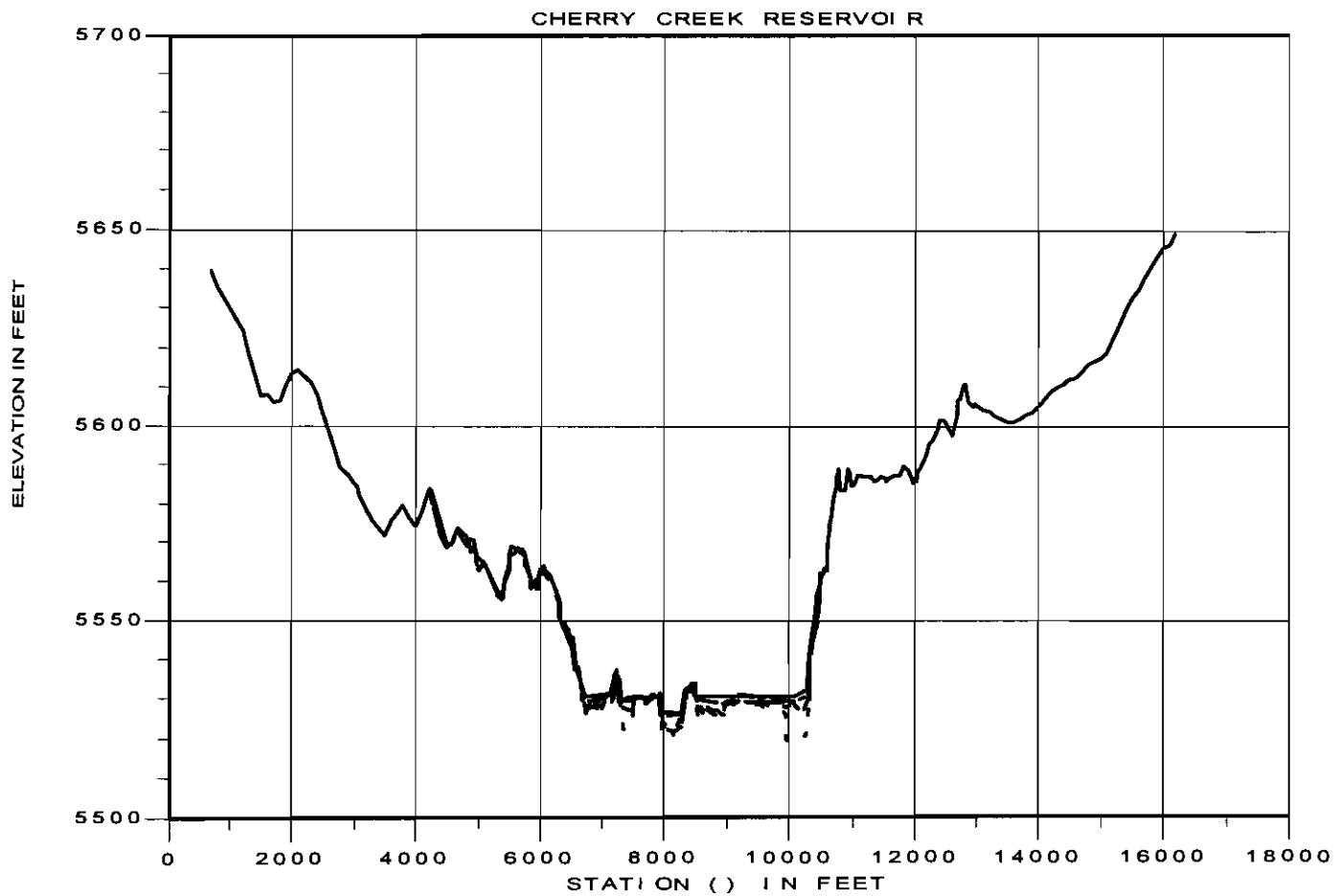
CC- 02 17AUG1965
CC- 02 11JUL1974
CC- 02 15JUN1988 5550. 9

PLATE V-9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5650
5600
5550
5500
ELEVATION IN FEET
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2000
4000
6000
8000
10000
12000
14000
16000
18000
STATI ON ( ) I N FEET
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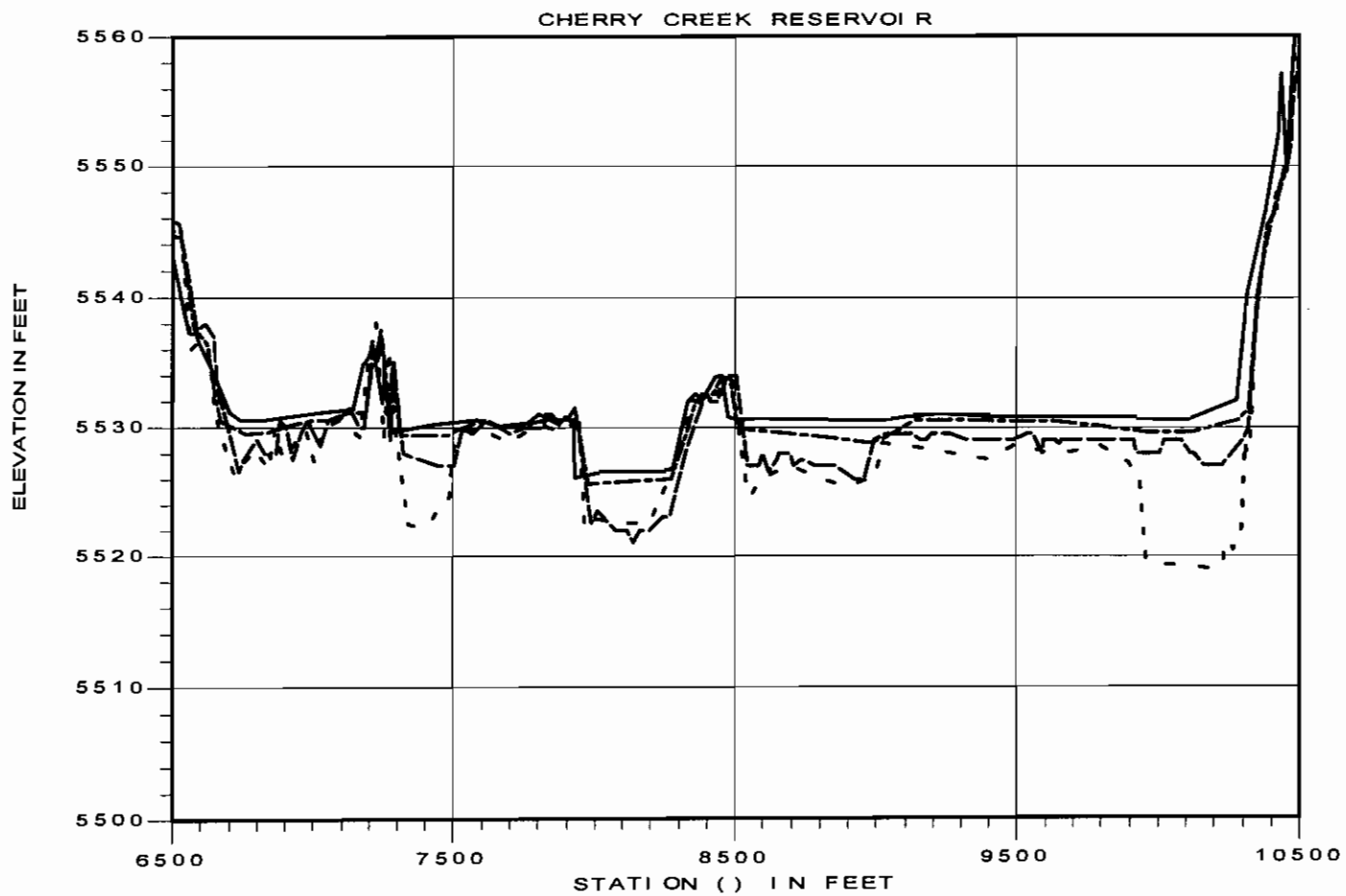
CC- 03 17AUG1965
CC- 03 11JUL1974
CC- 03 15JUN1988 5550. 9

PLATE V-10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ELEVATION IN FEET
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5550
5540
5530
5520
5510
5500
6500
7500
8500
9500
10500
STATI ON ( ) I N FEET
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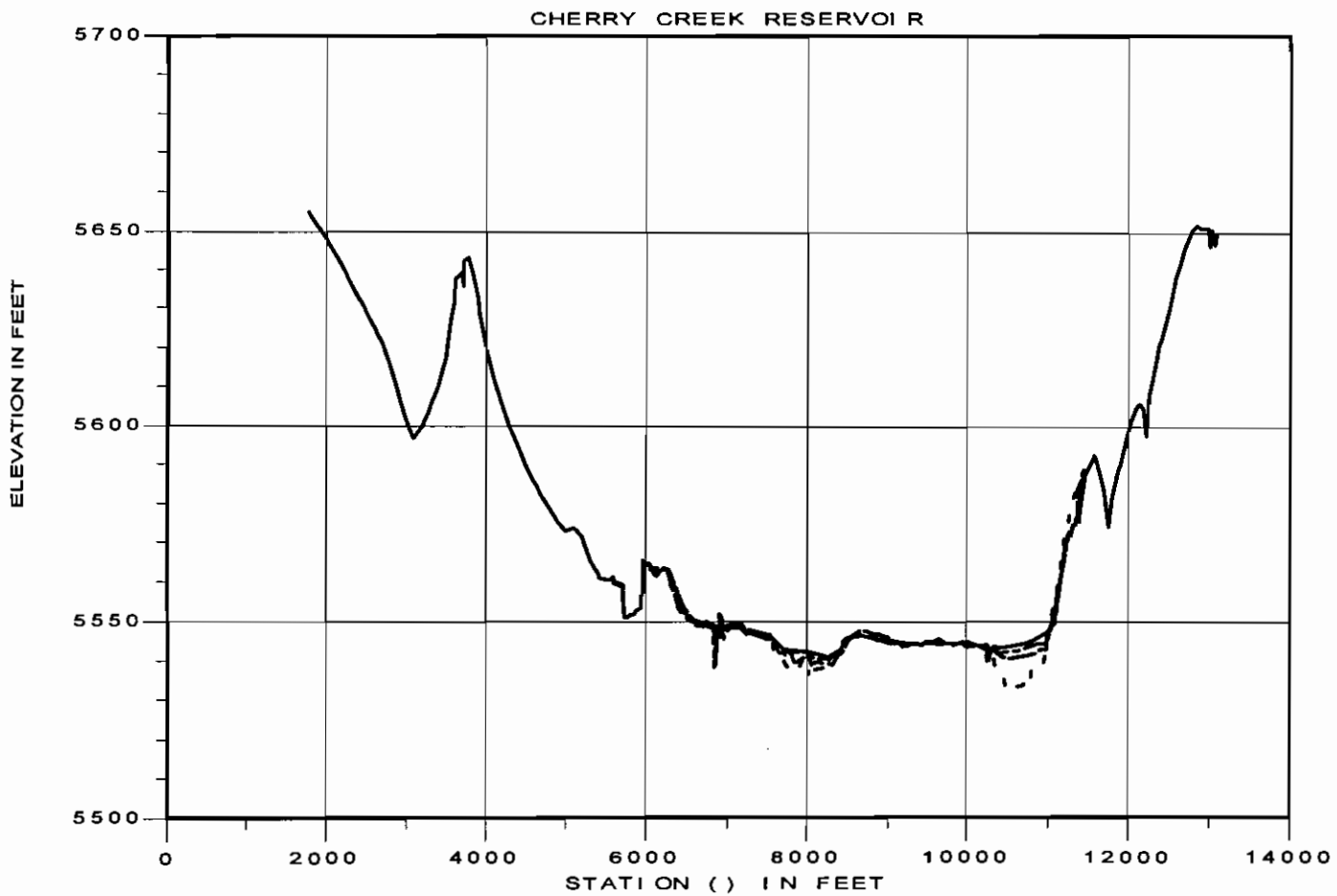
CC- 03 17AUG1965
CC- 03 11JUL1974
CC- 03 15JUN1988 5550. 9

