VOLUMETRIC SURVEY REPORT

OF

SOMERVILLE LAKE

JULY 2003 SURVEY

Prepared by the:

TEXAS WATER DEVELOPMENT BOARD

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EXECUTIVE OVERVIEW

The Texas Water Development Board entered into a contract with the Brazos River Authority to perform a volumetric survey of Somerville Lake. The goal of the study was to produce updated elevation-area and elevation-volume tables using current GPS, acoustical depth sounder and GIS technology.

Records indicate the top of the conservation (TOC) pool for Somerville Lake is at elevation 238.0 feet above mean sea level. A lake boundary was digitized from digital orthophoto quadrangle images (DOQs). Depth and positional data was collected along a layout of transects (pre-plotted navigation lines) spaced approximately 500 feet apart using commercially available software.

Data were collected at Somerville Lake during the period of July 7 to July 11, 2003. During that period, the water levels varied between 238.13 ft and 238.22 ft. Approximately 72,000 data points were collected over 211 miles.

The result of the current survey indicates the lake encompasses 11,555 surface acres and contains 147,104 ac-ft at the TOC pool elevation 238.0 ft. The TWDB 1996 survey report (1995 field survey) found 11,456 surface acres and a total volume of 155,062 ac-ft. The 2003 survey indicates the lake has experienced little or no change in surface area (less than a 1% increase) and a 5% reduction in total volume at the TOC pool.

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ON SOMERVILLE LAKE
SURVEY OF JULY 2003

INTRODUCTION

Staff of the Surface Water Resources Division of the Texas Water Development Board (TWDB) conducted a volumetric survey of Somerville Lake during the period July 7 through July 11, 2003. The purpose of the survey was to determine the current volume of the lake level at conservation pool elevation (CPE) 238.0 feet above mean sea level[1] (msl). For the purpose of this report, the term “top of conservation (TOC) pool” will be used to mean the conservation pool elevation (238.0 feet) for Somerville Lake. The equipment and methodology used in the current survey was similar to that used in the September 1995 TWDB volumetric survey[2]. 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 lake elevation gage at Somerville Lake. The datum for this gage is reported as mean sea level (msl) National Geodetic Vertical Datum of 1929 (NGVD 1929)[3]. Thus, elevations are reported here in feet (ft) above mean sea level (msl) NGVD 29. Volume and area calculations in this report are referenced to water levels provided by the USGS gage: USGS 08109900 Somerville Lk nr Somerville, TX.

The following table summarizes information and pertinent data for Somerville Dam and Somerville Lake and is based on information furnished by the U.S. Army Corps of Engineers[4]. Reservoir data is based on the results of the current survey.

PERTINENT DATA

Table 1. Somerville Dam and Somerville Lake Pertinent Data

<u>Owner of Dam and Facilities:</u>

U. S. Army Corps of Engineers

<u>Operator of Dam and Facilities:</u>

U. S. Army Corps of Engineers, Fort Worth District

<u>Engineer and General Contractor</u>

U. S. Army Corps of Engineers (Design)

Clement Brothers Company (General Contractor)

<u>Location:</u>

On Yegua Creek in Washington and Burleson Counties, 2 miles south of Somerville, TX (Figure 1).

<u>Purpose:</u>

Multi-purpose reservoir for flood control, water supply and recreation

<u>Authorization:</u>

Federal: Flood Control Act, September 3, 1954[5]

State: Certificate of Adjudication[6] 12-5164 was issued, by the Texas Water Commission on December 14, 1987 to the Brazos River Authority (BRA) to impound 160,110 ac-ft of water in Somerville Lake at TOC pool. The BRA was authorized a priority right to divert and use not to exceed 48,000 ac-ft of water per annum for municipal, industrial, irrigation, mining and recreational purposes. For detailed information about the water rights permits and the System Operation Order, refer to Volumetric Survey of Somerville Lake (TWDB, 1996).

Drainage area:

1,006 square miles

Dam:

Type	Rolled earth fill
Length	20,210 ft (plus 4,715 ft dike)
Maximum height	80 ft (above natural streambed)
Top width	20 ft (dike 34 ft)

Spillway:

Type	Ogee
Control	Uncontrolled
Length	1,250 ft (net at crest)
Crest elevation	258.0 ft

Outlet works:

Type	1 gate-controlled conduit
Dimensions	10-ft diameter
Invert elevation (lowest gate)	206.0 ft
Control	Two 5-ft X 10-ft tractor-type gates

Reservoir Data:

	ELEVATION (Above MSL)	CAPACITY (Acre-feet)	AREA (Acres)
Top of Conservation Storage Space	238.0	147,104	11,555
Lowest gated outlet (invert)	206.0	0	0

VOLUMETRIC SURVEYING TECHNOLOGY

The equipment used to perform the latest volumetric survey consisted of a 20-foot aluminum shallow-draft flat bottom SeaArk craft with cabin and powered by a 100-horsepower Yamaha 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 Omnistar differential GPS correction signal and a laptop computer. (Reference to brand names throughout this report does not imply endorsement by TWDB).

The GPS equipment, survey vessel, and depth sounder in combination provide an efficient hydrographic survey system. As the boat travels along 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 computer along with the positional data generated by the boat's GPS receiver. The data files collected are downloaded and transferred 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 at the time the data was collected. Accurate estimates of the lake volume can then be determined by building a 3-D TIN[7] model of the lake from the collected data.

PRESURVEY PROCEDURES

The lake's boundary was digitized using Environmental Systems Research Institute's (ESRI)[8] ArcGIS 8.3 from digital orthophoto quadrangles (DOQs). The DOQs 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 TOP reside in the public domain. More information can be obtained on the Internet at http://www.tnris.state.tx.us/DigitalData/doqs.htm.

The lake elevation, at the time the DOQs were photographed (February 20, 1995) was 239.82 ft. The lake and island boundaries were given an elevation of 239.8 ft and TWDB Staff utilized these updated boundary conditions in modeling Somerville Lake for this report. The lake elevations varied between elevation 238.13 ft and 238.22 ft during the survey.

The survey layout was designed by placing survey track lines at 500-foot intervals (Figure 2) within the digitized lake boundary using the HYPACK[9] software. The survey design required the use of approximately 200 survey track lines placed perpendicular to the original river channel and tributaries along the length of the lake. The survey track lines (transects/range lines) were designed in a pattern similar to those transects designed for the 1995 TWDB survey.

SURVEY PROCEDURES

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

Equipment Calibration and Operation

Prior to collecting data onboard the River Runner (shallow draft) boat, the Knudsen depth sounder was calibrated with the DIGIBAR-Pro Profiling Sound Velocimeter by Odem Hydrographic Systems[10]. This instrument is 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 it. 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 Knudsen depth sounder, which then provided the depth of the lake bottom. The depth was then checked manually with a weighed measuring tape to ensure that the depth sounder was properly calibrated and operating correctly.

The speed of sound in the water column varied from 4,940 feet per second to 4,949 feet per second during the Somerville Lake survey. 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, canceling each other out.

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 differential corrections from the Omnistar receiver. The lake's initialization file used by the HYPACK data collection program was set up to convert the collected Differential GPS positions to NAD 83, State Plane, Texas Central Zone coordinates on the fly.

Data Collection

TWDB staff collected data at Somerville Lake for 5 days during the period of July 7 to July 11, 2003. Lake levels remained above TOC pool during the survey and varied between elevations 238.13 ft and 238.22 ft, thus allowing the survey crew to collect data in most areas of the lake that would be inundated at TOC pool.

The design layout for collecting data at Somerville Lake required pre-plotting transects (range lines) that were perpendicular to the old Yegua Creek channel and tributaries. These transects had an average spacing of 500 ft. While collecting data, the boat operator would steer the boat on course (with GPS navigation) starting from one shore and heading to the opposite shore. The data collector would monitor the data display and depth sounder to make sure the latitude, longitude, and depth (x, y, z) values were being logged. The depth sounder and GPS equipment records 10 data points every second. These points are averaged to one data point per second for generating the model. The distance between data points depended on the speed of the boat. The maximum distance between data points during the resurvey of Somerville Lake was approximately 20 ft.

A shallow-draft boat was used to collect data during the current survey as opposed to the tri-hull boat used in the 1995 survey with the intentions of collecting more data in the upper reaches and shallower areas of the lake.

Over 72,000 data points were collected over the 211 miles traveled during the data collection phase of Somerville Lake. These points were stored digitally on the boat's computer in 225 data files. Random data were collected in those areas where the crew was not able to stay on course due to obstructions. Data were not collected in areas with significant obstructions or where the water was too shallow. Figure 2 shows the actual location of all data points collected.

Data Processing

The collected data were downloaded from diskettes onto TWDB's network computers and backups were made for future reference as needed. Each raw data file was run through the EDIT routine in the HYPACK Program. Anomalies 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. After all adjustments 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 ESRI's Arc/Info Workstation GIS 8.3 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 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[7]. 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 lake 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 from elevation 210.0 ft to 239.8 ft at one-tenth foot intervals using Arc/Info Workstation 8.3 software. The computed lake volume and area tables are presented in Appendix A and Appendix C, respectively for the 2003 Somerville Lake Survey.

The 1995 data was rerun with the boundary conditions used to compute the 2003 area and volume tables. The total volume at TOC pool was within 0.5% of the volume reported in the 1996 TWDB report, therefore the 1996 area and volume tables are presented in this report as originally reported in the 1996 report. The 1996 lake volume and area tables are presented in Appendix B and Appendix D. An elevation-volume graph and an elevation-area graph comparing both surveys are presented in Appendix E and Appendix F, respectively.

