Volumetric and Sedimentation Survey of WHITE ROCK LAKE

March 2015 Survey

Texas Water Development Board

February 2016

Texas Water Development Board

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City of Dallas

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Executive summary

In September 2014, the Texas Water Development Board (TWDB) entered into agreement with the U.S. Army Corps of Engineers, Fort Worth District, to perform a volumetric and sedimentation survey of White Rock Lake. The City of Dallas provided 50% of the funding for this survey, while the U.S. Army Corps of Engineers, Fort Worth District, provided the remaining 50% of the funding through their Planning Assistance to States Program. Surveying was performed using a multi-frequency (208 kHz, 50 kHz, and 24 kHz), sub-bottom profiling depth sounder. In addition, sediment core samples were collected in select locations and correlated with the multi-frequency depth sounder signal returns to estimate sediment accumulation thicknesses and sedimentation rates.

White Rock Dam and White Rock Lake are located on White Rock Creek, a tributary of the Trinity River, in Dallas County, within the city limits of Dallas, Texas. The conservation pool elevation of White Rock Lake is 457.9 feet above mean sea level (NGVD29). TWDB collected bathymetric data for White Rock Lake on March 19, 2015, March 25, 2015, and March 27, 2015. The daily average water surface elevations during the survey measured 458.3, 458.7, and 458.4 feet above mean sea level (NGVD29), respectively.

The 2015 TWDB volumetric survey indicates that White Rock Lake has a total reservoir capacity of 10,230 acre-feet and encompasses 995 acres at conservation pool elevation (457.9 feet above mean sea level, NGVD29). Previous capacity estimates according to the Soil Conservation Service Reservoir Sediment Data Summary sheet, calculated at spillway elevation 458.0 feet above mean sea level, include the original design estimate of 18,160 acre-feet, a 1935 estimate of 14,276 acre-feet, a 1956 estimate of 12,321 acre-feet, a 1970 estimate of 10,743 acre-feet, and a 1977 estimate of 10,721 acre-feet. A 1993 TWDB survey estimated a capacity of 9,004 acre-feet. The 2015 TWDB survey indicates White Rock Lake has a total reservoir capacity of 10,329 acre-feet at spillway elevation 458.0 feet above mean sea level.

The 2015 TWDB sedimentation survey measured 3,550 acre-feet of sediment below conservation pool elevation (457.9 feet NGVD29). Sediment accumulation is greatest in the area where the reservoir narrows northwest of the Dallas Arboretum and in pockets throughout the reservoir. TWDB recommends that a similar methodology be used to resurvey White Rock Lake in 10 years or after a major flood event.

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Note: References to brand names throughout this report do not imply endorsement by the Texas Water Development Board

Introduction

The Hydrographic Survey Program of the Texas Water Development Board (TWDB) was authorized by the 72nd Texas State Legislature in 1991. Section 15.804 of the Texas Water Code authorizes TWDB to perform surveys to determine reservoir storage capacity, sedimentation levels, rates of sedimentation, and projected water supply availability.

In September 2014, the Texas Water Development Board (TWDB) entered into agreement with the U.S. Army Corps of Engineers, Fort Worth District, to perform a volumetric and sedimentation survey of White Rock Lake. The City of Dallas provided 50% of the funding for this survey, while the U.S. Army Corps of Engineers, Fort Worth District, provided the remaining 50% of the funding through their Planning Assistance to States Program (TWDB, 2014). This report describes the methods used to conduct the volumetric and sedimentation survey, including data collection and processing techniques. This report serves as the final contract deliverable from TWDB to the City of Dallas and the U.S. Army Corps of Engineers, Fort Worth District, and contains as deliverables: (1) a shaded relief plot of the reservoir bottom [Figure 4], (2) a bottom contour map [Figure 6], (3) an estimate of sediment accumulation and location [Figure 10], and (4) an elevation-area-capacity table of the reservoir acceptable to the Texas Commission on Environmental Quality [Appendix A, B].

White Rock Lake general information

White Rock Dam and White Rock Lake are located on White Rock Creek a tributary of the Trinity River, in Dallas County, within the city limits of Dallas, Texas (Figure 1). White Rock Dam and White Rock Lake are owned and operated by the City of Dallas. Construction on White Rock Dam and deliberate impoundment began in 1910 (TWDB, 1973, SCS, 1978). White Rock Dam was completed on June 24, 1911 (Visser, 2011). White Rock Dam and White Rock Lake were built primarily for water supply storage for the City of Dallas. White Rock Lake was expected to serve as the city's major water source for 100 years, however, by 1926, the city had outgrown it. When Dallas Lake (now part of Lewisville Lake) was completed in 1929, White Rock Lake became a recreational destination (Butler, 2011). During the drought of the 1950's, White Rock Lake was briefly used for supplemental water supply in 1953 (WRLC, 2014, Butler, 2016). The lake is still operational as an emergency water supply for the City of Dallas and for direct use by Dallas Power and Light for a steam-electric generating plant as a standby service (Freese and Nichols, 2008).

Water rights for White Rock Lake have been appropriated to the City of Dallas through Certificate of Adjudication No. 08-2461 and Amendments to Certificate of Adjudication Nos. 08-2461A, and 08-2461B. The complete certificate is on file in the Information Resources Division of the Texas Commission on Environmental Quality.

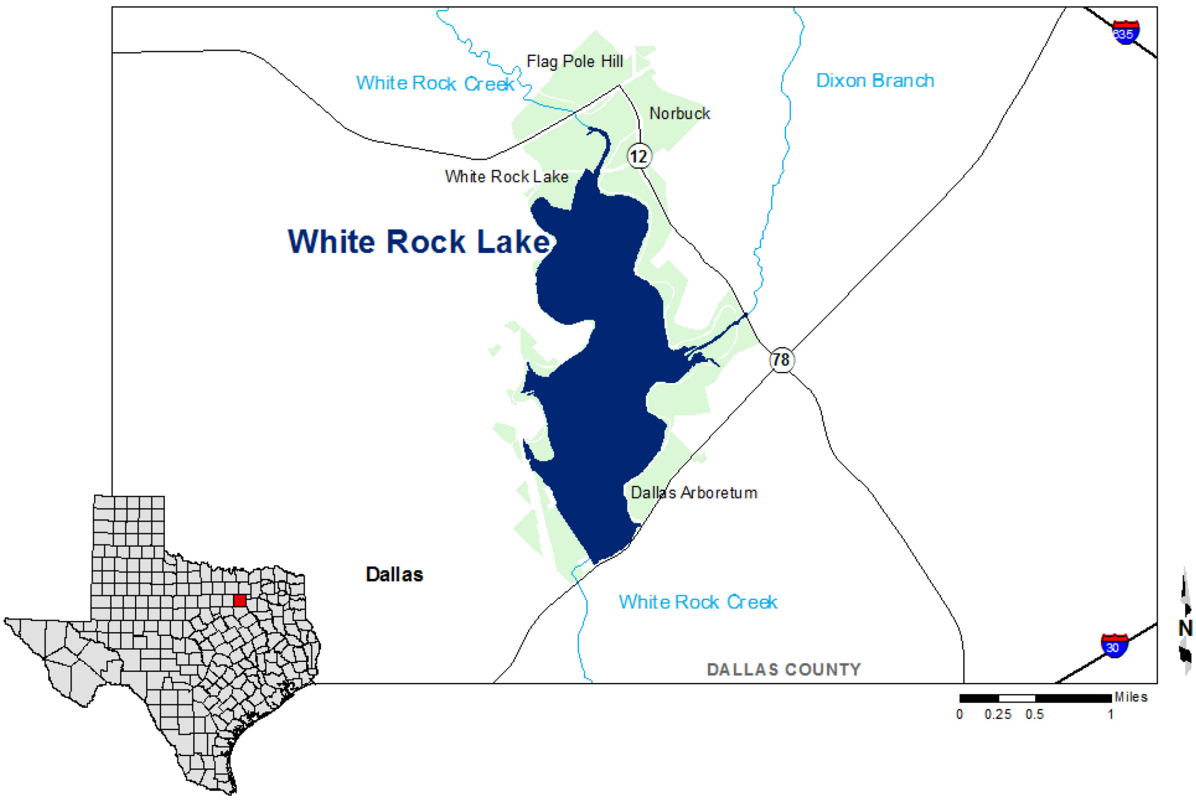


Figure 1. **Location of White Rock Lake**

Table 1.	Pertinent data for White Rock Dam and White Rock Lake		
Owner			
City of Dallas			
Design Engineer			
Forrest and Cotton, Inc. are consultants on maintenance of the present dam			
Location of dam			
On White Rock Creek in Dallas County, within the city limits of Dallas			
Drainage area			
100 square miles			
Dam			
Type	Earthfill		
Length	2,100 feet		
Height	40 feet		
Top width	20 feet		
Spillway			
Location	Left end of the dam		
Type	Broad-crested (uncontrolled)		
Control	2 weir type notches about 2.5 feet deep by 10 feet long, normally sealed with flash boards		
Crest length	450 feet		
Crest elevation	458.0 feet above mean sea level		
Reservoir data (Based on 2015 TWDB survey)			
Feature	**Elevation (feet** NGVD29[a]**)**	**Capacity (acre-feet)**	**Area (acres)**
Top of dam*	475.0	N/A	N/A
Spillway crest	458.0	10,329	998
Conservation pool[b]	457.9	10,230	995

Source: (TWDB, 1973, SCS, 1978) *Note: In 1978, a parapet wall was constructed along the crest of the dam raising the top elevation to 475.0 feet from 468.5 feet (Freese and Nichols, 2008).
[a] NGVD29 = National Geodetic Vertical Datum 1929
[b]C. Sanchez, personal communication, June 5, 2015

Volumetric and sedimentation survey of White Rock Lake

Datum

The vertical datum used during this survey is unknown. It is assumed to be equivalent to the National Geodetic Vertical Datum 1929 (NGVD29). Volume and area calculations in this report are referenced to water levels provided by the City of Dallas in feet above mean sea level. The horizontal datum used for this report is North American Datum 1983 (NAD83), and the horizontal coordinate system is State Plane Texas North Central Zone (feet).