PLATE V-11


CHERRY CREEK RESERVOI R
5700
5650
5600
5550
5500
ELEVATION IN FEET
0
2000
4000
6000
8000
10000
12000
14000
STATI ON ( ) I N FEET
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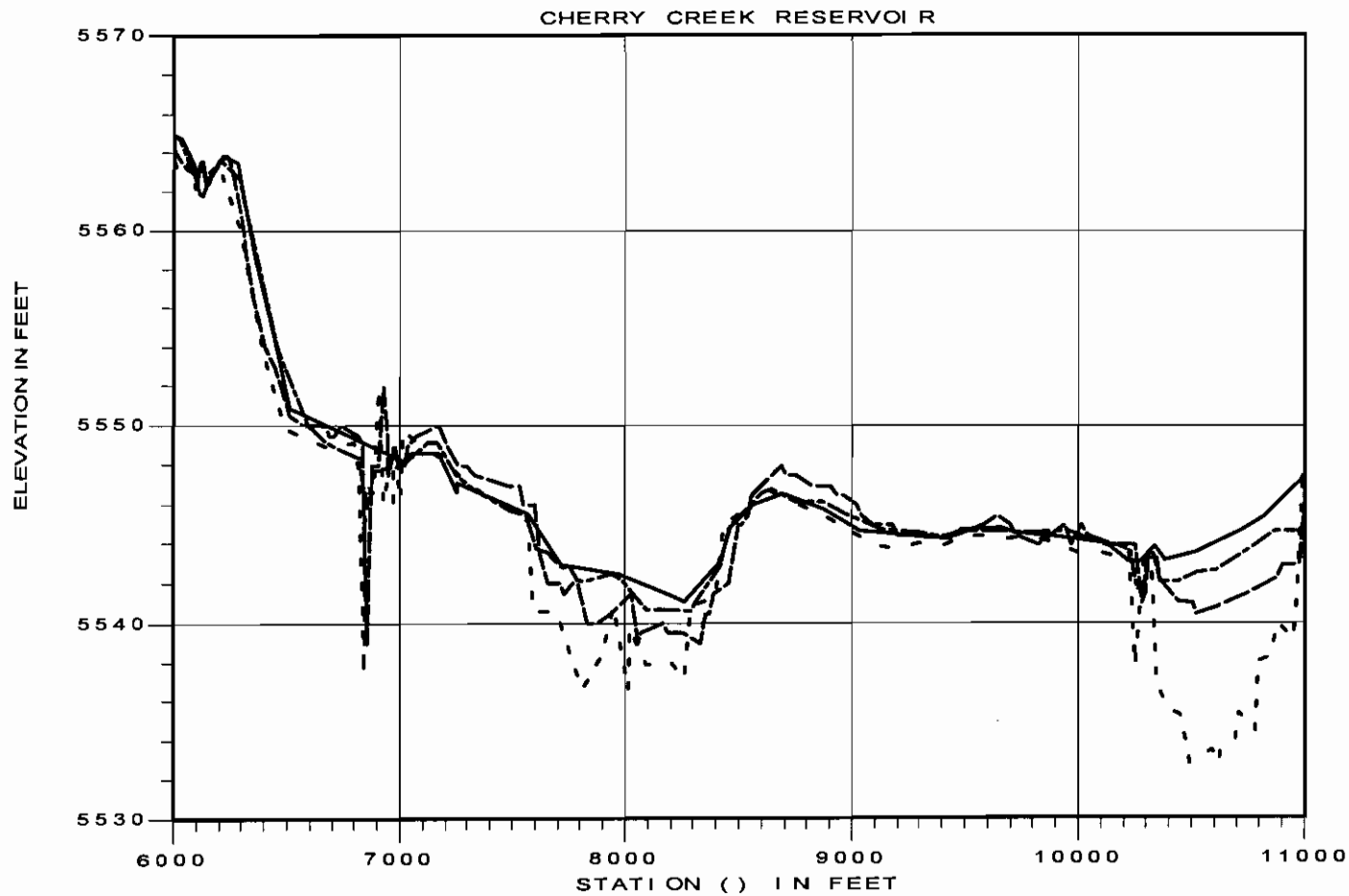
CC- 04 11AUG1965
CC- 04 11JUL1974
CC- 04 15JUN1988 5550. 9

PLATE V-12


CHERRY CREEK RESERVOI R
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5560
5550
5540
5530
ELEVATION IN FEET
6000
7000
8000
9000
10000
11000
STATI ON ( ) I N FEET
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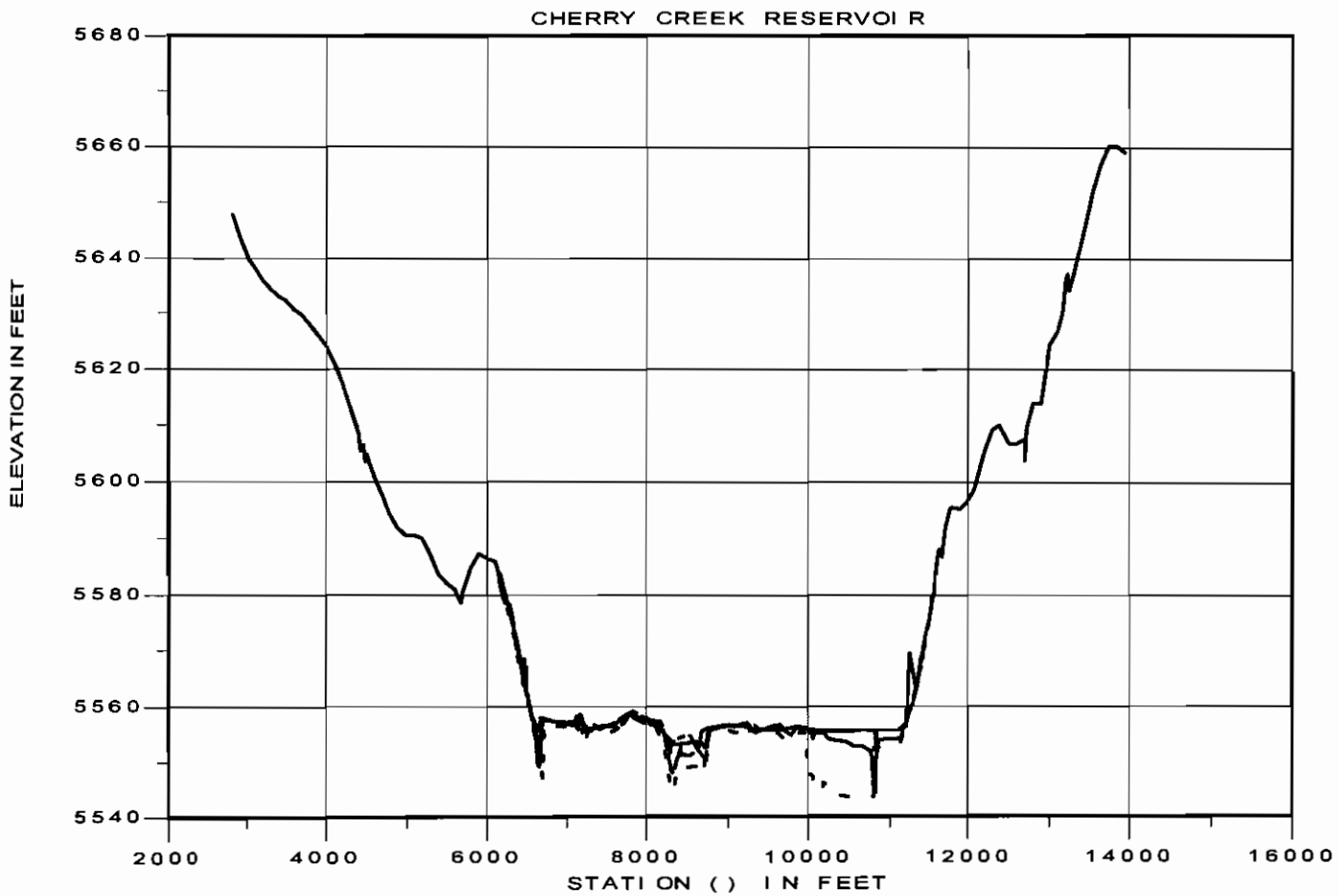
CC- 04 11AUG1965
CC- 04 11JUL1974
CC- 04 15JUN1988 5550. 9

PLATE V-13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ELEVATION IN FEET
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5660
5640
5620
5600
5580
5560
5540
2000
4000
6000
8000
10000
12000
14000
16000
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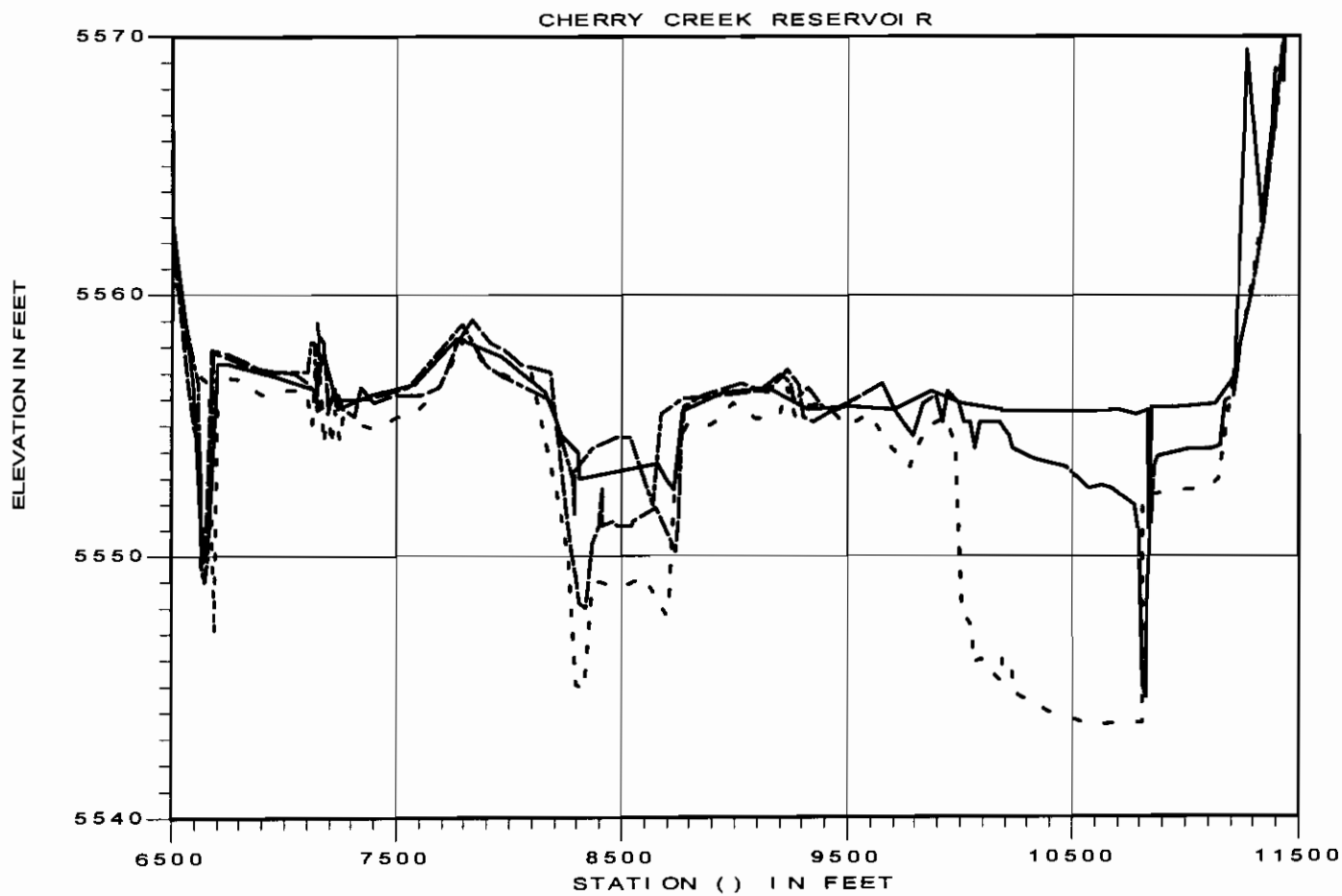
CC- 05 15JUL1974
CC- 05 15JUN1988 5554. 8

PLATE V-14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5560
5550
5540
ELEVATION IN FEET
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7500
8500
9500
10500
11500
STATI ON ( ) I N FEET
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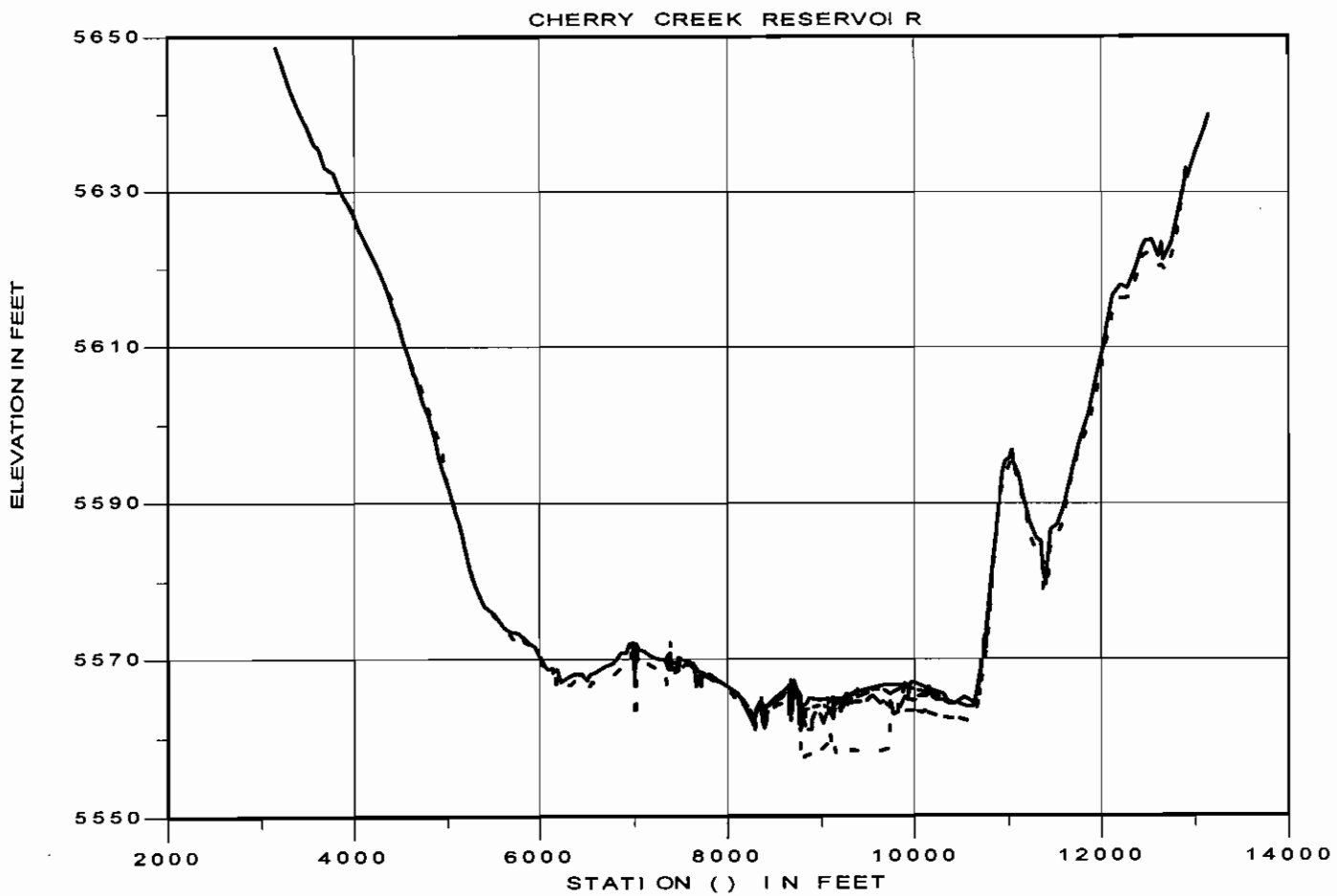
CC- 05 15JUL1974
CC- 05 15JUN1988 5554. 8

