UTE RESERVOIR
1992 Sedimentation Study

U.S. Department of the Interior
Bureau of Reclamation

7-2090 (4-81)
Bureau of Reclamation

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.

4. TITLE AND SUBTITLE	5. REPORT DATE
Ute Reservoir 1992 Sedimentation Survey	May 1993
	6. PERFORMING ORGANIZATION CODE D-5753
7. AUTHOR(S) Ronald L. Ferrari	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Bureau of Reclamation Denver Office Denver CO 80225	10. WORK UNIT NO.
	11. CONTRACT OR GRANT NO.
	13. TYPE OF REPORT AND PERIOD COVERED DIBR
12. SPONSORING AGENCY NAME AND ADDRESS Same	14. SPONSORING AGENCY CODE D-5753

15. SUPPLEMENTARY NOTES

Microfiche and hard copy available at the Denver Office, Denver, Colorado. Ed: TH

16. ABSTRACT

The Bureau of Reclamation completed a survey of Ute Reservoir in November 1992. The survey report presents the results of an investigation to monitor changes caused by sediment accumulation in Ute Reservoir after 29.9 years of reservoir operation. The report also describes the surveying procedures and equipment used in the 1992 investigation and provides data for future surveys. The primary purpose of the 1992 survey was the collection of data to compute the area-capacity relationships for operation of Ute Reservoir.

The 1992 survey determined that the reservoir has a storage capacity of 244,957 acre-feet and a surface area of 8,047 acres at spillway crest elevation 3787.0. Since closure in December 1962, the reservoir has accumulated a volume of 27,809 acre-feet of sediment below elevation 3787.0. This volume represents a 10.2-percent loss in total capacity and an average annual loss of 930 acre-feet for the operation period of December 1962 through November 1992.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS-- reservoir area and capacity/ sedimentation/ reservoir surveys/ sonar/ sediment distribution/ contour area/ sedimentation survey/

b. IDENTIFIERS-- Ute Reservoir/ New Mexico Interstate Stream Commission/

c. COSATI Field/Group ***COWRR:*** ***SRIM:***

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED	21. NO. OF PAGES
		56
	20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED	22. PRICE

UTE RESERVOIR

1992 SEDIMENTATION SURVEY

Ute Reservoir
Owned and Operated by
New Mexico
Interstate Stream Commission

1992 Sedimentation Survey Report
prepared by

Ronald L. Ferrari

BUREAU OF RECLAMATION
DIVISION OF EARTH SCIENCES
SURFACE WATER BRANCH
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DENVER OFFICE

DENVER, COLORADO

June 1993

ACKNOWLEDGMENTS

The Bureau of Reclamation prepared and published this report under the supervision of Robert I. Strand, Head, Sedimentation Section, Earth Sciences Division. The hydrographic survey was supervised by Ronald Ferrari, Hydraulic Engineer, and assisted by Steven Hughes, Engineer Technician, of the Denver Office. Personnel from the New Mexico and Oklahoma Interstate Stream Commissions assisted in the hydrographic survey. The preliminary field work of locating and flagging the existing sediment range end markers was performed by the New Mexico Interstate Stream Commission. Ronald Ferrari completed the data processing, sediment computations, area-capacity tables, and the report. Robert I. Strand and James O. Blanton III, Hydraulic Engineer, consulted in the sediment computations and report preparation.

Mission

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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INTRODUCTION

Ute Dam, located on the Canadian River in Quay County, New Mexico, is approximately 20 miles upstream from the New Mexico - Texas state line, 2.5 miles southwest of Logan, 3.5 miles downstream from Ute Creek, and at river mile 673.1 (fig. 1). The dam, designed and constructed by the Bechtel Corporation for the NMISC (New Mexico Interstate Stream Commission), was completed in May 1963. Storage began December 13, 1962. In April 1984 a modification project was completed which constructed a labyrinth spillway and increased the height of the dam, dike, and spillway crest.

The dam is a rolled earthfill structure 132 feet above the Canadian River streambed. The dam crest has a maximum elevation of 3812.0 feet mean sea level and a crest length of 2,050 feet. The structure includes an earthen dike section on the north bank of the Canadian River with a maximum height of 38 feet and a length of 3,640 feet. A concrete labyrinth spillway section with a crest elevation of 3787.0 feet and equivalent weir length of 3,360 feet is located upstream from an 840-foot-long ogee section between the main embankment and dike. The outlet tower, for low-flow releases, has a sill elevation of 3725.0 feet.

Ute Reservoir, which extends into San Miguel and Harding Counties, has a length of 32 miles, summation of Canadian River and Ute Creek, and an average width of 0.55 mile at reservoir pool elevation 3800.0. The average width is determined by dividing the surface area by the reservoir length at elevation 3800.0. The total Canadian River and Ute Creek drainage area above the dam is 11,110 square miles, of which 3,036 square miles contribute sediment inflow. The sediment contributing area is the total drainage area minus 1,110 square miles as identified by the USGS (U.S. Geological Survey) as probably noncontributing, 18 square miles of Ute Reservoir area, and 6,976 square miles of contributing drainage area above Conchas Lake dam.

At the beginning of reservoir storage in December 1962, Ute Reservoir had a calculated surface area of 8,202 acres with a capacity of 272,766 acre-feet at elevation 3787.0.

SUMMARY AND CONCLUSIONS

This report presents the results of an investigation to monitor changes caused by sediment accumulations in Ute Reservoir after 29.9 years of reservoir operations. It also describes the surveying procedures and equipment used in the 1992 investigation and provides data for future surveys. The primary purpose of the 1992 survey was the collection of data to compute the area-capacity relationships for operation of Ute Reservoir.

Table 1 contains a summary of reservoir sediment data for the 1992 survey. The 1992 survey determined that the reservoir has a storage capacity of 244,957 acre-feet and a surface area of 8,047 acres at spillway

crest elevation 3787.0. Since closure in December 1962, the reservoir has accumulated a volume of 27,809 acre-feet of sediment below elevation 3787.0. This volume represents a 10.2-percent loss in total capacity and an average annual loss of 930 acre-feet for the operation period of December 1962 through November 1992.

SURVEYS

Survey History

The original sediment ranges were surveyed by a NMISC contractor prior to inundation of water behind Ute Reservoir dam and are referred to as the original, or 1963, data. Figures 2 through 4 illustrate the range line network for Ute Reservoir. The original surface areas for Ute Reservoir were determined by planimetering topographic maps of the reservoir area developed prior to inundation. The topographic maps have a scale of one inch equals four hundred feet with a 10-foot contour interval.

In 1975, USGS conducted a sediment resurvey of Ute Reservoir and calculated a storage capacity of 136,235 acre-feet with a surface area of 5,229 acres at elevation 3770.0. Since closure in December 1962, the reservoir had a calculated sediment volume of 21,280 acre-feet below elevation 3770.0. The sediment volume was computed using horizontal contour areas planimetered at 5-foot contour intervals from the original reservoir topography that was revised using the 1975 survey data. This volume represented a 13.5-percent loss in total capacity at elevation 3770.0 and an average annual loss of 1,637 acre-feet for the 13-year operation period.

From October 1983 through March 1984 the USGS resurveyed Ute Reservoir and computed a revised area and capacity table. This survey was conducted prior to the dam and spillway modification, which raised the spillway crest from elevation 3760.0 to elevation 3787.0. The survey consisted of establishing new range end markers to replace those that would be inundated because of the increase in reservoir water surface elevation. On most of the range lines this task included extending only one of the bench marks because most of the original markers were established above elevation 3790.0. For two of the range lines it included changing the alignment of the original line, but the location was in the same general area. The survey also established additional range lines for future monitoring. Prior to this survey the maximum reservoir water surface was elevation 3760.8, which occurred in 1982. The 1984 study calculated a storage capacity of 134,483 acre-feet and a surface area of 5,245 acres at elevation 3770.0. Since closure in December 1962, the reservoir had a calculated volume of 23,032 acre-feet of sediment below elevation 3770.0. This volume represented a 14.6-percent loss in total capacity and an average annual loss of around 1,097 acre-feet, below elevation 3770.0, for the 21-year operation period of December 1962 through December 1983.

1992 Resurvey

Fieldwork for the 1992 survey began in September 1992 and ended on November 20, 1992. The preliminary field work, performed by NMISC, consisted of locating and flagging the existing sediment range end markers and relocating the destroyed ones. The hydrographic survey was performed at reservoir elevation 3784.26 using Reclamation's small boat bathymetric and total station survey systems. The small boat system consisted of a sonic depth recorder and reflector prism mounted on the boat. The distances from a known point, usually one of the range end markers, to the small boat were determined as it proceeded along the range line by an EDM (electronic distance measuring) instrument set up on shore aimed at the mounted reflector target. Range distances were communicated, by radio, from shore to the boat at preselected intervals and marked on the sonar charts as the boat proceeded across the reservoir. The boat was held on course as closely as possible by radio communication from the EDM operator to the survey boat. This system was used to collect the data for range lines C1 through C17, D1, K1, and U1 through U5. The data for range lines C18 through C22, P1, U6, and U7 were collected by a total station survey instrument and data recorder. Because the bottom at range lines C19 and C20 was too soft to cross, the elevations were measured by wading near the shore and setting the rod on top of the delta. The top of the delta was defined as the elevation the rod first experienced resistance before sinking. The measured elevation was then projected across to the original opposite bank of the range line for computation purposes.

RESERVOIR AREA AND CAPACITY

Development of 1992 Contour Areas

For the purposes of the 1992 sedimentation analysis and to better represent storage changes the reservoir was subdivided into segments using the range lines to delineate the limit of each segmental boundary. Reclamation digitized the segmental areas of the 10-foot contours for elevations 3680.0 through 3800.0 using copies of the original one inch equals four hundred feet topographic maps provided by NMISC. The total segmented areas for the digitized 10-foot contours compared fairly well with the original areas and required only minor adjustments to match the original total areas.

The 1992 reservoir surface areas were computed by the width adjustment method as described by Blanton (1982) and illustrated on figure 5. The method entails computing the new segmented contour area, A_1, between any two ranges by applying an adjustment factor to the original segmental contour area, A_0. The computed adjustment factor for each segment was the ratio of the new average width to the original average width for both the upstream and downstream ranges at the specified contour elevation. These calculations were computed by Reclamation's computer program RESSED. The input data included the original and 1992 range line data along with the segmented areas for the specified contour elevation. The program computes the 1992 surface area for each segment at the given contour elevations. A comparison

of simultaneous plots of original and 1992 range profiles indicated the lateral distribution of sediment at the different measured contour elevations. Where these plots indicate changes have occurred on the side slopes of the reservoir, a judgement decision was made to determine whether the change was caused by survey inaccuracies or actual deposition or erosion. The adjustment factor was set to 1.0 if it was judged the measured change was survey inaccuracy. Additional modifications to the calculated width adjustment factor were done to better represent the contour surface area changes. Because the original topography of Ute Reservoir had only 10-foot contours, it was decided that a better representation of the sediment surface areas should be obtained. These sediment surface areas were developed by plotting the 1992 average bottom profile versus the original thalweg profile and transferring the location of the 1992 contour crossing to the original topography, and digitizing the resulting sediment surface areas. This procedure was done for all contour crossings that terminated within a segment.

The RESSED program output lists the revised areas for each segment and notes where judgement led to overriding the adjustment factors. The output also notes where the adjustment factors were overridden to reflect the digitized surface areas of the contours that terminated within the segments. The 1992 total reservoir surface area at a given contour was the summation of all segmental areas at that elevation. The 1992 total area computation results are listed in column 2 of table 2.

1992 Revised Storage Capacity

The storage-elevation relationships based on the 1992 underwater survey data were developed using Reclamation's area-capacity computer program ACAP (Reclamation, 1985). The 1992 surface areas resulting from the RESSED computations at 10-foot contour intervals from elevation 3680.0 through 3790.0 and the original surface area at elevation 3800.0 were used as the control parameters for computing reservoir capacity. The original surface area of 11,237.1 acres was used for the 3800.0 contour because it was judged that the reservoir has not affected this contour area. The program computes an area at elevation increments of 0.01- to 1.0-foot by linear interpolation between the given contour intervals. The program begins by testing the initial capacity equation over successive intervals to ensure that the equation fits within an allowable error limit, which was set at 0.000001 for Ute Reservoir. This capacity equation is then used over the full range of intervals fitting within this allowable error limit. For the first interval at which the initial allowable error limit is exceeded, a new capacity equation (integrated from basic area curve over that interval) begins testing the fit until it also exceeds the error limit. Thus, the capacity curve is defined by a series of curves, each fitting a certain region of data. Final area equations are derived by differentiating the capacity equations, which are of second order polynomial form:

$$y = a_1 + a_2x + a_3x^2$$

where:

y = capacity,
x = elevation above a reference base,
a_1 = intercept, and
a_2 and a_3 = coefficients

Results of the 1992 Ute Reservoir area and capacity computations are listed in table 1 and table 2, and plotted on figure 6. A separate set of 1992 area and capacity tables will be published for the 0.01-, 0.1-, and 1-foot elevation increments. The 1992 area and capacity computations results are listed in columns (4) and (5) of table 2. Column 2 in the table gives the original measured contour areas used in the original area and capacity computation and column 3 gives the original capacity computed by ACAP. Both the original and 1992 area and capacity curves are plotted on figure 6 for a visual comparison of changes. The 1992 survey determined that the reservoir has a storage capacity of 244,957 acre-feet and a surface area of 8,047 acres at spillway crest elevation 3787.0.

SEDIMENT ANALYSES

Sedimentation accumulation

Sediments have accumulated in Ute Reservoir to a total volume of 27,809 acre-feet below elevation 3787.0, spillway crest, since storage began in December 1962. This volume represents a 10.2-percent loss in total capacity and an average annual accumulation rate of 930 acre-feet for the 29.9-year period of operation. The net sediment accumulation rate from the contributing basin was 0.306 acre-feet per square mile per year for the same period. The measured annual inflow rate is about 36 percent of the original estimate of 2,590 acre-feet for runoff conditions experienced prior to 1962. The original estimate was based upon computed yield rates for Pajarito Creek, Ute Creek, and the Canadian River.

The estimated average annual water inflow into Ute Reservoir for the years 1963 through 1989 was 49,614 acre-feet, see table 1 (Reclamation, 1992). This estimate represents about 27 percent of the historical flow of the Canadian River at the USGS stream-gauging station at Logan, New Mexico, which is located immediately downstream from Ute Dam. This gauge measured 100 percent of the historical inflow to the reservoir, which was 186,100 acre-feet per year for the period of 1935 through 1962.

Sedimentation Summary

The results of the sediment data and volume computations for the 1992 survey are shown in table 1 and table 2. The data include a tabulation of incremental sediment inflow volume and sediment accumulation computed for the period between initial conditions and the 1992 resurvey. Table 1 includes information on the drainage basin, records of estimated inflow, reservoir operations, and reservoir storage.

Table 3 compares the area and capacity results of the original versus the 1975, 1984, and 1992 surveys. The 1975 and 1984 surveys were accomplished by the USGS prior to the spillway modification. The maximum reservoir water surface for the operation period of these studies was elevation 3760.8, which occurred in 1982. This table is given for comparison purposes only because a description of the 1975 and 1984 sediment study analysis on how their areas were calculated was not available. The original and 1992 capacity values were computed by Reclamation's program ACAP using the measured surface areas. The 1975 and 1984 values were computed by a different program and are slightly higher than the ACAP results using the same surface area input. The last column gives the unadjusted total segment areas that were digitized by Reclamation from the original topographic maps, as described in the development of 1992 contour areas section. For the 1992 sediment analysis, adjustment factors were applied to the digitized segmental areas to make them equal to the original total areas listed in column 2. Reclamation's width adjustment method uses the original areas that developed the original area-capacity table.

RESERVOIR SEDIMENT DISTRIBUTION

Longitudinal Distribution

The distribution of sediment throughout the length of the reservoir is illustrated by plots of the thalweg profile representing the original and 1992 resurveyed profiles for the Canadian River and Ute Creek as shown on figures 7 and 8. The distribution of sediment is also illustrated by plots of the thalweg profiles of the original, 1975, 1984, and 1992 resurveyed profiles for the Canadian River and Ute Creek as shown on figures 9 and 10. Thalweg elevations representing original and the resurveyed reservoir conditions were taken from the 1992 survey notes and large scale plots of the 1975 and 1984 range line data. Except for the possibility of some missed low points, the plotted profile should closely resemble actual channel bottom conditions during the original range survey completed prior to inundation of the reservoir. Except for some minor inaccuracies in sounding and being slightly off line, the bottom of the 1975, 1984, and 1992 profiles should closely represent channel bottom conditions at the time of those resurveys. The channel distance used for range line location is the original river channel distance from the dam to each range line in an upstream direction on the Canadian River and from the confluence to each range line in an upstream direction on Ute Creek.

Lateral Distribution

For this study, the 1963 range line data were determined using several sources because the original survey notes or coordinate data were not available. A 1983 sediment projection study by Reclamation determined the distance versus elevation for many of the original range lines by digitizing large scale plots of the original range lines provided by NMISC. Plots from the USGS 1984 sediment resurvey were used to modify the 1963 data files because the length and alignment of some of the ranges were affected. Those portions of the range lines surveyed for the first time in 1984 were imported into the 1963 data files to be used in measuring changes caused by sediment deposition. Some major changes were made to the 1963 data files for range lines C4 and C10 along with some minor changes to a few other sections. NMISC provided large scale range line plots which included superimposed data from the 1963, 1975, and 1984 surveys. Examination of these plots along with the 1992 survey plots suggested that the 1963 data had a bust in the plotted data for sections C4 and C10. This theory was supported by the one inch equals four hundred feet topography maps of the reservoir area. The range lines were plotted by Reclamation from left to right bank looking downstream.

Ground profiles for the 32 original sediment ranges are shown on figures 11 through 42. The 1992 range profile data is superimposed on these plots to indicate the changes which have occurred and to represent in general the lateral distribution of sediment within the reservoir from elevation 3800.0 and below. A 1992 survey was not accomplished for range lines P1 because of destroyed monuments and time restraints. The 1992 survey did get some elevation shots of the creek channel of P1, which indicated no change since 1963. No resurvey was done for the range lines located upstream from C22 and U7 because they were located above elevation 3800.0 and it was judged that no reservoir deposition had occurred above that elevation. Modifications were done to the 1963 and 1992 survey cross section data for input into Reclamation's computer program used for sediment analysis. These modifications included changing the cross section labels for each range line; that is, C1 through C22 became 1 through 22, D1 became 201, K1 and K2 became 301 and 302, and U1 through U7 became 101 through 107. Modification to the 1992 data included shifting stations slightly to better align features and removing measured data that was not actual sediment build up. For sediment computation purposes, a complete section was needed for all ranges. For this reason, the original data was inserted into the 1992 data file to complete the areas not surveyed in 1992.

REFERENCES

Blanton, James O. III, *Procedures for Monitoring Reservoir Sedimentation: Technical Guideline*, Bureau of Reclamation, Denver, Colorado, 1982.

Bureau of Reclamation, *ACAP85 User's Manual*, Denver Office, Denver, Colorado, 1985.

Bureau of Reclamation, *Surface Water Supply Technical Memorandum, Eastern New Mexico Water Supply Project*, Denver Office, Denver, Colorado, September 1992.

RESERVOIR SEDIMENT
DATA SUMMARY

Ute Reservoir
NAME OF RESERVOIR

1
DATA SHEET NO.

DAM	1. OWNER Interstate Stream Commission		2. STREAM Canadian River		3. STATE New Mexico	
	4. SEC. 21 TWP. 13N RANGE 33E		5. NEAREST P.O. Logan		6. COUNTY Quay	
	7. LAT 35° 20' 35" LONG 103° 26' 37"		8. TOP OF DAM ELEVATION 3812.0[1]		9. SPILLWAY CREST EL. 3787.0[2]	
RESERVOIR	10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, Ac	13. ORIGINAL CAPACITY, AF	14. GROSS STORAGE ACRE- FEET	15. DATE STORAGE BEGAN
	a. FLOOD CONTROL					
	b. MULTIPLE USE					12/13/62
	c. POWER					
	d. WATER SUPPLY	3787.0[3]	8,202	222,900	272,766	16. DATE NORMAL OPERATION BEGAN
	e. IRRIGATION					
	f. CONSERVATION	3741.6[4]	2,376	29,158	49,866	
	g. INACTIVE	3725.0[5]	1,238	20,708	20,708	5/1963
	17. LENGTH OF RESERVOIR 32[6] MILES			AVG. WIDTH OF RESERVOIR 0.55 MILES		
BASIN	18. TOTAL DRAINAGE AREA 11,140 SQUARE MILES			22. MEAN ANNUAL PRECIPITATION INCHES		
	19. NET SEDIMENT CONTRIBUTING AREA 3,041[7] SQUARE MILES			23. MEAN ANNUAL RUNOFF 0.084 INCHES		
	20. LENGTH MILES	AV. WIDTH MILES		24. MEAN ANNUAL RUNOFF 49,614[8] ACRE-FEET		
	21. MAX. ELEVATION	MIN. ELEVATION		25. ANNUAL TEMP. MEAN °F RANGE °F to °F		

SURVEY DATA

26. DATE OF SURVEY	27. PER. YRS.	28. ACCL. YRS.	29. TYPE OF SURVEY	30. NO. OF RANGES OR INTERVAL	31. SURFACE AREA, AC.	32. CAPACITY ACRE-FEET	33. C/I RATIO AF/AF
12/62			Contour (D)	10-ft	8,202[9]	272,766[9]	5.50
11/92	29.9	29.9	Range (D)	32	8,047[9]	244,957[9]	4.94

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIP.	35. PERIOD WATER INFLOW, ACRE FEET			WATER INFLOW TO DATE, AF	
		a. MEAN ANN.	b. MAX. ANN.	c. TOTAL	a. MEAN ANN.	b. TOTAL
11/92		49,614[8]	238,196[8]	1,339,591[8]	49,614[8]	1,339,591[8]

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SEDIMENT DEPOSITS TO DATE, AF		
	a. TOTAL	b. AV. ANN.	c. /MI.²-YR.	a. TOTAL	b. AV. ANNUAL	c. /MI.²-YR.
11/92	27,809	930	0.306	27,809	930	0.306

26. DATE OF SURVEY	39. AV. DRY WT. (#/FT³)	40. SED. DEP. TONS/MI.²-YR.		41. STORAGE LOSS, PCT.		42. SEDIMENT INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANNUAL	b. TOTAL TO DATE	a. PER.	b. TOT.
11/92				0.341[10]	10.20[10]		

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW CREST ELEVATION 3787.0										
			109.0-87.0	87.0-77.0	77.0-67.0	67.0-57.0	57.0-47.0	47.0-37.0	37.0-27.0	27.0-17.0	17.0-7.0	7.0-Crest
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION										
11/92			10.0	13.6	9.1	6.4	9.5	11.9	14.4	12.4	8.0	4.7

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	100-105	105-110	110-115	115-120	120-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														
	N/A														

Table 1. - Reservoir sediment data summary (page 1 of 2).

