VOLUMETRIC SURVEY OF LAKE CORPUS CHRISTI RESERVOIR

Prepared for:

City of Corpus Christi

Prepared by:
Texas Water Development Board

November 5, 2002

Texas Water Development Board

J. Kevin Ward, Executive Administrator

This report was prepared by staff of the Surface Water Section:

Barney Austin, Ph.D.

Duane Thomas
Randall Burns
Marc Sansom

With significant contributions and review by:

City of Corpus Christi Water Department
Eduardo Garaňa, P.E., Director
Lou Hilzinger, LCCR Reservoir Supervisor

Published and Distributed
by the
Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LAKE CORPUS CHRISTI RESERVOIR VOLUMETRIC SURVEY REPORT

INTRODUCTION

Staff of the Surface Water Section of the Texas Water Development Board (TWDB) conducted a volumetric survey of Lake Corpus Christi Reservoir during the period of December 11, 2001 through January 17, 2002. The purpose of the survey was to determine the current volume of the reservoir at the conservation pool elevation. This survey will establish a basis for comparison to future surveys from which the location and rates of sediment deposition in the conservation pool over time can be determined. Survey results are presented in the following pages in both graphical and tabular form.

The vertical datum used during this survey is that used by the United States Geological Survey (USGS) for the reservoir elevation gage at Lake Corpus Christi Reservoir (08210500 LAKE CORPUS CHRISTI NEAR MATHIS, TX). The datum for this gage is reported as mean sea level (msl) (USGS, 2000). Thus, elevations are reported here in feet (ft) above mean sea level (msl). Volume and area calculations in this report are referenced to water levels provided by the USGS gage.

Lake Corpus Christi Reservoir is located on the Nueces River (Nueces River Basin) in San Patricio, Jim Wells and Live Oak Counties, four miles southwest of Mathis, Texas (Figure 1). At conservation pool elevation 94.0 ft msl, the reservoir is approximately 24 miles in length and has approximately 186 miles of shoreline. Records indicate the drainage area is approximately 16,656 square miles.

There have been numerous sediment surveys and other studies performed on the historic Lake Lovenskiold and associated La Fruta Dam predecessor to the current, Lake Corpus Christi Reservoir (LCCR) and associated Wesley E. Seale Dam. These studies will be discussed in the following section. Original calculations for the proposed LCCR were made in 1957, based on a

1948 Soil Conservation Service (SCS) Sediment Survey, for LCCR at a projected conservation pool elevation of 94.0 ft. SCS calculations showed the reservoir to have 22,050 surface acres and 302,140 ac-ft of conservation storage capacity. In 1972 McCaughan & Ethridge Consulting Engineers re-evaluated the 1948 conditions and determined their calculations to be more accurate and therefore used in this report for the original design information for the current reservoir. The results showed the surface area for the proposed LCCR at conservation pool elevation 94.0 ft would be 19,860 acres. The total volume of the reservoir would be 292,758 ac-ft of water and the usable conservation storage above the dead pool elevation of 55.5 ft would be 290,917 ac-ft of water (McCaughan & Ethridge Consulting Engineers 1973).

RESERVOIR HISTORY AND GENERAL INFORMATION

The City of Corpus Christi (City) was authorized to construct a structure on the Nueces River near Mathis, TX to impound 300,000 ac-ft of water. The authorization was granted under Permit No. 933 (January 15, 1925) as amended by Permit No. 1463 (August 19, 1940) and Permit No. 1656 (September 15, 1952).

Construction started on La Fruta Dam in 1927 and was completed in 1929. The impoundment of water formed by La Fruta Dam was called Lake Lovenskiold. A partial failure of La Fruta Dam occurred in late 1930. Reconstruction of the dam utilized much of the original structure. Five 35 ft long by 20 ft tall taintor gates replaced part of the uncontrolled spillway. The tops of the taintor gates were at elevation 74.0 ft and that also being the conservation pool elevation. The reconstruction of the dam was completed in 1934.

Original design information (1934) showed that Lake Lovenskiold had a capacity of 54,430 ac-ft of water and a surface area of 5,493 acres at conservation pool elevation 74.0 ft. The U. S. Soil Conservation Service performed two sediment surveys of Lake Lovenskiold in 1942 and 1948. The 1942 results showed, at elevation 74.0 ft, the capacity was 43,800 ac-ft of water and the same surface area of 5,493 acres. The 1948 sediment survey results indicate (at elevation 74.0 ft) a capacity of 39,390 ac-ft of water and a surface area of 5,484 acres.

In the early 1950's the state legislature created the Lower Nueces River Water Supply District (LNRWSD) in order to develop a larger water supply for the City of Corpus Christi and the South Texas Region (City of Corpus Christi 1998). The State Board of Water Engineers authorized LNRWSD, under Water Rights Permit No. 1656, (September 15, 1952) to construct a dam and create a 300,000 ac-ft capacity reservoir on the Nueces River for municipal and industrial purposes.

On November 19, 1955 construction started on the new dam at a site located just downstream of the existing La Fruta Dam. The new dam was named after Wesley E. Seale, a former mayor and city councilman for the City of Corpus Christi and Chairman of the LNRWSD.

Wesley E. Seale Dam is an earthfill and concrete structure, with a total length (including spillways) of 5,980 ft and a height of 75 ft (TWDB 1971). The design of the structure includes a north (emergency) spillway with 33 gates and the south (service) spillway with 27 gates. The crest elevation of both concrete spillways is 88.0 ft. Each gate is 37.5 ft long and 8.75 ft tall with a top of gate elevation of 94.0 ft. Originally the gates were floating-crest-type gates and would open with cables and counterbalances when the lake level reached elevation 94.0 ft.

The outlet works are located at the south end of the structure and consist of a 48-inch diameter "Bunger" valve and three rectangular openings, 2.5 ft by 4.0 ft with invert elevations at 55.5 ft. The outlet works are used for pass-through flows and to release water downstream to the O. N. Stevens Water Treatment Plant for the municipal water supply of the City of Corpus Christi.

The design engineer for Wesley E. Seale Dam was Ambursen Engineering Company and the general contractor was H. B. Zachery Co. The estimated cost of the dam was $9, 779,200 and the total cost of the project was $21,750,000.

The dam was completed on April 26, 1958 and at that time impoundment of water began. Before the old La Fruta Dam was inundated, the taintor gates were removed and part of the embankment was breached.

On October 3, 1962, the City of Corpus Christi was granted Water Right Permit No. 2026. The permit summarized previous permits (No's. 933, 1463 and 1656) issued to the City of Corpus Christi.

During the first four years of operation of Wesley E. Seale Dam, the conservation pool elevation was held at elevation 88.0 ft (crest of the concrete spillways). This allowed time for the depletion of oil and gas reserves in the upper basin of the reservoir. On July 1, 1964, the crest gates were closed and the reservoir reached conservation pool elevation 94.0 ft for first time on October 5, 1964. Shortly thereafter, on February 23, 1965, some of the gates were destroyed by surge action caused by strong winds. The reservoir's water level dropped six feet to the concrete crest beam elevation of 88.0 ft.

The engineering firm of Forrest and Cotton Inc. re-designed the crest gates and the hoisting mechanisms by replacing the counterweight and cables with a positive screw type hoist and powered by electrical motors. In case of an electric power failure, a diesel powered generator served as a back-up source of power and/or auxiliary gasoline engines. The gates could also be lifted manually. Gardner Engineering Corporation of Houston was awarded the contract and completed the modifications on November 30, 1965. On September 7, 1965, the gates were raised into position to store water again at conservation pool elevation 94.0 ft (City of Corpus Christi. 1998). Operation of the outlet works and crest gates are performed from the control tower located at the south end of the structure.

The City of Corpus Christi contracted with McCaughan & Ethridge Consulting Engineers on September 25,1972 to perform a sediment survey of LCCR and to determine the extent to which sedimentation had reduced the reservoir's storage capacity. The Oceanographic Division of Southwest Research Institute, Inc. performed the field work and data collection. Data were collected over a five-day period (October 1 – 5, 1972). The water level, at the time of the survey, varied between elevations 93.96 ft and 94.06 ft. The vessel used during data collection was a flat-bottom "houseboat" type of cabin cruiser. A minimum of a four-member team was required for the data collection. There was one person to pilot the boat, one person to navigate and two people to collect depth soundings and horizontal positions. The data collection team used two radio transmitters stationed on-land and a third unit (receiver) on-board the data collection platform. Via triangulation, the boat's location could be plotted for every data collection event as long as the radio signals were received on-board. Approximately, 150 miles of data were collected on LCCR during the 1972 sediment survey. The boundary used during the 1972 sediment survey was obtained from an aerial mosaic flown and photographed in October 1967. The reservoir's water level was at 94.0 ft when photographed at that time.

Results of the study showed the reservoir had 19,336 surface acres and contained a volume of 272,352 ac-ft of water at conservation pool elevation 94.0 ft. The usable conservation storage between elevation 55.5 ft and 94.0 ft was 271,511 ac-ft. For further information on the McCaughan & Ethridge Consulting Engineers' 1972 Sediment Survey, please refer to the City of Corpus Christi's Records Division.

In 1983, the Texas Water Commission issued Certificate of Adjudication No. 21-2464 to the City of Corpus Christi and the Lower Nueces River Water Supply District (Texas Water Commission 1983). Among other authorizations listed in the certificate, the Commission granted the water right owners permission to impound 300,000 ac-ft of water in a reservoir on the Nueces River known as Lake Corpus Christi. The City was authorized to divert and use 150,000 ac-ft of water per annum for municipal purposes and 150,000 ac-ft of water per annum for industrial purposes. The owners were also granted the right to use the impounded water of Lake Corpus Christi for non-consumptive purposes. Copies of the Permits and Certificate of Adjudication (original and amended) may be obtained from the Texas Natural Resource Conservation Commission's (TNRCC) Central Records.

As stated earlier, the LNRWSD was established to manage and finance major water supply projects while the City of Corpus Christi would manage the daily operations and maintenance of LCCR. It was set up from the start that the City would repay the debt incurred to

LNRWSD by purchasing water from LCCR over a 30-year period. At the end of the fiscal year 1985-1986 the City's debt to the LNRWSD was paid in full. The LNRWSD was dissolved and all District-owned property was transferred to the City.

In 1986, the City of Corpus Christi entered into a contractual agreement with the United States Geological Survey to perform a sediment survey of LCCR. Data collection was performed by Navigation Management Inc., of Anthony, Florida between the period of January 21 and February 2, 1987 (USGS 1988). Water level elevations varied between 93.97 ft and 94.04 ft. Lamon Aerial Photo Inc. furnished the boundary used during that survey. An aerial photograph was taken on April 1, 1987 when the water level was at conservation pool elevation 94.0 ft. A total of 28,716 shot points were collected over approximately 518 miles of travel during data collection. Only depth data were obtained in the Nueces River portion of the survey due to the lack of horizontal positioning signals. An elevation-area-capacity table was developed and published in a USGS report in 1988 from the findings of the 1987 survey.

Results of the study showed the reservoir had 18,883 surface acres and contained a volume of 266,832 ac-ft of water at conservation pool elevation 94.0 ft. The usable conservation storage was 266,703 ac-ft of water. For further information about the 1987 survey please refer to the United States Geological Survey open-file report (88-388) titled "Rate of sediment deposition and subsequent water storage reduction within Lake Corpus Christi, Texas."

An error was found in the USGS elevation-area-capacity table developed from the 1987 survey and the City of Corpus Christi contracted with HDR Engineering Inc. to re-compute the table. HDR Engineering Inc. developed a new (revised) elevation-area-capacity table by planimetering a contour map of the bathymetry of Lake Corpus Christi Reservoir from the information gathered during the 1987 survey. The revised elevation-area-capacity table showed Lake Corpus Christi Reservoir had 19,251 acres of water and contained a volume of 241,241 ac-ft of water at conservation pool elevation 94.0 ft. In a letter dated April 23, 1991, the Water Supply Superintendent for the City of Corpus Christi informed the Texas Water Development Board that the City of Corpus Christi was using the revised elevation-area-capacity table developed by HDR Engineering Inc., as of January 1, 1991 (City of Corpus Christi, 1991).

Correspondence from HDR Engineering, Inc., dated May 23, 2002, to the City of Corpus Christi Water Department Director summarized the comparisons of the findings for the original capacity (1956) and the three surveys, 1972 McCaughan & Ethridge, 1987 USGS and the 2002 TWDB on Lake Corpus Christi Reservoir. HDR Engineering Inc. found that the total conservation storage reported in the 1972 McCaughan & Ethridge data, the 1988 USGS tabulations and the 2002 TWDB data appear to be in line when plotted as an elevation-capacity curve for Lake Corpus Christi Reservoir. HDR Engineering Inc. noted that the total conservation storage in the revised elevation-area-capacity table did not fit the curve and that the 1956 original capacity estimates were also brought into question (HDR Engineering, Inc., 2002). It appears that despite the error in the tabulated data, the capacity estimate from the original 1988 USGS report was reasonable. All of these mentioned figures are presented in Table 2, page 17.

Following construction of the Wesley E. Seale Dam the City were charged with inspecting and maintaining appurtenant structures. It would be responsible for sanitary, environmental inspections and water quality sampling of approximately 18,800 surface acres of LCCR and maintenance of all City-owned land and facilities. The responsibilities would also include inspection of septic systems and other facilities such as boat docks, piers and bulkheads that would require permits. Any excavation near the reservoir, recreation units and domestic withdrawals would also fall under the permit process.

Investments into maintaining a structurally sound facility continued into the 1990’s. In 1995 a contract in excess of $4.4 million was awarded for crest gate rehabilitation. In 1999 a $23 million stabilization project began to secure the integrity of the dam and to add additional monitoring equipment. The water level was lowered to elevation 91.0 ft during the remedial modifications of the dam and spillway gates. In 2001 permission was granted by the TNRCC to restore the reservoir to conservation pool elevation, 94.0 ft.

The following table summarizes information for Wesley E. Seale Dam and Lake Corpus Christi Reservoir.

Table 1. Wesley E. Seamy Dam and Lake Corpus Christi Reservoir

---

Owner

City of Corpus Christi

Engineers and General Contractors

Ambursen Company

H.B. Zachery Co.

Forrest and Cotton Inc. (modification of gates 1966)

Gardner Engineering Corp. (gates 1966)

Freese and Nichols (Dam Stability Analysis 1996)

Location

On the Nueces River in San Patricio and Jim Wells Counties, 4 miles southwest of Mathis.

Drainage Area

16,656 square miles

Dam

Type	Earthfill and concrete (Ambursen)
Length (total)	5,980 ft.

Spillway (north or emergency)

Spillway (south or service)

Outlet Works

Type	3 openings, each 2.5 by 4 ft.
Control	48 in. cylinder "Bunger" valve
Invert elevation	55.5 ft above msl

Water flows in Nueces River channel O.N Stevens Water Treatment Plant.

State Authorization

State Board of Water Engineers Permit No. 933, January 15,1925; State Board of Water Engineers Permit No. 1656, September 15, 1952, City of Corpus Christi by various permits has water use rights summarized by Permit No. 2026 (October 3, 1962).

Reservoir Data (2002 Survey)	Elevation (above msl)	Capacity (acre-feet)	Area (acres)
Feature			
Top of Dam	106.0	-	-
Spillway Crest	88.0	159,695	15,723
Conservation Pool Elevation	94.0	257,260	18,286
Invert low flow outlet	55.5	299	45
Usable (Conservation) Storage		256,961	

VOLUMETRIC SURVEYING TECHNOLOGY

The equipment used to perform the latest volumetric survey consisted of a 23-foot aluminum tri-hull SeaArk craft with cabin, equipped with twin 90-Horsepower Honda outboard motors. (Reference to brand names throughout this report does not imply endorsement by TWDB). Installed within the enclosed cabin are a Coastal Oceanographics' Helmsman Display (for navigation), an Innerspace Technology Model 449 Depth Sounder and Model 443 Velocity Profiler, Trimble Navigation, Inc. AG132 GPS receiver with differential GPS correction signal and an on-board 486 computer. A water-cooled generator provides electrical power through an in-line uninterruptible power supply. In shallow areas and where navigational hazards such as stumps were present, a 20-foot aluminum shallow-draft flat bottom SeaArk craft with cabin and equipped with one 115-horsepower Evinrude outboard motor was used. The portable data collection equipment on-board the boat included a Knudsen 320 B/P Echosounder (depth sounder), a Trimble Navigation, Inc. AG132 GPS receiver with differential GPS correction signal and a laptop computer.

The GPS equipment, survey vessel, and depth sounder in combination provide an efficient hydrographic survey system. As the boat travels across the pre-plotted transect lines, the depth sounder takes approximately ten readings of the lake bottom each second. The depth readings are stored on the laptop along with the positional data generated by the boat's GPS receiver. The data files collected are downloaded from the laptop and brought to the office for editing after the survey is completed. During editing, poor-quality data is removed or corrected, multiple data points are averaged to one data point per second, and the average depths are converted to elevation readings based on the water-level elevation recorded on the day the survey was performed. Accurate estimates of the lake volume can be quickly determined by building a 3-D model of the reservoir from the collected data.

