Volumetric and Sedimentation Survey of LAKE HOUSTON

December 2011 Survey

Texas Water Development Board

July 2013

Texas Water Development Board

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Coastal Water Authority

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

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Executive summary

In December 2011 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 Lake Houston. The U.S. Army Corps of Engineers, Fort Worth District, provided 50% of the funding for this survey through their Planning Assistance to States Program, while the Coastal Water Authority provided the remaining 50%. Surveying was performed using a multi-frequency (200 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.

Lake Houston Dam and Lake Houston are located on the San Jacinto River in Harris County, approximately 18 miles northeast of downtown Houston, Texas. The conservation pool elevation of Lake Houston is 41.73 feet (NAVD88). TWDB collected bathymetric data for Lake Houston between December 13, 2011, and December 19, 2011. The daily average water surface elevation during the survey ranged between 41.64 and 41.72 feet (NAVD88).

The 2011 TWDB volumetric survey indicates that Lake Houston has a total reservoir capacity of 124,661 acre-feet and encompasses 10,160 acres at conservation pool elevation (41.73 feet above mean sea level, NAVD88). Previous capacity estimates include the original design estimate of 158,553 acre-feet at the time of impoundment in 1954 and a 1965 survey estimate of 146,769 acre-feet. A TWDB volumetric survey conducted in 1994 was re-evaluated using current processing procedures resulting in an updated capacity estimate of 136,381 acre-feet.

Based on two methods for estimating sedimentation rates, the 2011 TWDB sedimentation survey estimates Lake Houston loses between 344 and 689 acre-feet of capacity per year due to sedimentation below conservation pool elevation (41.73 feet above mean sea level, NAVD88). The sedimentation survey indicates sediment accumulation varies throughout the reservoir. Accumulations of sediment are thicker within the natural depressions throughout the reservoir than in the river channels. The heaviest accumulations measured by this survey are between 1.14 and 2.84 miles north of the dam on the western half of the reservoir. TWDB recommends that a similar methodology be used to resurvey Lake Houston 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. 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 December 2011 TWDB entered into agreement with U.S. Army Corps of Engineers, Fort Worth District, to perform a volumetric and sedimentation survey of Lake Houston. The U.S. Army Corps of Engineers, Fort Worth District, provided 50% of the funding for this survey through their Planning Assistance to States Program, while the Coastal Water Authority provided the remaining 50% (TWDB, 2010). 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 U.S. Army Corps of Engineers, Fort Worth District and contains as deliverables: (1) an elevation-area-capacity table of the reservoir acceptable to the Texas Commission on Environmental Quality [Appendix A, B], (2) a bottom contour map [Figure 5], (3) a shaded relief plot of the reservoir bottom [Figure 3], and (4) an estimate of sediment accumulation and location [Figure 10].

Lake Houston general information

Lake Houston Dam and Lake Houston are located on the San Jacinto River in Harris County, approximately 18 miles northeast of downtown Houston, Texas (Figure 1). Lake Houston Dam and Lake Houston are owned by the City of Houston and operated by the Coastal Water Authority (COH, 2013). Construction on Lake Houston Dam began on January 21, 1952. The dam was completed and deliberate impoundment began on April 9, 1954 (TWDB, 1973).

The Coastal Water Authority was created by the Texas Legislature in 1967 as a conservation and reclamation district. The Coastal Water Authority delivers untreated surface water to be used for municipal purposes to the cities of Houston, Baytown, and Deer Park. The Coastal Water Authority also delivers untreated surface water directly to industries and agricultural customers (CWA, 2011).

Lake Houston Dam and Lake Houston were built primarily as a water supply reservoir for the City of Houston, supplying water for municipal, industrial, and irrigation purposes (TWC, 1987). The City of Houston supplies water to Harris County and portions

of the seven surrounding counties. Surface water supplies from Lake Livingston on the Trinity River, as well as lakes Houston and Conroe on the San Jacinto River, account for 71 percent of Houston's water supply. Groundwater, from the Evangeline and Chicot aquifers, supplies the remaining 29 percent (COH, 2013). The Harris-Galveston Subsidence District, a special purpose district created in 1975 by the Texas Legislature, is responsible for regulating groundwater withdrawals in Harris and Galveston counties to reduce subsidence and prevent flooding (HGSD, 2013a). The Harris-Galveston Subsidence District adopted a new Regulatory Plan in 2013 with "an overall goal to reduce groundwater withdrawal to no more than 20% (10% in Regulatory Area 1) of total water demand" (HGSD, 2013b). Additional pertinent data about Lake Houston Dam and Lake Houston can be found in Table 1.

Water rights for Lake Houston have been appropriated to the City of Houston through Certificate of Adjudication No. 10-4965. The complete certificate is on file in the Information Resources Division of the Texas Commission on Environmental Quality.