Approximately 2,400 additional points were added to the TIN model used in the 1996 TWDB survey report to interpolate and contour the lake surface area[2]. These points were added to the 2003 data set and a TIN was generated and compared to the TIN using only the 2003 data set. The volumes at TOC pool compared to within less than 1% while the areas varied around 4%, the TIN using the additional data points having the larger area. This is an artifact of the interpolation routine used in Arc\Info, where in areas of limited information "flat triangles"[7] are drawn. These flat triangles are not used in the volume calculations but add area in large increments at their respective elevation. The volumes and areas reported here are from the TIN developed using only the 2003 data set. The volumes have been left unchanged while the area calculations from elevation 235.6 ft to 239.8 ft was linearly interpolated to improve the estimated area at these elevations. The current survey is the most accurate and changes between the 1996 and 2003 surveys are identified in the tables and plots presented in this report.

Other products developed from the model include, a shaded relief map (Figure 3), a shaded depth range map (Figure 4) and a contour map. Figures 3 and 4 were developed directly from the TIN model by assigning different colors to specified ranges. To develop the contour map, 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 2-ft intervals is presented in Figure 5. Finally, endpoint coordinates for seven range lines can be found in Appendix G. These range lines compare the current TWDB bathymetric TIN model (2003) and a TIN model based on the 1995 data using the current boundary. Differences between cross-sections might be due to the fact that the 2003 range lines do not exactly match the range lines driven in the 1995 survey. The range line plots are presented in Appendix H.

RESULTS

Results from the 2003 TWDB resurvey indicate Somerville Lake encompasses 11,555 surface acres and contains a total volume of 147,104 ac-ft at TOC pool. The length of the shoreline at the digitized elevation of 239.8 ft was calculated to be approximately 84 miles. The deepest point physically measured during the survey was at elevation 210.0 ft corresponding to a depth of 28 ft from TOC pool. This point was located approximately 1,400 ft upstream of Somerville Dam.

SUMMARY AND COMPARISONS

The Federal Flood Control Act of September 3, 1954 authorized the construction of Somerville Dam and creation of Somerville Lake. Construction commenced in June 1962. Deliberate impoundment began January 3, 1967. Original design information, based on USGS topographic maps dated 1959 estimated the volume of the lake at the TOC pool to be 160,100 ac-ft with surface area of 11,460 acres. Prior to this report, the most recent volumetric survey report on Somerville Lake was published by the TWDB in February 1996.

At TOC pool, the 2003 TWDB survey calculated 11,555 surface acres and reports a volume of 147,104 ac-ft. The capacity of the active pool (conservation storage) between elevations 238.0 ft and 206.0 ft is 147,104 ac-ft. The dead pool storage or that capacity of water below the invert of the lowest outlet (elevation 206.0 ft) was 0 ac-ft. The 1996 elevation-area-capacity table indicates that Somerville Lake had a volume of 155,062 ac-ft and a surface area of 11,456 acres at the TOC pool.

A comparative summary of the historical data and the results of the TWDB 2003 resurvey are presented in Table 2. Comparisons between the original design volume calculations and the two TWDB volumetric surveys are difficult and some apparent changes might simply be due to methodological differences. 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 of Somerville Lake

FEATURE	USACE Original Design	TWDB Volumetric Survey	TWDB Current Survey
Year	1959	1995	2003
Area (acres)	11,460	11,456	11,555
Volume (ac-ft)	160,100	155,062	147,104

Notes:

1. Original design data was furnished by the U. S. Army Corps of Engineers, Fort Worth District

2. All results from top of conservation pool elevation 238.0 ft

REFERENCES

1. Texas Water Development Board. 1966. Report 48. "Dams and Lakes in Texas, Historical and Descriptive Information"

2. Texas Water Development Board, 1996, "Volumetric Survey of Somerville Lake"

3. United States Geological Survey, 2002, Water Data Report TX-02-3. "Water Resources Data Texas Water Year 2002"

4. United States Army Corps of Engineers, Fort Worth District, Reservoir Control Office. December 2003 <http://www.swf-wc.usace.army.mil/> December 2003

5. Texas Water Development Board. 1973. Report 126 Part II. "Engineering Data on Dams and Lakes in Texas"

6. Texas Water Commission, 1987, Certificate of Adjudication 12-5164

7. ESRI, Environmental Systems Research Institute, 1995. ARC/INFO Surface Modeling and Display, TIN Users Guide.

8. ESRI, Environmental Systems Research Institute, 2002. "What is ArcGIS"

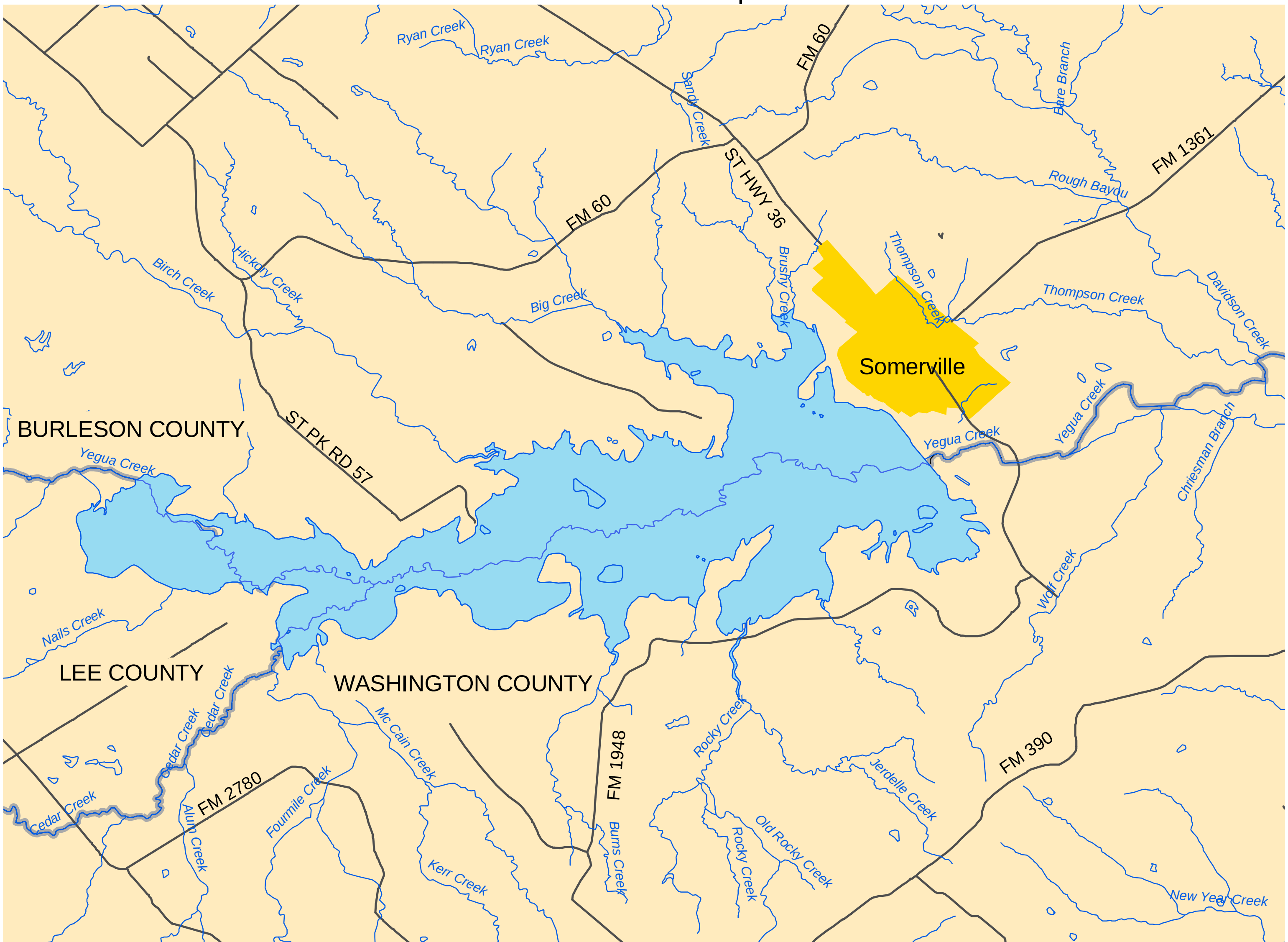
9. http://www.coastalo.com, Coastal Oceanographics, Inc., 2003. "HYPACK MAX Gold, v2.12A"

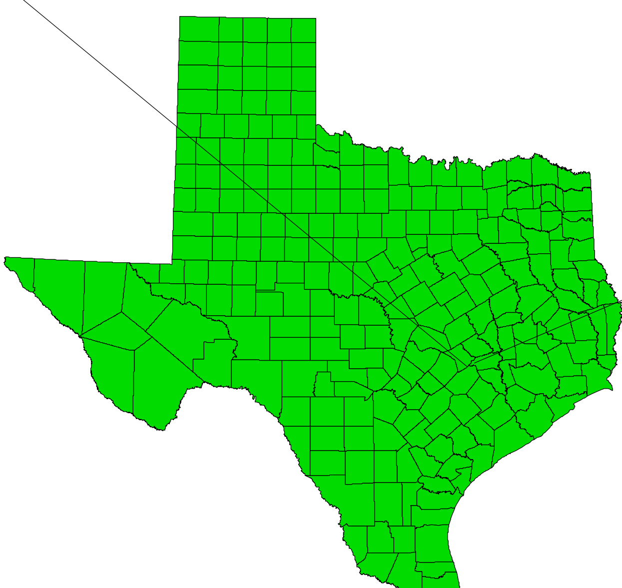
10. Odem Hydrographic Systems, Inc., 1999. "Digibar-Pro Profiling Sound Velocimeter Operation Manual"