PLATE V-15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ELEVATION IN FEET
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5630
5610
5590
5570
5550
2000
4000
6000
8000
10000
12000
14000
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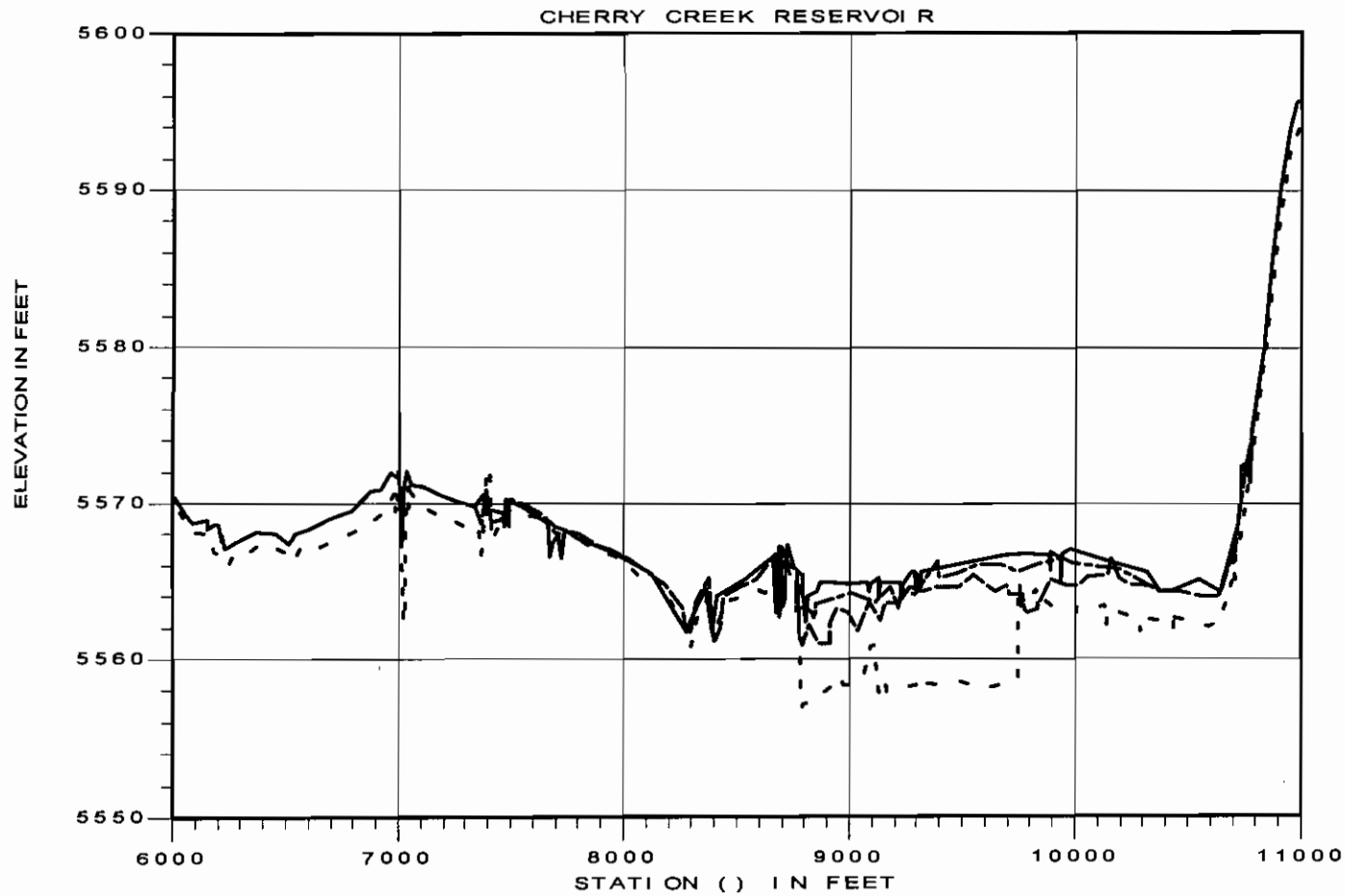
CC- 06 23AUG1965
CC- 06 15JUL1974
CC- 06 10JUN1988 5563. 6

PLATE V-16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5570
5560
5550
ELEVATION IN FEET
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7000
8000
9000
10000
11000
STATI ON ( ) I N FEET
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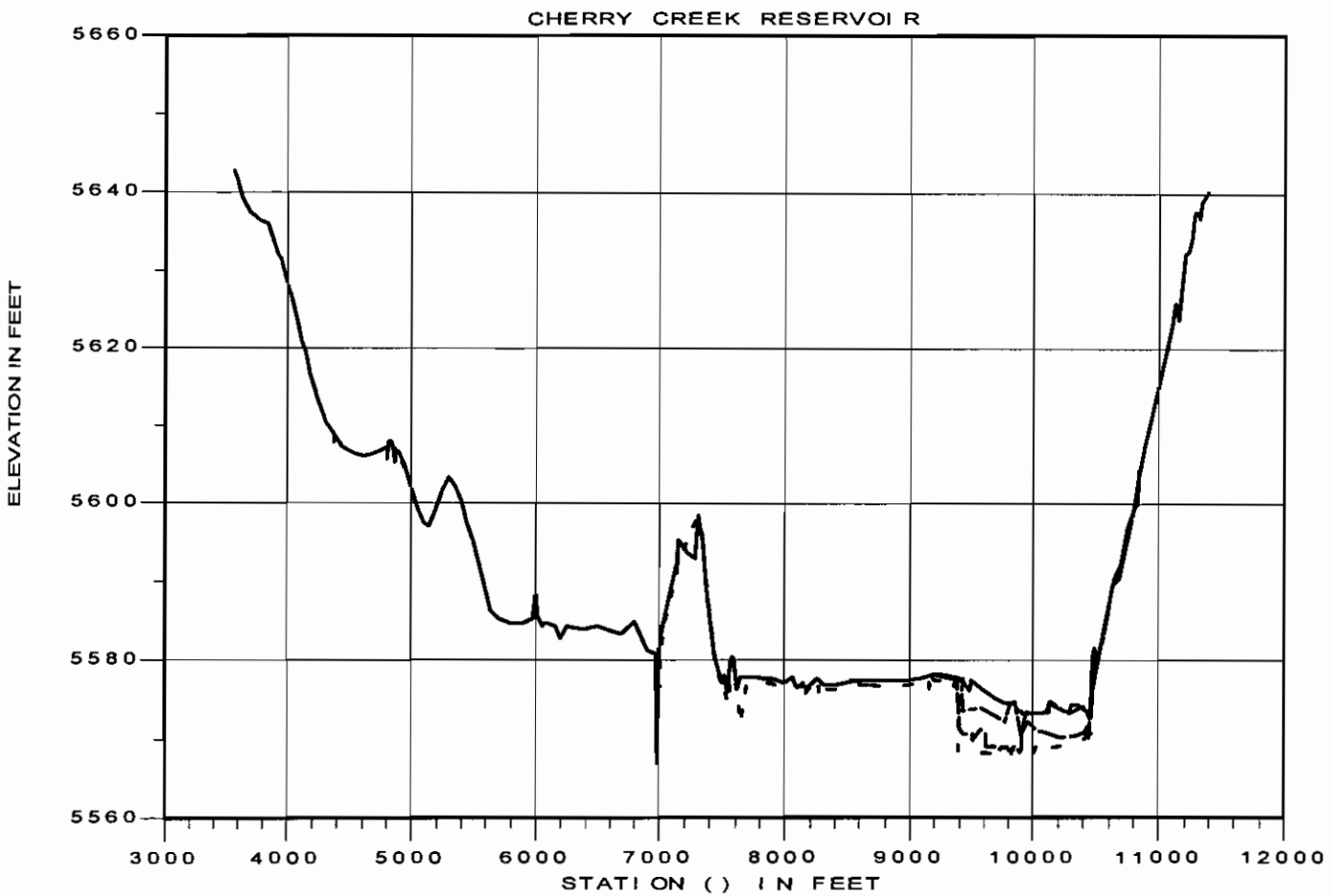
CC- 06 15JUL1974
CC- 06 10JUN1988 5563. 6

PLATE V-17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ELEVATION IN FEET
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4000
5000
6000
7000
8000
9000
10000
11000
12000
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CC- 07 23AUG1965
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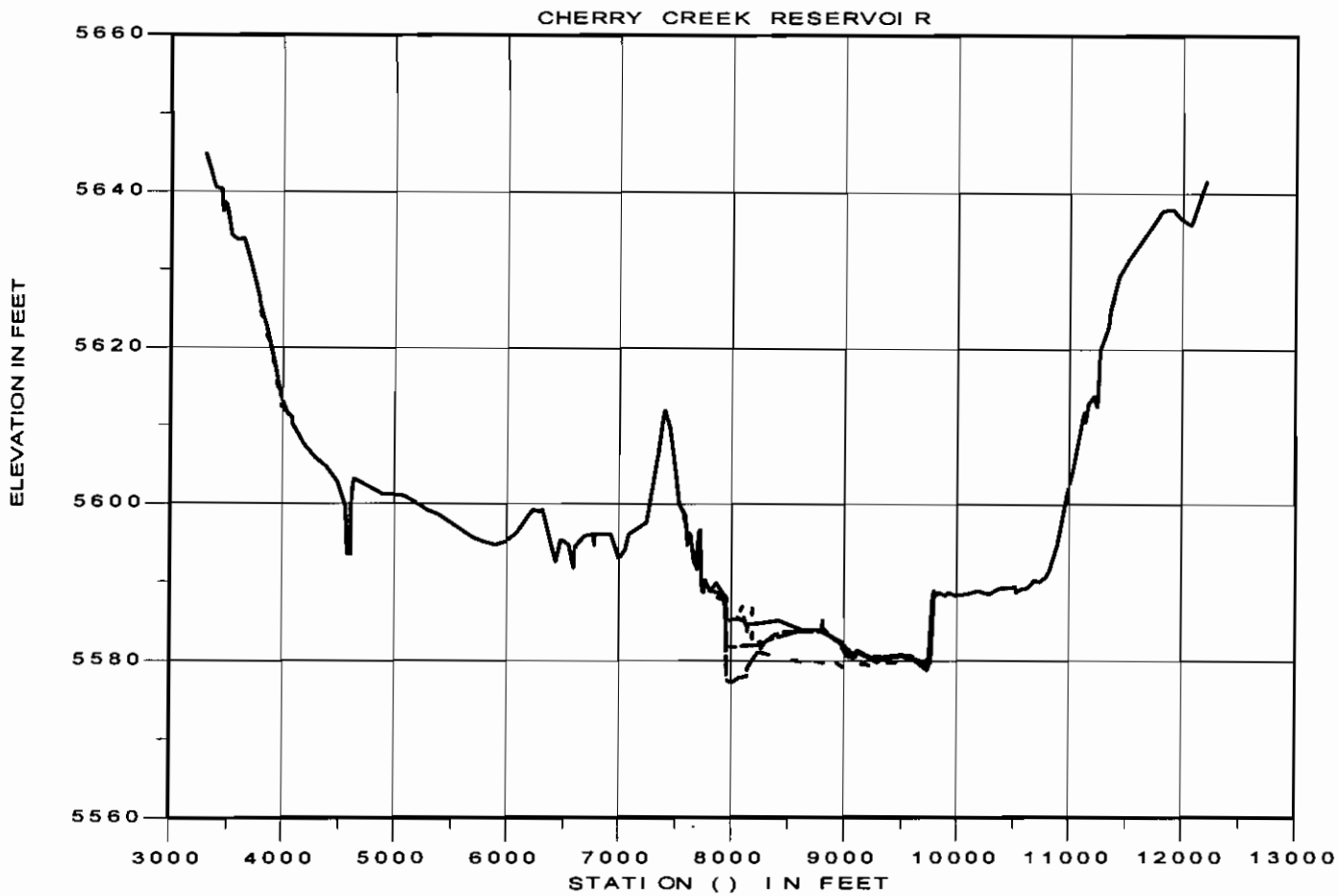
CC- 07 10JUN1988 5573. 5