PRE-SURVEY PROCEDURES

The reservoir's boundary was digitized using Environmental Systems Research Institute's (ESRI) ArcView from digital orthophoto quadrangle images (DOQ's). The DOQ's were produced by VARGIS of Texas LLC for the TEXAS Orthoimagery Program (TOP). The DOQ products produced for the Department of Information Resources and the GIS Planning Council under the Texas Orthoimagery Program reside in the public domain. More information can be obtained on the Internet at http://www.tnris.state.tx.us/DigitalData/doqs.htm. The reservoir boundary was created by digitizing from the MATHIS, SANDIA, DINERO and MULOS HILLS, TEXAS DOQ's. The reservoir elevations, at the time the DOQ's were photographed (January 15, 1995, January 31, 1995, February 01, 1995, February 02, 1995 and January 12, 1996) were 88.13 ft, 88.07 ft, 88.04 ft, 88.13 ft and 87.32 ft. respectively. The fact that water levels were approximately six to seven feet lower than conservation pool elevation (94.0 ft.) when the DOQ's photographs were taken concerned TWDB staff and City Officials. This matter was discussed in a meeting prior to the survey and City Staff decided to contract with Tobin International out of San Antonio to fly and photograph LCCR while the reservoir was at conservation pool elevation. Aerial photographs of the reservoir were taken on January 25, 2002 when the reservoir's water level elevation was 94.10 ft. These photos were used to digitize the boundary of the reservoir. This updated boundary and the lines digitized from the above DOQ's at their respective elevations were utilized by TWDB Staff in the model for the current study.

The survey layout was designed by placing survey track lines at 500 ft intervals within the digitized reservoir boundary using HYPACK software. The survey design required the use of approximately 500 survey lines placed perpendicular to the original river channel and tributaries along the length of the reservoir. The design also included approximately 90 track-lines at 500 ft intervals that were placed parallel to the river channel in the main basin of the reservoir. These lines were added in order to have better coverage in the main basin of the reservoir.

SURVEY PROCEDURES

The following procedures were followed during the volumetric survey of Lake Corpus Christi Reservoir performed by the TWDB. Information regarding equipment calibration and operation, the field survey, and data processing is presented.

Equipment Calibration and Operation

While onboard the Hydro-survey boat and prior to collecting data, the depth sounder was calibrated with the Innerspace 443 Velocity Profiler, an instrument used to measure the variation in the speed of sound at different depths in the water column. The average speed of sound through the entire water column below the boat was determined by averaging local speed-of-sound measurements collected through the water column. The velocity profiler probe was first placed in the water to acclimate the probe. The probe was next raised to the water surface where the depth was considered zero. The probe was then gradually lowered on a cable to a depth just above the lake bottom, and then raised again to the surface. During this lowering and raising procedure, local speed-of-sound measurements were collected, from which the average speed was computed by the velocity profiler. This average speed of sound was entered into the ITI449 depth sounder, which then provided the depth of the lake bottom. The depth was then checked manually with a measuring tape to ensure that the depth sounder was properly calibrated and operating correctly.

Onboard the River-runner (shallow draft) boat, the depth sounder was calibrated using the bar check feature in the Knudsen software program. This was accomplished by positioning the transducer over a known (measured) depth. The speed of sound was then adjusted (either higher or lower) until the displayed depths matched the known depth. The depth was then checked manually with a stadia (survey) rod to ensure that the depth sounder was properly calibrated and operating correctly.

The speed of sound in the water column ranged from 4,780 feet per second to 4,830 feet per second during the LCCR. Based on the measured speed of sound for various depths and the average speed of sound calculated for the entire water column, the depth sounder is accurate to within $\pm$0.2 ft. An additional estimated error of $\pm$0.3 ft arises from variation in boat inclination. These two factors combine to give an overall accuracy of $\pm$0.5 ft for any instantaneous reading. These errors tend to be fairly minimal over the entire survey, since some errors are positive and some are negative. Further information on these calculations is presented in Appendix G.

During the survey, the horizontal mask setting on the onboard GPS receiver was set to 10 degrees and the PDOP (Position Dilution of Precision) limit was set to seven to maximize the accuracy of the horizontal positioning. An internal alarm sounds if PDOP rises above seven to advise the field crew that the horizontal position has degraded to an unacceptable level. Further positional accuracy is obtained through the Omnistar receiver. The reservoir's initialization file used by the HYPACK data collection program was set up to convert the collected Differential GPS positions to state-plane coordinates on the fly.

Field Survey

TWDB staff collected data at LCCR for approximately 14 days during the period of December 11, 2001 through January 17, 2002. The City of Corpus Christi was able to maintain the water-level elevations during the survey at a fairly constant level between elevation 94.29 ft on Dec. 13, 2001 and elevation 94.06 ft on Jan. 7, 2002. The survey crew experienced a variety of weather conditions during data collection at LCCR. It was on the second day (Dec. 12, 2002) of the survey, that the crew was forced to collect data in protective areas due to high winds (and waves).

In total, approximately 247,628 data points were collected over the 580 miles traveled. These points were stored digitally on the boat's computer in 813 data files. Data were not collected in areas with significant obstructions or where the depths were too shallow to navigate. Figure 2 shows the actual location of all data points collected.

Data collection for LCCR began at Wesley E. Seale Dam and continued upstream in the main reservoir and into the Nueces River and contributing creeks. The "planned line" design for data collection at LCCR included 500 cross-sectional lines at 500 ft spacing increments laid out perpendicular to the original river channel. Data were also collected on approximately 80 parallel (to the original river channel) lines in what is considered the main basin of LCCR. These lines were added to form a 500 ft grid pattern for better coverage and contour definition in the main basin. Additional data were also collected around the three intake structures that serve the Cities of Mathis, Alice and Beeville.

Lake Corpus Christi Reservoir is an on-channel reservoir on the Nueces River with Wesley E. Seale Dam located at the south end of the reservoir. The Nueces River basically flows in a north to south direction with several tributaries flowing into the reservoir from both sides of the reservoir.

The geographic location of Wesley E. Seale Dam is just downstream of the Charquitas Creek and Nueces River confluence. The inundated floodplain of the Nueces River at elevation 94.0 ft forms a somewhat "hour glass" shaped reservoir. The common county line of Live Oak and San Patricio Counties dissects the two large swaths (or bodies of water) almost equally, north and south, near County Road 888. As expected, the southern (lower) swath, located closer to the dam was deeper while the northern (upper) swath was shallower with deltas and silt bars. The upper swath receives flow of the Nueces River from the north.

The topography surrounding LCCR varied from canyon type relief at the dam site to flat terrain in parts of the upper reaches of the reservoir. The land use surrounding the reservoir included a mixture of parks, recreational facilities, residential development, ranchland and undeveloped property.

The bathymetry of the reservoir bottom was consistent with the surrounding terrain. As the survey boat traveled across the pre-plotted transects, depths were recorded in the computer files and the depth sounder's analog chart. Distinguishable features observed during the data collection phase included the Nueces River channel or thalweg as the river and creeks meandered through the upper catchment basin. The thalweg was less noticeable in the lower portion (or near the dam) of the reservoir. The survey crew also noted the rise in the bathymetry when the boat would cross over the old Mathis or La Fruta Dam and the old Missouri-Pacific railway line.

The survey crew usually maintained course along the pre-plotted lines but occasionally had to veer in order to avoid obstructions such as stands of trees (stick ups) and stumps, aquatic vegetation, fences, boathouses and fishing piers, vertical clearances and shallow areas.

As the survey crew collected data upstream and passed the deltaic formation where the Nueces River opens into the catchment basin, the reservoir became more atypical of a river. The distance between the shorelines became narrow and the river channel bottom was more "V" shaped.

Data were collected along pre-plotted lines until large woody debris and canopy along the riverbanks kept the crew from staying on course. At that point, the survey crew began collecting data in a zigzag pattern.

Concerns about where to end the data collection on the upstream end of the Nueces River were discussed between staff of the City of Corpus Christi and TWDB. After reviewing the 1987 USBR sediment survey report and historical USGS topographic maps, both TWDB and the City agreed to end data collection at a point where the Nueces River meanders closest to the Missouri-Pacific railroad tract. This point is downstream of the Gussettville Bridge and the approximate coordinates are Latitude 28º 16' 39" north and Longitude 98º 02' 17" west.

Data Processing

The collected data were downloaded from diskettes onto TWDB's network computers. Tape backups were made for future reference as needed. To process the data, the EDIT routine in the HYPACK Program was run on each raw data file. Data points such as depth spikes or data with missing depth or positional information were deleted from the files. A correction for the lake elevation at the time of data collection was also applied to each file during the EDIT routine. During the survey, the water surface pool elevation varied from 94.06 ft on January 7, 2002 to 94.29 ft on December 13, 2001 according to the USGS gage and provided by the City of Corpus Christi Staff. After all changes had been made to the raw data files, the edited files were saved.

The edited files were then combined into a single X, Y, Z data file, to be used with the GIS software to develop a model of the lake bottom elevation.

The resulting data file was imported into Environmental System Research Institute's (ESRI) Arc/Info Workstation GIS software. This software was used to convert the data to a MASS points file. The MASS points and the boundary file were then used to create a Digital Terrain Model (DTM) of the reservoir's bottom surface using Arc/Info's TIN software module. The module generates a triangulated irregular network (TIN) from the data points and the boundary file using a method known as Delauney's criteria for triangulation. A triangle is formed between three non-uniformly spaced points, including all points along the boundary. If there is another point within the triangle, additional triangles are created until all points lie on the vertex of a triangle. All of the data points are used in this method. The generated network of three-dimensional triangular planes represents the bottom surface. With this representation of the bottom, the software then calculates elevations along the triangle surface plane by determining the elevation along each leg of the triangle. The reservoir area and volume can be determined from the triangulated irregular network created using this method of interpolation.

Volumes and areas were calculated from the TIN for the entire reservoir at one-tenth of a foot interval from minimum elevation to conservation pool level. From elevation 35.6 ft to 94.1 ft, the surface areas and volumes the lake were computed using Arc/Info software. The computed reservoir volume table is presented in Appendix A and the area table in Appendix B. An elevation-volume graph and an elevation-area graph are presented in Appendix C and Appendix D respectively.

Other products developed from the model include a shaded relief map (Figure 3) and a shaded depth range map (Figure 4). To develop these maps, the TIN was converted to a lattice using the TINLATTICE command and then to a polygon coverage using the LATTICEPOLY command. Linear filtration algorithms were applied to the DTM to produce smooth cartographic contours. The resulting contour map of the bottom surface at 5 ft intervals is presented in Figure 5. Finally, the location of cross-section endpoints in Appendix E and the corresponding cross-section plots in Appendix F were approximated from those sediment range lines used in the 1972 sediment study.

RESULTS

Results from the 2002 TWDB survey indicate Lake Corpus Christi Reservoir encompasses 18,286 surface acres and contains a total volume of 257,260 acre-feet at the conservation pool elevation of 94.0 ft. The shoreline at this elevation was calculated to be 160 miles whereas the digitized 94.1 ft boundary measures 186 miles. The deepest point physically measured during the survey was 54 feet (elevation 35 ft), and was located approximately 1,600 feet upstream of Wesley E. Seale Dam.

SUMMARY AND COMPARISONS

Wesley E. Seale Dam was completed in 1958 and deliberate impoundment began the same year. Several sediment surveys and studies have been performed on Lake Corpus Christi Reservoir. Original design information was furnished from a 1948 Soil Conservation Service Sediment Survey. The most recent Sediment Survey Report on Lake Corpus Christi Reservoir was published by the United States Geological Survey (USGS) in 1988. A summary of the capacities determined by the various surveys is presented in Tables 2 and 3.

At conservation pool elevation 94.0 ft, the current survey measured 18,286 surface acres and a capacity of 257,260 acre-feet. Due to differences in the methodologies used and recent technological advances, the TWDB 2002 figure is greater than that being used by the City of Corpus Christi since 1991 (241,241 acre-feet). The dead pool, below elevation 55.5 ft, was found to be 299 acre-feet, and thus the conservation storage found in this survey is 256,961 acre-feet.

It is recommended that a similar survey be performed in five to ten years or after major flood events to monitor changes to the lake's capacity.

Table 2. Area and volume comparisons at elevation 94.0 feet msl.

	USSCS[1]	McCaughan & Ethridge[2]	USGS[3]	HDR[4]	TWDB[5]
Year	1948	1973	1988	1991	2002
Area (acres)	19,860	19,336	18,883	19,251	18,286
Total Volume (acre-feet)	292,758	272,352	266,832	241,241	257,260
Conservation Storage (ac-ft) (Between elev. 55.5ft-94.0 ft)	290,917	271,511	266,703	-	256,961

[1]Original design information. Calculations for area and volume up to elevation 94.0 ft based on a sediment survey performed by the U.S. Soil Conservation Service.
[2]Sediment Survey Report by McCaughan & Ethridge Consulting Engineers.
[3]Sediment Survey Report by United States Geological Survey.
[4]Re-calculated elevation-area-capacity tables by HDR Engineering Inc. based on the 1987 sediment survey and subsequent 1988 USGS report.
[5]Volumetric Survey performed by the Texas Water Development Board.

Table 3. Area and volume comparisons at elevation 74.0 feet msl.

Year	1934	1942	1948	2002
Area (acres)	5,493	5,493	5,484	4,569
Total Volume (acre-feet)	54,430	43,800	39,390	23,339

REFERENCES

1. City of Corpus Christi. April 23, 1991. Correspondence to the Texas Water Development Board
2. City of Corpus Christi. 1998. "Tour Of The Wesley E. Seale Dam At Lake Corpus Christi Reservoir"
3. HDR Engineering, Inc. 2002 “Lake Corpus Christi Sediment Survey Review” Correspondence to the City of Corpus Christi Water Department Director
4. McCaugan & Ethridge Consulting Engineers. 1973. "Report on Sedimentation Survey of Lake Corpus Christi"
5. Texas Water Commission, 1983. “Certificate of Adjudication No. 21-2464”
6. Texas Water Development Board. 1966. Report 48. “Dams and Lakes in Texas, Historical and Descriptive Information”
7. Texas Water Development Board. 1971. Report 126 Part III. “Engineering Data on Dams and Lakes in Texas”
8. United States Geological Survey. 1988. Open-file Report 88-388. "Rate of sediment deposition and subsequent water storage reduction within Lake Corpus Christi, Texas"
9. United States Geological Survey. 2000. Water Data Report TX-00-5. “Water Resources Data Texas Water Year 2000”

Appendix A

Lake Corpus Chisiti Reservoir

RESERVOIR VOLUME TABLE

TEXAS WATER DEVELOPMENT BOARD

JANUARY 2002 SURVEY

VOLUME IN ACRE-FEET

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
35							0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	1
38	1	1	1	1	1	1	1	1	1	1
39	1	1	1	1	1	2	2	2	2	2
40	2	2	2	2	2	3	3	3	3	3
41	3	3	4	4	4	4	4	5	5	5
42	5	6	6	6	6	7	7	7	8	8
43	9	9	9	10	10	11	11	12	12	13
44	14	14	15	16	17	18	19	19	20	21
45	22	23	24	26	27	28	29	30	32	33
46	34	36	37	39	40	42	43	45	46	48
47	50	51	53	55	57	58	60	62	64	66
48	68	70	72	74	76	78	80	83	85	87
49	89	92	94	96	99	101	103	106	108	111
50	113	116	119	121	124	127	129	132	135	138
51	140	143	146	149	152	155	158	161	164	167
52	170	173	176	179	182	186	189	192	195	199
53	202	206	209	213	216	220	223	227	231	234
54	238	242	246	249	253	257	261	265	269	273
55	278	282	286	290	295	299	304	308	313	318
56	323	328	333	338	343	349	354	360	366	373
57	379	386	393	400	407	415	422	430	439	447
58	456	465	474	483	493	503	513	524	535	546
59	558	571	584	598	612	627	643	660	677	695
60	714	734	755	776	798	821	845	870	896	923
61	952	982	1013	1046	1082	1119	1159	1201	1246	1293
62	1342	1392	1445	1499	1555	1612	1670	1730	1790	1852
63	1915	1980	2046	2114	2184	2256	2329	2405	2483	2563
64	2645	2728	2812	2898	2985	3074	3166	3259	3354	3451
65	3551	3653	3759	3867	3978	4091	4207	4325	4445	4566
66	4688	4811	4936	5061	5187	5315	5444	5574	5705	5837
67	5971	6106	6243	6381	6521	6661	6803	6946	7091	7237
68	7385	7533	7683	7835	7989	8144	8302	8461	8622	8785
69	8950	9116	9285	9455	9626	9799	9975	10152	10331	10513
70	10697	10885	11077	11273	11475	11682	11895	12113	12337	12568
71	12806	13050	13302	13561	13826	14099	14380	14668	14965	15269
72	15580	15899	16225	16559	16900	17249	17605	17968	18339	18717
73	19103	19496	19896	20303	20716	21137	21564	21997	22438	22885
74	23339	23799	24265	24737	25215	25699	26188	26682	27181	27685
75	28193	28707	29226	29749	30278	30813	31352	31898	32449	33007
76	33570	34140	34716	35298	35886	36480	37080	37687	38301	38920
77	39545	40176	40814	41457	42106	42761	43422	44089	44762	45441
78	46126	46818	47515	48218	48926	49642	50364	51094	51831	52575
79	53325	54083	54848	55619	56397	57182	57973	58770	59574	60384
80	61202	62028	62861	63702	64552	65410	66277	67152	68037	68931
81	69835	70751	71676	72610	73555	74510	75475	76451	77435	78429
82	79431	80442	81461	82488	83524	84567	85619	86679	87748	88825
83	89910	91003	92105	93214	94333	95459	96593	97736	98888	100047
84	101215	102391	103575	104768	105969	107179	108397	109623	110858	112102
85	113354	114615	115885	117163	118450	119745	121049	122360	123680	125008
86	126343	127686	129038	130397	131764	133140	134524	135916	137317	138727
87	140146	141574	143012	144460	145937	147428	148928	150437	151955	153481
88	155016	156565	158126	159695	161271	162853	164442	166037	167638	169245
89	170858	172476	174100	175730	177366	179006	180652	182303	183960	185621
90	187287	188957	190632	192312	193997	195685	197379	199076	200778	202484
91	204194	205907	207625	209347	211072	212801	214534	216270	218011	219755