Figure 1

SOMERVILLE LAKE

Location Map



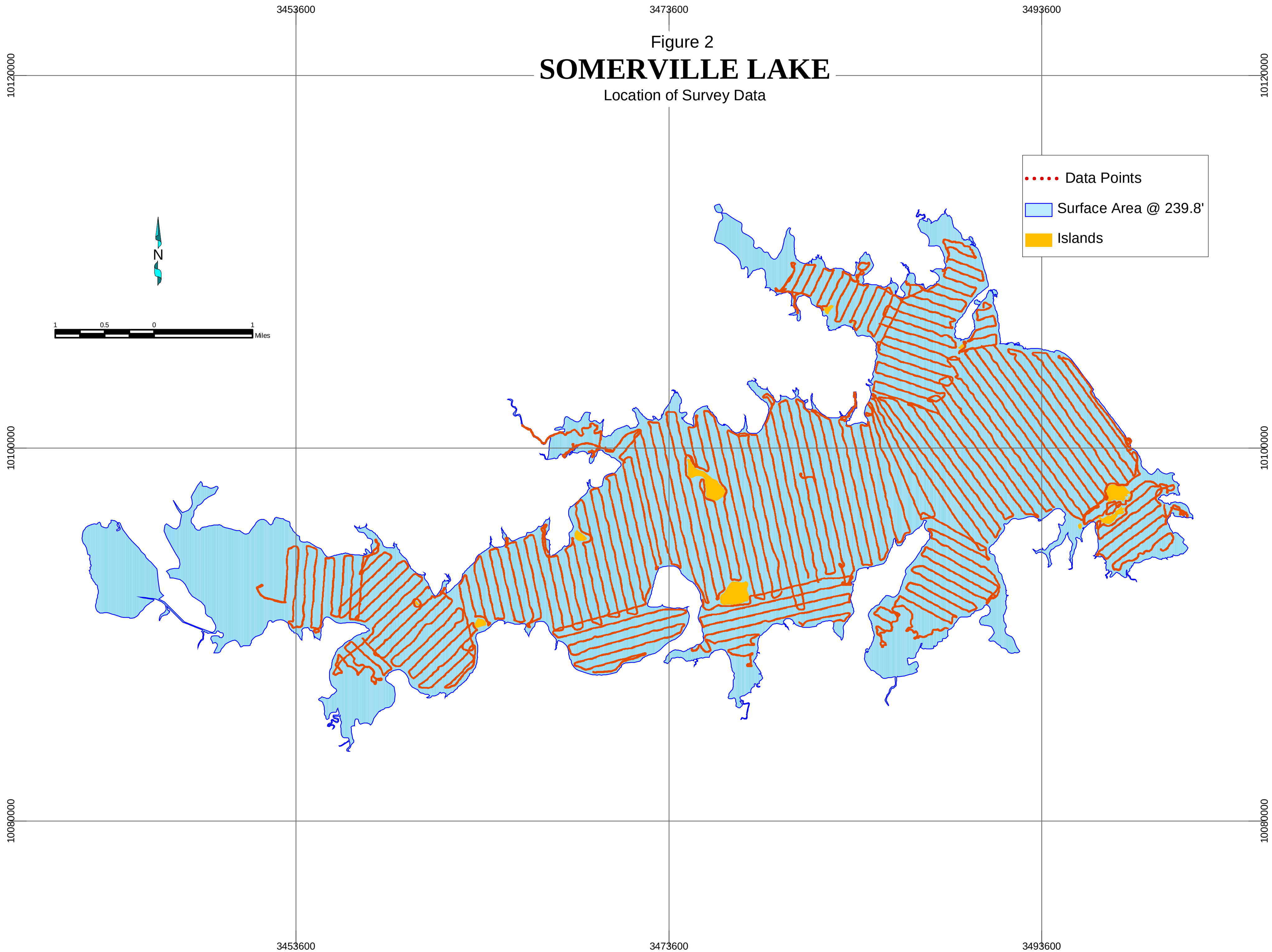


TWDB Survey July 2003

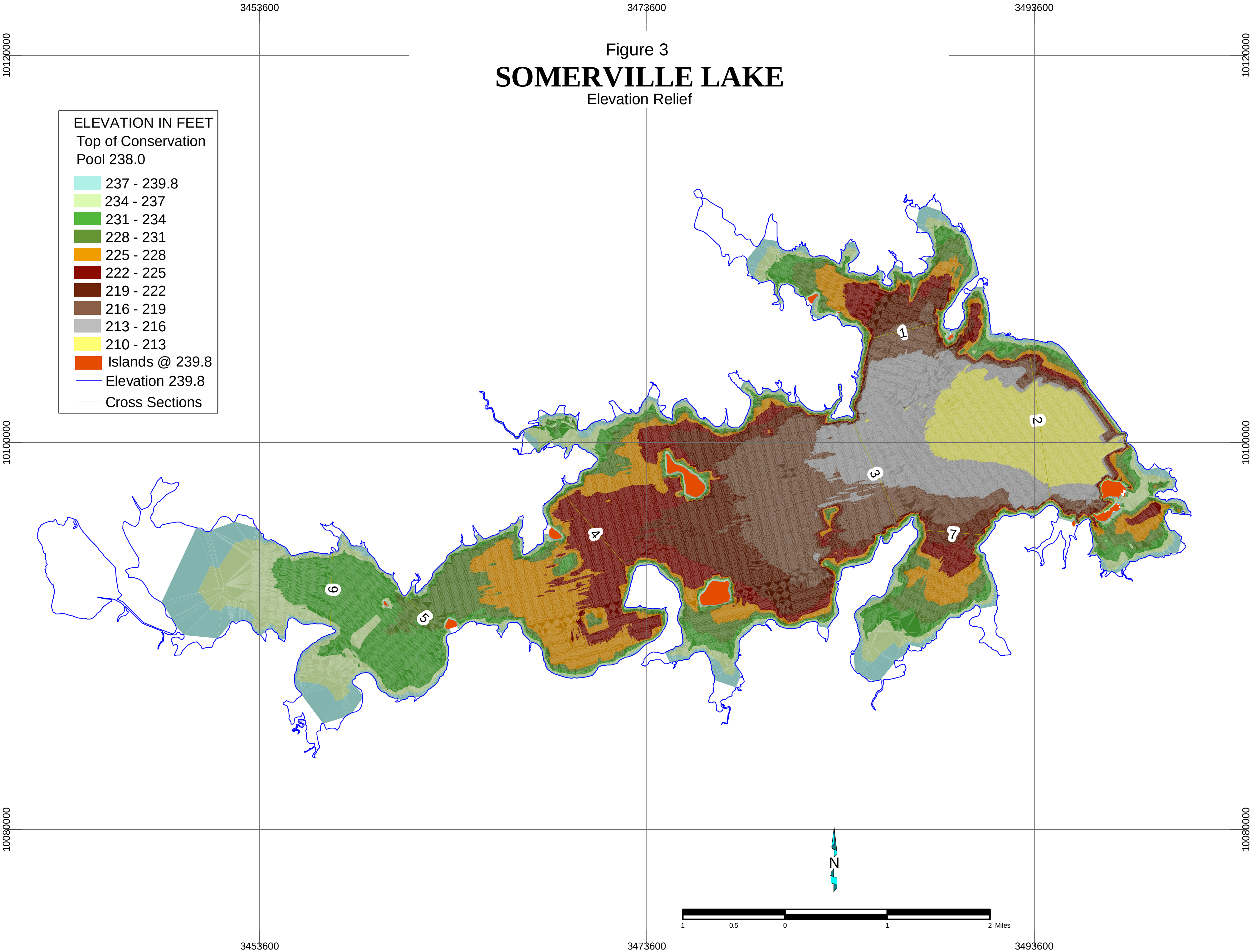
Figure 2

SOMERVILLE LAKE

Location of Survey Data



TWDB Survey July 2003



TWDB Survey July 2003

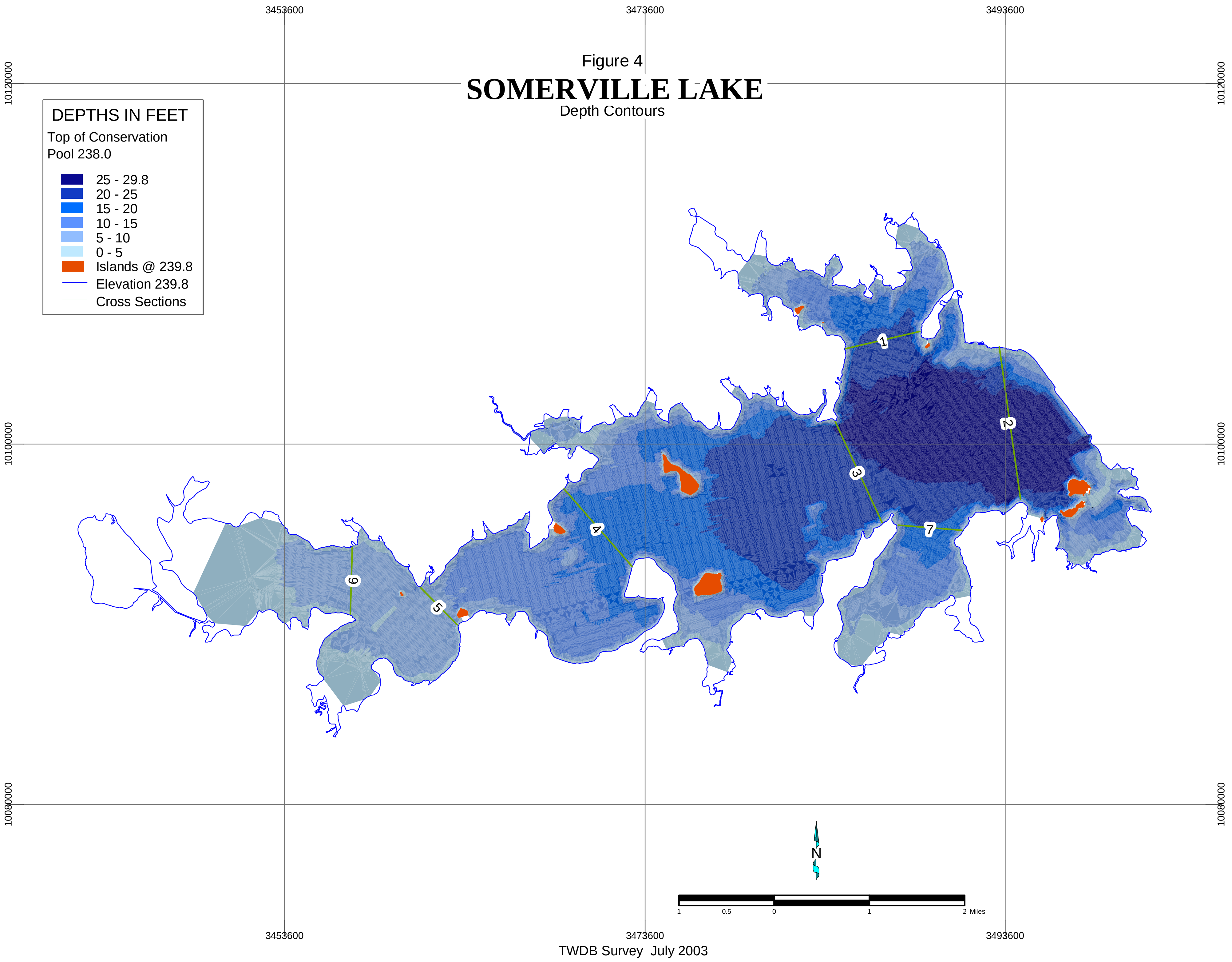


Figure 4
SOMERVILLE LAKE
Depth Contours
DEPTHS IN FEET
Top of Conservation
Pool 238.0
25 - 29.8
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Islands @ 239.8
Elevation 239.8
Cross Sections
3453600
3473600
3493600
10120000
10100000
10080000
1
2
3
4
5
6
7
N
1
0.5
0
1
2 Miles
TWDB Survey July 2003

Appendix A

Somerville Lake

RESERVOIR VOLUME TABLE

TEXAS WATER DEVELOPMENT BOARD JULY 2003 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
210	0	0	0	1	2	5	10	17	27	39
211	53	73	97	127	160	196	237	282	331	384
212	440	500	563	630	699	772	848	927	1009	1094
213	1182	1273	1368	1465	1566	1670	1777	1886	1999	2115
214	2235	2358	2486	2618	2754	2895	3040	3189	3343	3500
215	3660	3824	3992	4163	4337	4516	4699	4886	5077	5272
216	5472	5677	5888	6103	6323	6548	6779	7016	7258	7506
217	7757	8013	8272	8535	8802	9072	9346	9623	9905	10191
218	10481	10776	11074	11377	11685	11996	12312	12632	12956	13283
219	13615	13950	14290	14632	14979	15328	15681	16037	16396	16758
220	17123	17491	17862	18236	18612	18992	19375	19761	20150	20542
221	20937	21336	21739	22146	22556	22970	23388	23809	24233	24661
222	25093	25527	25965	26406	26851	27299	27750	28205	28663	29124
223	29589	30057	30528	31003	31482	31964	32449	32939	33432	33929
224	34430	34935	35445	35961	36483	37011	37546	38085	38629	39179
225	39736	40299	40868	41442	42021	42606	43195	43789	44387	44989
226	45595	46206	46819	47437	48059	48684	49314	49947	50585	51226
227	51871	52521	53173	53830	54490	55155	55824	56497	57176	57858
228	58545	59236	59931	60629	61332	62038	62748	63461	64178	64899
229	65623	66351	67082	67816	68554	69295	70039	70786	71537	72290
230	73047	73806	74569	75335	76104	76875	77650	78427	79208	79992
231	80780	81571	82367	83167	83972	84781	85595	86412	87235	88063
232	88896	89734	90576	91424	92276	93133	93995	94861	95733	96609
233	97491	98378	99269	100165	101065	101971	102880	103795	104713	105637
234	106566	107500	108438	109381	110328	111280	112236	113196	114160	115129
235	116103	117081	118063	119050	120042	121039	122041	123048	124059	125074
236	126092	127113	128137	129163	130193	131226	132261	133300	134342	135387
237	136435	137487	138542	139600	140661	141727	142795	143867	144942	146021
238	147104	148190	149279	150373	151470	152571	153676	154785	155897	157014
239	158134	159259	160387	161520	162656	163797	164942	166091	167245	

Above TOC

Appendix B

Somerville Lake

RESERVOIR VOLUME TABLE

TEXAS WATER DEVELOPMENT BOARD — November 1995 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
203	0	0	0	0	0	0	0	0	0	0
204	0	0	0	0	0	0	0	0	0	0
205	0	0	0	0	0	0	0	0	0	0
206	0	0	0	0	0	0	0	0	0	0
207	0	0	0	0	0	0	0	0	0	0
208	0	0	0	0	0	0	0	0	1	1
209	2	4	7	11	15	21	29	39	53	70
210	91	116	147	182	222	266	313	363	417	473
211	533	597	663	731	802	877	954	1035	1119	1207
212	1297	1390	1486	1584	1684	1786	1891	1998	2107	2220
213	2335	2454	2576	2702	2832	2965	3102	3244	3390	3540
214	3694	3851	4012	4176	4343	4516	4693	4875	5061	5253
215	5450	5651	5856	6067	6283	6505	6733	6966	7204	7447
216	7693	7944	8199	8457	8719	8986	9256	9530	9808	10091