TWDB bathymetric and sedimentation data collection

TWDB collected bathymetric data for White Rock Lake on March 19, 2015, March 25, 2015, and March 27, 2015. The daily average water surface elevations during the survey measured 458.3, 458.7, and 458.4 feet above mean sea level (NGVD29), respectively (C. Sanchez, personal communication, May 4, 2015). For data collection, TWDB used a Specialty Devices, Inc. (SDI), single-beam, multi-frequency (208 kHz, 50 kHz, and 24 kHz) sub-bottom profiling depth sounder integrated with differential global positioning system (DGPS) equipment. Data was collected along pre-planned survey lines oriented perpendicular to the assumed location of the original river channels and spaced approximately 250 feet apart. The depth sounder was calibrated daily using a velocity profiler to measure the speed of sound in the water column and a weighted tape or stadia rod for depth reading verification. Figure 2 shows where data collection occurred during the 2015 TWDB survey.

All sounding data was collected and reviewed before sediment core sampling sites were selected. Sediment core samples are collected at regularly spaced intervals within the reservoir, or at locations where interpretation of the acoustic display would be difficult without site-specific sediment core data. After analyzing the sounding data, TWDB selected four locations to collect sediment core samples (Figure 2). The sediment core samples were collected on May 20, 2015, with a custom-coring boat and SDI VibeCore system.

Sediment cores are collected in 3-inch diameter aluminum and/or clear acrylic tubes. Analysis of the acoustic data collected during the bathymetric survey assists in determining the depth of penetration the tube must be driven during sediment sampling. The goal is to collect a sediment core sample extending from the current reservoir-bottom surface, through the accumulated sediment, and to the pre-impoundment surface. After retrieving the sample, a stadia rod is inserted into the top of the aluminum tubes to assist in locating the top of the sediment in the tube. This identifies the location of the layer corresponding to the current reservoir-bottom surface. The aluminum tube is cut to this level, capped, and transported back to TWDB headquarters for further analysis. Sediment levels in the clear acrylic tubes were measured before transport back to TWDB headquarters. During this time, some settling of the upper layer can occur.

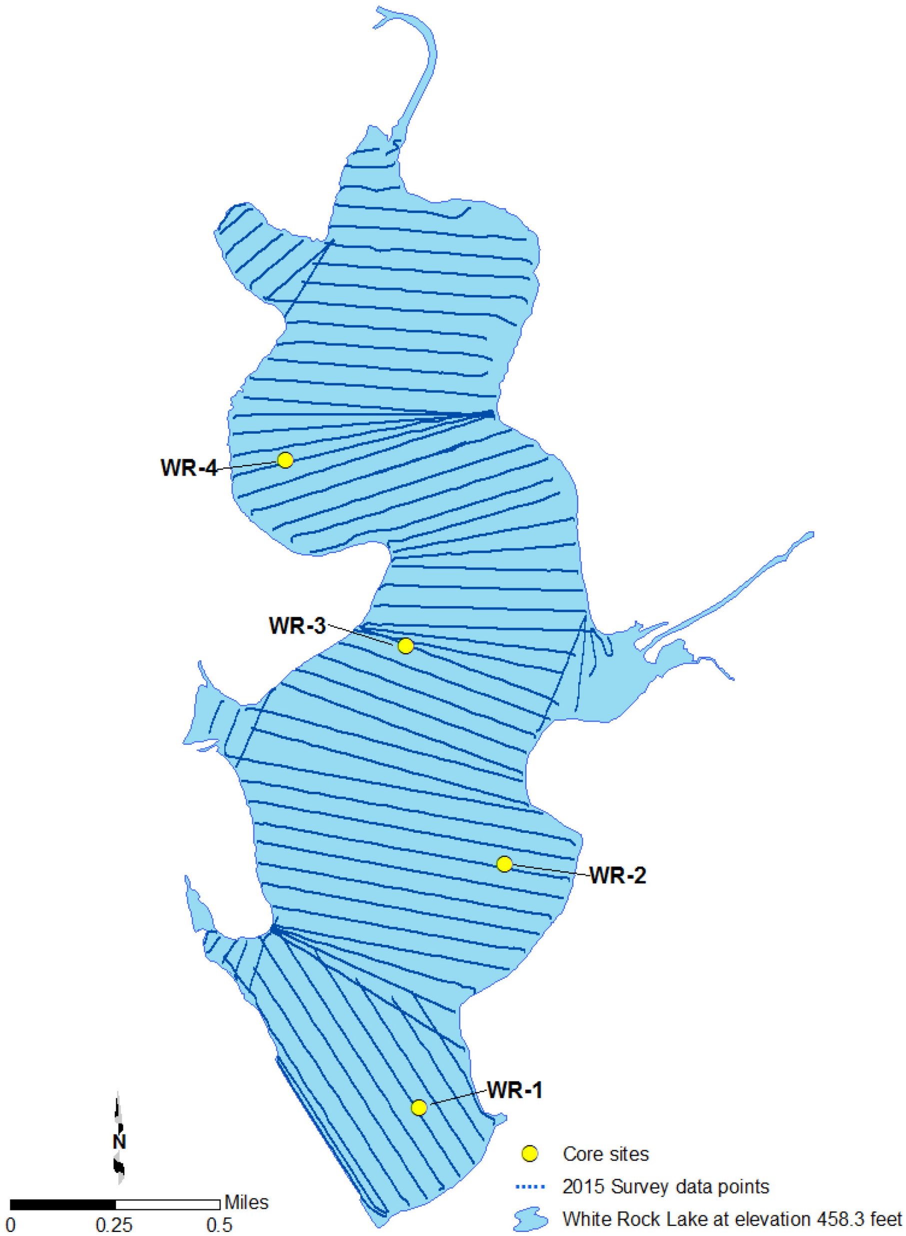


Figure 2. Data collected during 2015 TWDB White Rock Lake survey

Data processing

Model boundaries

The reservoir boundary was digitized from aerial photographs, also known as digital orthophoto quarter-quadrangle images (DOQQs), obtained from the Texas Natural Resources Information System (TNRIS, 2015a) using Environmental Systems Research Institute's ArcGIS software. The quarter-quadrangle that covers White Rock Lake is Dallas NW. The DOQQ was photographed on July 24, 2014, while the daily average water surface elevation measured 458.3 feet above mean sea level (D. Qualls, personal communication, December 9, 2015). According to metadata associated with the 2014 DOQQs, the photographs have a resolution or ground sample distance of 1.0 meter and a horizontal accuracy within ± 6 meters to true ground (TNRIS, 2015b, USDA, 2015). For this analysis, the boundary was digitized at the land-water interface in the 2014 photographs and assigned an elevation of 458.3 feet.

Triangulated Irregular Network model

Following completion of data collection, the raw data files collected by TWDB were edited to remove data anomalies. The reservoirs current bottom surface is automatically determined by the data acquisition software. DepthPic©, software developed by SDI, Inc., was used to display, interpret, and edit the multi-frequency data by manually removing data anomalies in the current bottom surface. TWDB developed an algorithm to automatically determine the pre-impoundment surface, i.e., sediment thickness, based on the intensity of the acoustic returns. Hydropick, software developed in-house and in collaboration with Enthought, Inc. (GitHub, 2015a, GitHub, 2015b), was used to calibrate the algorithm and manually edit the pre-impoundment surfaces in areas where the algorithm did not perform as expected. For further analysis, all data was exported into a single file, including the current reservoir bottom surface, pre-impoundment surface, and sediment thickness at each sounding location. The water surface elevation at the time of each sounding was used to convert each sounding depth to a corresponding reservoir-bottom elevation. This survey point dataset was then preconditioned by inserting a uniform grid of artificial survey points between the actual survey lines. Bathymetric elevations at these artificial points were determined using an anisotropic spatial interpolation algorithm described in the next section. This technique creates a high resolution, uniform grid of interpolated bathymetric elevation points throughout a majority of the reservoir (McEwen et al., 2014a). Finally, the point file resulting from spatial interpolation was used in conjunction with sounding and boundary data to create volumetric and sediment Triangulated Irregular Network (TIN) models utilizing the 3D Analyst Extension of ArcGIS. The 3D Analyst algorithm uses Delaunay's criteria for triangulation to create a grid composed of triangles from non-uniformly spaced points, including the boundary vertices (ESRI, 1995).