Lake Corpus Chisiti Reservoir
RESERVOIR VOLUME TABLE (continued)

TEXAS WATER DEVELOPMENT BOARD JANUARY 2002 SURVEY

VOLUME IN ACRE-FEET ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
92	221503	223255	225011	226770	228533	230301	232071	233846	235625	237407
93	239193	240983	242776	244574	246375	248180	249988	251800	253617	255437
94	257260	259088								

Appendix B

Lake Corpus Christi Reservoir

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — JANUARY 2002 SURVEY

AREA IN ACRES — ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
35							0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	1	1	1	1	1	1	1
39	1	1	1	1	1	1	1	1	1	1
40	1	1	1	1	1	1	1	1	1	2
41	2	2	2	2	2	2	2	2	2	2
42	3	3	3	3	3	3	3	3	4	4
43	4	4	4	5	5	5	5	6	6	7
44	7	7	8	8	8	9	9	9	10	10
45	10	11	11	11	12	12	12	13	13	13
46	14	14	14	15	15	15	16	16	16	17
47	17	17	17	18	18	18	19	19	19	20
48	20	20	20	21	21	21	22	22	22	23
49	23	23	23	24	24	24	24	25	25	25
50	26	26	26	26	27	27	27	27	28	28
51	28	28	29	29	29	29	30	30	30	30
52	31	31	31	32	32	32	33	33	33	34
53	34	34	35	35	35	36	36	37	37	37
54	38	38	38	39	39	40	40	40	41	41
55	42	43	43	44	44	45	46	47	47	48
56	49	50	51	53	54	55	57	59	61	63
57	66	68	70	72	75	77	79	81	83	86
58	88	90	93	95	98	101	104	109	113	117
59	122	128	134	141	148	155	163	171	179	186
60	194	201	209	218	226	235	244	254	265	278
61	292	307	324	343	363	386	410	435	458	479
62	499	517	535	550	564	576	588	600	612	625
63	639	654	671	689	707	728	749	771	790	807
64	821	836	850	867	883	901	921	940	962	986
65	1011	1038	1067	1097	1124	1147	1169	1189	1205	1217
66	1227	1236	1247	1259	1270	1282	1293	1305	1317	1332
67	1346	1360	1374	1387	1399	1413	1427	1441	1454	1467
68	1480	1493	1509	1526	1544	1565	1586	1603	1620	1639
69	1656	1674	1691	1707	1723	1743	1762	1781	1803	1829
70	1859	1898	1942	1989	2042	2101	2155	2210	2275	2343
71	2410	2482	2551	2620	2693	2771	2845	2925	3007	3074
72	3144	3226	3304	3376	3450	3523	3594	3668	3745	3819
73	3895	3969	4034	4100	4171	4238	4303	4372	4439	4504
74	4569	4633	4693	4751	4808	4863	4915	4965	5014	5062
75	5112	5162	5213	5263	5315	5370	5425	5482	5547	5607
76	5665	5727	5788	5849	5911	5974	6037	6100	6164	6222
77	6281	6344	6404	6461	6522	6580	6637	6699	6764	6823
78	6880	6942	7000	7058	7124	7190	7256	7330	7409	7472
79	7537	7614	7681	7747	7814	7877	7940	8004	8071	8141
80	8214	8296	8373	8450	8541	8627	8709	8800	8897	8989
81	9092	9203	9294	9388	9508	9605	9699	9802	9890	9977
82	10068	10152	10231	10311	10397	10475	10556	10649	10729	10808
83	10894	10975	11055	11139	11223	11303	11386	11472	11555	11637
84	11720	11802	11885	11969	12054	12137	12221	12308	12393	12478
85	12566	12653	12739	12826	12912	12995	13076	13156	13235	13314
86	13393	13473	13553	13633	13715	13797	13881	13968	14055	14144
87	14235	14329	14427	14538	14862	14958	15048	15134	15220	15308
88	15394	15568	15655	15723	15789	15856	15920	15981	16040	16098
89	16156	16213	16272	16327	16381	16434	16485	16536	16586	16635
90	16683	16730	16775	16820	16865	16909	16957	16998	17038	17078
91	17118	17157	17195	17234	17272	17310	17348	17385	17423	17461

Lake Corpus Christi Reservoir
RESERVOIR AREA TABLE (continued)

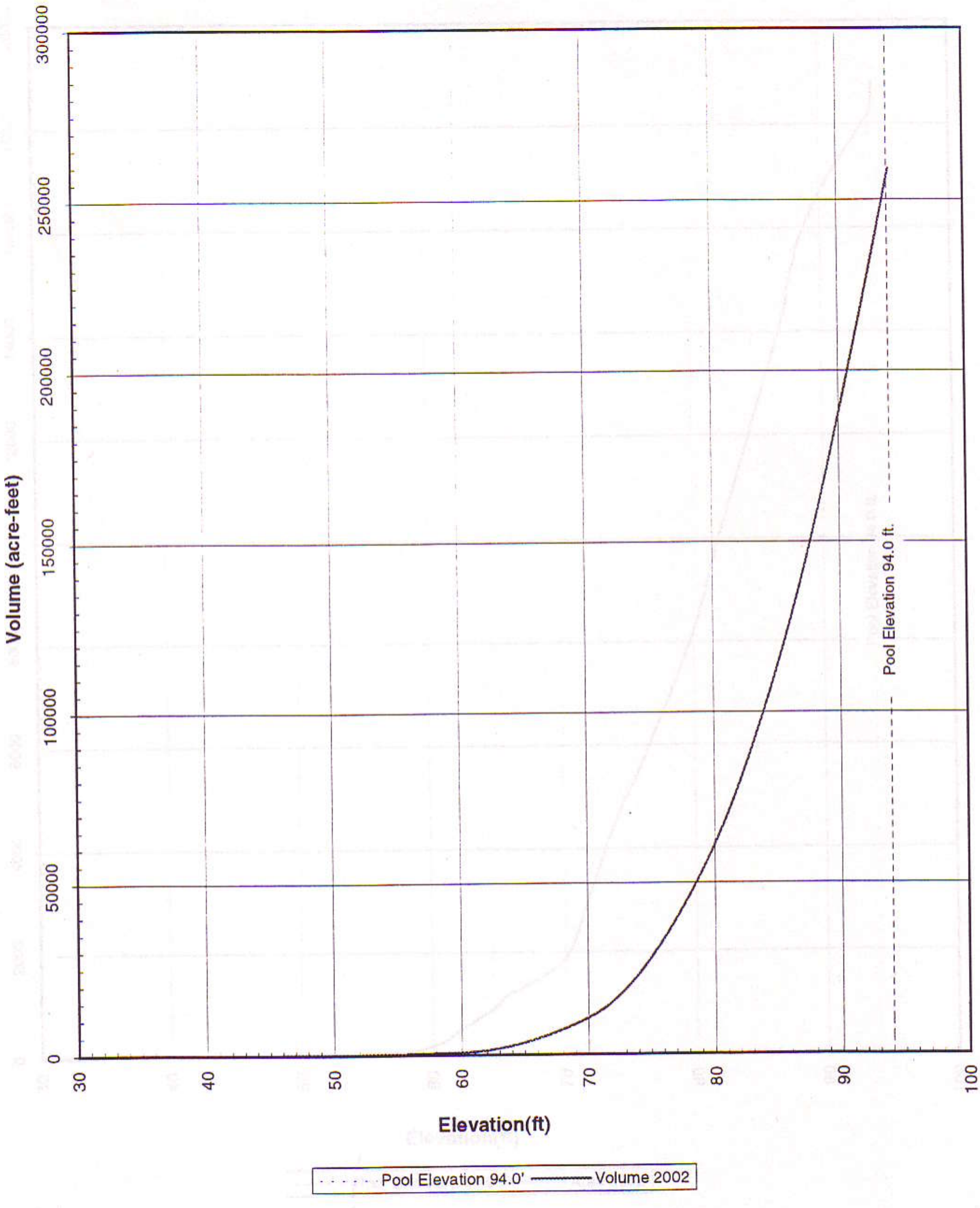
TEXAS WATER DEVELOPMENT BOARD

JANUARY 2002 SURVEY

AREA IN ACRES

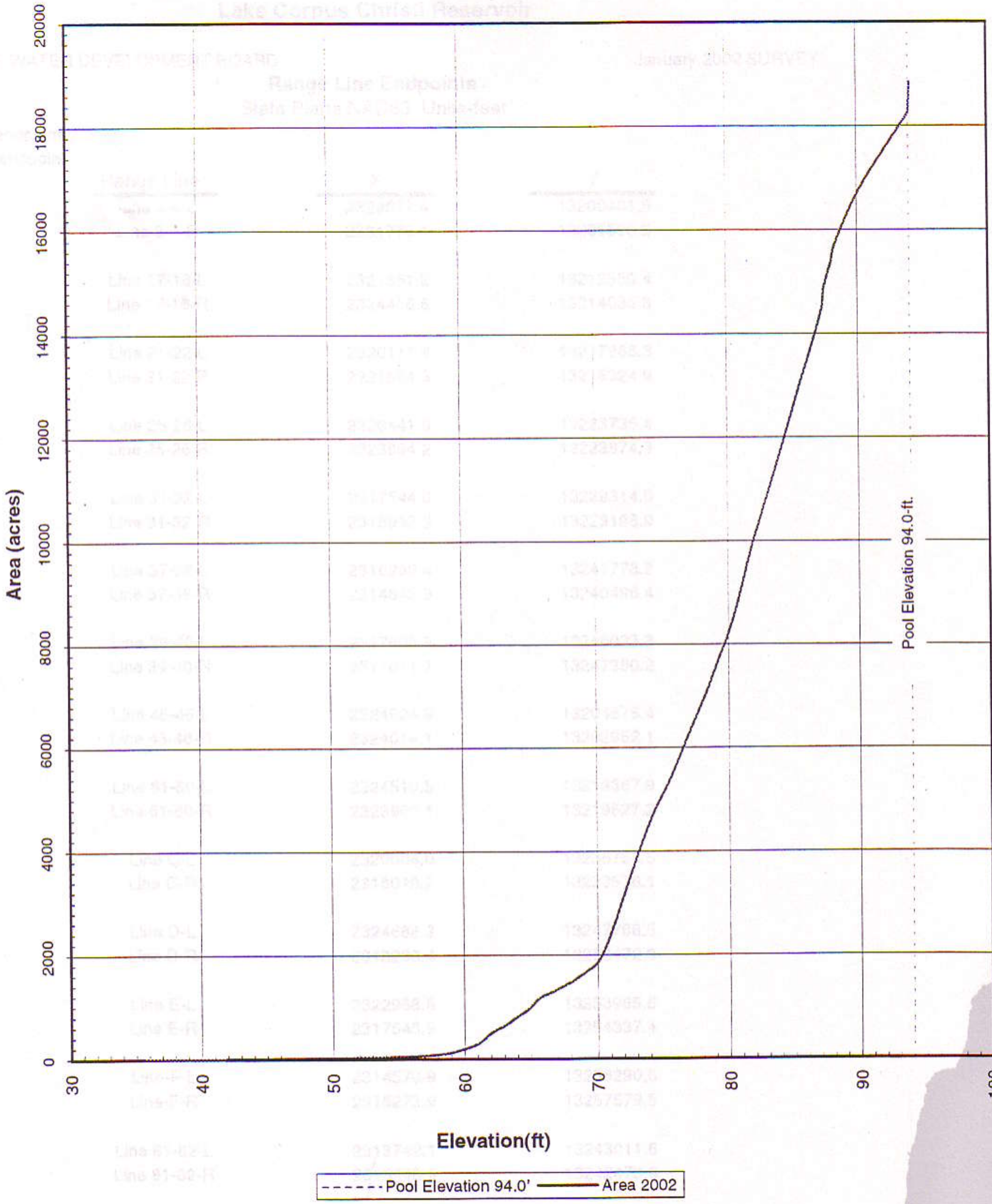
ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
92	17499	17537	17575	17614	17652	17690	17728	17766	17804	17842
93	17879	17917	17954	17992	18029	18067	18104	18142	18180	18218
94	18256	18833								