217	10377	10668	10962	11261	11564	11871	12183	12499	12819	13143
218	13471	13803	14138	14476	14818	15164	15512	15865	16220	16579
219	16941	17306	17675	18046	18421	18799	19180	19564	19951	20341
220	20734	21130	21529	21932	22337	22746	23158	23572	23989	24409
221	24833	25259	25688	26120	26555	26992	27433	27878	28325	28776
222	29230	29687	30148	30612	31080	31552	32028	32508	32993	33482
223	33977	34477	34982	35494	36014	36541	37073	37610	38153	38700
224	39252	39809	40370	40937	41508	42085	42667	43253	43843	44438
225	45038	45641	46249	46861	47476	48096	48719	49345	49976	50609
226	51247	51888	52532	53180	53831	54486	55144	55806	56471	57140
227	57813	58490	59171	59856	60544	61235	61930	62628	63330	64036
228	64745	65457	66172	66891	67613	68338	69066	69797	70532	71269
229	72010	72755	73502	74252	75005	75762	76521	77283	78047	78815
230	79587	80362	81141	81924	82712	83505	84303	85105	85912	86723
231	87539	88360	89185	90016	90852	91692	92536	93385	94239	95096
232	95957	96822	97691	98563	99440	100320	101204	102091	102982	103877
233	104775	105677	106582	107490	108403	109319	110238	111161	112088	113019
234	113954	114893	115835	116781	117732	118686	119646	120610	121579	122553
235	123535	124521	125511	126504	127501	128502	129507	130516	131529	132545
236	133566	134593	135624	136658	137696	138739	139785	140836	141891	142951
237	144015	145087	146165	147251	148343	149443	150554	151671	152795	153925
238	155062									

Appendix C

Somerville Lake

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD JULY 2003 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
203	0	0	0	0	0	0	0	0	0	0
204	0	0	0	0	0	0	0	0	0	0
205	0	0	0	0	0	0	0	0	0	0
206	0	0	0	0	0	0	0	0	0	0
207	0	0	0	0	0	0	0	0	0	0
208	0	0	0	0	0	0	1	2	4	8
209	14	24	32	42	54	67	88	116	151	189
210	234	280	327	374	421	458	488	518	551	585
211	616	645	674	699	727	760	792	824	858	889
212	917	943	969	992	1013	1035	1057	1082	1109	1139
213	1170	1204	1242	1278	1313	1351	1397	1440	1482	1520
214	1557	1588	1621	1657	1698	1746	1797	1843	1891	1941
215	1987	2032	2081	2137	2190	2248	2306	2358	2404	2445
216	2485	2529	2566	2604	2641	2681	2722	2764	2804	2844
217	2885	2924	2966	3009	3052	3093	3137	3182	3223	3261
218	3298	3333	3367	3401	3438	3473	3505	3537	3572	3606
219	3638	3668	3699	3732	3764	3794	3824	3855	3885	3916
220	3947	3977	4008	4040	4071	4100	4129	4159	4188	4217
221	4246	4274	4305	4335	4364	4394	4426	4457	4491	4523
222	4558	4592	4626	4661	4698	4736	4780	4826	4872	4920
223	4971	5024	5086	5160	5233	5293	5348	5400	5449	5496
224	5544	5592	5640	5690	5742	5792	5838	5884	5929	5972
225	6015	6058	6098	6136	6174	6212	6250	6285	6320	6356
226	6391	6426	6461	6495	6529	6564	6600	6636	6673	6711
227	6750	6788	6827	6863	6897	6931	6967	7003	7037	7072
228	7105	7138	7170	7203	7234	7266	7298	7330	7362	7393
229	7425	7457	7487	7518	7548	7577	7605	7634	7664	7696
230	7731	7769	7810	7855	7907	7955	8001	8045	8089	8136
231	8185	8232	8281	8331	8379	8424	8468	8511	8551	8591
232	8631	8670	8708	8745	8783	8820	8857	8893	8928	8963
233	8998	9034	9069	9105	9141	9177	9214	9250	9287	9328
234	9368	9404	9443	9484	9526	9571	9616	9667	9713	9772
235	9842	9879	9916	9953	9991	10029	10068	10108	10147	10188
236	10250	10286	10324	10362	10402	10444	10486	10530	10575	10621
237	10685	10749	10816	10887	10961	11079	11142	11205	11269	11335
238	11456									

