

Volumetric Survey of Lake Whitney

June 2005 Survey



Prepared by:

The Texas Water Development Board

September 2006

Texas Water Development Board

J. Kevin Ward, Executive Administrator

Texas Water Development Board

E. G. Rod Pittman, Chairman
William W. Meadows, Member
Dario Vidal Guerra, Jr., Member

Jack Hunt, Vice Chairman
Thomas Weir Labatt III, Member
James Herring, Member

Prepared for:

Brazos River Authority

In cooperation with:

U.S Army Corps of Engineers, Fort Worth District

Authorization for use or reproduction of any original material contained in this publication, i.e. not obtained from other sources, is freely granted. The Board would appreciate acknowledgment.

This report was prepared by staff of the Surface Water Resources Division:

Barney Austin, Ph.D.

Duane Thomas
Randall Burns
Tony Connell
Holly Weyant

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

Executive Summary

In May of 2005, the Texas Water Development Board (TWDB) entered into agreement with the Brazos River Authority, for the purpose of performing a volumetric survey of Lake Whitney while the reservoir was near the top of the conservation pool elevation. This information was converted into updated Elevation-Volume and Elevation-Area Tables. Additionally, the results of the 2005 survey were compared to a previous resurvey of Lake Whitney conducted by the U.S. Army Corps of Engineers (USACE) in 1959. Cross-sections from the 2005 survey are compared to similar cross-sections from the 1959 USACE resurvey and to the original cross-sections of 1951, as plotted in the 1959 report.

The results of the TWDB 2005 Survey indicate Lake Whitney has a capacity of 554,203 acre-feet and encompasses 23,220 acres at the conservation pool elevation of 533.0 feet above mean sea level. The Report of Sedimentation, Resurvey, Whitney Reservoir, in 1959 by the USACE indicated Lake Whitney had a volume of 627,100 acre-feet and encompassed 23,560 acres at conservation pool elevation. It appears that between 2005 and 1959, Lake Whitney lost 72,897 acre-feet or 11.6% of its capacity and experienced a 1.4 % decrease in area.

Forty-three sediment range lines were established in 1951 by the USACE and thirty-two were resurveyed in 1959. The original range line end points are unavailable, therefore, TWDB staff re-established sediment range lines in the vicinity of the original range lines. Nine cross-sections presented in the 1959 report, including both the 1951 and the 1959 cross-sections, are presented for comparison with the 2005 cross-sections in Appendix G.

Table of Contents

Lake Whitney General Information.....	1
Volumetric Survey of Lake Whitney.....	3
Introduction.....	3
Bathymetric Survey	3
Datum.....	4
Survey Results	4
Data Processing.....	5
Model Boundary	5
Triangular Irregular Network (TIN) Model.....	6
Sediment Range Lines	7
References.....	8

List of Tables

Table 1: Pertinent Data for Whitney Dam and Lake Whitney

Table 2: Area and Volume Comparisons of Lake Whitney

Table 3: Endpoint Coordinates of Sediment Range Lines

List of Figures

Figure 1: Location of Lake Whitney Map

Figure 2: Map of TWDB 2005 Survey Data

Figure 3: Elevation Relief Map

Figure 4: Depth Ranges Map

Figure 5: Contour Map

Appendices

APPENDIX A: 2005 LAKE WHITNEY VOLUME TABLE

APPENDIX B: 2005 LAKE WHITNEY AREA TABLE

APPENDIX C: 2005 ELEVATION- VOLUME GRAPH

APPENDIX D: 2005 ELEVATION- AREA GRAPH

APPENDIX E: VOLUME COMPARISONS BETWEEN 2005 AND 1959

APPENDIX F: ELEVATION-VOLUME GRAPH COMPARING 2005 AND 1959

APPENDIX G: SEDIMENT RANGE LINES

Lake Whitney General Information

Lake Whitney is located in Bosque and Hill Counties on the main stem of the Brazos River in Central Texas. The primary purpose of Lake Whitney is flood control. Secondly the lake supports the production of hydroelectric power and recreation. Lake Whitney is a part of the Mid-Brazos Project in the Fort Worth District of the U.S. Army Corps of Engineers.¹

Lake Whitney was originally authorized by Congress under the Flood Control Act of August 18, 1941 (Public Law 228, 77th Congress, 1st Session)². However, when the U.S. became involved in World War II all funding was diverted to the war effort. Construction was reauthorized by the Flood Control Act of December 22, 1944 (Public Law 534, 78th Congress, 2nd Session).^{2,3} Construction of Whitney Dam began on May 12, 1947, and deliberate impoundment began on December 10, 1951. Construction of the powerhouse began in April 1951 and power generation began on June 25, 1953.^{2,3} Whitney Dam powerhouse uses two 13,000 volt generators that produce 15,000 kilowatts per hour and have a turbine capacity of 20,700 horsepower, each. Average annual power production is 73,100,000 kilowatt-hours.⁴

Lake Whitney is owned by the U.S Government and operated by the U.S Army Corps of Engineers. The water rights to Lake Whitney are appropriated to the Brazos River Authority (BRA) by Certificate of Adjudication 12-5157, with a priority date of August 30, 1982. The BRA is authorized to impound 50,000 acre-feet of water, between elevations 520 feet and 533 feet above mean sea level, in Lake Whitney. The certificate authorizes a priority right to divert and use not to exceed 18,336 acre-feet of water per annum from the reservoir for municipal and industrial purposes. The amount of this priority right may be used in computing the sum of priority rights for the purpose of system operation as authorized by Commission Order of July 23, 1964. For purposes of system operation the BRA is authorized to exceed the priority right and annually divert and use from Lake Whitney not to exceed 25,000 acre-feet of water per annum for municipal purposes and 25,000 acre-feet of water for industrial purposes. All diversions and use of water exceeding 18,336 acre-feet in any calendar year shall be charged against the sum of the amounts designated as priority rights in other reservoirs included in the

System Operation Order. The owner is also authorized to use the water impounded for non-consumptive recreational uses. Section 5-O renders this certificate junior in priority rights to any rights which may be granted by the Texas Water Commission to the City of Stephenville pursuant to Application No. 4237.

Additionally, the BRA has subordinated their Lake Whitney rights to Somervell County Water District's Permit 5744. The complete certificates and permits are on file in the Records Division of the Texas Commission on Environmental Quality (TCEQ).

More information about Whitney Dam and Lake Whitney are presented below in Table 1. A map showing the location of Lake Whitney is presented in Figure 1.

Table 1. Pertinent Data for Whitney Dam and Lake Whitney^{5,6}

Owner of Lake Whitney and Facilities	
The U.S. Government, Operated by the U.S. Army Corps of Engineers, Fort Worth District.	
Engineer (Design)	
U.S Army Corps of Engineers	
Location of Dam	
River Mile 442.4 on the Brazos River in Hill and Bosque Counties, 38 miles upstream from Waco, and 7.4 miles southwest of the City of Whitney.	
Drainage Area	
Approximately 27,189 square miles, of which 9,566 square miles is probably noncontributing.	
Dam	
Type	Concrete gravity and earthfill
Length	17,695 ft
Maximum Height	159 ft
Top Width	Embankment 34 ft and spillway 28 ft
Spillway	
Type	Ogee
Length (net at crest)	680.0 ft
Crest elevation	533.0 ft above msl
Control	17 tainter gates, each 40 by 38 ft
Outlet Works	
Type	16 conduits, each 5 by 9 ft
Control	Gates operated from tunnel
Invert elevation	448.83 ft above msl
Power Generation Features	
Number of units	2
Total capacity	30,000 kw

Table 1. Pertinent Data for Whitney Dam and Lake Whitney (Continued)

Reservoir Data (Based on TWDB 2005 Volumetric Survey)

Feature	Elevation (ft above msl)	Capacity (Acre-feet)	Area (Acres)
Top of Concrete Dam	584.0	N/A	N/A
Top of earth embankment	580.0	N/A	N/A
Maximum design water surface	573.0	N/A	N/A
Top of flood-control pool	571.0	N/A	N/A
Spillway Crest (top of ultimate Power pool)	533.0	554,203	23,220
Top of interim power pool	523.0	365,457	15,614
Invert of lowest intake*	448.83	854	165
Streambed**	425.0	0	0
Sediment reserve and power-head Storage space	520.0	320,711	14,301

*Capacity and area values given for elevation 448.8 ft above msl

**Lowest elevation surveyed during TWDB 2005 Survey: 432.71 ft above msl

Volumetric Survey of Lake Whitney

Introduction

In May of 2005, the Texas Water Development Board entered into agreement with the Brazos River Authority, for the purpose of performing a volumetric survey of Lake Whitney while the reservoir was at or near the top of the conservation pool elevation. This information was converted into updated Elevation-Volume and Elevation-Area Tables. Additionally, the results of the 2005 survey are compared to a prior survey of Lake Whitney conducted by the U.S. Army Corps of Engineers in 1959. Cross-sections of the 2005 survey are compared to cross-sections from the 1959 USACE report and to 1951 cross sections presented in the same report.

Bathymetric Survey

Bathymetric data collection for Lake Whitney occurred between June 20th and June 30th of 2005, while the water surface elevation was above the conservation pool elevation of 533.0 ft above mean sea level (msl). The water surface elevation varied between 533.30 ft and 533.81 ft above msl during the TWDB survey. The survey team used two boats equipped with depth sounders, velocity profilers, and integrated Differential Global Positioning System (DGPS) equipment to navigate along pre-planned range lines spaced approximately 500 feet apart in a perpendicular fashion to the original

stream channel. During the 2005 survey, the team navigated over 533 miles of range lines and collected over 270,000 data points. Figure 2 shows the data points collected during the TWDB 2005 survey.

The depth sounders were calibrated each day using the velocity profilers to measure the speed of sound in the water column and a weighted tape or stadia rod to verify the depth reading. The average speed of sound through the water column varied between 4,934.6 and 4,960.2 feet per second during the 2005 survey.

Datum

The vertical datum used during this survey is that used by the United States Geological Survey (USGS) for the reservoir elevation gauge USGS 08092500 Whitney Lk nr Whitney, TX.⁷ The datum for this gauge is reported as National Geodetic Vertical Datum 1929 (NGVD29) or mean sea level (msl), thus elevations reported here are in feet (ft) above msl. Volume and area calculations in this report are referenced to water levels provided by the USGS gauge. The horizontal datum used for this report is NAD83 State Plane Texas Central Zone.

Survey Results

The results of the TWDB 2005 Survey indicate Lake Whitney has a volume of 554,203 acre-feet and encompasses 23,220 acres at conservation pool elevation. The results of the TWDB survey are compared to the USACE 1959 Resurvey of Lake Whitney in Table 2.

Feature	USACE	TWDB
	Resurvey	Volumetric Survey
Year	1959	2005
Area (Acres)	23,560	23,220
Volume (Acre-feet)	627,100	554,203

Between the 2005 TWDB Survey and 1959, Lake Whitney appears to have lost 72,897 acre-feet or 11.6 % of its volume and experienced a 1.4 % decrease in area. The

USACE 1959 Resurvey consisted of resurveying 32 of the original 43 range lines that were established in 1951.² The original 1951 capacities for Lake Whitney are unavailable, although the 1959 report includes several tables of original volumes between many of the range lines. The Corps original calculations consisted of planimetry of the area within each 10-foot contour on maps prepared by the BRA in 1937 and 1938 and deriving the volumes from the area curve at each foot using the average end-area method. The ranges that were resurveyed in 1959 were spotted on the 10-foot contour map and the segmental areas were planimetryed at 10-foot intervals and capacities were calculated between the ranges.² Due to the methodological differences in computing the area and volume, direct comparisons of the TWDB 2005 survey with prior surveys of Lake Whitney are not recommended and are presented here for informational purposes only.⁸ The TWDB considers the 2005 survey to be a significant improvement over previous methods and recommends that Lake Whitney be resurveyed in 5 to 10 years. The Brazos River Authority might also want to consider using a multi-frequency depth sounder which would allow more accurate identification of sediment depth, location, and volume.

Data Processing

Model Boundary

The reservoir boundary was digitized from aerial photographs using Environmental Systems Research Institute's (ESRI) ArcGIS 9.1 software. The aerial photographs, or digital orthophoto quadrangle images (DOQs), used for Lake Whitney were Laguna Park, Smiths Bend, Allen Bend, Whitney, Lakeside Village, Blum, Brazos Point, Morgan, and Blanton. These images were photographed between August 4th and September 8th of 2004. At the time the photographs were taken, the water surface elevation measured between 533.32 ft and 532.72 ft above mean sea level. Although only two of the photographs were above conservation pool elevation, at the recommended mapping scale of 1:12,000 for the DOQs, the difference in the land water interface between photos of varying water surface elevations is indiscernible. Therefore,

for modeling purposes, the boundary was digitized at the land water interface from the photos, and assigned the conservation pool elevation of 533.0 ft.