Lake Corpus Christi Reservoir
January 2002
Prepared by: TWDB

Appendix C Elevation vs. Volume



Lake Corpus Christi Reservoir
January 2002
Prepared by: TWDB

Appendix D Elevation vs. Area

Appendix E

Lake Corpus Christi Reservoir

TEXAS WATER DEVELOPMENT BOARD

January 2002 SURVEY

Range Line Endpoints

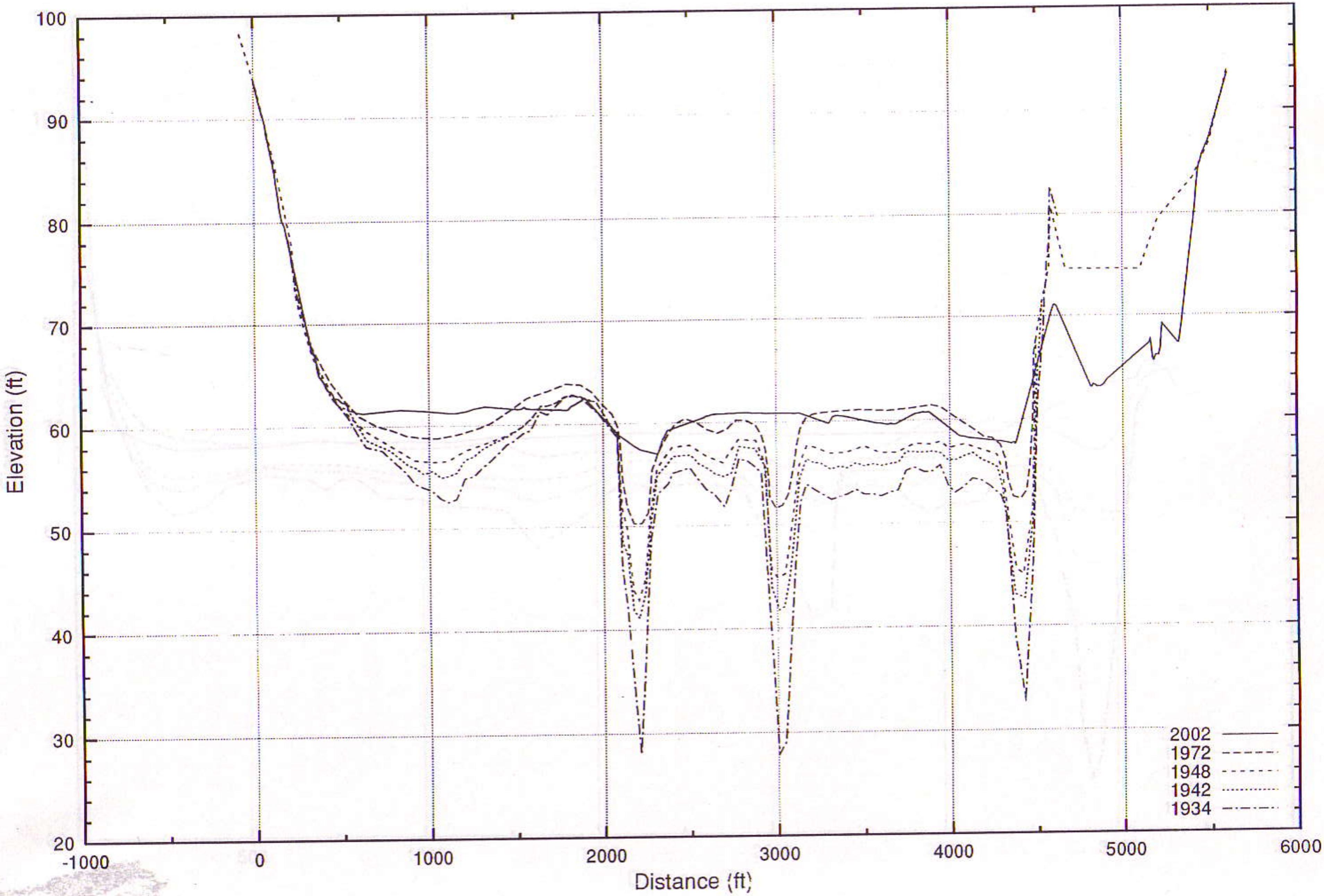
State Plane NAD83 Units-feet

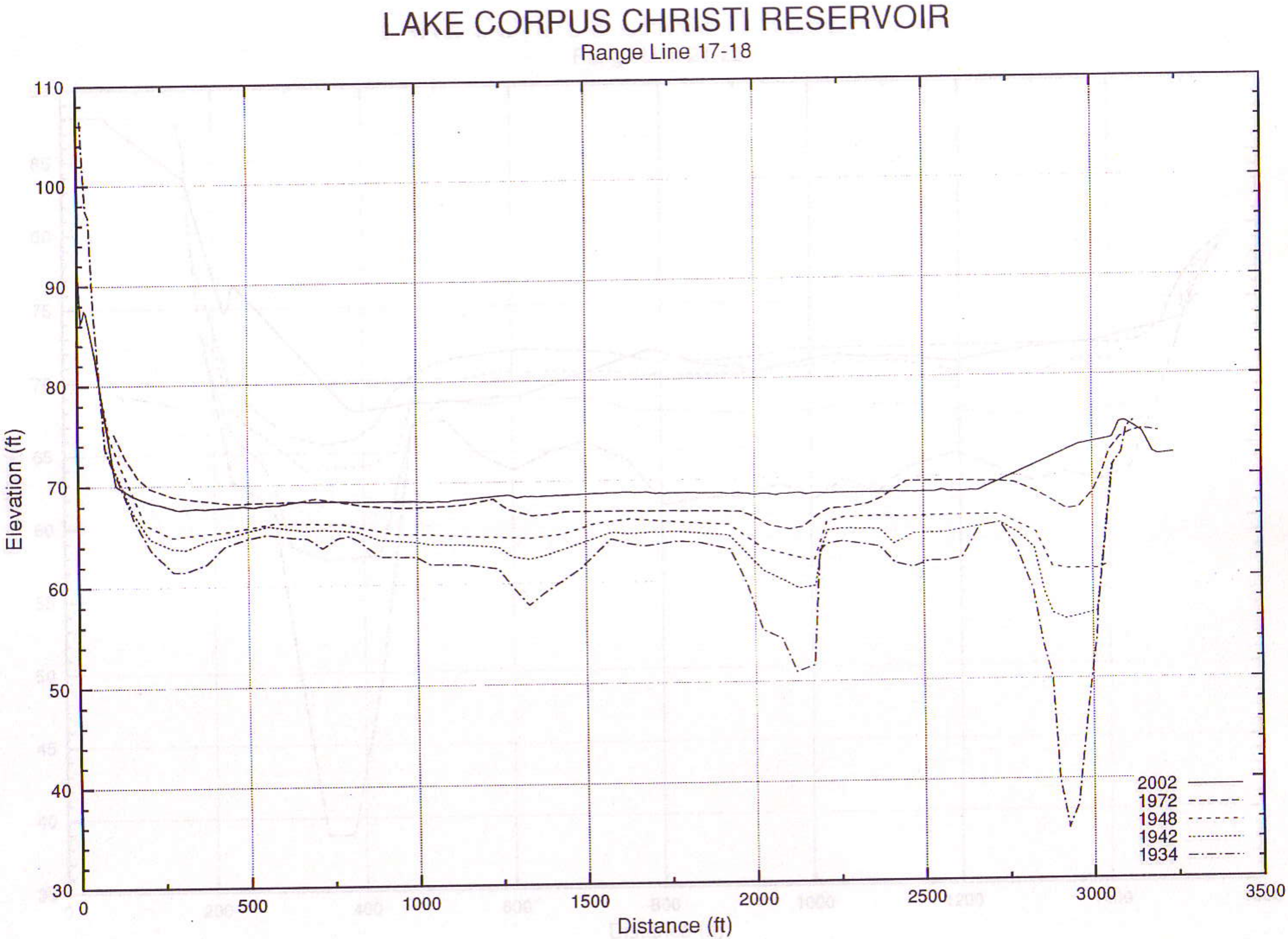
L-Left endpoint
R-right endpoint

Range Line	X	Y
Line 3-4-L	2329677.4	13200401.5
Line 3-4-R	2331779.1	13205596.3
Line 17-18-L	2321361.2	13212950.4
Line 17-18-R	2324416.6	13214035.8
Line 21-22-L	2320111.8	13217868.3
Line 21-22-R	2321564.3	13218324.9
Line 25-26-L	2320441.0	13223735.4
Line 25-26-R	2323894.2	13223874.3
Line 31-32-L	2317544.0	13229314.0
Line 31-32-R	2318932.3	13229198.9
Line 37-38-L	2316290.4	13241778.8
Line 37-38-R	2314643.9	13240496.4
Line 39-40-L	2317605.9	13246023.3
Line 39-40-R	2311011.7	13247380.2
Line 45-46-L	2324024.9	13204875.4
Line 45-46-R	2324014.1	13202952.1
Line 61-60-L	2324510.5	13219367.9
Line 61-60-R	2323600.1	13219627.2
Line C-L	2320004.0	13236758.5
Line C-R	2316019.2	13233536.1
Line D-L	2324688.3	13247768.5
Line D-R	2318288.4	13250472.3
Line E-L	2322958.8	13253965.5
Line E-R	2317645.9	13254337.4
Line-F-L	2314570.9	13256290.6
Line-F-R	2315273.9	13257579.5
Line 81-82-L	2313742.1	13243011.6
Line 81-82-R	2313948.9	13242473.8
RAMIRENA-L	2311151.7	13244689.2
RAMIRENA-R	2311877.5	13239095.9