PLATE V-18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ELEVATION IN FEET
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4000
5000
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8000
9000
10000
11000
12000
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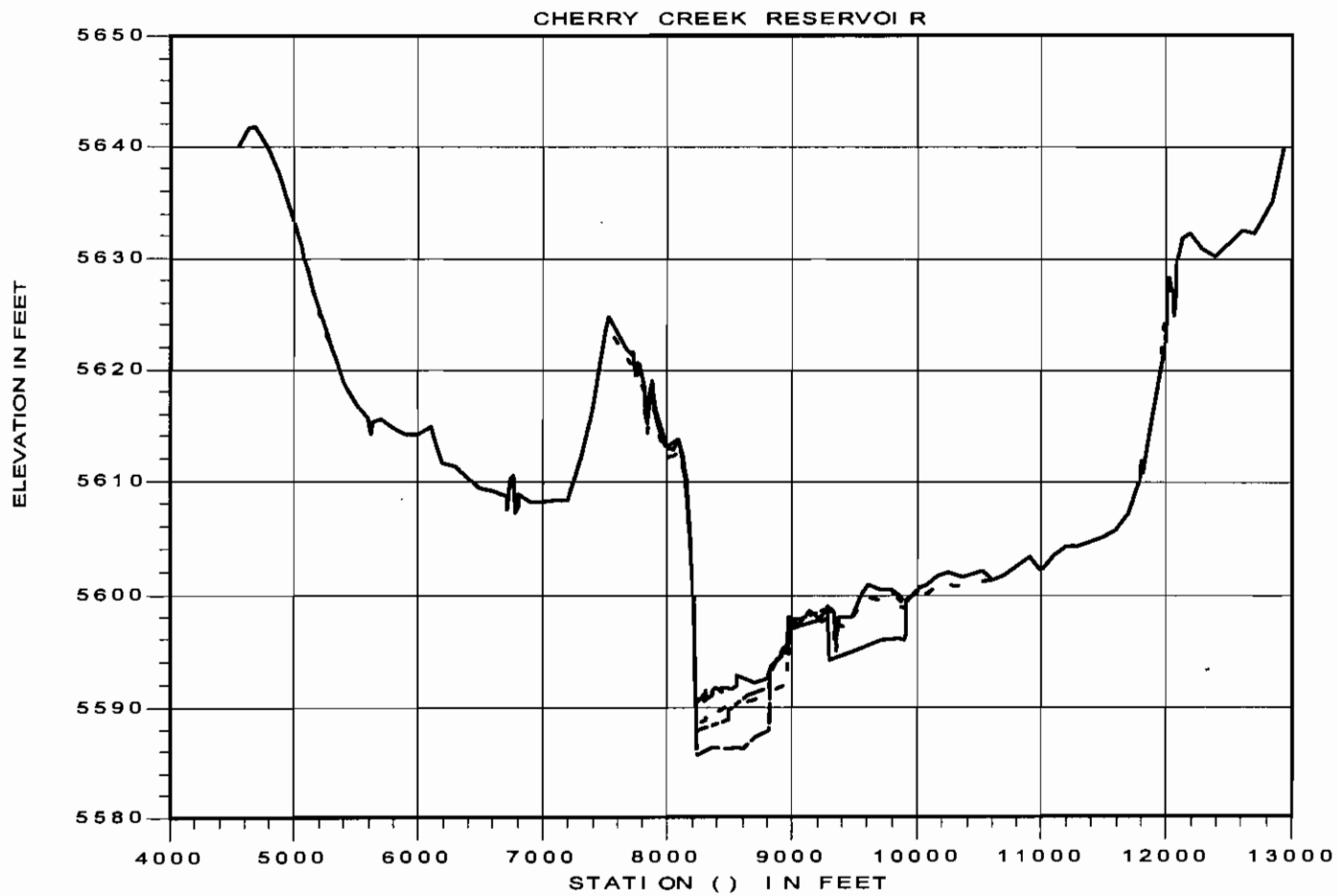
CC- 08 17JUL1974
CC- 08 09JUN1988 5585. 2

PLATE V-19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5610
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5590
5580
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5000
6000
7000
8000
9000
10000
11000
12000
13000
STATI ON ( ) I N FEET
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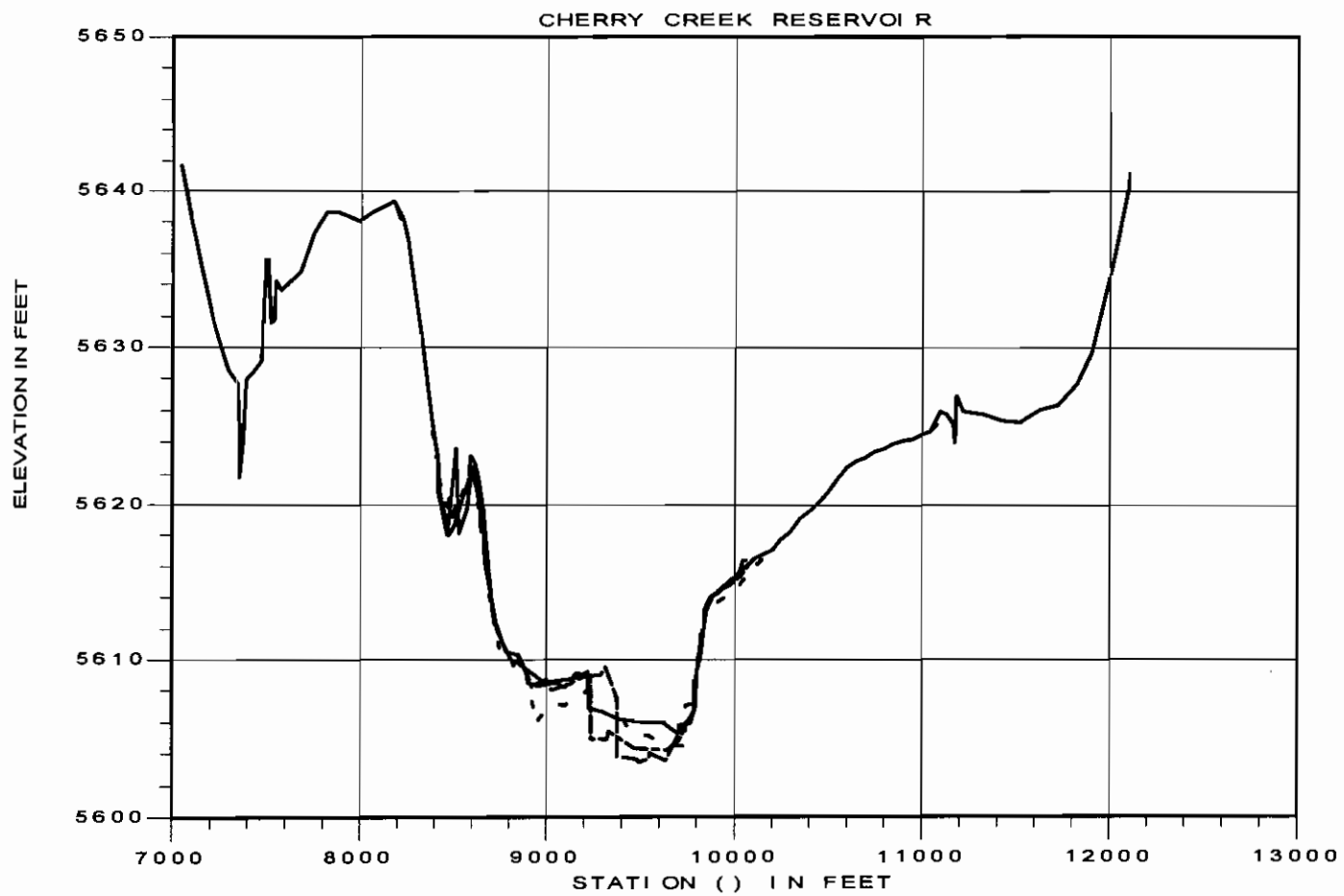
CC-09 21AUG1965
CC-09 16JUL1974
CC-09 09JUN1988 5596.0

PLATE V-20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5610
5600
ELEVATION IN FEET
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8000
9000
10000
11000
12000
13000
STATI ON ( ) I N FEET
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CC- 10 21AUG1965
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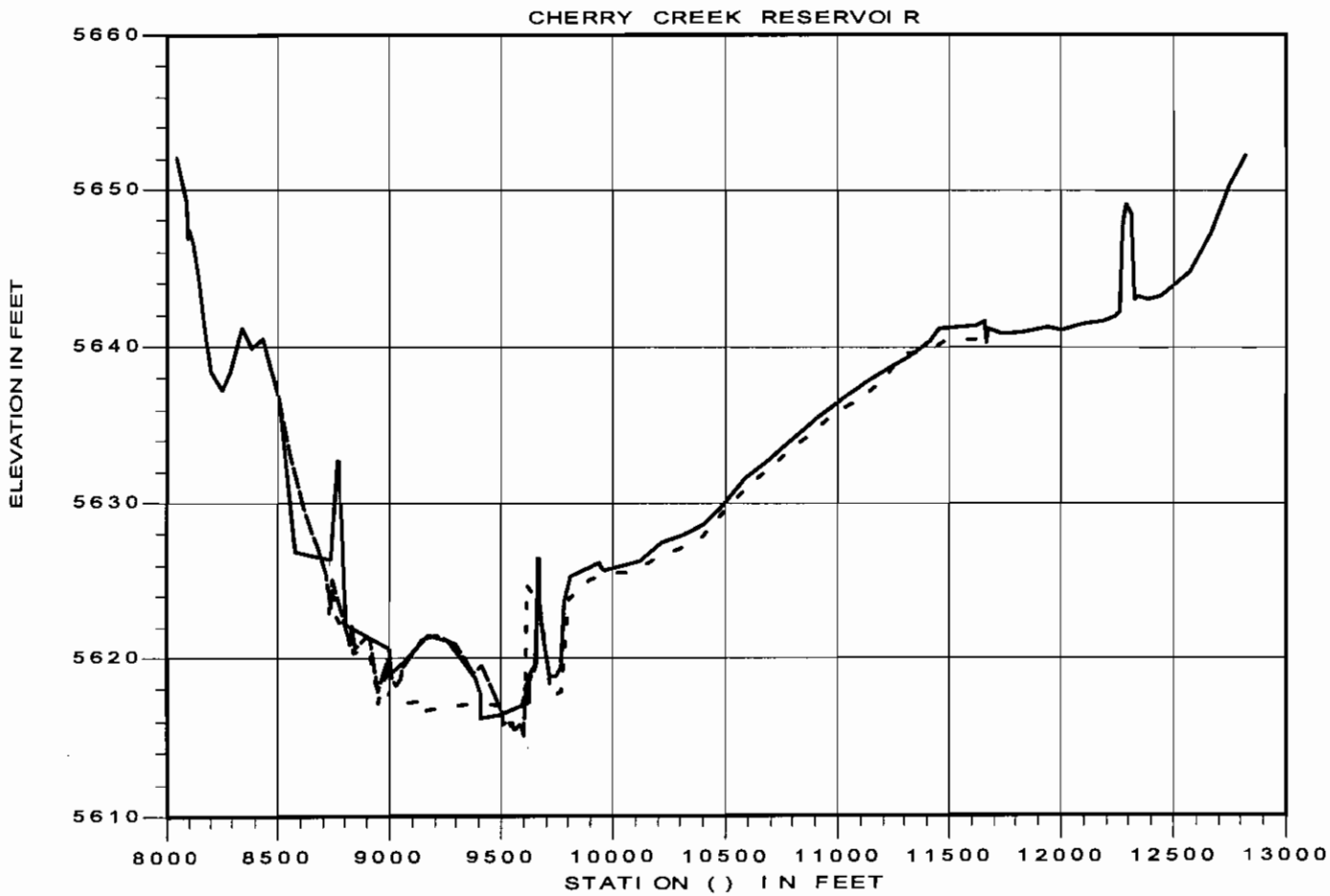
CC- 10 08JUN1988 5606. 2

PLATE V-21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ELEVATION IN FEET
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5640
5630
5620
5610
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9000
9500
10000
10500
11000
11500
12000
12500
13000
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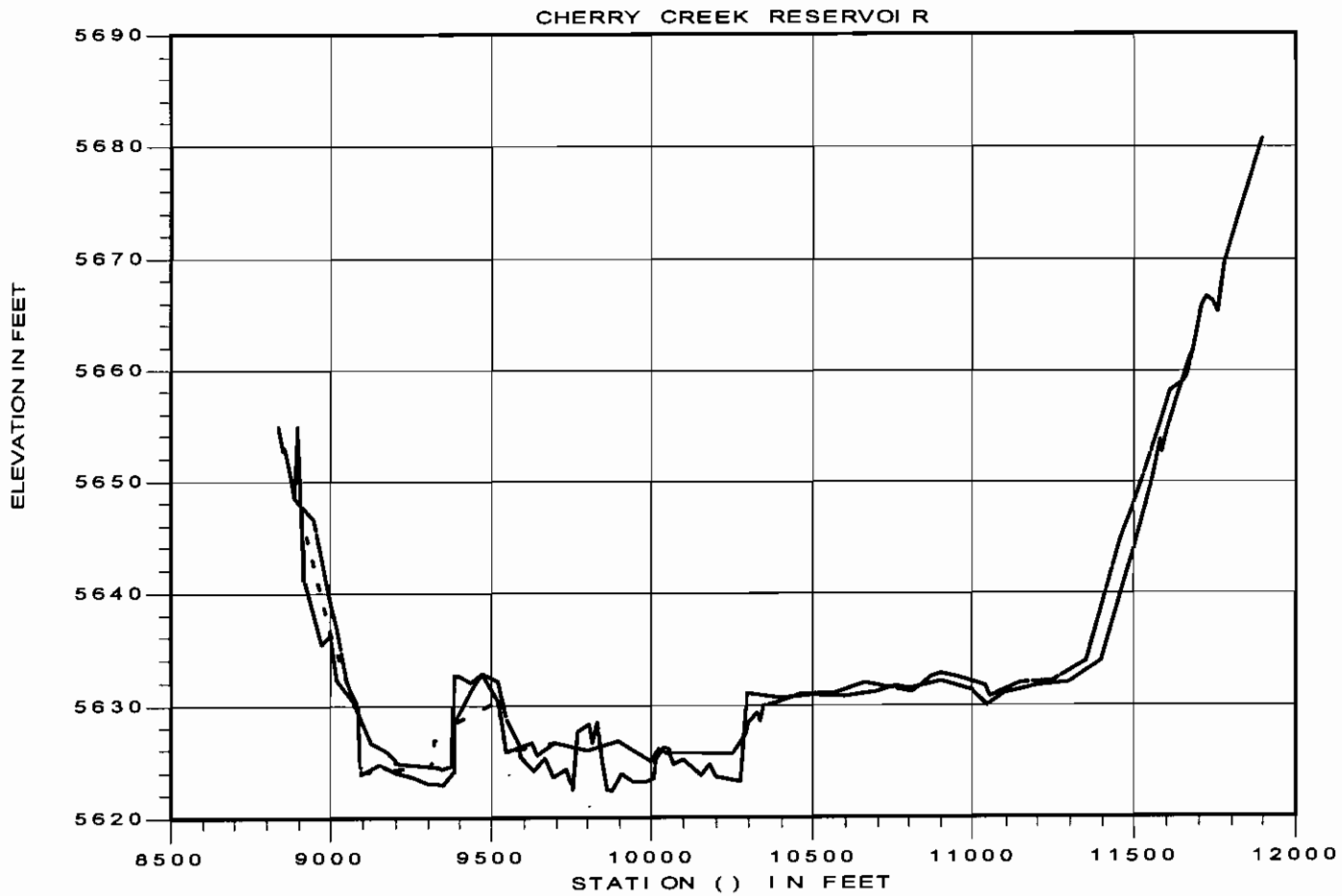
CC- 11 16JUL1974
CC- 11 08JUN1988