Spatial interpolation of reservoir bathymetry

Isotropic spatial interpolation techniques such as the Delaunay triangulation used by the 3D Analyst extension of ArcGIS are, in many instances, unable to suitably interpolate bathymetries between survey lines common to reservoir surveys. Reservoirs and stream channels are anisotropic morphological features where bathymetry at any particular location is more similar to upstream and downstream locations than to transverse locations. Interpolation schemes that do not consider this anisotropy lead to the creation of several types of artifacts in the final representation of the reservoir bottom surface and hence to errors in volume. These include: artificially-curved contour lines extending into the reservoir where the reservoir walls are steep or the reservoir is relatively narrow; intermittent representation of submerged stream channel connectivity; and oscillations of contour lines in between survey lines. These artifacts reduce the accuracy of the resulting volumetric and sediment TIN models in areas between actual survey data.

To improve the accuracy of bathymetric representation between survey lines, TWDB developed various anisotropic spatial interpolation techniques. Generally, the directionality of interpolation at different locations of a reservoir can be determined from external data sources. A basic assumption is that the reservoir profile in the vicinity of a particular location has upstream and downstream similarity. In addition, the sinuosity and directionality of submerged stream channels can be determined by directly examining the survey data, or more robustly by examining scanned USGS 7.5 minute quadrangle maps (known as digital raster graphics) and hypsography files (the vector format of USGS 7.5 minute quadrangle map contours), when available. Using the survey data, polygons are created to partition the reservoir into segments with centerlines defining directionality of interpolation within each segment. For surveys with similar spatial coverage, these interpolation definition files are in principle independent of the survey data and could be applied to past and future survey data of the same reservoir. In practice, however, minor revisions of the interpolation definition files may be needed to account for differences in spatial coverage and boundary conditions between surveys. Using the interpolation definition files and survey data, the current reservoir-bottom elevation, pre-impoundment elevation, and sediment thickness are calculated for each point in the high resolution uniform grid of artificial survey points. The reservoir boundary, artificial survey points grid, and survey data points are used to create volumetric and sediment TIN models representing the reservoir bathymetry and sediment accumulation throughout the reservoir.

Specific details of this interpolation technique can be found in the HydroTools manual (McEwen et al., 2014a) and in McEwen et al., 2014b.

In areas inaccessible to survey data collection, such as small coves and shallow upstream areas of the reservoir, linear interpolation is used for volumetric and sediment accumulation estimations. The linear interpolation follows a linear definition file linking the survey points file to the lake boundary file (McEwen et al., 2014a). Without linearly interpolated data, the TIN model builds flat triangles. A flat triangle is defined as a triangle where all three vertices are equal in elevation, generally the elevation of the reservoir boundary. Reducing flat triangles by applying linear interpolation improves the elevation-capacity and elevation-area calculations. It is not always possible to remove all flat triangles, and linear interpolation is only applied where adding bathymetry is deemed reasonable.

Figure 3 illustrates typical results from application of the anisotropic interpolation and linear interpolation techniques to White Rock Lake. In Figure 3A, steep slopes indicated by surveyed cross sections are not continuously represented in areas between survey cross sections. This is an artifact of the TIN generation routine rather than an accurate representation of the physical bathymetric surface. Inclusion of interpolation points in creation of the volumetric TIN model, represented in Figure 3B, directs Delaunay triangulation to better represent the reservoir bathymetry between survey cross-sections. The bathymetry shown in Figure 3C was used in computing reservoir capacity and area tables (Appendix A, B).

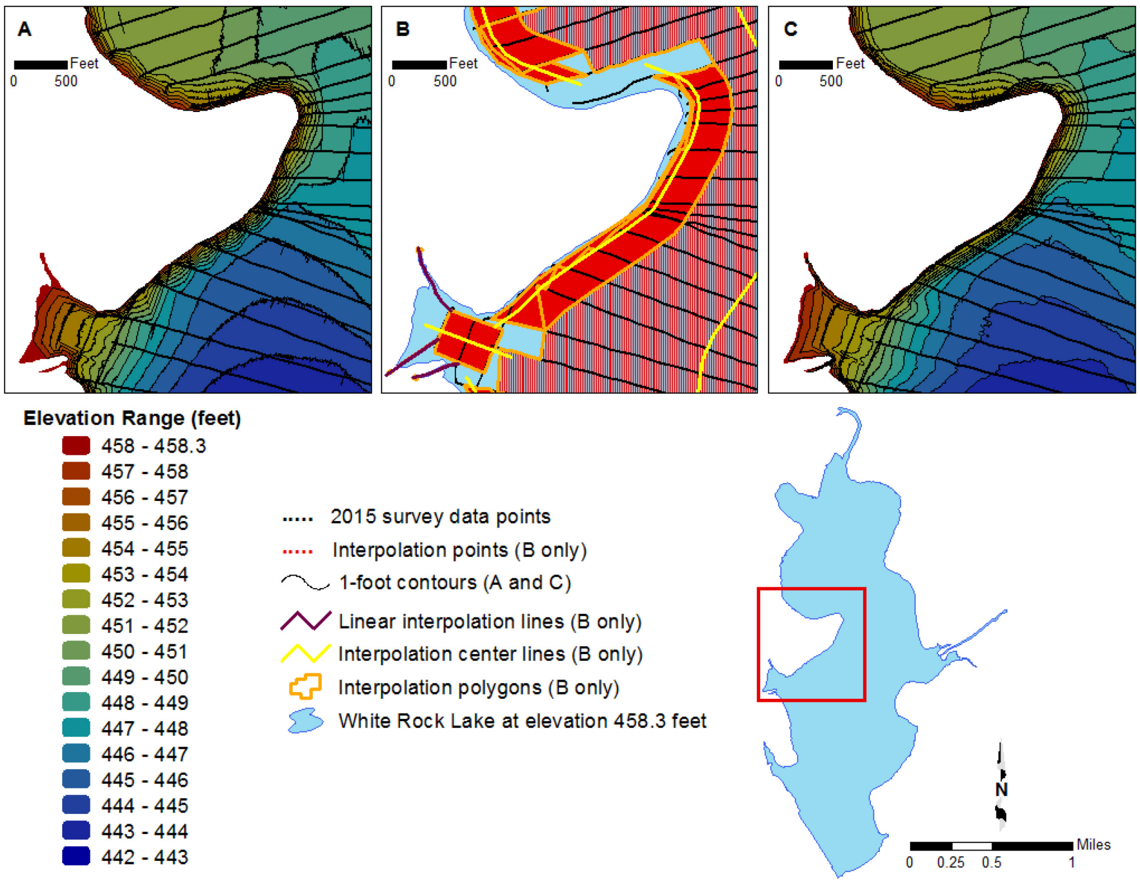


Figure 3. **Anisotropic spatial interpolation and linear interpolation of White Rock Lake sounding data - A) bathymetric contours without interpolated points, B) sounding points (black) and interpolated points (red), C) bathymetric contours with the interpolated points**

Area, volume, and contour calculation

Using ArcInfo software and the volumetric TIN model, volumes and areas were calculated for the entire reservoir at 0.1-foot intervals, from 438.8 to 458.3 feet. The elevation-capacity table and elevation-area table, updated for 2015, are presented in Appendices A and B, respectively. The capacity curve is presented in Appendix C, and the area curve is presented in Appendix D.

The volumetric TIN model was converted to a raster representation using a cell size of 1 foot by 1 foot. The raster data was then used to produce: an elevation relief map (Figure 4), representing the topography of the reservoir bottom; a depth range map (Figure 5), showing shaded depth ranges for White Rock Lake; and a 1-foot contour map (Figure 6).