45. RANGE IN RESERVOIR OPERATION

YEAR	MAX. ELEV.[11]	MIN. ELEV.[11]	INFLOW, AF[8]	YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF
1963	3728.6	3701.6	28,606	1964	3733.0	3726.5	14,613
1965	3759.9	3731.2	102,302	1966	3760.1	3753.0	41,210
1967	3760.0	3756.5	68,324	1968	3757.5	3755.3	17,810
1969	3760.1	3755.6	127,376	1970	3758.4	3756.1	17,085
1971	3757.4	3755.5	39,364	1972	3760.0	3755.0	74,356
1973	3758.2	3756.0	13,304	1974	3756.2	3753.7	9,325
1975	3755.8	3753.9	16,376	1976	3755.3	3753.2	19,281
1977	3758.6	3753.8	45,230	1978	3756.6	3754.6	16,809
1979	3760.1	3755.8	32,936	1980	3756.8	3753.6	20,027
1981	3759.6	3753.0	82,189	1982	3760.8	3743.6	117,659
1983	3742.6	3739.6	14,050	1984	3745.0	3739.4	18,329
1985	3748.7	3745.1	43,046	1986	3764.9	3756.1	45,926
1987	3787.2	3765.3	238,196	1988	3786.0	3783.9	35,906
1989	3786.2	3783.3	39,956	1990	3784.8	3782.4	-
1991[12]	3786.0	3783.7	-	1992	-	-	-

46. ELEVATION - AREA - CAPACITY DATA FOR ORIGINAL CAPACITY

ELEV.	AREA	CAP.	ELEV.	AREA	CAP.	ELEV.	AREA	CAP.
3678	0	0	3680	6	6	3690	140	608
3700	322	2,789	3710	590	7,352	3720	975	15,177
3725	1,238	20,708	3730	1,500	27,552	3740	2,226	46,185
3741.6	2,376	29,158	3750	3,162	73,124	3760	4,131	109,588
3770	5,454	157,515	3780	6,973	219,652	3787	8,202	272,766
3790	8,729	298,164	3800	11,237	397,996			

46. ELEVATION - AREA - CAPACITY DATA FOR 1992 CAPACITY

ELEV.	AREA	CAP.	ELEV.	AREA	CAP.	ELEV.	AREA	CAP.
3703.3	0	0	3710	239	801	3720	818	6,086
3725	1,058	10,777	3730	1,299	16,670	3740	1,904	32,682
3741.6	2,051	35,846	3750	2,823	56,310	3760	3,669	88,764
3770	5,224	133,229	3780	6,758	193,141	3787	8,047	244,957
3790	8,599	269,925	3800	11,237	369,106			

47. REMARKS AND REFERENCES

[1] Original dam height, prior to 1984 construction, was elevation 3801.0.

[2] Crest elevation of labyrinth spillway completed in April 1984. Original spillway crest elevation 3760.0.

[3] Design capacity elevations raised after labyrinth spillway completion in 1984.

[4] This elevation is for an inactive pool for fish and wildlife purposes established by agreement between the New Mexico Interstate Stream Commission and the New Mexico State Game Commission.

[5] Elevation established by sill of outlet works.

[6] Total length includes 24 miles of Canadian River and 8 miles of Ute Creek.

[7] Represents noncontributing area of 1,110 mi^2, reservoir area of 13 mi^2, and contributing drainage area above Conchas Lake of 6,976 mi^2.

[8] Estimated annual inflow to Ute Reservoir for calendar years 1963 through 1989 (27 years). Values from Bureau of Reclamation report dated September 1992 titled "Surface Water Supply Technical Memorandum, Eastern New Mexico Water Supply Project."

[9] Surface area and capacity at elevation 3787.0, spillway crest. Area and capacity calculated by Bureau of Reclamation program ACAP.

[10] Average annual and total sediment deposits divided by 272,766 acre-feet (original capacity at elevation 3787.0).

[11] End-of-month values from USGS publications.

[12] January 1991 through September 1991 data only.

48. AGENCY MAKING SURVEY Bureau of Reclamation

49. AGENCY SUPPLYING DATA Bureau of Reclamation | DATE February 1993

Table 1. - Reservoir sediment data summary (page 2 of 2).

Table 2. - Summary of 1992 survey results.

(1) Elevation (feet)	(2) Original Area (acres)	(3) Original Capacity (acre-feet)	(4) 1992 Area (acres)	(5) 1992 Capacity (acre-feet)	(6) Measured Sediment Volume (acre-feet)	(7) Percent Measured Sediment	(8) Percent Reservoir Depth
3800	11,237.1	397,996	11,237.1	369,106	28,890	-	-
3790	8,729.3	298,164	8,599.0	269,925	28,239	-	-
3787	8,202	272,766	8,047	244,957	27,809	100.0	100.0
3780	6,973.1	219,652	6,757.9	193,141	26,511	95.3	93.6
3770	5,454.3	157,515	5,224.4	133,229	24,286	87.3	84.4
3760	4,131.1	109,588	3,668.7	88,764	20,824	74.9	75.2
3750	3,161.7	73,124	2,822.7	56,310	16,814	60.5	66.0
3740	2,226.1	46,185	1,903.6	32,682	13,503	48.6	56.9
3730	1,500.4	27,552	1,298.8	16,670	10,882	39.1	47.7
3720	974.7	15,177	818.0	6,086	9,091	32.7	38.5
3710	590.3	7,352	239.1	801	6,551	23.6	29.4
3703.3	411	3,998	0	0	3,998	14.4	23.2
3700	322.3	2,789	0	0	2,789	10.0	20.2
3690	113.9	608	0	0	608	2.2	11.0
3680	6.4	6	0	0	6	0.02	1.8
3678	0	0	0	0	0	0.0	0.0

(1) Elevation of reservoir water surface.
(2) Original reservoir surface area.
(3) Original calculated reservoir capacity computed using ACAP from original measured surface areas.
(4) Reservoir surface area from 1992 survey.
(5) 1992 calculated reservoir capacity computed using ACAP from 1992 surface areas.
(6) Measured sediment volume = column (3) - column (5).
(7) Measured sediment expressed in percentage of total sediment (27,809).
(8) Depth of reservoir expressed in percentage of total depth (109 feet).

Table 3. - Summary of sedimentation survey results.

Elevation (feet)	Original[1] Area (acres)	Original[1] Capacity (acre-feet)	1975[2] Area (acres)	1975[2] Capacity (acre-feet)	1984[3] Area (acres)	1984[3] Capacity (acre-feet)	1992[4] Area (acres)	1992[4] Capacity (acre-feet)	Digitized[5] 1962 Surface Areas (acres)
3800	11,237	397,996	-	-	11,112	368,263	11,237	369,106	11,060
3790	8,729	298,164	-	-	8,428	271,174	8,599	269,925	8,629
3787	8,202	272,766	-	-	7,947	246,617	8,047	244,957	-
3780	6,973	219,652	-	-	6,834	194,882	6,758	193,141	6,806
3770	5,454	157,515	5,229	136,235	5,245	134,483	5,224	133,229	5,257
3760	4,131	109,588	3,842	90,470	3,821	89,574	3,669	88,764	4,067
3750	3,161	73,124	2,820	58,044	2,833	56,305	2,823	56,310	3,077
3740	2,226	46,185	1,928	34,351	1,854	32,959	1,904	32,682	2,182
3730	1,500	27,552	1,332	18,545	1,361	16,958	1,299	16,670	1,456
3720	975	15,177	852	7,855	850	6,111	818	6,086	947
3710	590	7,352	288	2,960	264	1,258	239	801	606
3703.3	411	3,998	167	839	0	0	0	0	-
3700	322	2,789	0	0	0	0	0	0	313
3690	114	608	0	0	0	0	0	0	108
3680	6	6	0	0	0	0	0	0	5
3678	0	0	0	0	0	0	0	0	0

[1] Area and capacity values from table dated 12/5/63. Area and capacity computed by Reclamation's area-capacity program ACAP.
[2] Area and capacity values from table dated Dec. - Jan 1975-76. Area and capacity not computed by ACAP.
[3] Area and capacity values from table dated 1/1/84. Area and capacity not computed by ACAP.
[4] Area and capacity values from table dated 11/92. Area and capacity computed by ACAP.
[5] Total of segmental surface areas digitized by Reclamation for the 1992 Ute Reservoir sedimentation study from the original topographic maps. For the 1992 sedment analysis an adjustment factor was applied for the digitized surface area value to equal the original surface areas listed in column 2.

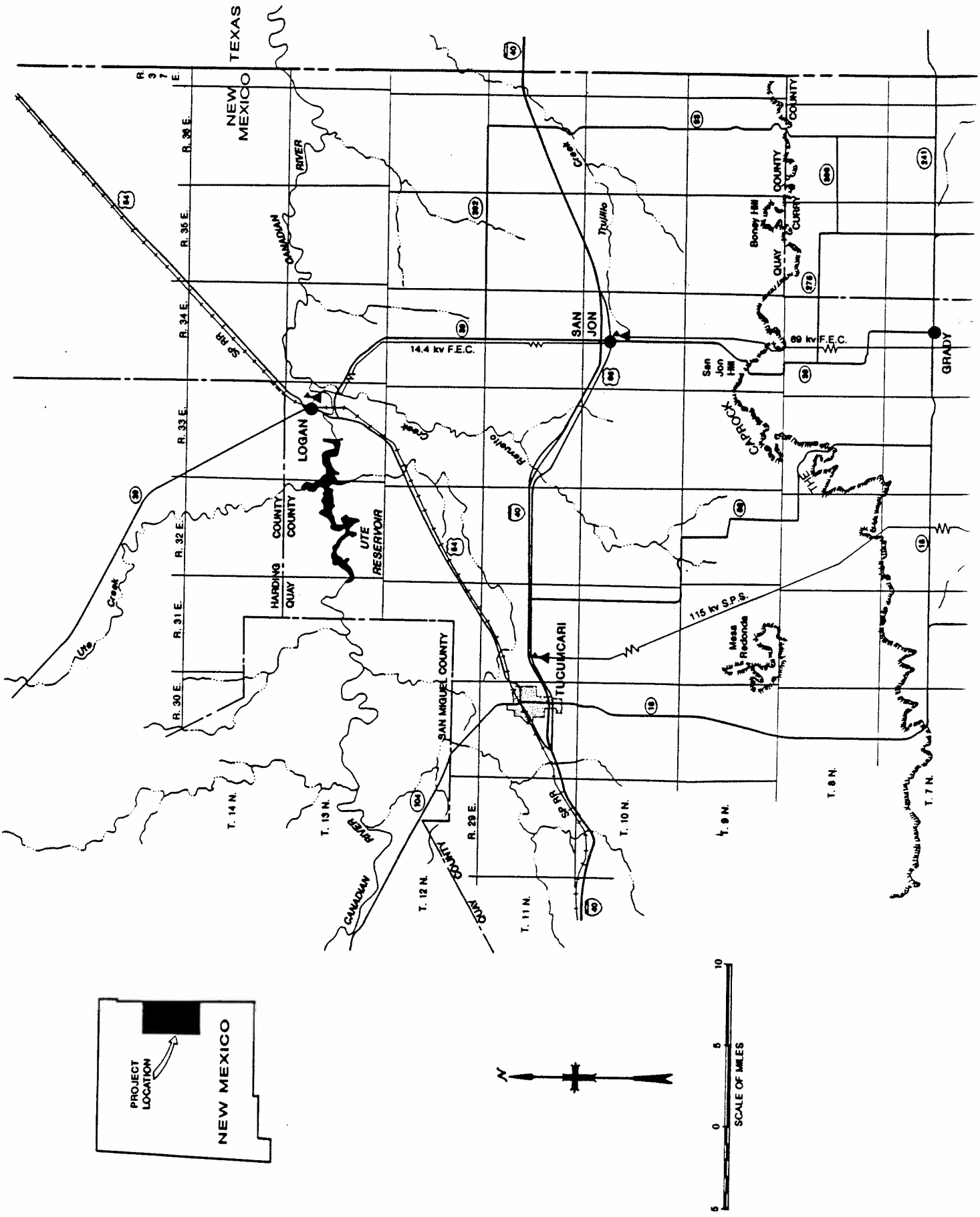

Figure 1. - Ute Reservoir location map.

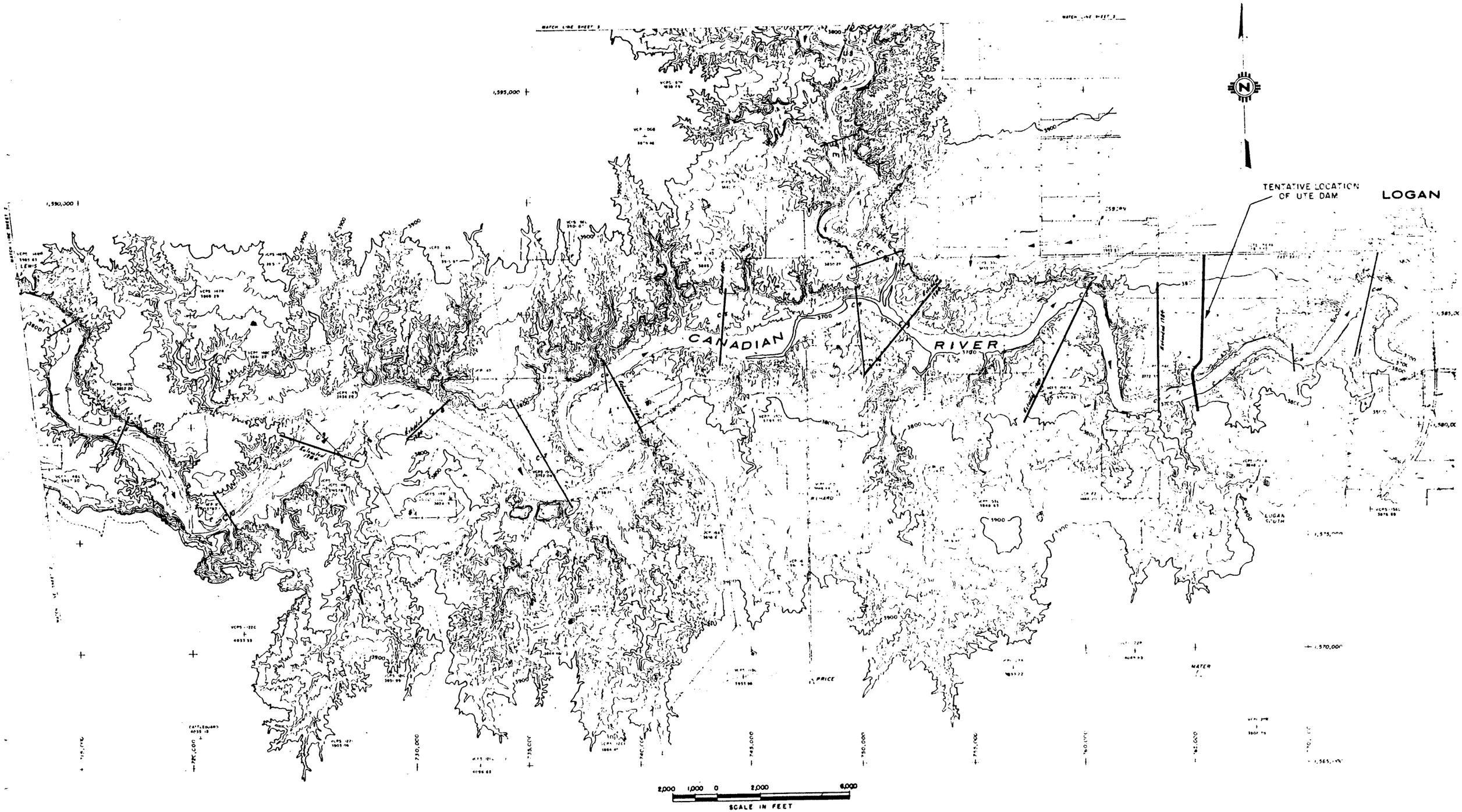

Figure 2. - Ute Reservoir range location map.

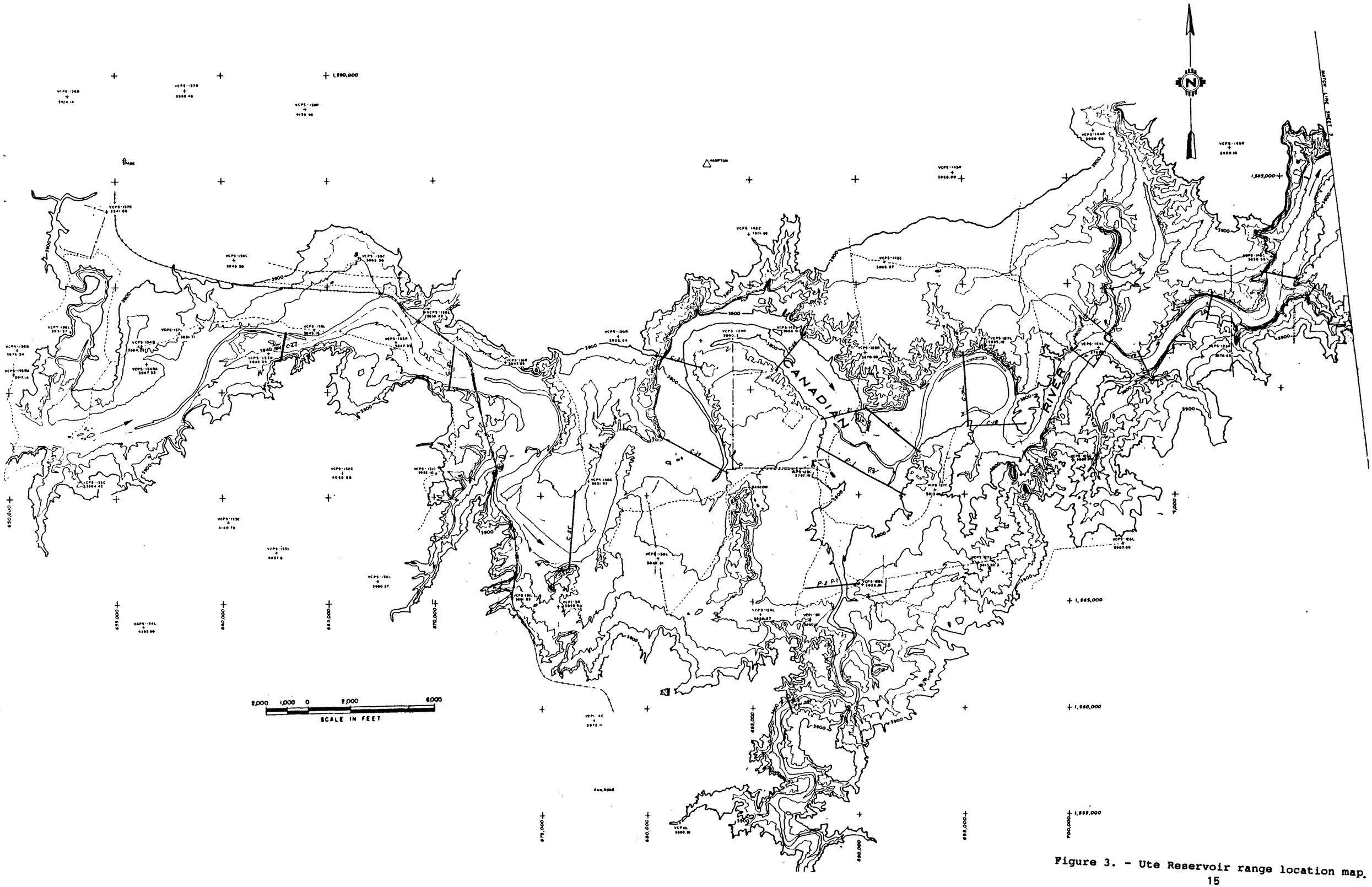

Figure 3. - Ute Reservoir range location map.

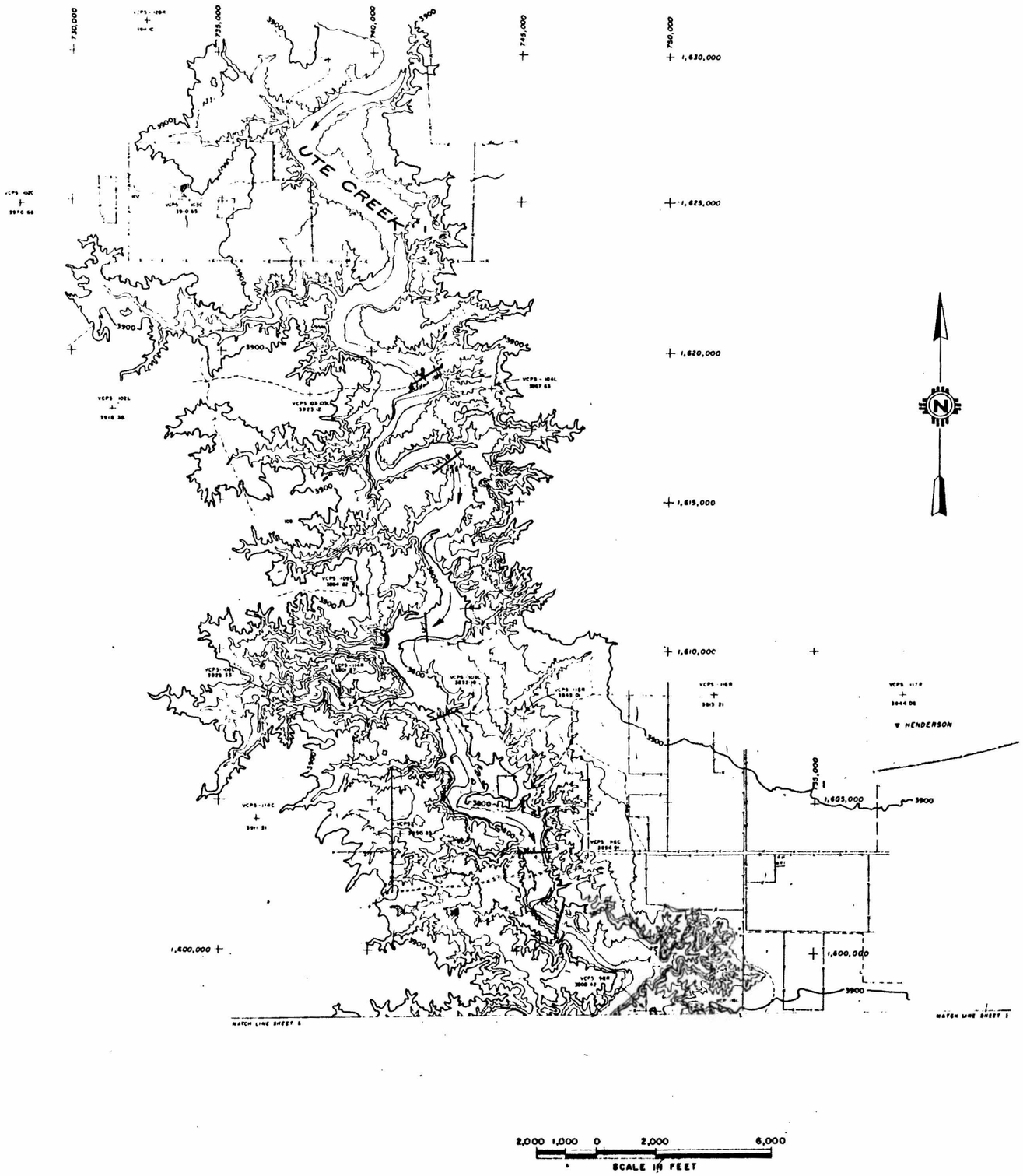

Figure 4. - Ute Reservoir range location ma

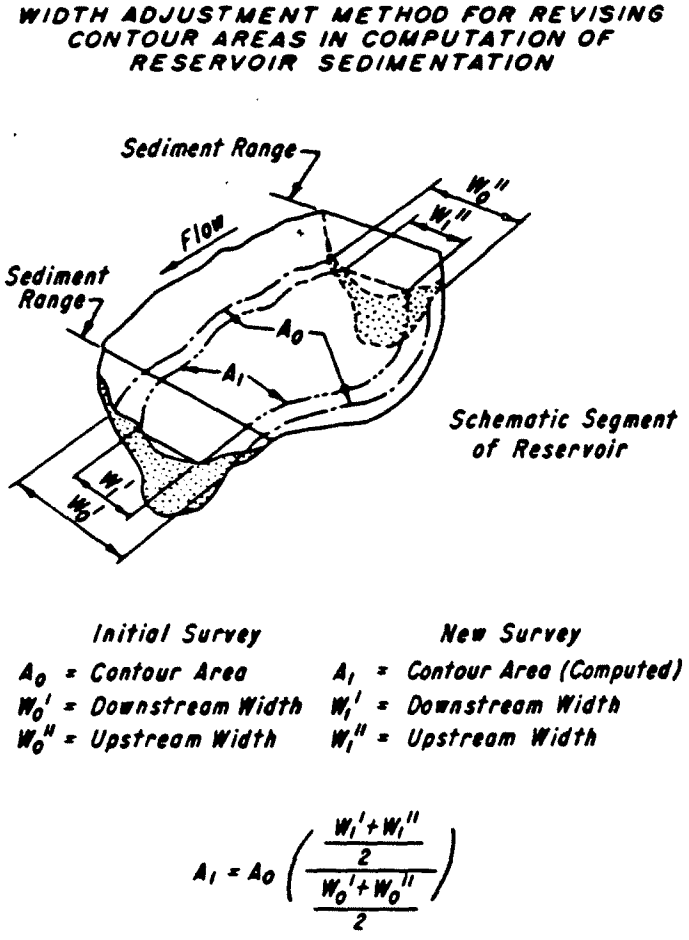

Figure 5. - Width adjustment method for revising contour areas.