The United States Department of Agriculture, Farm Service Agency's, Aerial Photography Field Office (APFO), National Agriculture Imagery Program (NAIP) acquires the photographic imagery during the agricultural growing seasons in the continental U.S.⁹ The imagery resides in the public domain and can be downloaded from the Texas Natural Resources Information System (TNRIS) website at <http://www.tnr.is.state.tx.us/>. For more information visit the APFO website at <http://www.apfo.usda.gov/NAIP.html> or contact TNRIS.

Triangular Irregular Network (TIN) Model

Upon completion of data collection, the raw data files are edited in HYPACK MAX to remove any data anomalies. The water surface elevations for each respective day are applied and the depths are converted to corresponding elevations and exported as a MASS points file. The MASS points and boundary files are used to create a Triangulated Irregular Network (TIN) model, a function of the 3D Analyst Extension of ArcGIS. The model uses Delauney's criteria for triangulation to place a triangle between three non-uniformly spaced points, including the boundary.¹⁰

Using Arc/Info software, volumes and areas are calculated from the TIN Model for the entire lake at one-tenth of a foot intervals, from elevation 432.7 ft to elevation 533.0 ft. The Elevation-Volume and Elevation-Area Tables, updated for 2005, are presented in Appendices A and B, respectively. An Elevation-Volume graph and an Elevation- Area graph are presented in Appendices C and D, respectively. Appendix E compares the Elevation-Volume Tables of 2005 to 1959, and Appendix F is a graphical representation comparing the 2005 volumes to 1959.

The TIN Model was interpolated and averaged using a cellsize of 10 ft and converted to a raster. The raster was used to produce Figure 3, an Elevation Relief Map representing the topography of the lake bottom, Figure 4, a map showing shaded depth ranges for Lake Whitney, and Figure 5, a 5-ft contour map.

Sediment Range Lines

Sedimentation Ranges were established by the USACE between April and December of 1951, and the first resurvey was conducted by the USACE from April to May of 1959.² The ranges were established to calculate the area, volume, and sedimentation rate of Lake Whitney. Nine of the cross-sections plotted in the 1959 report, including plots from 1951, were scanned and digitized for comparison with the 2005 cross-sections.

The original data and endpoint coordinates for each line are unavailable; therefore, the survey team estimated the range line endpoints by geo-referencing a paper copy of a 1963 USACE revised map showing original range line locations. The range lines were digitized from the map and the endpoint coordinates were projected to NAD83 from NAD27, the projection of the USACE map. Distortion is introduced during this process due to the aging and photocopying of the original map. However, horizontal distortion between the 2005 cross-sections and the historical cross-sections are predominately a result of map scale; for example, on the rectified USACE paper map, with a scale of 1:72,000, each range line may represent as much as 200 feet in width across the reservoir, while the 2005 map that the cross-sections were extracted from, has a 1:12,000 map scale, equal to the DOQs the reservoir boundary was digitized from. Horizontal distortion was corrected by aligning prominent features in the 2005 profiles to match those in the historical profiles. Other factors contributing to the variations in the cross-sections may include survey intensity, interpolations of the TIN Model from which the 2005 cross-sections were extracted, and/or sediment accumulation in the reservoir.

Generally, the cross-sectional comparisons indicate significant sedimentation at and upstream of SR09. Downstream of SR09, significant sediment accumulation appears to be confined to the historical stream channels. A resurvey using a multi-frequency depth sounder would aid in locating and quantifying the sediment volume within the reservoir.

The plotted cross-sectional comparisons are presented in Appendix G. Also in Appendix G is a map showing the location of the range lines and Table 3, a list of the endpoint coordinates for each range line re-established in 2005 by the TWDB.

References

1. U.S. Army Corps of Engineers Fort Worth District Lake Whitney Homepage, 08/24/05, <http://www.swf-wc.usace.army.mil/whitney/pages/Index.htm>, 02/09/06.
2. Report on Sedimentation Resurvey, Whitney Reservoir, Brazos River, Texas 1959, Brazos River Basin, U.S. Army Corps of Engineer District, Fort Worth, Corps of Engineers, Fort Worth, Texas, September 1963.
3. U.S. Army Corps of Engineers Fort Worth District Lake Whitney Homepage, 08/24/05, <http://www.swf-wc.usace.army.mil/whitney/pages/GenInfo.htm>, 02/09/06.
4. U.S. Army Corps of Engineers Fort Worth District Lake Whitney Homepage, 08/24/05, <http://www.swf-wc.usace.army.mil/whitney/pages/DamPow.htm>, 02/09/06.
5. United States Department of the Interior. United States Geological Survey. Water Resources Data Texas Water Year 2002, Volume 3. San Jacinto river Basin, Brazos River Basin, San Bernard River Basin, and Intervening Coastal Basins. S.C. Gandara, Water-Data Report TX-02-3
6. Texas Water Development Board, Report 126, Engineering Data on Dams and Reservoirs in Texas, Part II, November 1973.
7. United States Geological Survey, <http://tx.usgs.gov/> 25 July 2005.
8. Blanton III, James O. Bureau of Reclamation. 1982. "Procedures for Monitoring Reservoir Sedimentation."
9. United States Department of Agriculture, Farm Service Agency, Aerial Photography Field Office, National Agriculture Imagery Program, <http://www.apfo.usda.gov/NAIP.html>, 2/10/06.
10. ESRI, Environmental Systems Research Institute. 1995. ARC/INFO Surface Modeling and Display, TIN Users Guide.

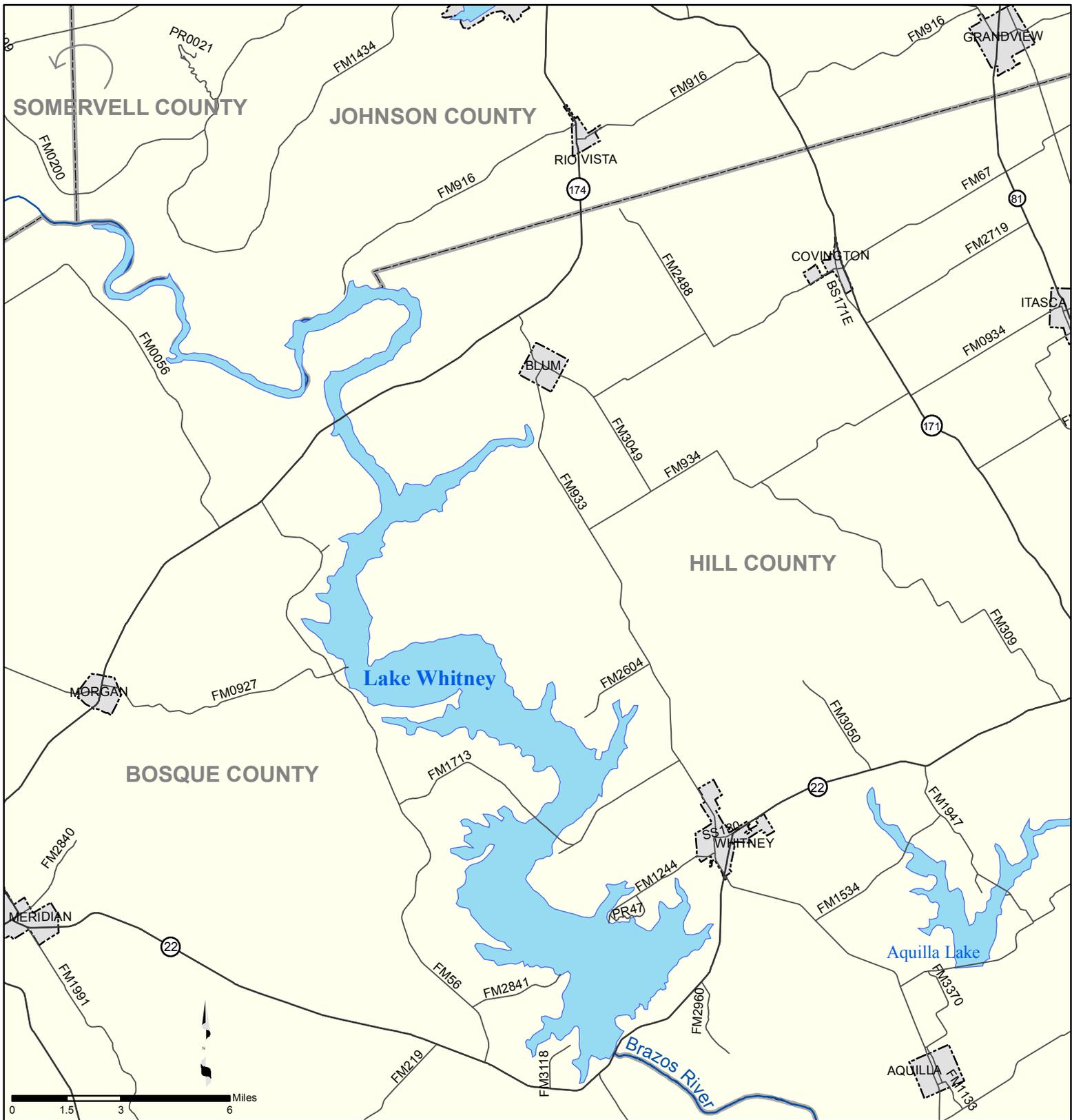


Figure 1

Whitney Lake

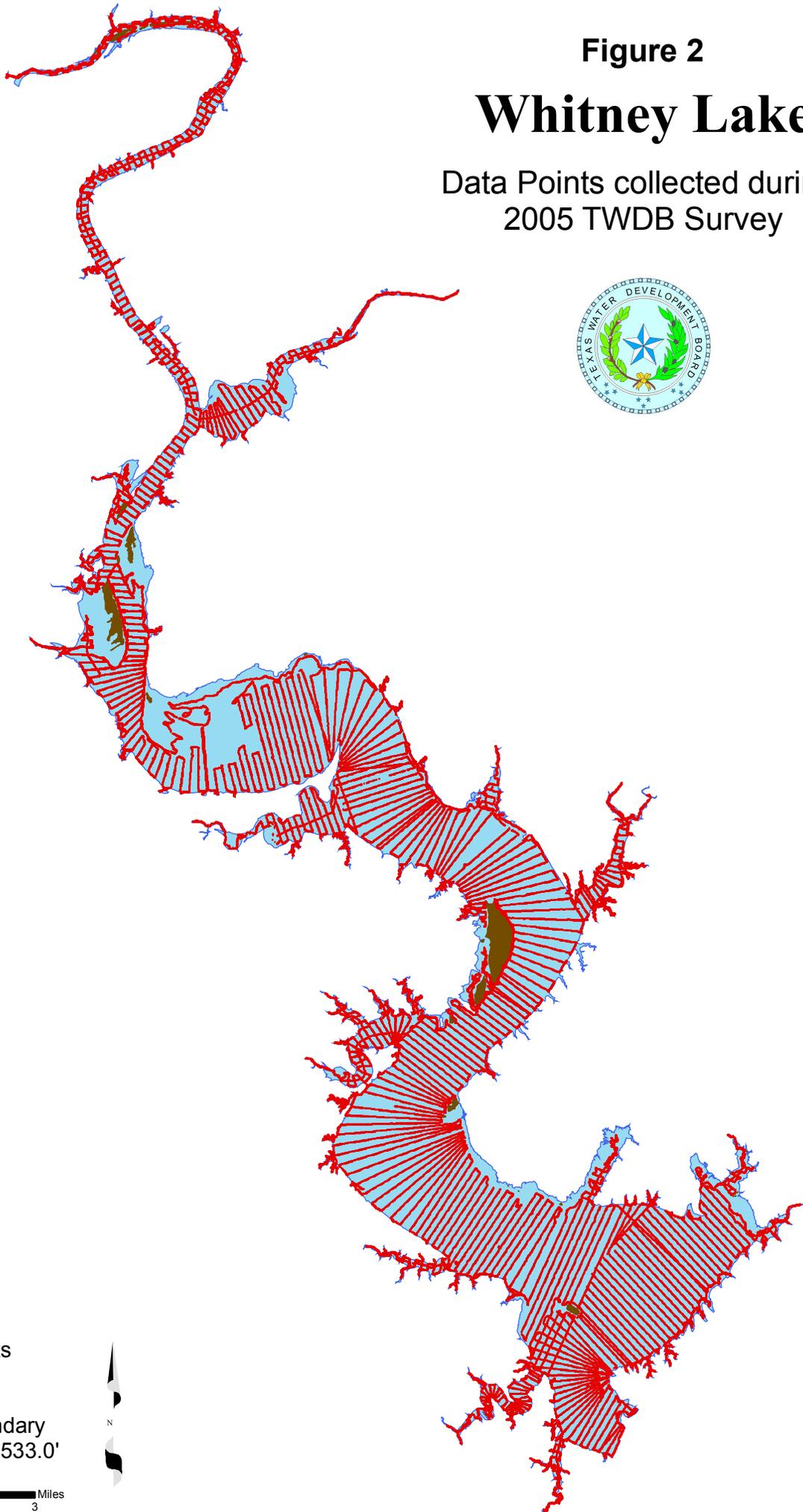
Location Map



Figure 2

Whitney Lake

Data Points collected during
2005 TWDB Survey



Legend

- Data Points
- Islands
- Lake Boundary
Elevation: 533.0'