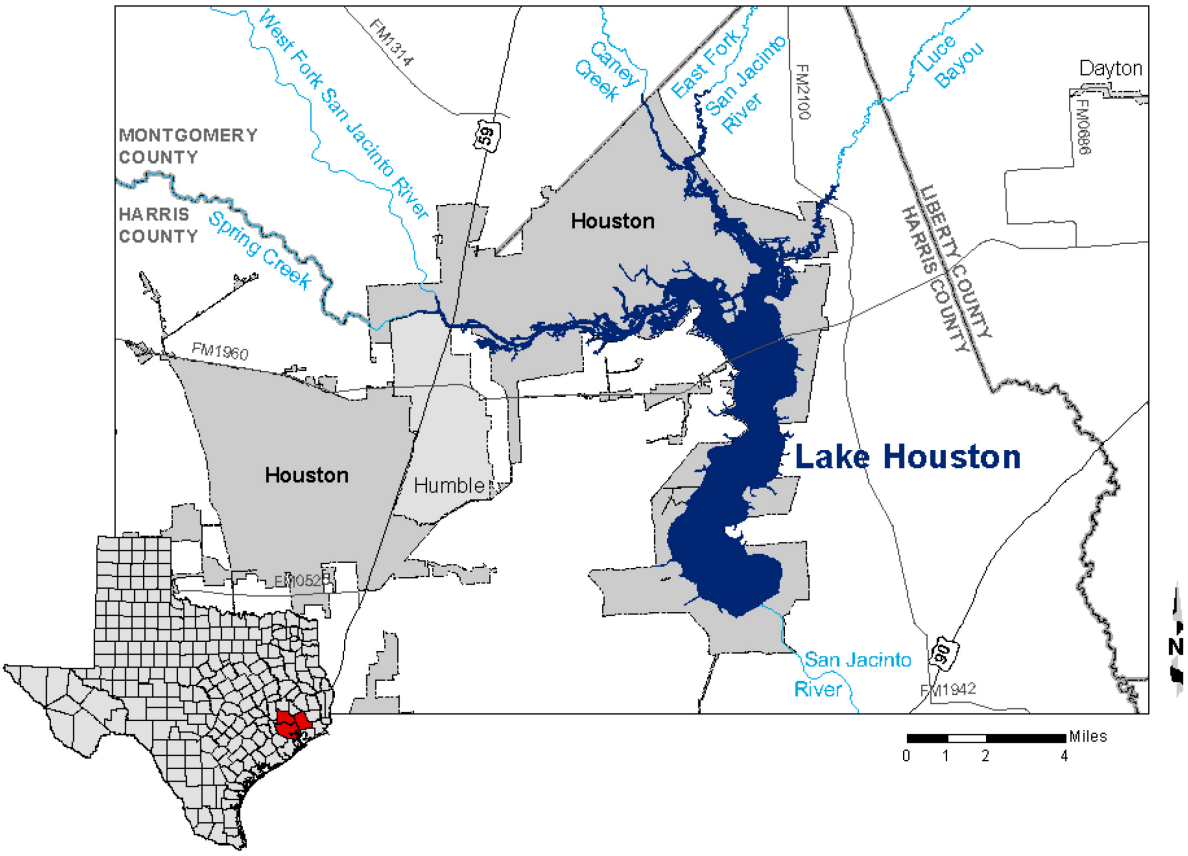


Figure 1. Location of Lake Houston

Table 1. Pertinent data for Lake Houston Dam and Lake Houston

Owner

City of Houston

Engineer (design)

Ambursen Engineering Company (original)
Brown & Root, Inc. (1970 erosion control)

Location of dam

On the San Jacinto River in Harris County, approximately 18 miles northeast of downtown Houston, Texas

Drainage area

2,828 square miles

Dam

Type	Earthfill and concrete spillway section
Length (total)	12,037 feet
Height (concrete)	45 feet
Height (earthfill)	65 feet
Top width	Varies

Spillway

Type	Concrete slab and buttress
Crest elevation	41.73 feet above mean sea level
Length	3,160 feet
Control for water release	2 tainter gates, each 18 by 20.5 feet
Location	Between the earthfill sections
Elevation of tainter gate sill	25.23 feet above mean sea level

Outlet works

Water supply	2 conduits, each 6 feet diameter
Low-flow release	Sluice gate, 36-inch diameter

Reservoir data (Based on 2011 TWDB survey)

Feature	Elevation (feet NAVD88[a])	Capacity (acre-feet)	Area (acres)
Top of dam	60.23	N/A	N/A
Spillway crest/ Top of conservation pool elevation	41.73	124,661	10,160
Sill of tainter gates	25.23	13,994	2,833
Invert of 6-ft conduits	21.23	6,161	1,310
Invert of 3-ft sluice gate	19.23	3,975	858
Conservation storage capacity[b]	-	120,686	-

Source: (TWDB, 1973)

[a] NAVD88 = North American Vertical Datum 1988

[b] Conservation storage capacity equals total capacity at conservation pool elevation minus dead pool capacity. Dead pool refers to water that cannot be drained by gravity through a dam's outlet works.

Volumetric and sedimentation survey of Lake Houston

Datum

The vertical datum used during this survey is the North American Vertical Datum 1988 (NAVD88). This datum is also utilized by the United States Geological Survey (USGS) for the reservoir elevation gage *USGS 08072000 Lk Houston nr Sheldon, TX* (USGS, 2012). Elevations herein are reported in feet relative to the NAVD88 datum. Volume and area calculations in this report are referenced to water levels provided by the USGS gage. The horizontal datum used for this report is North American Datum 1983

(NAD83), and the horizontal coordinate system is State Plane Texas South Central Zone (feet).

TWDB bathymetric and sedimentation data collection

TWDB collected bathymetric data for Lake Houston between December 13, 2011, and December 19, 2011. The daily average water surface elevations during the survey ranged between 41.64 and 41.72 feet (NAVD88). For data collection, TWDB used a Specialty Devices, Inc. (SDI), single-beam, multi-frequency (200 kHz, 50 kHz, and 24 kHz) sub-bottom profiling depth sounder integrated with differential global positioning system (DGPS) equipment. Data collection occurred while navigating along pre-planned survey lines oriented perpendicular to the assumed location of the original river channels and spaced approximately 500 feet apart. Many of the survey lines were also surveyed by TWDB during the 1994 survey. 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 2011 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. Following the analysis of the sounding data, TWDB selected six locations to collect sediment core samples (Figure 2). The sediment core samples were collected on November 7, 2012, with a custom-coring boat and SDI VibeCore system.

Sediment cores are collected in 3-inch diameter aluminum 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, through the accumulated sediment, and to the pre-impoundment surface. After retrieving the sample, a stadia rod is inserted into the top of the tube to assist in locating the top of the sediment in the tube. This identifies the location of the layer corresponding to the current reservoir surface. The aluminum tube is cut to this level, capped, and transported back to TWDB headquarters for further analysis. During this time, some settling of the upper layer can occur.

