VOLUMETRIC SURVEY OF EAGLE MOUNTAIN LAKE

Prepared for:

Tarrant Regional Water District

In cooperation with the

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EAGLE MOUNTAIN LAKE
VOLUMETRIC SURVEY REPORT

INTRODUCTION

Staff of the Surface Water Section of the Texas Water Development Board (TWDB) conducted a volumetric survey of Eagle Mountain Lake between April 18 and April 26, 2000. The primary purpose of this survey was to determine the volume of the lake at the pool elevation during the time of the survey. The lake elevation varied between 643.19 feet and 643.43 feet during the survey, and was approximately 5.8 feet below the conservation pool elevation of 649.1 feet. Subsequent data was collected on May 16 and May 17, 2001 when the lake elevation was 649.05 feet and 649.06 feet respectively. This report supercedes the January 26, 2001 report of the same name in which comparison of results was made only to elevation 643.0 feet. Comparisons of results between the present survey and past surveys are made for elevation 649.1 feet later in this report. Results from this survey will serve as a basis for comparison to future surveys to allow the location and rates of sediment deposition to 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 Eagle Mountain Lake (08045000 EAGLE MOUNTAIN RESERVOIR ABOVE FORT WORTH, TX). The datum for this gage is reported as mean sea level (msl) (USGS, 1999). Thus, elevations are reported here, according to the same datum, in feet above mean sea level (msl). Volume and area calculations in this report are referenced to water levels provided by the USGS gage.

Prior surveys of Eagle Mountain Lake were conducted in 1968, by the U.S. Army Corps of Engineers, and in 1988, by Freese and Nichols. The volume at conservation storage elevation (649.1 feet) was found to be 190,460 acre-feet in 1968 (TWDB, 1973), and 178,440 feet in

1988 (Freese and Nichols, 1988). The corresponding surface areas at that elevation were found to be 9,200 acres in 1968, and 9,030 acres in 1988.

LAKE HISTORY AND GENERAL INFORMATION

Historical information on Eagle Mountain Lake was obtained from TWDB (1966), TWDB (1973), and a sedimentation survey report prepared for the Tarrant County Water Control and Improvement District No. 1 by Freese and Nichols (1988). The Tarrant Regional Water District (TRWD) owns the water rights to Eagle Mountain Lake. TRWD also owns, operates and maintains associated Eagle Mountain Dam. The lake is located on the West Fork Trinity River (Trinity River Basin) in Tarrant County, 14 miles northwest of Fort Worth, Texas (Figure 1). Records indicate the drainage area is approximately 1,970 square miles. At conservation pool elevation (649.1) feet the lake has approximately 83 miles of shoreline and is 11 miles long. The widest point of the lake is approximately 3.25 miles and is located about 0.5 miles upstream of the dam.

One of the main functions of Eagle Mountain Lake is to regulate floodwaters on the West Fork Trinity River in coordination with the operations of Lake Bridgeport, which is located upstream of Eagle Mountain Lake. The Board of Water Engineers issued Water Rights Permit No. 1074 (Application No. 1145) to the Tarrant County Water Control and Improvement District No. 1 on May 1, 1928. The permit authorized the District to construct a dam across the West Fork Trinity River in Tarrant County and to impound 210,000 acre-feet of water. Annual diversions of 162,000 acre-feet of water for municipal, industrial and irrigation were granted. Permit No. 1254 was granted to the District on February 28, 1938 as an amendment to Permit No. 1074. The permit basically included “recreational and pleasure” use of the water in Eagle Mountain Lake. Permit No. 1074 was again amended on September 30, 1953 in Permit No. 1682. There were no changes in the amount of impoundment or diversion, but the amendment described in more detail the municipal and irrigation uses of the diverted water within the boundaries of the District. The Texas Water Commission issued a special minute order dated October 9, 1962 that approved the application for amendment to the original construction plans in Permit No. 1074. The plans included the construction of an emergency spillway. In order to improve the discharge characteristics and increase the discharge capacity, the construction would consist of excavation and fill to widen and realign the original country spillway. The modifications to the emergency spillway added a six-foot-high fuse plug that would increase the floodwater retarding capabilities of the facility without jeopardizing the integrity of the dam. This design would increase the surcharge storage by 106,640 acre-feet. Permit No. 1074A, dated September 20, 1965, reduced the original 93,000 acre-feet of water releases from Lake Bridgeport to 90,000 acre-feet of water. The 162,000 acre-feet of water originally authorized to be impounded in Eagle Mountain Lake were also reduced to 159,600 acre-feet of water. Authorization was granted in the amended Permit No. 1073B (Lake Bridgeport) to reduce the releases from Lake Bridgeport to Eagle Mountain Lake to 86,000 acre-feet of water annually. The Texas Water Commission on April 5, 1985 issued Certificate of Adjudication No. 08-3809 to the Tarrant County Water Control and Improvement District No. 1. The certificate granted the District the right to impound not to exceed 210,000 acre-feet of water in a reservoir known as Eagle Mountain Lake. The owner was authorized to divert, not to exceed 159,600 acre-feet of water per annum for subsequent downstream diversion from the West Fork Trinity River for municipal and industrial purposes. Diversion could also be used for irrigation of land within the boundaries of the District. On May 15, 1985 an amendment was issued for Certificate of Adjudication No. 08-3809(A). Permission was granted to use 1,105 acre-feet of water, previously designated for municipal use, for mining purposes.

Construction for Eagle Mountain Lake and Dam started on January 23, 1930. The dam was completed October 24, 1932 and impoundment began on February 28, 1934. The design engineer for the project was Hawley, Freese and Nichols. The general contractor was McKenzie and Uvalde Construction Companies. The estimated cost of the dam was $3,637,000. A second spillway was added in 1971. The project engineer was Freese, Nichols and Endress and the general contractor was Guy H. James Construction Co. The new spillway was completed on July 31,1971 at an estimated cost of $2,565,679.

Engineering designs (TWDB, 1974) show that the original Eagle Mountain Dam consisted of two earthfill embankments. Eagle Mountain, both the original and new concrete spillways, and the Burgess Gap emergency spillway lie between the main dam and spillway. The main dam is approximately 4,800 feet in length with a maximum height of 85 feet above the natural streambed. The dam has a 25-foot-wide crest at elevation of 682.0 feet. The spillway dam is located to the west of the main dam and Eagle Mountain. Located within the levee are the original and new spillways. The original spillway is a concrete structure consisting of an ogee crest that is divided into four 25-foot wide bays. Three of the four bays are equipped with vertical lift gates while the fourth bay is left uncontrolled. The crest elevation is 649.1 feet. The new spillway (1971) is located 300 feet to the east of the original spillway. The new side-channel structure consists of a concrete ogee crest and forebay that discharges through a 25-foot-square conduit. The ogee crest has an elevation of 637.0 and is controlled by six roller gates, each 11.25 feet by 22.0 feet. The emergency spillway is located at Burgess Gap between the main dam and spillway dam. The emergency spillway was modified in 1965. The natural cut channel is 1,300 feet in length with a crest elevation of 670.0 feet. A fuse plug was added as part of the modifications and is six feet tall with a crest elevation of 676.0 feet.

The outlet works consist of four 48-inch outlet gates and are operated from a control house located on the upstream face (east end) of the main dam. The invert elevation for all four gates is 599.9 feet. Flows are discharged downstream of the main dam through a conduit that extends through the embankment.

SURVEYING TECHNOLOGY

The equipment used to perform the volumetric survey consists 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. 4000SE GPS receiver, an OmniSTAR receiver, 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 (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. 4000SE GPS receiver, an OmniSTAR receiver, 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 lake surface, the depth sounder takes approximately ten readings of the lake bottom each second. The depth readings are stored on the survey vessel's on-board computer along with the corrected positional data generated by the boat's GPS receiver. The daily data files collected are downloaded from the computer 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 get one data point per second, and average depths are converted to elevation readings based on the lake 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 map boundary was created from the Avondale and Azle, Texas DOQs. The lake elevations at the time the DOQs were photographed were 649.11 feet (January 31, 1995) and 649.03 feet (January 19, 1995). In addition, a portion of the lake's upstream boundary was digitized at elevation 649 feet with AutoCad software from USGS 7.5-minute quadrangle map for BOYD, TEX. (1960) (photo-revised 1968, photo-inspected 1973).

The DOQ graphic boundary file was transformed from UTM Zone 14 datum to NAD '83, using Environmental Systems Research Institute’s (ESRI) Arc/Info PROJECT command with the NADCOM (standard conversion method within the United States) parameters. Similarly, the portion of the boundary digitized from the USGS 7.5-minute quadrangle map was transformed from NAD '27 to NAD '83.

The survey layout was designed by placing survey track lines at 500-foot intervals within the digitized lake boundary using HYPACK software. The survey design required the use of approximately 257 survey lines along the length of the lake.

SURVEY PROCEDURES

Equipment Calibration and Operation

At the beginning of each day of the survey, the depth sounder was calibrated with the Innerspace 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 moisten and acclimate the probe. The probe was next raised to the water surface where the depth was zeroed. The probe was then gradually lowered on a cable to a depth just above the lake bottom, and then raised 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.

On the 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.

While surveying Eagle Mountain Lake, the speed of sound in the water column ranged from 4833 feet per second to 4850 feet per second. 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 feet. An additional estimated error of $\pm$0.3 feet arises from variation in boat inclination. These two factors combine to give an overall accuracy of $\pm$0.5 feet for any instantaneous reading. These errors tend to be minimized over the entire survey, since some readings are positive and some are negative. Further information on these calculations is presented in Appendix E.

During the survey, the horizontal mask setting on the on-board GPS receiver was set to 10°, and the PDOP (Position Dilution of Precision) limit was set to 7 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. The lake's initialization file used by the Hypack data collection program was set up to convert the collected DGPS positions to state-plane coordinates on the fly.

Field Survey

Originally, TWDB staff collected data at Eagle Mountain Lake for eight days between April 18 and April 26, 2000. According to the USGS gauging station, the lake level elevations ranged between 643.19 and 643.43 feet during that period, or approximately 5.8 feet below conservation pool elevation of 649.1. TWDB staff then returned to Eagle Mountain Lake for two days on May 16 and 17, 2001 when the lake elevations were 649.05 and 649.06 respectively. Weather during most of the data collection period consisted of sunny days, warm temperatures, and 10 to 20 mile-per-hour winds.

The survey crew was able to collect data on 200 of the 257 pre-plotted survey transects in the lake during the April 2000 survey dates. An additional 22 pre-plotted were collected during the May 2001 survey dates. Random data was collected along the shoreline and in those areas that were too restricted to drive the pre-plotted lines. Approximately 104,827 data points were collected over the 199 miles traveled. These points, shown in Figure 2, were stored digitally on the boat's computer in 290 data files.

The West Fork Trinity River meanders in a north to south direction and empties into the main body of Eagle Mountain Lake at the north end of the basin. The Dosier, Indian and Derrett Creeks empty into the lake from the east. Tributaries that join Eagle Mountain Lake from the west are the

Ash, Walnut, Swift and Briar Creeks. The east shoreline has more relief, with steep slopes cliffs and valleys, than the west bank, which has generally flat to rolling hills.

More residential and commercial development (marinas) was observed in the lower part of the main basin than in the upper end, where acreage properties and undeveloped land was found.

An analog strip-chart recording collected during the survey showed the bathymetry of the lake bottom to be fairly regular (no major drops or rises) in the main basin of the lake. Data was collected around the perimeter of Pelican Island to be used later to adjust the lake boundary. TXU Electric has an electric power generating plant located on the east bank of the lake near Pelican Island. The survey crew collected extra data around the intake structure and discharge channel for the power plant and around other intake structures. The bathymetry of the lake bottom was similar to the topography surrounding the lake. A defined channel (thalweg) for the West Fork Trinity River was evident on the analog chart as the crew traveled in a perpendicular (east and west) direction in the main basin of the lake.

The field crew encountered navigational hazards, in the form of submerged stumps and shallow depths outside the old river channel, in the upper reaches of Eagle Mountain Lake in the West Fork Trinity River. Data was collected in this area at a much slower rate using the shallow draft boat. Data collection was halted in the upper reaches of the lake that were less than one foot deep.

The collected data were stored in individual data files for each pre-plotted range line or random data collection event. These files were downloaded to diskettes at the end of each day for subsequent processing.

Data Processing

The collected data were downloaded from diskettes onto TWDB's computer network. 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 file. A correction to account for the lake’s elevation when the data were collected was also applied to each file during the EDIT routine. During the April 2000 survey dates, the water surface fluctuated between elevation 643.19 and 643.43 feet. During the May 2001 survey dates, the water surface fluctuated between elevation 649.05 and 649.06 feet. These elevations were provided by USGS gage 08045000 EAGLE MOUNTAIN RESERVOIR ABOVE FORTH WORTH, TX. After all corrections were applied to the raw data file, the edited file was saved with a different extension. The edited files were combined into a single (x,y,z) data file, to be used with the GIS software to develop a model of the lake's bottom surface.

The resulting data file was downloaded to a Sun Ultra 20 workstation running the UNIX operating system. Environmental System Research Institute’s (ESRI) Arc/Info GIS 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 lake'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 actual 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 lake area and volume can be determined from the triangulated irregular network for water elevations of interest using this method of interpolation.

Volumes presented in Appendix A were calculated from the TIN using Arc/Info software. Surface areas presented in Appendix B were computed using Arc/Info software below elevation 649.1 feet.

Other products developed from the model include a shaded elevation range 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 elevation contour map of the bottom surface at two-foot intervals is presented in Figure 5. Cross sections for the range lines shown on Figures 3, 4, and 5 are presented Appendix G.