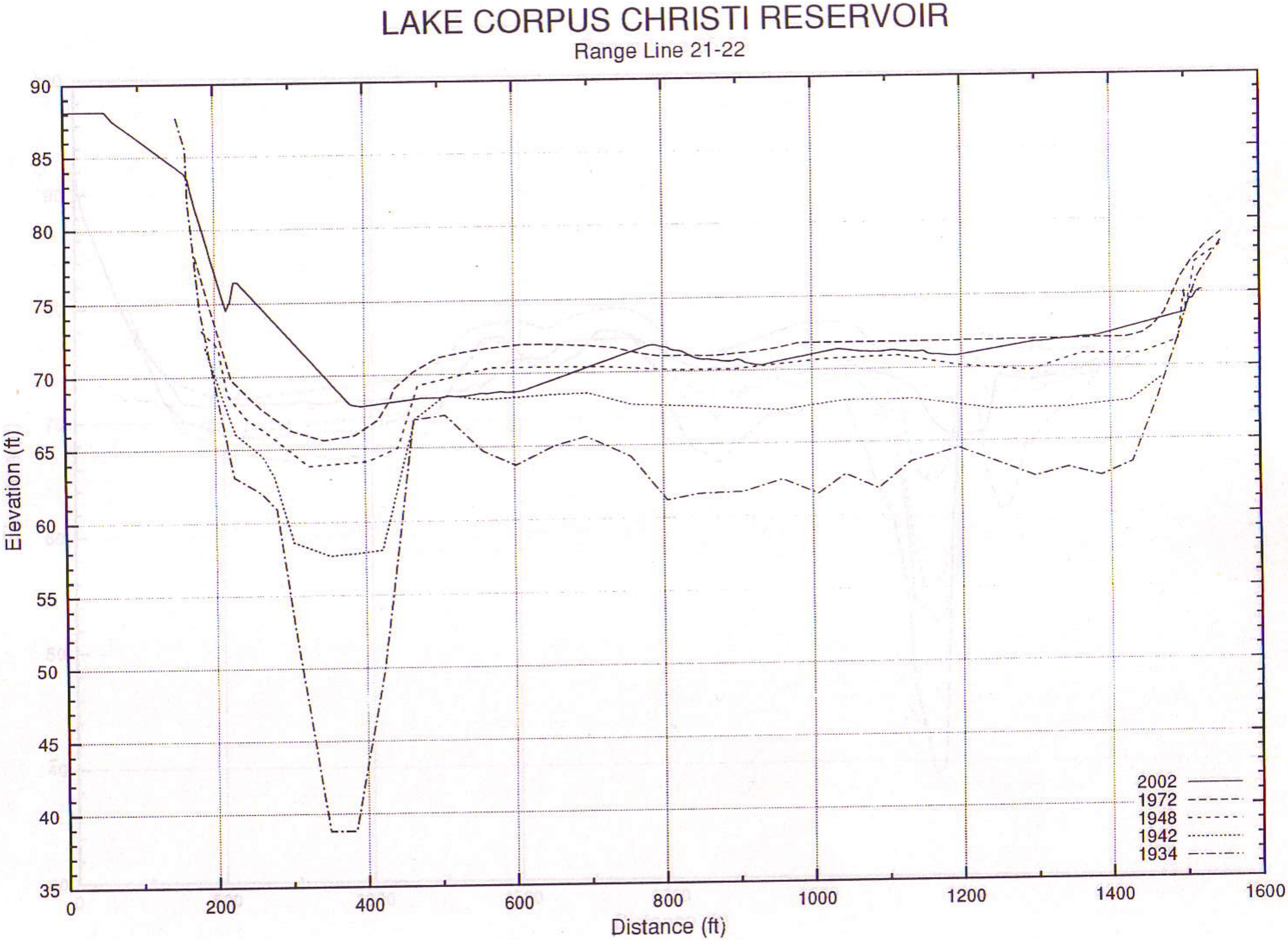
LAKE CORPUS CHRISTI RESERVOIR

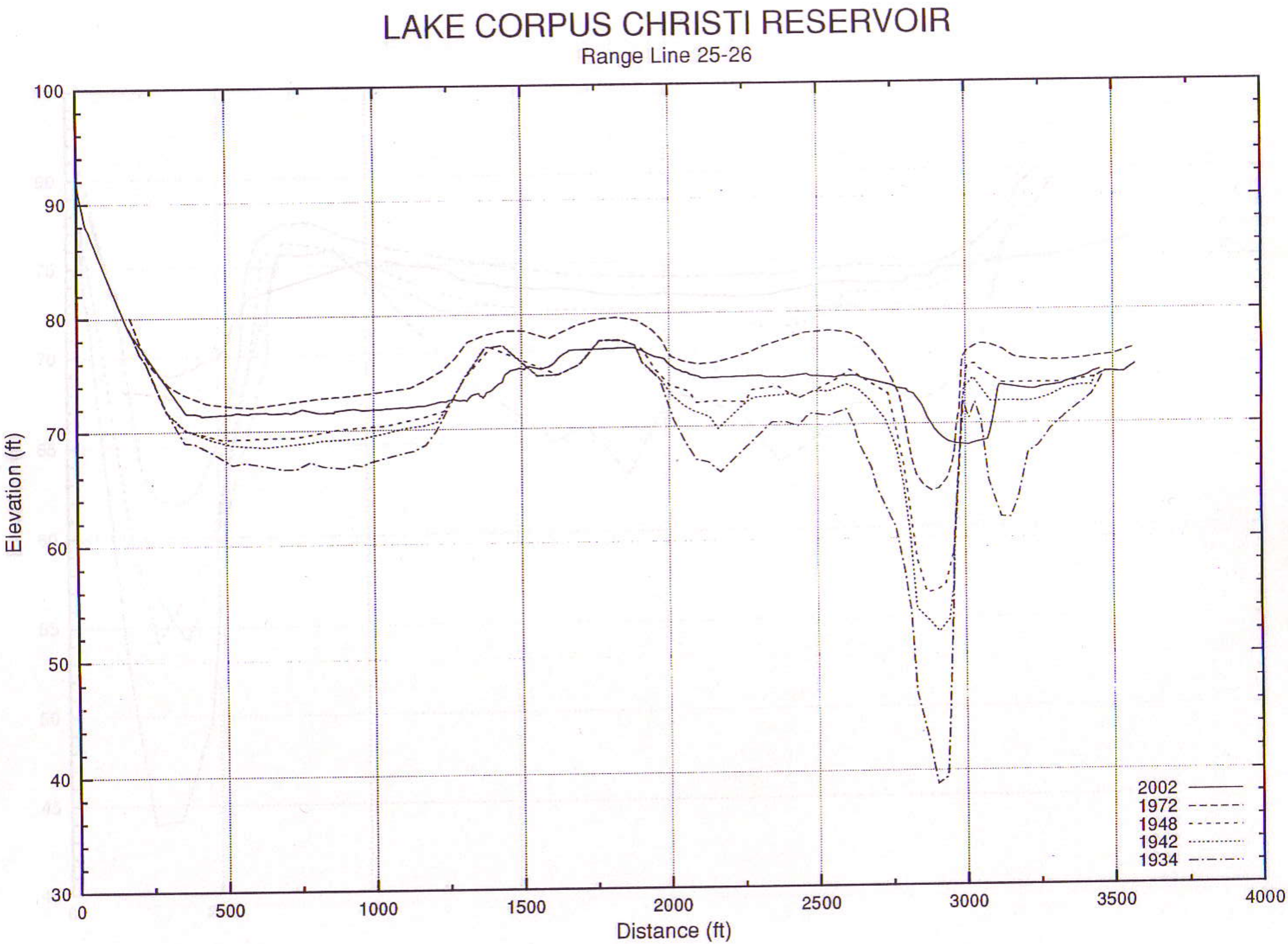
Range Line 3-4

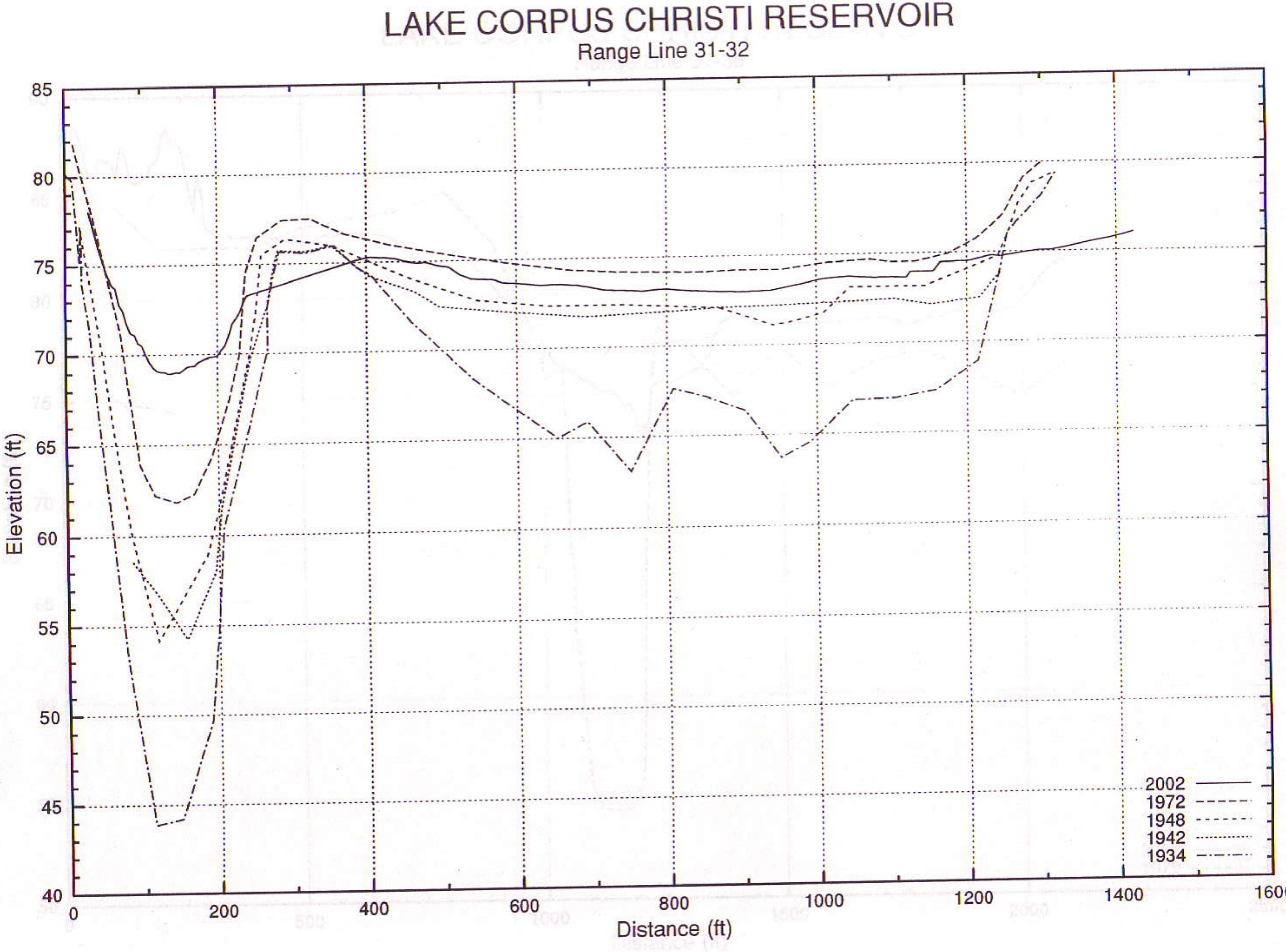


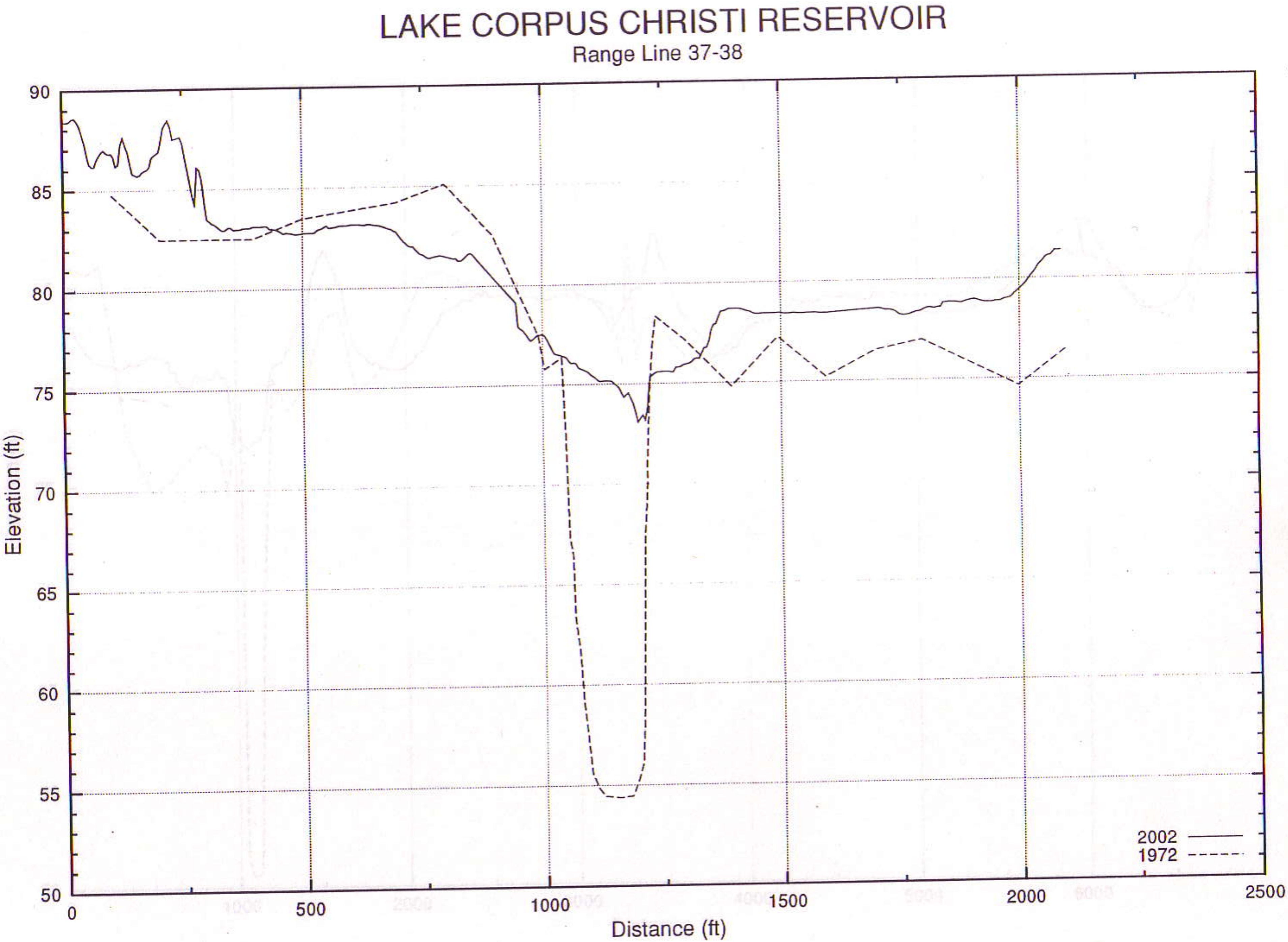


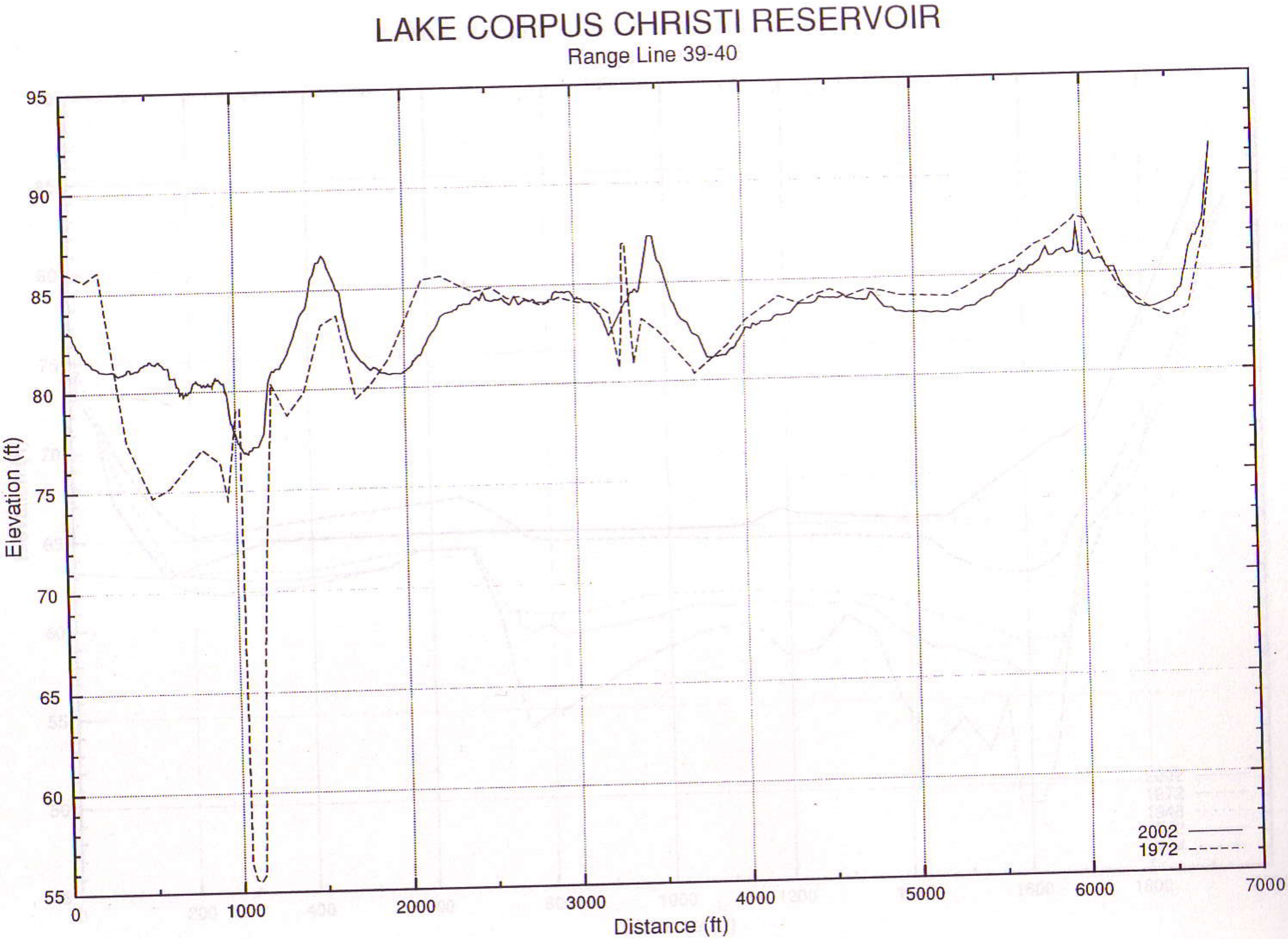
LAKE CORPUS CHRISTI RESERVOIR
Range Line 17-18
Elevation (ft)
Distance (ft)
110
100
90
80
70
60
50
40
30
0
500
1000
1500
2000
2500
3000
3500
2002
1972
1948
1942
1934


LAKE CORPUS CHRISTI RESERVOIR
Range Line 21-22
Elevation (ft)
Distance (ft)
90
85
80
75
70
65
60
55
50
45
40
35
0
200
400
600
800
1000
1200
1400
1600
2002
1972
1948
1942
1934


LAKE CORPUS CHRISTI RESERVOIR
Range Line 25-26
Elevation (ft)
Distance (ft)
100
90
80
70
60
50
40
30
0
500
1000
1500
2000
2500
3000
3500
4000
2002
1972
1948
1942
1934


LAKE CORPUS CHRISTI RESERVOIR
Range Line 31-32
Elevation (ft)
Distance (ft)
85
80
75
70
65
60
55
50
45
40
0
200
400
600
800
1000
1200
1400
1600
2002
1972
1948
1942
1934


LAKE CORPUS CHRISTI RESERVOIR
Range Line 37-38
Elevation (ft)
Distance (ft)
90
85
80
75
70
65
60
55
50
0
500
1000
1500
2000
2500
2002
1972

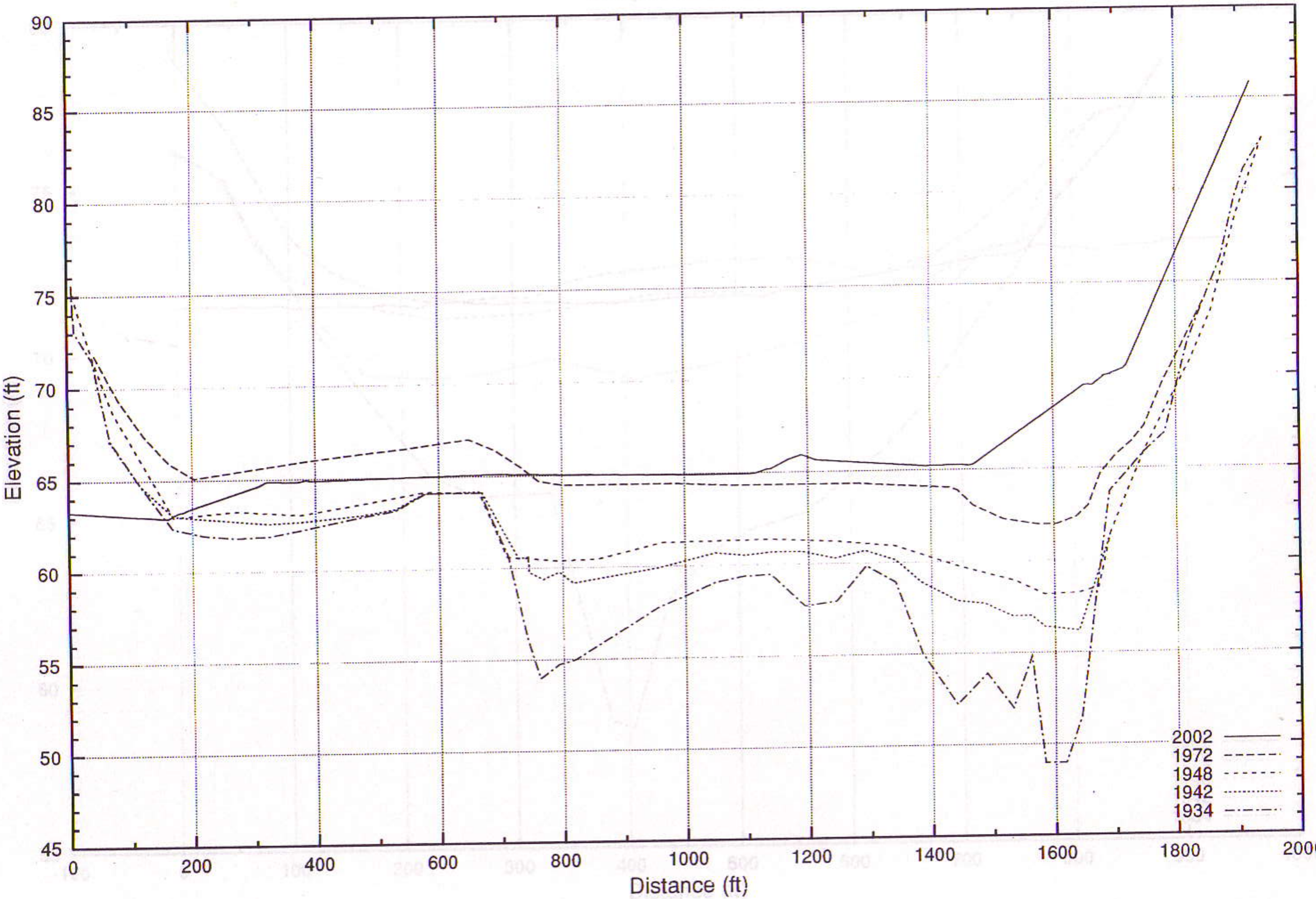


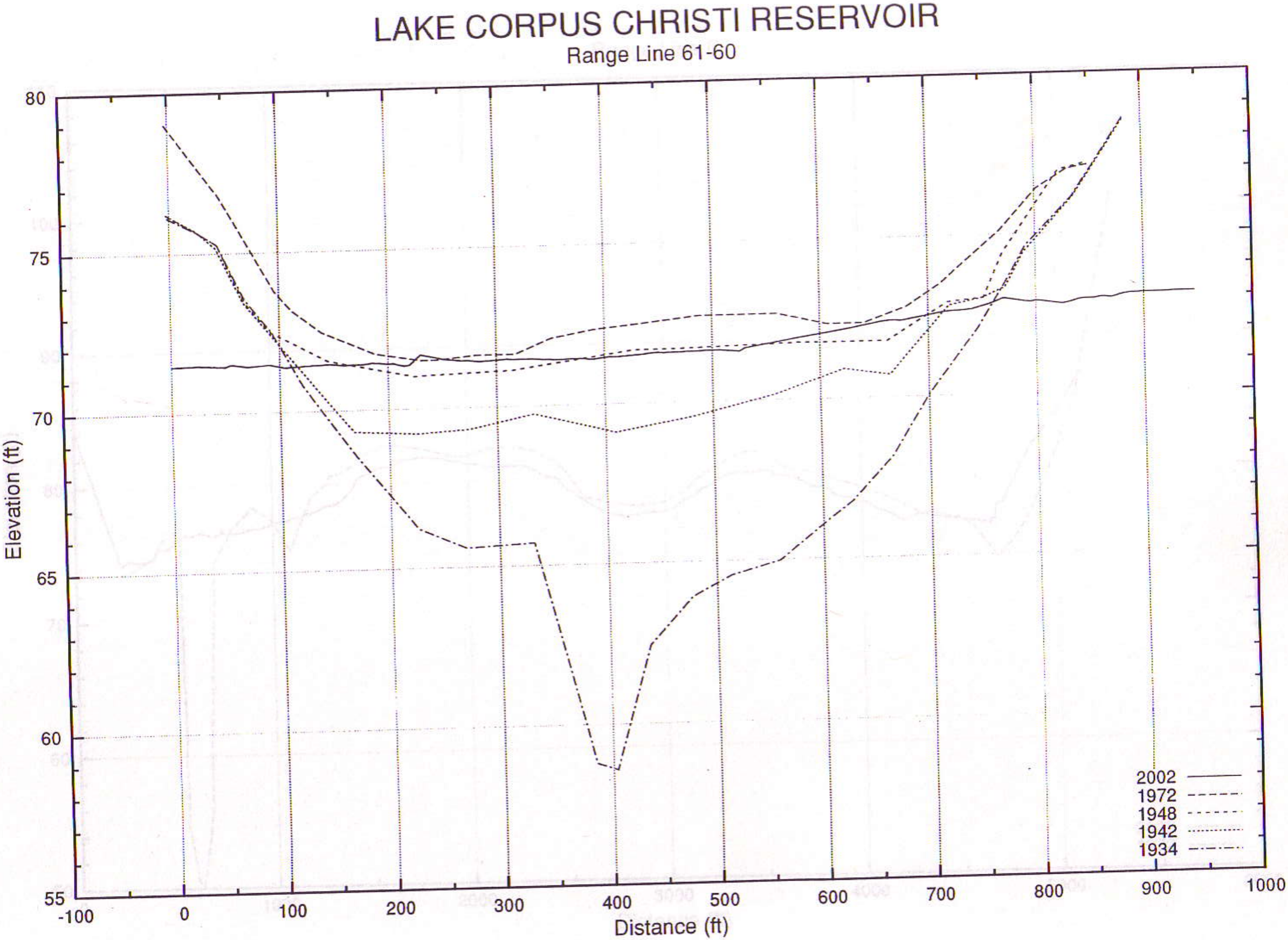
LAKE CORPUS CHRISTI RESERVOIR
Range Line 39-40
Elevation (ft)
Distance (ft)
95
90
85
80
75
70
65
60
55
0
1000
2000
3000
4000
5000
6000
7000
2002
1972