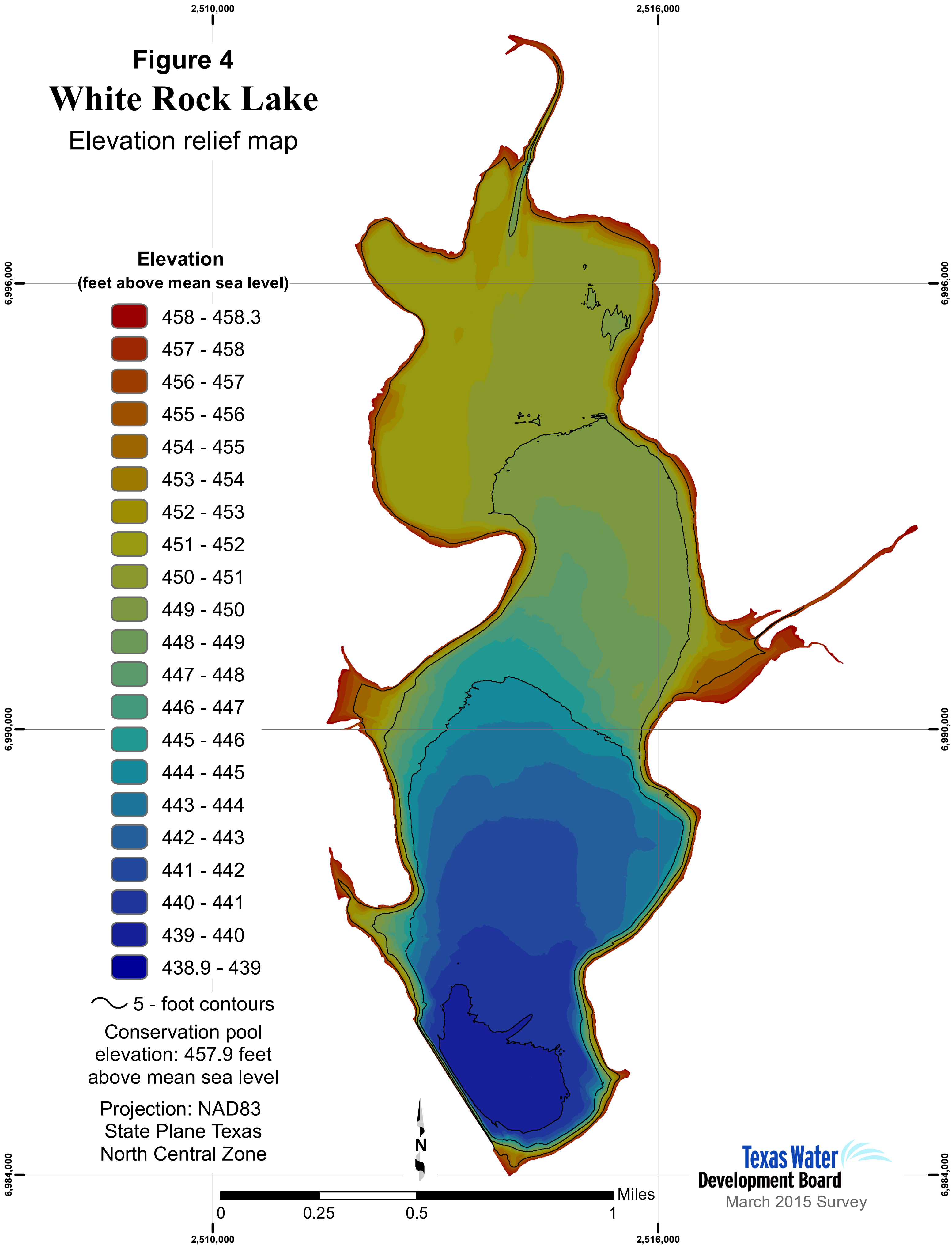
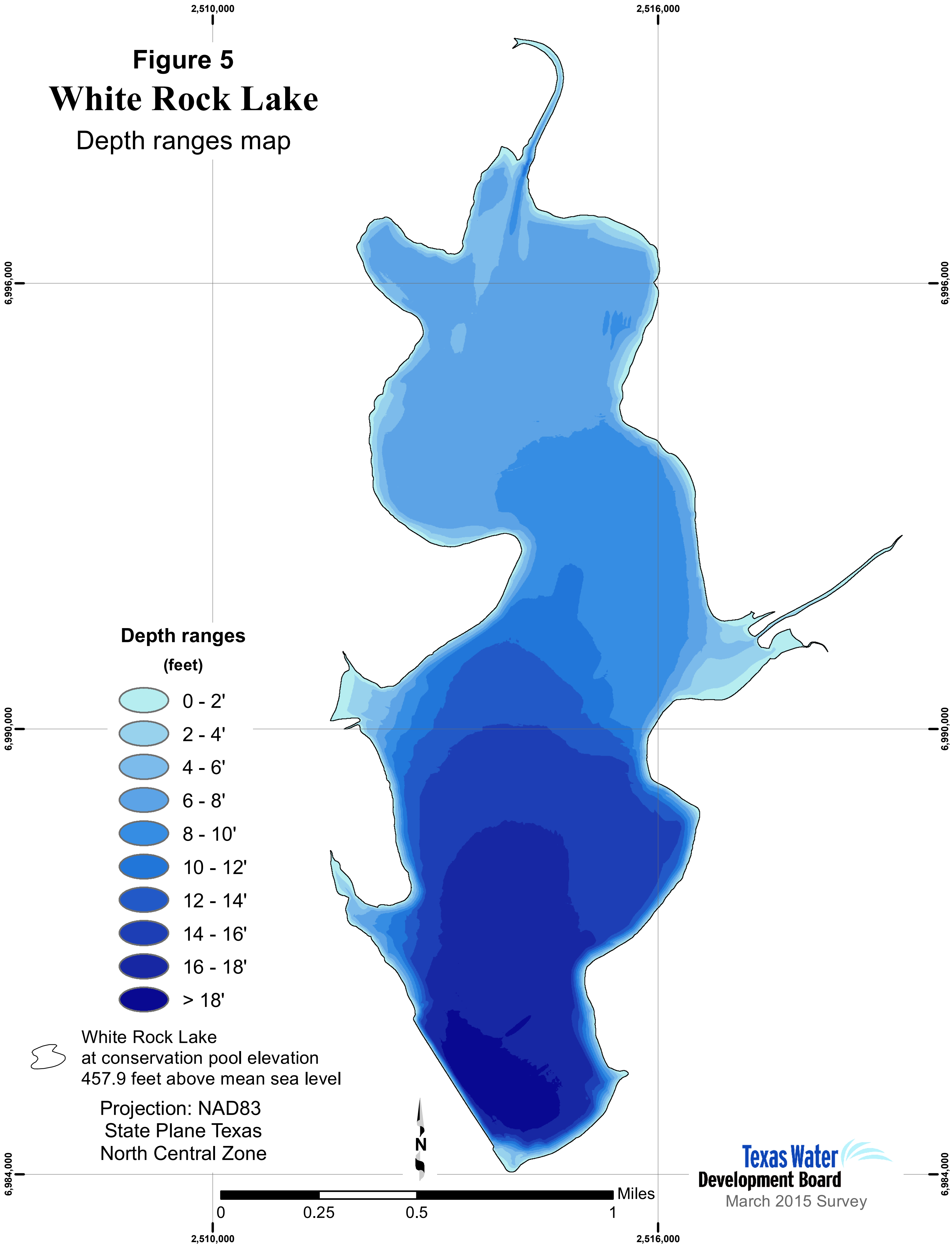