RESULTS

Results from the 2000 TWDB survey indicate that Eagle Mountain Lake encompasses 8702 surface acres and contains a total volume of 182,505 acre-feet at pool elevation 649.1 feet. Dead pool storage, the volume below the invert elevation of the low-flow outlet pipe at 599.9 feet, is 5 acre-feet. Thus, the conservation storage at elevation 649.1 (total volume - dead storage) for Eagle Mountain Lake is 182,500 acre-feet. The shoreline at pool elevation 649.1 feet was calculated to be approximately 83.5 miles. The deepest point of the lake measured during the surveys was at elevation 598.2 feet and corresponds to a depth of 50.9 feet relative to conservation pool elevation 649.1 feet. That depth was located approximately 1,200 feet upstream from the center of Eagle Mountain Dam.

SUMMARY AND COMPARISONS

Eagle Mountain Lake was initially impounded in 1934. Storage calculations in 1988 (Freese and Nichols, 1988) reported the volume at pool elevation 649.1 feet to be 178,440 acre-feet with a surface area of 9,030 acres.

TWDB staff performed a volumetric survey of Eagle Mountain Lake between April 18 and April 26, 2000. Subsequent data were collected on May 16 and May 17, 2001 when the lake elevation had risen to near conservation pool elevation. The 2000-2001 survey utilized differential global positioning system, depth sounder and geographical information system technology to create a digital model of the lake's bathymetry. Results indicate that the lake's volume at the pool elevation of 649.1 feet is 182,505 acre-feet, with a corresponding area of 8,702 acres.

Comparisons between the 1968, 1988 and present (2000-2001) surveys are described in Table

1 for elevation 649.1 feet msl. Decreases in volume and area were found between 1968 and 1988, while volume increased and area decreased between 1988 and 2000. The increase in volume between 1988 and 2000 is probably due to differences in technology used during the surveys. Between 1968 and 2000, the area decreased by 498 acres (-5.7%), and the volume decreased by 7,955 (-4.2 %) acre-feet. Comparing between the 1988 and 2000 results, the area decreased by 328 acres (-3.6%), and the volume increased by 4,065 acre-feet (+2.3 %). The difference in volume between 1968 and 2000 (volume measured in 2000 minus volume measured in 1968) is presented in Appendix E at elevations between 599 feet and 649 feet msl. A similar plot for difference in area (area measured in 2000 minus area measured in 1968) is presented in Appendix F. The loss in area shown in Appendix F between elevations 599 feet and approximately 616 feet msl and again between elevations of approximately 623 feet and 649 feet suggests that sedimentation occurs primarily between these elevations. The increase in area between elevations of approximately 616 feet and 623 feet msl suggests that some erosion takes place at those elevations. Again, comparison between the data sets is difficult and some changes might simply be due to methodological differences.

It is recommended that the same methodology be used in five to ten years or after major flood events to monitor changes to the lake's storage volume, and that a survey be conducted when the lake again reaches conservation pool elevation to allow calculation of volumes and areas up to conservation pool elevation.

Table 1. Area and volume comparisons at elevation 649.1 feet msl.

Year	1968	1988	2000
Area (acres)	9,200	9,030	8,702
Volume (acre-feet)	190,460	178,440	182,505

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Information. Report 48.

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Appendix A

Eagle Mountain Lake
RESERVOIR VOLUME TABLE

TEXAS WATER DEVELOPMENT BOARD — MAY 2001 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
598			0	0	0	0	0	0	1	1
599	1	1	2	2	2	3	3	4	5	5
600	6	7	8	9	10	11	12	13	14	15
601	17	18	19	21	22	24	25	27	29	31
602	32	34	37	39	41	43	46	48	51	53
603	56	59	62	65	68	71	75	78	82	86
604	90	94	99	105	111	117	124	132	140	149
605	159	170	184	200	218	240	263	290	318	349
606	382	416	452	489	528	568	610	653	698	744
607	791	840	890	942	996	1050	1105	1162	1220	1279
608	1339	1400	1462	1526	1591	1657	1724	1793	1862	1932
609	2004	2076	2150	2225	2302	2380	2460	2541	2624	2709
610	2796	2884	2975	3068	3163	3261	3360	3462	3565	3671
611	3778	3888	3999	4113	4230	4350	4474	4601	4730	4862
612	4997	5134	5274	5417	5562	5709	5859	6011	6164	6320
613	6478	6637	6799	6962	7127	7295	7464	7636	7811	7988
614	8167	8349	8533	8719	8908	9099	9293	9489	9687	9887
615	10090	10294	10500	10708	10917	11128	11341	11556	11772	11991
616	12212	12434	12659	12885	13112	13341	13572	13804	14037	14271
617	14507	14745	14983	15223	15465	15707	15951	16197	16443	16691
618	16940	17190	17441	17694	17948	18203	18459	18716	18975	19235
619	19497	19760	20025	20291	20559	20828	21099	21372	21646	21922
620	22200	22479	22761	23045	23331	23619	23908	24200	24493	24788
621	25084	25381	25680	25980	26281	26584	26888	27194	27501	27809
622	28119	28430	28743	29057	29372	29688	30006	30325	30645	30966
623	31288	31612	31937	32263	32591	32920	33250	33582	33915	34250
624	34587	34925	35265	35607	35950	36294	36640	36988	37337	37687
625	38039	38392	38747	39103	39461	39821	40182	40544	40909	41276
626	41644	42015	42387	42761	43138	43515	43895	44276	44659	45044
627	45430	45818	46208	46600	46994	47391	47790	48191	48594	49000
628	49408	49818	50231	50646	51064	51484	51906	52331	52757	53186
629	53617	54050	54484	54920	55358	55797	56237	56679	57122	57567
630	58013	58461	58911	59362	59815	60270	60726	61184	61643	62105
631	62568	63033	63500	63968	64440	64913	65388	65866	66346	66829
632	67314	67800	68289	68780	69273	69767	70264	70763	71264	71767
633	72272	72779	73290	73802	74318	74836	75357	75881	76408	76938
634	77471	78006	78544	79083	79626	80170	80717	81266	81817	82371
635	82925	83482	84040	84600	85162	85726	86291	86858	87426	87997
636	88568	89141	89716	90293	90871	91451	92032	92616	93201	93788
637	94377	94967	95560	96154	96750	97348	97948	98551	99157	99765
638	100376	100988	101603	102220	102839	103460	104082	104708	105335	105965
639	106597	107231	107867	108506	109147	109790	110435	111083	111733	112387
640	113044	113706	114371	115039	115710	116384	117060	117738	118419	119103
641	119790	120480	121174	121871	122570	123272	123975	124681	125388	126098
642	126808	127521	128236	128952	129670	130390	131112	131836	132562	133291
643	134021	134753	135487	136223	136961	137701	138443	139187	139933	140682
644	141432	142184	142939	143696	144455	145216	145979	146745	147514	148285
645	149058	149834	150612	151392	152175	152959	153746	154535	155326	156120
646	156916	157714	158515	159318	160124	160931	161741	162553	163366	164182
647	164999	165818	166639	167461	168285	169110	169937	170765	171594	172426
648	173258	174091	174927	175763	176601	177441	178281	179123	179967	180812
649	181657	182505								