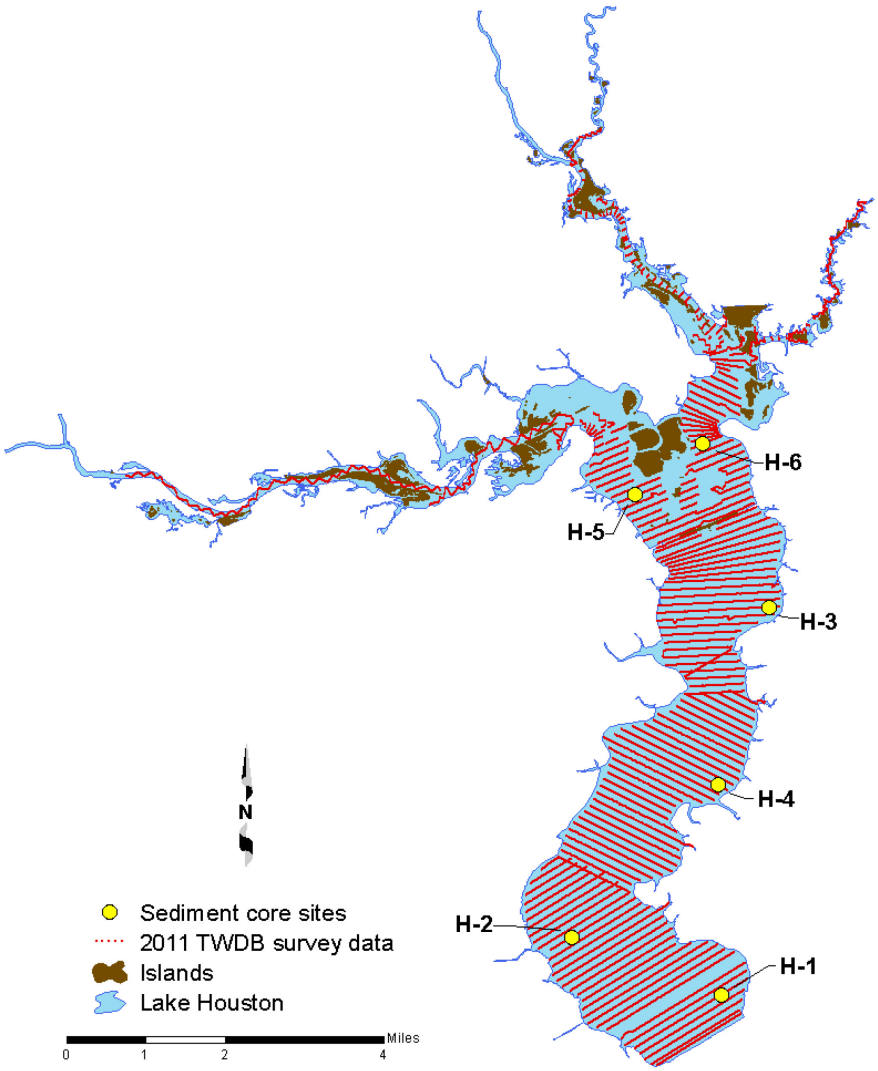


Figure 2. Data collected during 2011 TWDB Lake Houston survey

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 (TNIRIS, 2009) using Environmental Systems Research Institute's ArcGIS 9.3.1 software. The quarter-quadrangles that cover Lake Houston are Maedan (NE, SW, SE), Moonshine Hill (NW, NE, SW, SE), Huffman (NW, SW), Harmaston (NE, SE), and Crosby (NW, SW). The DOQQs were photographed on May 3, 2010, while the daily average water surface elevation measured 42.31 feet (NAVD88). According to metadata associated with the 2010 DOQQs, the photographs have a resolution or ground sample distance of 1.0-meters and a horizontal accuracy within + / - 6 meters to

true ground (USDA, 2011, TNRIS, 2010). For this analysis, the boundary was digitized at the land-water interface in the 2010 photographs given an elevation of 42.31 feet.

Triangulated Irregular Network model

Following completion of data collection, the raw data files collected by TWDB were edited to remove data anomalies. DepthPic©, software developed by SDI, Inc., is used to display, interpret, and edit the multi-frequency data by manually removing data anomalies in the current bottom surface and manually digitizing the reservoir-bottom surface at the time of initial impoundment (i.e. pre-impoundment surface). For processing outside of DepthPic©, an in-house software package, HydroTools, is used to identify the current reservoir-bottom surface, pre-impoundment surface, sediment thickness at each sounding location, and output the data into a single file. 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 is then preconditioned by inserting a uniform grid of artificial survey points between the actual survey lines. Bathymetric elevations at these artificial points are determined using an anisotropic spatial interpolation algorithm described in the spatial interpolation of reservoir bathymetry section below. This technique creates a high resolution, uniform grid of interpolated bathymetric elevation points throughout a majority of the reservoir (McEwen et al., 2011). Finally, the point file resulting from spatial interpolation is 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 from direct examination of 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 (USGS, 2007). Using the survey data, polygons are created to partition the reservoir into segments with centerlines defining directionality of interpolation within each segment. These interpolation definition files are independent of survey data and can be applied to past and future data of the same reservoir. 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., 2011a) and in McEwen et al., 2011b.

In areas inaccessible to survey data collection, such as small coves and shallow upstream areas of the reservoir, linear extrapolation is used for volumetric and sediment accumulation estimations. The linear extrapolation follows a linear definition file linking the survey points file to the lake boundary file (McEwen et al., 2011a). Without extrapolated 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 extrapolation improves the elevation-capacity and elevation-area calculations. It is not possible to remove all flat triangles, and linear extrapolation is only applied where adding bathymetry is deemed reasonable. For example, linear extrapolation was deemed reasonable and applied to Lake Houston in the following situations: in small coves of the main body of the lake; in obvious channel features; in areas where prior surveys indicate channel morphology; and in areas where features (e.g., boat docks) in the aerial photography indicate channel morphology.

Figure 3 illustrates typical results from application of the anisotropic interpolation and linear extrapolation techniques to Lake Houston. The bathymetry shown in Figure 3C was used in computing reservoir capacity and area tables (Appendix A, B). In Figure 3A, deeper channels 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, represented in Figure 3C, in creation of the volumetric TIN model directs Delaunay triangulation to better represent the lake bathymetry between survey cross-sections.