Appendix D

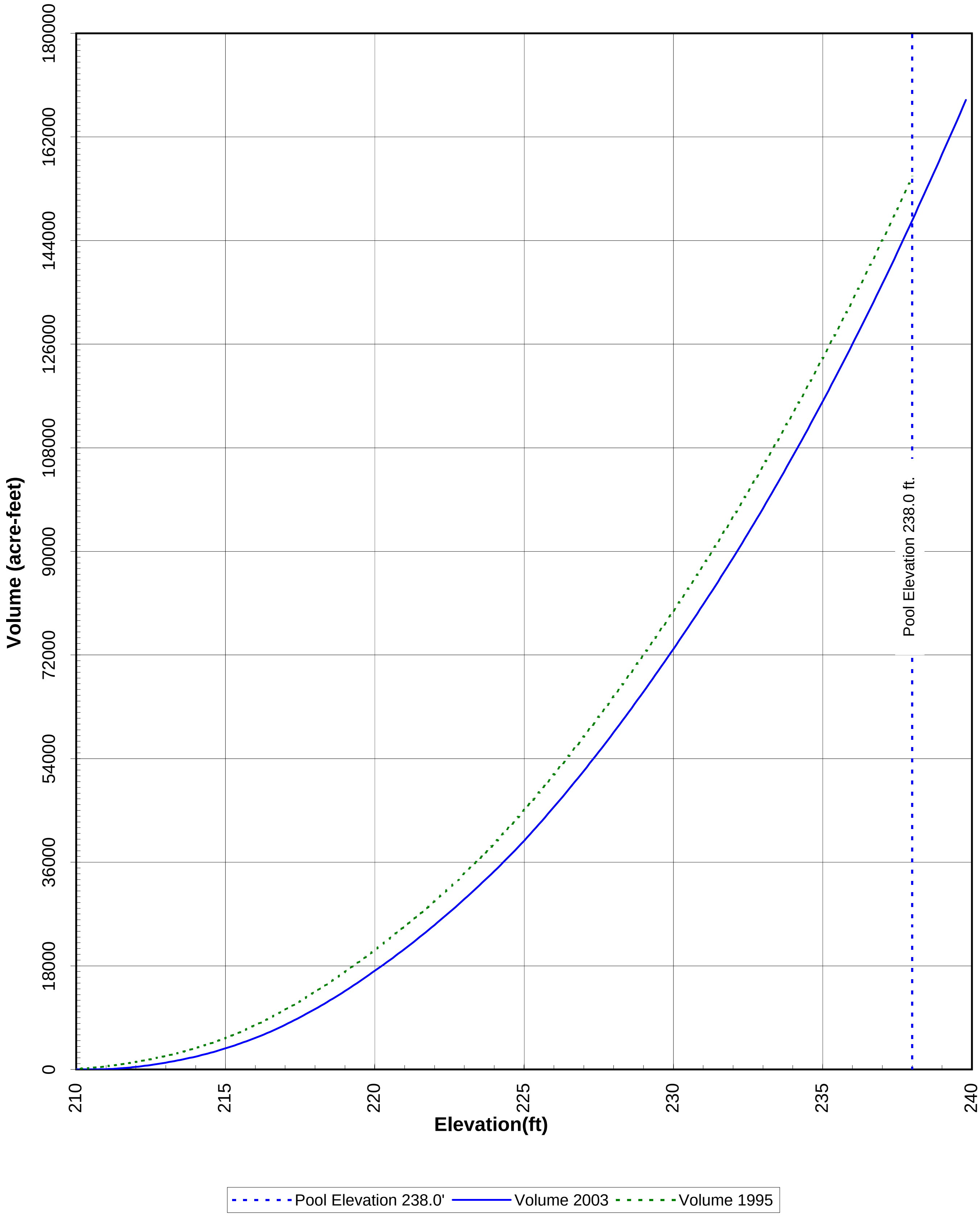
Somerville Lake

RESERVOIR AREA TABLE

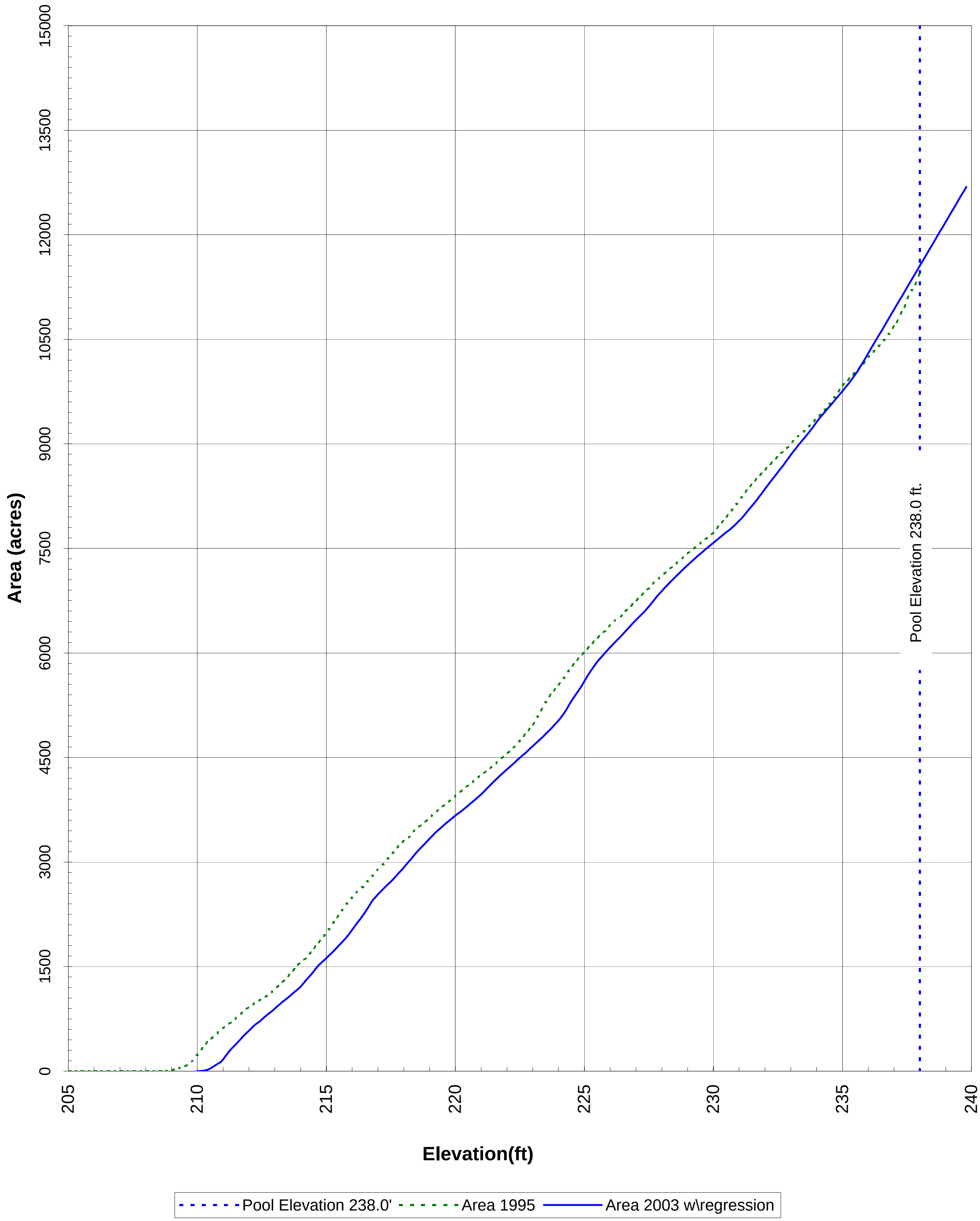
TEXAS WATER DEVELOPMENT BOARD November 1995 SURVEY