PLATE V-22


CHERRY CREEK RESERVOI R
ELEVATION IN FEET
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5640
5630
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8500
9000
9500
10000
10500
11000
11500
12000
STATI ON ( ) I N FEET
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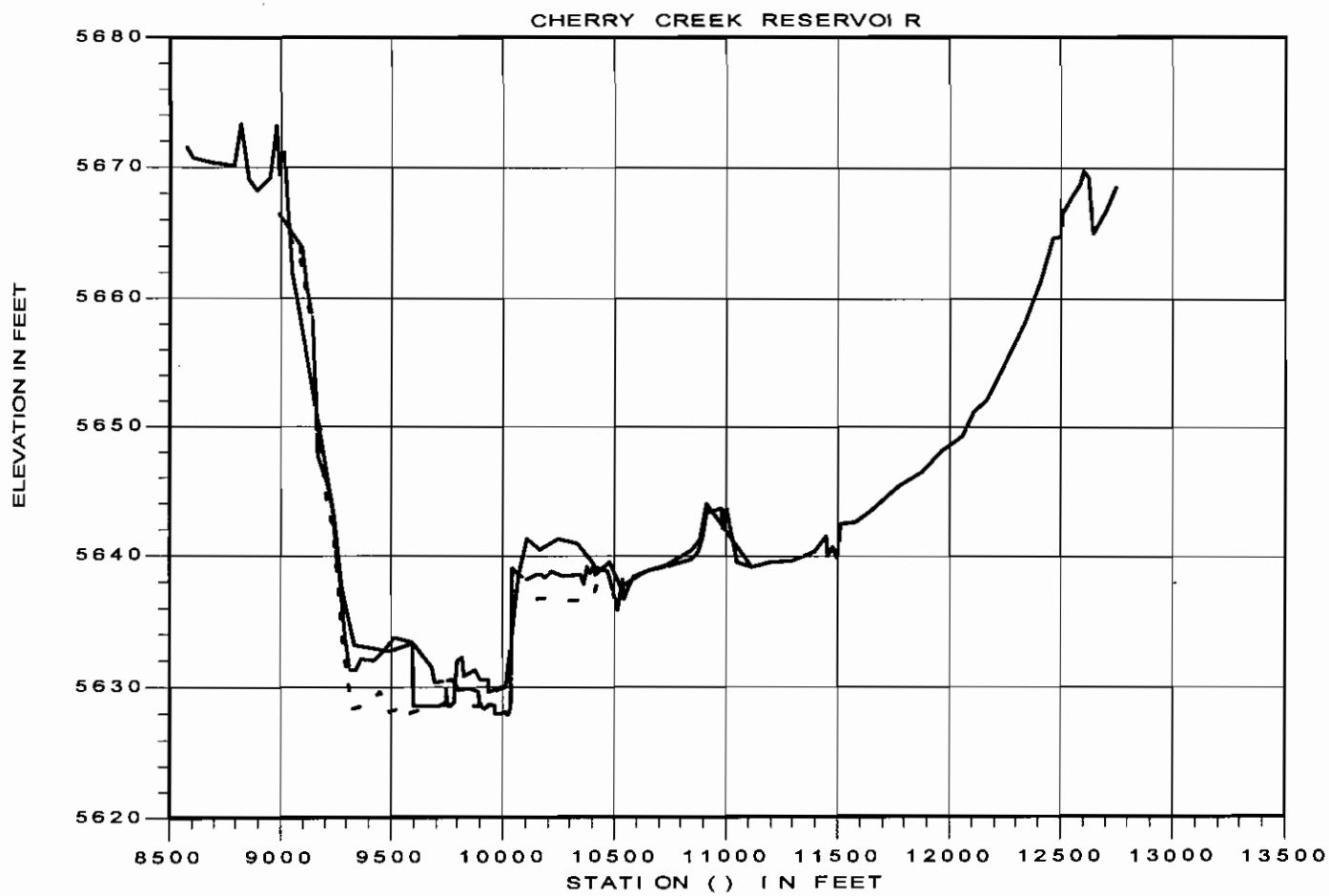
CC- 12 07JUN1988 5624. 4

PLATE V-23


CHERRY CREEK RESERVOI R
ELEVATION IN FEET
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5670
5660
5650
5640
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5620
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9000
9500
10000
10500
11000
11500
12000
12500
13000
13500
STATI ON ( ) I N FEET
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CC- 13 04OCT1965
CC- 13 16JUL1974
CC- 13 08JUN1988 5628. 7

PLATE V-24

Appendix A

Omaha District Reservoir Area-Capacity Analysis

AREA-CAPACITY COMPUTATION PROCEDURES

OMAHA DISTRICT METHOD

The Omaha District procedure for determining reservoir capacity versus elevation is an offshoot of the traditional "average-end-area" method, adjusted to include factors that take into account the nonuniformity of reservoir contours. For this procedure portions of the reservoir bounded by one or more sediment rangelines and the dam crest contour are considered as segments for determining storage capacity. Those portions of a segment situated between consecutive contours are referred to as sub-segments. The four steps required in developing this method are as follows:

$$L = \frac{V_o}{1/2\,(A_o' + A_o'')} \tag{1}$$

$$V_t = \frac{(A_t' + A_t'')\,L}{2} \tag{2}$$

$$V_t = \frac{V_o}{(A_o' + A_o'')}\,(A_t' + A_t'') \tag{3}$$

$$\text{Let } f = \frac{V_o}{A_o' + A_o''}$$

$$V_t = f\,(A_t' + A_t'') \tag{4}$$

where:

L = The effective length of the subsegment

V_o = Original volume of the subsegment

V_f = Future volume of the subsegment (difference between V_o and sediment volume)

A_o' = Original area of downstream subsegment section

A_o'' = Original area of upstream subsegment section or sections

A_f' and A_f'' = Respective future subsegment section areas

f = Constant factor (ratio) for sub-segment

Figure 1 illustrates these variables.

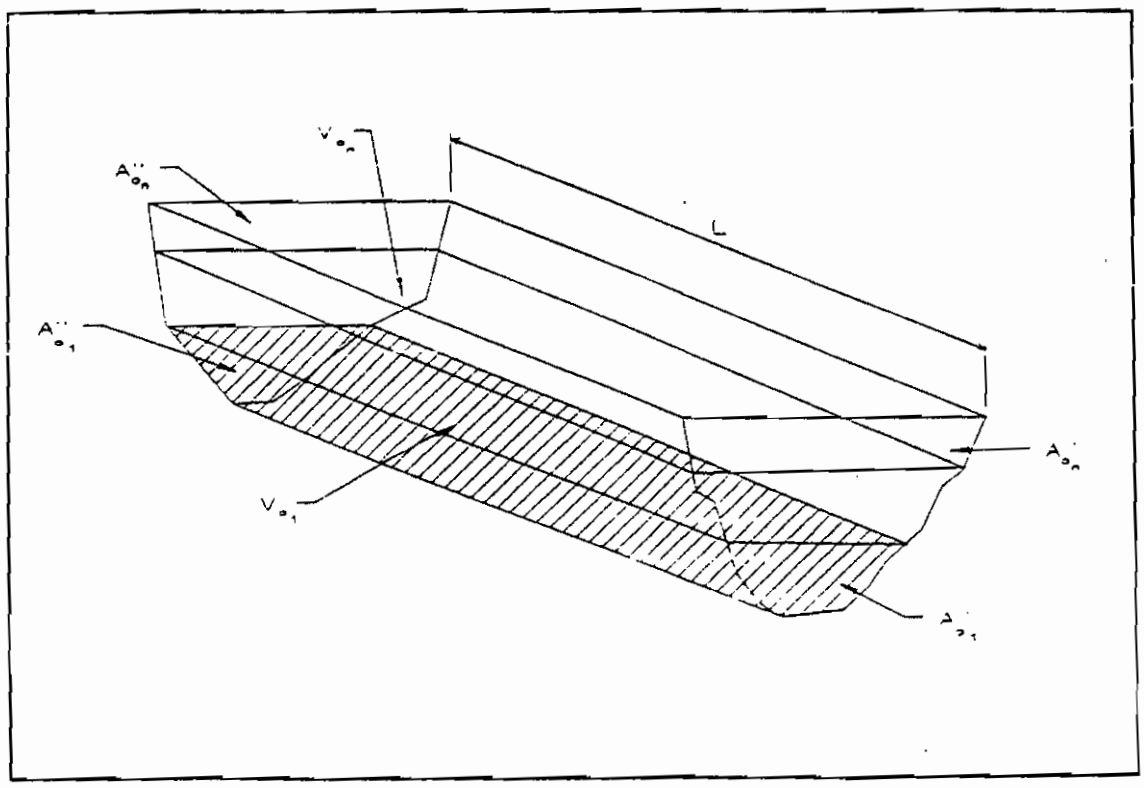

Figure 1.

Constant Factor Method Variables

The first equation above is based upon the effective length of an incremental volume, namely, the distance by which the mean end area is multiplied to obtain the original volume. Equation 2 shows it is possible to estimate the subsequent volume having the same effective length as the original volume. In Equation 3, the effective length cancels out and the constant factor (also referred to as "ratio") obtained is simply a ratio of the original volume to the sum of the original end areas. Substituting the factor f for this ratio, Equation 4 becomes the simplified formula for computing volumes. Once determined for a unit, this factor is assumed constant and is applied in computations for all future sedimentation surveys.

Capacity computations require 3 or 4 (depending upon whether or not the analysis being performed is the initial capacity computation for the reservoir) successive computer programs, all developed in the Omaha District. The output from each program serves as an input file to the program that follows.

The first program uses digitized/planimetered surface areas at given contour elevations for each segment of the reservoir to compute original segment volumes at incremental elevations (V_o in the above equations). These volumes are combined with original cross section end areas (A'_o and A''_o above), computed from another program, to calculate subsegment ratios (the constant factor f in Equation 3 and 4) using a third program. This surface area-to-volume-to-ratio procedure needs to be run only for the original capacity computations of each reservoir since the computed ratios are assumed to remain constant for all subsequent resurveys. The remaining program in the series combines reservoir subsegment and segment volumes to compute total reservoir volume versus elevation. For all future

resurveys the reservoir storage-elevation relationship is updated (to account for sediment deposition) by multiplying the new segment end areas by the original constant factor (Equation 4).

Appendix B

Bear Creek Area-Capacity Tables

Capacity tables for the one-hundredth foot increments are available by contacting the Omaha District office of the U.S. Army Corps of Engineers.

SUMMARY OF AREA-CAPACITY TABLES

Bear Creek Project 1980 EFFECTIVE 11 JUL 2000

AREA IN ACRES
(1980 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	1	1
5520	2	3	5	6	8	10	12	14	16	19
5530	22	25	28	31	34	38	41	44	47	51
5540	54	58	61	65	68	70	74	77	80	82
5550	85	87	89	92	95	99	102	105	109	112
5560	116	119	123	127	131	134	138	142	146	151
5570	156	161	165	170	177	183	188	194	200	208
5580	215	221	228	236	245	256	265	274	282	290
5590	297	304	312	319	327	334	342	349	357	366
5600	374	382	390	399	409	419	430	439	449	458
5610	466	474	482	492	503	514	525	536	548	560
5620	574	589	602	613	622	630	638	647	656	663
5630	670	678	686	694	703	712	721	730	739	749
5640	759	768	778	787	798	809	819	829	840	850
5650	861	871	882	892	903	913	923	934	944	955
5660	965	976	987	997	1007	1017	1027	1037	1047	1058
5670	1068	1078	1089	1099	1111	1122	1133	1143	1155	1168
5680	1180									

Bear Creek Project 1980 EFFECTIVE 11 JUL 2000

CAPACITY IN ACRE-FEET
(1980 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	1	1	3
5520	4	7	11	17	24	33	44	57	72	89
5530	110	134	161	191	224	260	300	342	388	437
5540	490	546	606	669	736	805	877	953	1032	1113
5550	1197	1283	1371	1461	1555	1652	1753	1857	1964	2075
5560	2189	2307	2428	2553	2682	2815	2951	3091	3236	3384
5570	3538	3697	3860	4027	4201	4381	4567	4758	4955	5159
5580	5371	5590	5814	6047	6287	6538	6799	7069	7348	7634
5590	7928	8229	8537	8853	9176	9507	9845	10191	10544	10906
5600	11276	11654	12041	12435	12840	13254	13679	14114	14558	15012
5610	15474	15944	16422	16909	17407	17916	18436	18967	19509	20063
5620	20630	21212	21809	22417	23035	23661	24295	24937	25589	26249
5630	26916	27590	28272	28962	29660	30368	31085	31811	32546	33290
5640	34044	34808	35581	36364	37156	37960	38774	39598	40433	41278
5650	42134	43000	43877	44764	45662	46570	47488	48417	49356	50306
5660	51266	52237	53219	54212	55214	56227	57249	58281	59323	60376
5670	61439	62512	63596	64690	65795	66912	68040	69178	70327	71489
5680	72663									

SUMMARY OF AREA-CAPACITY TABLES

Bear Creek Project 1987 EFFECTIVE 11 JUL 2000

AREA IN ACRES
(1987 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	0
5520	1	2	4	6	8	10	11	13	16	20
5530	24	28	32	35	37	40	42	45	47	51
5540	54	57	60	63	66	70	74	77	80	83
5550	85	88	90	93	96	99	101	104	107	111
5560	115	118	121	125	129	134	138	142	146	151
5570	156	160	164	170	176	182	188	194	200	207
5580	214	221	229	236	245	256	265	274	282	290
5590	297	304	311	319	327	333	341	348	356	364
5600	373	381	389	398	408	418	429	438	448	457
5610	466	474	483	493	503	514	525	535	547	559
5620	573	588	601	612	620	628	637	646	655	663
5630	670	677	685	694	703	712	720	729	739	748
5640	758	768	777	787	798	808	819	829	839	850
5650	861	871	882	892	902	913	923	934	944	954
5660	965	976	987	997	1007	1017	1026	1036	1047	1057
5670	1068	1078	1089	1099	1110	1121	1132	1143	1154	1167
5680	1180									