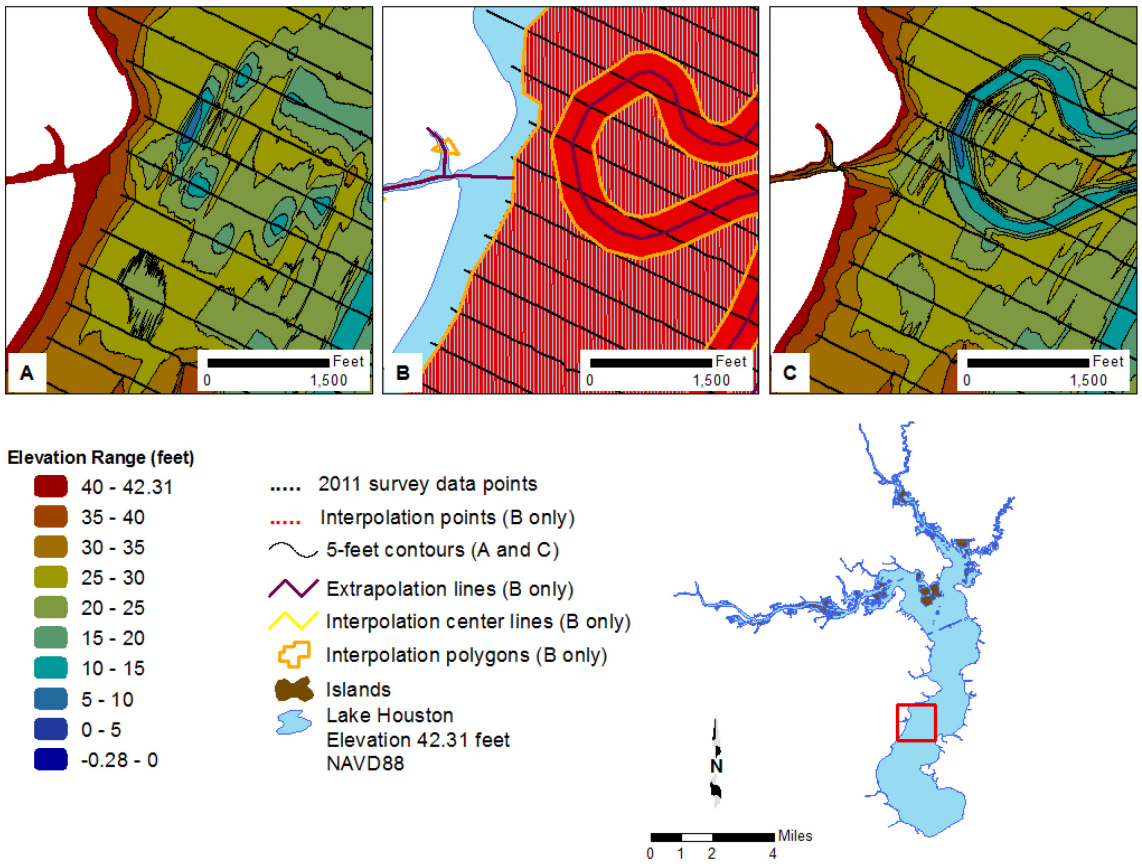


Figure 3. Anisotropic spatial interpolation and linear extrapolation of Lake Houston sounding data – A) bathymetric contours without interpolated points, B) sounding points (black) and interpolated points (red), C) bathymetric contours with the interpolated points

Area, Volume, and Contour Calculations

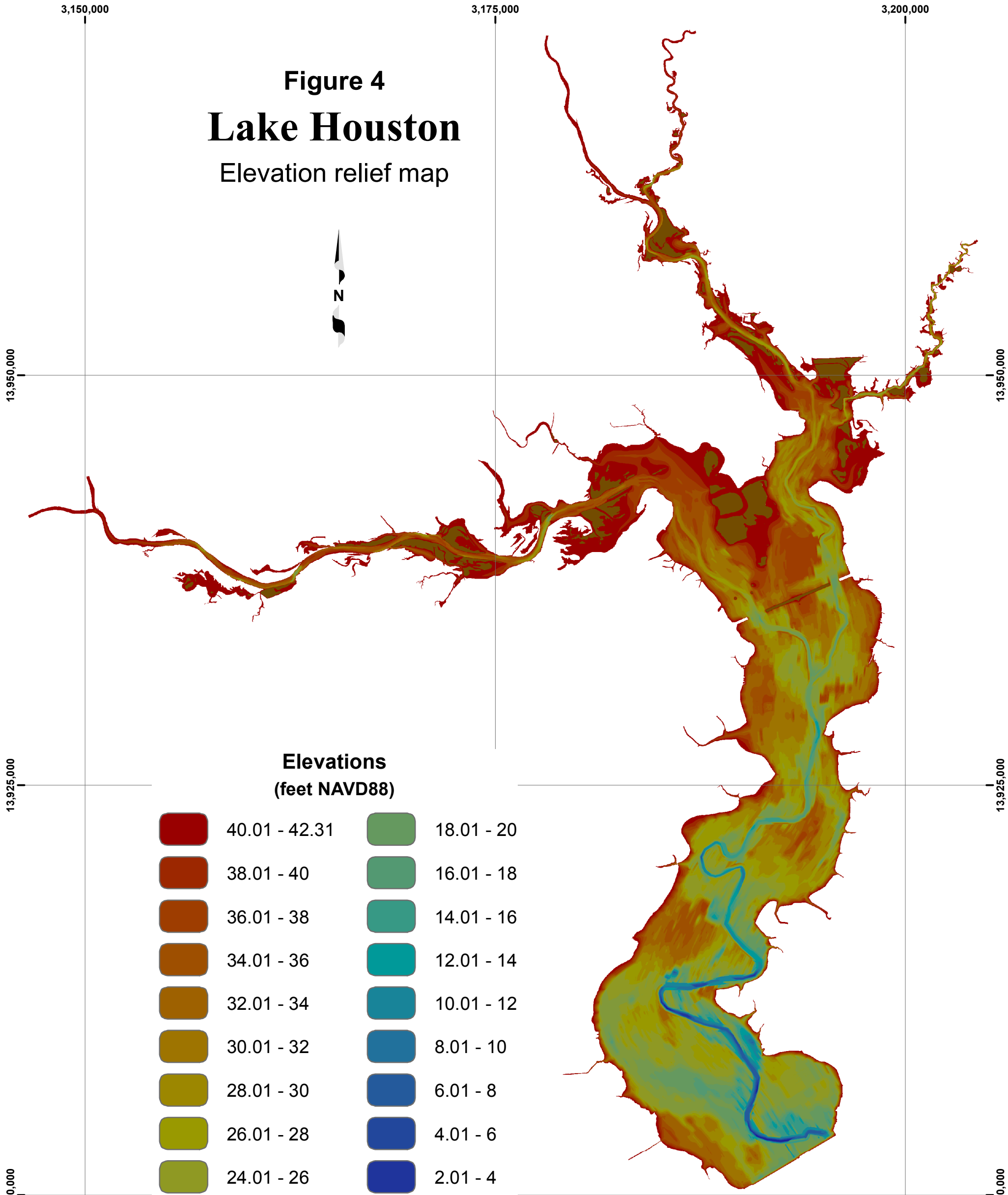
Using ArcInfo software and the volumetric TIN model, volumes and areas were calculated for the entire reservoir at 0.01 feet intervals, from elevation -0.30 to 42.31 feet. The elevation-capacity table and elevation-area table, updated for 2011, are presented in Appendices A and B, respectively. The area-capacity curves are presented in Appendix C.