0 0.5 1 2 3 Miles

Figure 3

Whitney Lake

Elevation Relief Map



Elevation
Feet above msl
NAD83
State Plane
Texas Central Zone

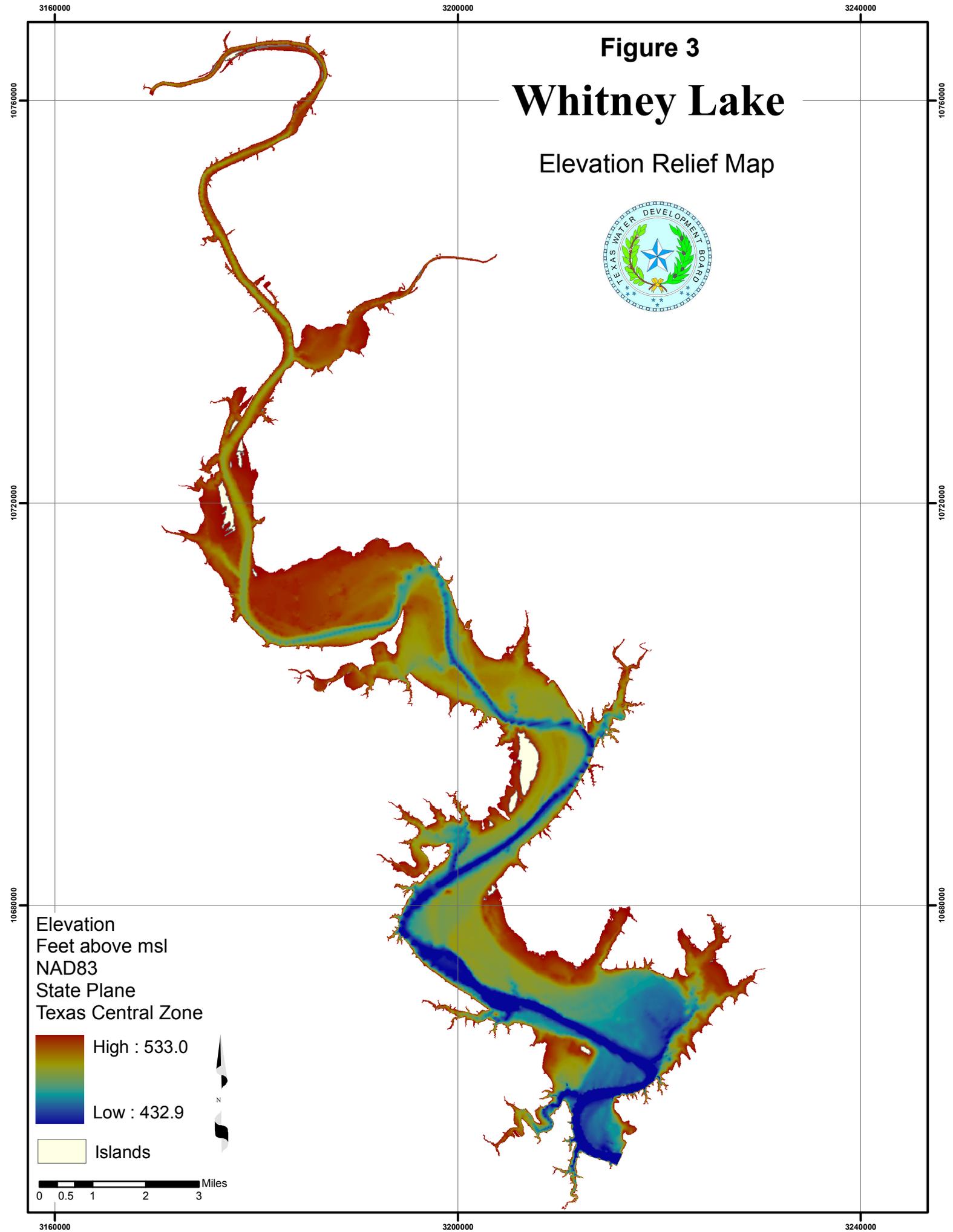
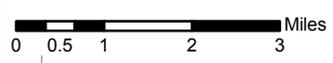
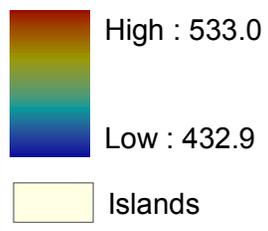


Figure 4

Whitney Lake

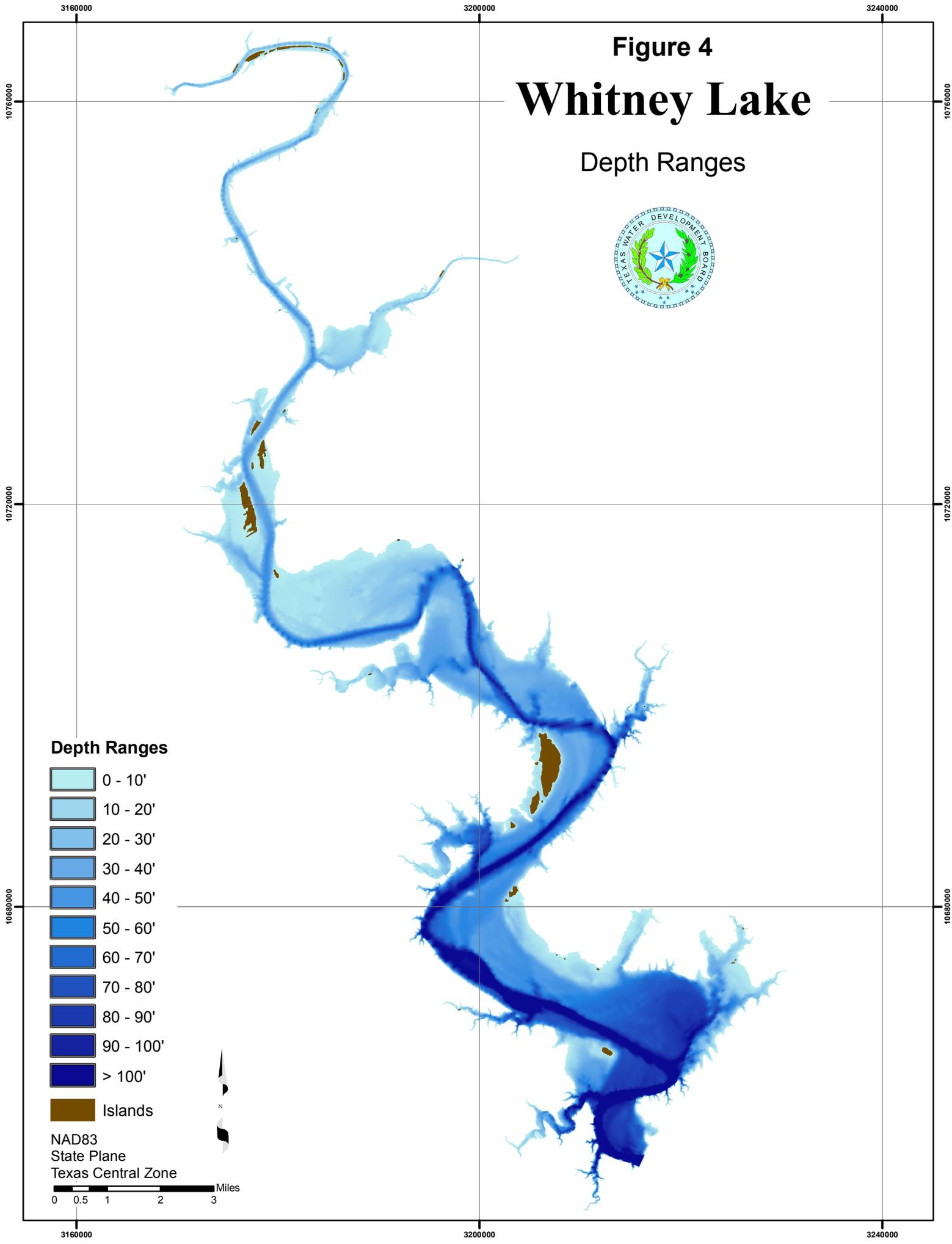
Depth Ranges



Depth Ranges

-  0 - 10'
-  10 - 20'
-  20 - 30'
-  30 - 40'
-  40 - 50'
-  50 - 60'
-  60 - 70'
-  70 - 80'
-  80 - 90'
-  90 - 100'
-  > 100'
-  Islands

NAD83
State Plane
Texas Central Zone



Appendix A
Whitney Lake
RESERVOIR VOLUME TABLE

TEXAS WATER DEVELOPMENT BOARD

JUNE 2005 SURVEY

Conservation Pool Elevation 533.0'

ELEVATION in Feet	VOLUME IN ACRE-FEET									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
432								0	0	0
433	0	0	0	0	0	0	0	0	0	0
434	0	0	0	1	1	1	1	1	1	2
435	2	2	2	3	3	3	4	4	4	5
436	5	6	7	7	8	9	10	11	12	13
437	15	16	17	19	21	22	24	26	27	29
438	31	33	35	38	40	42	45	47	49	52
439	55	57	60	63	66	69	72	75	78	81
440	84	87	91	94	98	101	105	109	113	117
441	121	125	129	134	138	143	148	153	158	163
442	168	174	179	185	191	197	203	209	215	222
443	228	235	242	249	255	263	270	277	284	292
444	300	307	315	323	331	339	348	356	364	373
445	382	391	400	409	418	427	437	447	456	466
446	477	487	498	509	520	532	543	555	567	579
447	592	605	617	631	644	657	671	685	699	714
448	728	743	758	774	789	805	821	837	854	870
449	887	904	921	939	956	974	992	1,010	1,029	1,047
450	1,066	1,085	1,104	1,124	1,143	1,163	1,183	1,203	1,223	1,244
451	1,265	1,286	1,307	1,329	1,351	1,373	1,396	1,418	1,441	1,465
452	1,488	1,512	1,536	1,560	1,585	1,610	1,635	1,661	1,686	1,712
453	1,739	1,765	1,792	1,819	1,846	1,874	1,902	1,930	1,959	1,987
454	2,017	2,046	2,075	2,105	2,135	2,166	2,197	2,228	2,259	2,291
455	2,323	2,355	2,387	2,420	2,453	2,487	2,520	2,554	2,589	2,624
456	2,659	2,694	2,730	2,765	2,802	2,838	2,875	2,913	2,950	2,989
457	3,027	3,066	3,105	3,144	3,184	3,224	3,265	3,306	3,348	3,389
458	3,432	3,474	3,517	3,561	3,605	3,649	3,694	3,739	3,785	3,831
459	3,877	3,924	3,971	4,019	4,068	4,116	4,166	4,215	4,266	4,316
460	4,368	4,419	4,472	4,524	4,578	4,632	4,686	4,741	4,796	4,852
461	4,909	4,966	5,024	5,082	5,141	5,201	5,261	5,322	5,383	5,445
462	5,507	5,570	5,634	5,698	5,763	5,829	5,895	5,962	6,030	6,098
463	6,167	6,236	6,306	6,377	6,448	6,520	6,593	6,666	6,740	6,814
464	6,889	6,965	7,042	7,119	7,196	7,275	7,354	7,434	7,514	7,595
465	7,677	7,760	7,843	7,927	8,012	8,097	8,184	8,271	8,359	8,448
466	8,537	8,628	8,719	8,811	8,903	8,997	9,091	9,187	9,283	9,380
467	9,478	9,576	9,676	9,776	9,878	9,980	10,083	10,187	10,292	10,398
468	10,505	10,613	10,721	10,831	10,942	11,054	11,167	11,281	11,396	11,513
469	11,630	11,748	11,867	11,987	12,109	12,231	12,354	12,478	12,602	12,728
470	12,855	12,983	13,112	13,241	13,371	13,503	13,635	13,768	13,902	14,036
471	14,172	14,308	14,445	14,583	14,722	14,861	15,002	15,143	15,285	15,427
472	15,571	15,715	15,860	16,006	16,153	16,300	16,449	16,598	16,748	16,898
473	17,050	17,202	17,355	17,509	17,663	17,819	17,975	18,132	18,290	18,449
474	18,608	18,769	18,930	19,092	19,255	19,419	19,583	19,749	19,915	20,082
475	20,250	20,419	20,589	20,760	20,931	21,104	21,277	21,451	21,626	21,802
476	21,978	22,156	22,335	22,514	22,695	22,876	23,058	23,242	23,427	23,612
477	23,799	23,987	24,176	24,366	24,558	24,750	24,944	25,139	25,335	25,533
478	25,731	25,931	26,133	26,335	26,539	26,744	26,950	27,157	27,366	27,576
479	27,787	27,999	28,213	28,428	28,644	28,861	29,080	29,300	29,521	29,744
480	29,969	30,194	30,421	30,650	30,880	31,111	31,344	31,578	31,813	32,050
481	32,289	32,529	32,770	33,013	33,258	33,505	33,753	34,003	34,255	34,510
482	34,766	35,025	35,286	35,549	35,815	36,082	36,352	36,625	36,900	37,177
483	37,456	37,737	38,021	38,307	38,595	38,886	39,178	39,474	39,772	40,072
484	40,376	40,682	40,991	41,304	41,620	41,938	42,259	42,582	42,908	43,237
485	43,568	43,902	44,238	44,576	44,918	45,261	45,608	45,957	46,308	46,662
486	47,018	47,376	47,737	48,099	48,465	48,832	49,203	49,575	49,950	50,327
487	50,706	51,087	51,471	51,857	52,245	52,635	53,028	53,423	53,820	54,220
488	54,621	55,024	55,430	55,837	56,247	56,660	57,074	57,491	57,910	58,331
489	58,754	59,179	59,606	60,035	60,466	60,899	61,334	61,771	62,210	62,652
490	63,095	63,541	63,990	64,440	64,892	65,347	65,803	66,262	66,722	67,184
491	67,648	68,114	68,582	69,052	69,524	69,998	70,474	70,952	71,431	71,913