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
203	0	0	0	0	0	0	0	0	0	0
204	0	0	0	0	0	0	0	0	0	0
205	0	0	0	0	0	0	0	0	0	0
206	0	0	0	0	0	0	0	0	0	0
207	0	0	0	0	0	0	0	0	0	0
208	0	0	0	0	0	0	1	2	4	8
209	14	24	32	42	54	67	88	116	151	189
210	234	280	327	374	421	458	488	518	551	585
211	616	645	674	699	727	760	792	824	858	889
212	917	943	969	992	1013	1035	1057	1082	1109	1139
213	1170	1204	1242	1278	1313	1351	1397	1440	1482	1520
214	1557	1588	1621	1657	1698	1746	1797	1843	1891	1941
215	1987	2032	2081	2137	2190	2248	2306	2358	2404	2445
216	2485	2529	2566	2604	2641	2681	2722	2764	2804	2844
217	2885	2924	2966	3009	3052	3093	3137	3182	3223	3261
218	3298	3333	3367	3401	3438	3473	3505	3537	3572	3606
219	3638	3668	3699	3732	3764	3794	3824	3855	3885	3916
220	3947	3977	4008	4040	4071	4100	4129	4159	4188	4217
221	4246	4274	4305	4335	4364	4394	4426	4457	4491	4523
222	4558	4592	4626	4661	4698	4736	4780	4826	4872	4920
223	4971	5024	5086	5160	5233	5293	5348	5400	5449	5496
224	5544	5592	5640	5690	5742	5792	5838	5884	5929	5972
225	6015	6058	6098	6136	6174	6212	6250	6285	6320	6356
226	6391	6426	6461	6495	6529	6564	6600	6636	6673	6711
227	6750	6788	6827	6863	6897	6931	6967	7003	7037	7072
228	7105	7138	7170	7203	7234	7266	7298	7330	7362	7393
229	7425	7457	7487	7518	7548	7577	7605	7634	7664	7696
230	7731	7769	7810	7855	7907	7955	8001	8045	8089	8136
231	8185	8232	8281	8331	8379	8424	8468	8511	8551	8591
232	8631	8670	8708	8745	8783	8820	8857	8893	8928	8963
233	8998	9034	9069	9105	9141	9177	9214	9250	9287	9328
234	9368	9404	9443	9484	9526	9571	9616	9667	9713	9772
235	9842	9879	9916	9953	9991	10029	10068	10108	10147	10188
236	10250	10286	10324	10362	10402	10444	10486	10530	10575	10621
237	10685	10749	10816	10887	10961	11079	11142	11205	11269	11335
238	11456									



Somerville Lake
July 2003
Prepared by: TWDB



Somerville Lake
July 2003
Prepared by: TWDB

Appendix G

Somerville Lake

TEXAS WATER DEVELOPMENT BOARD JULY 2003 SURVEY

Range Line Endpoints

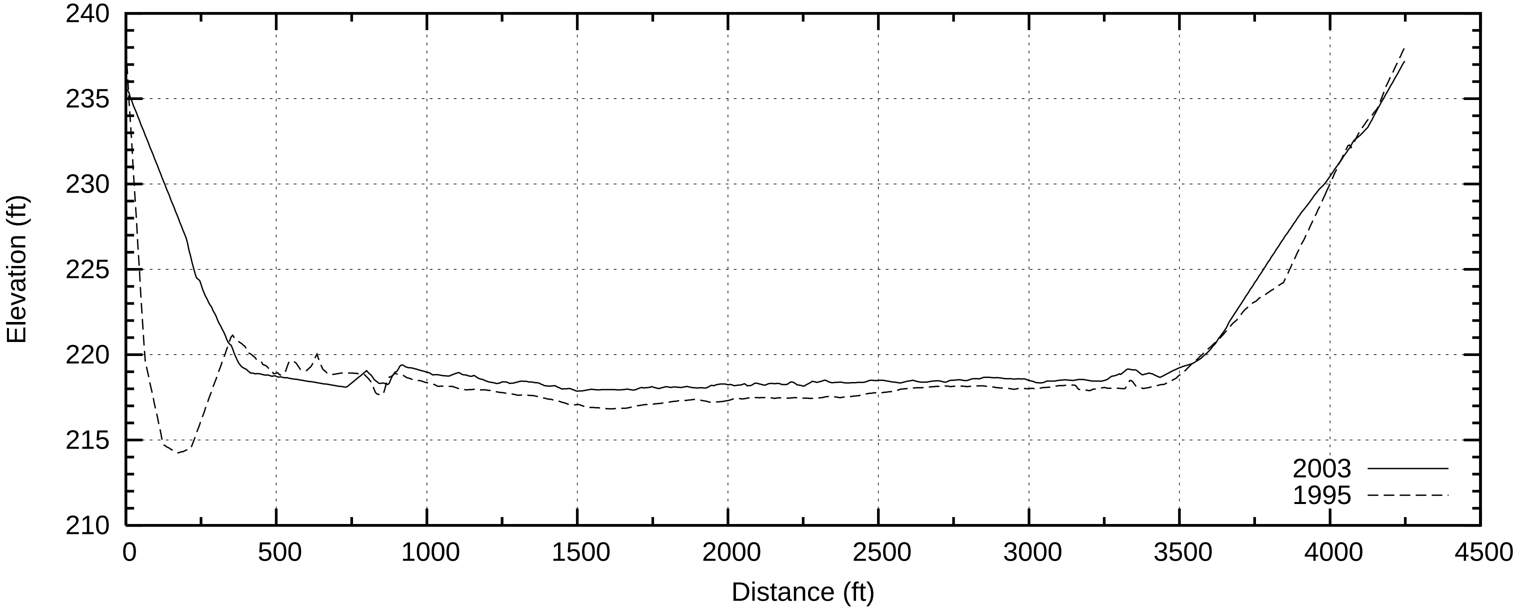
State Plane NAD83 Units-feet

L-Left endpoint
R-right endpoint

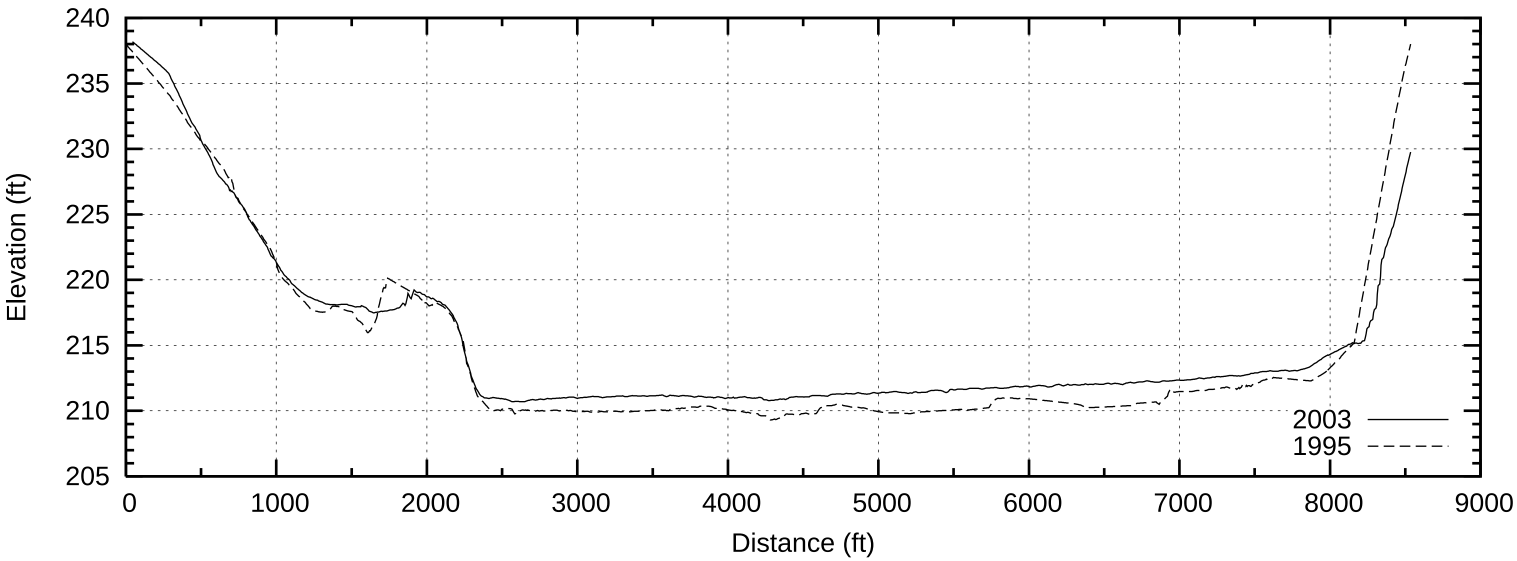
Range Line	X	Y
SR 01-L	3488838.2	10106239.7
SR 01-R	3484702.7	10105268.3
SR 02-L	3493235.2	10105382.7
SR 02-R	3494423.7	10096930.9
SR 03-L	3484139.4	10101231.4
SR 03-R	3486745.5	10095644.6
SR 04-L	3469117.5	10097512.9
SR 04-R	3472890.2	10093212.3
SR 05-L	3461157.1	10092042.9
SR 05-R	3463192.6	10089971.7
SR 06-L	3457382.5	10094279.3
SR 06-R	3457272.3	10090552.8
SR 07-L	3487632.8	10095495.2
SR 07-R	3491166.3	10095207.3