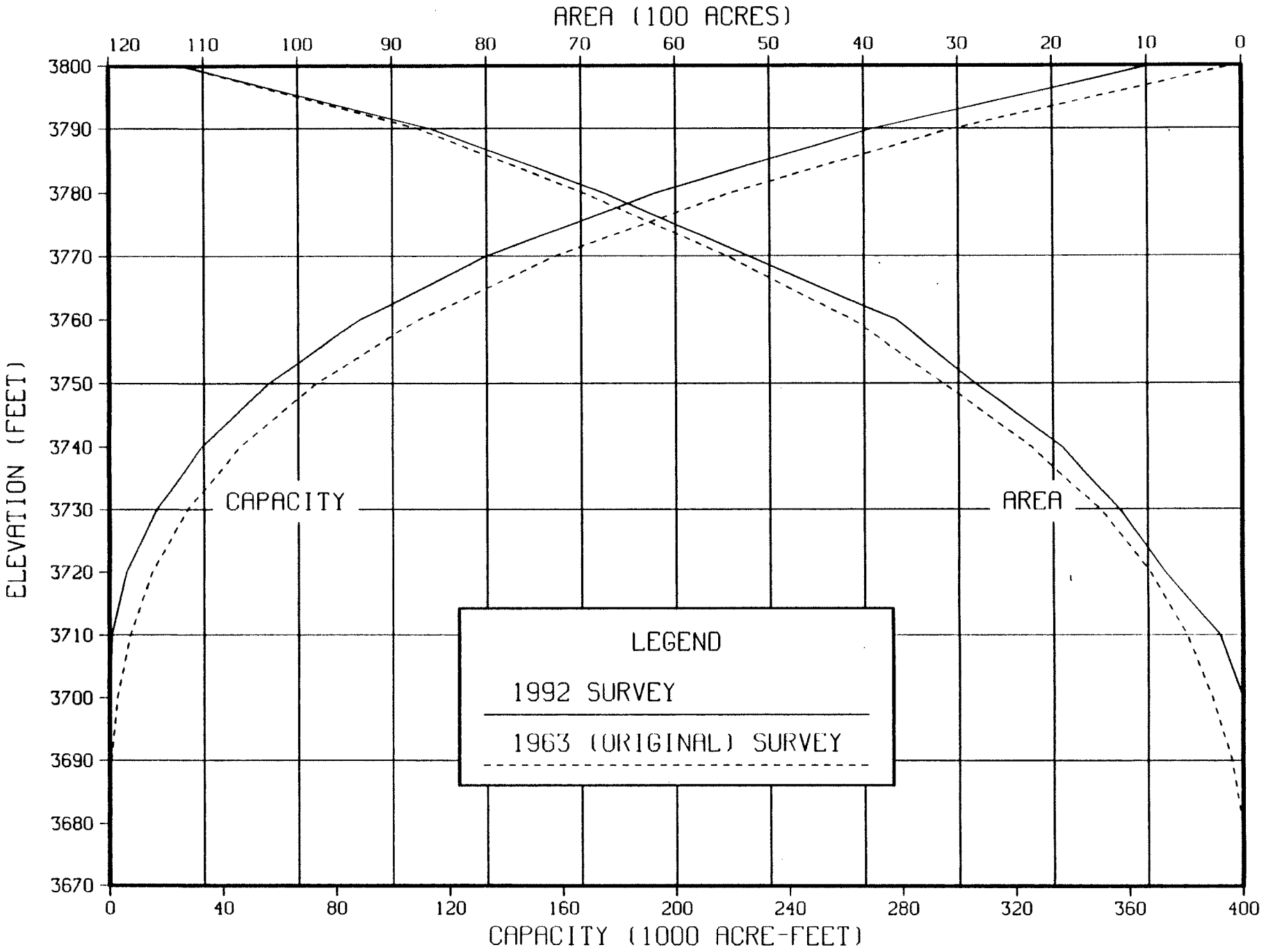

Figure 6. - Area and capacity curves - Ute Reservoir.

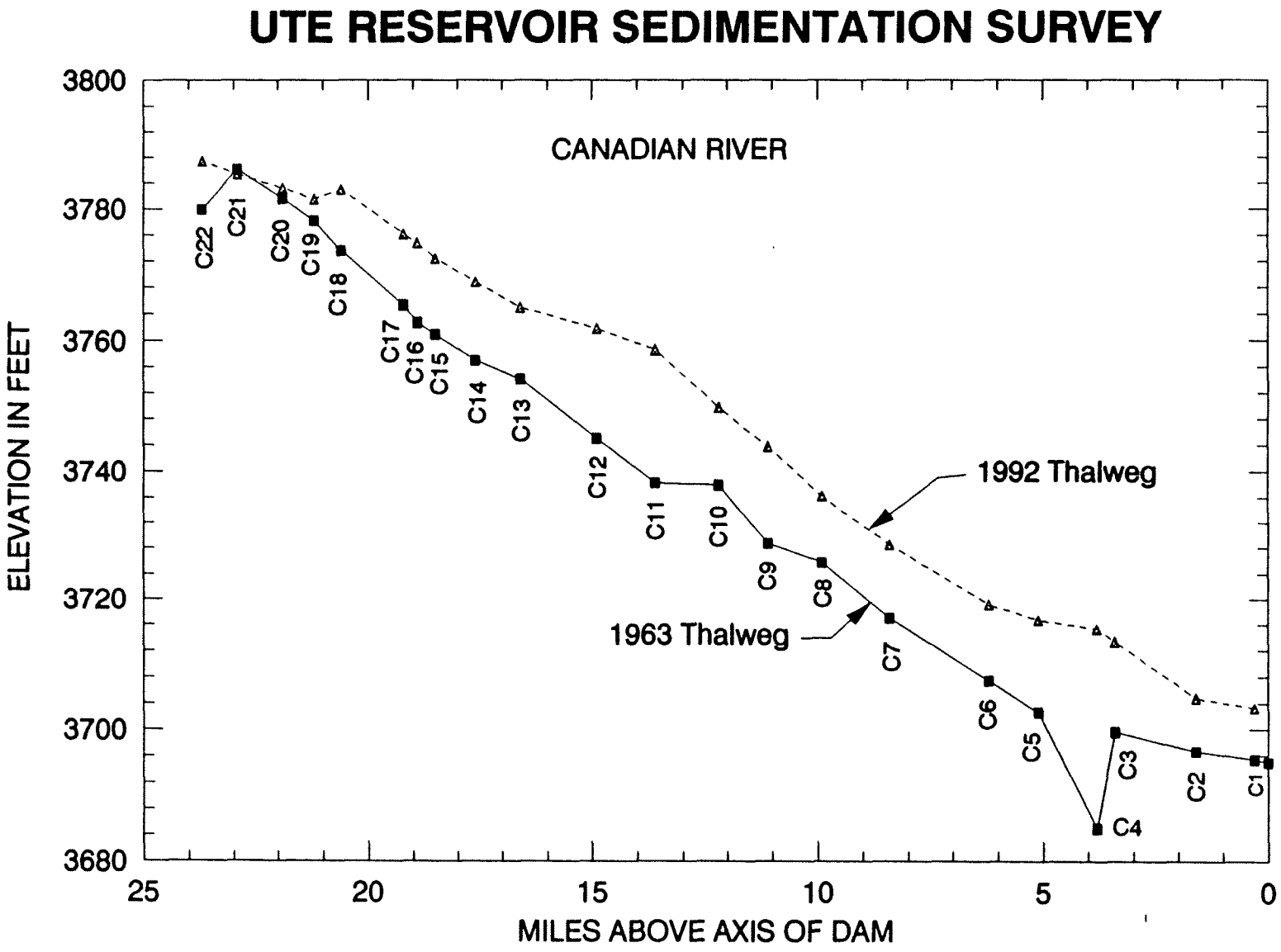

Figure 7. - Longitudinal profile - Canadian River.

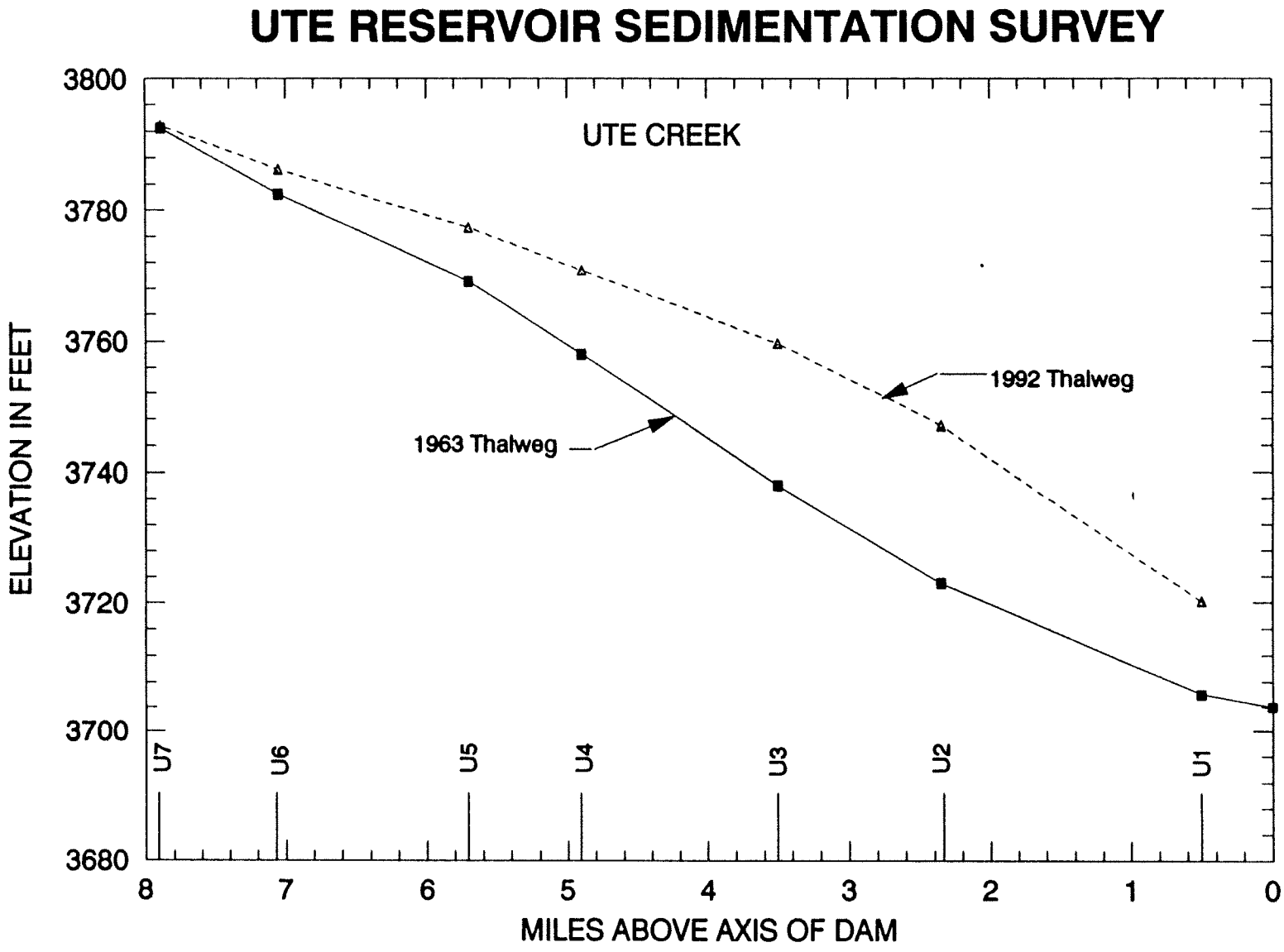

Figure 8. - Longitudinal profile - Ute Creek.

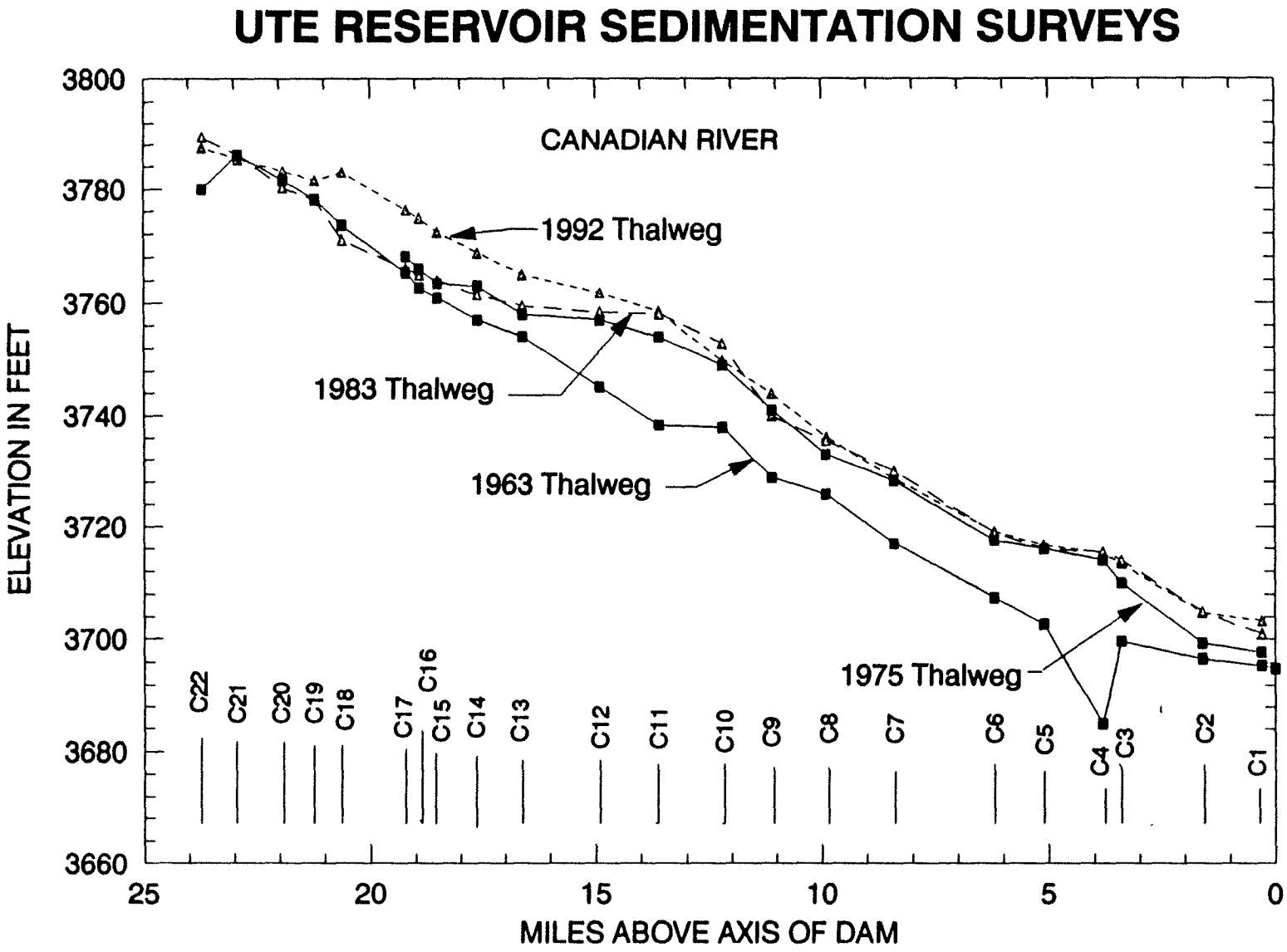

Figure 9. - Longitudinal profile - Canadian River.

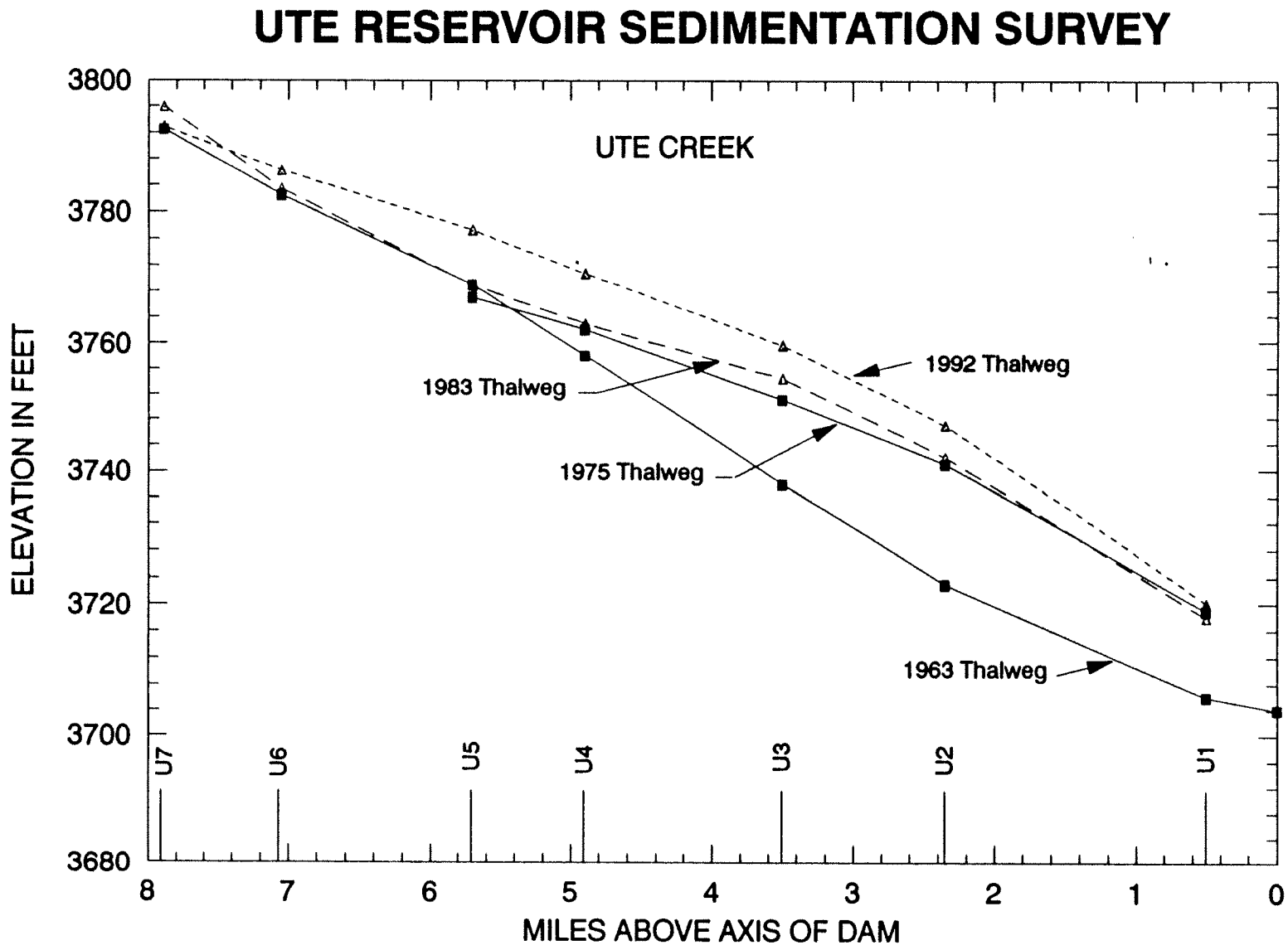

Figure 10. - Longitudinal profile - Ute Creek.

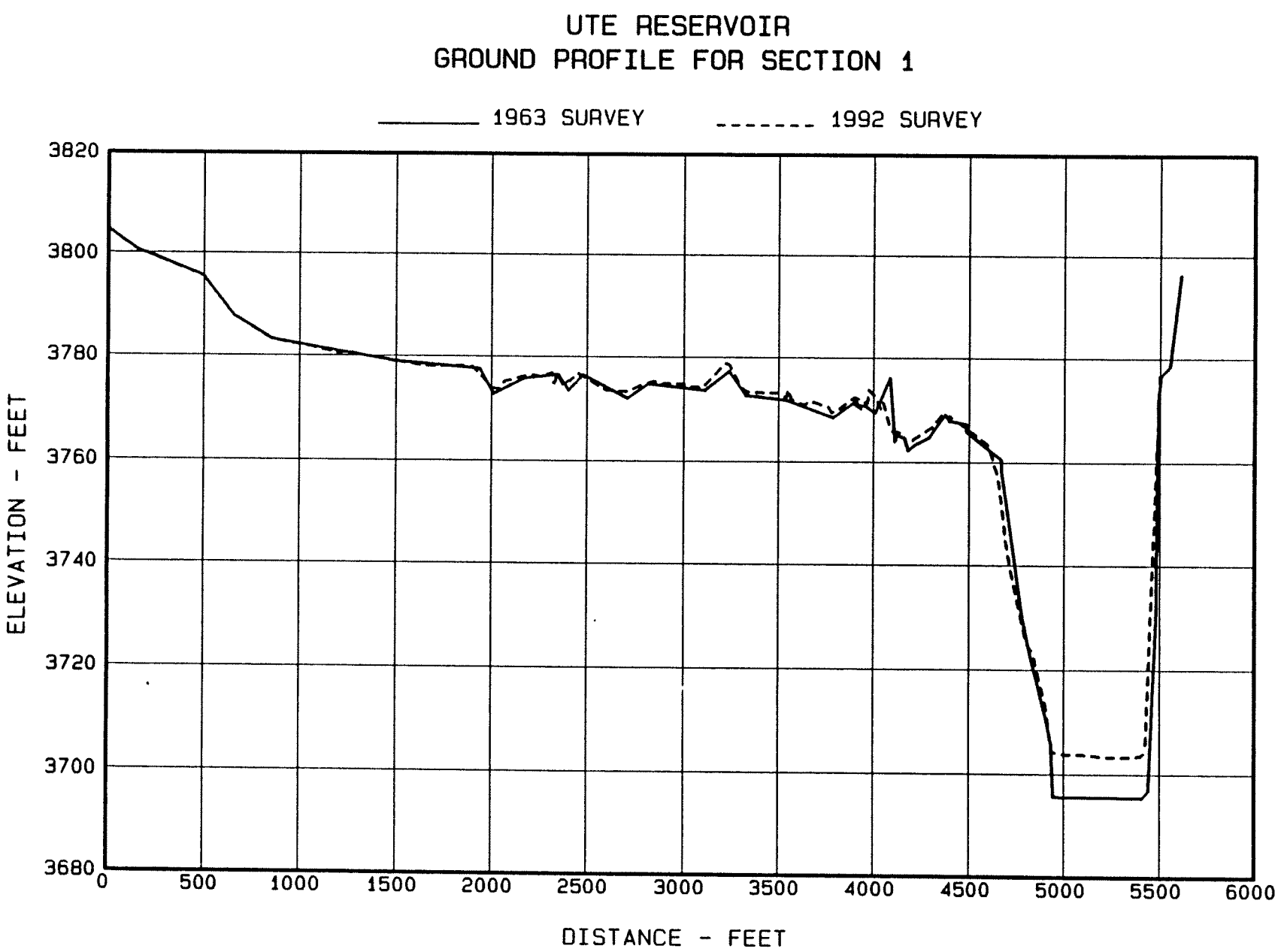

Figure 11. - Sediment Range 1 - Canadian River.