Appendix B
Whitney Lake
RESERVOIR AREA TABLE

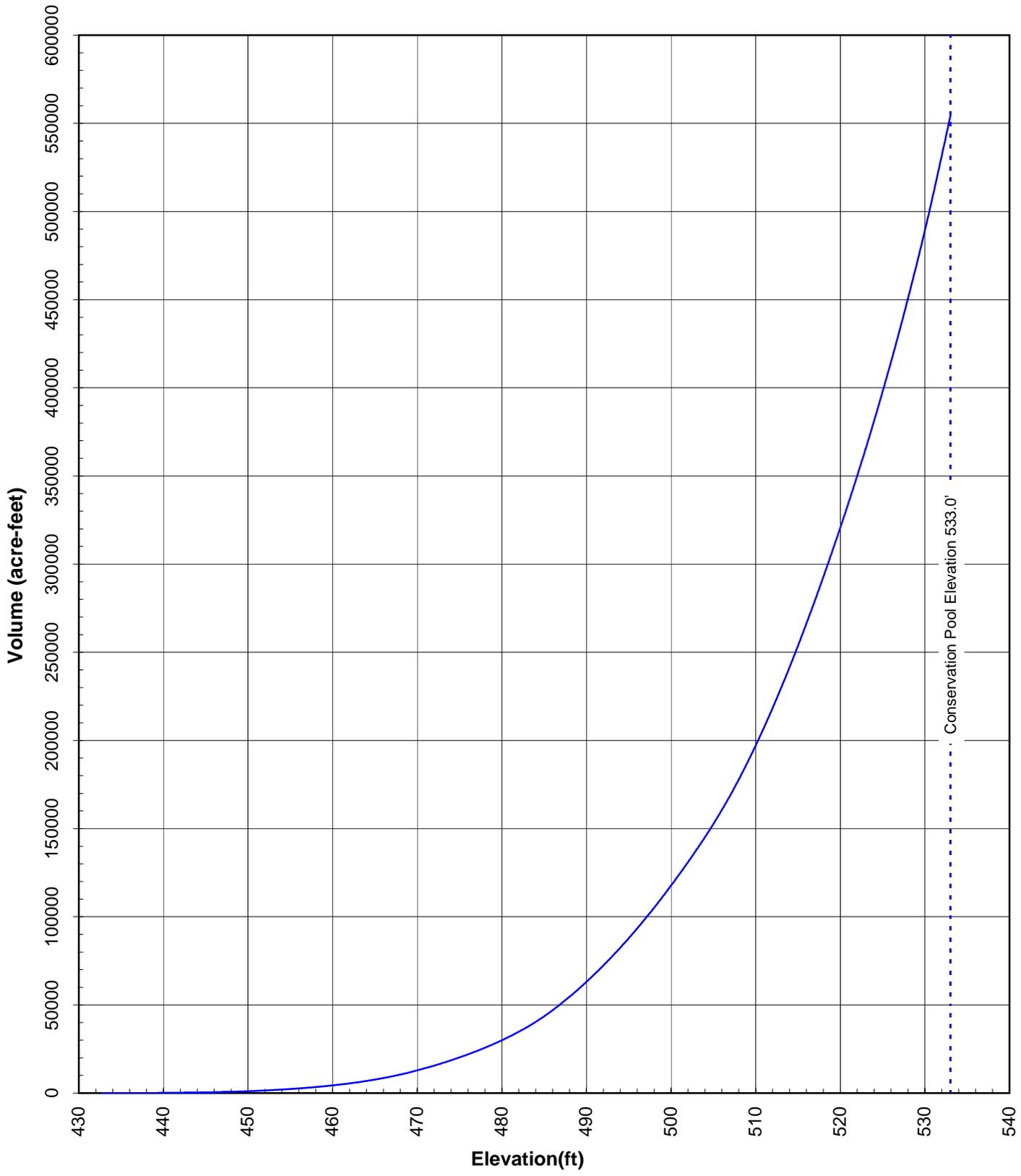
TEXAS WATER DEVELOPMENT BOARD

JUNE 2005 SURVEY

Conservation Pool Elevation 533.0'

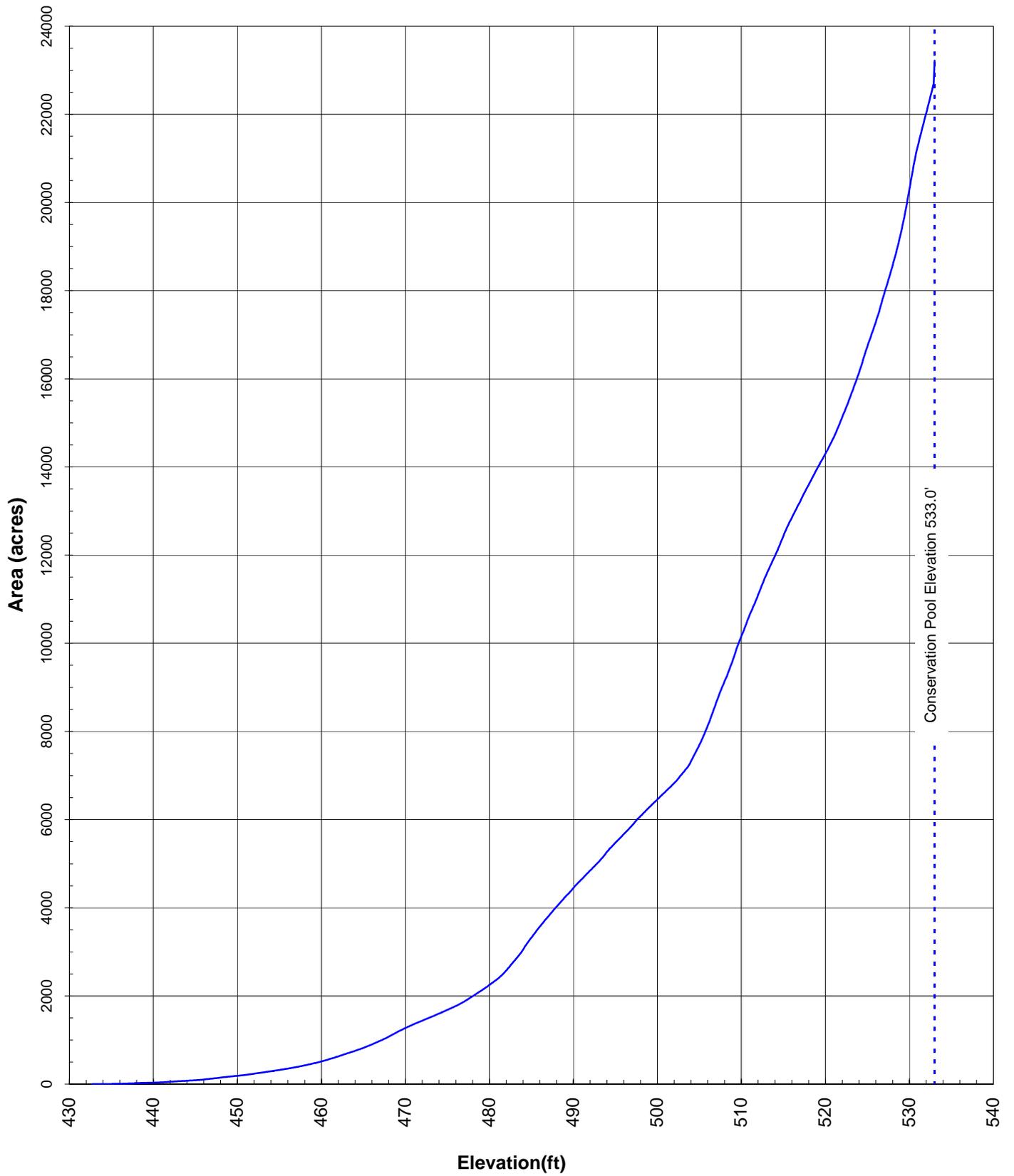
ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	AREA IN ACRES									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
432								0	0	0
433	0	0	0	0	0	0	0	0	0	1
434	1	1	1	1	1	1	2	2	2	2
435	2	3	3	3	3	4	4	4	5	5
436	6	6	7	8	8	9	10	11	12	12
437	13	14	15	15	16	17	17	18	19	19
438	20	21	21	22	23	23	24	25	25	26
439	26	27	28	28	29	30	30	31	31	32
440	33	33	34	35	36	36	37	38	39	40
441	42	43	44	45	46	47	49	50	51	53
442	54	55	56	58	59	60	61	62	63	65
443	66	67	68	69	70	71	72	73	75	76
444	77	78	79	80	81	82	83	85	86	87
445	88	89	91	92	93	94	96	97	99	102
446	104	106	109	111	113	115	117	120	122	124
447	126	128	130	132	134	136	138	141	143	146
448	148	151	153	155	157	159	161	163	165	167
449	169	171	173	175	177	179	181	183	185	187
450	189	191	192	194	196	198	201	203	205	208
451	210	213	215	218	221	223	226	229	231	234
452	236	239	242	245	248	250	253	256	259	261
453	264	267	270	272	275	278	281	283	286	289
454	292	295	297	300	303	306	309	312	315	318
455	321	324	327	330	333	336	339	342	345	348
456	352	355	358	362	365	368	372	375	379	382
457	386	389	393	397	401	404	408	412	416	420
458	424	429	433	437	441	445	450	454	458	463
459	467	471	476	480	485	490	495	500	505	510
460	515	520	525	531	536	541	547	552	558	563
461	569	575	581	586	592	598	604	610	616	621
462	627	634	640	647	654	660	666	673	679	685
463	692	698	704	710	716	723	729	735	741	747
464	754	760	767	774	781	787	794	801	808	815
465	821	829	836	844	852	860	868	876	884	892
466	900	907	915	923	932	940	949	957	966	974
467	983	991	1,000	1,009	1,017	1,027	1,036	1,045	1,054	1,064
468	1,073	1,083	1,093	1,103	1,113	1,124	1,136	1,147	1,158	1,167
469	1,177	1,187	1,197	1,207	1,216	1,226	1,235	1,244	1,254	1,263
470	1,273	1,282	1,291	1,300	1,308	1,317	1,325	1,334	1,342	1,351
471	1,359	1,367	1,375	1,383	1,391	1,399	1,407	1,415	1,423	1,431
472	1,439	1,447	1,455	1,463	1,471	1,479	1,487	1,495	1,503	1,510
473	1,518	1,526	1,534	1,542	1,550	1,558	1,567	1,575	1,583	1,591
474	1,600	1,608	1,616	1,625	1,634	1,642	1,651	1,659	1,668	1,676
475	1,685	1,694	1,702	1,711	1,719	1,728	1,736	1,745	1,754	1,763
476	1,772	1,781	1,790	1,800	1,809	1,819	1,829	1,840	1,852	1,863
477	1,874	1,885	1,896	1,908	1,920	1,932	1,944	1,956	1,969	1,981
478	1,993	2,005	2,018	2,031	2,043	2,055	2,068	2,081	2,093	2,105
479	2,117	2,130	2,142	2,155	2,167	2,181	2,194	2,208	2,222	2,235
480	2,250	2,264	2,278	2,291	2,305	2,319	2,334	2,348	2,362	2,377
481	2,392	2,408	2,424	2,440	2,456	2,473	2,492	2,514	2,534	2,555
482	2,576	2,597	2,620	2,643	2,665	2,689	2,713	2,736	2,760	2,782
483	2,804	2,825	2,847	2,870	2,893	2,917	2,941	2,966	2,992	3,019
484	3,047	3,079	3,112	3,142	3,169	3,195	3,221	3,248	3,274	3,299
485	3,324	3,349	3,374	3,399	3,425	3,450	3,475	3,501	3,525	3,549
486	3,571	3,594	3,618	3,641	3,664	3,690	3,715	3,738	3,759	3,780
487	3,802	3,824	3,847	3,869	3,892	3,916	3,940	3,962	3,983	4,003
488	4,023	4,044	4,066	4,089	4,112	4,134	4,156	4,177	4,198	4,221
489	4,241	4,261	4,281	4,301	4,320	4,340	4,361	4,382	4,403	4,425
490	4,448	4,471	4,493	4,515	4,535	4,555	4,574	4,593	4,612	4,630
491	4,649	4,669	4,689	4,710	4,731	4,750	4,769	4,788	4,807	4,827