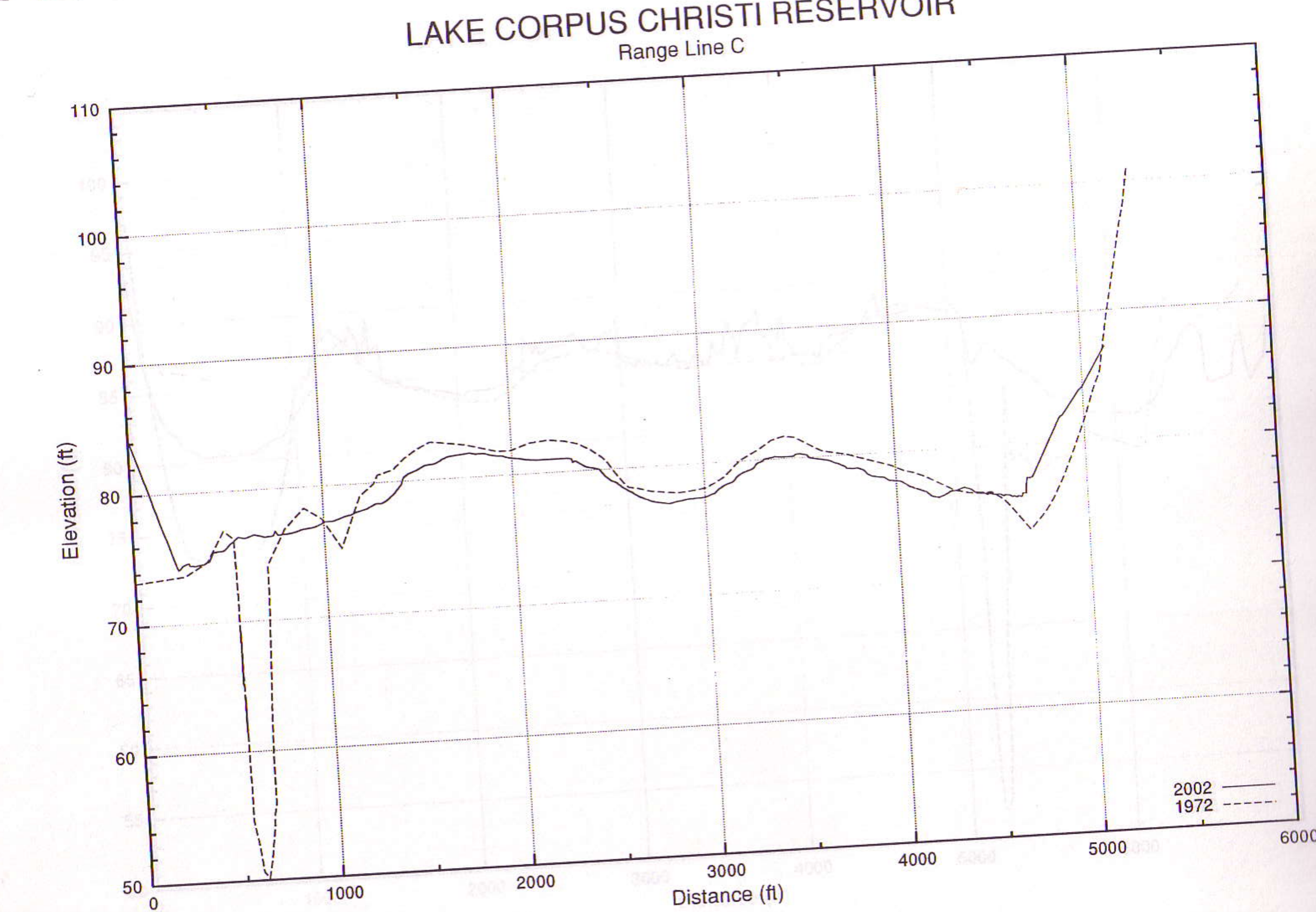
Appendix F

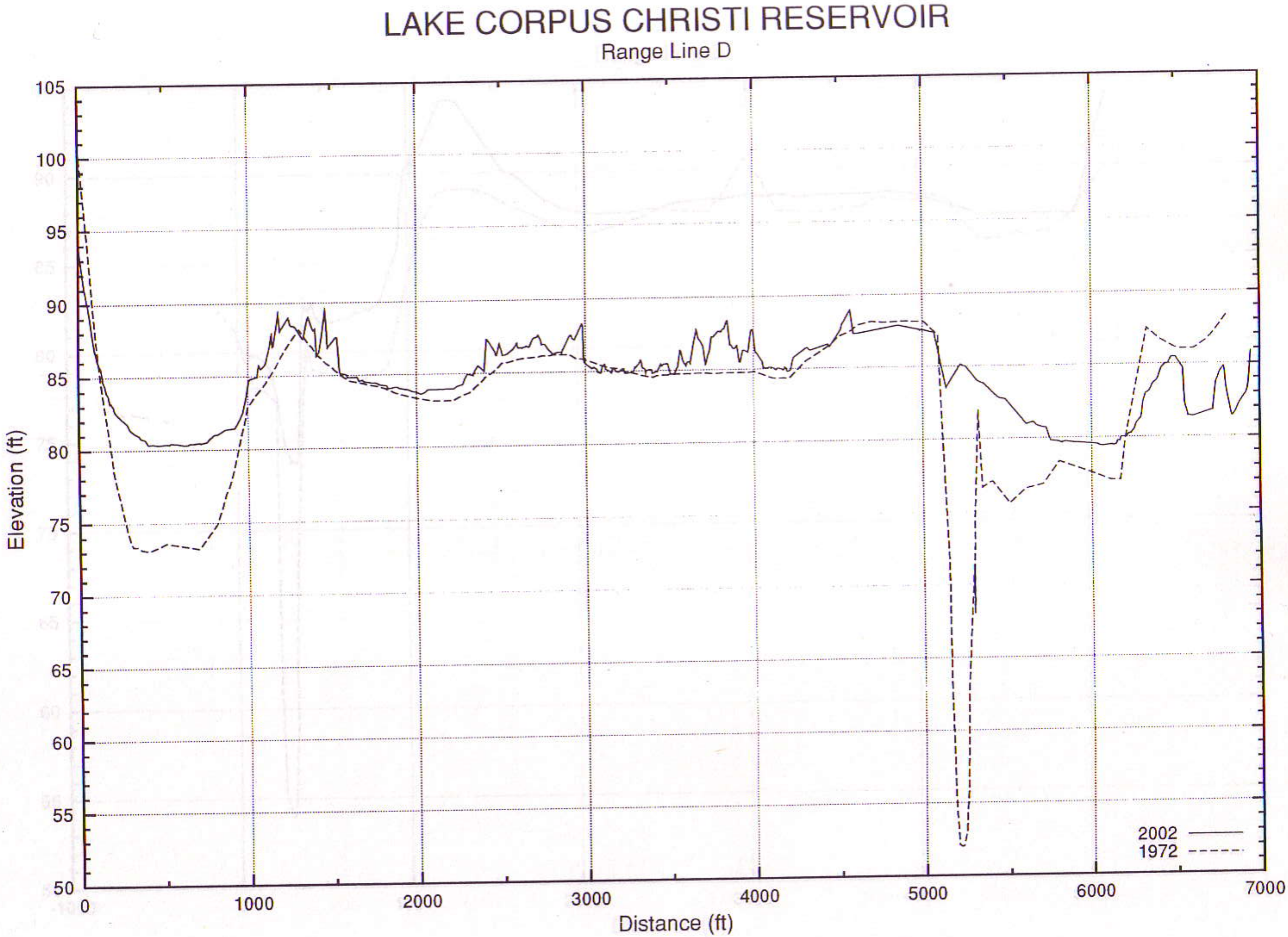
LAKE CORPUS CHRISTI RESERVOIR

Range Line 45-46



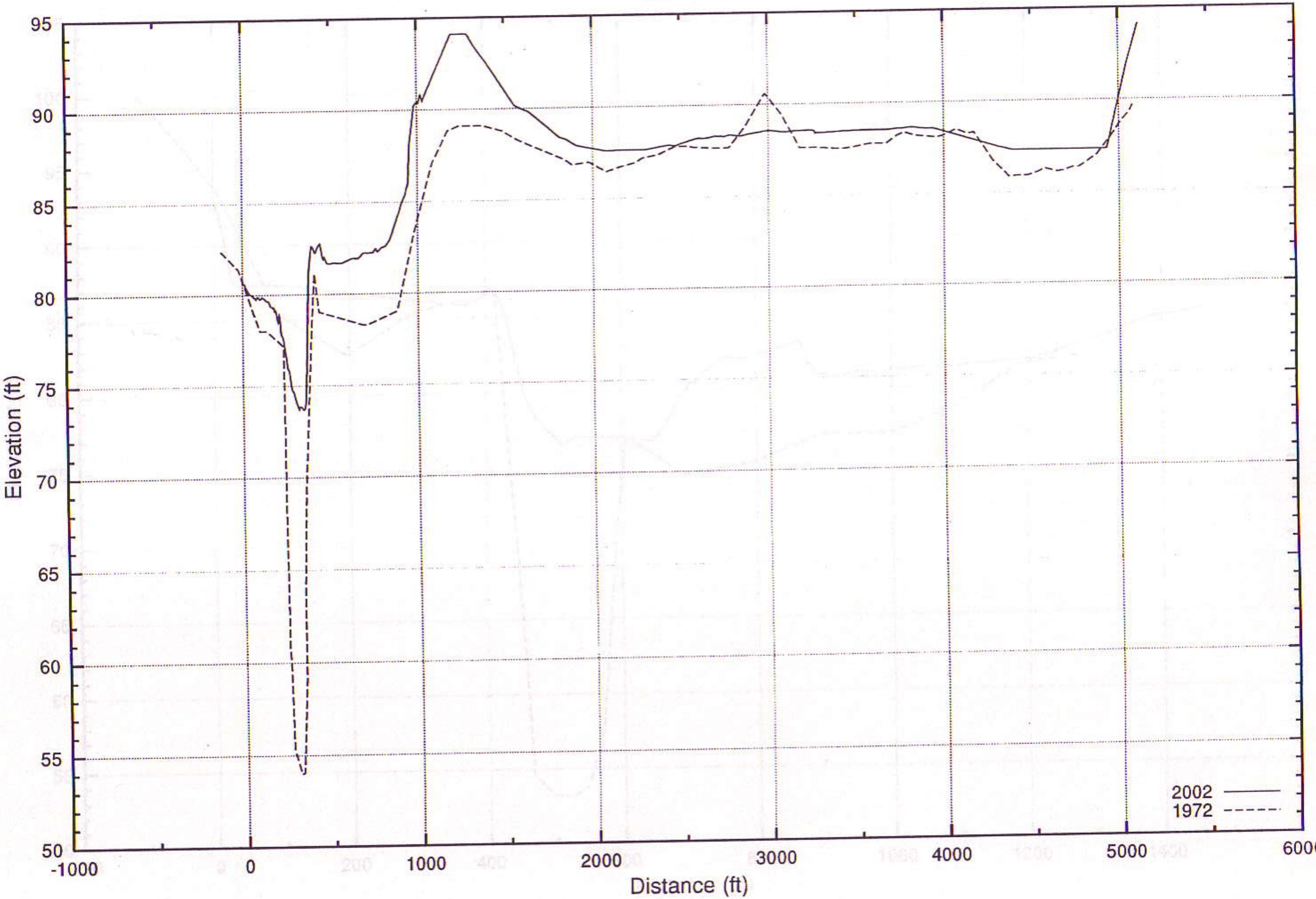

LAKE CORPUS CHRISTI RESERVOIR
Range Line 61-60
Elevation (ft)
Distance (ft)
80
75
70
65
60
55
-100
0
100
200
300
400
500
600
700
800
900
1000
2002
1972
1948
1942
1934

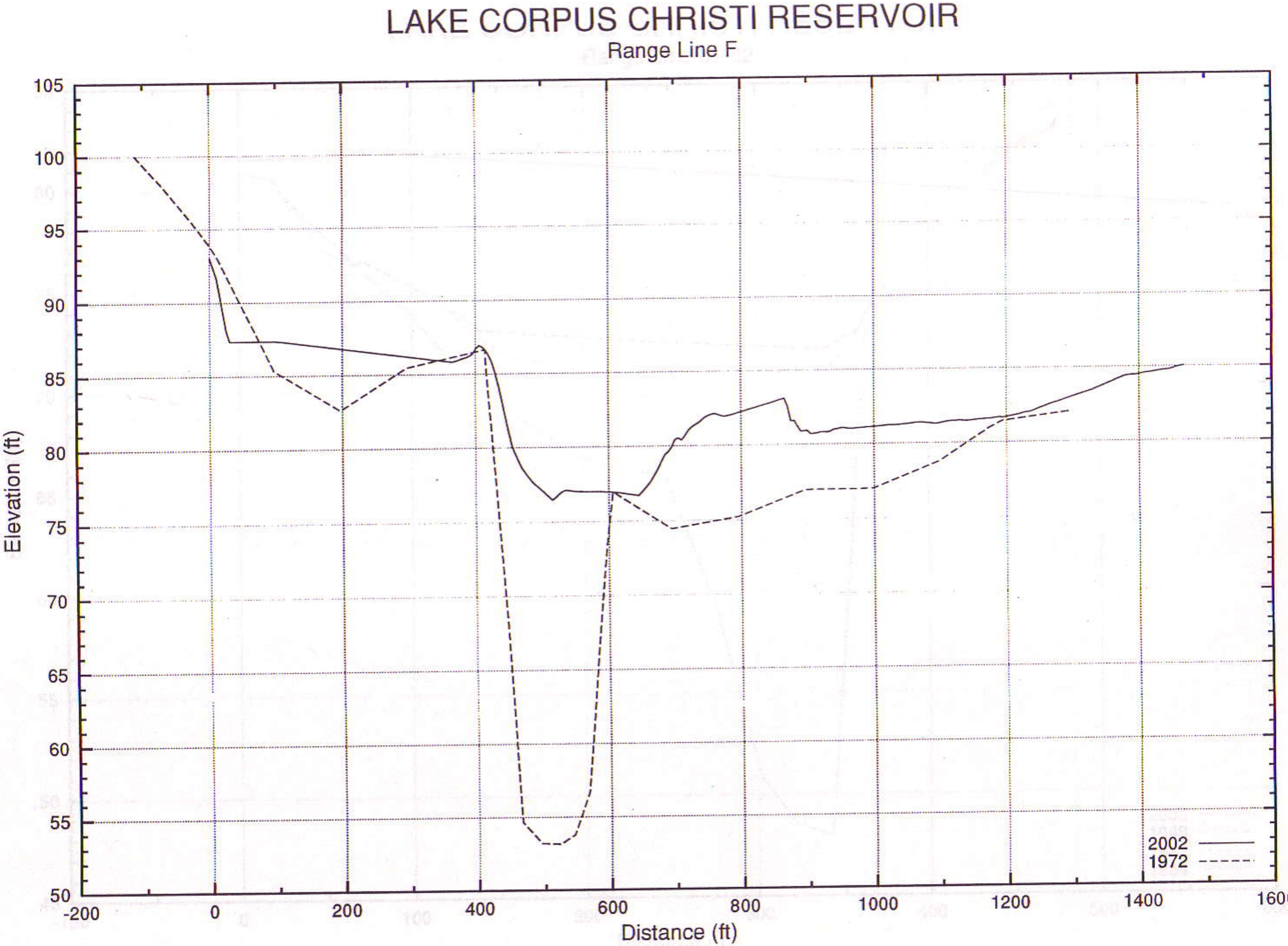

LAKE CORPUS CHRISTI RESERVOIR
Range Line C
Elevation (ft)
Distance (ft)
110
100
90
80
70
60
50
0
1000
2000
3000
4000
5000
6000
2002
1972