Bear Creek Project 1987 EFFECTIVE 11 JUL 2000

CAPACITY IN ACRE-FEET
(1987 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	0
5520	0	2	5	11	18	27	38	50	65	83
5530	105	131	161	195	231	270	311	355	401	450
5540	503	559	617	679	744	812	884	960	1038	1120
5550	1204	1291	1380	1472	1567	1665	1765	1868	1974	2083
5560	2196	2313	2432	2556	2683	2815	2951	3091	3235	3383
5570	3537	3695	3857	4024	4197	4376	4561	4752	4949	5153
5580	5364	5582	5807	6040	6280	6531	6792	7062	7341	7627
5590	7921	8222	8530	8845	9169	9499	9836	10181	10533	10893
5600	11262	11639	12024	12417	12820	13233	13657	14091	14534	14987
5610	15449	15919	16397	16885	17383	17892	18412	18942	19483	20036
5620	20602	21183	21778	22385	23002	23626	24258	24900	25551	26210
5630	26877	27551	28232	28922	29620	30328	31044	31769	32503	33247
5640	34000	34763	35536	36318	37111	37914	38728	39552	40387	41231
5650	42087	42953	43830	44717	45614	46522	47440	48369	49308	50257
5660	51217	52188	53170	54162	55164	56176	57198	58229	59271	60323
5670	61386	62459	63543	64637	65742	66858	67985	69123	70271	71432
5680	72606									

SUMMARY OF AREA-CAPACITY TABLES

Bear Creek Project 1997 EFFECTIVE 12 JUL 2000

AREA IN ACRES
(1997 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	0
5520	0	1	2	4	6	9	12	14	17	18
5530	20	21	23	25	29	34	37	40	44	48
5540	51	55	58	61	65	69	72	76	79	82
5550	84	87	89	92	95	98	100	103	106	109
5560	113	116	119	123	127	132	136	141	146	150
5570	155	160	165	170	176	183	189	195	202	209
5580	215	222	229	237	246	256	265	274	282	290
5590	296	304	311	319	326	333	340	348	355	364
5600	373	381	389	398	408	419	429	439	449	457
5610	466	474	484	494	504	515	526	537	548	561
5620	575	589	602	613	621	628	637	646	654	661
5630	668	675	683	691	701	710	719	728	737	747
5640	757	767	776	786	796	807	817	827	837	848
5650	859	870	880	891	901	912	922	932	942	952
5660	961	971	981	991	1002	1012	1023	1033	1044	1055
5670	1065	1076	1087	1097	1109	1120	1131	1142	1153	1166
5680	1179									

Bear Creek Project 1997 EFFECTIVE 12 JUL 2000

CAPACITY IN ACRE-FEET
(1997 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	0
5520	0	0	2	5	10	18	29	42	58	76
5530	95	116	138	162	189	221	257	296	338	384
5540	434	487	544	604	667	734	805	879	957	1038
5550	1121	1207	1295	1386	1479	1576	1675	1777	1882	1990
5560	2101	2216	2333	2454	2579	2709	2844	2982	3126	3274
5570	3427	3585	3747	3915	4088	4268	4454	4646	4844	5050
5580	5262	5481	5706	5939	6180	6431	6692	6962	7240	7527
5590	7820	8120	8428	8743	9066	9396	9733	10077	10429	10788
5600	11157	11534	11919	12312	12715	13129	13553	13987	14432	14885
5610	15347	15817	16296	16785	17284	17794	18315	18847	19389	19944
5620	20512	21095	21691	22299	22917	23542	24174	24816	25466	26124
5630	26789	27461	28140	28827	29523	30229	30944	31668	32400	33143
5640	33895	34657	35429	36210	37001	37803	38615	39437	40269	41112
5650	41966	42831	43706	44592	45488	46395	47312	48239	49177	50124
5660	51081	52047	53023	54009	55006	56013	57031	58059	59098	60148
5670	61208	62279	63361	64453	65556	66671	67797	68933	70081	71240
5680	72413									

Appendix C

Chatfield Area-Capacity Tables

Capacity tables for the one-hundredth foot increments are available by contacting the Omaha District office of the U.S. Army Corps of Engineers.

SUMMARY OF AREA-CAPACITY TABLES

Chatfield Project 1977 EFFECTIVE 24 JUL 2000

AREA IN ACRES
(1977 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	0
5380	1	2	3	5	9	12	13	16	23	35
5390	45	50	59	79	110	146	180	209	237	266
5400	293	318	346	377	412	448	484	518	551	584
5410	616	648	680	712	742	772	800	830	864	900
5420	937	972	1007	1047	1092	1139	1185	1229	1272	1315
5430	1358	1401	1444	1488	1533	1579	1624	1669	1715	1763
5440	1812	1861	1909	1957	2004	2050	2097	2144	2191	2238
5450	2285	2330	2377	2425	2476	2529	2582	2633	2679	2721
5460	2760	2801	2844	2886	2929	2970	3011	3053	3098	3147
5470	3198	3248	3296	3344	3392	3441	3489	3538	3585	3631
5480	3676	3720	3766	3814	3863	3911	3956	4003	4057	4118
5490	4181	4242	4301	4361	4421	4482	4543	4604	4662	4719
5500	4774	4830	4886	4944	5002	5061	5119	5177	5235	5293
5510	5351	5411	5469	5525	5579	5632	5687	5741	5795	5849
5520	5901	5954	6007	6062	6118	6175	6231	6287	6343	6399
5530	6455									

Chatfield Project 1977 EFFECTIVE 24 JUL 2000

CAPACITY IN ACRE-FEET
(1977 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	1
5380	1	3	6	10	17	29	42	56	75	103
5390	145	194	246	312	405	533	698	893	1116	1368
5400	1648	1954	2285	2646	3040	3470	3937	4439	4974	5542
5410	6142	6774	7438	8135	8862	9620	10406	11220	12067	12948
5420	13868	14823	15812	16838	17906	19022	20185	21392	22643	23937
5430	25274	26654	28076	29542	31052	32609	34211	35857	37549	39288
5440	41076	42913	44799	46732	48713	50740	52814	54934	57102	59316
5450	61578	63886	66239	68640	71090	73592	76148	78757	81415	84116
5460	86857	89637	92460	95325	98233	101183	104174	107205	110280	113402
5470	116575	119799	123071	126392	129760	133177	136642	140156	143718	147326
5480	150980	154678	158421	162211	166049	169937	173871	177849	181878	185964
5490	190114	194327	198599	202930	207321	211773	216286	220860	225494	230185
5500	234932	239734	244592	249507	254480	259512	264602	269750	274957	280221
5510	285543	290924	296365	301863	307416	313022	318681	324396	330164	335987
5520	341862	347790	353770	359805	365894	372041	378244	384503	390818	397189
5530	403616									

SUMMARY OF AREA-CAPACITY TABLES

Chatfield Project 1991 EFFECTIVE 07 AUG 2000

AREA IN ACRES
(1991 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	0
5380	1	2	3	6	10	12	13	16	23	35
5390	45	49	57	78	110	149	185	215	244	271
5400	296	321	348	377	408	441	474	505	535	563
5410	588	613	640	672	710	751	790	827	863	898
5420	932	964	999	1037	1079	1121	1160	1200	1244	1292
5430	1342	1391	1438	1484	1529	1573	1616	1661	1709	1759
5440	1812	1866	1917	1964	2007	2048	2089	2132	2179	2229
5450	2281	2332	2382	2430	2478	2526	2576	2625	2670	2713
5460	2755	2797	2841	2885	2930	2975	3019	3064	3109	3155
5470	3200	3244	3290	3337	3387	3439	3490	3540	3587	3633
5480	3677	3721	3766	3814	3862	3909	3953	4000	4054	4117
5490	4183	4247	4308	4369	4428	4487	4547	4607	4665	4722
5500	4778	4835	4892	4948	5003	5057	5109	5163	5222	5284
5510	5350	5416	5478	5536	5589	5641	5694	5748	5802	5854
5520	5905	5957	6009	6063	6119	6176	6232	6288	6343	6399
5530	6454									

Chatfield Project 1991 EFFECTIVE 07 AUG 2000

CAPACITY IN ACRE-FEET
(1991 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	0
5380	0	2	4	8	16	28	41	55	74	102
5390	144	192	242	307	398	528	697	898	1128	1386
5400	1670	1978	2312	2674	3066	3490	3948	4438	4959	5508
5410	6085	6685	7311	7966	8656	9387	10159	10968	11813	12694
5420	13610	14558	15539	16557	17614	18715	19856	21036	22257	23525
5430	24842	26209	27624	29086	30593	32145	33739	35377	37061	38795
5440	40580	42420	44312	46254	48241	50269	52337	54447	56602	58805
5450	61060	63367	65725	68131	70586	73088	75639	78240	80889	83581
5460	86316	89092	91911	94774	97681	100634	103631	106673	109760	112892
5470	116070	119293	122559	125873	129234	132647	136112	139628	143192	146803
5480	150458	154157	157900	161690	165528	169415	173346	177321	181346	185430
5490	189580	193797	198075	202414	206813	211270	215787	220365	225002	229696
5500	234446	239252	244116	249037	254012	259043	264126	269261	274453	279705
5510	285021	290405	295853	301361	306925	312540	318207	323928	329704	335532
5520	341412	347343	353326	359362	365452	371600	377804	384064	390380	396751
5530	403178									

SUMMARY OF AREA-CAPACITY TABLES

Chatfield Project 1998 EFFECTIVE 07 AUG 2000

AREA IN ACRES
(1998 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	0
5380	0	1	2	5	9	12	13	15	22	34
5390	44	49	58	77	104	135	164	189	217	246
5400	275	302	331	362	398	437	476	511	542	567
5410	588	609	634	665	703	742	779	814	852	890
5420	929	966	1004	1044	1087	1131	1173	1215	1258	1302
5430	1344	1386	1429	1474	1523	1572	1620	1668	1717	1766
5440	1818	1870	1920	1967	2009	2049	2089	2132	2179	2229
5450	2282	2333	2383	2432	2480	2527	2577	2625	2670	2713
5460	2754	2795	2837	2881	2926	2971	3016	3061	3107	3152
5470	3197	3241	3287	3335	3385	3439	3492	3543	3590	3635
5480	3677	3720	3765	3811	3859	3906	3949	3995	4049	4112
5490	4179	4243	4304	4365	4425	4486	4547	4608	4667	4723
5500	4779	4837	4895	4950	5004	5056	5106	5160	5218	5280
5510	5346	5412	5474	5532	5586	5639	5693	5748	5802	5855
5520	5907	5959	6013	6067	6123	6180	6236	6292	6348	6403
5530	6458									

Chatfield Project 1998 EFFECTIVE 07 AUG 2000

CAPACITY IN ACRE-FEET
(1998 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5370	0	0	0	0	0	0	0	0	0	0
5380	0	0	2	5	12	23	36	49	67	94
5390	135	182	234	299	388	508	659	836	1038	1270
5400	1531	1820	2136	2482	2861	3278	3735	4230	4758	5314
5410	5893	6491	7112	7760	8443	9166	9928	10724	11557	12428
5420	13338	14286	15270	16294	17359	18468	19621	20815	22052	23332
5430	24656	26021	27428	28879	30377	31925	33522	35166	36859	38600
5440	40392	42236	44132	46077	48066	50096	52165	54275	56430	58633
5450	60889	63197	65556	67964	70421	72924	75476	78079	80727	83420
5460	86154	88928	91744	94603	97507	100456	103450	106489	109573	112703
5470	115878	119098	122361	125672	129031	132443	135909	139428	142995	146609
5480	150266	153964	157706	161494	165329	169213	173141	177111	181131	185210
5490	189356	193568	197842	202177	206572	211027	215544	220122	224760	229456
5500	234207	239015	243882	248805	253783	258814	263895	269027	274215	279463
5510	284776	290156	295600	301105	306665	312278	317944	323665	329440	335269
5520	341151	347084	353070	359110	365204	371356	377564	383828	390148	396524
5530	402955									

Appendix D

Cherry Creek Area-Capacity Tables

Capacity tables for the one-hundredth foot increments are available by contacting the Omaha District office of the U.S. Army Corps of Engineers.