- - - Conservation Pool Elevation 533.0'
 — Volume 2005

Whitney Lake
 June 2005
 Prepared by: TWDB



- - - - - Conservation Pool Elevation 533.0'
 — Area 2005

Whitney Lake
 June 2005
 Prepared by: TWDB

Appendix E
Whitney Lake
RESERVOIR VOLUME COMPARISON TABLE
 TEXAS WATER DEVELOPMENT BOARD

Conservation Pool Elevation 533.0'

TWDB 2005 SURVEY vs. USACE 1959 RESURVEY²

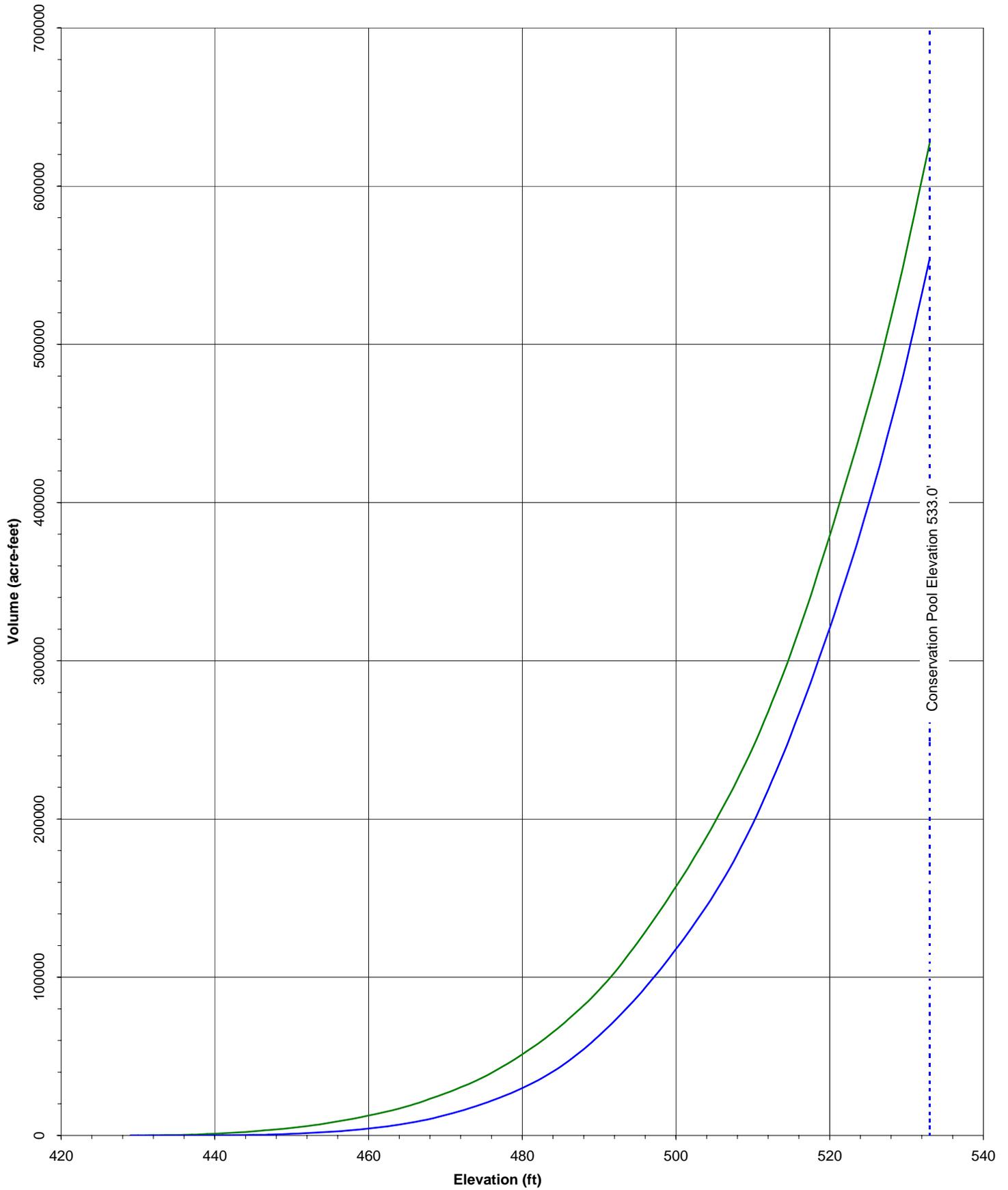
VOLUME IN ACRE-FEET

ELEVATION INCREMENT IS ONE FOOT

ELEVATION in feet	0	1	2	3	4	5	6	7	8	9
430	0	0	0	0	0	2	5	15	31	55
	9	43	110	180	260	340	450	580	730	920
440	84	121	168	228	300	382	477	592	728	887
	1,100	1,400	1,600	1,900	2,200	2,600	3,000	3,400	3,900	4,300
450	1,066	1,265	1,488	1,739	2,017	2,323	2,659	3,027	3,432	3,877
	4,800	5,400	5,900	6,600	7,300	8,100	8,900	9,700	10,600	11,600
460	4,368	4,909	5,507	6,167	6,889	7,677	8,537	9,478	10,505	11,630
	12,600	13,600	14,700	15,800	17,000	18,400	19,900	21,500	23,200	24,900
470	12,855	14,172	15,571	17,050	18,608	20,250	21,978	23,799	25,731	27,787
	26,700	28,500	30,500	32,500	34,700	37,000	39,600	42,300	45,100	48,100
480	29,969	32,289	34,766	37,456	40,376	43,568	47,018	50,706	54,621	58,754
	51,200	54,500	57,900	61,500	65,300	69,300	73,500	77,800	82,300	86,900
490	63,095	67,648	72,397	77,339	82,489	87,863	93,434	99,203	105,182	111,359
	91,900	97,200	102,900	109,000	115,400	121,900	128,600	135,500	142,600	149,800
500	117,725	124,276	131,011	137,948	145,123	152,633	160,539	168,927	177,830	187,205
	157,200	164,800	172,600	180,600	189,000	197,500	206,400	215,500	225,000	234,800
510	197,112	207,515	218,385	229,725	241,503	253,707	266,358	279,392	292,804	306,581
	245,200	256,200	267,800	279,800	292,300	305,400	319,100	333,400	348,200	363,500
520	320,711	335,196	350,091	365,457	381,329	397,768	414,778	432,378	450,621	469,550
	379,100	395,000	411,100	427,400	444,000	461,000	478,800	497,400	517,100	537,800
530	489,334	510,148	531,805	554,203						
	559,200	581,300	603,900	627,100						

TWDB 2005 Survey values on top

USACE 1959 Resurvey Values on Bottom



- - - - Conservation Pool Elevation 533.0'
 — USACE 1959 Resurvey
 — TWDB 2005

Whitney Lake
 June 2005
 Prepared by TWDB

3,160,000

3,200,000

Appendix G

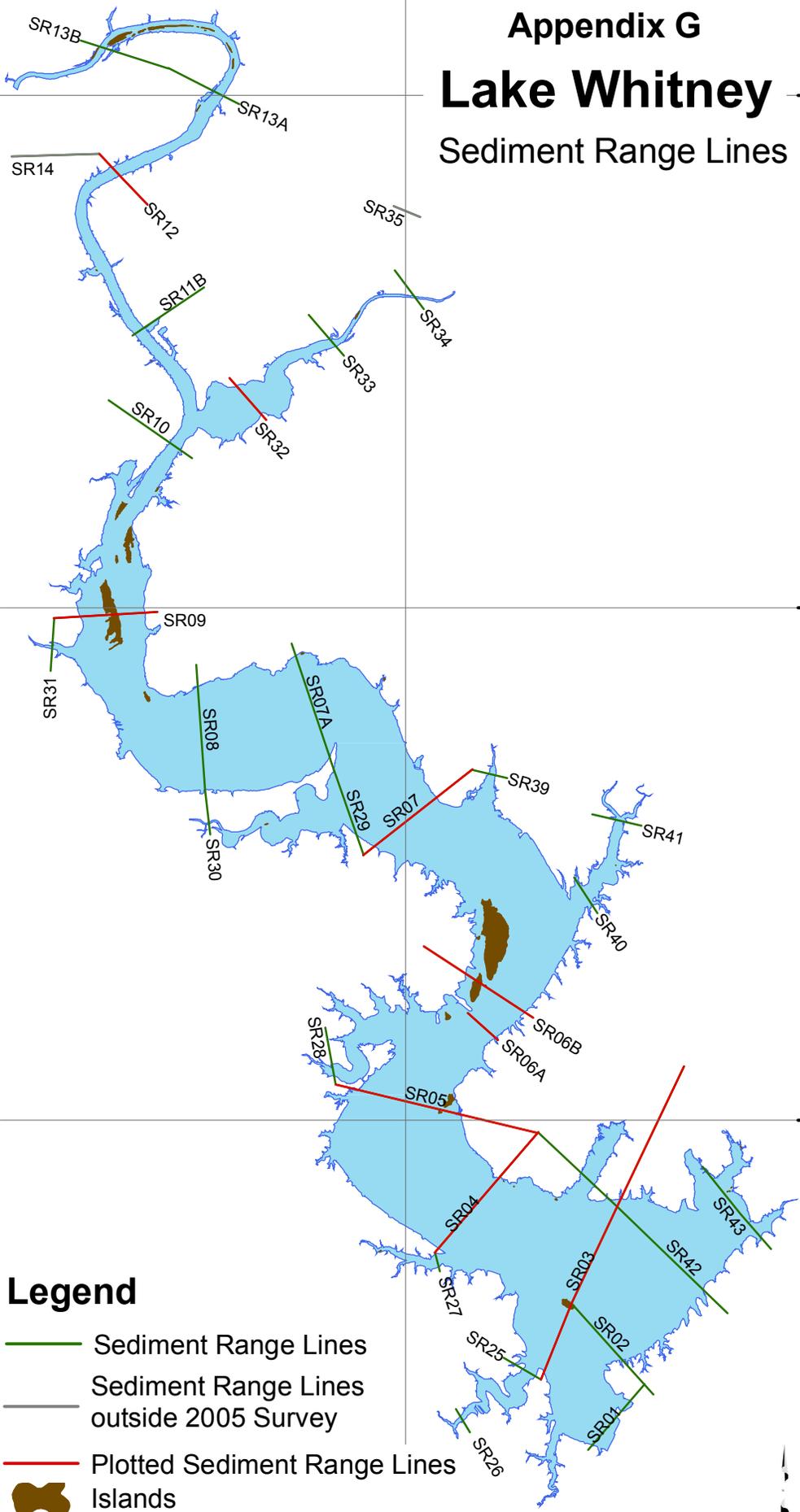
Lake Whitney Sediment Range Lines

10,760,000

Table 3. Endpoint Coordinates for Whitney Lake Sediment Range Lines est. 2005 TWDB

Range	L=Left R=Right	X	Y
SR01	L	3,218,623.047081	10,659,363.516084
	R	3,214,210.499983	10,654,246.000000
SR02	L	3,219,335.250020	10,658,572.999996
	R	3,212,934.550527	10,665,677.514418
SR03**	L	3,221,690.500012	10,684,212.000034
	R	3,210,542.499980	10,659,757.999987
SR04**	L	3,210,319.942514	10,679,007.215590
	R	3,202,271.499972	10,669,646.999997
SR05**	L	3,210,319.942514	10,679,007.215590
	R	3,194,539.750011	10,682,773.000018
SR06A**	L	3,207,211.249969	10,686,254.000034
	R	3,204,858.750002	10,688,358.999964
SR06B**	L	3,209,943.250031	10,687,987.000010
	R	3,201,432.249982	10,693,560.999989
SR07**	L	3,205,208.249966	10,707,405.999978
	R	3,196,721.255340	10,700,712.734643
SR07A	L	3,191,123.250010	10,717,236.000023
	R	3,194,144.499987	10,708,157.000023
SR08	L	3,183,691.249989	10,715,556.999966
	R	3,184,350.499984	10,705,787.999977
SR09**	L	3,180,634.749976	10,719,693.000011
	R	3,172,583.791081	10,719,215.390198
SR10	L	3,183,331.750005	10,731,680.000031
	R	3,176,858.749991	10,736,235.000029
SR11B	L	3,184,262.749972	10,745,016.000033
	R	3,178,722.000009	10,741,267.000008
SR12**	L	3,179,879.749966	10,751,510.000023
	R	3,176,103.499980	10,755,478.999977
SR13A	L	3,187,018.749965	10,759,338.000002
	R	3,181,478.500007	10,762,150.000005
SR13B	L	3,174,670.250016	10,764,298.999978
	R	3,181,478.500007	10,762,121.999965
SR14*	L	3,169,267.750025	10,755,257.999967
	R	3,176,103.499980	10,755,452.000017
SR15*	L	3,162,128.750026	10,754,707.000027
	R	3,161,191.500001	10,752,446.999973
SR16*	L	3,153,032.500012	10,759,393.000002
	R	3,151,020.249996	10,760,577.999994
SR17*	L	3,142,916.500009	10,766,365.999992
	R	3,142,585.750001	10,764,492.000020
SR18*	L	3,139,305.500025	10,777,281.999984
	R	3,138,891.999978	10,775,324.999971
SR19*	L	3,126,929.249965	10,780,617.000030
	R	3,127,425.499978	10,779,182.999988
SR25	L	3,207,623.750007	10,661,465.000012
	R	3,210,540.250032	10,659,756.999978
SR26	L	3,203,936.499971	10,657,444.000014
	R	3,205,019.749966	10,655,610.999986
SR27	L	3,202,294.249964	10,669,625.000012
	R	3,202,690.249995	10,668,209.999999
SR28	L	3,193,727.249978	10,687,245.999984
	R	3,194,529.249986	10,682,769.999991
SR29	L	3,194,144.499987	10,708,120.999981
	R	3,196,721.255340	10,700,712.734643
SR30	L	3,184,367.249994	10,705,793.000023
	R	3,184,761.250006	10,702,318.999999
SR31	L	3,172,583.791081	10,719,215.390198
	R	3,172,333.749980	10,715,069.000029
SR32**	L	3,189,141.749988	10,734,670.000010
	R	3,186,250.249976	10,737,957.999984
SR33	L	3,195,182.499999	10,739,681.000012
	R	3,192,449.249998	10,742,909.000013
SR34	L	3,201,401.249986	10,743,325.000011
	R	3,199,143.500024	10,746,354.999996
SR35*	L	3,201,150.749993	10,750,540.999995
	R	3,199,061.999996	10,751,392.000021
SR39	L	3,207,943.999990	10,706,699.999986
	R	3,205,174.750019	10,707,342.999976
SR40	L	3,214,965.999997	10,696,166.999976
	R	3,213,136.249999	10,698,936.000017
SR41	L	3,218,378.000029	10,702,990.999967
	R	3,214,570.499971	10,703,880.999990
SR42	L	3,225,103.499981	10,664,918.999997
	R	3,210,367.250030	10,679,012.000027
SR43	L	3,228,515.750015	10,669,913.999997
	R	3,223,175.000013	10,676,342.000030