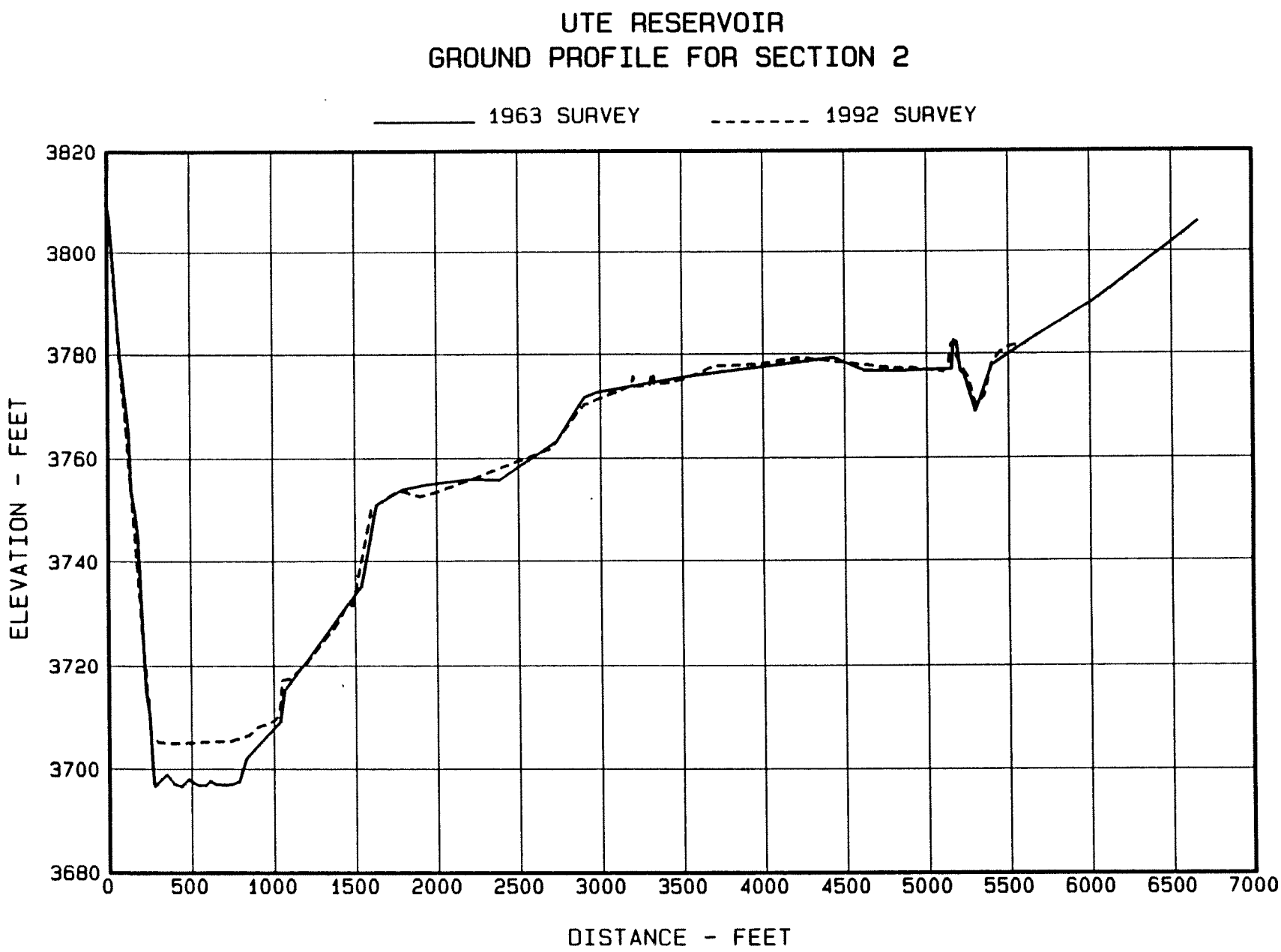

Figure 12. - Sediment Range 2 - Canadian River.

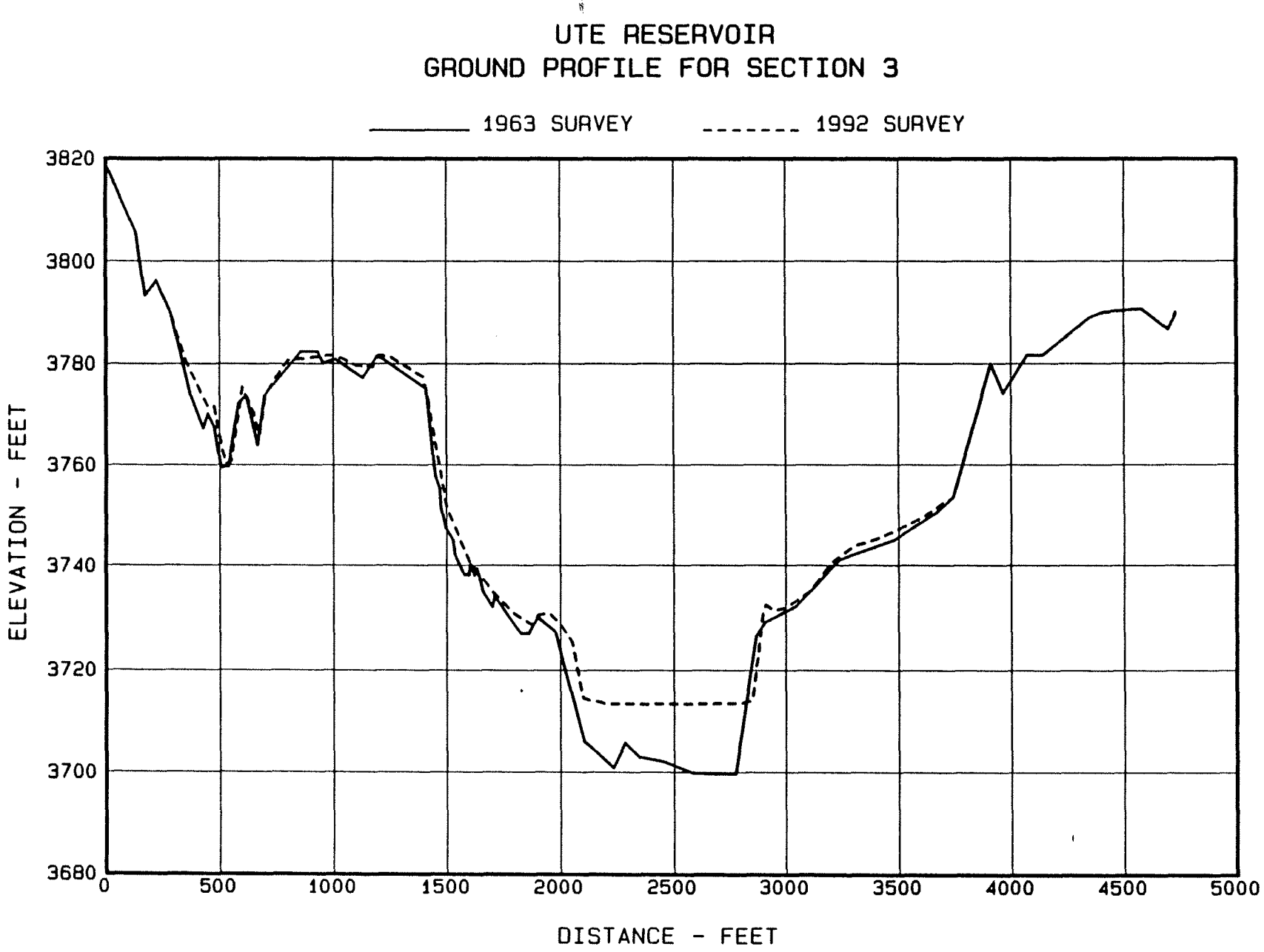

Figure 13. - Sediment Range 3 - Canadian River.

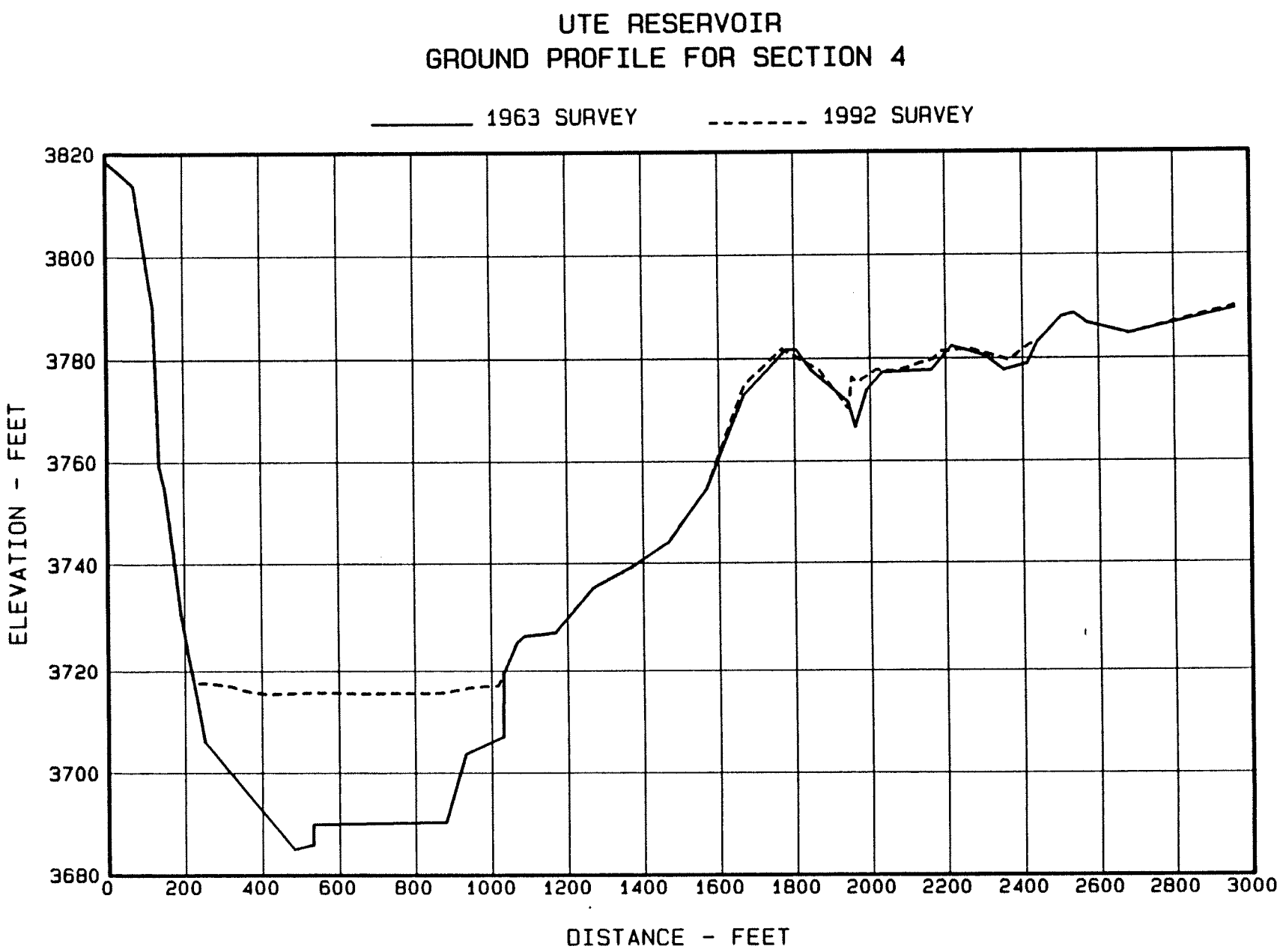

Figure 14. - Sediment Range 4 - Canadian River.

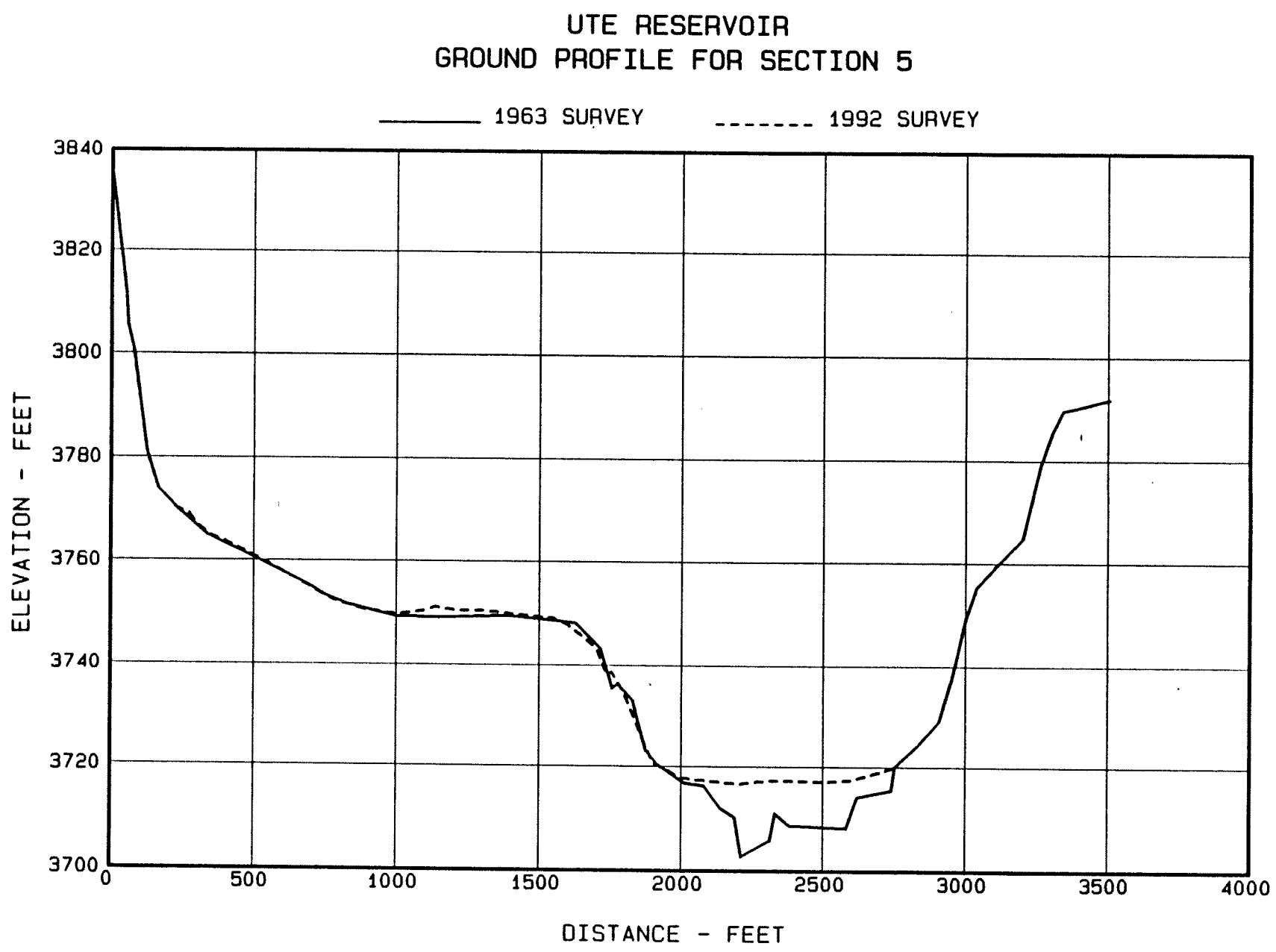

Figure 15. - Sediment Range 5 - Canadian River.

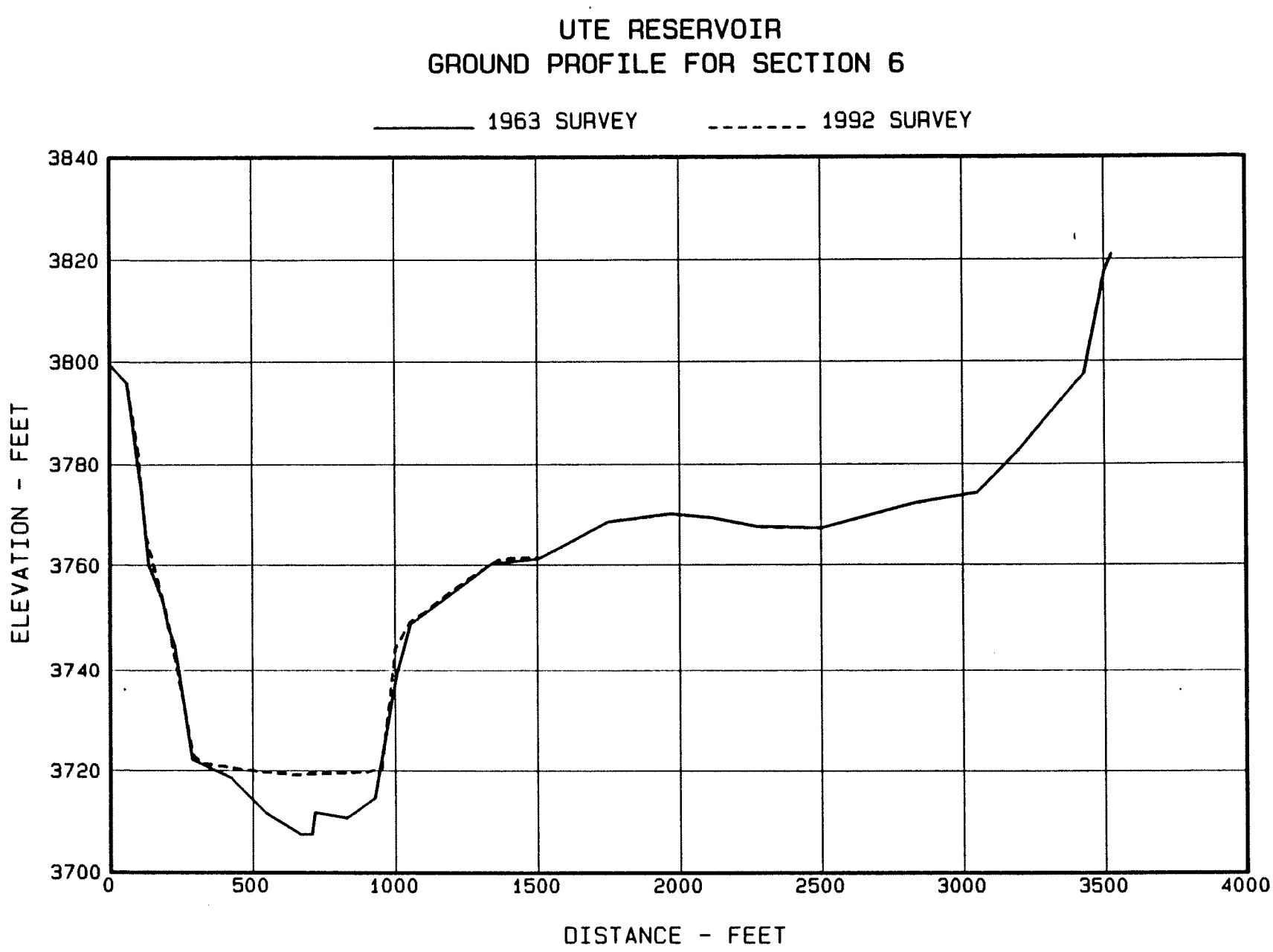

Figure 16. - Sediment Range 6 - Canadian River.

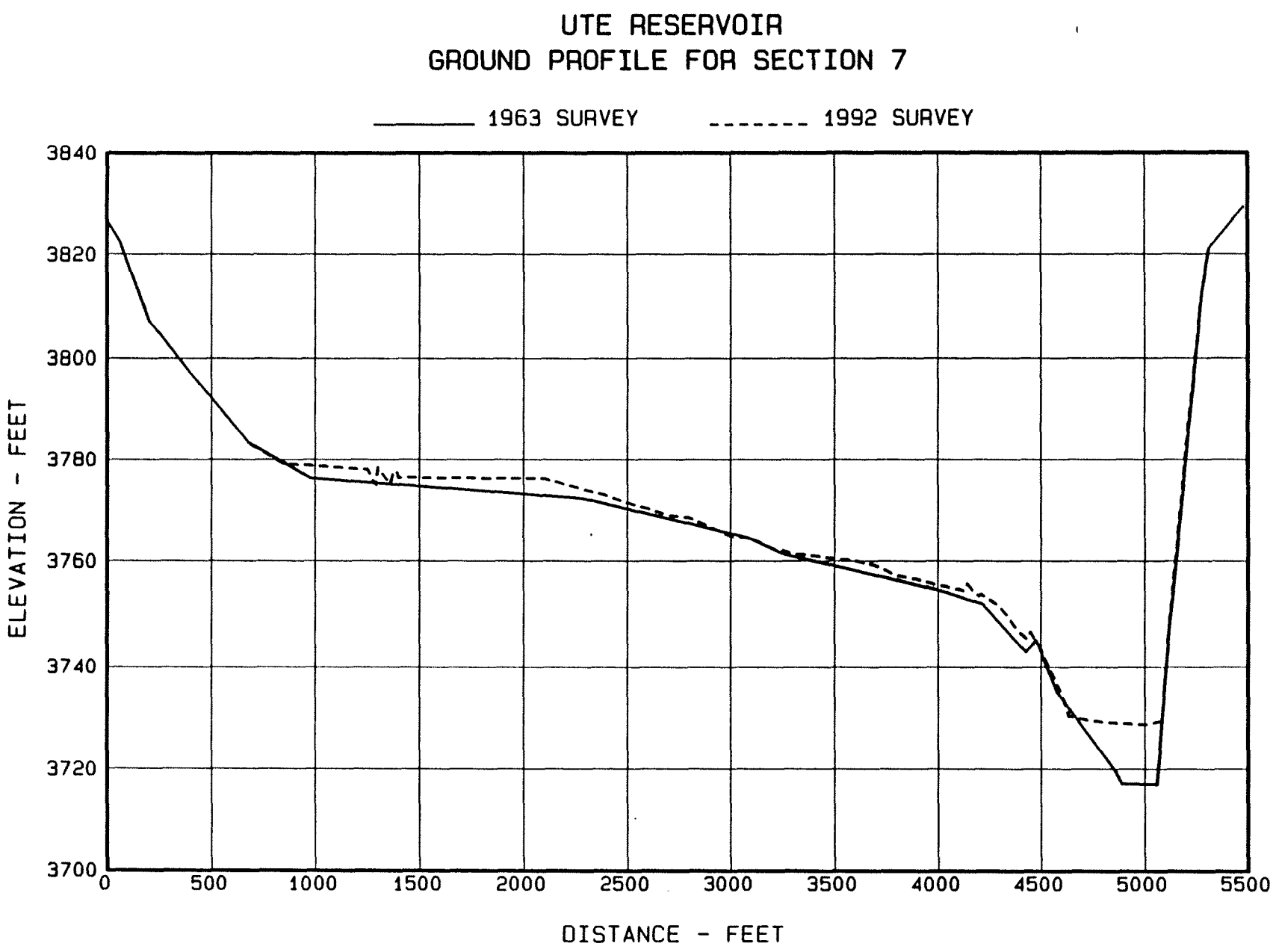

Figure 17. - Sediment Range 7 - Canadian River.