Figure 4
White Rock Lake
Elevation relief map

Figure 5
White Rock Lake
Depth ranges map



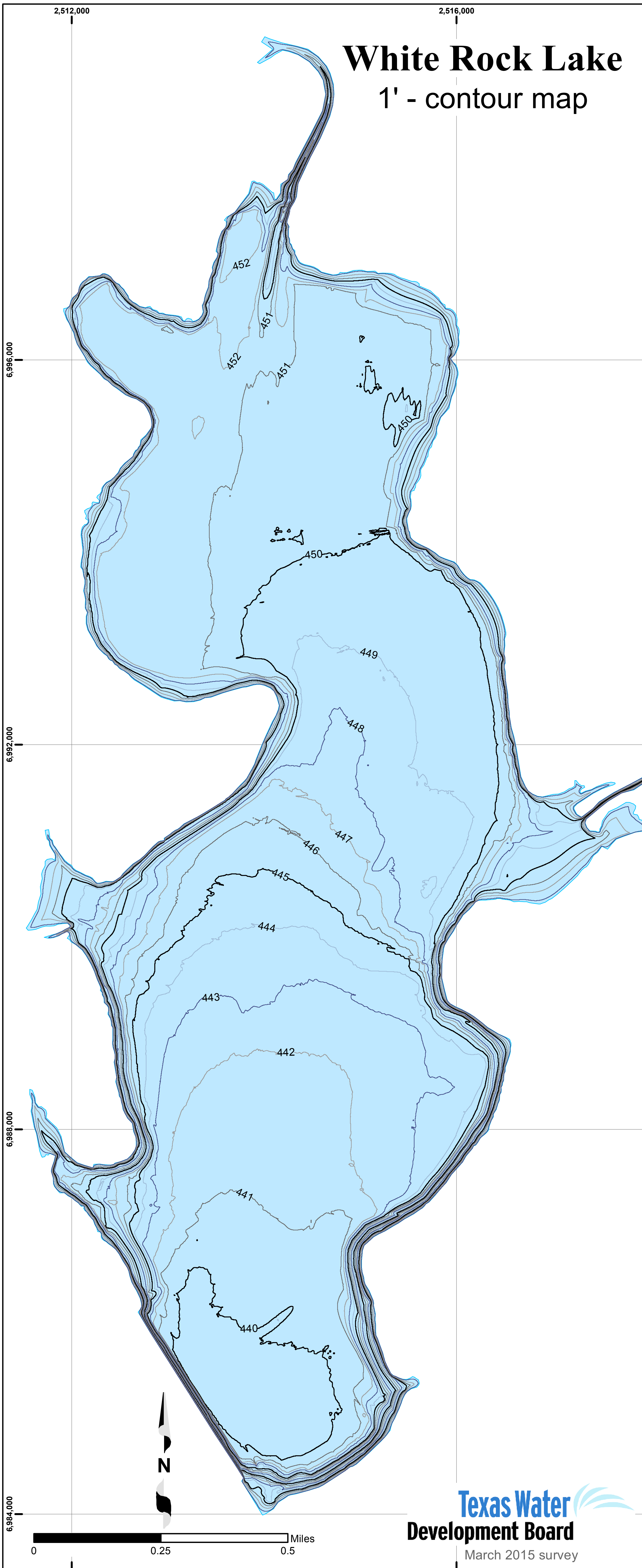


Figure 6

Contours (feet)

458
457
456
455
454
453
452
451
450
449
448
447
446
445
444
443
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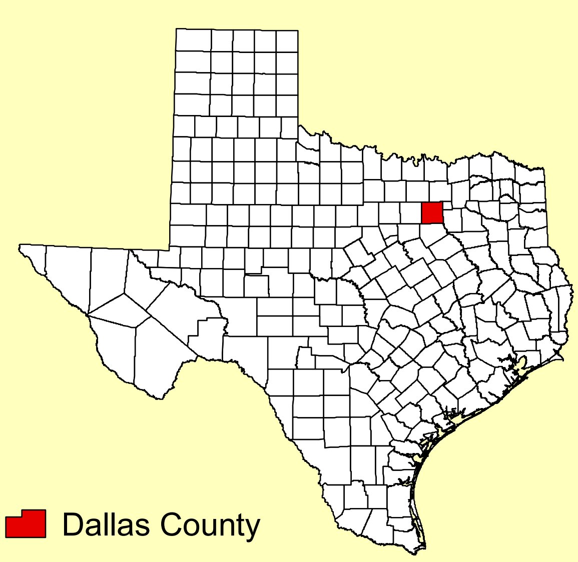
441
440
439

White Rock Lake elevation 458.3 feet above mean sea level

Conservation pool elevation: 457.9 feet above mean sea level

Projection: NAD83 State Plane Texas North Cental Zone (feet)



Dallas County

This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of White Rock Lake.
The Texas Water Development Board makes no representations nor assumes any liability.

Analysis of sediment data from White Rock Lake

Sedimentation in White Rock Lake was determined by analyzing the acoustic signal returns of all three depth sounder frequencies using customized software called Hydropick. While the 208 kHz signal is analyzed to determine the current bathymetric surface, all three frequencies, 208 kHz, 50 kHz, and 24 kHz, are analyzed to determine the reservoir bathymetric surface at the time of initial impoundment, i.e., pre-impoundment surface. Sediment core samples collected in the reservoir are correlated with the acoustic signals in each frequency to assist in identifying the pre-impoundment surface. The difference between the current surface and the pre-impoundment surface yields a sediment thickness value at each sounding location.

Analysis of the sediment core samples was conducted at TWDB headquarters in Austin. Each sample was split longitudinally and analyzed to identify the location of the pre-impoundment surface. The pre-impoundment surface is identified within the sediment core sample by one or more of the following methods: (1) a visual examination of the sediment core for terrestrial materials, such as leaf litter, tree bark, twigs, intact roots, etc., concentrations of which tend to occur on or just below the pre-impoundment surface; (2) changes in texture from well sorted, relatively fine-grained sediment to poorly sorted mixtures of coarse and fine-grained materials; and (3) variations in the physical properties of the sediment, particularly sediment water content and penetration resistance with depth (Van Metre et al., 2004). The total sample length, sediment thickness, and the pre-impoundment thickness were recorded. Physical characteristics of the sediment core, including Munsell soil color, texture, relative water content, and presence of organic materials, were also recorded (Table 2).

Table 2. Sediment core sampling analysis data - White Rock Lake

Core	Easting[a] (ft)	Northing[a] (ft)	Total core sample/ post-impoundment sediment	Sediment core description	Munsell soil color
WR-1	2514523.30	6985496.02	120"/ 80.0"	0-27.5" high water content, loam	GLEY1 2.5/10Y
				27.5-80.0" high water content, dense, few clay pockets, clay loam	GLEY1 3/10Y
				80.0-89.0" high water content, more dense, few clay pockets, clay loam	GLEY1 2.5/10Y
				89.0-120.0" low water content, high density, small dry clay pieces, clay loam	GLEY1 2.5/10Y
WR-2	2515596.90	6988558.12	120"/67.0"	0-11.0" very high water content, loam	GLEY1 2.5/10Y
				11.0-67.0" lower water content, dense	GLEY1 3/10Y
				67.0-117.5" very dense, small dry clay pockets, loamy clay	5Y 2.5/1
				117.5-120.0" very dense, dry soil, tiny pieces organic matter, clay	5Y 4/1
WR-3	2514351.07	6991309.18	67"/55.0"	0-1.5" fluff lost in compression	N/A
				1.5-22.5" high water content, dense, silty clay loam	5Y 3/1
				22.5-55.0" high water content, more dense, silty clay loam	5Y 2.5/1
				55.0-65.5" very dense, clay loam	5Y 4/1
				65.5-67.0"low water content, dense, tiny organic matter, loamy clay	2.5Y 3/1
WR-4	2512841.05	6993637.50	93"/38.0"	0-8.0" fluff lost with compression	N/A
				8.0-18.0" high water content, silty loam	2.5Y 2.5/1
				18.0-38.0" layer identified by color change seen in photograph of core	N/A
				18.0-77.0" high water content, very dense, small organic matter at top 1" of layer, small clay pockets, clay loam, possible layer from 18.0-38.0"	5Y 2.5/2
				77.0-93.0" low water content, small organics present, clay loam	10YR 4/1

[a] Coordinates are based on NAD83 State Plane Texas North Central System (feet)

A photograph of sediment core WR-3 is shown in Figure 7 and is representative of the sediment cores sampled from White Rock Lake. The base of the sample is denoted by the blue line. The pre-impoundment boundary (yellow line) was evident within this sediment core sample at 55.0 inches and identified by the change in color, texture, moisture, porosity, and structure. Identification of the pre-impoundment surface for the remaining sediment cores followed a similar procedure.

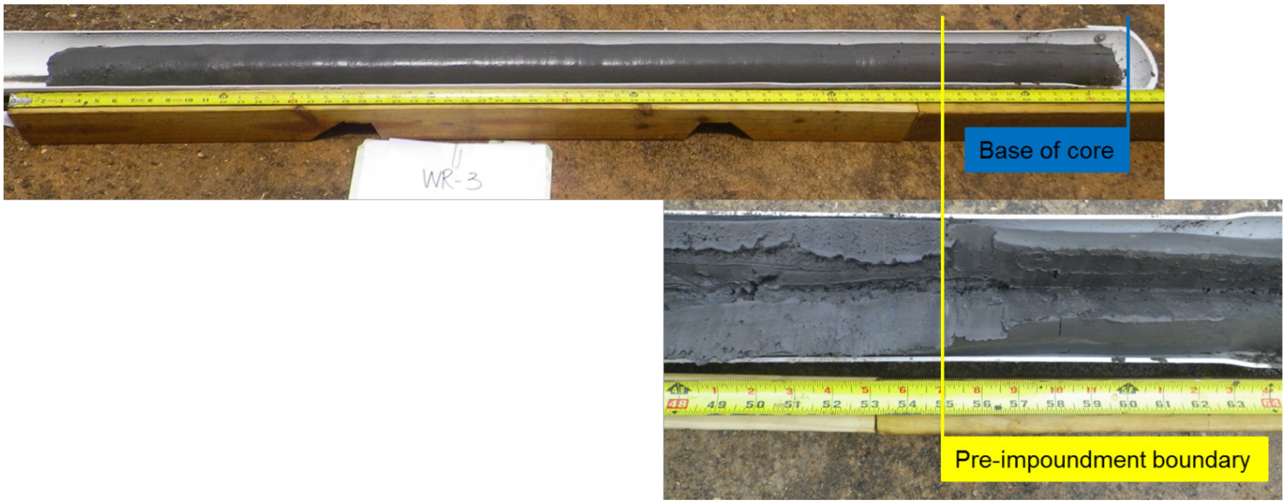


Figure 7. Sediment core WR-3 from White Rock Lake

Figure 8 and 9 illustrate how measurements from sediment core samples are used with sonar data to help identify the interface between the post- and pre-impoundment layers in the acoustic signal.