The volumetric TIN model was converted to a raster representation using a cell size of 2 feet by 2 feet. 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 Lake Houston; and a 5-foot contour map (Figure 6 - attached).

Figure 4

Lake Houston

Elevation relief map



Elevations
(feet NAVD88)

40.01 - 42.31	18.01 - 20
38.01 - 40	16.01 - 18
36.01 - 38	14.01 - 16
34.01 - 36	12.01 - 14
32.01 - 34	10.01 - 12
30.01 - 32	8.01 - 10
28.01 - 30	6.01 - 8
26.01 - 28	4.01 - 6
24.01 - 26	2.01 - 4
22.01 - 24	0.01 - 2
20.01 - 22	-0.27 - 0

Islands

Boundary elevation:
42.31 feet NAVD88
Conservation pool elevation:
41.73 feet NAVD88

Projection: NAD83
State Plane
Texas South Central Zone (feet)

0 0.75 1.5 3 Miles

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Figure 5

Lake Houston

Depth ranges map

3,150,000
3,175,000
3,200,000
13,950,000
13,925,000
13,900,000

N

Depth ranges
(feet)

- 0 - 5'
- 5 - 10'
- 10 - 15'
- 15 - 20'
- 20 - 25'
- 25 - 30'
- 30 - 35'
- 35 - 40'
- > 40'
- Islands

Boundary elevation:
42.31 feet NAVD88
Conservation pool elevation:
41.73 feet NAVD88

Projection: NAD83
State Plane
Texas South Central Zone (feet)

0 0.75 1.5 3
Miles

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Analysis of sediment data from Lake Houston

Sedimentation in Lake Houston was determined by analyzing the acoustic signal returns of all three depth sounder frequencies in the DepthPic© software. The 200 kHz signal was analyzed to determine the current bathymetric surface of the reservoir, while all three frequencies, 200 kHz, 50 kHz, and 24 kHz, were 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 were used to assist in identifying the location of the pre-impoundment surface in the acoustic signals. 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 both 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 color, texture, relative water content, and presence of organic materials, were also recorded (Table 2).

Table 2. Sediment core sampling analysis data – Lake Houston

Core	Easting[a] (ft)	Northing[a] (ft)	Total core sample/ post-impoundment sediment	Sediment core description	Munsell soil color
H-1	3194309.39	13905086.08	60”/52.5”	0-52.5” loose silty loam sediment	5Y 4/1 with bands of 10YR 2/1
				52.5-60” dense, silty clay with organics present	10YR 4/1
H-2	3184301.81	13908916.32	60”/23”	0-23” very loose silty clay sediment Note: the VibeCore may have been submerged in sediment, possible loss or underestimate of this layer	5Y 4/1
				23-50” dense sandy clay sediment, some organics present	10YR 3/1
				50-60” dense sediment, sand, organics present	10YR 5/2
H-3	3197430.82	13930951.61	22”/16.5”	0-16.5” loose silty clay sediment	5Y 4/1 with bands of 5Y 2.5/1
				16.5-22” dense compact silty clay soil with peds and organics present	Not recorded
H-4	3194094.68	13919097.67	24”/19.5”	0-19.5” loose silty clay sediment	5Y 5/1 with bands of 5Y 2.5/1
				19.5-24” dense silty clay loam sediment with peds and organics present	2.5Y 4/1
H-5	3188506.67	13938425.52	27”/22”	0-6” loose silty clay sediment	2.5Y 3/1
				6-8” denser sandy clay sediment	10YR 5/1
				8-22” loose silty clay sediment	2.5Y 4/2
				22-27” dense silty clay loam, organics present	5Y 4/1
H-6	3193059.62	13941848.15	50.5”/48”	0-9” loose silty clay sediment	2.5Y 3/1
				9-48” loose silty clay sediment	5Y 4/1
				48-50.5” dense clay loam sediment	10YR 5/1

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

A photograph of sediment core H-5 is shown in Figure 7 and is representative of the sediment cores sampled from Lake Houston. The 200 kHz frequency measures the top layer as the current bottom surface of the reservoir.