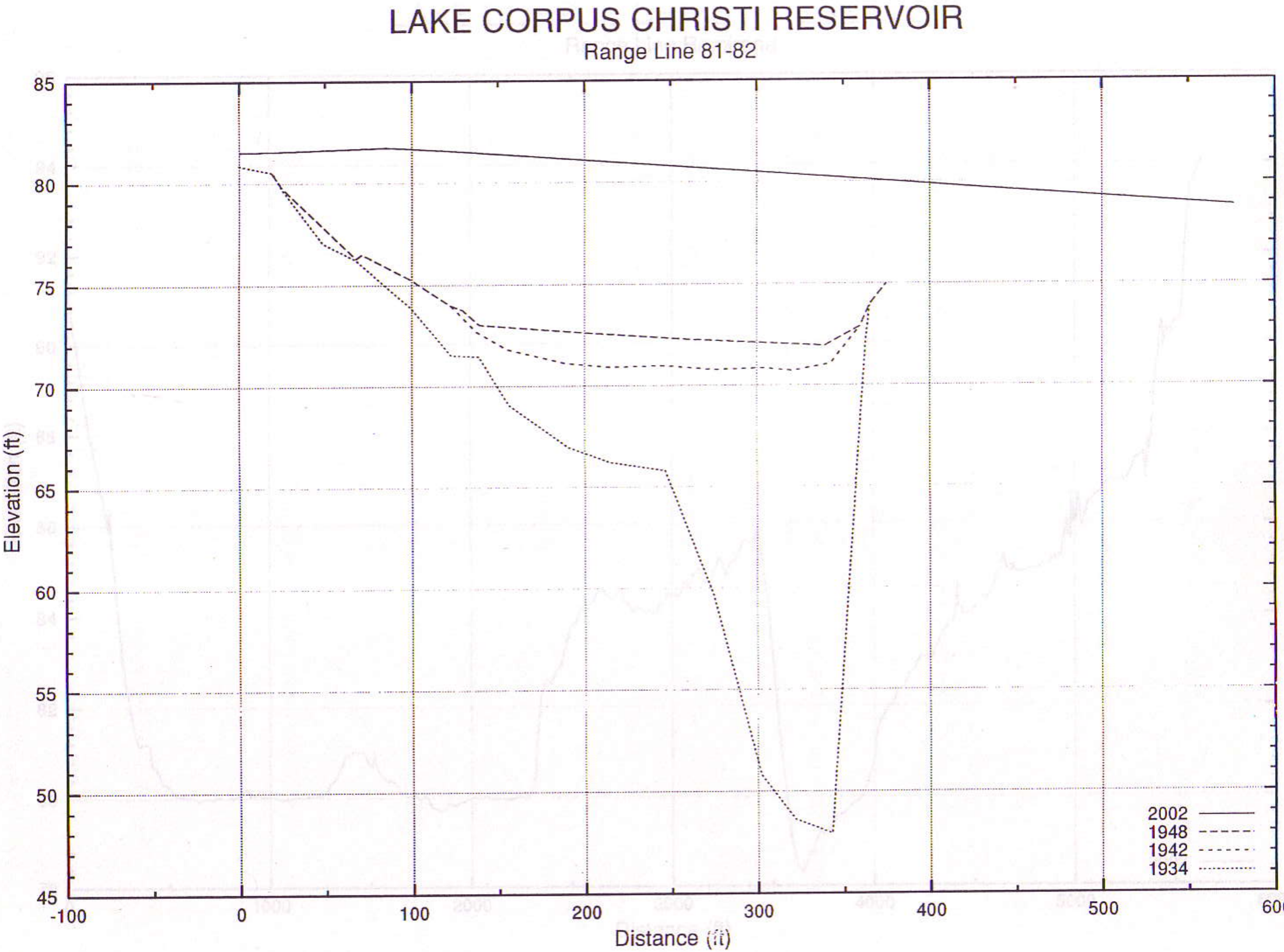

LAKE CORPUS CHRISTI RESERVOIR
Range Line D
Elevation (ft)
105
100
95
90
85
80
75
70
65
60
55
50
0
1000
2000
3000
4000
5000
6000
7000
Distance (ft)
2002
1972

LAKE CORPUS CHRISTI RESERVOIR

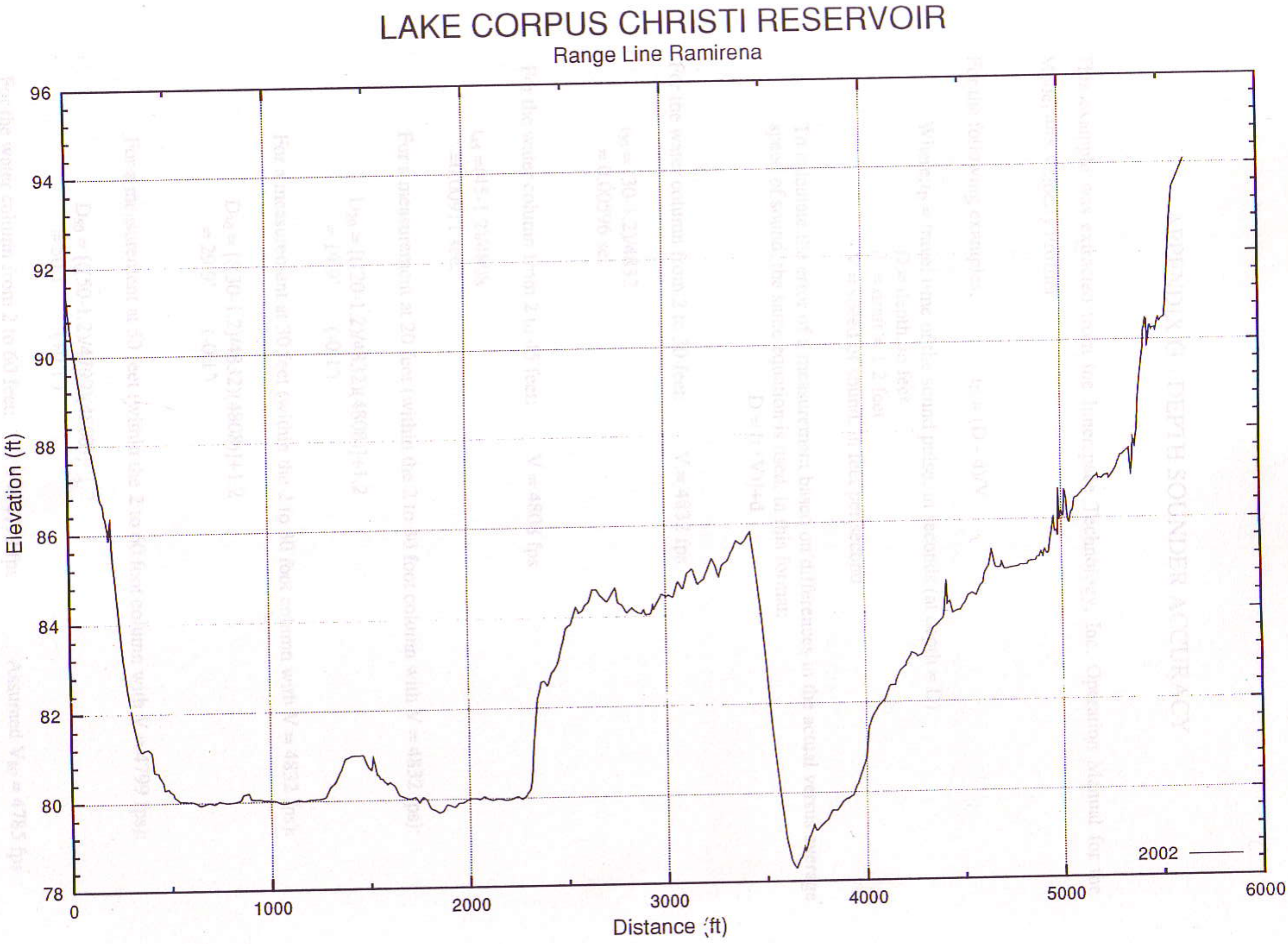
Range Line E




LAKE CORPUS CHRISTI RESERVOIR
Range Line F
Elevation (ft)
Distance (ft)
105
100
95
90
85
80
75
70
65
60
55
50
-200
0
200
400
600
800
1000
1200
1400
1600
2002
1972



LAKE CORPUS CHRISTI RESERVOIR
Range Line 81-82
Elevation (ft)
Distance (ft)
85
80
75
70
65
60
55
50
45
-100
0
100
200
300
400
500
600
2002
1948
1942
1934


LAKE CORPUS CHRISTI RESERVOIR
Range Line Ramirena
Elevation (ft)
96
94
92
90
88
86
84
82
80
78
0
1000
2000
3000
4000
5000
6000
Distance (ft)
2002

APPENDIX G - DEPTH SOUNDER ACCURACY

This example was extracted from the Innerspace Technology, Inc. Operation Manual for the Model 443 Velocity Profiler.

For the following examples, $t_D = (D - d)/V$

Where: t_D = travel time of the sound pulse, in seconds (at depth = D)
D = depth, in feet
d = draft = 1.2 feet
V = speed of sound, in feet per second

To calculate the error of a measurement based on differences in the actual versus average speed of sound, the same equation is used, in this format:

$$D = [t\ (V)]+d$$

For the water column from 2 to 30 feet: V = 4832 fps

$t_{30} = (30-1.2)/4832$
$= 0.00596$ sec.

For the water column from 2 to 45 feet: V = 4808 fps

$t_{45} = (45-1.2)/4808$
$= 0.00911$ sec.

For a measurement at 20 feet (within the 2 to 30 foot column with V = 4832 fps):

$D_{20} = [((20-1.2)/4832)(4808)]+1.2$
$= 19.9'$ (-0.1')

For a measurement at 30 feet (within the 2 to 30 foot column with V = 4832 fps):

$D_{30} = [((30-1.2)/4832)(4808)]+1.2$
$= 29.9'$ (-0.1')

For a measurement at 50 feet (within the 2 to 60 foot column with V = 4799 fps):

$D_{50} = [((50-1.2)/4799)(4808)]+1.2$
$= 50.1'$ (+0.1')

For the water column from 2 to 60 feet: V = 4799 fps Assumed V_{80} = 4785 fps

t_{60} =(60-1.2)/4799
=0.01225 sec.

For a measurement at 10 feet (within the 2 to 30 foot column with V = 4832 fps):

D_{10} = [((10-1.2)/4832)(4799)]+1.2
= 9.9' (-0.1')

For a measurement at 30 feet (within the 2 to 30 foot column with V = 4832 fps):

D_{30} = [((30-1.2)/4832)(4799)]+1.2
= 29.8' (-0.2')

For a measurement at 45 feet (within the 2 to 45 foot column with V = 4808 fps):

D_{45} = [((45-1.2)/4808)(4799)]+1.2
= 44.9' (-0.1')

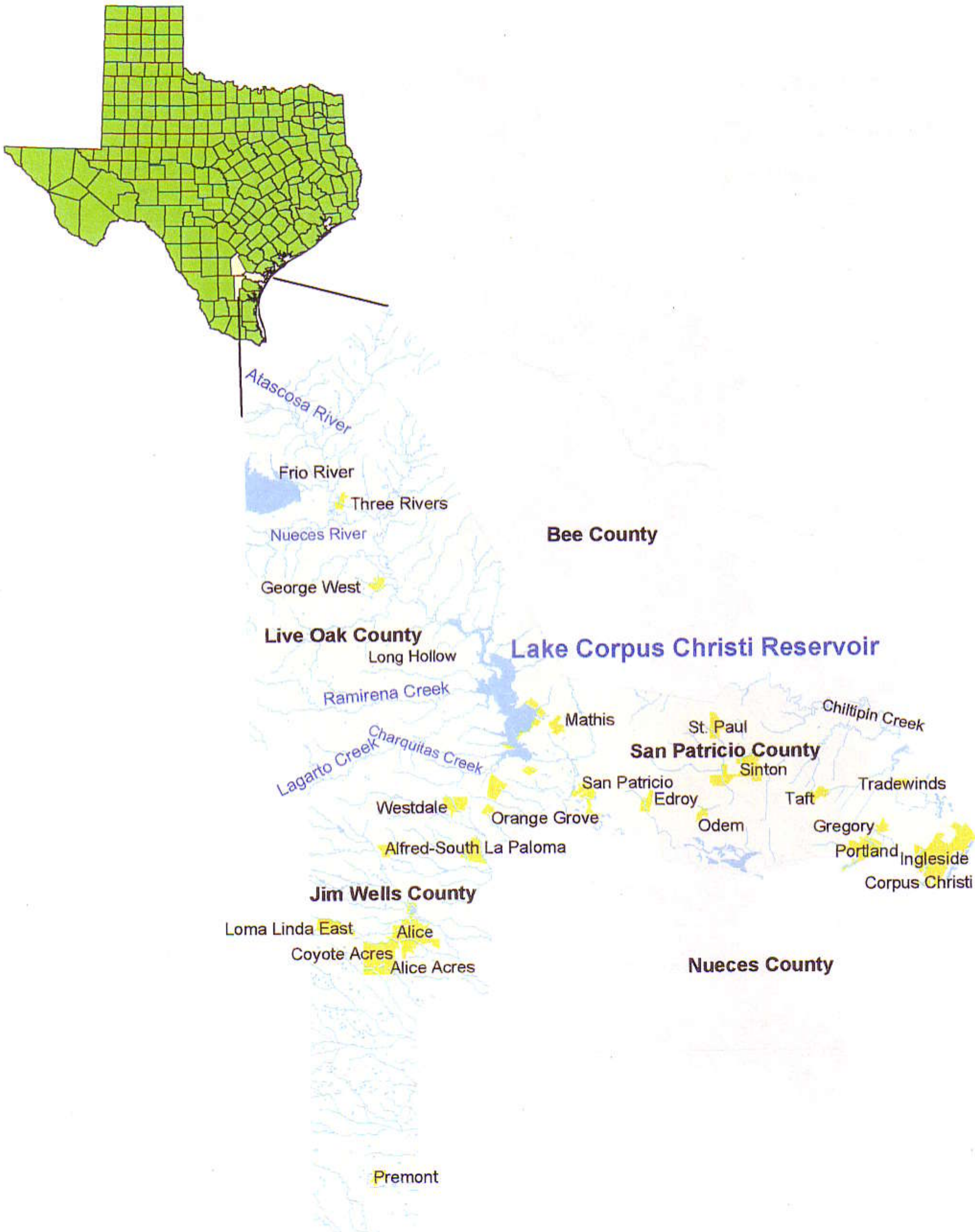
For a measurement at 80 feet (outside the 2 to 60 foot column, assumed V = 4785 fps):

D_{80} = [((80-1.2)/4785)(4799)]+1.2
= 80.2' (+0.2')