Coordinates in NAD83 (feet) State Plane Texas Central Zone
 * Cross-Sections located outside extent of TWDB 2005 Survey
 ** Cross-Sections selected for comparison, plotted

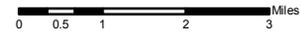


Legend

- Sediment Range Lines
- Sediment Range Lines outside 2005 Survey
- Plotted Sediment Range Lines
- Islands
- Lake Boundary at Elev. 533.0 ft

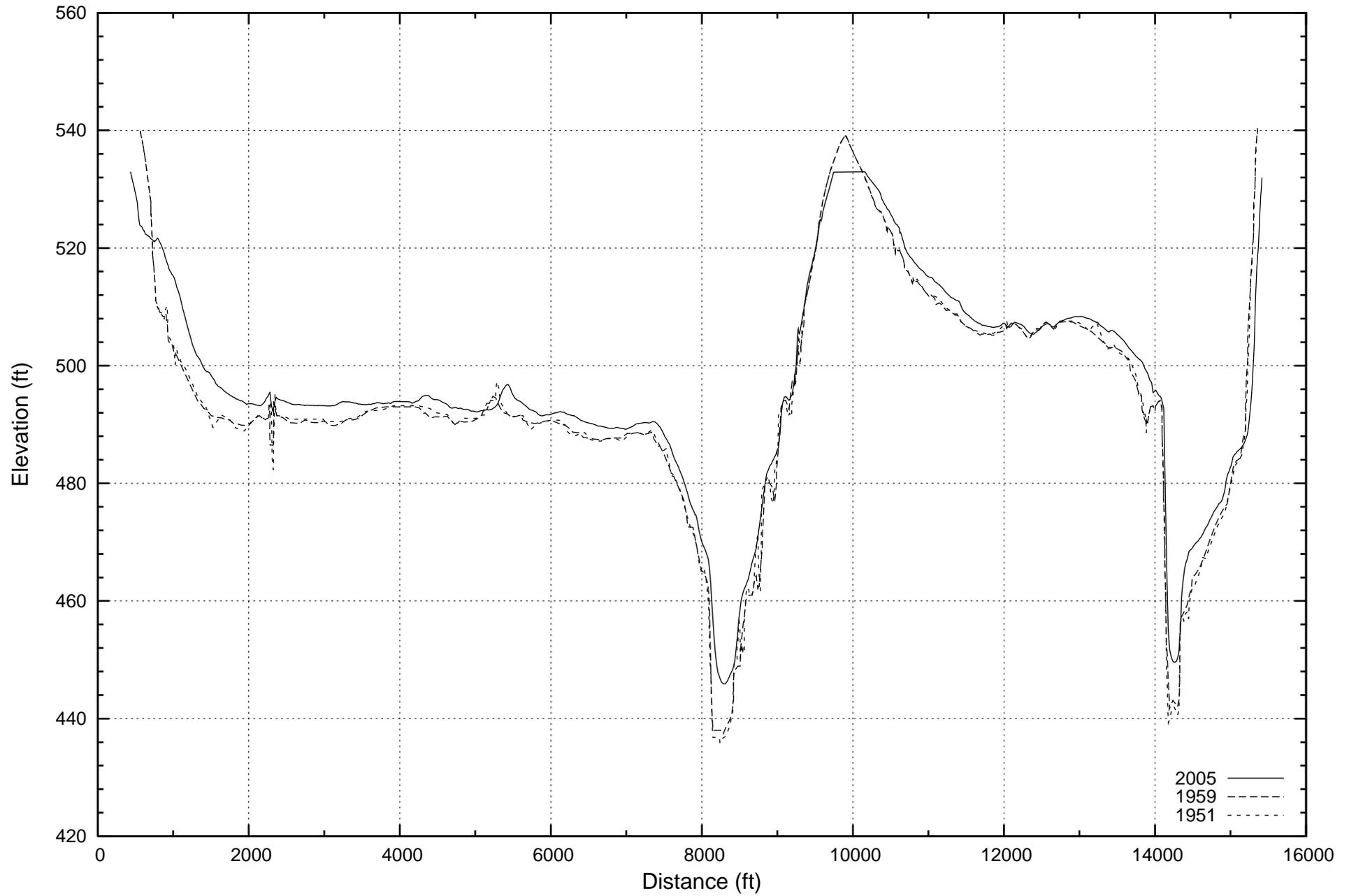
3,160,000

3,200,000



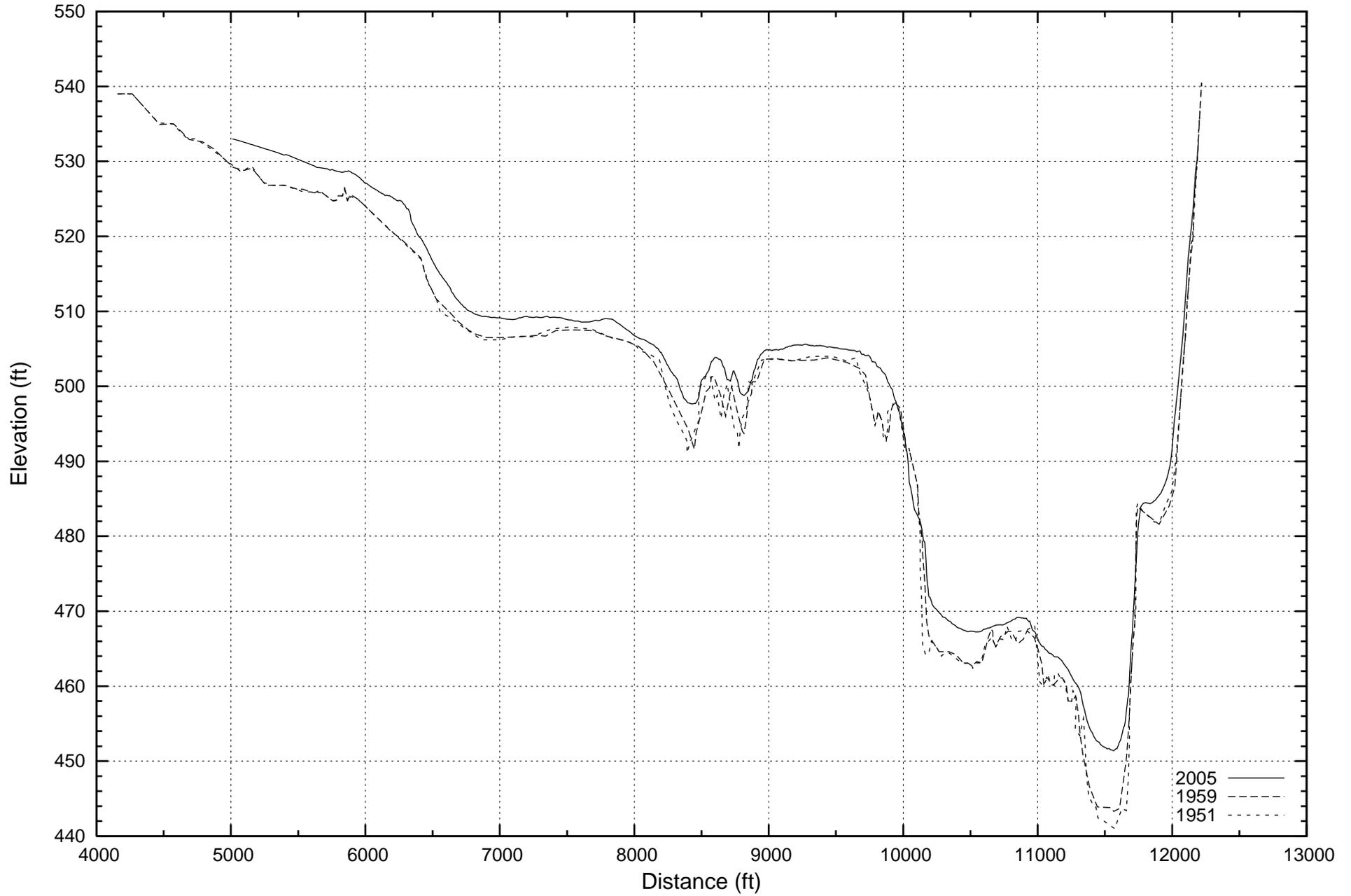
Lake Whitney

Range Line SR03



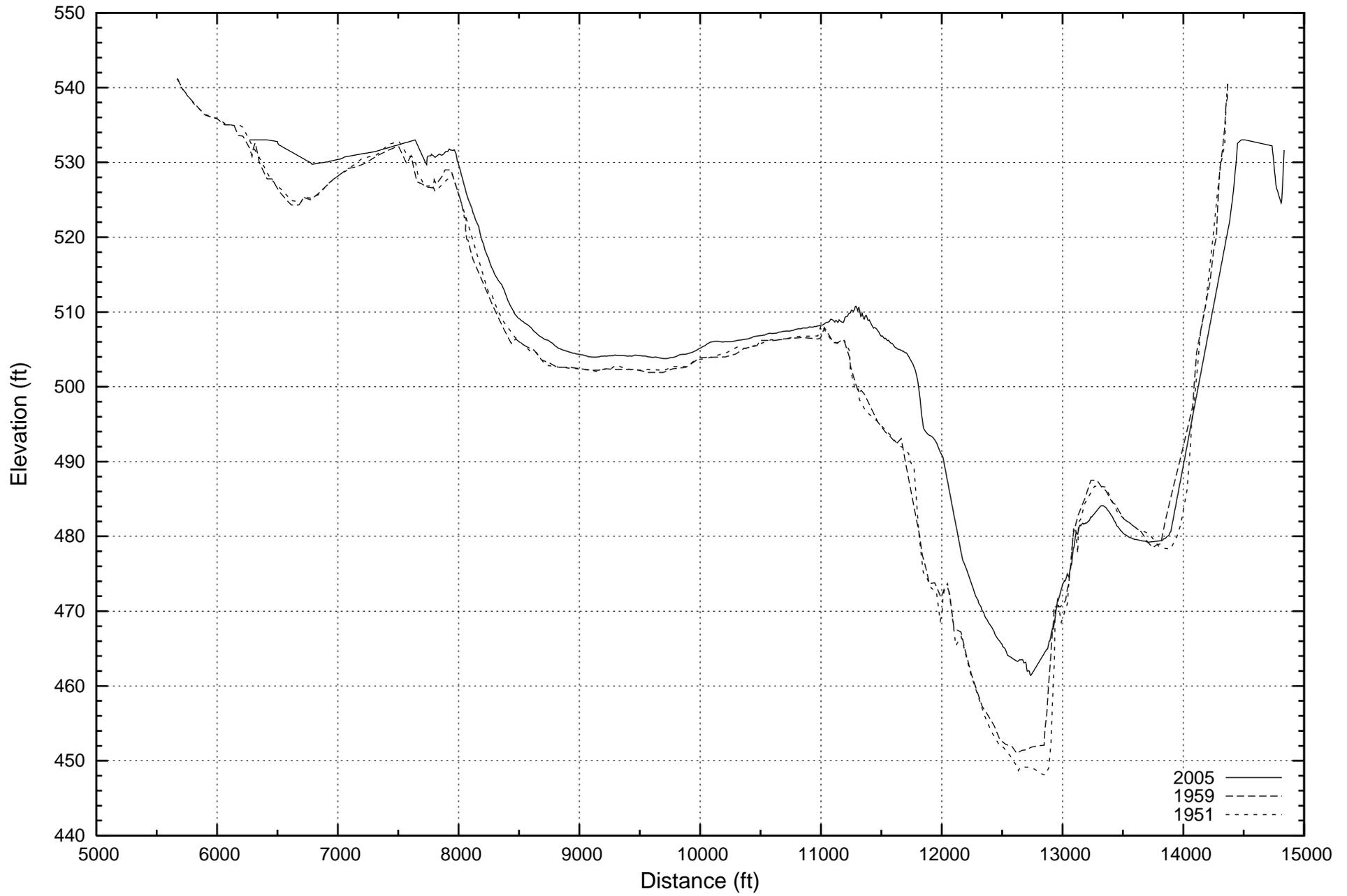