Appendix B

Eagle Mountain Lake
RESERVOIR AREA TABLE

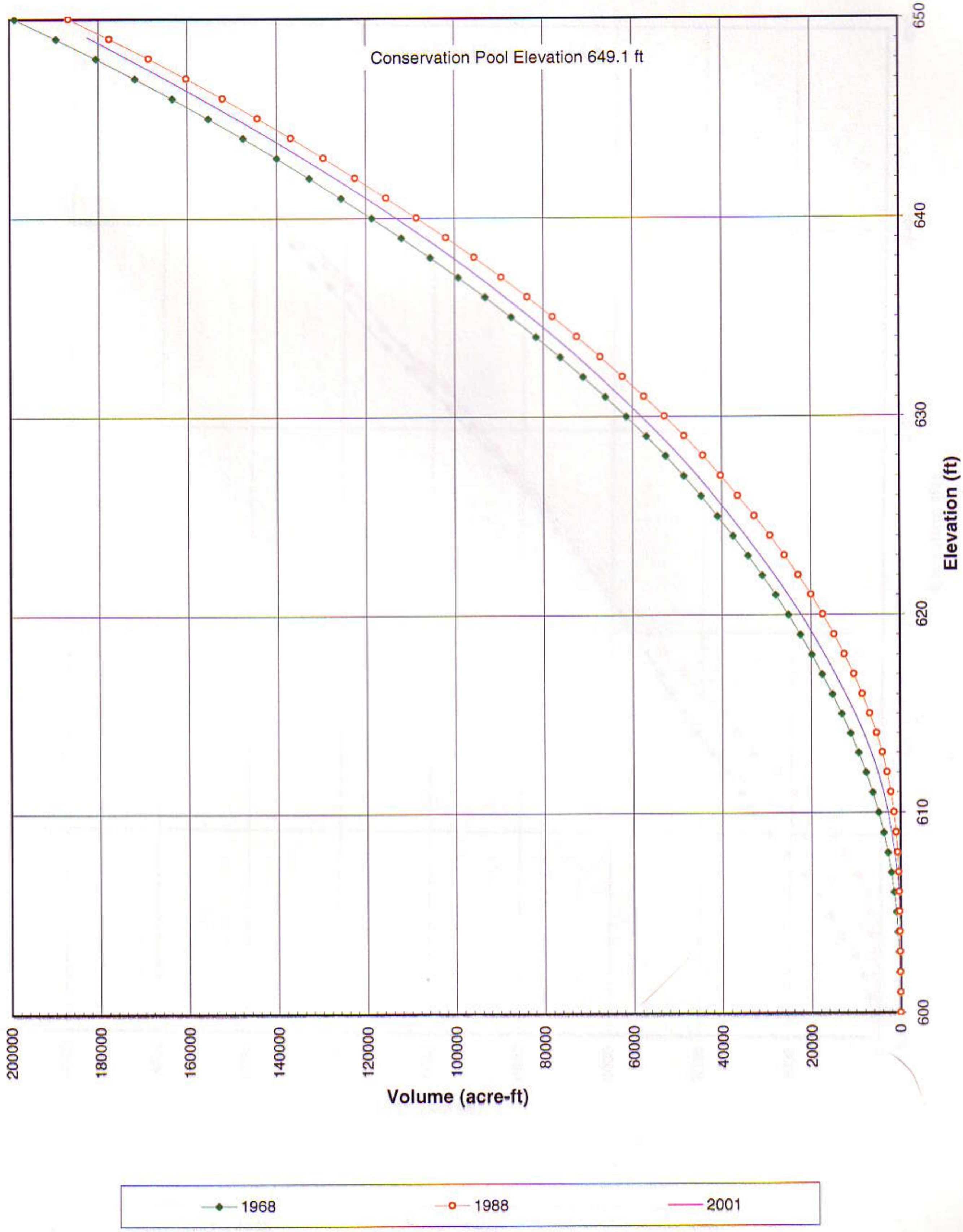
TEXAS WATER DEVELOPMENT BOARD

MAY 2001 SURVEY

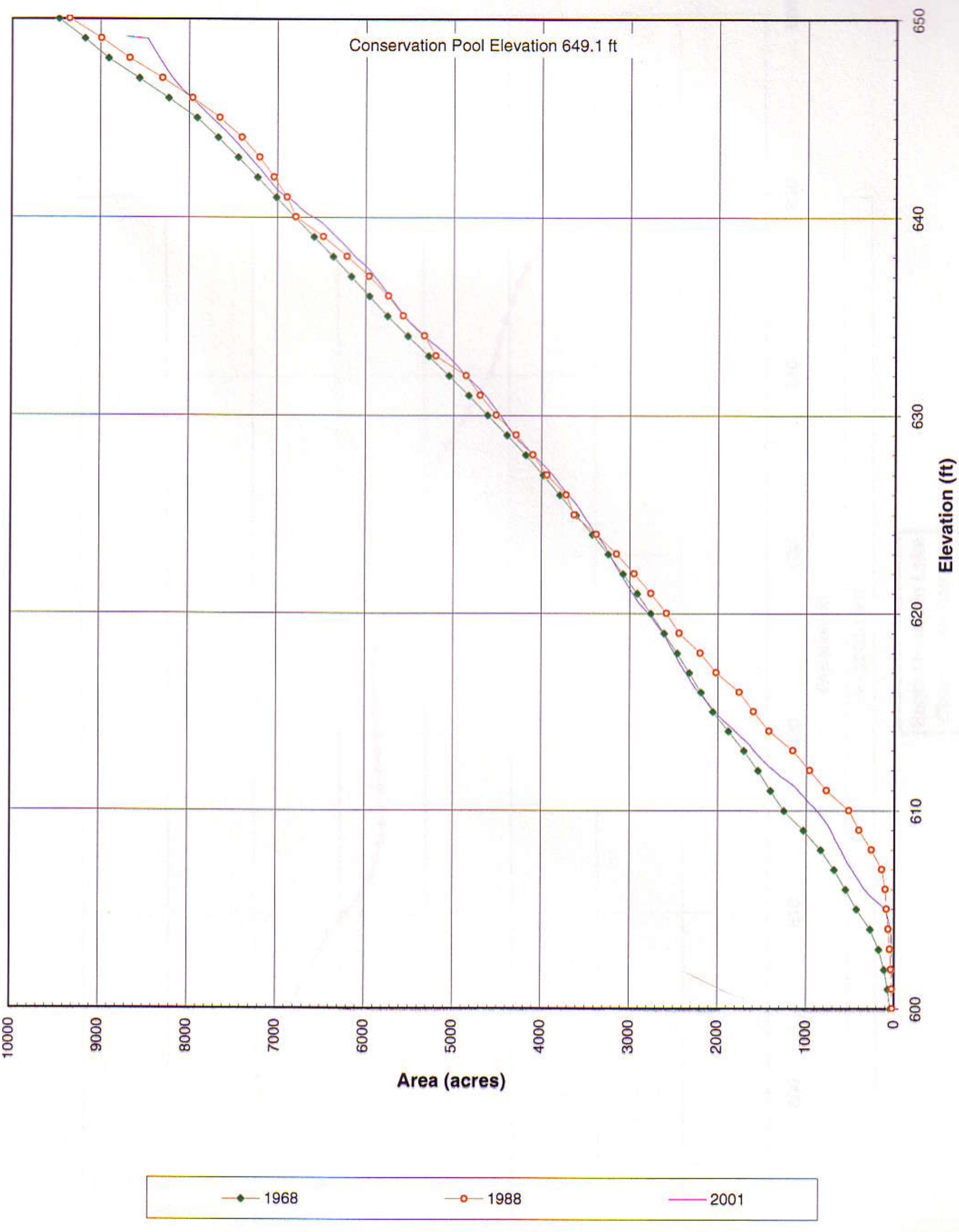
AREA IN ACRES

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
598			0	0	1	1	1	2	2	2
599	2	3	3	4	5	6	6	7	7	7
600	8	8	9	9	10	10	11	11	12	12
601	13	13	14	15	15	16	16	17	18	19
602	19	20	21	22	23	23	24	25	26	27
603	28	29	30	31	32	33	35	36	38	40
604	43	47	51	56	61	67	74	80	86	94
605	105	124	147	172	199	226	251	275	297	316
606	335	351	366	380	394	409	426	439	454	468
607	481	496	511	526	538	550	561	571	582	594
608	606	619	631	643	655	667	678	689	699	709
609	720	731	745	758	773	789	807	822	839	858
610	876	895	918	942	965	985	1004	1023	1046	1067
611	1086	1104	1125	1152	1186	1218	1252	1283	1310	1335
612	1359	1386	1414	1439	1462	1484	1506	1528	1548	1568
613	1586	1605	1624	1642	1661	1684	1709	1735	1759	1782
614	1805	1826	1851	1874	1900	1925	1948	1971	1994	2013
615	2033	2051	2069	2086	2103	2120	2138	2156	2177	2197
616	2216	2233	2251	2269	2284	2298	2311	2325	2339	2353
617	2366	2380	2394	2407	2421	2434	2446	2458	2470	2483
618	2495	2507	2520	2532	2544	2557	2569	2581	2595	2609
619	2623	2638	2654	2671	2687	2703	2719	2734	2750	2767
620	2786	2806	2828	2849	2870	2890	2907	2923	2939	2954
621	2967	2980	2993	3007	3021	3035	3049	3063	3076	3091
622	3105	3119	3132	3145	3158	3170	3182	3194	3207	3219
623	3232	3244	3257	3269	3282	3295	3310	3325	3341	3358
624	3376	3393	3409	3423	3438	3452	3467	3482	3497	3512
625	3526	3541	3555	3570	3586	3602	3619	3636	3656	3676
626	3696	3715	3734	3751	3769	3787	3804	3820	3838	3855
627	3872	3891	3910	3931	3954	3977	3998	4022	4046	4069
628	4092	4115	4139	4163	4189	4212	4235	4258	4278	4298
629	4317	4336	4352	4368	4383	4397	4412	4426	4441	4456
630	4471	4487	4504	4520	4538	4554	4571	4588	4605	4622
631	4639	4658	4678	4699	4721	4743	4766	4790	4815	4838
632	4859	4878	4898	4917	4936	4956	4977	4999	5020	5042
633	5063	5088	5114	5141	5170	5198	5225	5253	5284	5313
634	5341	5365	5388	5411	5434	5457	5480	5501	5521	5540
635	5558	5575	5592	5609	5627	5644	5661	5677	5693	5708
636	5724	5740	5756	5773	5790	5807	5824	5843	5861	5880
637	5897	5915	5933	5951	5970	5991	6015	6042	6070	6096
638	6117	6138	6158	6178	6198	6218	6239	6261	6286	6309
639	6331	6354	6376	6398	6420	6442	6465	6490	6518	6552
640	6594	6634	6668	6697	6723	6748	6771	6795	6822	6853
641	6887	6922	6954	6982	7005	7026	7046	7065	7083	7101
642	7118	7136	7155	7173	7191	7210	7231	7251	7272	7291
643	7311	7330	7351	7371	7391	7411	7431	7451	7472	7493
644	7513	7535	7556	7577	7600	7623	7647	7674	7699	7722
645	7744	7768	7791	7814	7836	7858	7879	7902	7924	7947
646	7971	7995	8019	8043	8066	8088	8108	8127	8146	8164
647	8183	8199	8215	8230	8244	8259	8274	8288	8302	8317
648	8331	8345	8359	8373	8387	8400	8414	8427	8440	8454
649	8467	8702								

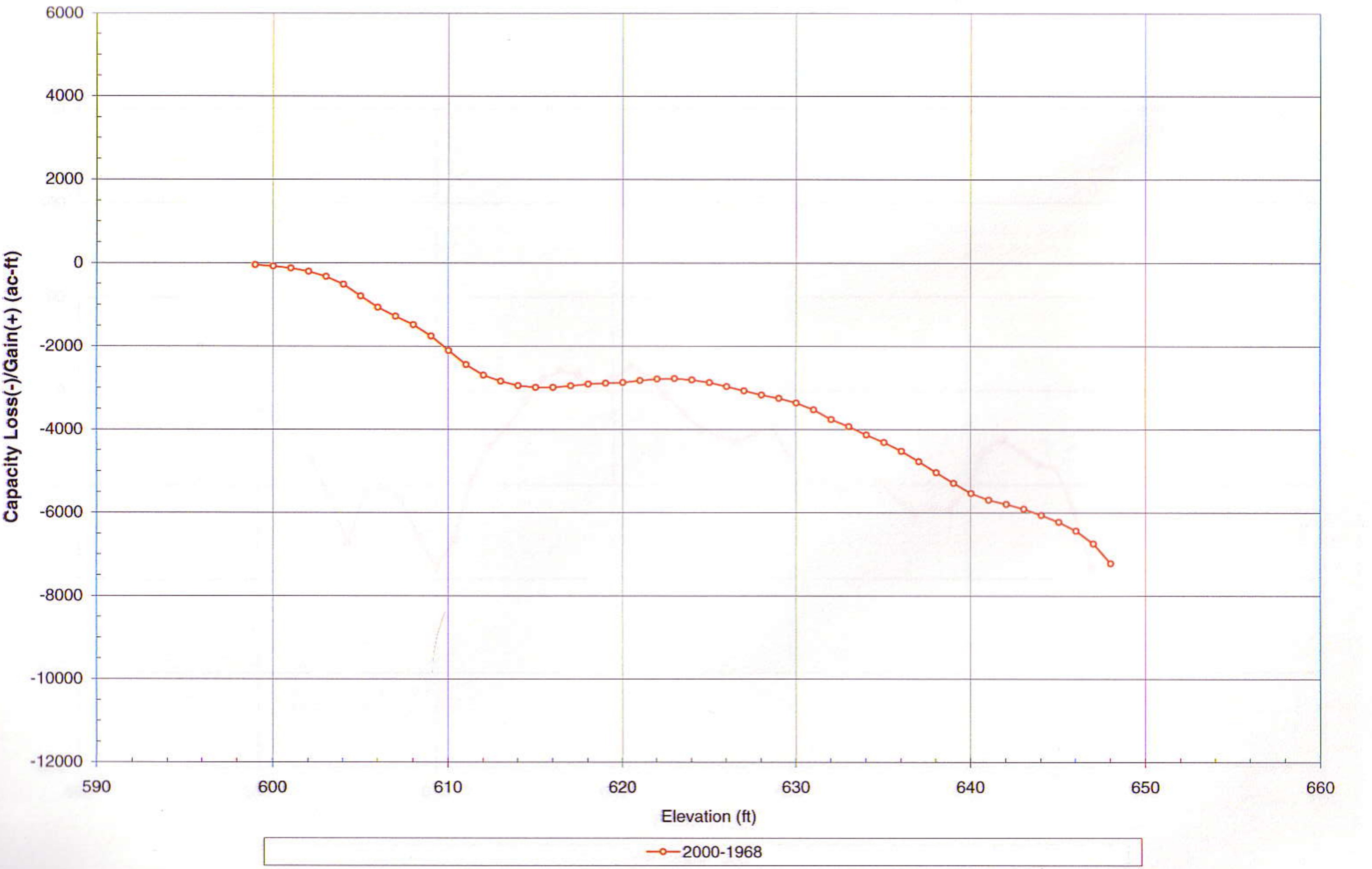


Eagle Mountain Lake
May 2001
Volume vs Elevation



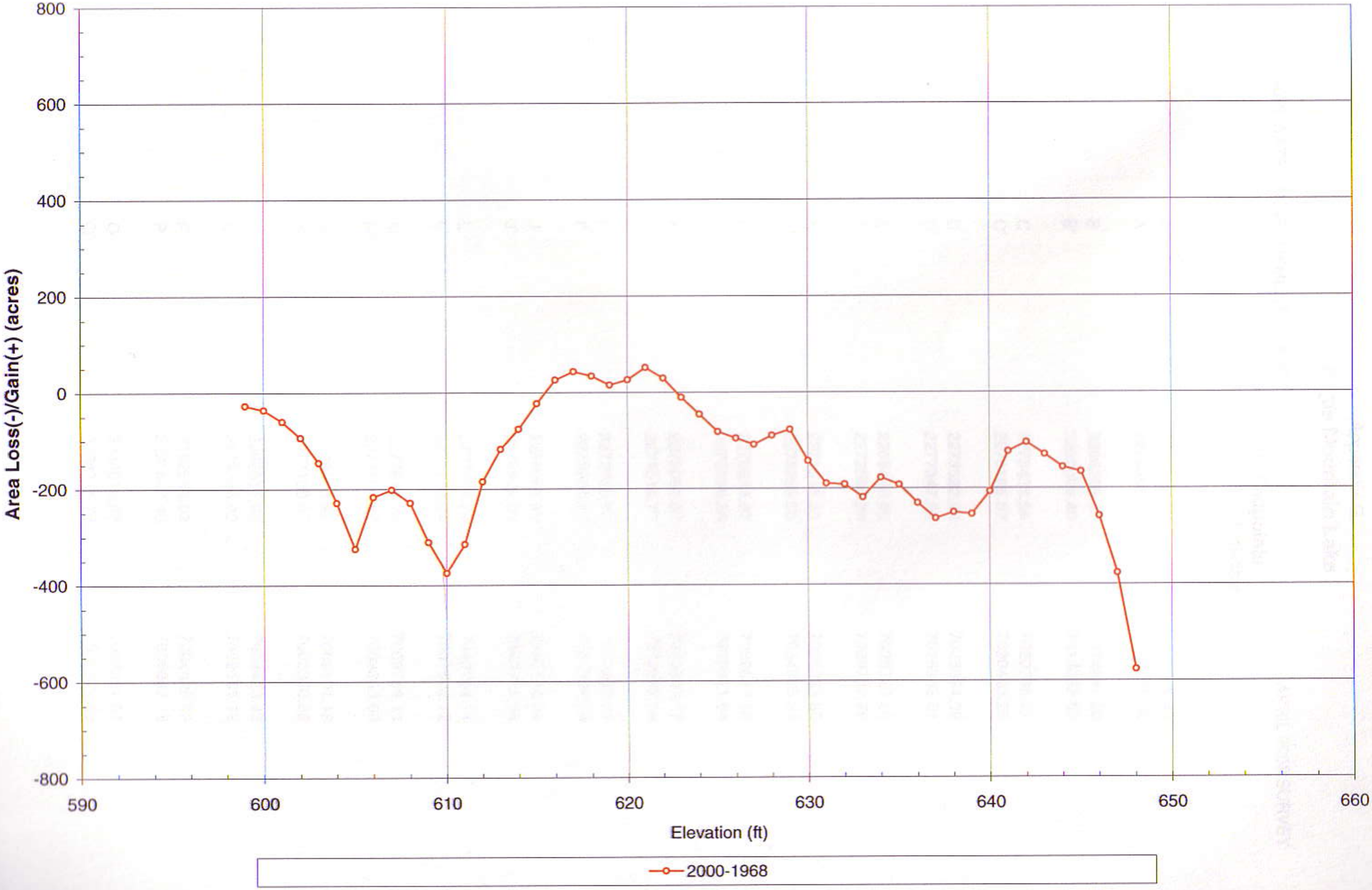
Eagle Mountain Lake
May 2001
Area vs Elevation