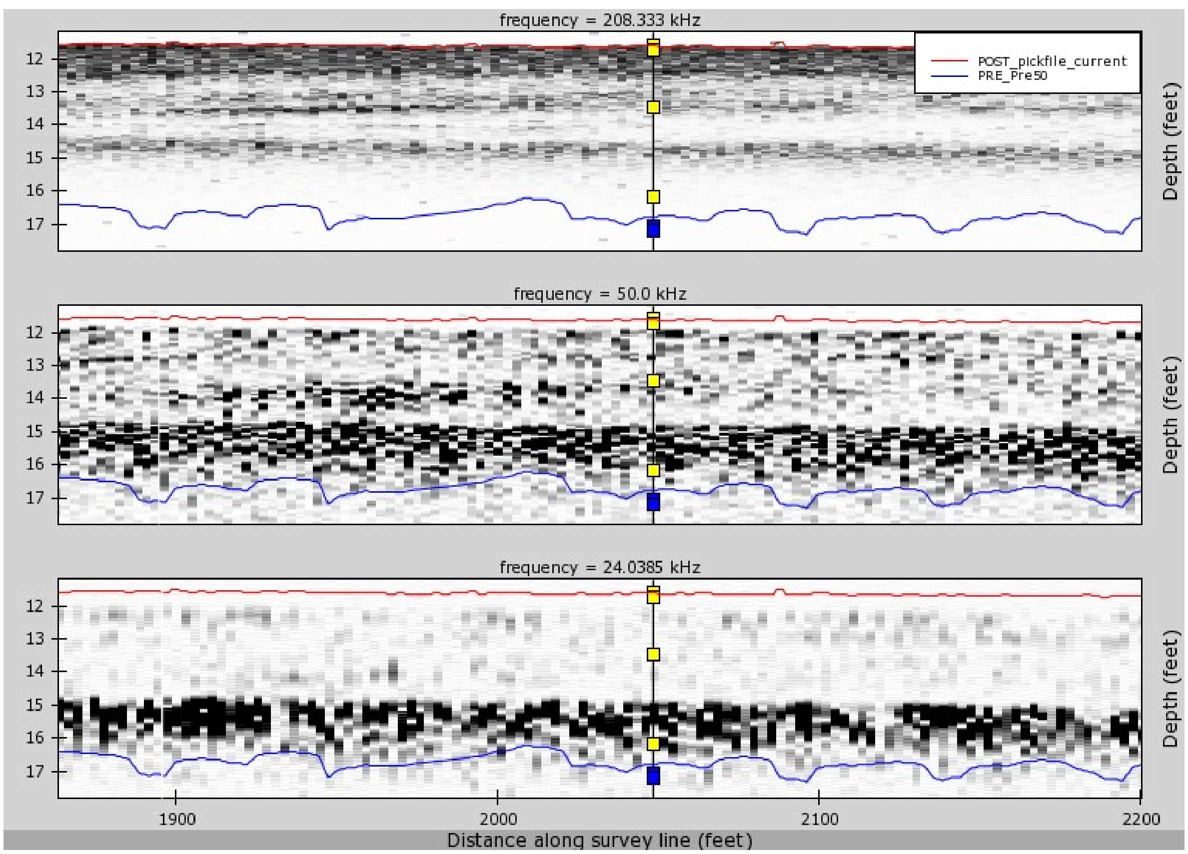


Figure 8. Comparison of sediment core WR-3 with acoustic signal returns

Figure 8 compares sediment core sample WR-3 with the acoustic signals as seen in Hydropick for each frequency: 208 kHz, 50 kHz, and 24 kHz. The current bathymetric surface is automatically determined based on signal returns from the 208 kHz transducer and represented by the top red line in Figure 8.The pre-impoundment surface is identified by comparing boundaries observed in the 208 kHz, 50 kHz and 24 kHz signals to the location of the pre-impoundment surface of the sediment core sample. Each layer of sediment identified in the sediment core sample during analysis (Table 2) is represented by a yellow or blue box. The yellow boxes represent post-impoundment sediment. The blue boxes mark the bottom of the pre-impoundment sediment layers and the lower blue box is also the bottom of the sediment core sample.

In this case the boundary in the 50 kHz signal most closely matched the pre-impoundment interface of the sediment core sample; therefore, the 50 kHz signal was used to locate the pre-impoundment surface (blue line in Figure 8). Figure 9 shows sediment core sample WR-3 correlated with the 50 kHz frequency of the nearest surveyed cross-section. The pre-impoundment surface is first identified along cross-sections for which sediment core samples have been collected and used as a guide for identifying the pre-impoundment surface along cross-sections where sediment core samples were not collected.

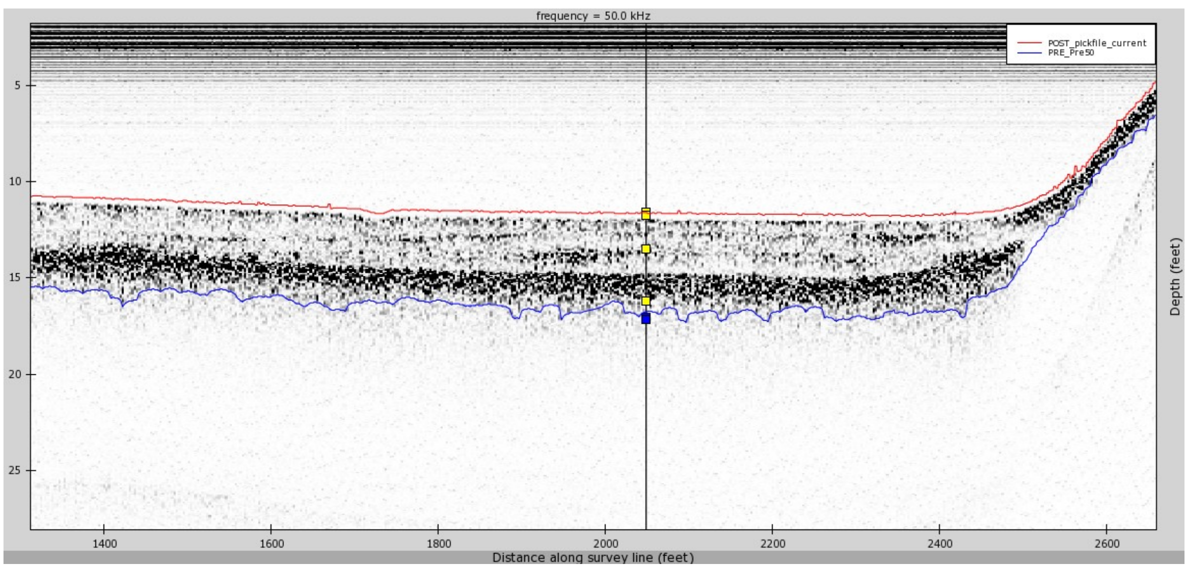


Figure 9. Cross-section of data collected during survey, displayed in Hydropick (50 kHz frequency), correlated with sediment core sample WR-3 and showing the current surface in red and pre-impoundment surface in blue

The pre-impoundment surface was automatically generated in Hydropick using Otsu's thresholding algorithm of classifying greyscale intensity images into binary (black and white) images based on maximum inter-class variance. The acoustic return images of a selected frequency from each survey line were processed using this technique and the pre-impoundment surface identified as the bottom black/white interface (where black is the sediment layer) of the resulting binary image (D. Pothina, personal communication, October 2, 2014). The pre-impoundment surface is then verified and edited manually as needed.

After the pre-impoundment surface from all cross-sections is identified, a sediment thickness TIN model is created following standard GIS techniques (Furnans, 2007). Sediment thicknesses were interpolated between surveyed cross-sections using HydroTools with the same interpolation definition file used for bathymetric interpolation. For the purposes of the TIN model creation, TWDB assumed sediment thickness at the reservoir boundary was zero feet (defined as the 458.3 foot elevation contour). The sediment thickness TIN model was converted to a raster representation using a cell size of 1 foot by 1 foot and used to produce a sediment thickness map of White Rock Lake (Figure 10).