Lake Whitney

Range Line SR04



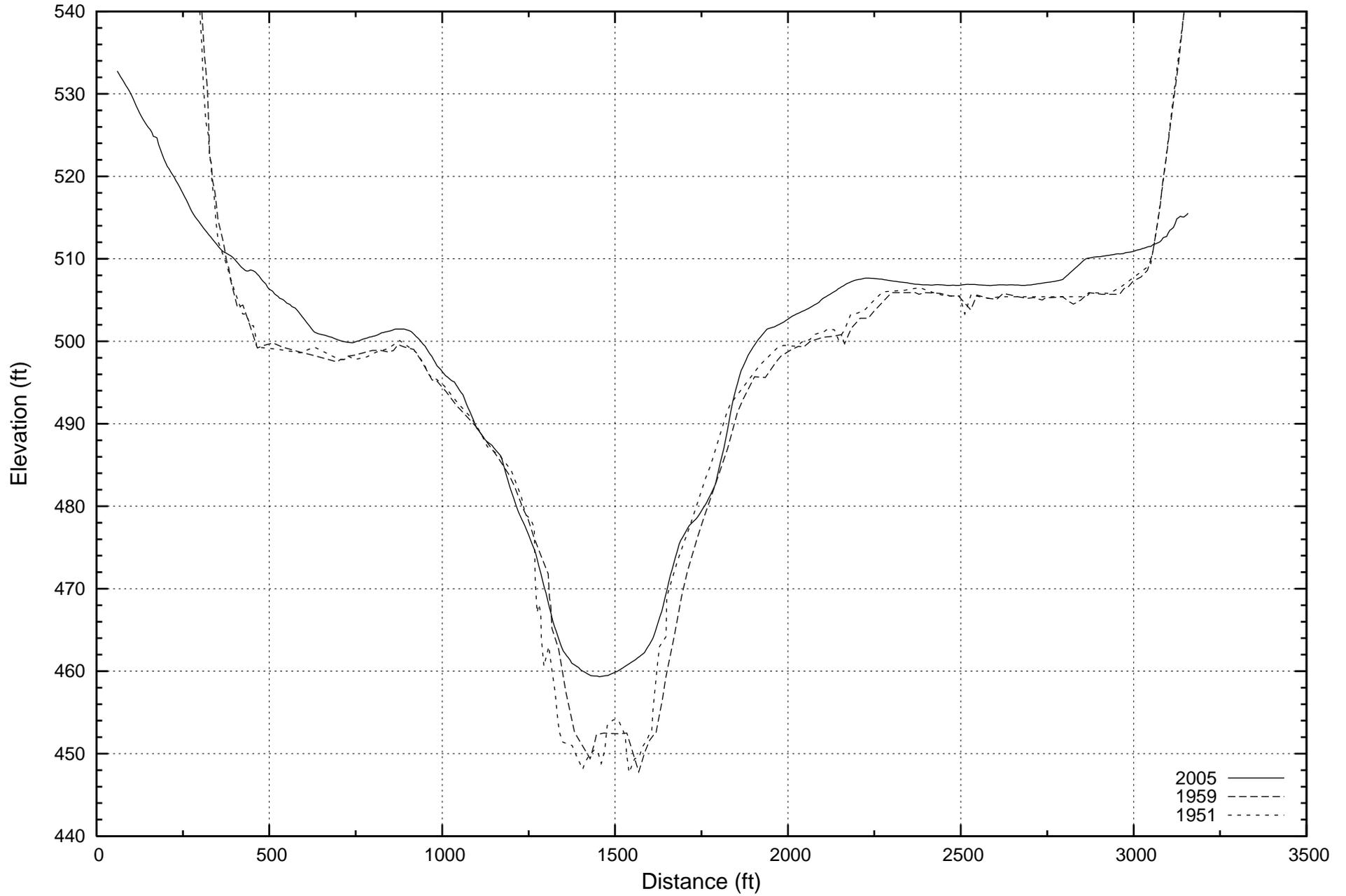
Lake Whitney

Range Line SR05



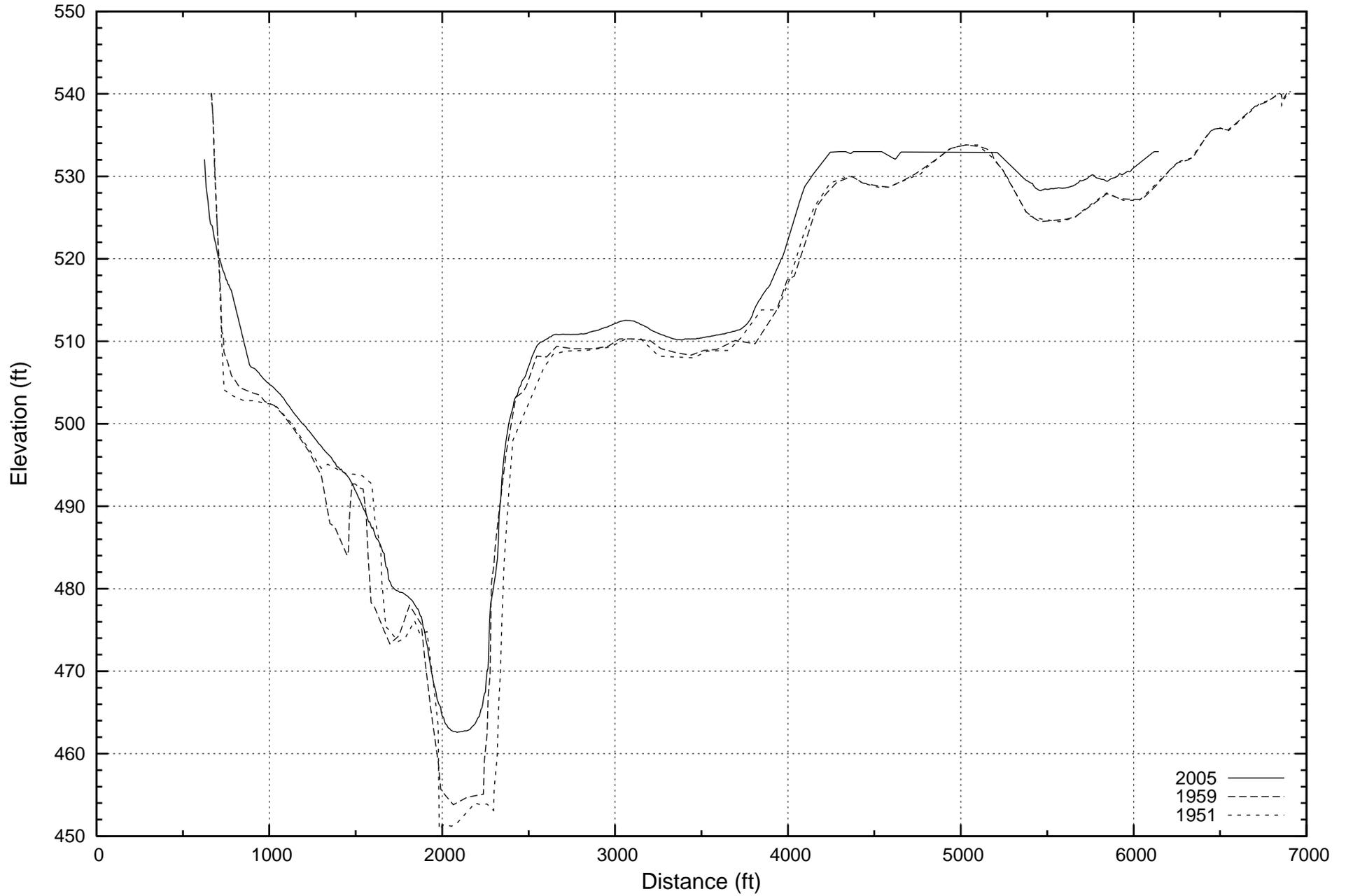
Lake Whitney

Range Line SR06A



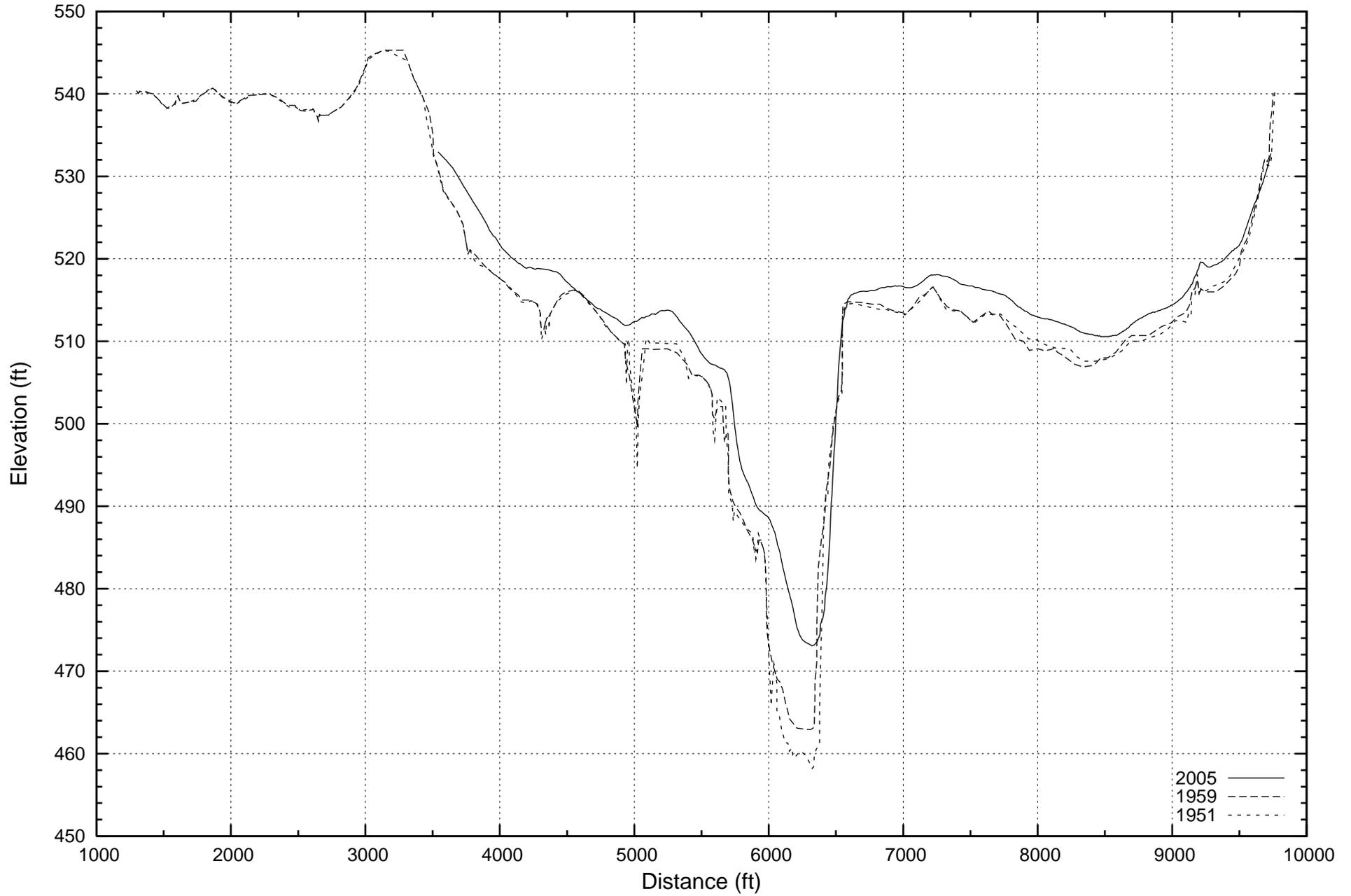
Lake Whitney

Range Line SR06B



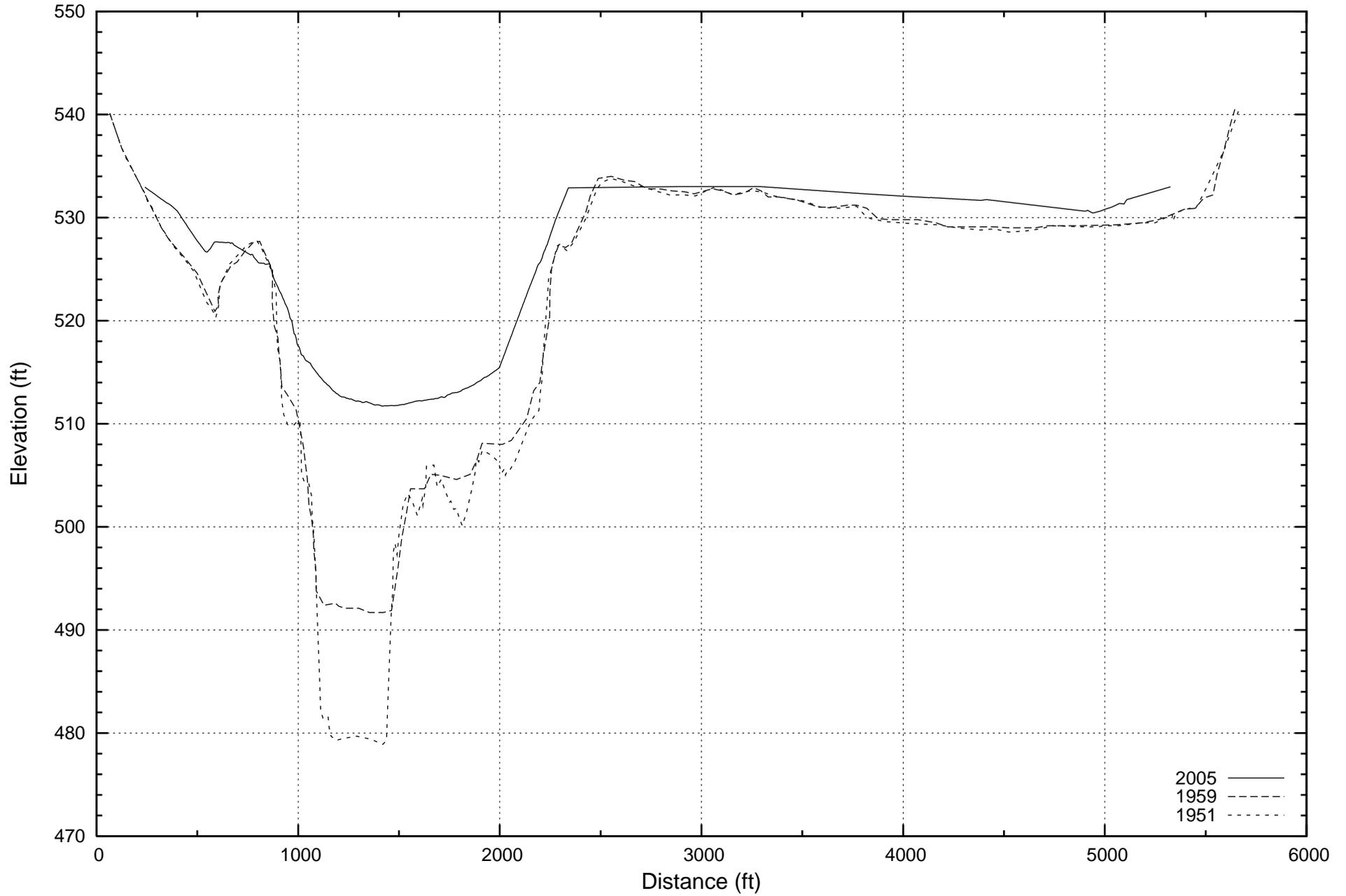
Lake Whitney

Range Line SR07



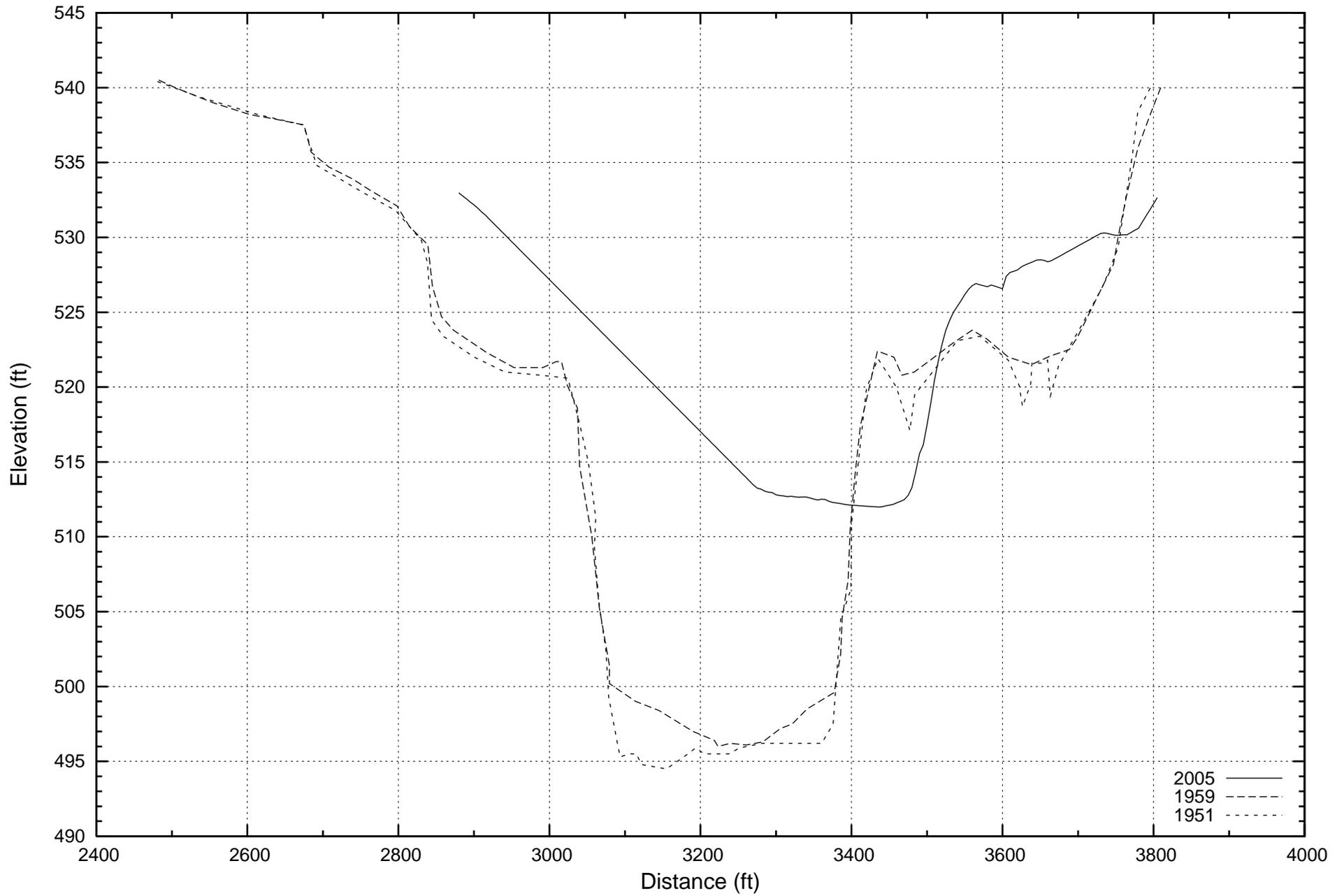
Lake Whitney

Range Line SR09



Lake Whitney

Range Line SR12



Lake Whitney

Range Line SR32

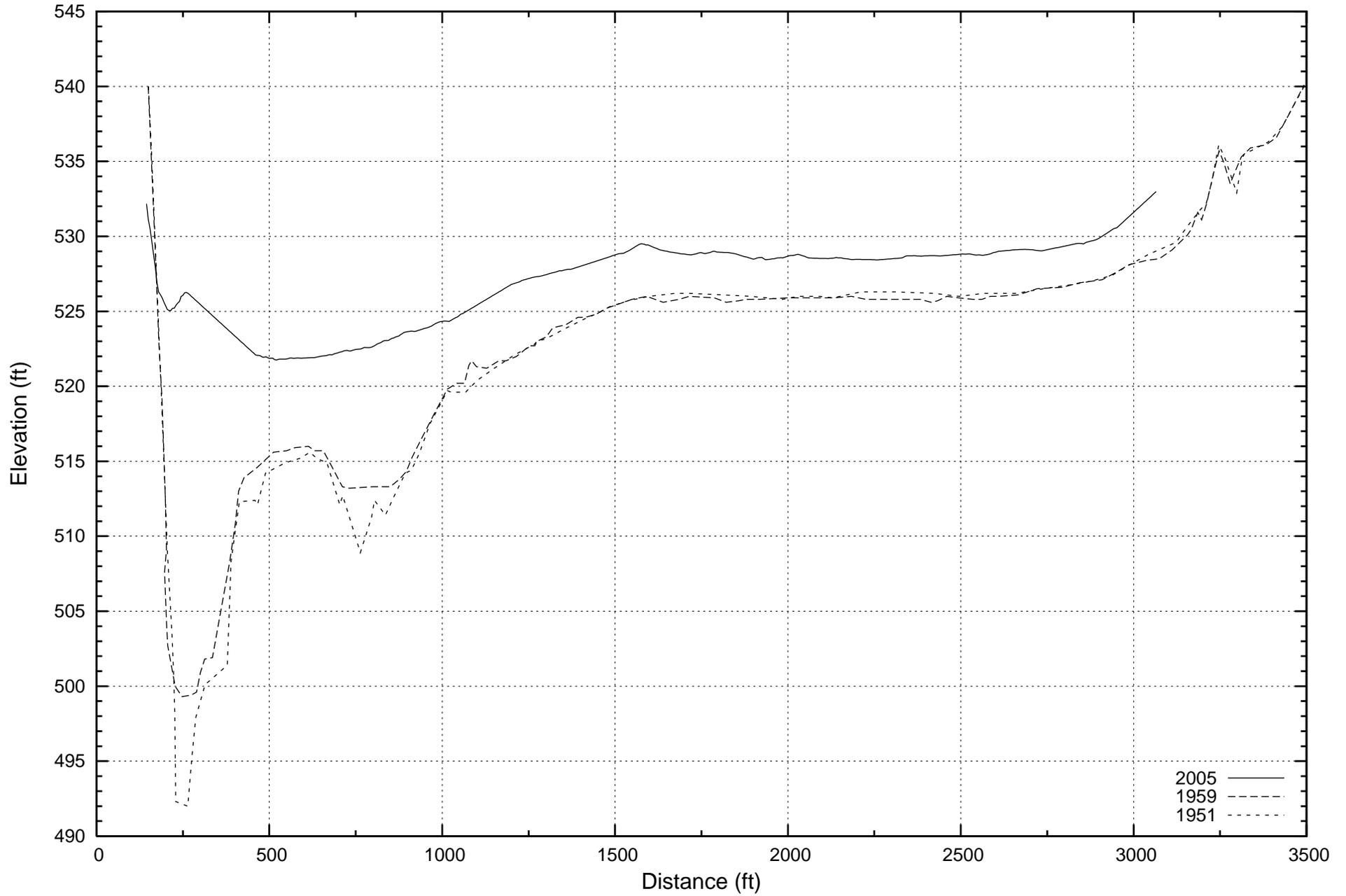