Figure 1

LAKE CORPUS CHRISTI RESERVOIR

Location Map

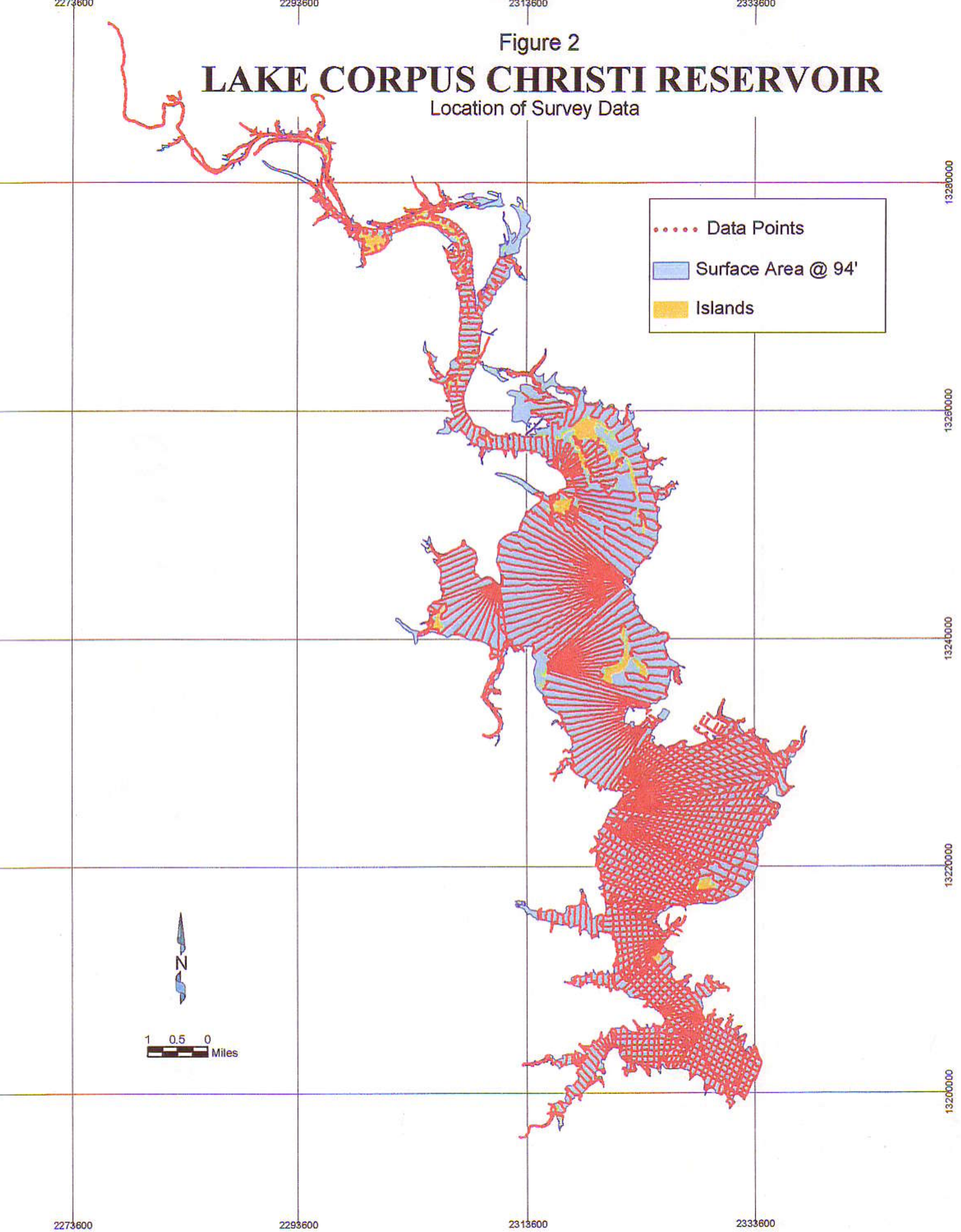


TWDB Survey January 2002

Figure 2

LAKE CORPUS CHRISTI RESERVOIR

Location of Survey Data

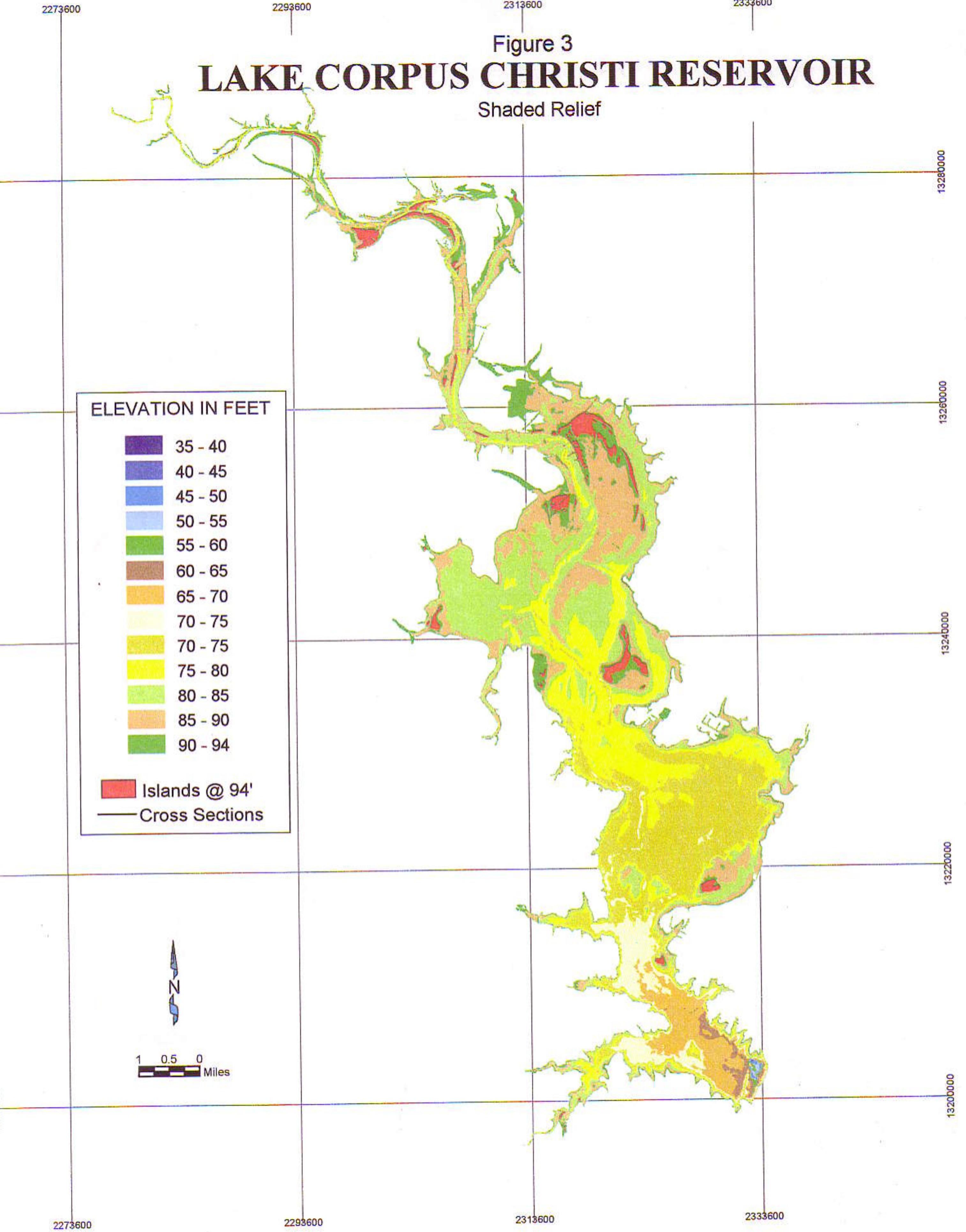


TWDB Survey January 2002

Figure 3

LAKE CORPUS CHRISTI RESERVOIR

Shaded Relief

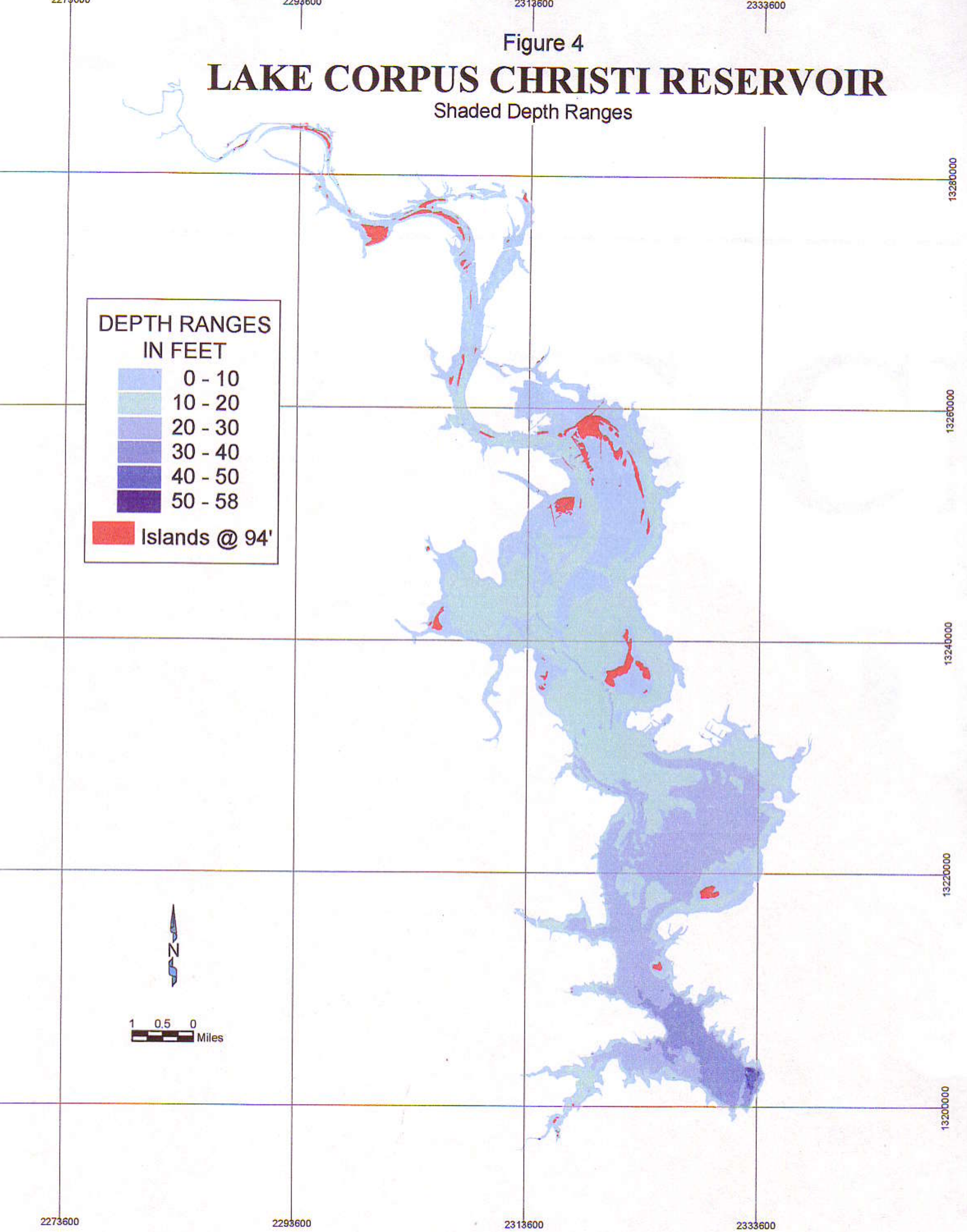


TWDB Survey January 2002

Figure 4

LAKE CORPUS CHRISTI RESERVOIR

Shaded Depth Ranges

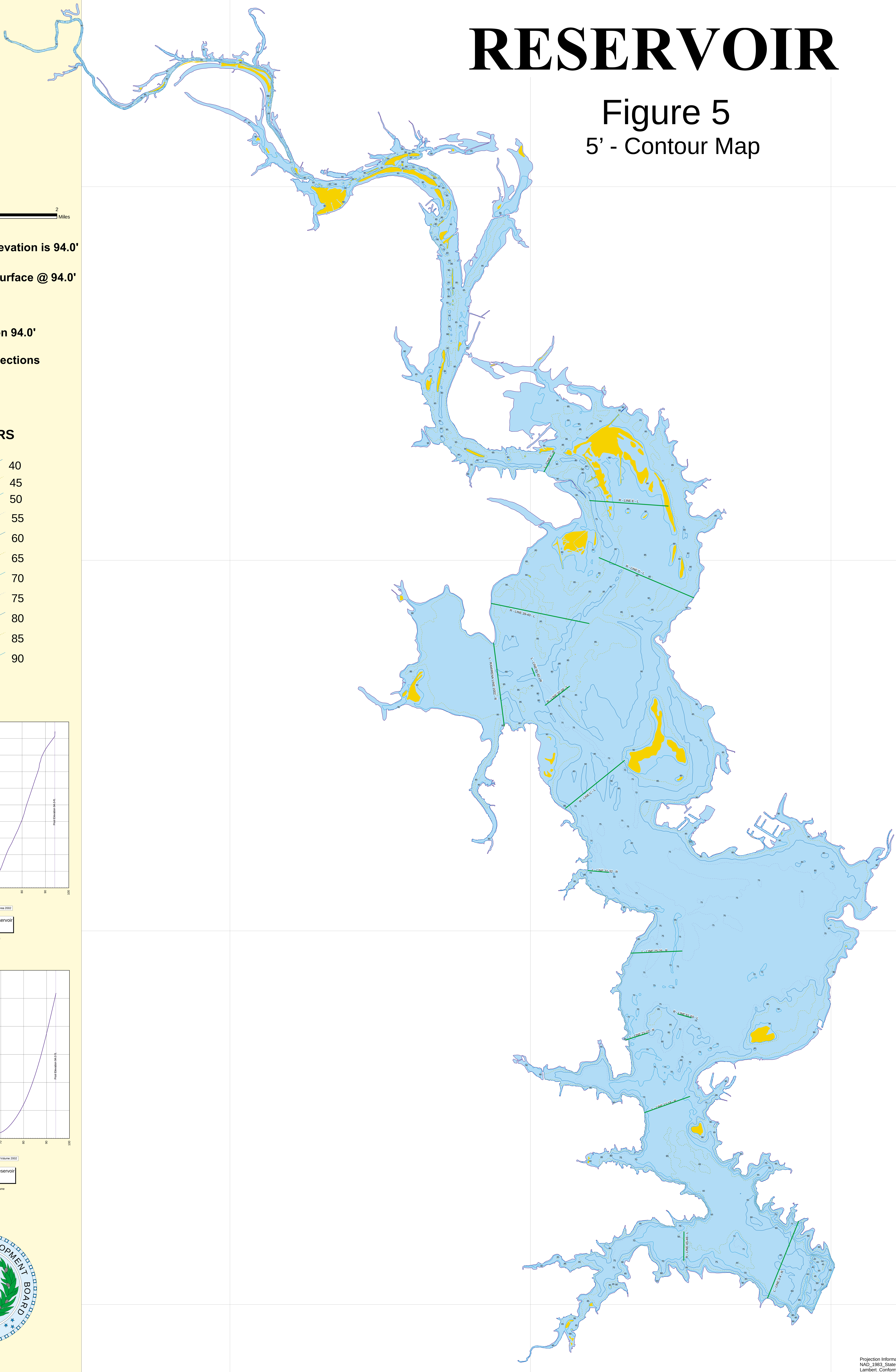


TWDB Survey January 2002

LAKE CORPUS CHRISTI RESERVOIR

Figure 5

5' - Contour Map



Conservation Pool Elevation is 94.0'

Water Surface @ 94.0'

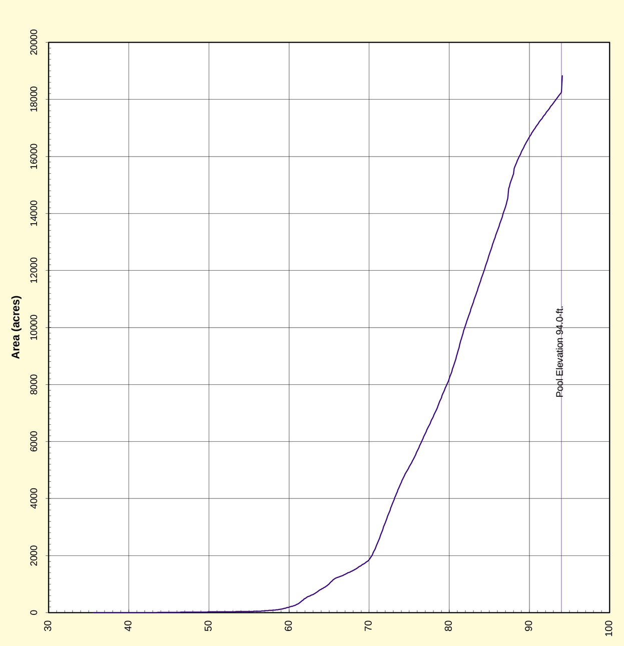
Islands

Elevation 94.0'

Cross Sections

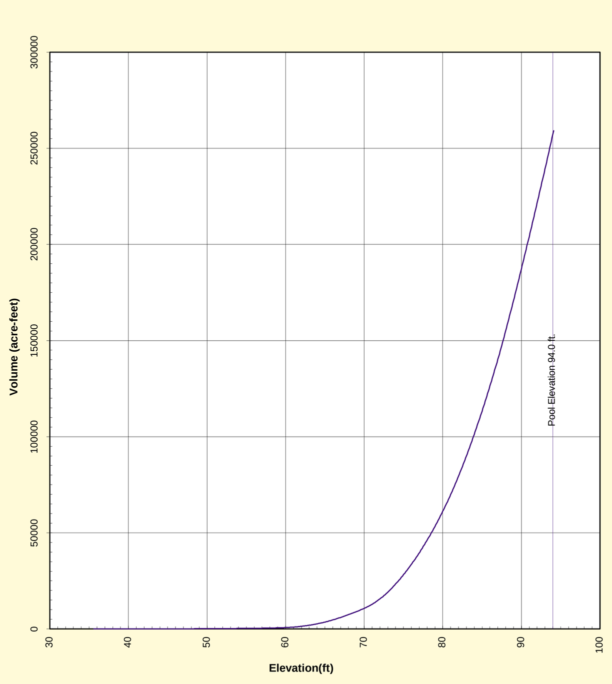
CONTOURS

40
45
50
55
60
65
70
75
80
85
90



Lake Corpus Christi Reservoir
January 2002
Prepared by: TWDB

Appendix D Elevation vs. Area



Lake Corpus Christi Reservoir
January 2002
Prepared by: TWDB

Appendix C Elevation vs. Volume

This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of Lake Corpus Christi Reservoir. The Texas Water Development Board makes

TEXAS WATER DEVELOPMENT BOARD JANUARY 2002 SURVEY

Projection Information:
NAD_1983_StatePlane_Texas_South_Central_FIPS_4204
Lambert_Conformal_Conic
False_Easting: 1968500.000000
False_Northing: 13123333.333333
Central_Meridian: -99.000000
Standard_Parallel_1: 28.383333
Standard_Parallel_2: 30.283333
Latitude_Of_Origin: 27.833333

GCS_North_American_1983