Somerville Lake

Range Line SR01

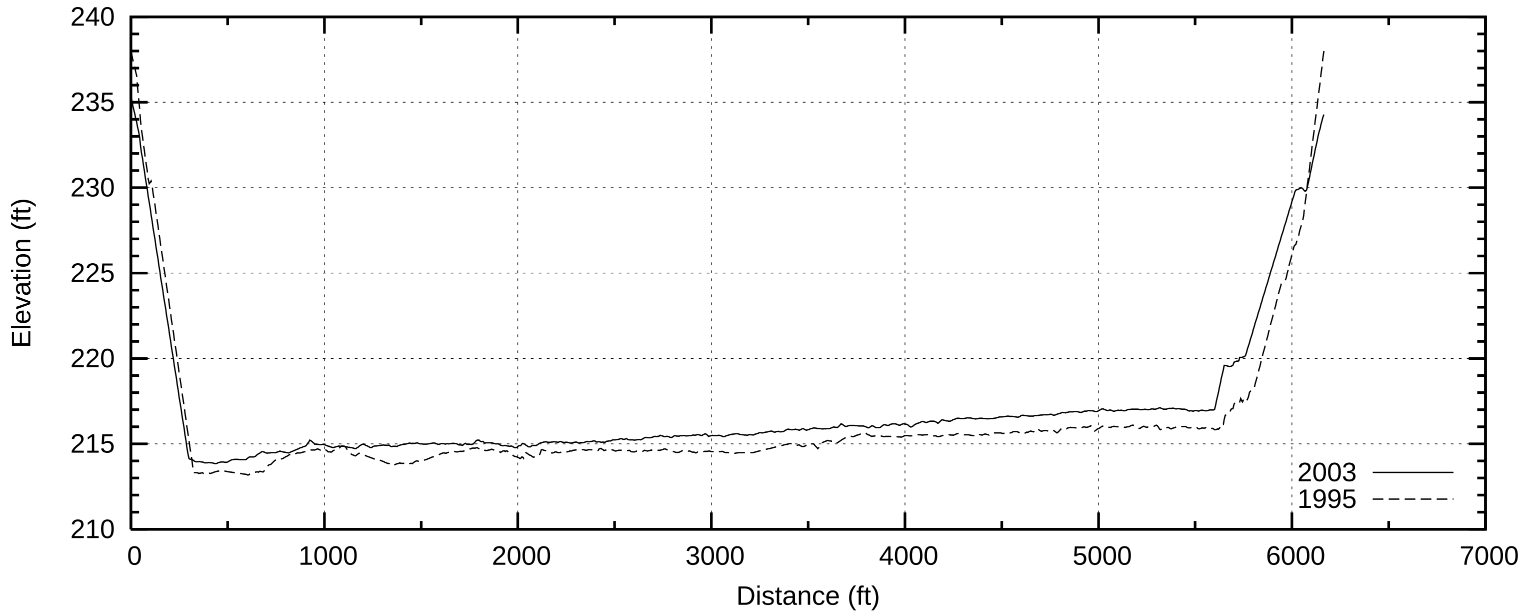


Range Line SR02

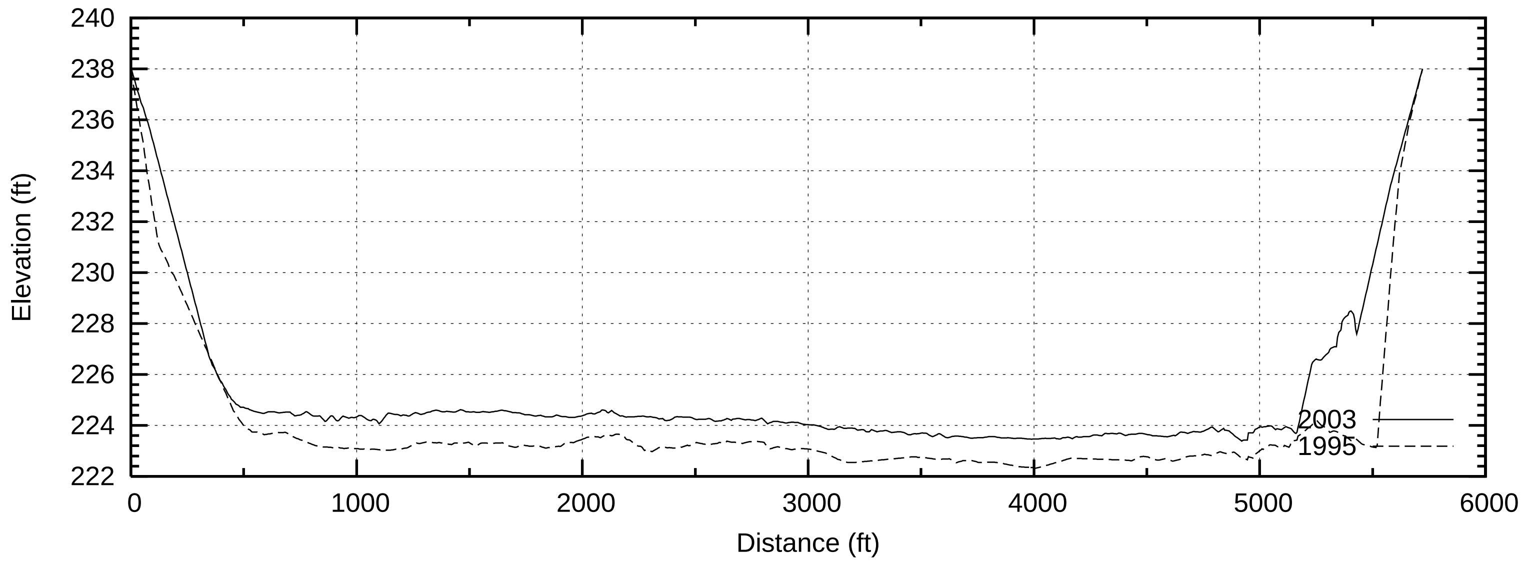


Somerville Lake

Range Line SR03

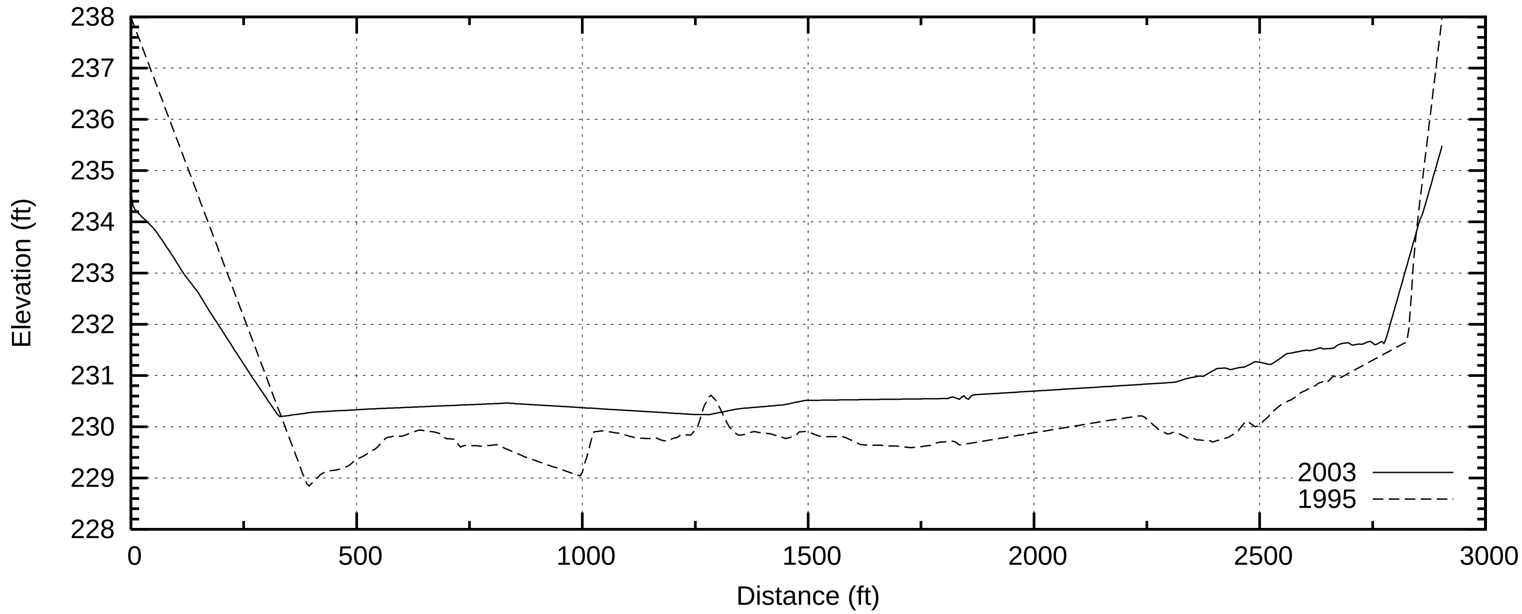


Range Line SR04

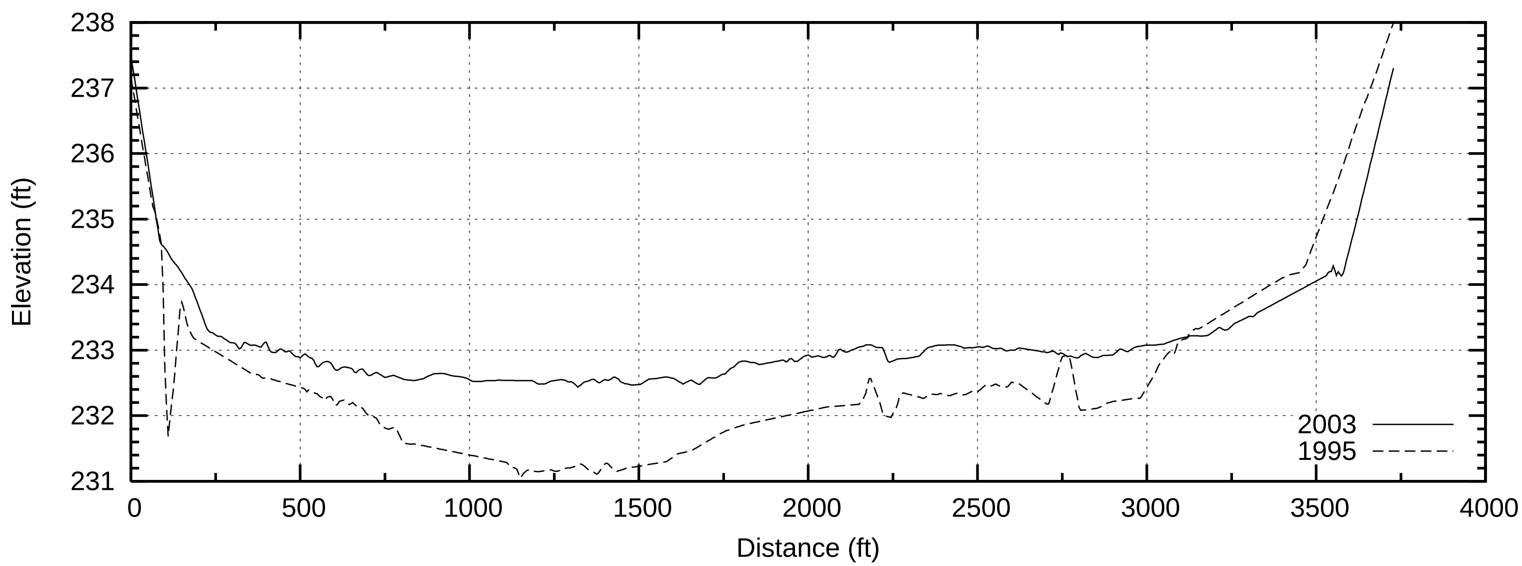


Somerville Lake

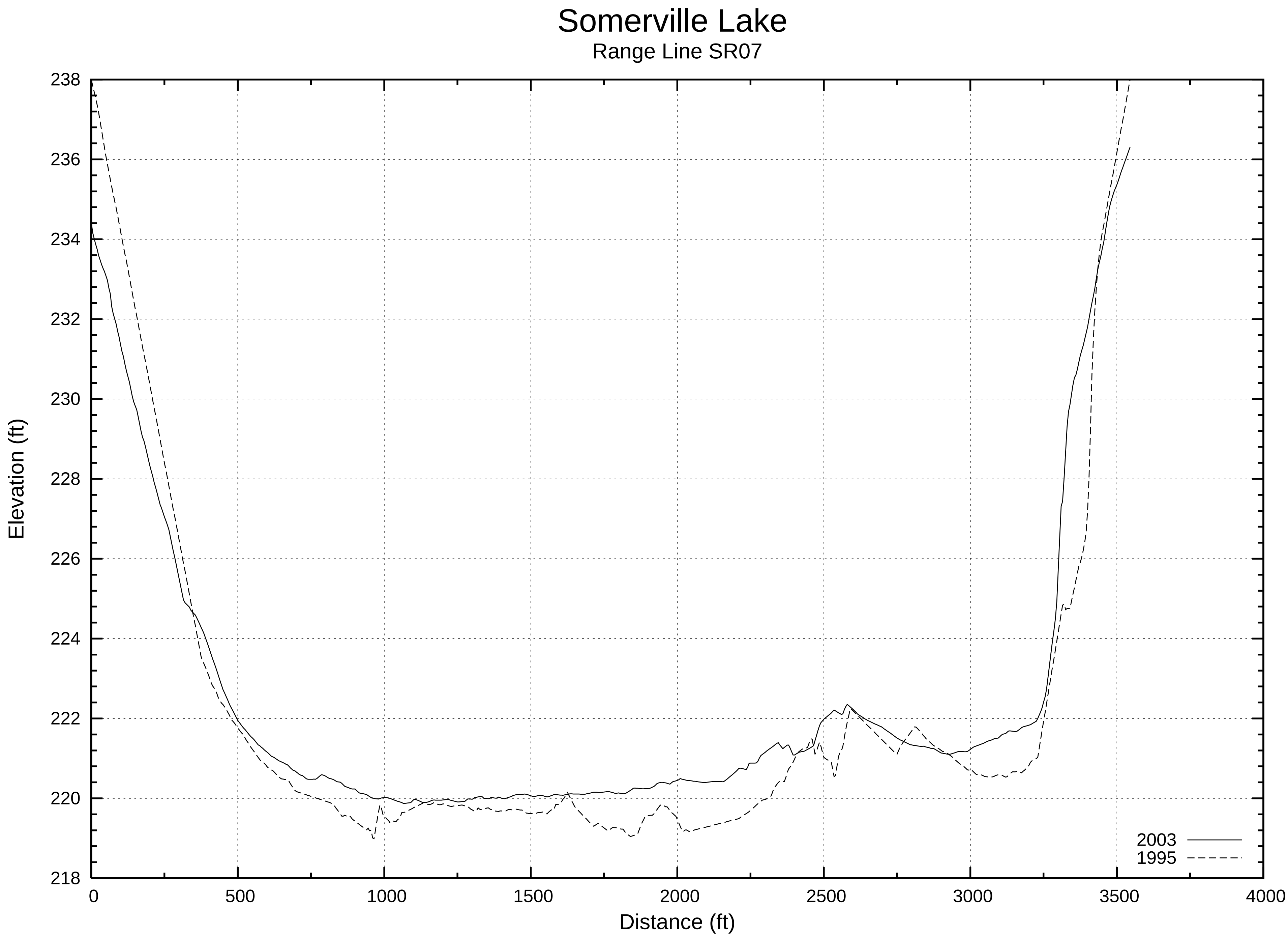
Range Line SR05



Range Line SR06



Appendix H


Somerville Lake
Range Line SR07
Elevation (ft)
238
236
234
232
230
228
226
224
222
220
218
0
500
1000
1500
2000