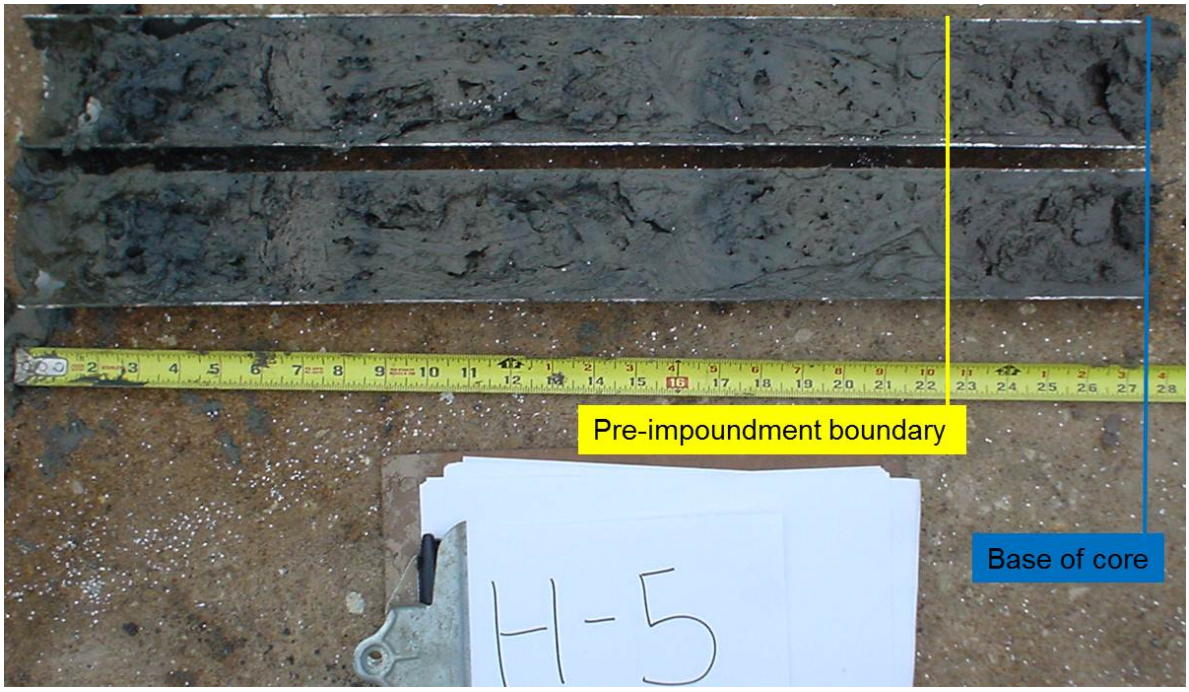


Figure 7. Sediment core H-5 from Lake Houston

Sediment core sample H-5 consisted of 27 inches of total sediment corresponding to the length of the aluminum sampling tube. The upper sediment layer (horizon), 0–6.0 inches, consisted of loose silty clay soil with a high water content, and measured 2.5Y 3/1 on the Munsell soil color chart. The second horizon, beginning at 6.0 inches and extending to 8.0 inches below the surface, consisted of a denser sandy clay soil with a 10YR 5/1 Munsell soil color. The third horizon, from 8.0 inches to 22.0 inches consisted of a silty clay soil with a 2.5Y 4/2 Munsell soil color. The fourth horizon, from 22.0 inches to the base of the core at 27.0 inches, consisted of a dense silty clay loam. Organics were present and a Munsell soil color of 5Y 4/1 was measured for this fourth layer of sediment. The base of the sample is denoted by the blue line in Figure 7.

The pre-impoundment boundary (yellow line in Figure 7) was evident within this sediment core sample at 22.0 inches and identified by the change in soil color, texture, moisture, porosity, and structure. Identification of the pre-impoundment surface for the remaining sediment cores followed a similar procedure.

Figures 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. Within DepthPic©, the current surface is automatically determined based on signal returns from the 200 kHz transducer and verified by TWDB staff, while the

pre-impoundment surface must be determined visually. The pre-impoundment surface is first identified along cross-sections for which sediment core samples have been collected.

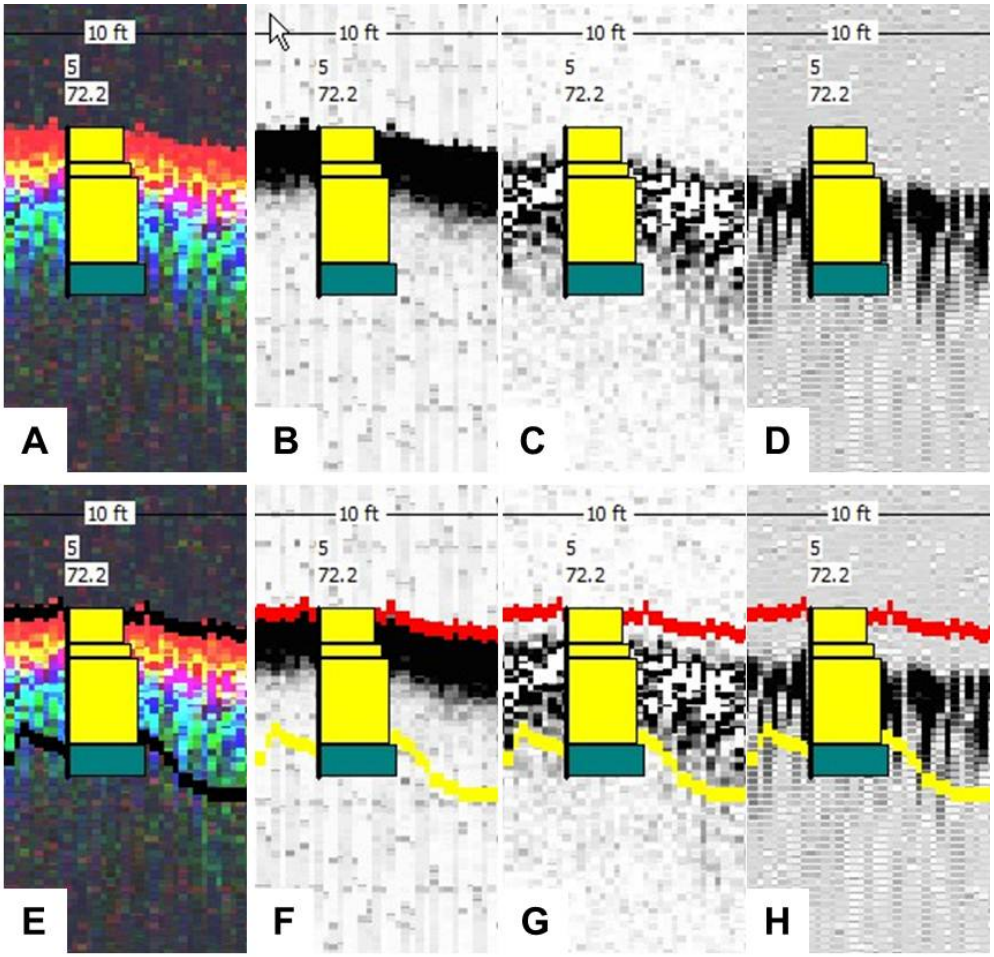


Figure 8. Comparison of sediment core H-5 with acoustic signal returns
A,E) combined acoustic signal returns, B,F) 200 kHz frequency, C,G) 50 kHz frequency, D,H) 24 kHz frequency