SUMMARY OF AREA-CAPACITY TABLES

Cherry Creek Project 1950 EFFECTIVE 26 JUL 2000

AREA IN ACRES
(1950 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5500	0	0	0	0	0	1	2	3	4	4
5510	12	20	21	26	34	44	58	75	95	118
5520	140	156	169	185	203	222	245	269	296	325
5530	353	379	402	426	452	477	503	529	557	584
5540	611	638	664	690	717	744	771	800	828	857
5550	886	914	941	969	998	1027	1055	1085	1115	1145
5560	1174	1201	1228	1256	1286	1316	1349	1383	1418	1455
5570	1490	1521	1551	1583	1618	1654	1693	1734	1777	1822
5580	1868	1909	1949	1990	2032	2074	2116	2159	2203	2248
5590	2293	2336	2380	2423	2467	2510	2553	2597	2640	2684
5600	2727	2770	2813	2856	2899	2943	2987	3032	3077	3123
5610	3167	3209	3251	3294	3339	3386	3434	3483	3535	3588
5620	3639	3685	3730	3778	3828	3881	3937	3996	4058	4122
5630	4187	4248	4307	4367	4426	4485	4545	4604	4663	4723
5640	4783									

Cherry Creek Project 1950 EFFECTIVE 26 JUL 2000

CAPACITY IN ACRE-FEET
(1950 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5500	0	0	0	0	0	0	2	5	9	13
5510	18	38	58	81	110	149	199	265	349	455
5520	586	736	898	1074	1268	1480	1713	1970	2252	2562
5530	2902	3269	3660	4074	4513	4978	5468	5984	6527	7098
5540	7696	8321	8972	9649	10352	11083	11840	12626	13440	14283
5550	15155	16056	16984	17939	18923	19936	20977	22047	23147	24277
5560	25437	26625	27839	29081	30352	31653	32985	34351	35752	37188
5570	38662	40169	41704	43271	44871	46507	48180	49893	51649	53448
5580	55294	57184	59113	61083	63094	65147	67242	69380	71561	73787
5590	76058	78373	80731	83133	85578	88067	90599	93174	95793	98455
5600	101161	103910	106701	109536	112413	115335	118300	121310	124365	127465
5610	130611	133800	137029	140302	143618	146981	150391	153849	157358	160920
5620	164535	168198	171905	175658	179461	183315	187223	191190	195216	199306
5630	203461	207680	211958	216295	220692	225148	229663	234238	238872	243565
5640	248318									

SUMMARY OF AREA-CAPACITY TABLES

Cherry Creek Project 1961 EFFECTIVE 26 JUL 2000

AREA IN ACRES
(1961 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	-8	25	42	60	81	104
5520	126	143	158	176	195	216	239	264	291	320
5530	349	375	401	426	451	476	501	526	551	575
5540	599	621	643	666	691	718	746	775	806	839
5550	872	903	932	962	992	1022	1051	1081	1111	1141
5560	1169	1196	1224	1252	1282	1314	1346	1380	1416	1452
5570	1488	1519	1549	1582	1617	1654	1692	1733	1776	1821
5580	1866	1907	1947	1987	2029	2071	2114	2157	2201	2246
5590	2291	2335	2379	2423	2466	2510	2553	2597	2641	2684
5600	2728	2771	2814	2858	2901	2945	2989	3033	3078	3122
5610	3165	3206	3246	3289	3333	3380	3428	3477	3529	3583
5620	3634	3681	3727	3775	3826	3879	3934	3992	4052	4115
5630	4178	4238	4297	4355	4413	4472	4530	4588	4647	4705
5640	4762									

Cherry Creek Project 1961 EFFECTIVE 26 JUL 2000

CAPACITY IN ACRE-FEET
(1961 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	-33	-16	16	67	137	229
5520	345	481	631	798	983	1189	1416	1667	1944	2249
5530	2584	2947	3335	3749	4188	4652	5141	5655	6194	6757
5540	7345	7955	8587	9241	9920	10624	11356	12116	12907	13729
5550	14585	15473	16391	17338	18315	19323	20359	21426	22522	23648
5560	24804	25987	27197	28435	29702	31000	32330	33693	35091	36525
5570	37996	39501	41035	42600	44199	45834	47507	49219	50973	52772
5580	54616	56504	58431	60398	62406	64456	66548	68684	70863	73087
5590	75356	77670	80027	82428	84873	87361	89893	92468	95087	97750
5600	100456	103206	105998	108835	111714	114638	117605	120616	123672	126772
5610	129916	133102	136328	139595	142906	146262	149666	153118	156621	160177
5620	163787	167446	171150	174900	178700	182552	186458	190421	194442	198526
5630	202673	206882	211150	215476	219860	224303	228804	233363	237981	242657
5640	247391									

SUMMARY OF AREA-CAPACITY TABLES

Cherry Creek Project 1965 EFFECTIVE 09 AUG 2000

AREA IN ACRES
(1965 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	1
5520	25	68	107	144	179	211	241	269	294	317
5530	340	367	396	424	451	477	503	527	551	574
5540	595	617	640	663	687	713	739	767	797	827
5550	856	884	912	939	967	996	1025	1054	1084	1114
5560	1143	1169	1194	1222	1252	1284	1318	1353	1392	1432
5570	1470	1505	1538	1572	1609	1647	1687	1729	1773	1818
5580	1864	1907	1949	1991	2033	2075	2118	2161	2204	2247
5590	2291	2334	2376	2419	2462	2506	2549	2592	2636	2680
5600	2723	2767	2810	2853	2897	2941	2984	3028	3073	3117
5610	3160	3200	3241	3284	3328	3374	3422	3472	3524	3577
5620	3628	3675	3720	3768	3819	3872	3928	3986	4047	4111
5630	4175	4236	4295	4354	4412	4471	4530	4589	4648	4707
5640	4766									

Cherry Creek Project 1965 EFFECTIVE 09 AUG 2000

CAPACITY IN ACRE-FEET
(1965 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5510	0	0	0	0	0	0	0	0	0	1
5520	3	51	139	266	428	624	851	1107	1390	1696
5530	2024	2377	2759	3170	3608	4072	4563	5078	5617	6180
5540	6765	7371	8000	8651	9326	10026	10752	11505	12287	13099
5550	13941	14812	15710	16636	17589	18571	19582	20622	21691	22790
5560	23920	25077	26258	27466	28703	29971	31272	32607	33979	35391
5570	36843	38332	39853	41408	42998	44626	46293	48001	49752	51547
5580	53389	55275	57203	59173	61185	63239	65335	67475	69658	71883
5590	74153	76466	78821	81219	83660	86144	88672	91243	93857	96515
5600	99217	101962	104751	107583	110458	113377	116340	119346	122397	125492
5610	128631	131812	135032	138295	141600	144951	148349	151796	155294	158844
5620	162448	166101	169799	173542	177335	181180	185080	189036	193052	197131
5630	201275	205482	209747	214072	218455	222897	227398	231958	236577	241255
5640	245992									

SUMMARY OF AREA-CAPACITY TABLES

Cherry Creek Project 1974 EFFECTIVE 26 JUL 2000

AREA IN ACRES
(1974 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5520	0	0	0	53	100	136	171	205	238	271
5530	306	345	385	421	455	486	513	538	559	578
5540	596	616	638	661	686	711	737	764	793	822
5550	851	879	905	932	960	988	1017	1046	1076	1107
5560	1136	1162	1188	1216	1246	1277	1311	1346	1384	1423
5570	1461	1494	1526	1561	1597	1635	1675	1717	1762	1808
5580	1854	1898	1940	1982	2025	2068	2112	2155	2199	2243
5590	2287	2331	2374	2417	2461	2505	2548	2592	2636	2680
5600	2724	2767	2811	2854	2898	2942	2986	3030	3074	3118
5610	3161	3201	3242	3284	3328	3374	3422	3472	3524	3577
5620	3628	3674	3719	3767	3817	3870	3927	3985	4046	4110
5630	4174	4236	4295	4354	4413	4472	4531	4590	4649	4708
5640	4768									

Cherry Creek Project 1974 EFFECTIVE 26 JUL 2000

CAPACITY IN ACRE-FEET
(1974 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5520	0	0	0	24	106	224	378	566	788	1043
5530	1330	1655	2021	2425	2864	3336	3836	4363	4912	5482
5540	6069	6674	7301	7950	8624	9322	10046	10796	11575	12383
5550	13220	14086	14978	15896	16842	17816	18819	19850	20911	22003
5560	23125	24275	25449	26651	27881	29143	30436	31765	33129	34533
5570	35976	37455	38965	40508	42087	43702	45357	47053	48792	50577
5580	52409	54286	56206	58167	60171	62218	64308	66442	68619	70840
5590	73105	75414	77767	80162	82602	85085	87612	90182	92796	95454
5600	98156	100902	103691	106524	109400	112320	115285	118293	121345	124441
5610	127581	130763	133984	137247	140553	143904	147302	150749	154247	157797
5620	161401	165054	168750	172493	176285	180128	184026	187982	191997	196075
5630	200218	204424	208690	213014	217398	221841	226342	230903	235522	240201
5640	244939									

SUMMARY OF AREA-CAPACITY TABLES

Cherry Creek Project 1988 EFFECTIVE 26 JUL 2000

AREA IN ACRES
(1988 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5520	0	0	0	0	55	115	143	171	199	227
5530	273	328	371	410	446	479	508	533	555	573
5540	590	611	634	659	683	709	735	762	790	819
5550	847	873	899	926	953	981	1010	1038	1068	1099
5560	1127	1153	1178	1205	1235	1266	1300	1336	1374	1414
5570	1453	1487	1519	1554	1590	1629	1669	1711	1756	1802
5580	1847	1890	1932	1974	2016	2059	2104	2149	2194	2240
5590	2286	2333	2379	2424	2469	2513	2556	2599	2642	2684
5600	2726	2768	2810	2853	2896	2939	2983	3027	3072	3116
5610	3160	3201	3242	3285	3329	3375	3423	3472	3523	3576
5620	3627	3672	3717	3764	3814	3867	3923	3982	4044	4109
5630	4174	4235	4295	4354	4413	4473	4532	4592	4651	4710
5640	4770									

Cherry Creek Project 1988 EFFECTIVE 26 JUL 2000

CAPACITY IN ACRE-FEET
(1988 SURVEY)

ELEV	0	1	2	3	4	5	6	7	8	9
5520	0	0	0	0	9	110	240	397	583	796
5530	1037	1342	1693	2084	2513	2977	3471	3993	4538	5103
5540	5684	6284	6906	7553	8224	8920	9642	10391	11167	11972
5550	12805	13666	14552	15465	16405	17372	18368	19392	20445	21529
5560	22643	23784	24949	26140	27360	28610	29893	31211	32566	33959
5570	35394	36865	38368	39904	41476	43085	44734	46424	48157	49936
5580	51761	53631	55542	57495	59490	61528	63609	65736	67907	70124
5590	72387	74697	77053	79455	81901	84393	86928	89506	92127	94791
5600	97496	100243	103032	105864	108739	111657	114618	117623	120673	123767
5610	126906	130087	133308	136571	139878	143230	146628	150076	153573	157123
5620	160726	164377	168071	171811	175600	179440	183335	187287	191300	195376
5630	199518	203724	207989	212314	216697	221141	225643	230206	234827	239508
5640	244248									

Appendix E

Engineering Forms 1787

RESERVOIR SEDIMENT
DATA SUMMARY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

Bear Creek
NAME OF RESERVOIR

DATA SHEET NO.

DAM

1. OWNER Dept of Army; Corps of En	STREAM Bear Creek	3. STATE Colorado
4. SEC. 32 TWP. 4S RANGE 69W[A]	5. NEAREST P.O. Denver	6. COUNTY Jefferson
7. LAT. 39° 39 '00 " LONG. 105 8 '30 "	8. TOP OF DAM ELEVATION 5689.5	9. SPILLWAY CREST ELEV. 5667

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL	5635.5	717	28,762	30,726	
b. MULTIPLE USE	5558.0	109	1,892	1,964	Jul 1977
c. POWER					
d. WATER SUPPLY					16. DATE NORMAL OPER. BEGAN
e. IRRIGATION					
f. CONSERVATION					
g. INACTIVE	5528.0	16	72	72	May 1979

WATERSHED

17. LENGTH OF RESERVOIR 0.7 MILES		AV. WIDTH OF RESERVOIR 1.6	MILES
18. TOTAL DRAINAGE AREA 236	SQ. MI.	22. MEAN ANNUAL PRECIPITATION 18.2 (15-20)[B]	INCHES
19. NET SEDIMENT CONTRIBUTING AREA .235	SQ. MI.	23. MEAN ANNUAL RUNOFF 3.0	INCHES
20. LENGTH 36 MILES	AV. WIDTH 6.5 MILES	24. MEAN ANNUAL RUNOFF 37,600	AC.-FT.
21. MAX. ELEV. 14,264	MIN. ELEV. 5516	25. ANNUAL TEMP. MEAN 50	RANGE 20-100

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I, RATIO, AC.-FT. PER AC.-FT.
30 Oct 1980	0	-	Range	13	717	30,726	0.82
18 Jun 1987	6.64	6.64	Range	9	716	30,686	0.82
03 Dec 1997	10.47	17.11	Range	11	715	30,586	0.81

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW, ACRE-FEET			36. WATER INFL. TO DATE, AC.-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE
30 Oct 1980						
18 Jun 1987	19.39[C]	59,430	91,923	394,618	59,430	394,618
03 Dec 1997	19.53[C]	29,429	72,733	308,120	41,072	702,738

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET		
	a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
30 Oct 1980						
18 Jan 1987	40	6.02	0.0256	40	6.02	0.0256
03 Dec 1997	100	9.55	0.0406	140	8.18	0.0348

26. DATE OF SURVEY	39. AV. DRY WGT., LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR.		41. STORAGE LOSS, POT.		42. SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE

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PREVIOUS EDITIONS ARE OBSOLETE.

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION											
	157-135	135-120	120-105	105-90	90-75	75-60	60-45	45-30	30-15	15-Crest	Crest-+10	+10-+17.5
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											
03 Dec 1997[D]	9.0	20.0	8.2	6.7	-1.2	7.1	-3.5	9.8	11.0	20.0	9.0	3.9

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR														
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														
03 Dec 1997[D]	3.2	24.6	17.4	6.0	12.7	9.1	4.5	8.3	11.0	3.3					

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.
1978	5535.50	5528.0	5528	1988	5560.51	5557.50	36,972
1979	5568.20	5528.0	41,511	1989	5559.75	5558.00	8,926
1980	5575.90	5557.0	67,869	1990	5559.81	5557.69	23,721
1981	5559.18	5557.0	5,943	1991	5560.39	5557.13	31,075
1982	5559.12	5557.0	21,340	1992	5559.70	5557.80	25,841
1983	5580.96	5558.01	91,923	1993	5559.70	5558.04	17,183
1984	5562.76	5559.0	72,289	1994	5559.57	5557.95	17,022
1985	5561,77	5558.0	54,122	1995	5587.17	5557.68	72,733
1986	5559.58	5557.1	30,129	1996	5559.30	5558.10	17,005
1987	5564.25	5557.0	63,244	1997	5560.86	5557.30	43,361

46. ELEVATION-AREA-CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
5510	0	0						
5528	17	38						
5558	106	1,882						
5635.5	715	30,586						
5680.0	1179							
5684.5		77,846						

47. REMARKS AND REFERENCES

[A] Portion of the main dam and all of the South Dam are located in Sect 5, T5S, R69W.

[B] Basin average taken from Evergreen, CO station; 39 year record; basin range in ()

[C] Evergreen, CO station

[D] 1997 data showed a large gain at higher elevations. This due to a change in a road embankment that was added in this area. A negative value indicates degradation in the depth or reach designation.