2500
3000
3500
4000
Distance (ft)
2003
1995

Water Surface @ 239.8'

Islands

Cross Sections

Contours

212

214

216

218

220

222

224

226

228

230

232

234

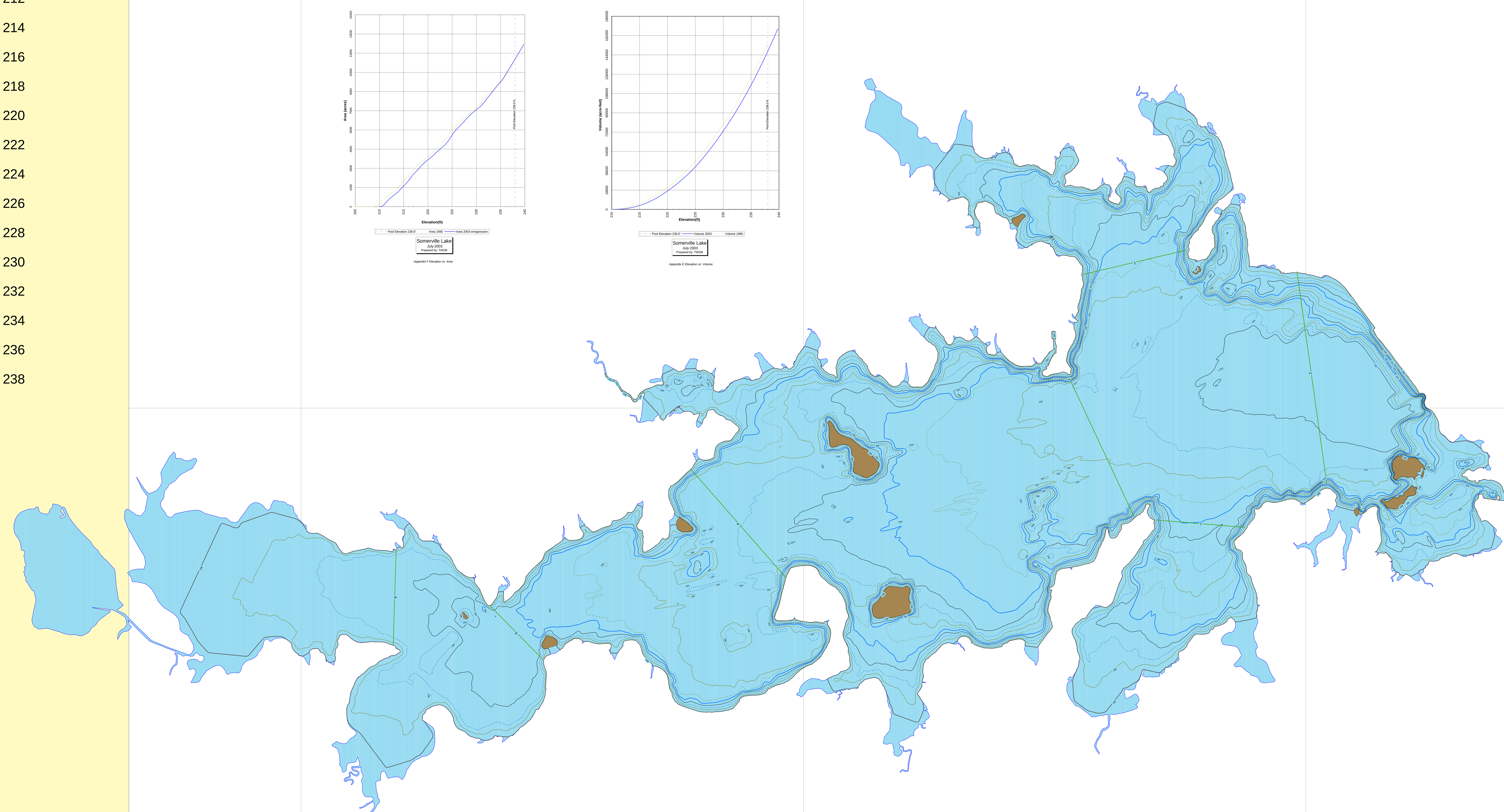
236

238

Figure 5

SOMERVILLE LAKE

2' - Contour Map



1 0.5 0 1 2 Miles

This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of Somerville Lake. The Texas Water Development Board makes no representations or assumes any liability.

Prepared by : TEXAS WATER DEVELOPMENT BOARD MARCH 2003