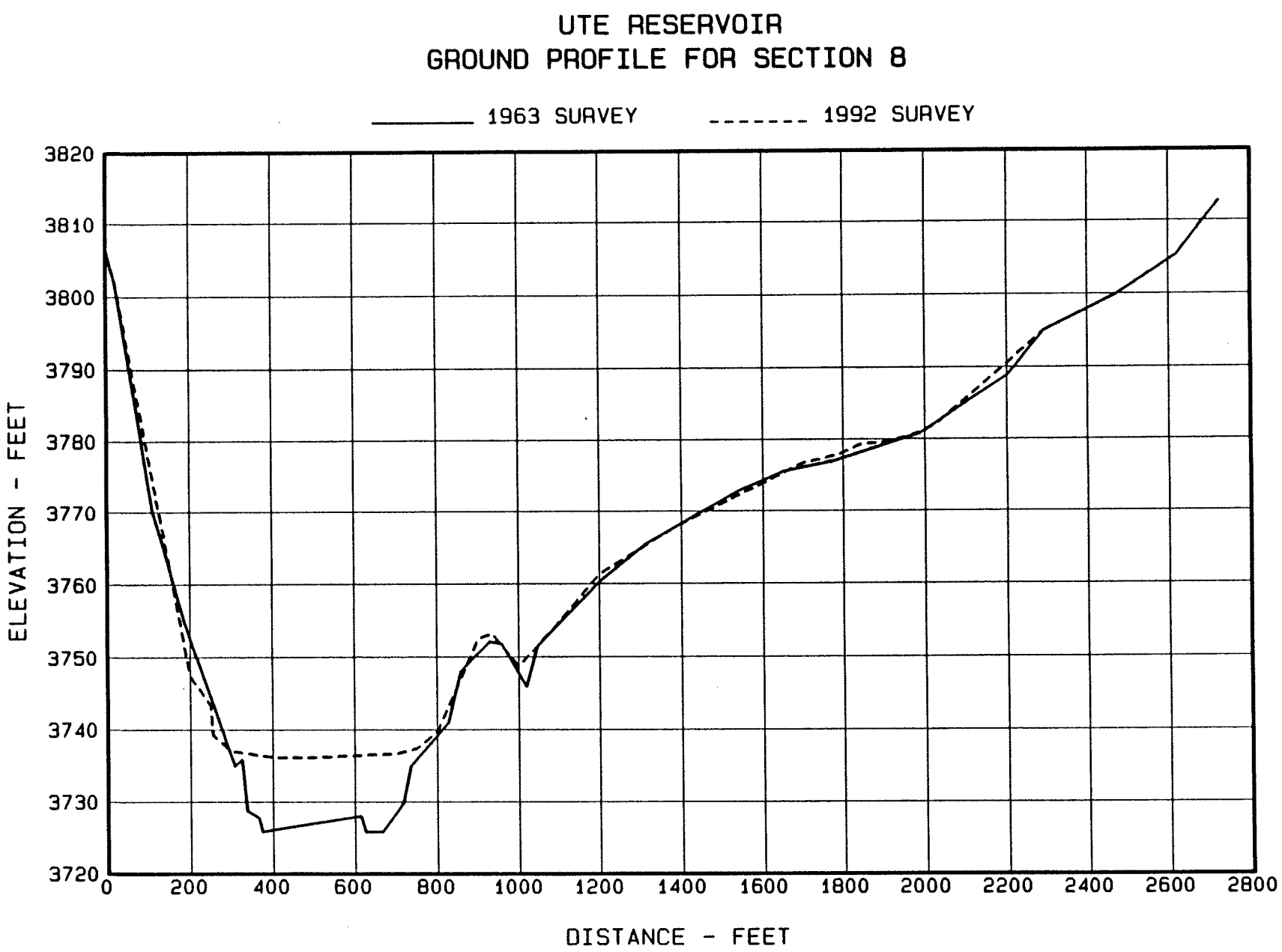

Figure 18. - Sediment Range 8 - Canadian River.

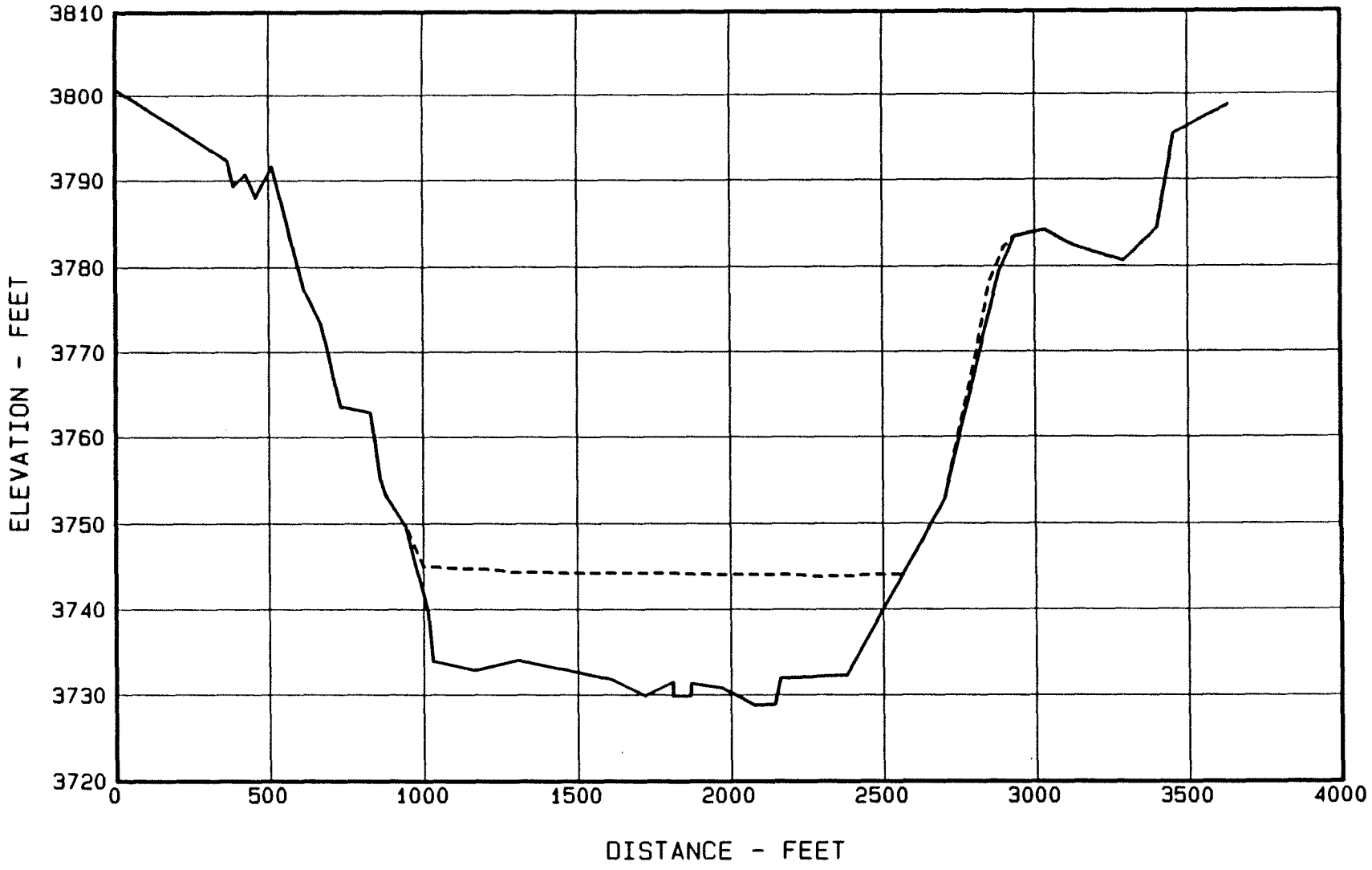

Figure 19. - Sediment Range 9 - Canadian River.

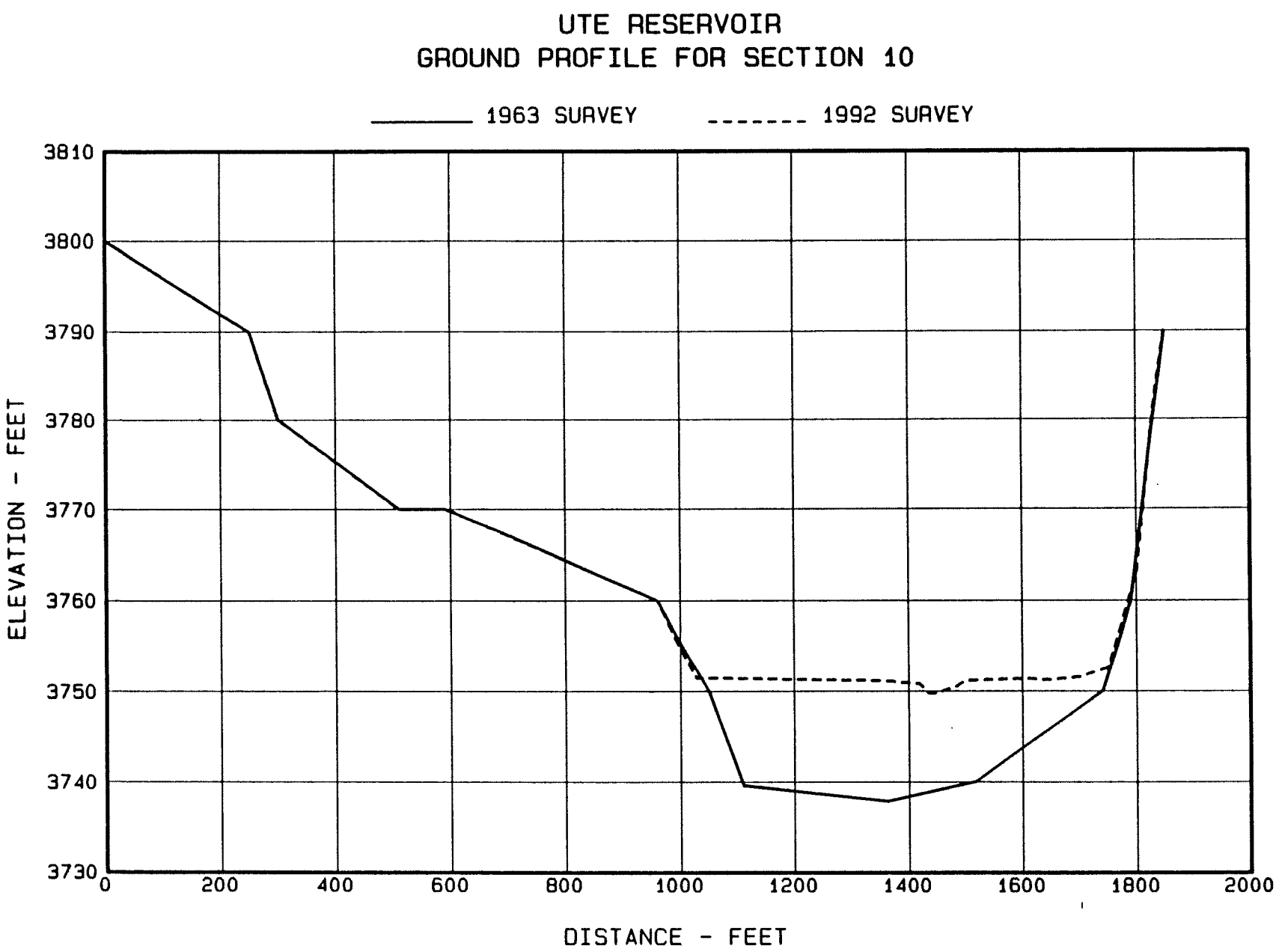

Figure 20. - Sediment Range 10 - Canadian River.

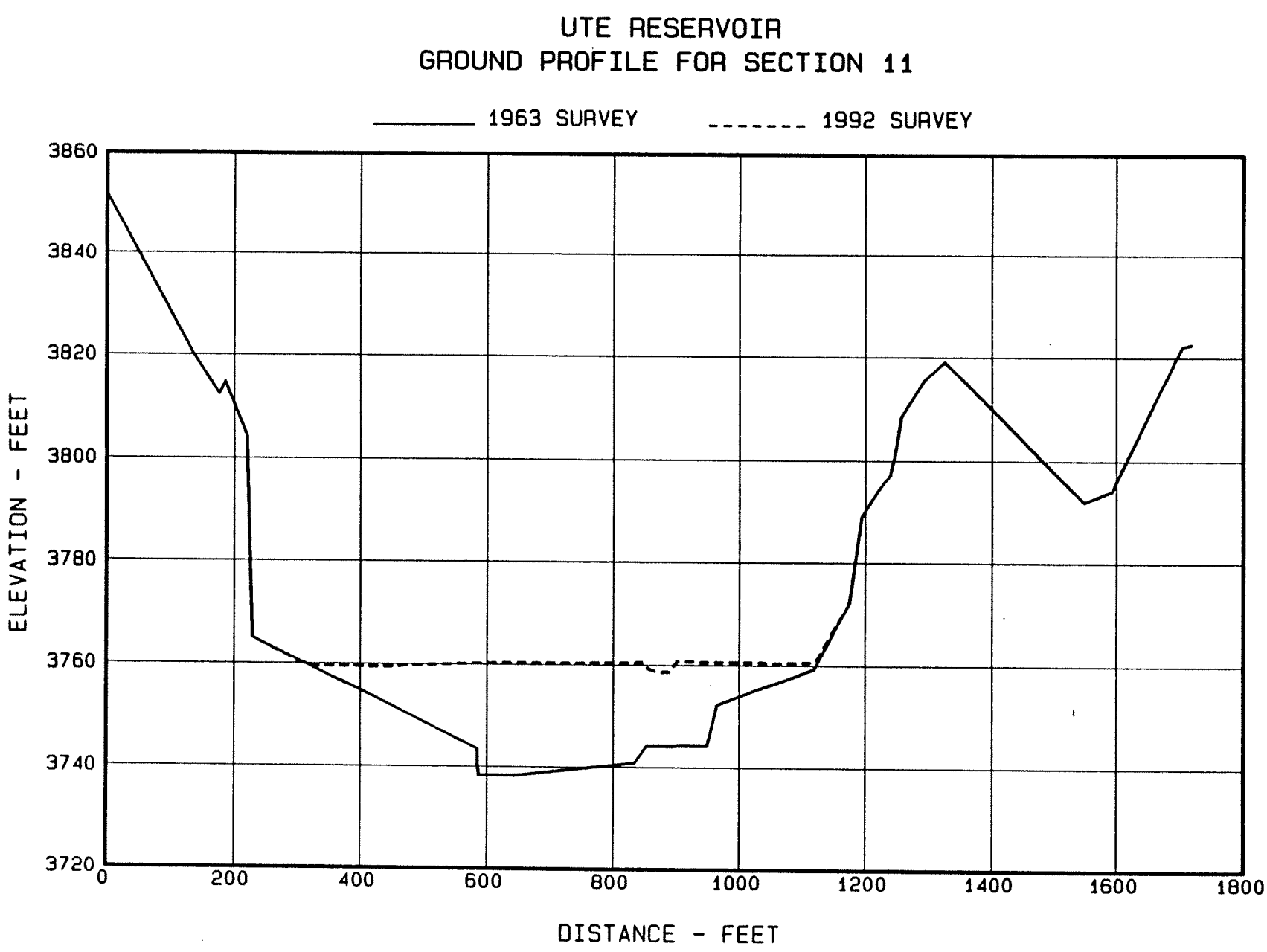

Figure 21. - Sediment Range 11 - Canadian River.

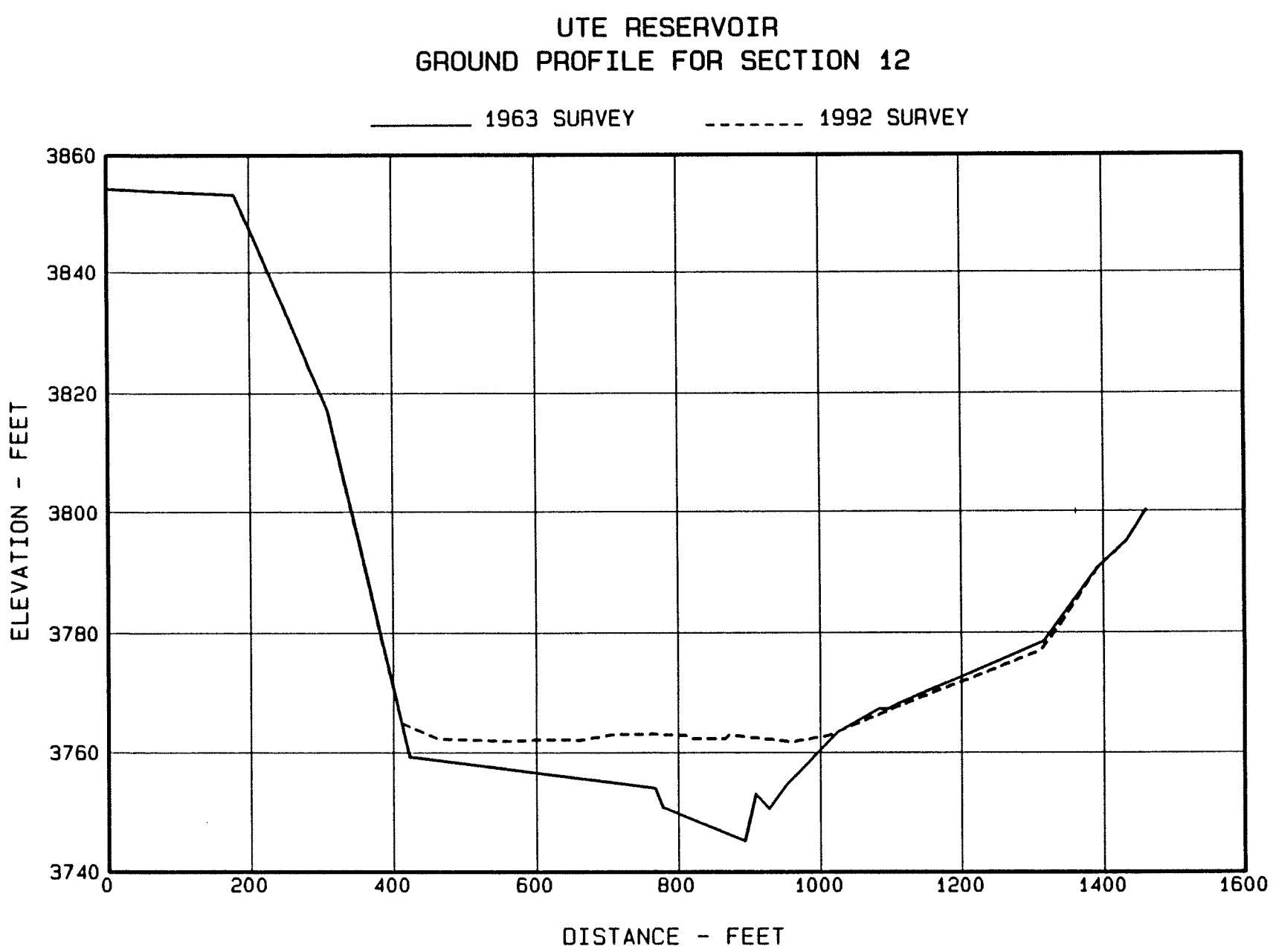

Figure 22. - Sediment Range 12 - Canadian River.

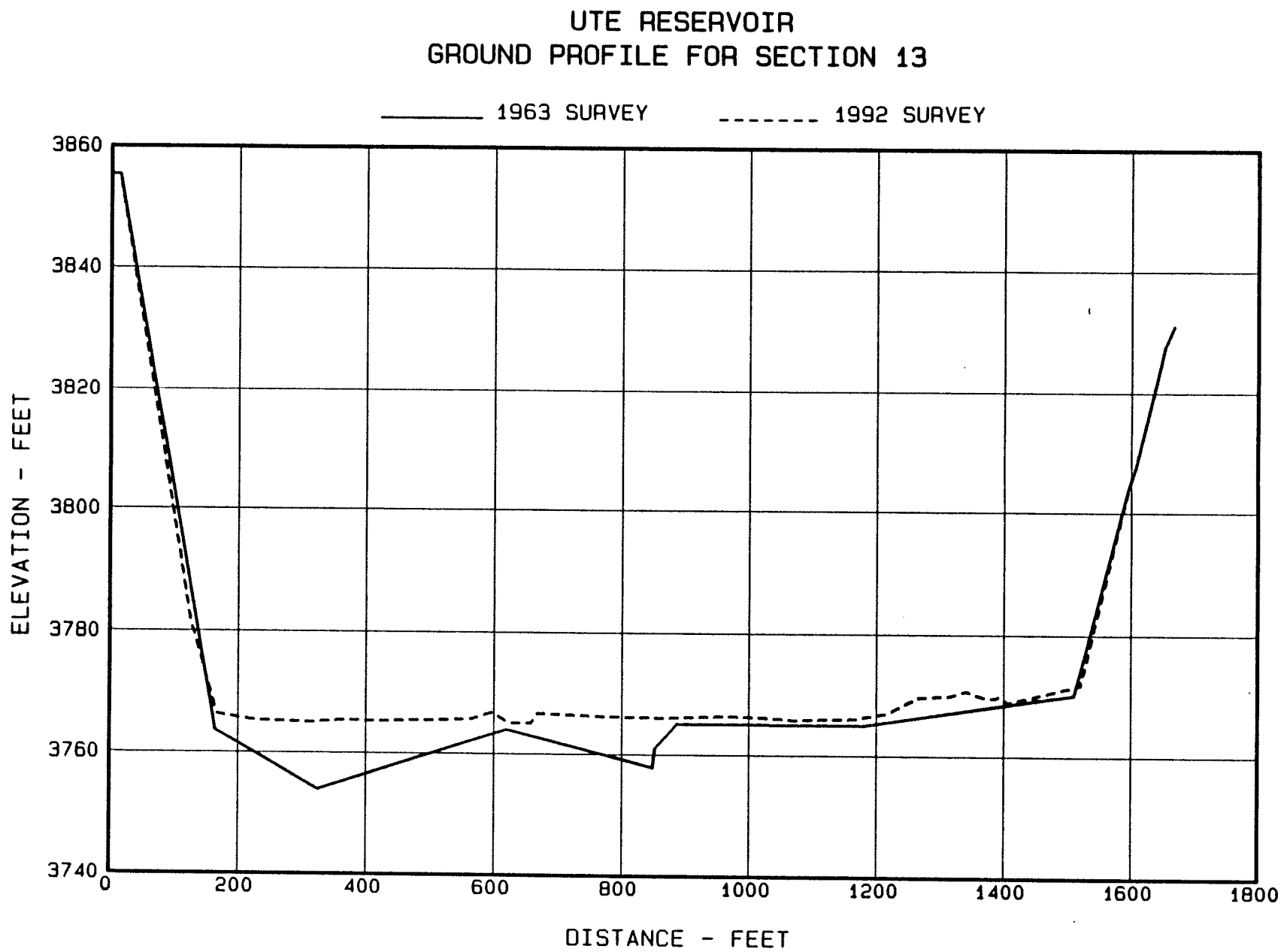

Figure 23. - Sediment Range 13 - Canadian River.