Appendix D



Eagle Mountain Lake Changes in Volume

Appendix E



Eagle Mountian Lake
Changes in Area

Appendix F

Appendix G

Eagle Mountain Lake

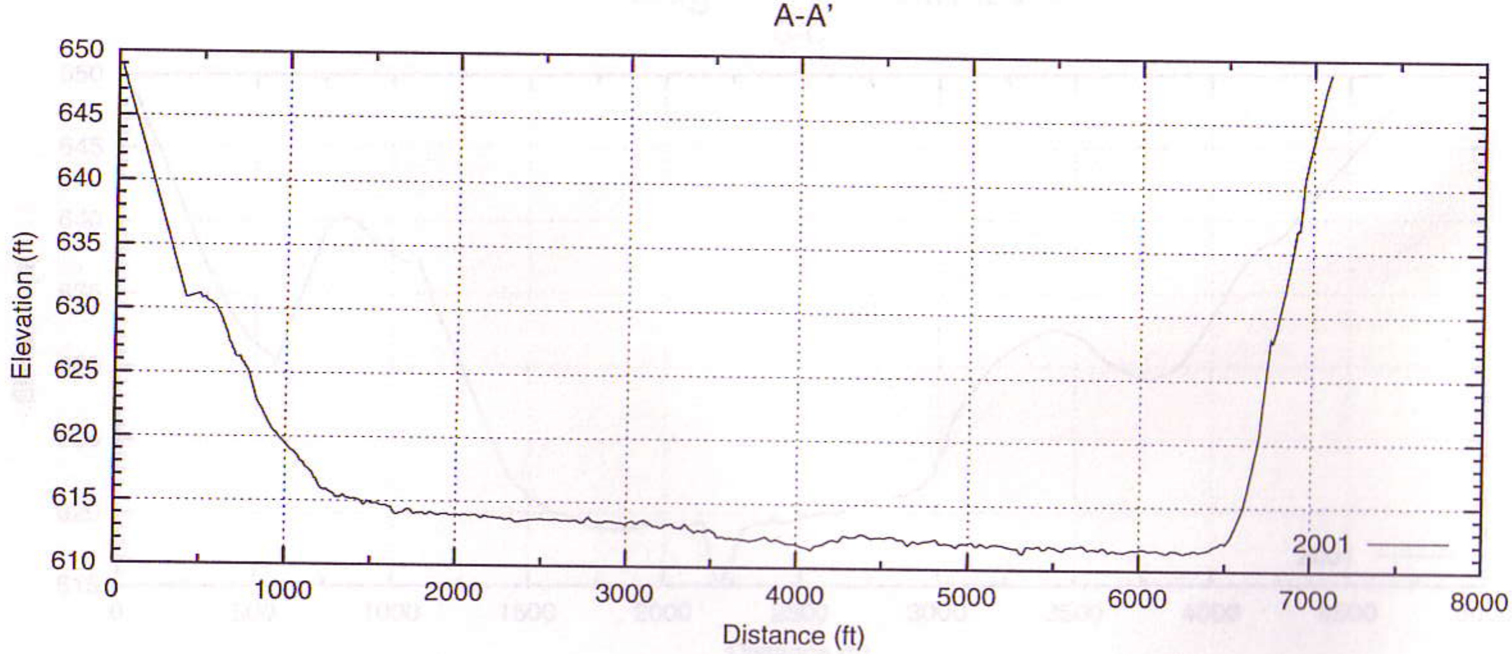
TEXAS WATER DEVELOPMENT BOARD APRIL 2000 SURVEY

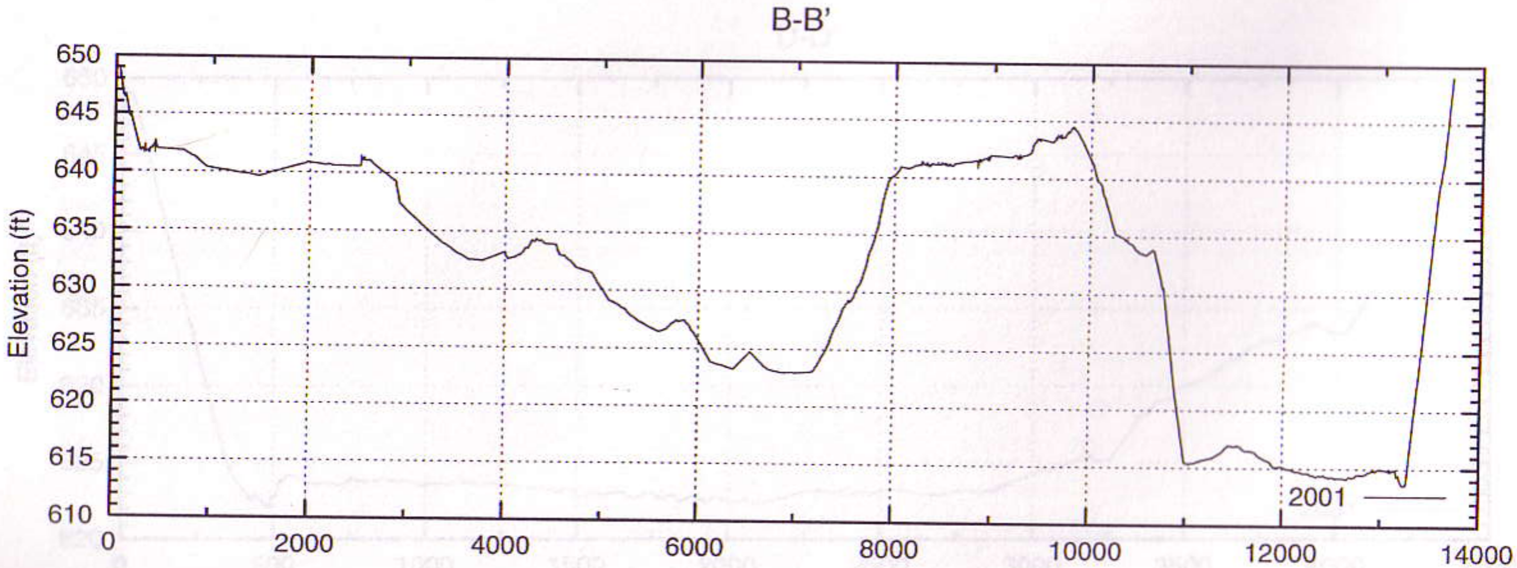
Range Line Endpoints

State Plane NAD83 Units-feet

Range Line	X	Y
A	2272424.26	7007265.43
A'	2279366.82	7009101.18
B	2266266.47	7014691.29
B'	2280009.40	7014332.53
C	2273433.56	7020735.71
C'	2278185.07	7020453.25
D	2273522.98	7023054.39
D'	2277347.32	7025363.01
E	2269448.60	7028320.50
E'	2272500.24	7029782.28
F	2271515.28	7035283.80
F'	2278399.50	7034865.34
G	2270883.97	7039587.18
G'	2273396.26	7039821.64
H	2272050.97	7043907.77
H'	2274519.77	7042267.09
I	2272050.97	7043907.77
I'	2273905.70	7045940.19
J	2268661.92	7046119.38
J'	2270861.94	7047757.34
L	2272614.24	7002766.11
L'	2271773.24	7001503.12
M	2272614.24	7002766.11
M'	2277109.67	7003350.66
N	2279366.82	7009101.18
N'	2277109.67	7003350.66
O	2282551.03	7004428.43
O'	2279366.82	7009101.18
P	2282551.03	7004428.43
P'	2286697.48	7006692.76
Q	2288015.97	7006852.57
Q'	2288326.72	7003239.56

Eagle Mountain Lake



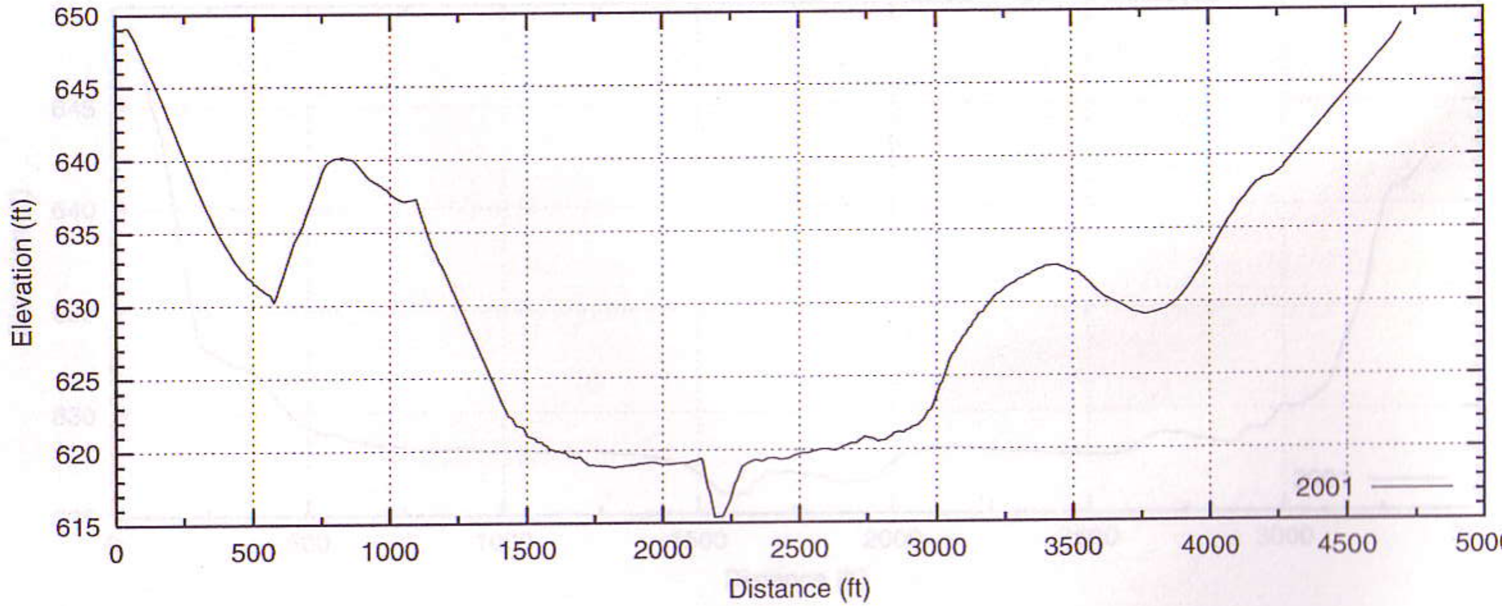


Distance (ft)

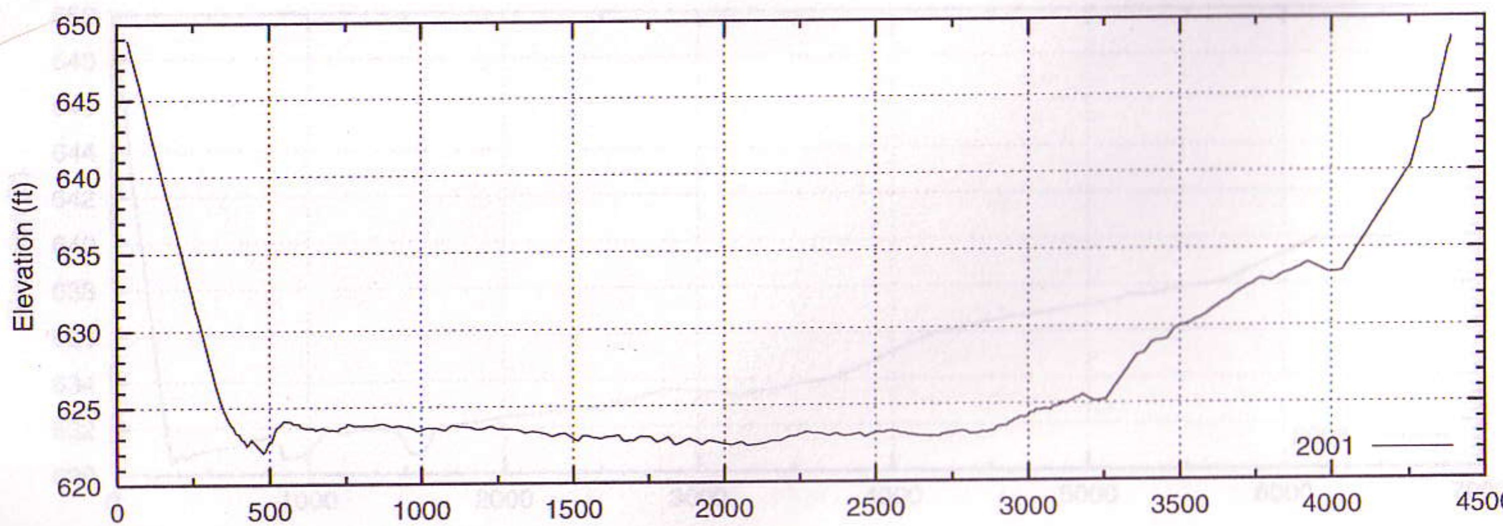
Appendix G

Eagle Mountain Lake

C-C'



D-D'