48. AGENCY MAKING SURVEY

49. AGENCY SUPPLYING DATA

50. DATE 19 Oct 2000

RESERVOIR SEDIMENT
DATA SUMMARY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

CHATFIELD
NAME OF RESERVOIR

DATA SHEET NO.

DAM

1. OWNER Dept of Army; Corps of Eng	2. STREAM South Platte River	3. STATE Colorado
4. SEC. 1 TWP. 6S RANGE 69W	5. NEAREST P.O. Denver	6. COUNTY Jefferson Douglas Arapahoe
7. LAT. 39° 33 '30 " LONG 105° 2 '30 "	8. TOP OF DAM ELEVATION 5527.0	9. SPILLWAY CREST ELEV. 5500.0

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL	5500.0	4774	206,856	234,932	Aug 1973
b. MULTIPLE USE	5432.0	1444	28,047	28,076	
c. POWER					16. DATE NORMAL OPER. BEGAN
d. WATER SUPPLY					
e. IRRIGATION					
f. CONSERVATION					Jun 1979
g. INACTIVE	5385.0	12	29	29	

17. LENGTH OF RESERVOIR 9.3[A] MILES | AV. WIDTH OF RESERVOIR 0.8 MILES

WATERSHED

18. TOTAL DRAINAGE AREA 3,018 SQ. MI.		22. MEAN ANNUAL PRECIPITATION 15.8[B]	INCHES
19. NET SEDIMENT CONTRIBUTING AREA 1261 SQ. MI.		23. MEAN ANNUAL RUNOFF 1.0	INCHES
20. LENGTH 121 MILES	AV. WIDTH 25 MILES	24. MEAN ANNUAL RUNOFF 163,430[C]	AC.-FT.
21. MAX. ELEV. 14,433	MIN. ELEV. 5380.0	25. ANNUAL TEMP MEAN 50	RANGE -20 to 100

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I RATIO, AC.-FT. PER AC.-FT.
03 May 1977	0	-	Range	22	4774	234,932	1.44
22 May 1991	14.06	14.06	Range	22	4778	234,446	1.44
23 Nov 1998	7.46	21.52	Range	22	4779	234,207	1.44

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW, ACRE-FEET			36. WATER INFL. TO DATE, AC.-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE
03 May 1977						
22 May 1991	18.6	193,577	450,443	2,721,686	193,577	2,721,686
03 Nov 1998	17.3	132,766	334,210	990,437	172,496	3,712,123

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET		
	a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
03 May 1977						
22 May 1991	486	34.57	0.0274	486	34.57	0.0274
03 Nov 1998	239	11.11	0.009	725	33.69	0.0267

26. DATE OF SURVEY	39. AV. DRY WGT., LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR.		41. STORAGE LOSS, PCT.		42. SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE

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PREVIOUS EDITIONS ARE OBSOLETE.

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION											
	123-100	100-80	80-70	70-60	60-50	50-40	40-30	30-20	20-10	10-Crest	Crest-+10	+10-+21.6
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											
03 Nov 1998[D]	16.7	58.8	12.5	9.4	0.7	2.0	-0.9	2.4	6.3	-4.7	6.0	-9.3

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														
03 Nov 1998[D]	26.5	-13.9	28.6	13.1	9.7	12.9	10.0	8.9	4.0	0.6					

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.
1979	5434.15	5413.76	156,877	1989	5432.9	5426.3	102,812
1980	5447.60	5432.00	341,634	1990	5432.57	5426.3	78,023
1981	5432.98	5429.0	61,623	1991	5432.11	5424.33	75,347
1982	5429.79	5425.24	110,082	1992	5432.48	5426.79	77,553
1983	5447.08	5429.87	450,443	1993	5432.2	5426.67	71,405
1984	5432.91	5427.56	419,788	1994	5432.10	5426.34	76,775
1985	5435.76	5427.42	340,587	1995	5446.40	5427.62	334,210
1986	5432.69	5426.17	123,275	1996	5432.3	5423.60	82.585
1987	5434.36	5424.50	269,627	1997	5432.56	5426.86	118,284
1988	5432.93	5424.00	124,822	1998	5432.74	5425.67	177,010

46. ELEVATION-AREA-CAPACITY DATA 03 Nov 1998

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
5377	0	0						
5385	12	23						
5432	1429	27,428						
5500	4779	234,207						
5521.6	5991	350,676						

47. REMARKS AND REFERENCES

A South Platte Arm is 5.7 miles and Plum Creek Arm is 3.6 miles
B Basin average taken from Sedalia, CO gage; 44 years of record
C 20 years of record 1977-1998
D A negative value indicates degradation in the depth or reach designation.

48. AGENCY MAKING SURVEY

49. AGENCY SUPPLYING DATA

50. DATE 19 Oct 2000

RESERVOIR SEDIMENT
DATA SUMMARY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

Cherry Creek
NAME OF RESERVOIR

DATA SHEET NO.

DAM

1. OWNER Dept of Army; Corps Engr	2. STREAM Cherry Creek	3. STATE Colorado
4. SEC. 2 TWP. 5S RANGE 67W	5. NEAREST P.O. Denver	6. COUNTY Arapahoe
7. LAT. 39° 38 ' 30 " LONG. 104 51' 30"	8. TOP OF DAM ELEVATION 5645.0	9. SPILLWAY CREST ELEV. 5598.0

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, ACRES	13. ORIGINAL CAPACITY, ACRE-FEET	14. GROSS STORAGE, ACRE-FEET	15. DATE STORAGE BEGAN
a. FLOOD CONTROL	5598.0				Oct 1948
b. MULTIPLE USE	5550.0				
c. POWER					16. DATE NORMAL OPER. BEGAN
d. WATER SUPPLY					
e. IRRIGATION					Mar 1960
f. CONSERVATION					
g. INACTIVE	A				

WATERSHED

17. LENGTH OF RESERVOIR	3.2	MILES	AV. WIDTH OF RESERVOIR	1.3	MILES
18. TOTAL DRAINAGE AREA	386	SQ. MI.	22. MEAN ANNUAL PRECIPITATION	16.3[B]	INCHES
19. NET SEDIMENT CONTRIBUTING AREA	380	SQ. MI.	23. MEAN ANNUAL RUNOFF	0.43	INCHES
20. LENGTH 44.2	MILES	AV. WIDTH 8.7	MILES	24. MEAN ANNUAL RUNOFF	8780 AC.-FT.
21. MAX. ELEV. 7500 (approx)		MIN. ELEV. 5504		25. ANNUAL TEMP MEAN 50	RANGE -20 to 100

SURVEY DATA

26. DATE OF SURVEY	27. PERIOD YEARS	28. ACCL. YEARS	29. TYPE OF SURVEY	30. NO. OF RANGES OR CONTOUR INT.	31. SURFACE AREA, ACRES	32. CAPACITY, ACRE-FEET	33. C/I. RATIO, AC.-FT. PER AC.-FT.
01 Apr 1950[C]	0	-	Range	13	2640	95,793	10.91
24 Apr 1961	11.15	11.15	Range	10	2641	95,087	10.83
17 Aug 1965	4.24	15.39	Range	13	2636	93,857	10.69
11 Jul 1974	8.90	24.29	Range	11	2636	92,796	10.57
15 Jul 1988	13.94	38.23	Range	12	2642[D]	92,127	10.49
01 Sep 1997[CD]	9.22	47.45	Range	13	2236[D]	83,834[D]	9.55[D]

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIPITATION	35. PERIOD WATER INFLOW, ACRE-FEET			36. WATER INFL. TO DATE, AC.-FT.	
		a. MEAN ANNUAL	b. MAX. ANNUAL	c. PERIOD TOTAL	a. MEAN ANNUAL	b. TOTAL TO DATE
01 Apr 1950[C]						
24 Apr 1961	11.17					
17 Aug 1965	17.01	8599	24,578	36,459	8,599	36,459
11 Jul 1974	19.47	6501	24,387	57,859	7,178	94,318
15 Jul 1988	16.70	11,015	30,923	153,554	9,153	247,872

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SED. DEPOSITS TO DATE, ACRE-FEET		
	a. PERIOD TOTAL	b. AV. ANNUAL	c. PER SQ. MI.-YEAR	a. TOTAL TO DATE	b. AV. ANNUAL	c. PER SQ. MI.-YEAR
01 Apr 1950						
24 Apr 1961	706	63.32	0.1666	706	63.32	0.1666
17 Aug 1965	1230	290.09	0.7634	1936	125.80	0.3311
11 Jul 1974	1061	119.21	0.3137	2997	123.38	0.3247
15 Jun 1988	669	47.99	0.1263	3666	95.89	0.2523

26. DATE OF SURVEY	39. AV. DRY WGT., LBS. PER CU. FT.	40. SED. DEP., TONS PER SQ. MI.-YR.		41. STORAGE LOSS, PCT		42. SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANN.	b. TOT. TO DATE	a. PERIOD	b. TOT. TO DATE

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW, AND ABOVE, CREST ELEVATION											
	94-80	80-70	70-60	60-50	50-40	40-30	30-20	20-10	10-Crest	Crest-+30	+30-+38.2	
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											
15 Jul 1988	8.7	32.8	8.0	7.1	10.7	12.0	7.6	4.0	0.3	3.0	5.9	

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR														
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-105	-110	-115	-120	-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														
15 July 1988[E]	44.6	11.4	7.3	9.1	12.9	6.5	4.8	2.7	0.9	-0.1					

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AC.-FT.
1978	5548.78	5547.00	1351	1988	5551.98	5550.04	19,141
1979	5547.65	5545.90	2745	1989	5552.04	5549.98	7934
1980	5551.14	5546.42	4860	1990	5551.75	5549.98	5534
1981	5550.06	5548.81	1765	1991	5551.39	5549.90	4602
1982	5548.93	5547.66	1849	1992	5551.48	5548.52	9182
1983	5557.89	5547.66	29,411	1993	5550.65	5548.95	5898
1984	5556.58	5551.00	30,923	1994	5550.90	5548.83	7353
1985	5553.49	5549.50	24,863	1995	5551.00	5548.75	11,484
1986	5552.32	5550.05	11,980	1996	5550.90	5548.80	7976
1987	5552.51	5550.08	17,009	1997	5550.81	5549.48	7920

46. ELEVATION-AREA-CAPACITY DATA

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
5504	0	0						
5550	847	12,805						
5598	2642	92,127						
5636.2	4307	226,566						

47. REMARKS AND REFERENCES

A No conservation or inactive storage is documented

B Basin average taken from Cherry Creek Dam Station; 49 year record

C 01 Apr is assumed date in 1950; 01 is assumed date in Sep 1997

D All 1997 data is included here although the data appears to be erroneous; calculations are not performed on 1997 data.

E A negative value indicates degradation in the depth or reach designation.

48. AGENCY MAKING SURVEY

49. AGENCY SUPPLYING DATA

50. DATE 19 Oct 2000

Appendix F

MRD/MRR/MRB Sediment Memoranda

MRD/MRR/MRB SEDIMENT MEMORANDA

NO.	TITLE	AUTHOR	DATE
1	Sedimentation in Kanapolis Reservoir	A. L. Hill & A. M. Gow	1955
2	1954 Aggradation Surveys in Garrison Reservoir	F. S. Witzigman & I. Sherperdson	1955
3	Degradation below Garrison Dam	F. S. Witzigman	1957
4	Observations of the Rate of Change in Sediment Concentration with Respect to Changing Hydraulic Conditions at the Head of a Reservoir	F. S. Witzigman	1955
5	Deposition in Fort Randall	R. H. Livesey	1955
6	Determination of Location and Rate of Growth of Delta Formations	L. C. Fowler	1957
7	Papillion Creek Site 11 - Sedimentation Studies and Area-Capacity Report	J. W. Garrison	1989
8	Sedimentation in Fort Peck Reservoir, 1937-1987	L. A. Timp	1989
9	Lake Francis Case Aggradation Study (Including the White River), 1953-1986	Stanley Consultants	1989
10	Cherry Creek Lake Sedimentation Studies & Area-Capacity Report, 1988	L. J. Morong	1988
11	Big Bend Project - Bad River Aggradation Assessment and Data Compilation	J. W. Garrison	1991
12	Sedimentation near the Confluence of the Missouri and Niobrara Rivers, 1954-1990	Resource Consultants and Engineers, Inc.	1992
13	Sedimentation in the Cheyenne River Arm - Lake Oahe, 1958-1991	Stanley Consultants	1993
14	Sedimentation in the Little Missouri River Arm of Lake Sakakawea	Resource Consultants and Engineers, Inc.	1993
15	Lake Oahe Aggradation Study, Volume I, 1958-1989	Resource Consultants and Engineers, Inc.	1993

MRD/MRR/MRB SEDIMENT MEMORANDA (Continued)

NO.	TITLE	AUTHOR	DATE
15a	Lake Oahe Aggradation Study, Volume II, 1958-1989	Resource Consultants and Engineers, Inc.	1993
16	Garrison Project, North Dakota. Downstream Channel and Sediment Trends Study	J. W. Garrison	1993
16a	Garrison Project, North Dakota. Downstream Channel and Sediment Trends Study	J. W. Garrison	Updated 1999
17	Sedimentation Conditions at Pipestem Lake, North Dakota, 1973-1993	M. J. Brown	1993
18	Sedimentation Conditions at the Salt Creek Projects near Lincoln, Nebraska, 1963-1994	L. A. Timp	1995
19	Sedimentation Conditions at the Papio Creek Projects near Omaha, Nebraska, 1976-1994	L. A. Timp	1996
20	Sedimentation Impacts in the Cheyenne River Arm - Lake Oahe - Phase II, Projected to 2058, - 1999	J. Tworek	1999
21	Phase I Study: Sedimentation at the Confluence of the Missouri and Musselshell Rivers, Fort Peck Lake, Montana, 1937 to 1998 - 2000	P. Anderson	2000
22	Missouri River - Oahe Dam to Big Bend Dam Aggradation Assessment	W.E.S.T. Consultants Inc.	1999
23	Tri-Lakes Sedimentation Studies Area-Capacity Report	L. F. Schaper	2001