Figure 5



LAKE WHITNEY

5' - Contour Map

CONTOURS

- 435
- 440
- 445
- 450
- 455
- 460
- 465
- 470
- 475
- 480
- 485
- 490
- 495
- 500
- 505
- 510
- 515
- 520
- 525
- 530

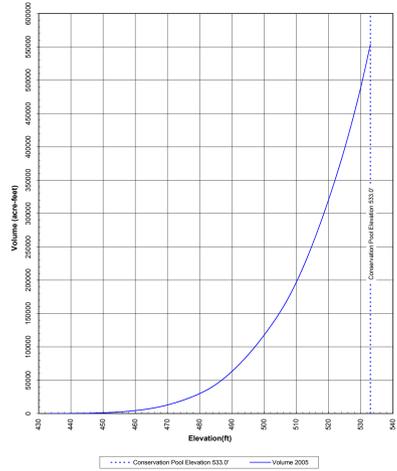
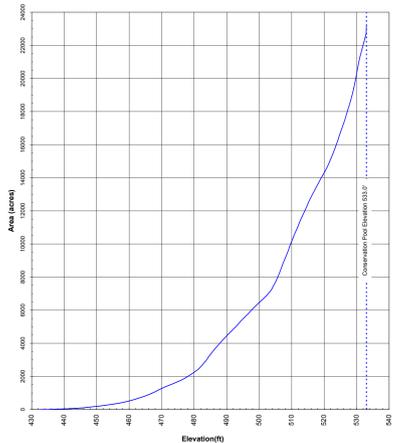
- Islands
- Whitney Lake
Elevation: 533.0'
Conservation Pool
Elevation

Projection: NAD83
State Plane
Texas Central Zone



Bosque and Hill Counties

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



Prepared by: TEXAS WATER DEVELOPMENT BOARD JUNE 2005 SURVEY