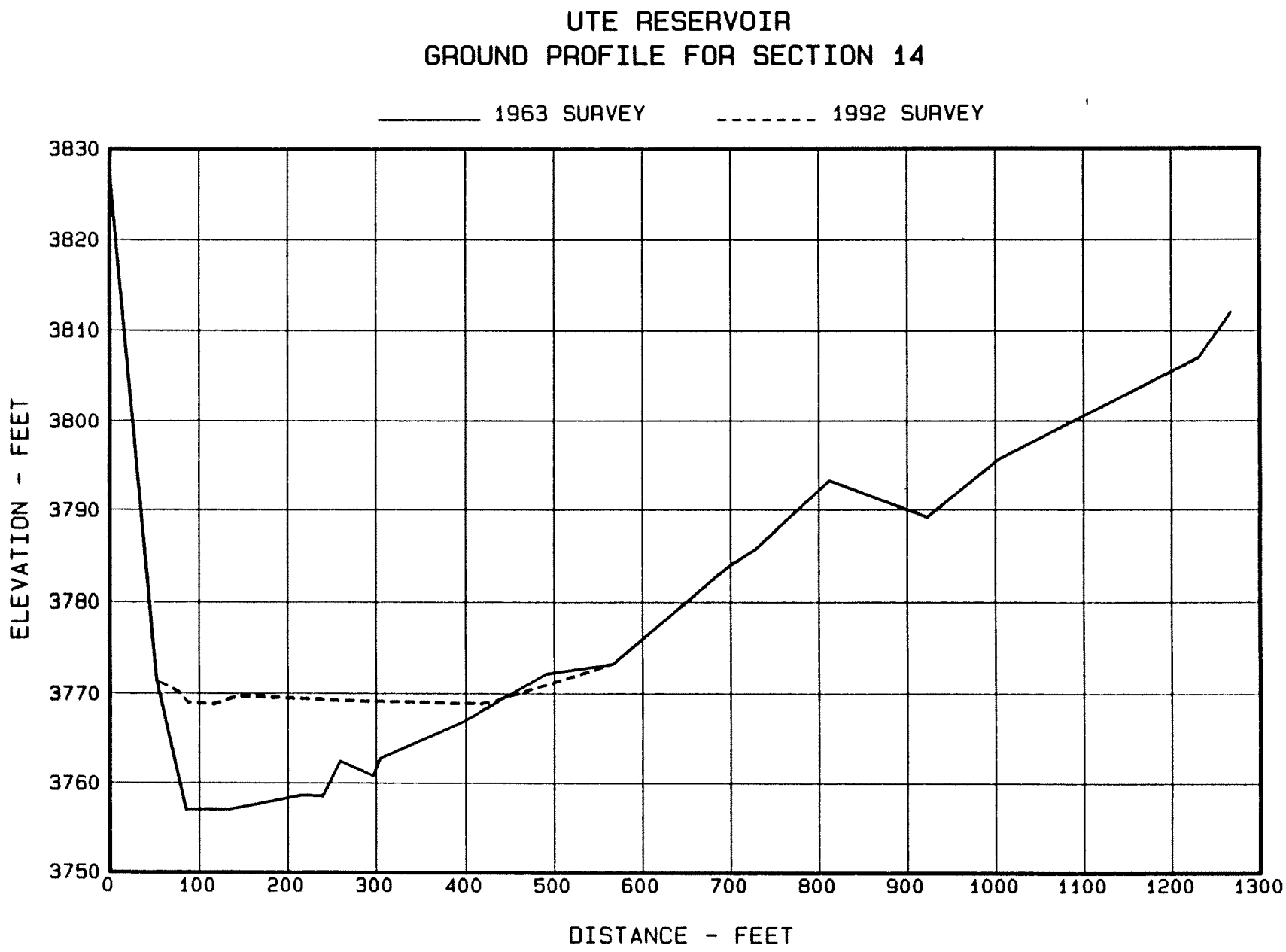

Figure 24. - Sediment Range 14 - Canadian River.

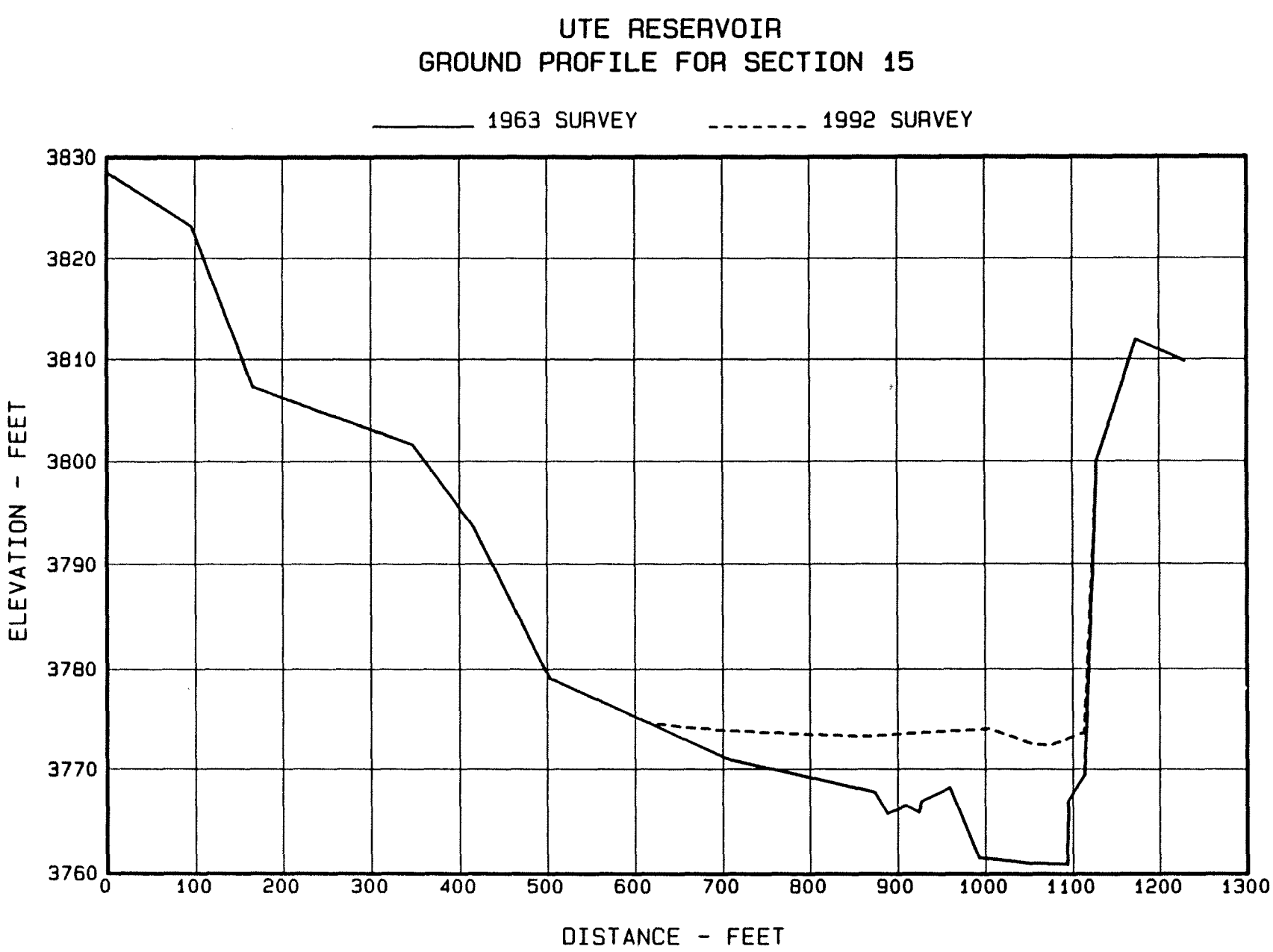

Figure 25. - Sediment Range 15 - Canadian River.

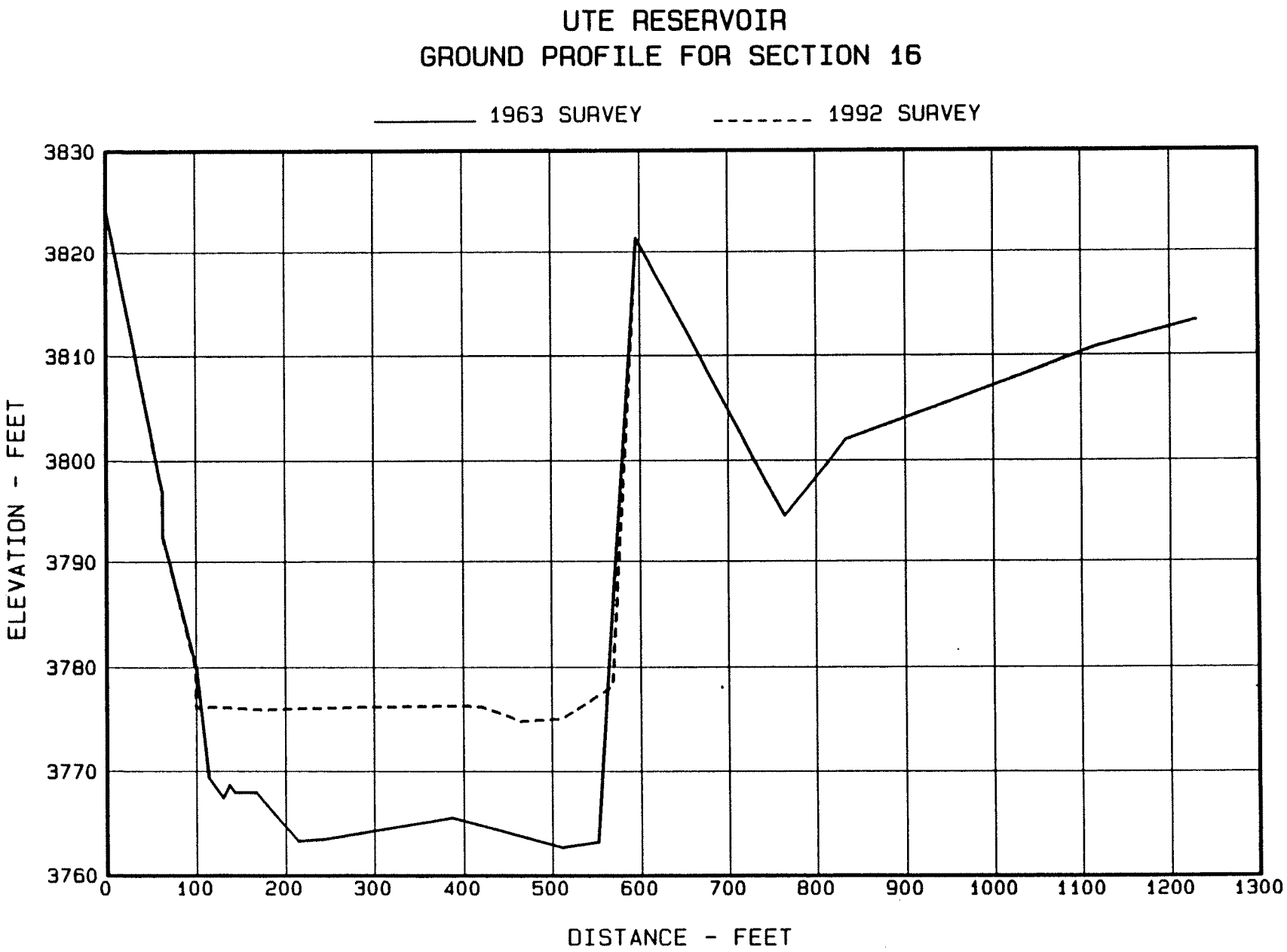

Figure 26. - Sediment Range 16 - Canadian River.

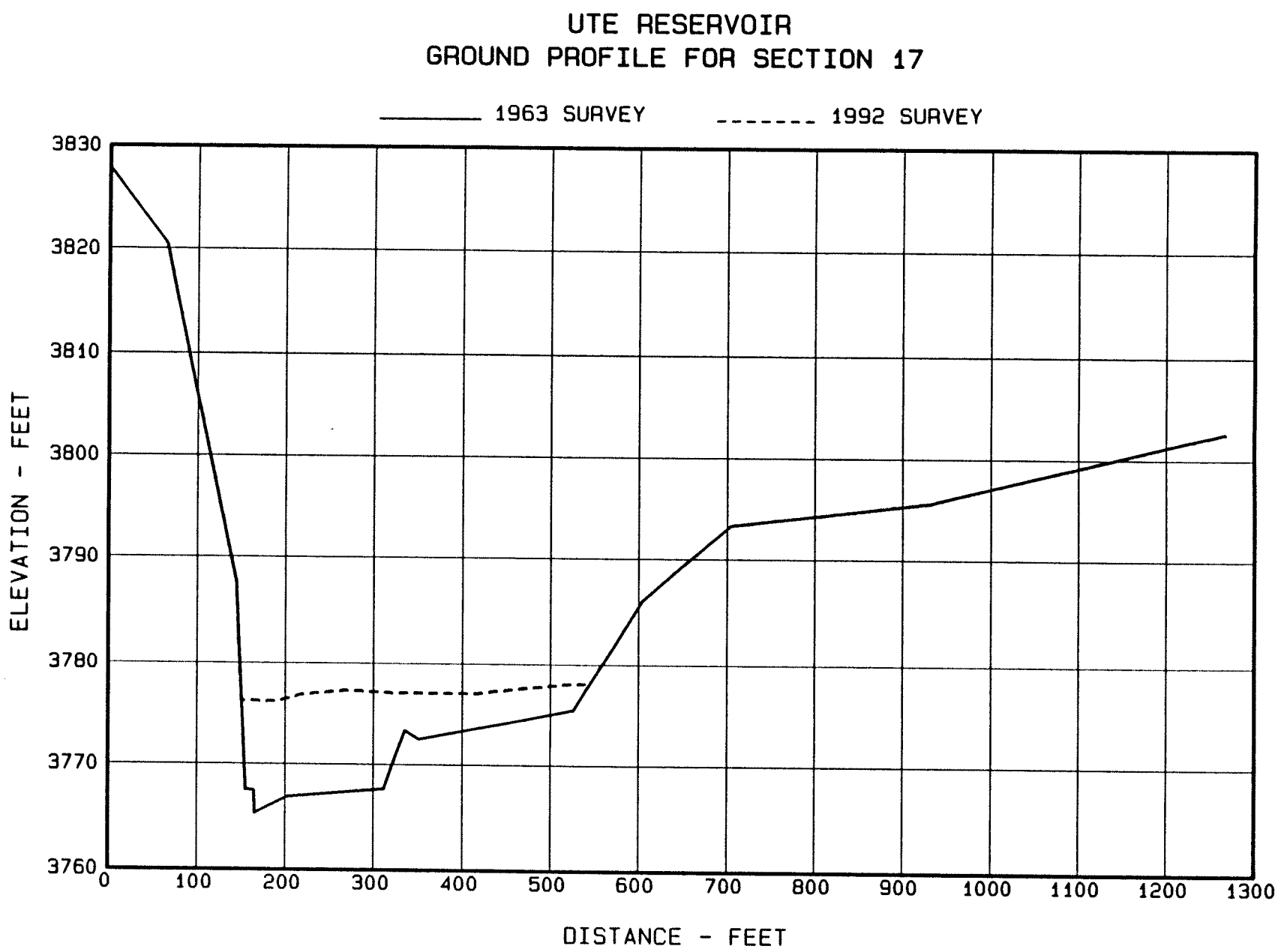

Figure 27. - Sediment Range 17 - Canadian River.

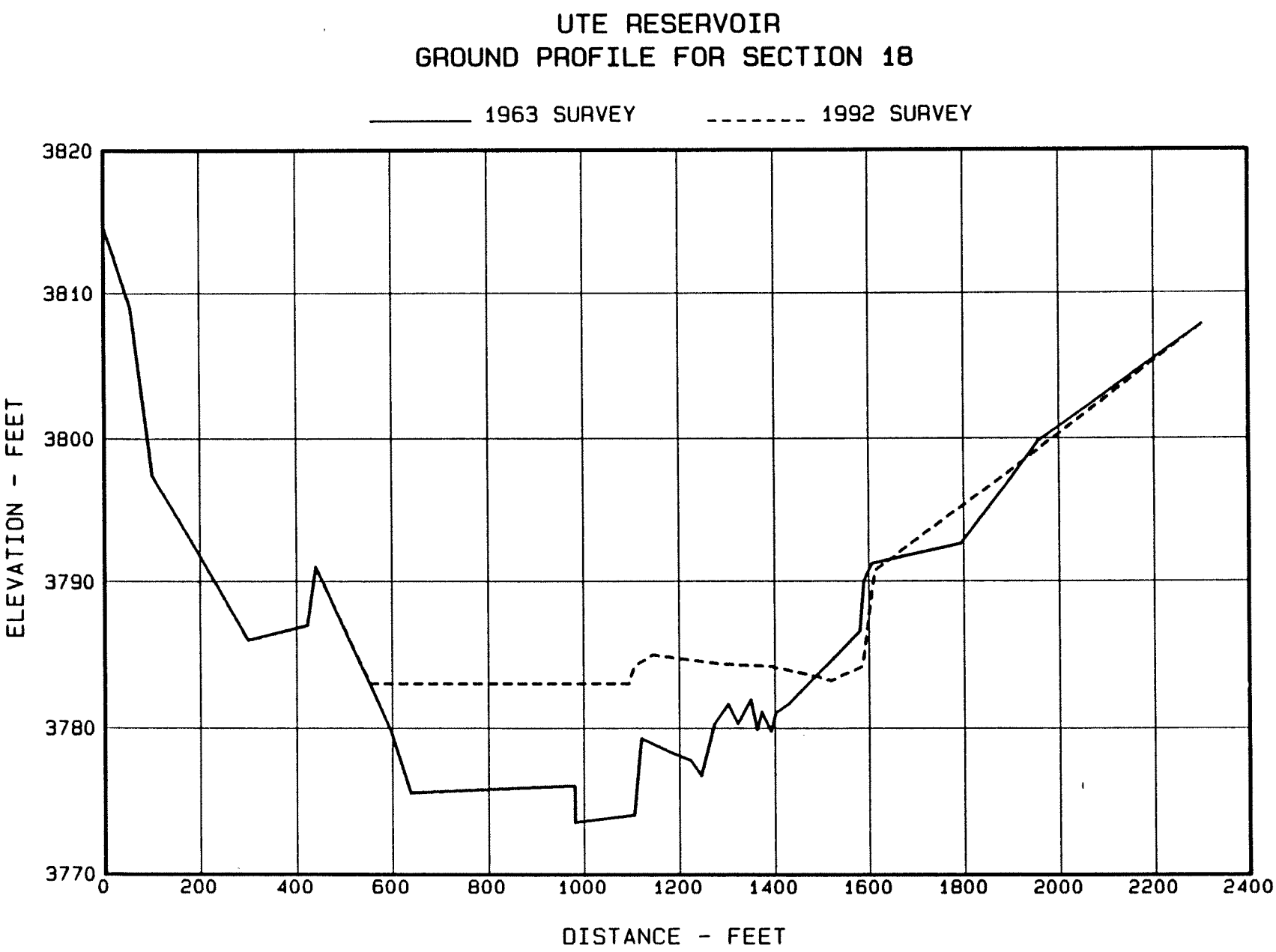

Figure 28. - Sediment Range 18 - Canadian River.

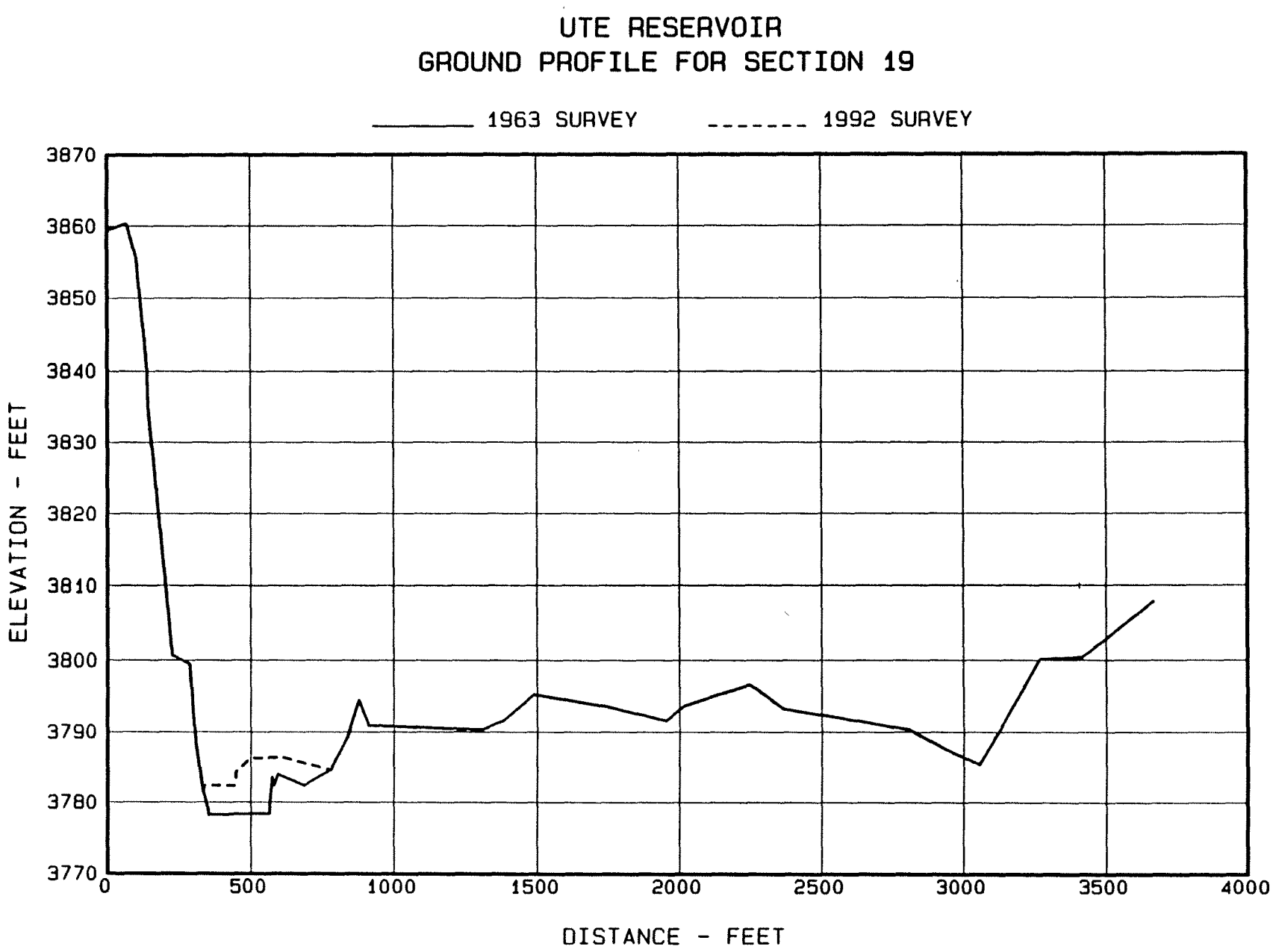

Figure 29. - Sediment Range 19 - Canadian River.

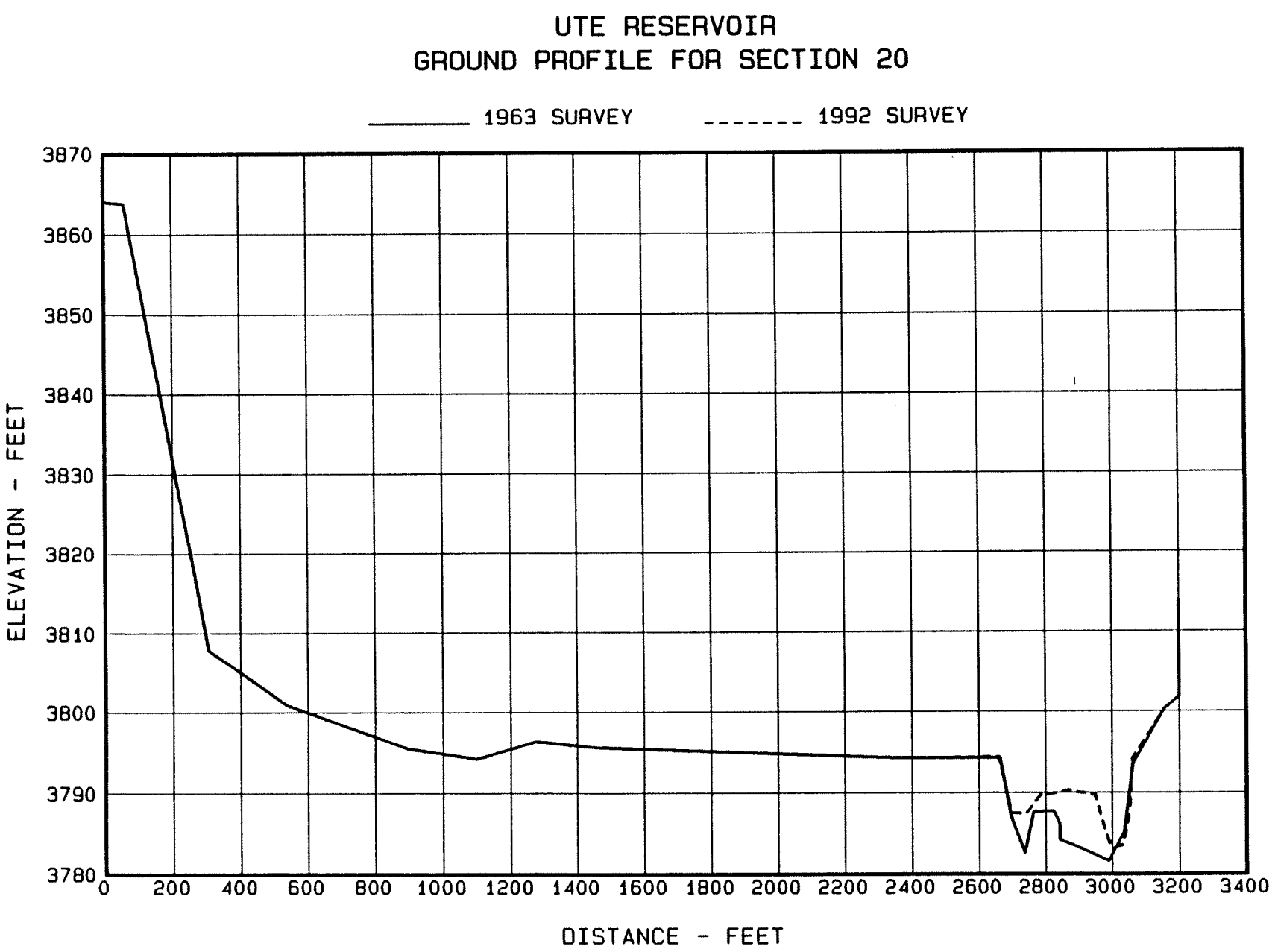

Figure 30. - Sediment Range 20 - Canadian River.