Figure 8 compares sediment core sample H-5 with the acoustic signals for all frequencies combined (A, E), 200 kHz (B, F), 50 kHz (C, G), and 24 kHz (D, H). The sediment core sample is represented in each figure as colored boxes. The yellow boxes represent post-impoundment sediment, and the blue box represents the pre-impoundment sediment. In Figure 8A-D, the bathymetric surfaces are not shown. In Figure 8E, the current bathymetric surface is represented as the top black line and in Figures 8 F-H as the top red line. The pre-impoundment surface is identified by comparing boundaries observed in the 200 kHz, 50 kHz, and 24 kHz signals to the location of the pre-impoundment surface of the sediment core sample. Each sediment core sample was compared to all three frequencies and the boundary in the 50 kHz signal most closely matched the pre-impoundment interface of the sediment core samples; therefore, the 50 kHz signal was used to locate the pre-impoundment layer. The pre-impoundment surface was manually drawn and is represented

by the bottom black line in Figure 8E, and by the yellow line in Figures 8F-H. Figure 9 shows sediment core sample H-5 correlated with the 50 kHz frequency of the nearest surveyed cross-section. The pre-impoundment surface identified along cross-sections where sediment core samples were collected is used as a guide for identifying the pre-impoundment surface along cross-sections where sediment core samples were not collected.

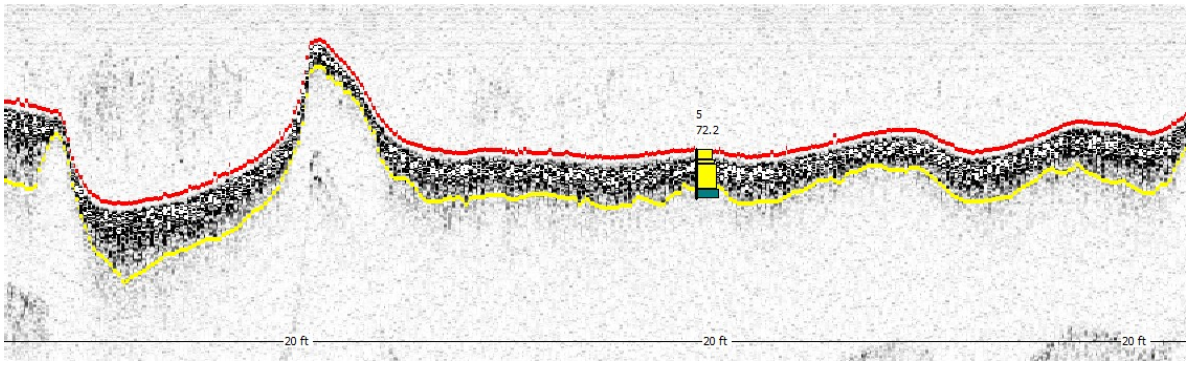


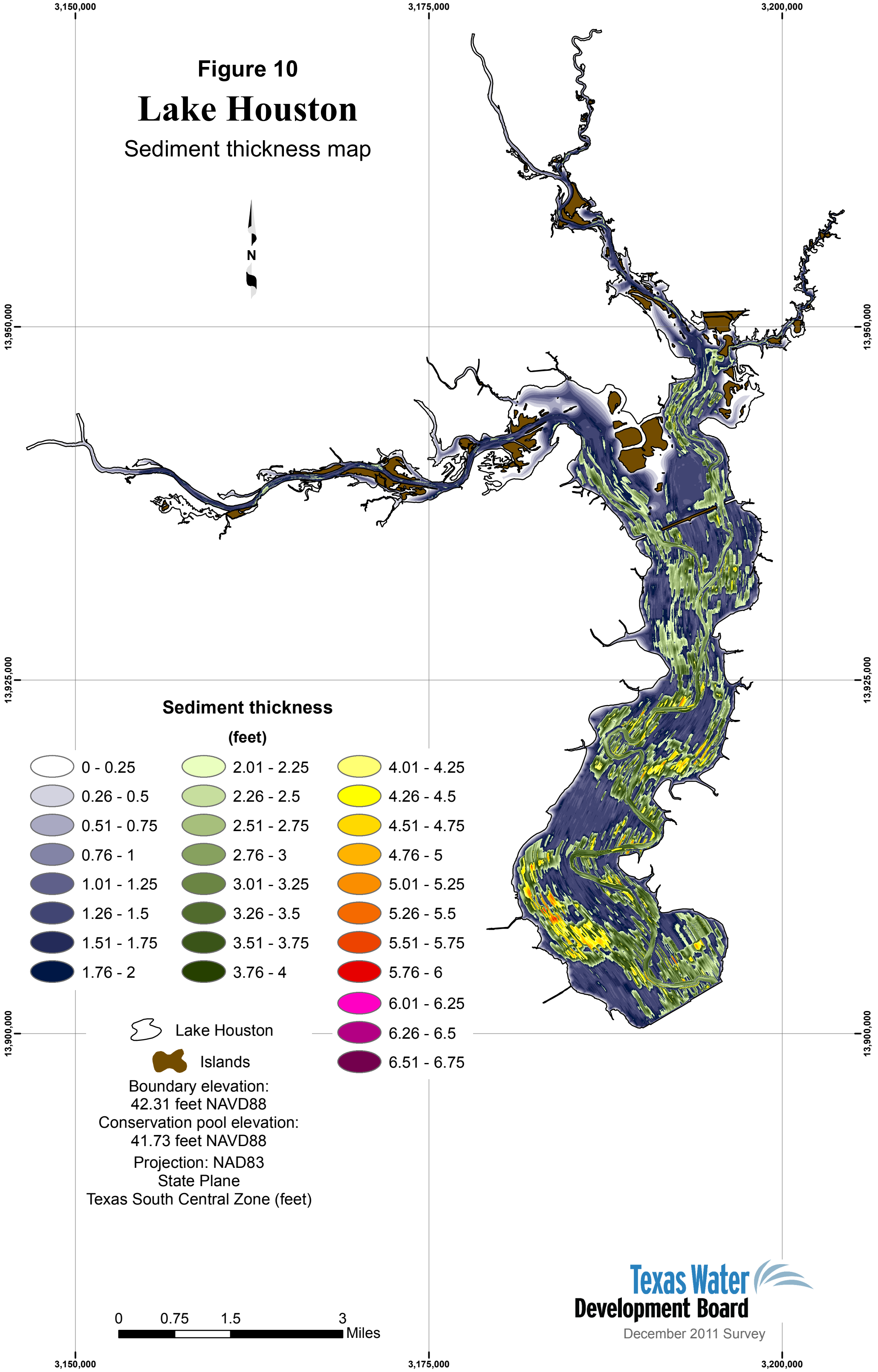
Figure 9. Cross-section of data collected during 2011 survey, displayed in DepthPic© (50 kHz frequency), correlated with sediment core sample H-5 and showing the current surface in red and pre-impoundment surface in yellow