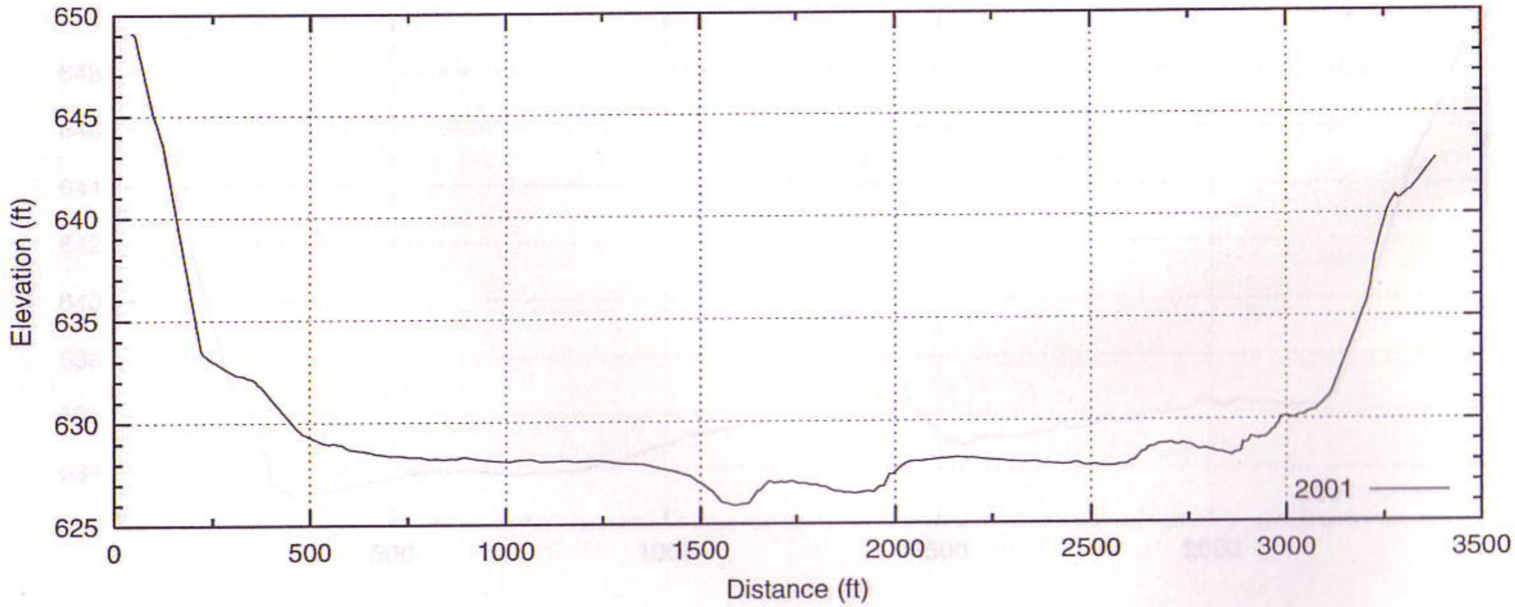


Distance (ft)

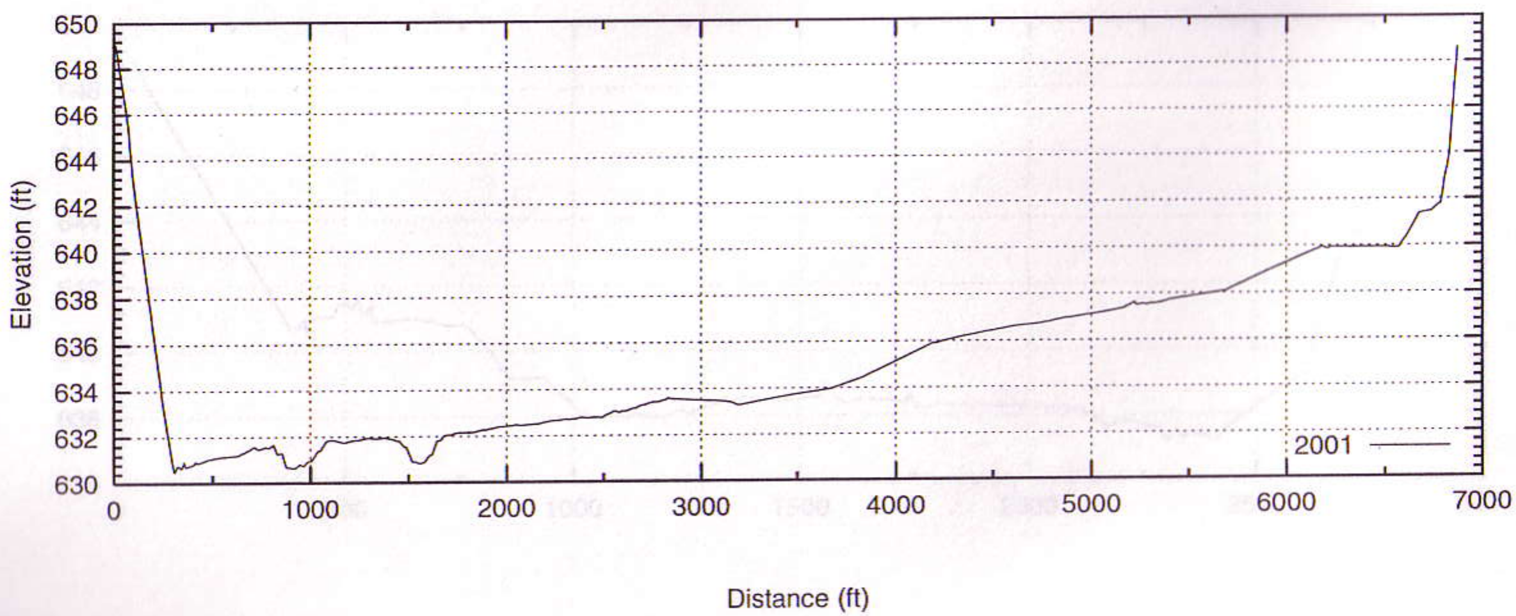
Appendix G

Eagle Mountain Lake

E-E'



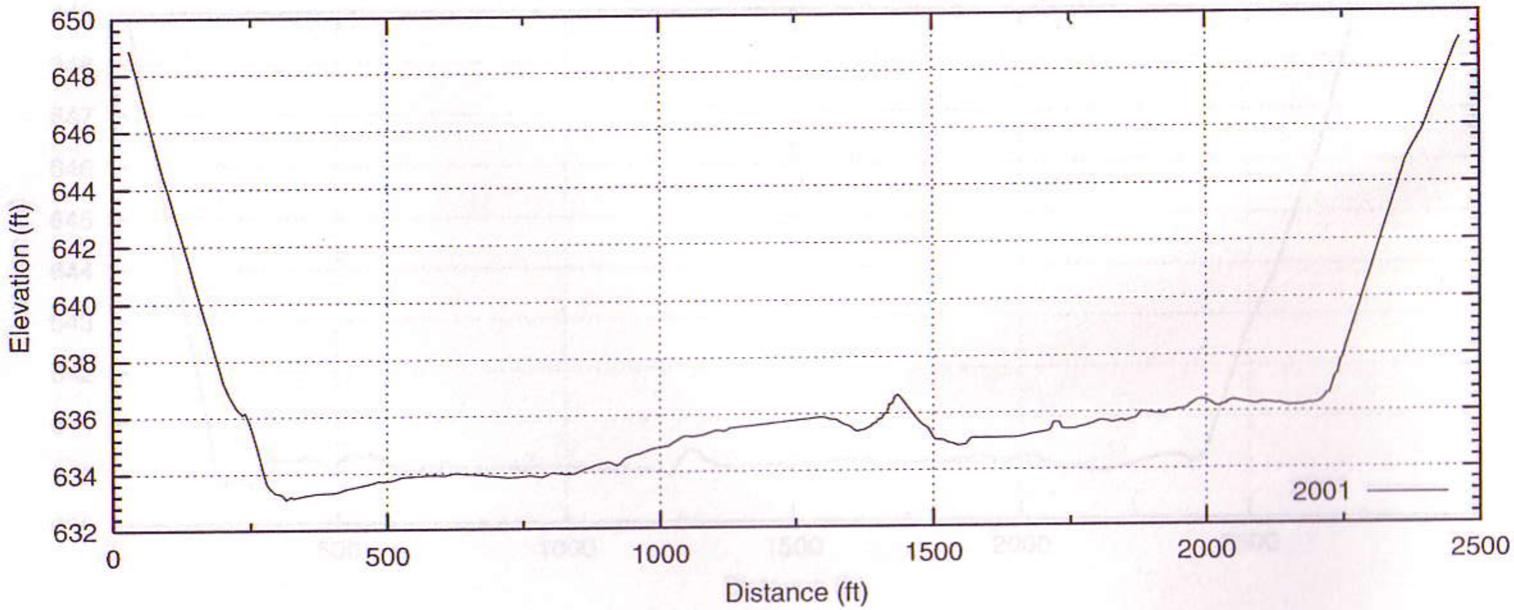
F-F'



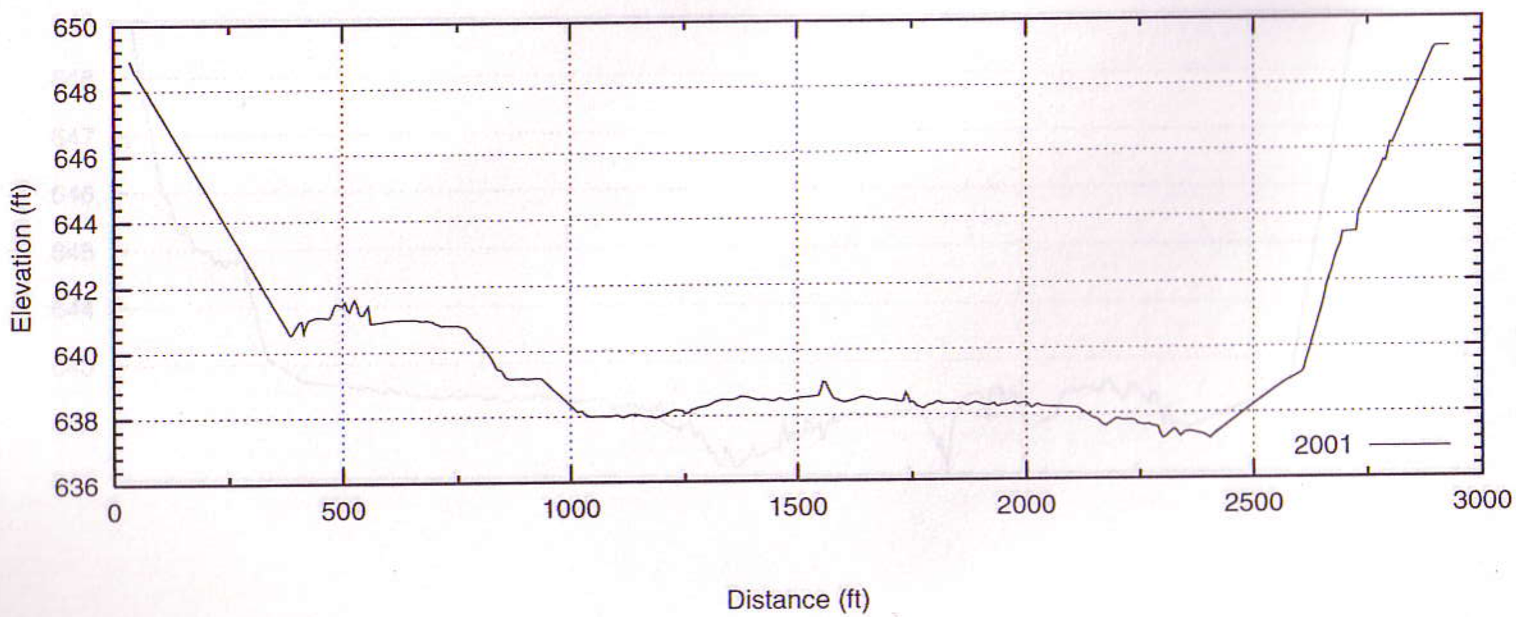
Appendix G

Eagle Mountain Lake

G-G'

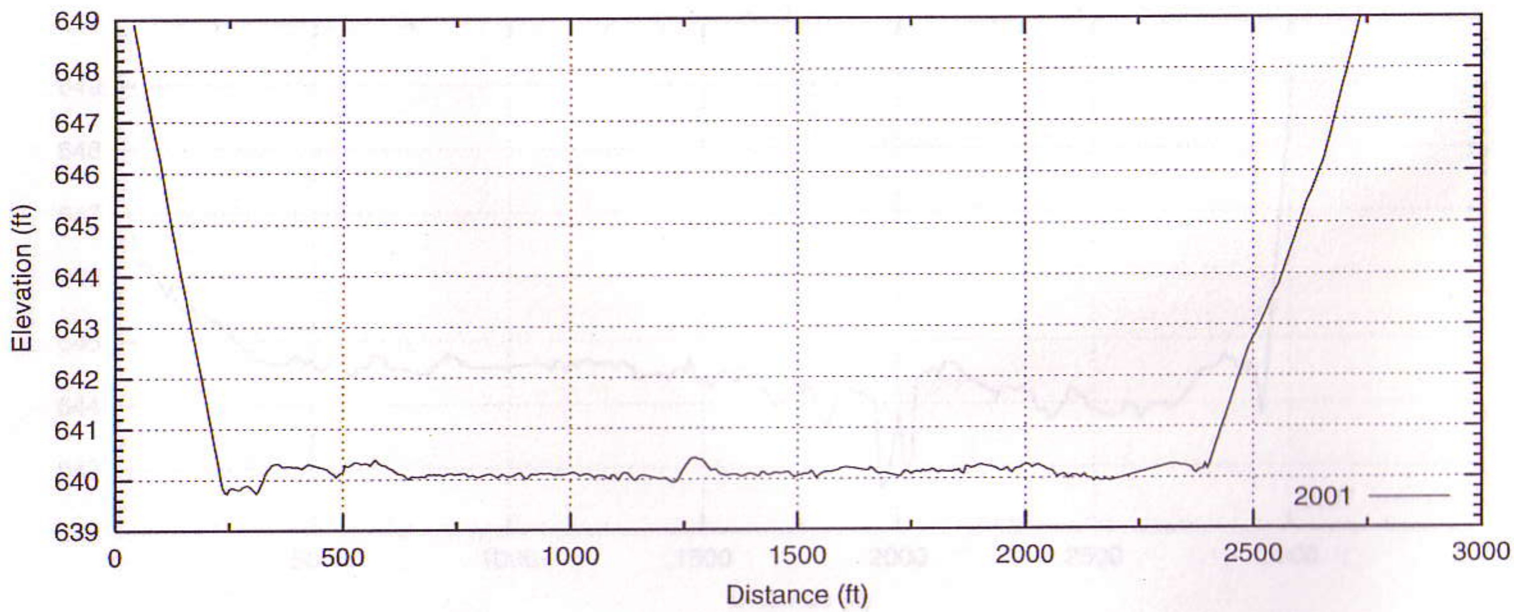


H-H'