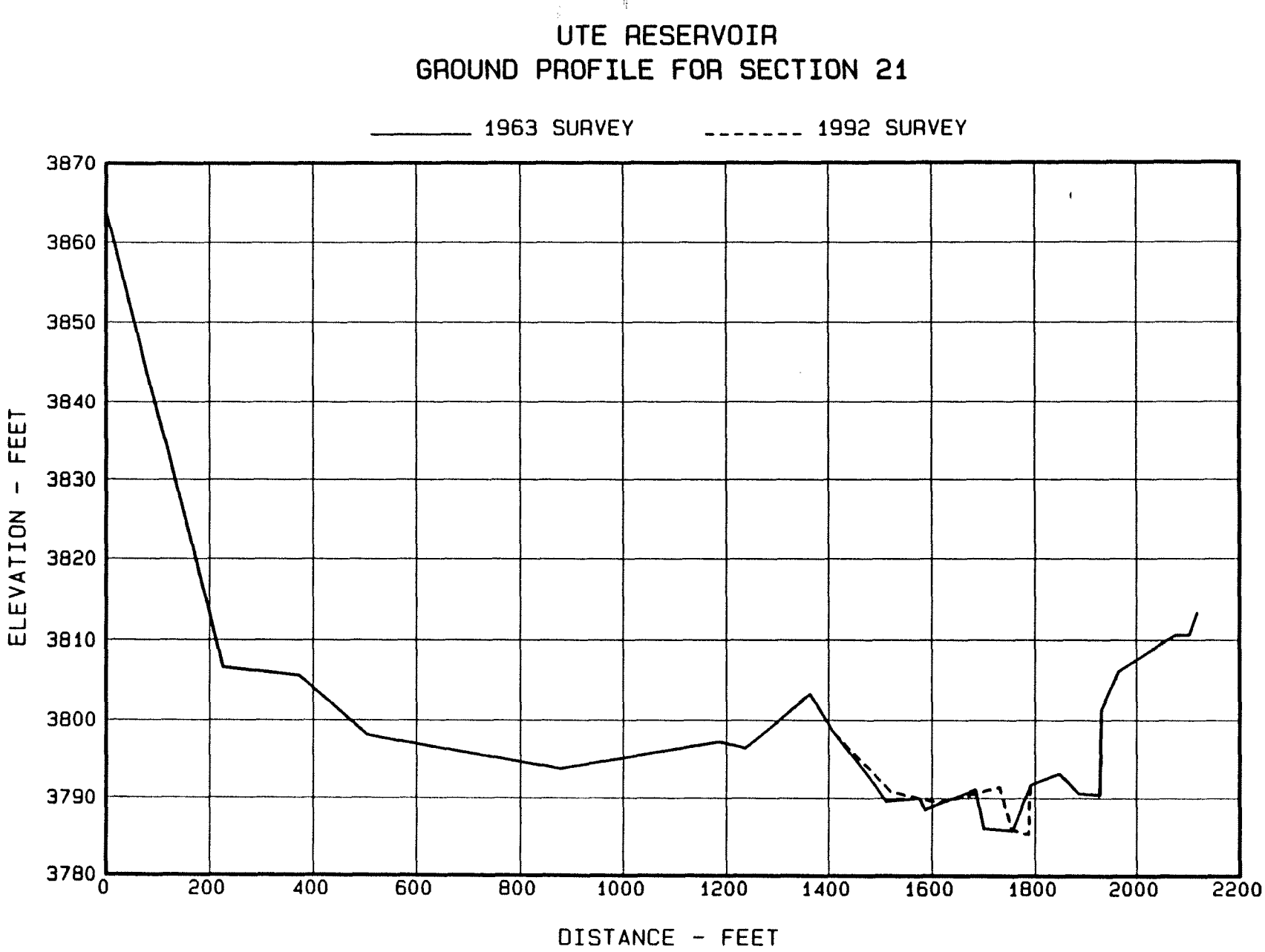

Figure 31. - Sediment Range 21 - Canadian River.

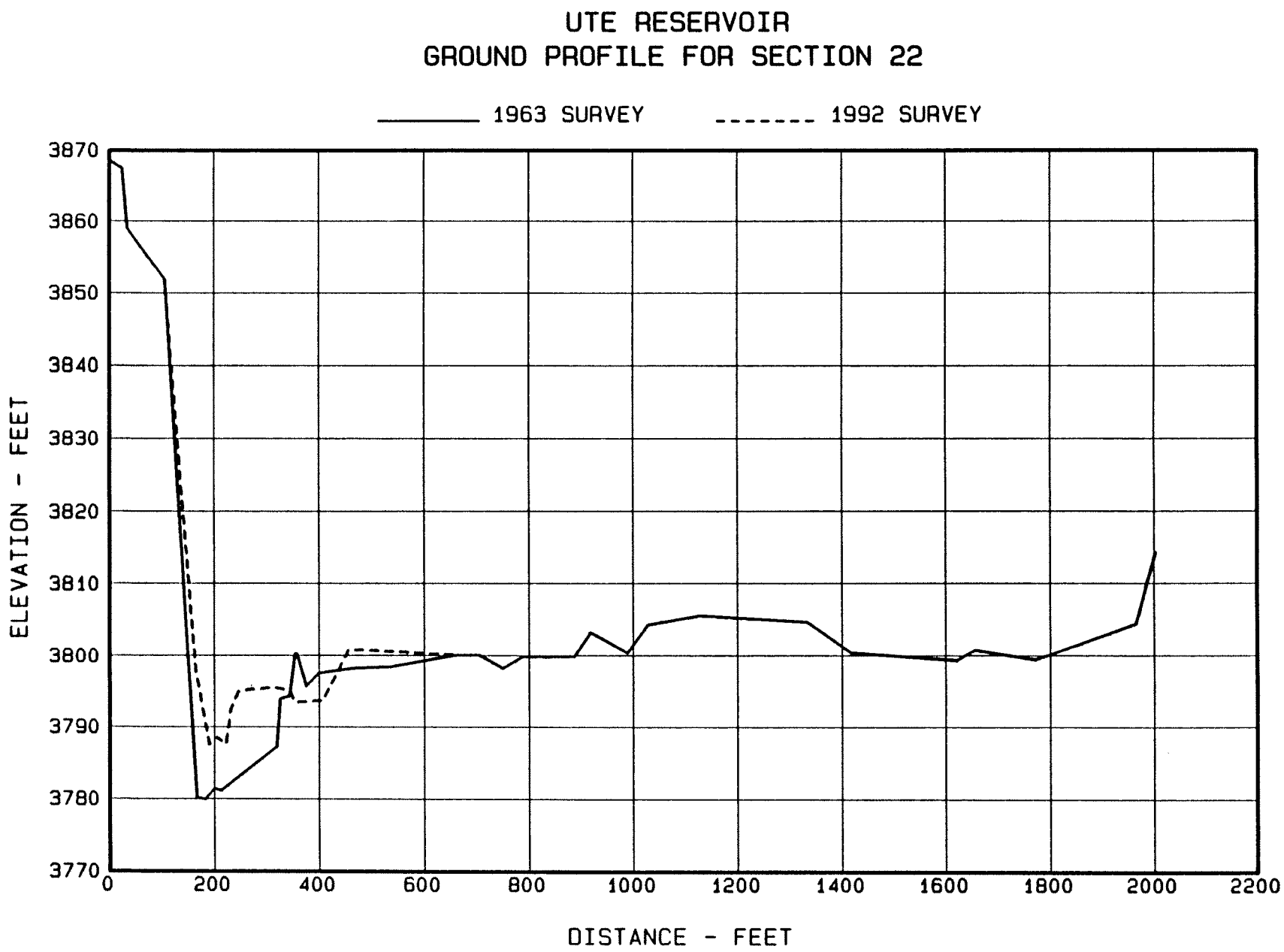

Figure 32. - Sediment Range 22 - Canadian River.

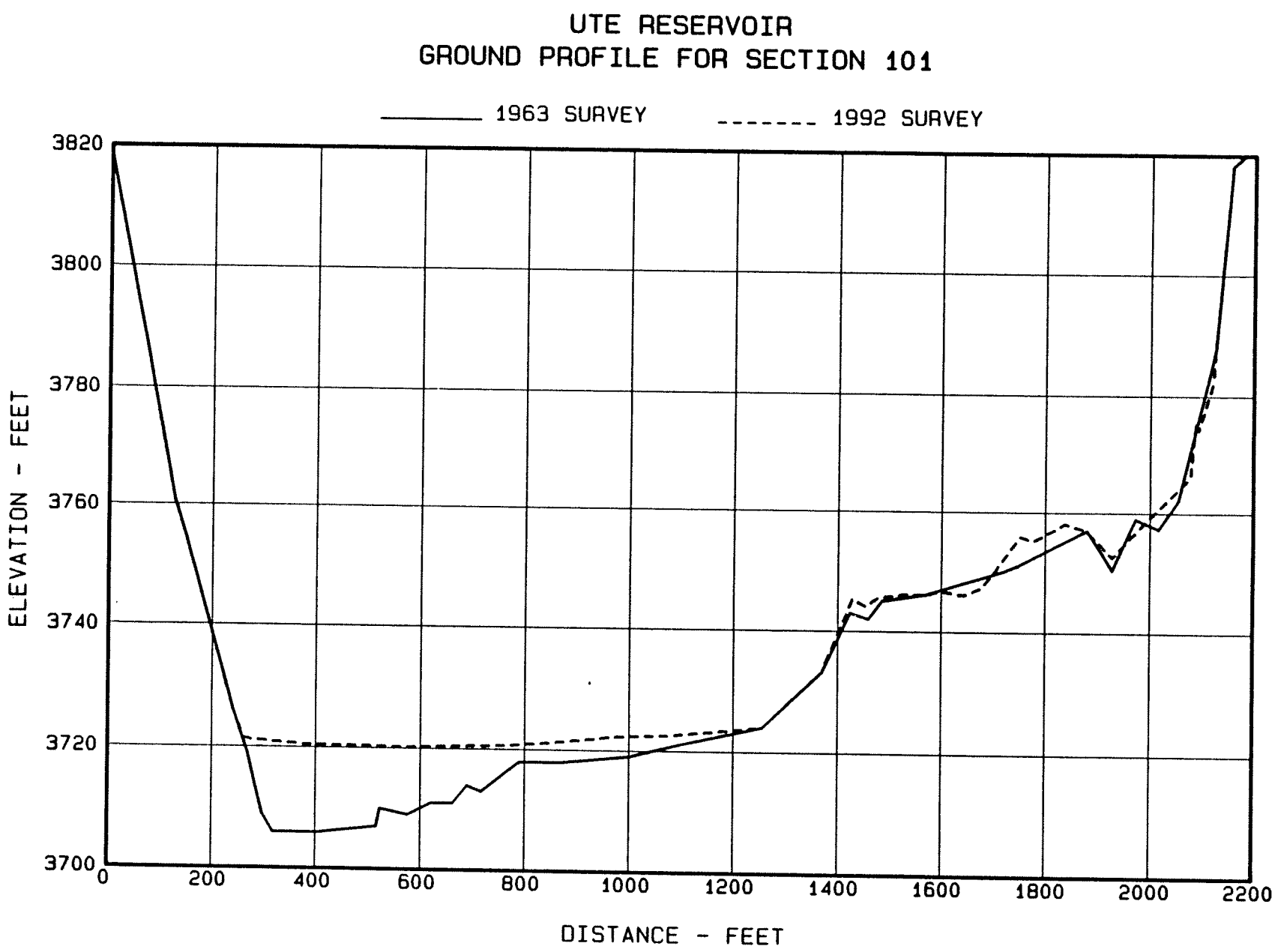

Figure 33. - Sediment Range 101 - Ute Creek.

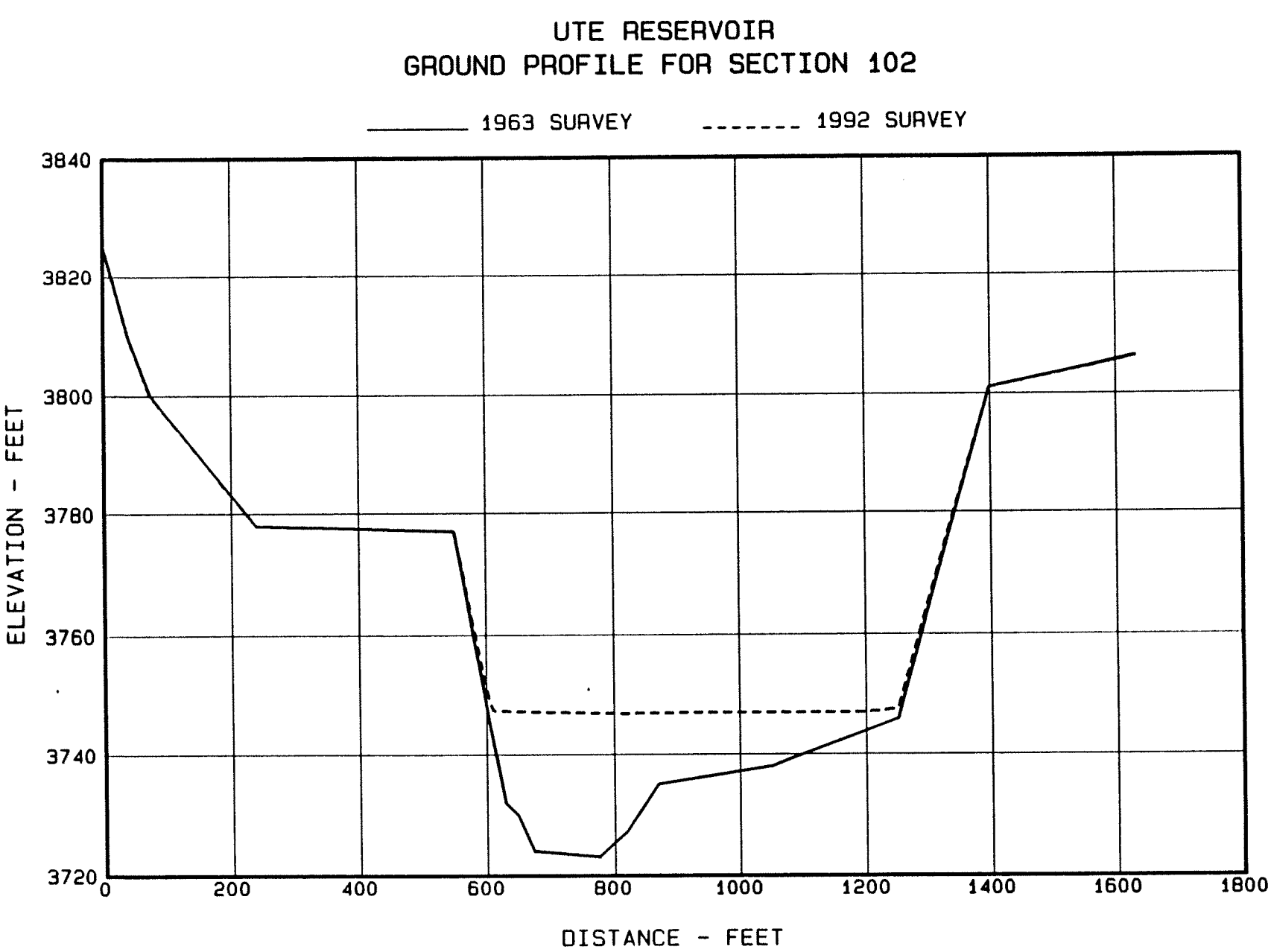

Figure 34. - Sediment Range 102 - Ute Creek.

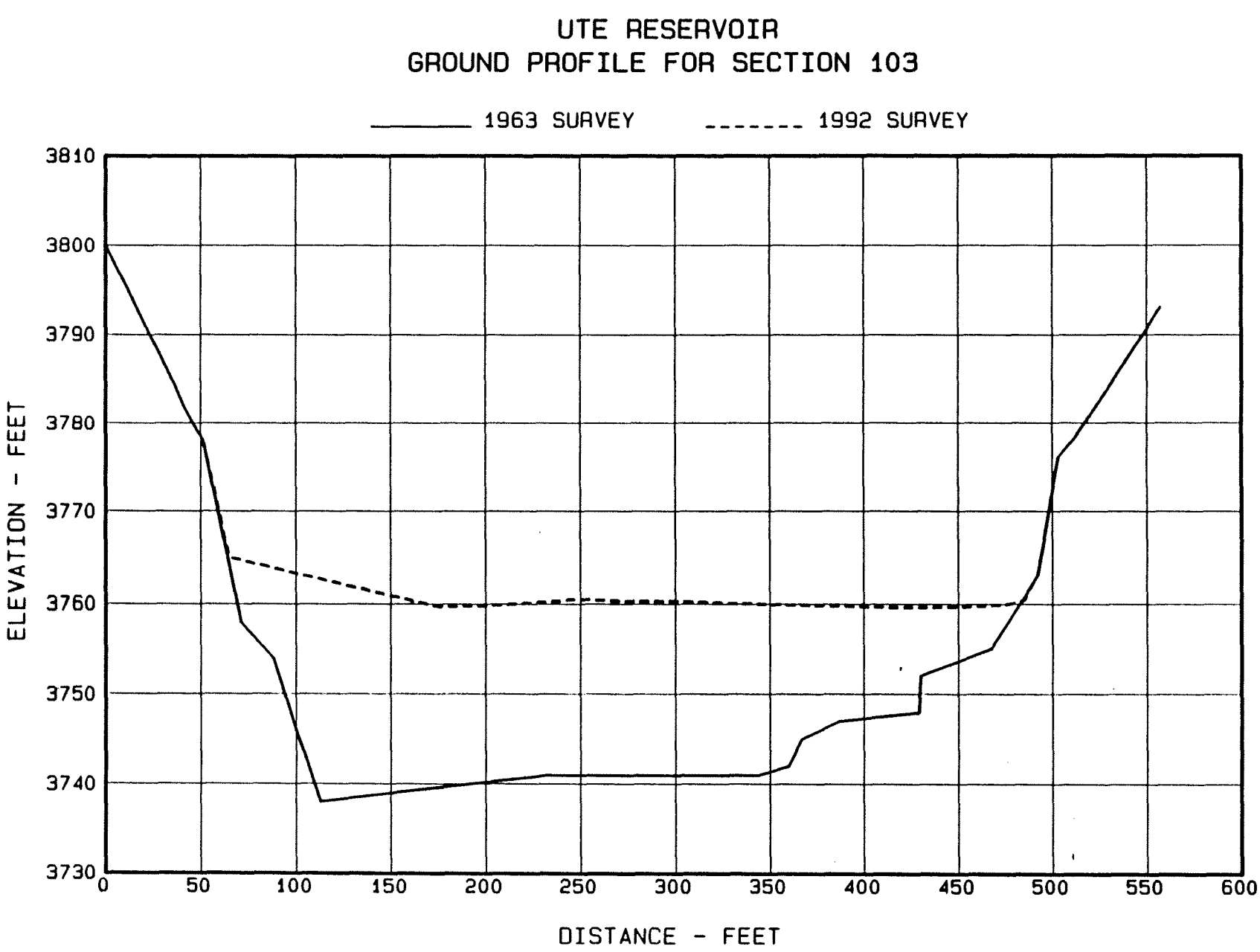

Figure 35. - Sediment Range 103 - Ute Creek.

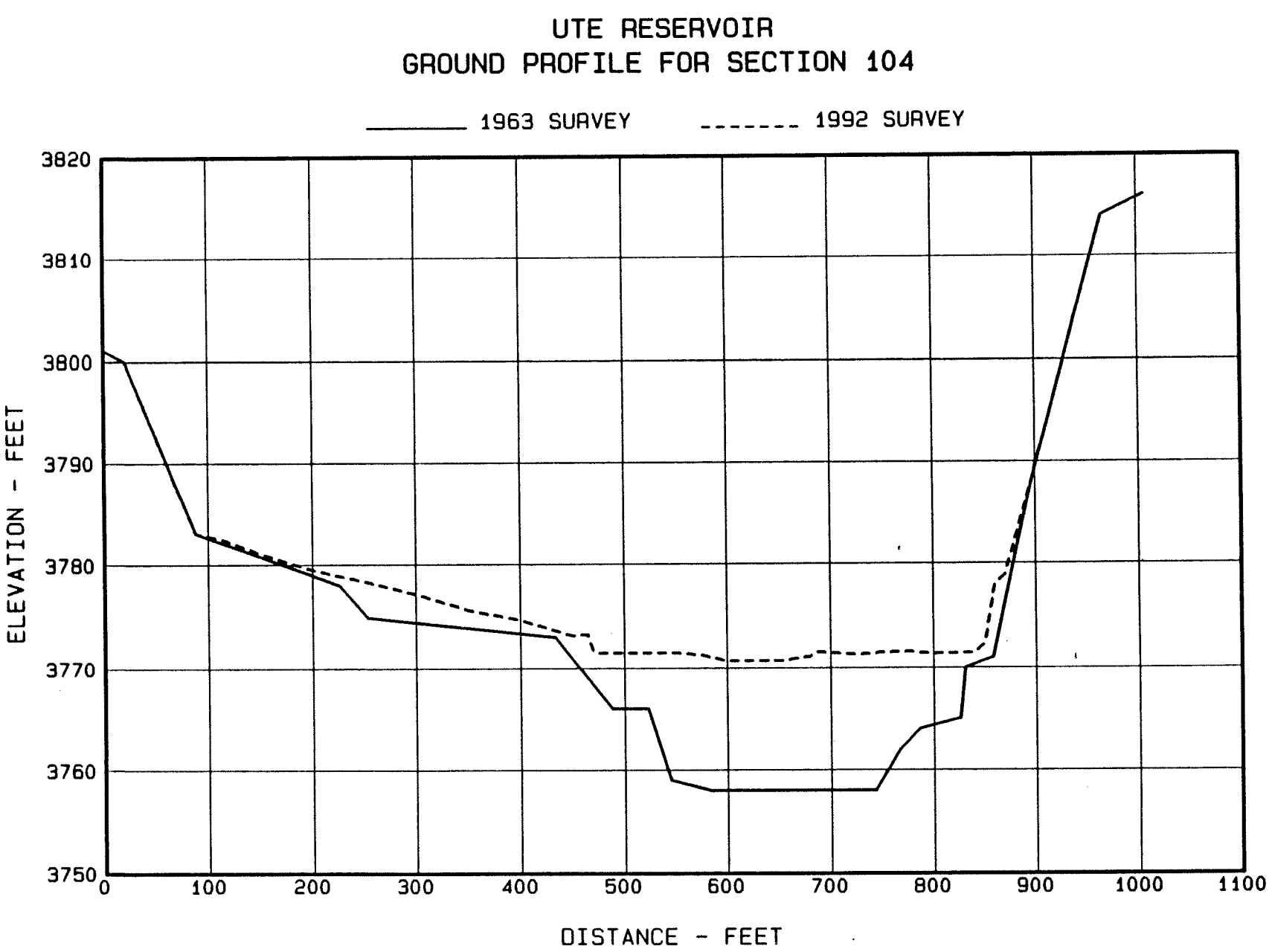

Figure 36. - Sediment Range 104 - Ute Creek.