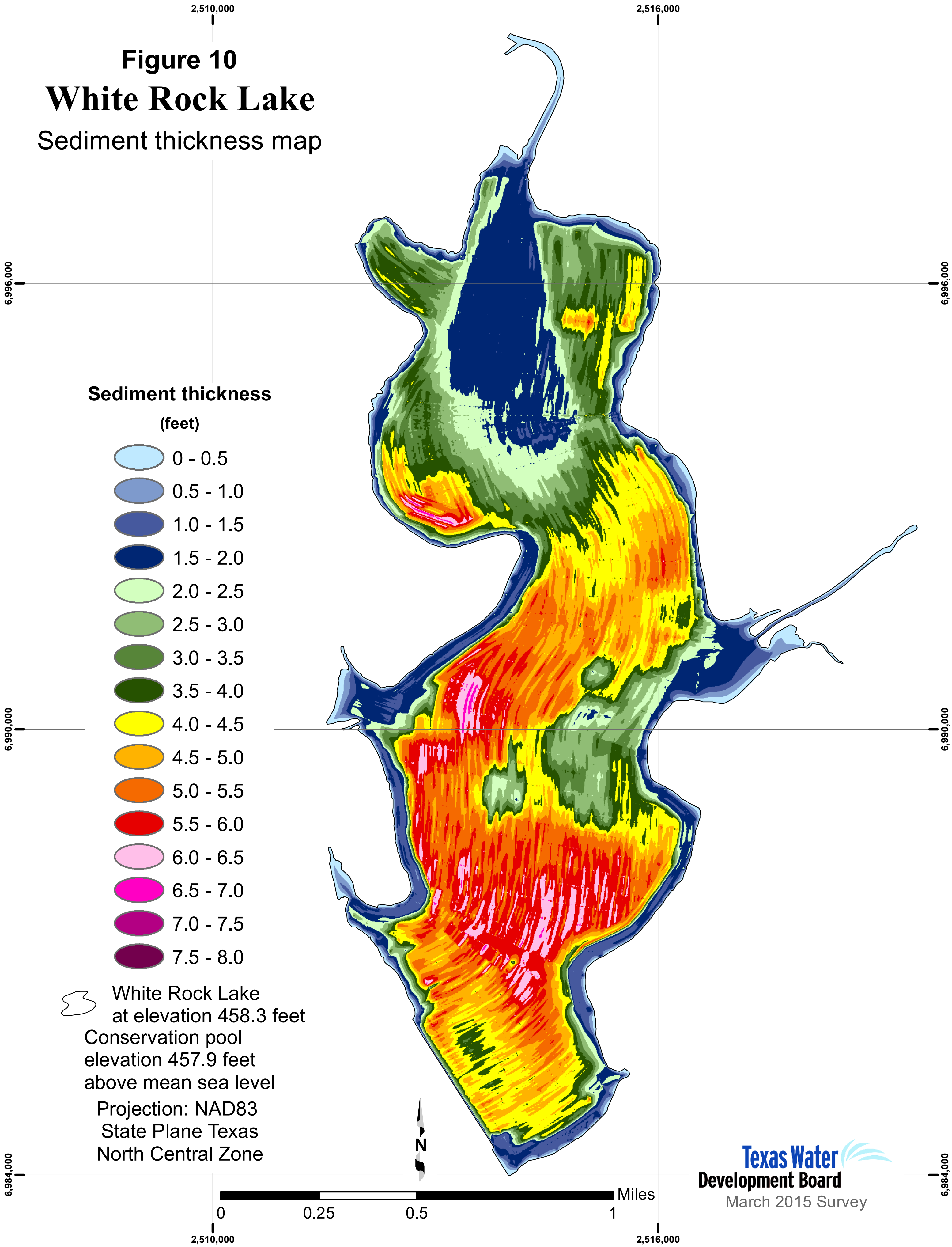


Figure 10
White Rock Lake
Sediment thickness map
Sediment thickness
(feet)
0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5
3.5 - 4.0
4.0 - 4.5
4.5 - 5.0
5.0 - 5.5
5.5 - 6.0
6.0 - 6.5
6.5 - 7.0
7.0 - 7.5
7.5 - 8.0
White Rock Lake
at elevation 458.3 feet
Conservation pool
elevation 457.9 feet
above mean sea level
Projection: NAD83
State Plane Texas
North Central Zone
N
Miles
0
0.25
0.5
1
Texas Water
Development Board
March 2015 Survey
2,510,000
2,516,000
6,996,000
6,990,000
6,984,000

Survey results

Volumetric survey

The results of the 2015 TWDB volumetric survey indicate White Rock Lake has a total reservoir capacity of 10,230 acre-feet and encompasses 995 acres at conservation pool elevation (457.9 feet above mean sea level, NGVD29). Previous capacity estimates for White Rock Lake, calculated at spillway elevation 458.0 feet above mean sea level, are provided in Table 3. Because of differences in past and present survey methodologies, and dredging since the lake was built, direct comparison of volumetric surveys to estimate loss of capacity is difficult and can be unreliable.

Table 3. Current and previous survey capacity and surface area data at spillway elevation 458.0 feet above mean sea level

Survey	Surface area (acres)	Total capacity (acre-feet)
Original design, 1910[a]	1,254	18,158
1935[a]	1,150	14,276
1956[a]	1,095	12,321
1970[a]	1,119	10,743
1977[a]	1,075	10,721
TWDB 1993[b]	1,088	9,004
TWDB 2015	998	10,329

[a] Source: (SCS, 1978)
[b] Source: (TWDB, 2003)

Sedimentation survey

The 2015 TWDB sedimentation survey measured 3,550 acre-feet of sediment below conservation pool elevation (457.9 feet NGVD29). Because White Rock Lake has been dredged multiple times, on and off between 1937 and 1941, from 1955-1956, 1974, and again from 1996 to 1998 (Butler, 2011, WRLC, 2014, Rodriguez et al., 2011), a reliable sedimentation rate could not be calculated. Dredging between 1937 and 1941 removed approximately 500,000 tons of sediment and reclaimed 90 acres of land (Butler, 2011, Rodriguez et al., 2011). During the 1955-1956 dredging, approximately 15,000 cubic yards of sediment were removed (Butler, 2011). During the 1974 dredging approximately 850 acre-feet of sediment was dredged (SCS, 1978); however, sediment was not removed from the site, but instead used to create Mockingbird Point where a dog park now exists (WRLC, 2014). Following a Clean Lakes Study in 1994 on the lake's sediment levels, approximately three million cubic yards of sediment were removed (Ostdick, 2007, Visser, 2011). Sediment accumulation is greatest in the area where the reservoir narrows northwest of the Dallas Arboretum and in pockets throughout the reservoir.

Recommendations

To improve estimates of sediment accumulation rates, TWDB recommends resurveying White Rock Lake in approximately 10 years or after a major flood event. To further improve estimates of sediment accumulation, TWDB recommends another sedimentation survey. A re-survey would allow a more accurate quantification of the average sediment accumulation rate for White Rock Lake.

TWDB contact information

More information about the Hydrographic Survey Program can be found at: http://www.twdb.texas.gov/surfacewater/surveys/index.asp

Any questions regarding the TWDB Hydrographic Survey Program may be addressed to:

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Appendix A

White Rock Lake

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD | March 2015 Survey

CAPACITY IN ACRE-FEET | Conservation Pool Elevation 457.9 feet NGVD29

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
438	0	0	0	0	0	0	0	0	0	0
439	0	0	0	0	0	1	2	3	5	8
440	12	17	23	29	37	45	53	62	71	80
441	90	100	111	122	134	146	160	174	189	205
442	222	240	259	278	298	319	340	362	385	409
443	433	458	484	511	538	566	595	624	654	684
444	714	745	776	808	840	873	906	939	972	1,006
445	1,041	1,075	1,110	1,145	1,181	1,217	1,253	1,290	1,327	1,364
446	1,402	1,440	1,478	1,517	1,556	1,595	1,635	1,674	1,714	1,755
447	1,795	1,836	1,878	1,919	1,961	2,003	2,045	2,087	2,130	2,174
448	2,217	2,262	2,306	2,351	2,397	2,443	2,490	2,538	2,586	2,636
449	2,685	2,736	2,788	2,841	2,895	2,950	3,007	3,065	3,124	3,183
450	3,243	3,304	3,367	3,430	3,496	3,563	3,632	3,702	3,773	3,845
451	3,918	3,992	4,067	4,143	4,221	4,300	4,381	4,464	4,547	4,632
452	4,717	4,803	4,890	4,977	5,064	5,152	5,240	5,328	5,417	5,506
453	5,595	5,685	5,774	5,864	5,954	6,045	6,135	6,226	6,317	6,409
454	6,500	6,592	6,684	6,776	6,869	6,961	7,054	7,147	7,241	7,334
455	7,428	7,522	7,616	7,711	7,805	7,900	7,995	8,090	8,185	8,281
456	8,376	8,472	8,568	8,664	8,761	8,857	8,954	9,051	9,148	9,245
457	9,343	9,441	9,538	9,637	9,735	9,833	9,932	10,031	10,130	10,230
458	10,329	10,429	10,529	10,630						