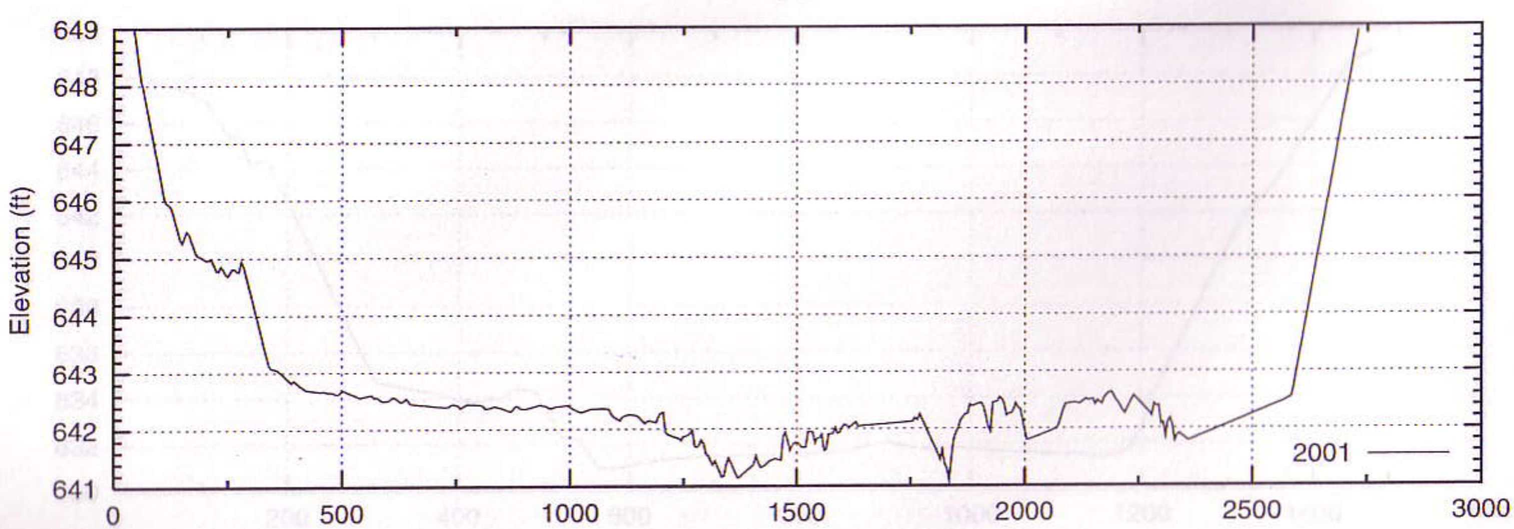


Eagle Mountain Lake

I-I'



J-J'

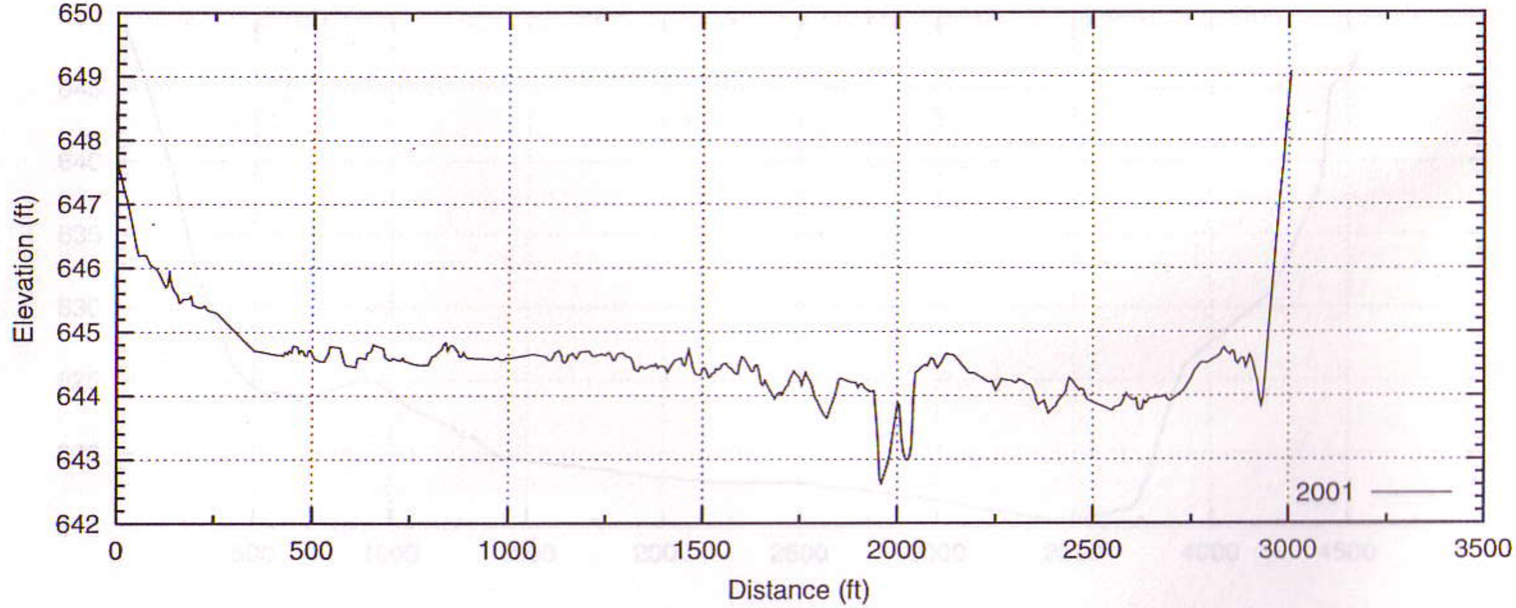


Distance (ft)

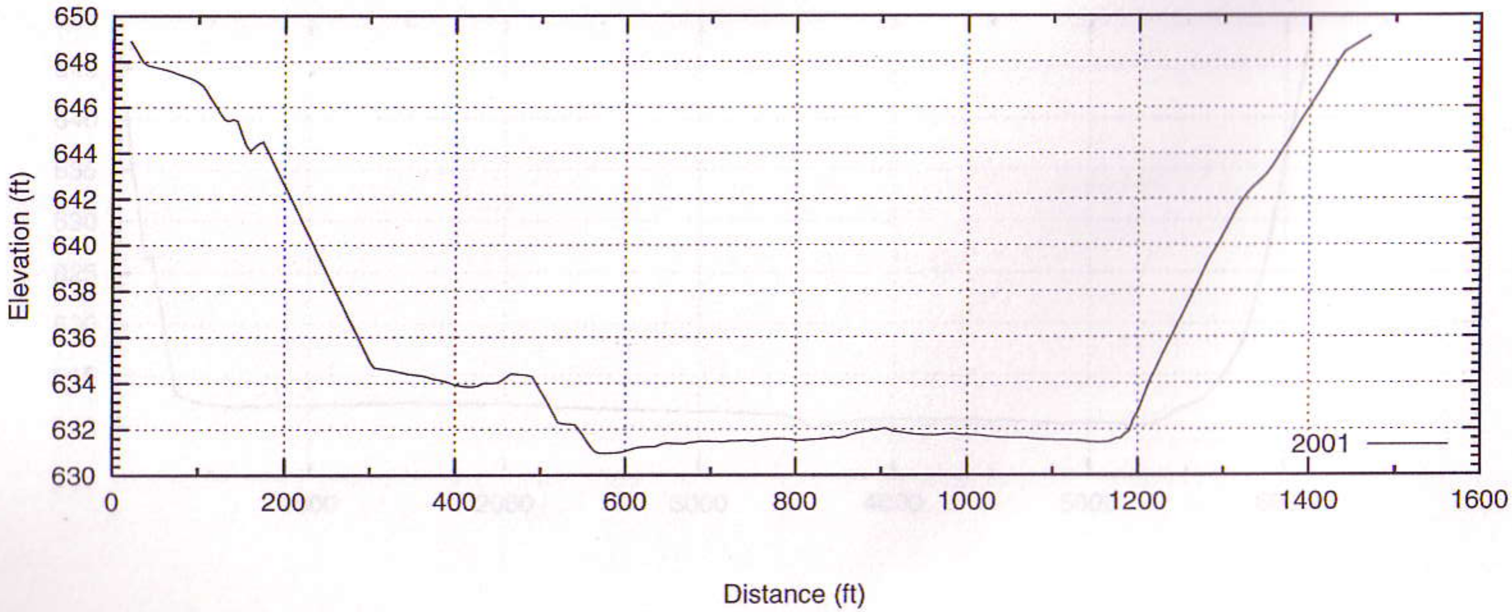
Appendix G

Eagle Mountain Lake

K-K'

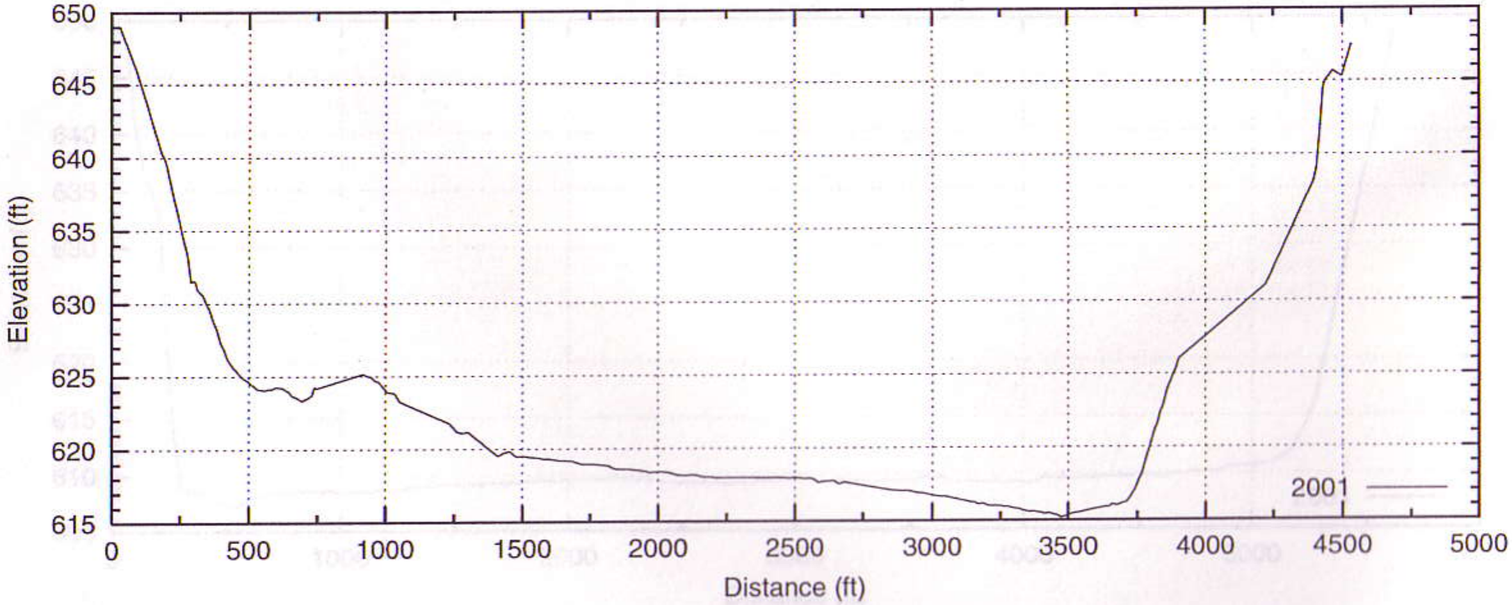


L-L'

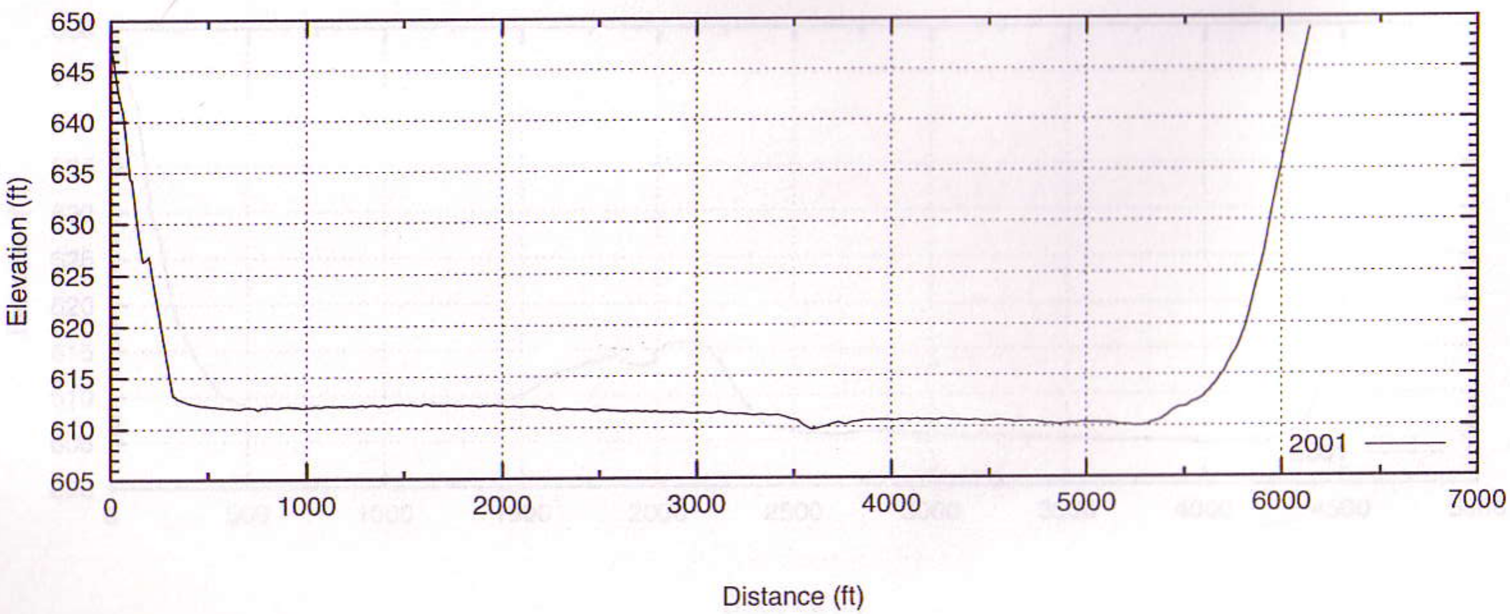


Eagle Mountain Lake

M-M'