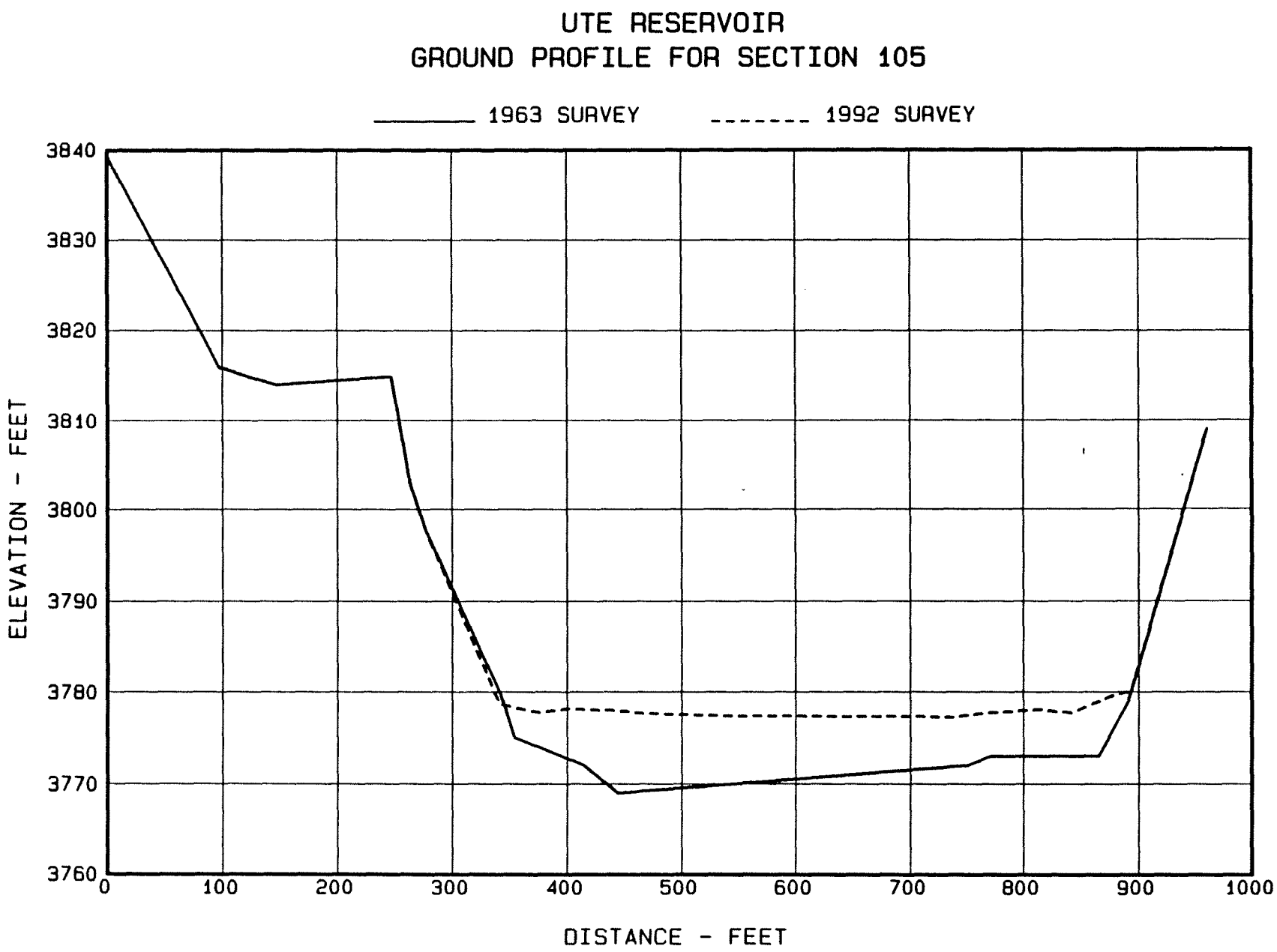

Figure 37. - Sediment Range 105 - Ute Creek.

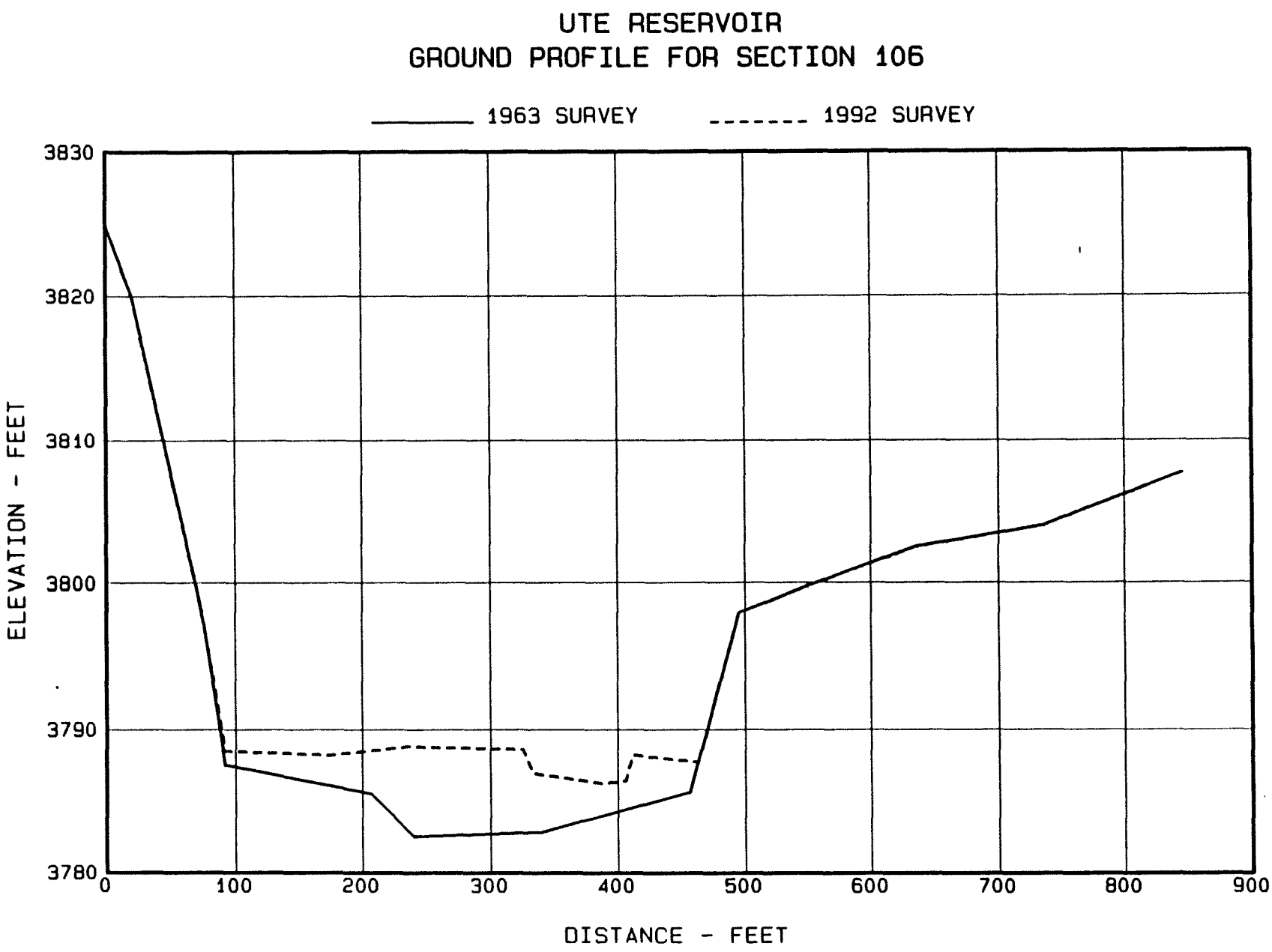

Figure 38. - Sediment Range 106 - Ute Creek.

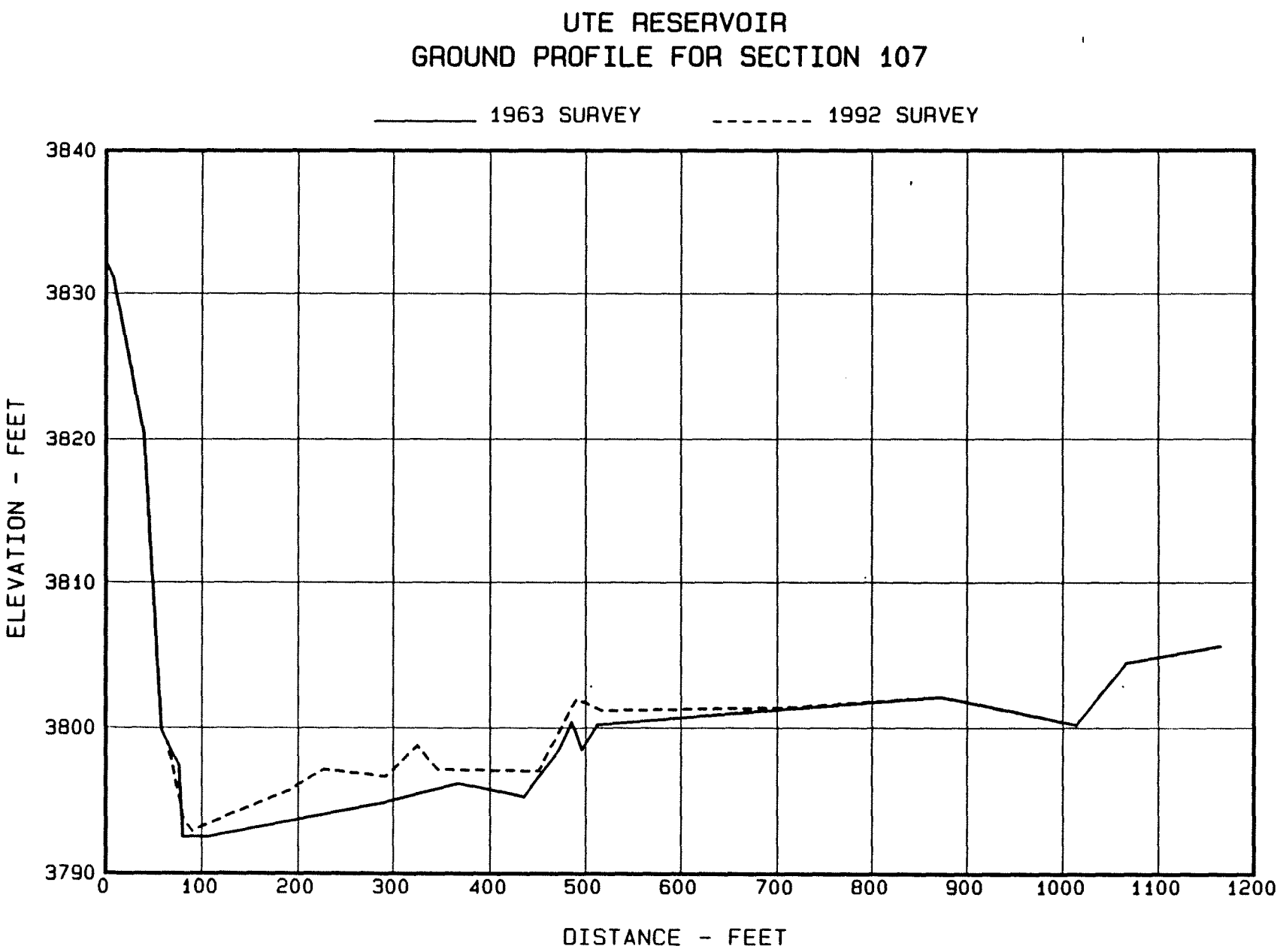

Figure 39. - Sediment Range 107 - Ute Creek.

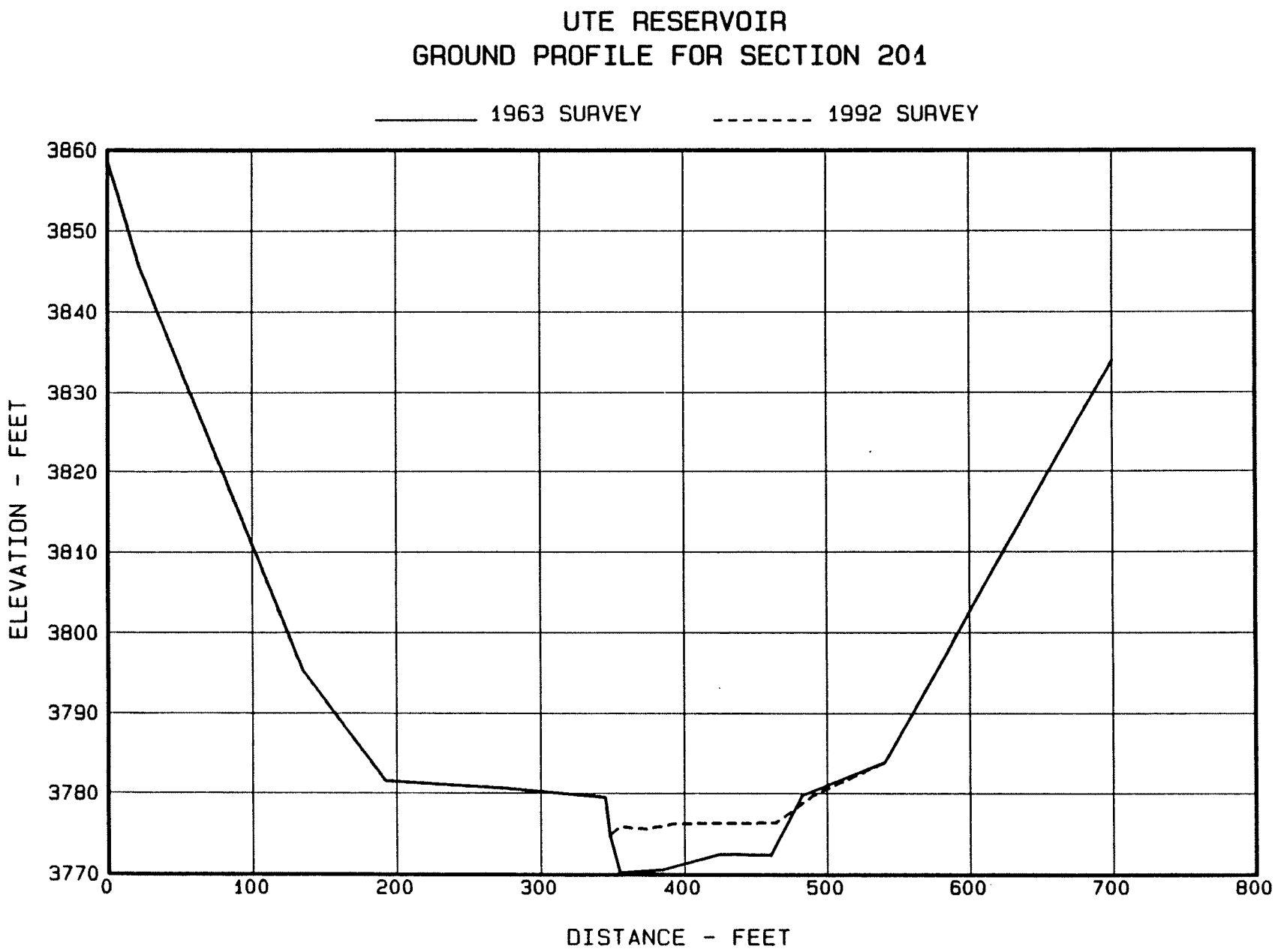

Figure 40. - Sediment Range 201 - Dripping Springs.

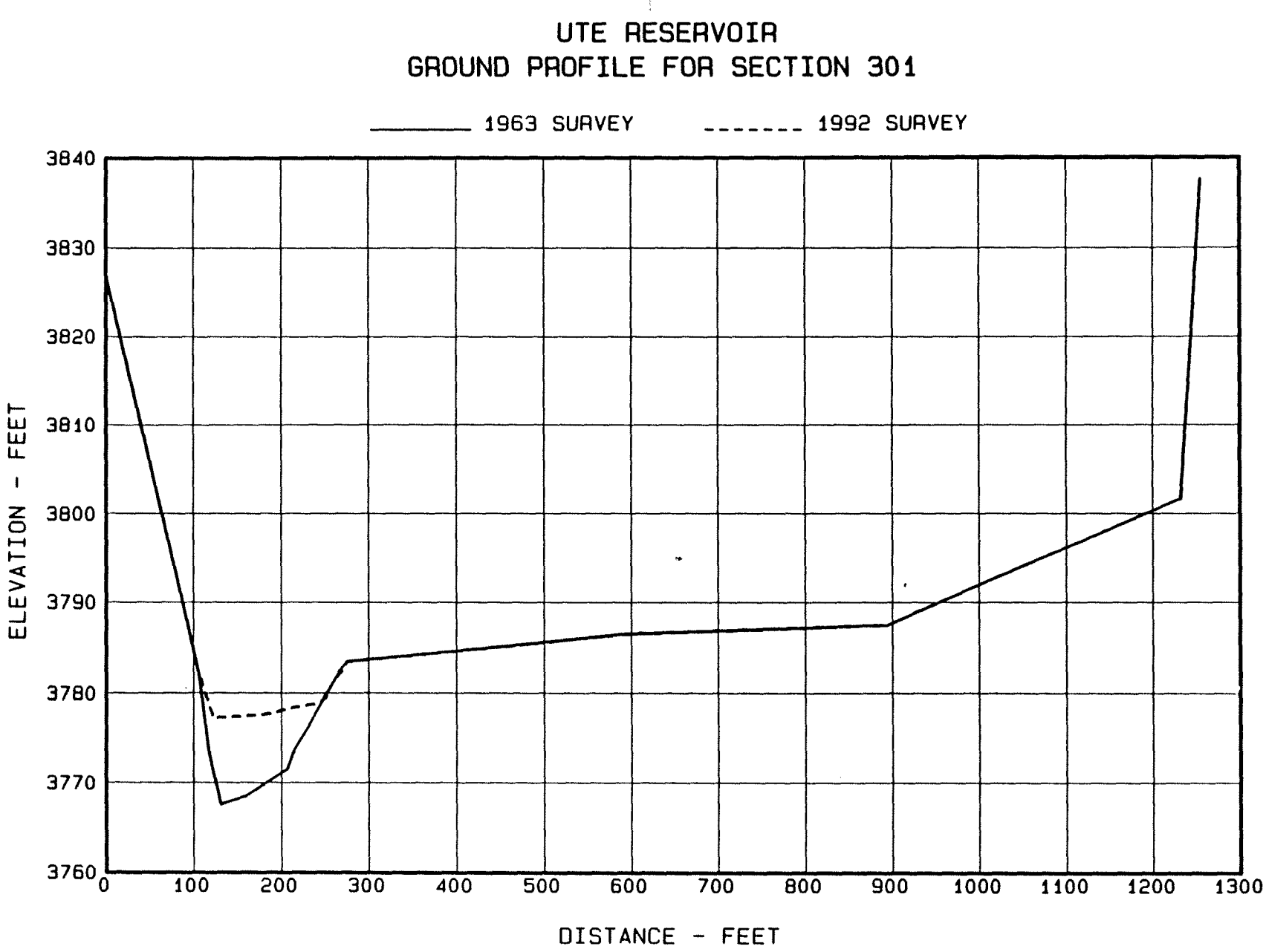

Figure 41. - Sediment Range 301 - Carros Creek.

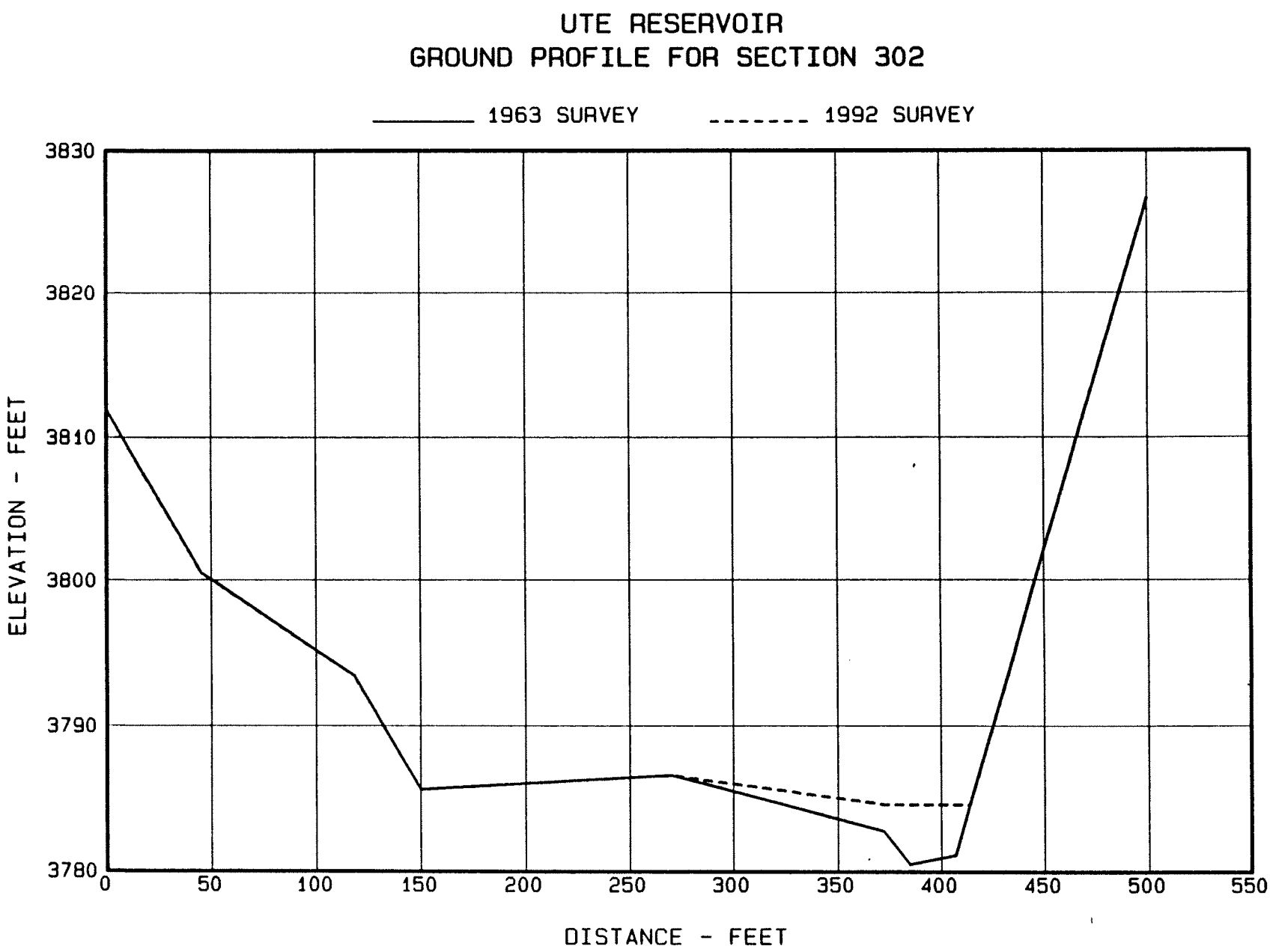

Figure 42. - Sediment Range 302 - Carros Creek.