Appendix B

White Rock Lake

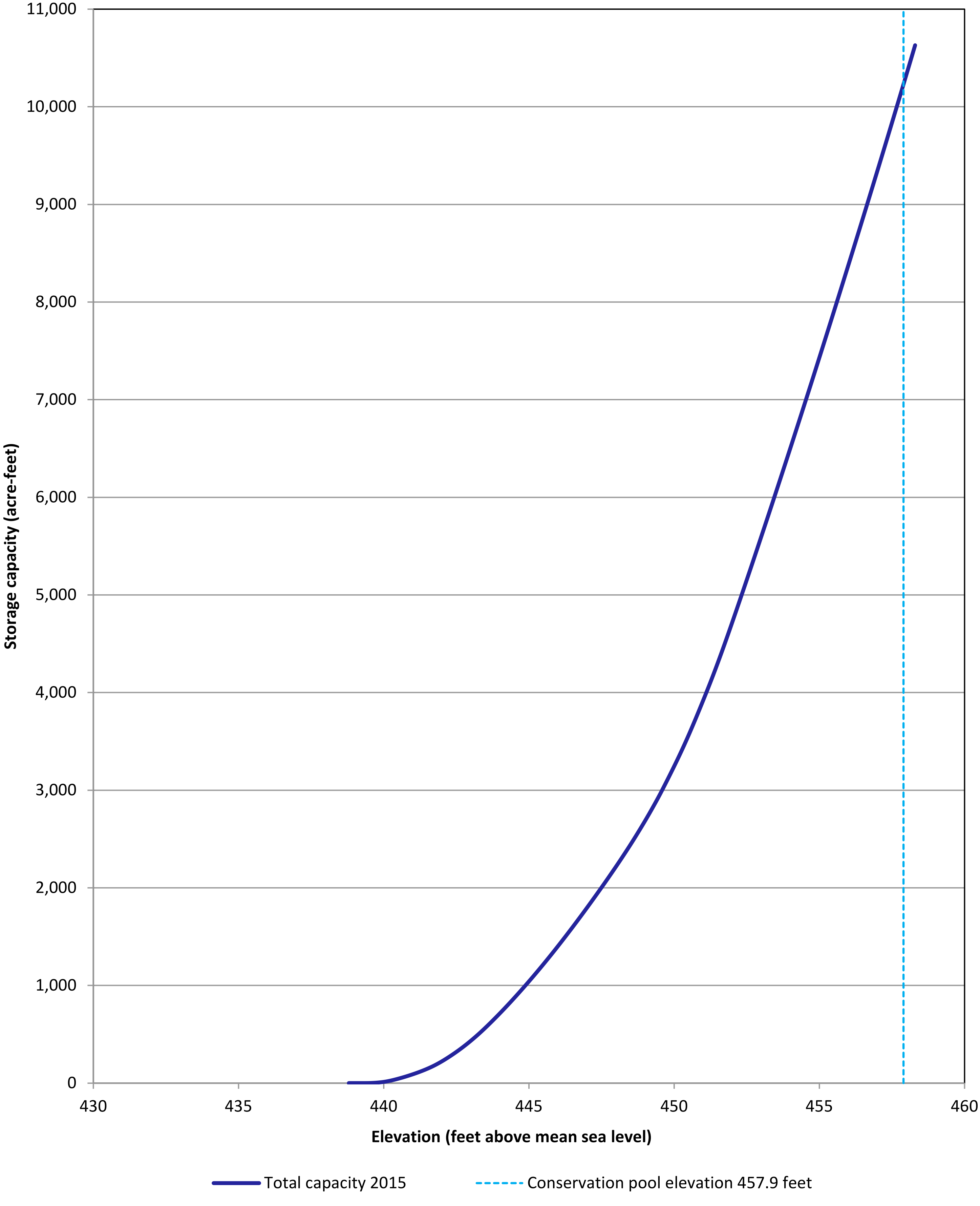
RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — March 2015 Survey

AREA IN ACRES — Conservation Pool Elevation 457.9 feet NGVD29

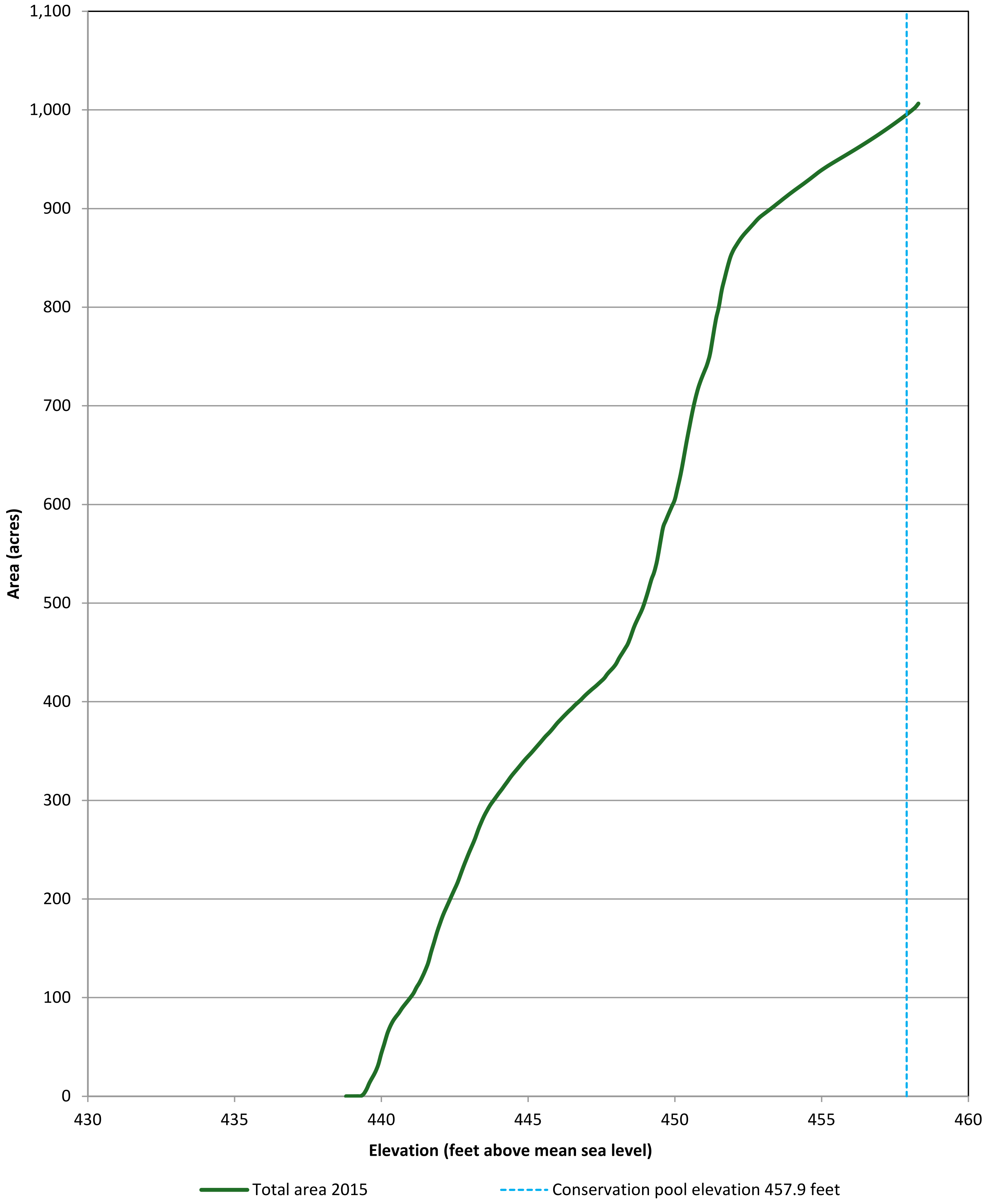
ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
438	0	0	0	0	0	0	0	0	0	0
439	0	0	0	0	2	7	14	19	25	32
440	43	53	63	71	76	81	84	89	93	97
441	100	105	110	115	121	128	135	146	156	166
442	175	183	190	197	204	210	217	225	233	240
443	248	254	262	270	277	284	289	295	299	303
444	307	311	315	319	323	327	331	334	338	341
445	345	348	351	355	358	362	365	368	371	375
446	379	382	385	388	391	394	397	399	402	405
447	408	411	413	416	418	421	424	428	431	435
448	438	444	449	454	459	466	475	482	488	495
449	503	513	524	532	544	560	577	584	591	598
450	605	617	631	647	663	679	694	707	718	727
451	734	742	753	770	787	800	817	829	841	851
452	858	863	868	872	875	879	882	885	888	891
453	894	896	898	900	903	905	907	910	912	915
454	917	919	921	923	925	928	930	932	935	937
455	939	941	943	945	947	948	950	952	954	955
456	957	959	961	963	965	966	968	970	972	974
457	976	978	980	982	984	987	989	991	993	995
458	998	1,000	1,003	1,006						



White Rock Lake
March 2015 Survey
Prepared by: TWDB

Appendix C: Capacity curve



White Rock Lake
March 2015 Survey
Prepared by: TWDB

Appendix D: Area curve