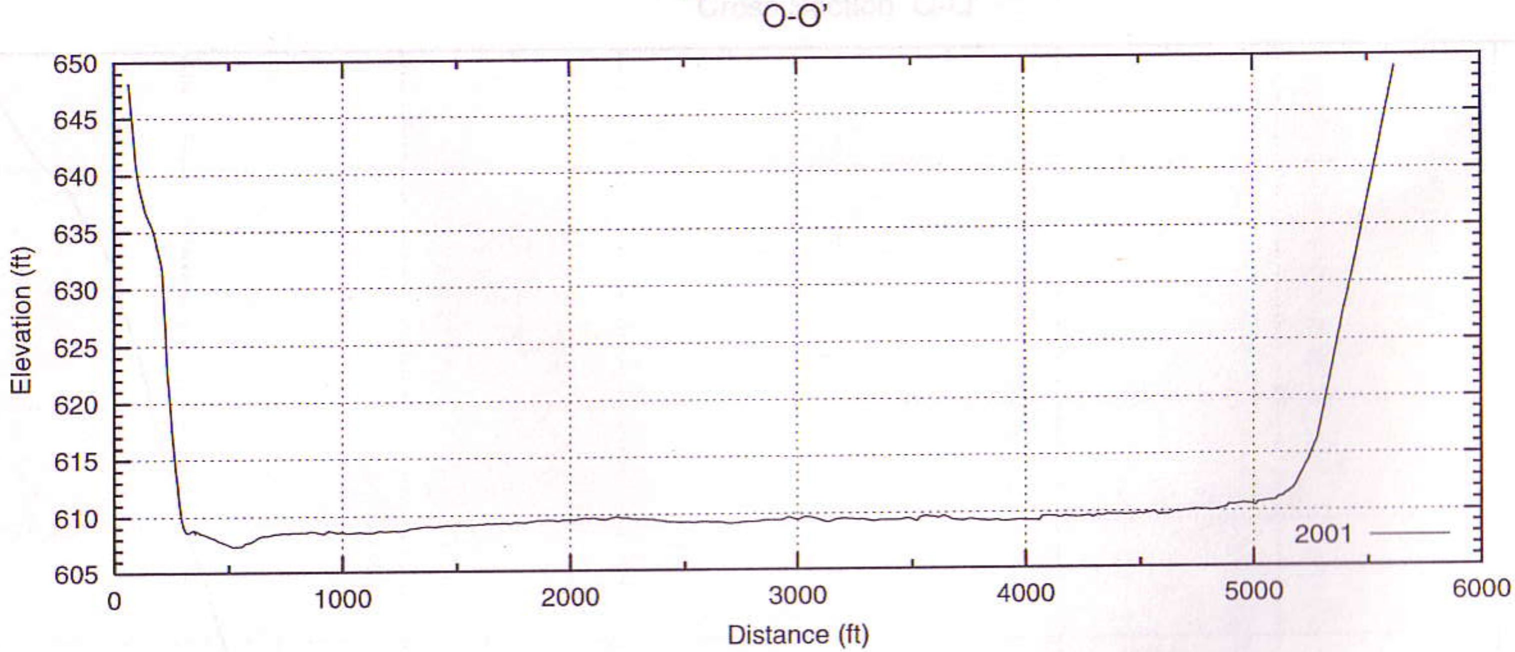


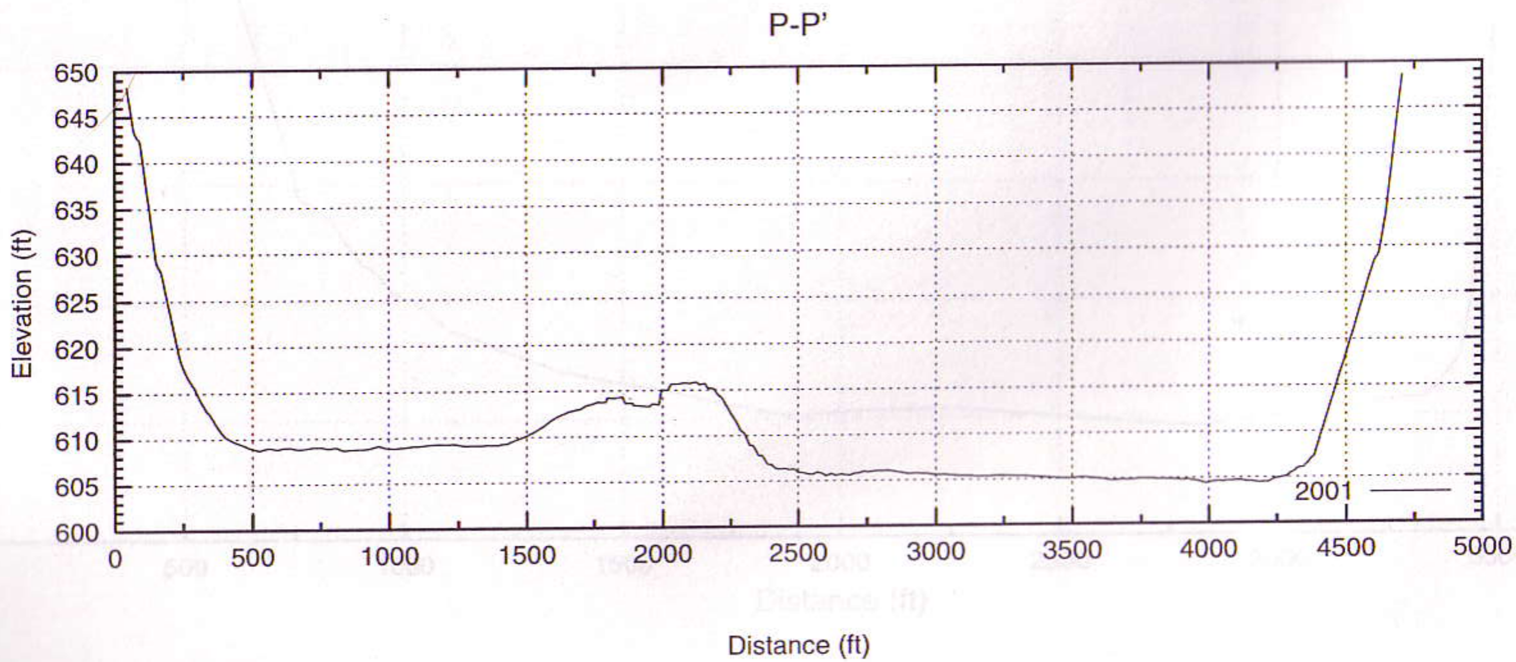
N-N'



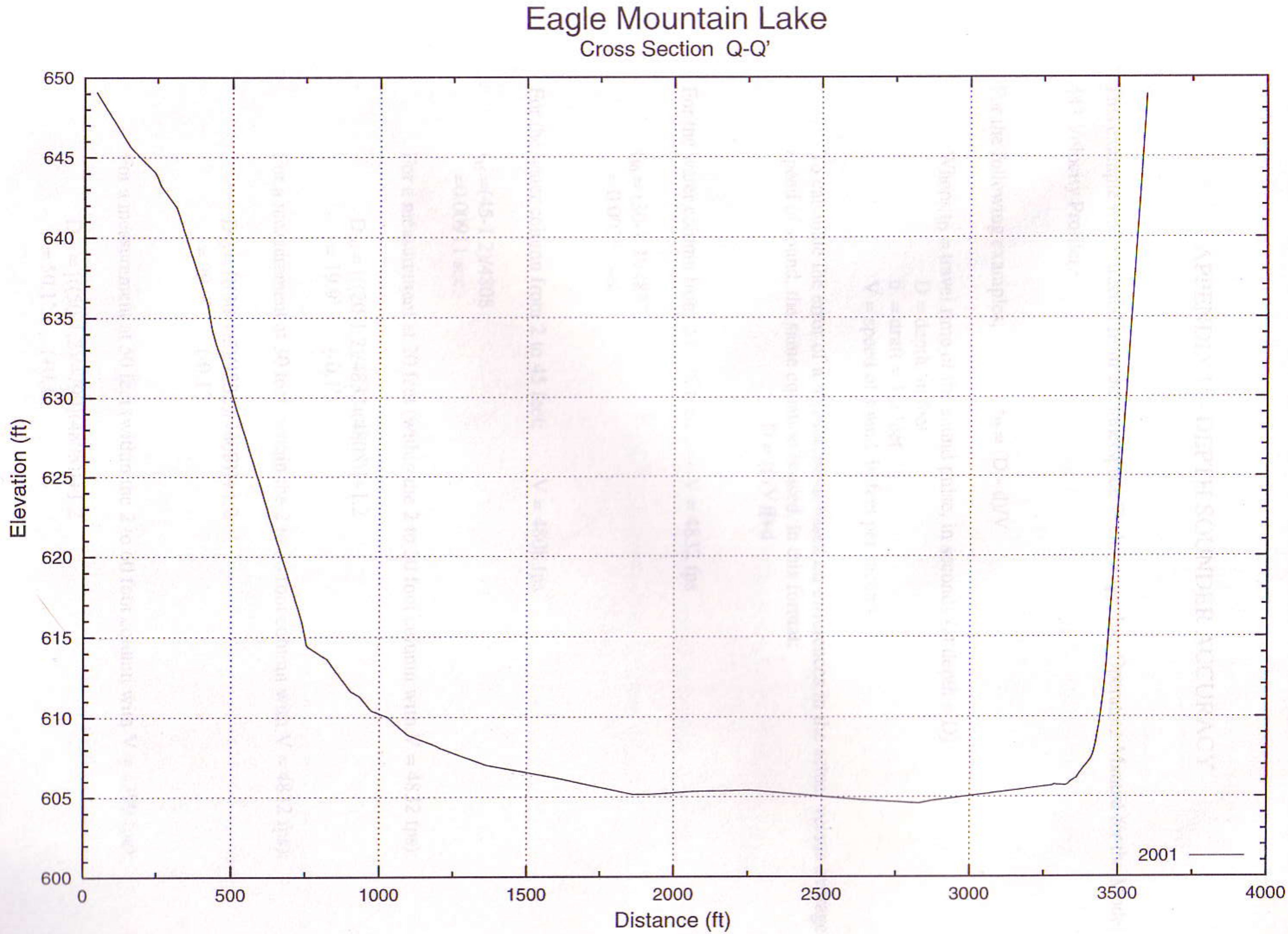
Appendix G

Eagle Mountain Lake





Appendix G



Eagle Mountain Lake
Cross Section Q-Q'
Elevation (ft)
Distance (ft)
650
645
640
635
630
625
620
615
610
605
600
0
500
1000
1500
2000
2500
3000
3500
4000
2001

APPENDIX H - 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')

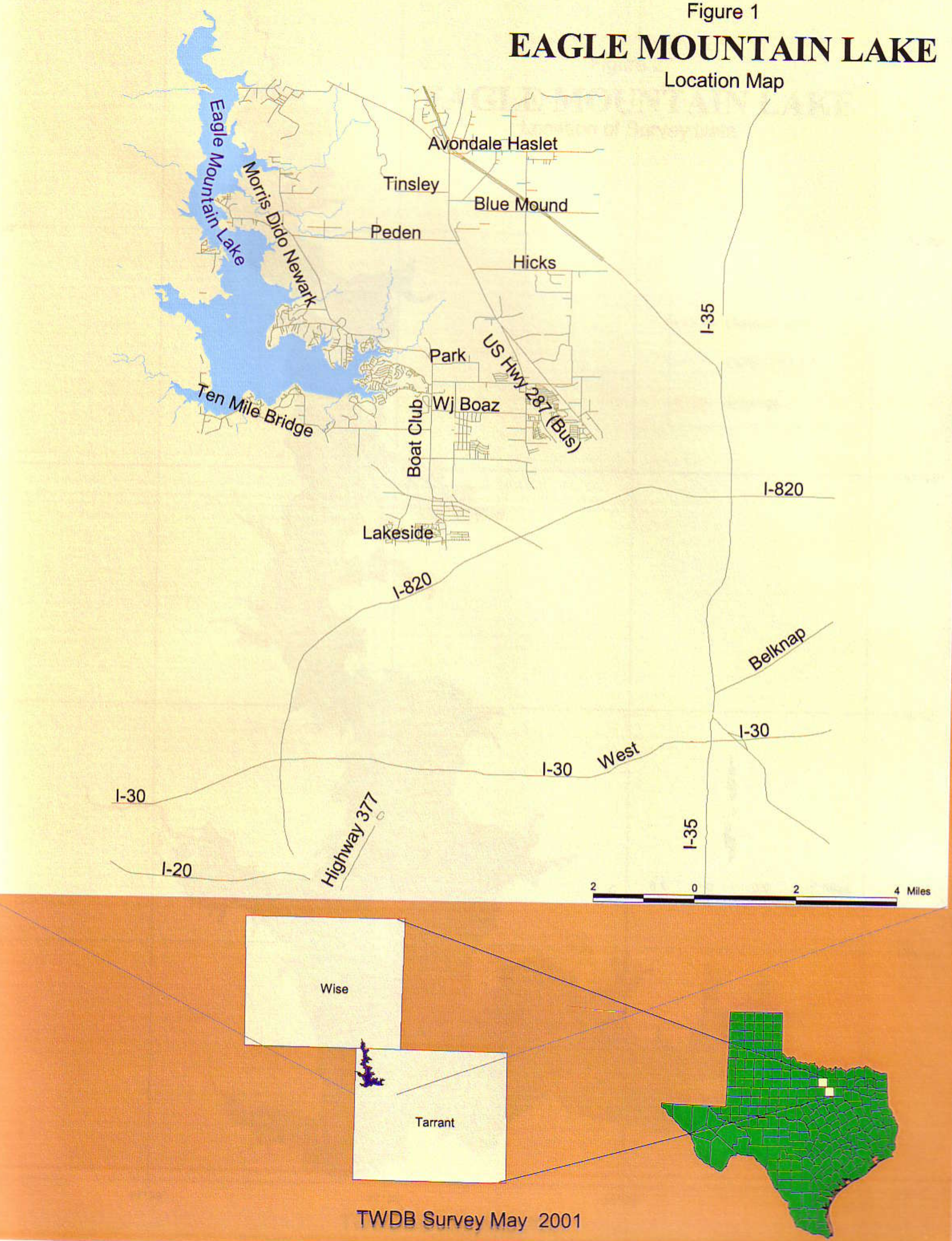
For a measurement at 80 feet (outside the 2 to 60 foot column, assumed V = 4785 fps):

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

Figure 1

EAGLE MOUNTAIN LAKE

Location Map

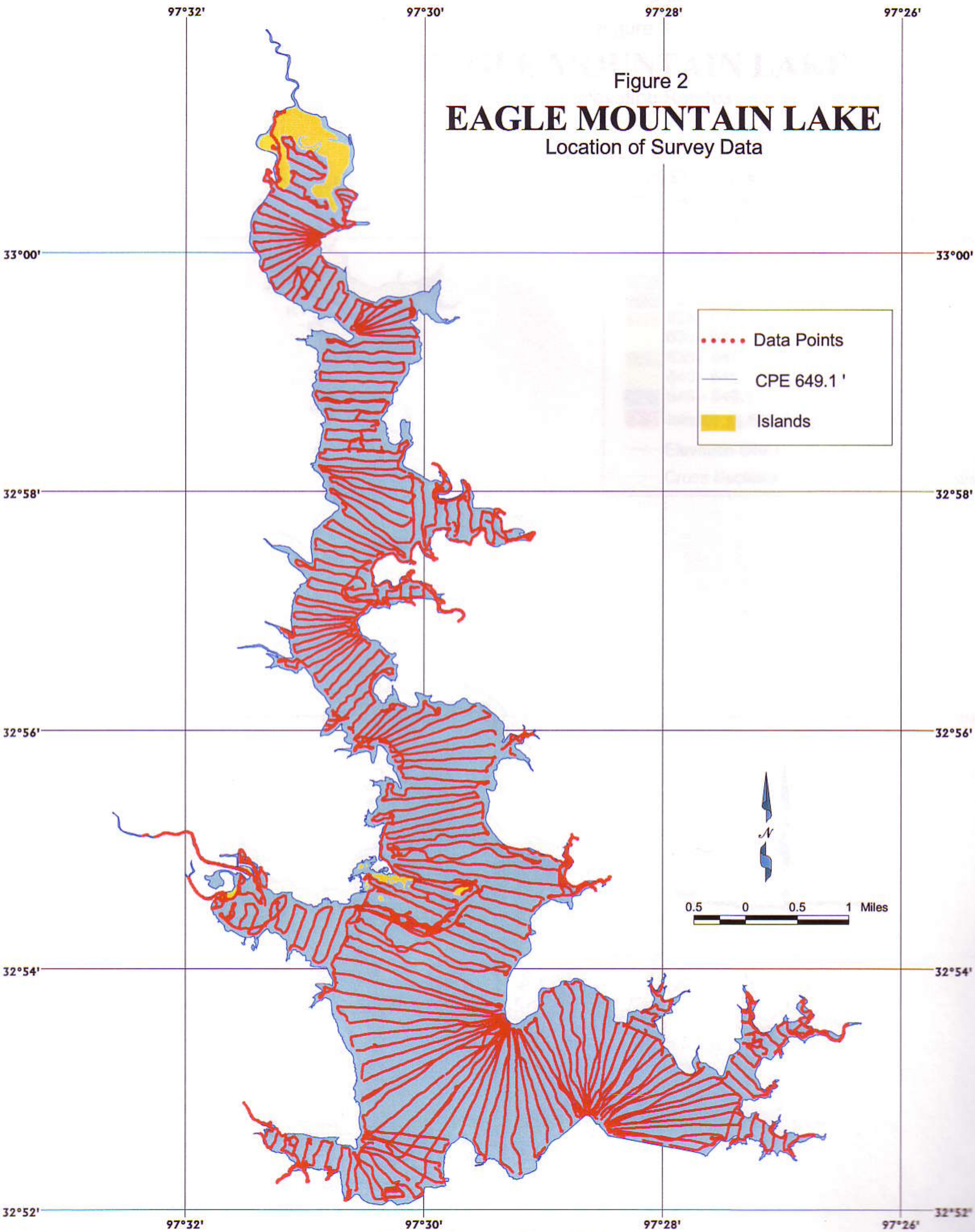


TWDB Survey May 2001

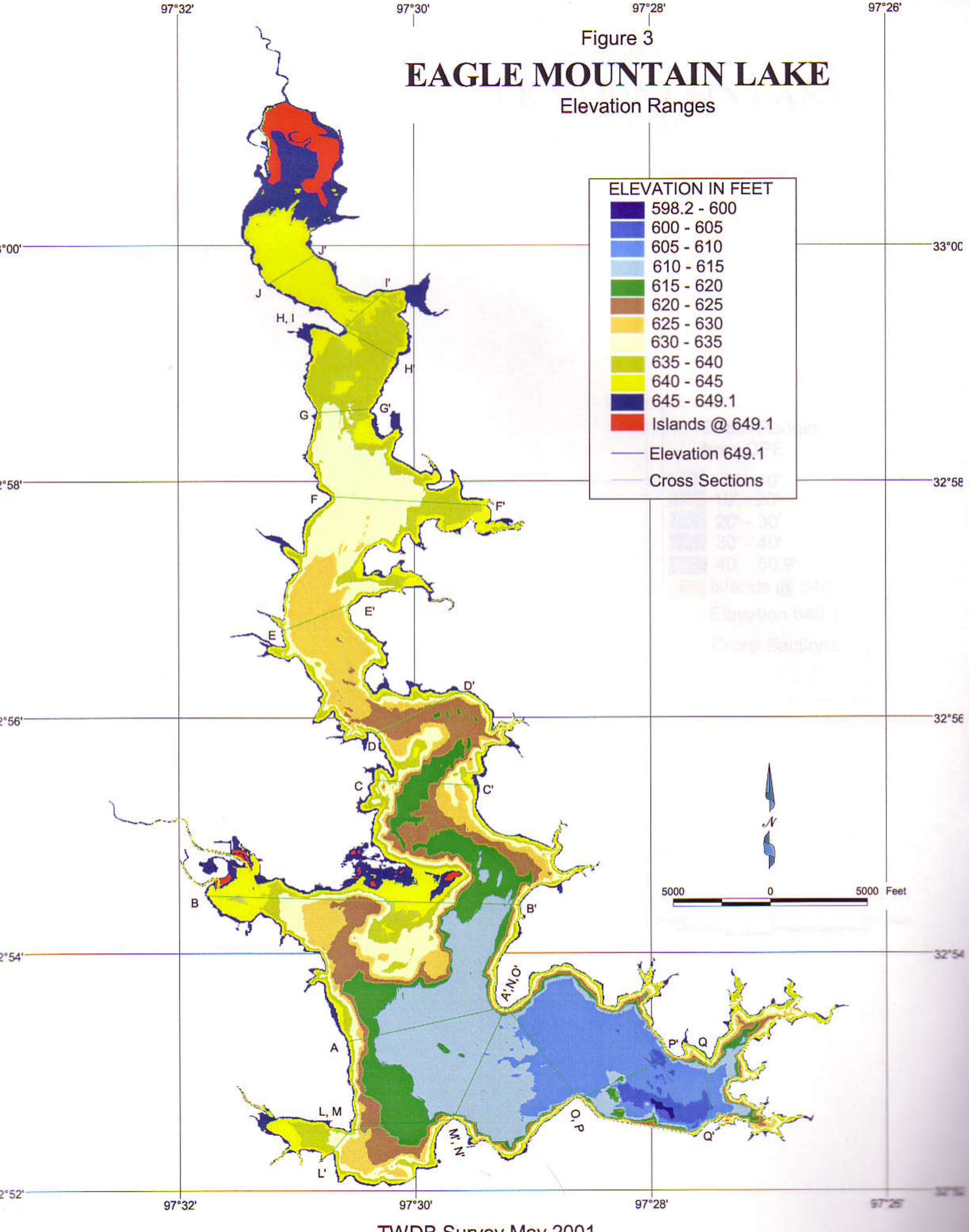
Figure 2

EAGLE MOUNTAIN LAKE

Location of Survey Data



TWDB Survey May 2001

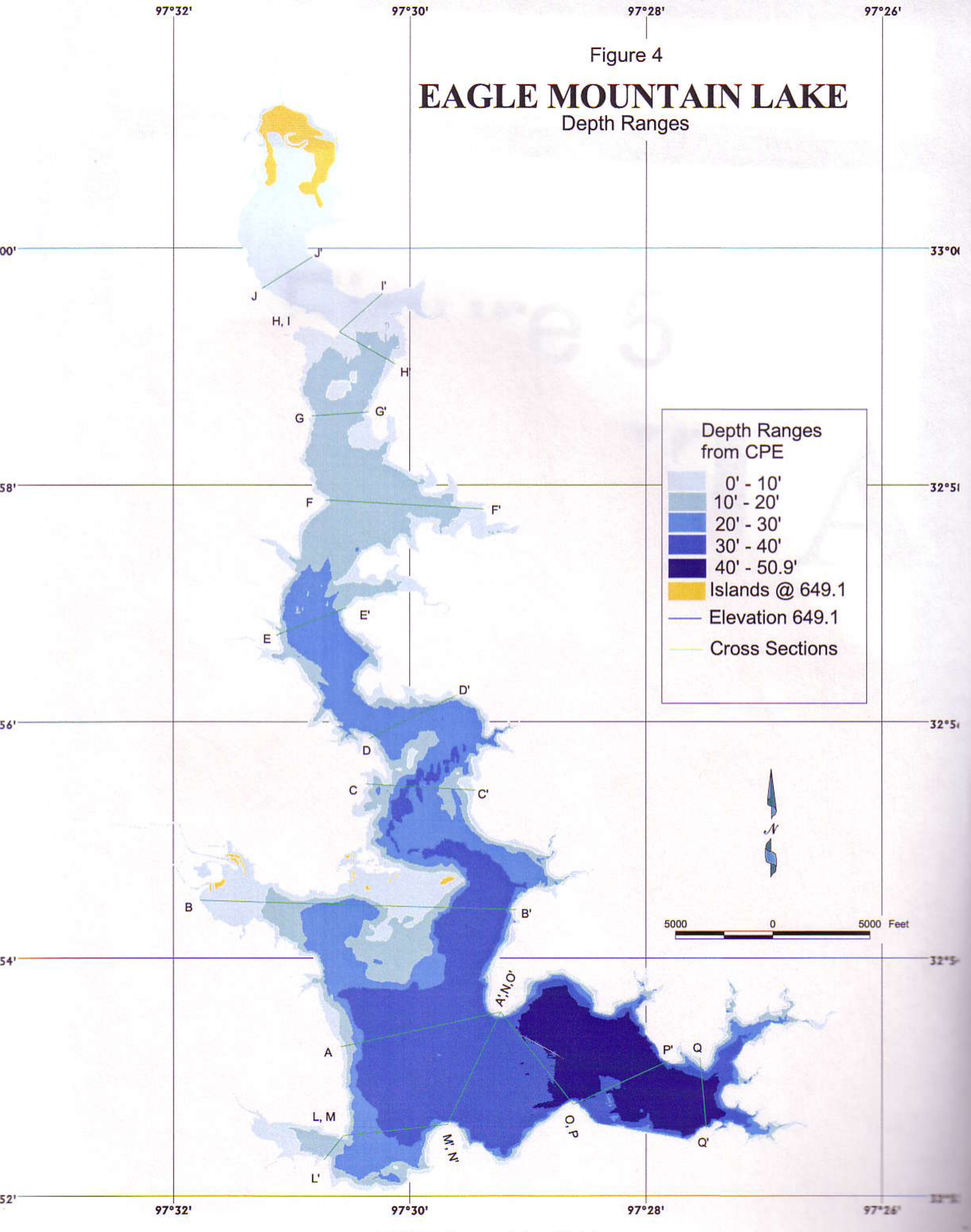


TWDB Survey May 2001

Figure 4

EAGLE MOUNTAIN LAKE

Depth Ranges



TWDB Survey May 2001

Figure 5

EAGLE MOUNTAIN LAKE

2' - Contour Map

TEXAS WATER DEVELOPMENT BOARD APRIL 2000 SURVEY