After the pre-impoundment surface from all cross-sections was 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 42.3 foot NAVD88 elevation contour). The sediment thickness TIN model was converted to a raster representation using a cell size of 5 feet by 5 feet and used to produce a sediment thickness map of Lake Houston (Figure 10).

Figure 10

Lake Houston

Sediment thickness map



Texas Water Development Board

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Survey results

Volumetric survey

The results of the 2011 TWDB volumetric survey indicate Lake Houston has a total reservoir capacity of 124,661 acre-feet and encompasses 10,160 acres at conservation pool elevation (41.73 feet NAVD88). The original design estimate at the time of impoundment in 1954 indicates Lake Houston was estimated to have a total capacity of 158,553 acre-feet and encompass 12,764 acres. A survey conducted in 1965 indicates Lake Houston had a total reservoir capacity of 146,769 acre-feet and encompassed 12,236 acres (Ambursen Engineering Corporation, 1966). Because of differences in past and present survey methodologies, direct comparison of volumetric surveys to estimate loss of capacity is difficult and can be unreliable.

To properly compare results from TWDB surveys of Lake Houston, TWDB applied the 2012 data processing techniques to the survey data collected in 1994. Specifically, TWDB applied anisotropic spatial interpolation to the 1994 survey dataset using the same interpolation definition file as was used for the 2011 survey. However, some interpolation polygons had to be expanded to include data in areas that were accessible for data collection in 1994, but not in 2011. A new volumetric TIN model was created using the original 1994 survey boundary. The 1994 survey used the 44.5-feet contour from 7.5 minute USGS quadrangle maps, with a stated accuracy of ± 1/2 the contour interval, as an outer model boundary (USBB, 1947). Differences in the 1994 boundary compared to the 2011 boundary indicate major channel migrations in the East and West Forks occurred between the time of the USGS map and 2010, the date of the aerial photos used to create the current survey boundary. Therefore, the interpolation polygons within the rivers were edited to fit within the 1994 survey boundary. Re-evaluation of the 1994 survey using current TWDB data processing methods resulted in a 2,391 acre-feet (1.8%) increase in reservoir capacity (Table 3).

Table 3. Current and previous survey capacity and surface area data

Survey*	Surface area (acres)	Total capacity (acre-feet)
Original[a]	12,764	158,553
1965[a]	12,236	146,769
TWDB 1994	11,854	133,990
TWDB 1994 re-calculated	11,800	136,381
TWDB 2011	10,160	124,661

*Note: Results of previous surveys of Lake Houston have been reported in different vertical datums. At different times the conservation pool elevation of Lake Houston has been reported as 43.8 feet above mean sea level or NGVD29, 41.73 feet NAVD88, or 44.5 feet lake datum. Lake datum refers to the original datum of the USGS gage and was reported to be 0.70 feet below NGVD29 datum. The new datum (NAVD88) is 2.77 feet above the previous datum (lake datum) (USGS, 2012).
[a] Source: (Ambursen Engineering Corporation, 1966)

Sedimentation survey

Based on two methods for estimating sedimentation rates, the 2011 TWDB sedimentation survey estimates Lake Houston loses between 344 and 689 acre-feet per year of capacity due to sedimentation below conservation pool elevation (41.73 feet NAVD88) (Table 4). The sedimentation survey indicates sediment accumulation varies throughout the reservoir. Accumulations of sediment are thicker within the natural depressions throughout the main body of the reservoir than in the river channels. The heaviest accumulations measured by this survey are between 1.14 and 2.84 miles north of the dam on the western half of the reservoir.

Sedimentation rates were calculated for the differences between the current volumetric survey and the original capacity estimate, the 1965 sedimentation survey capacity estimate, as well as the re-calculated 1994 TWDB capacity estimate (Table 4). Based on the 2011 estimated sediment volume, Lake Houston lost an average of approximately 344 acre-feet of capacity per year from 1954 to 2011. Comparison of capacity estimates of Lake Houston derived using differing methodologies are provided in Table 4 for sedimentation rate calculation.

Table 4. Capacity loss comparisons for Lake Houston

Survey	Volume comparisons at conservation pool elevation (ac-ft)			Pre-impoundment (ac-ft)
Original[a]	158,553	<>	<>	<>
1965[a]	<>	146,769	<>	<>
TWDB 1994 (re-calculated)	<>	<>	136,381	<>
TWDB pre-impoundment estimate based on 2011 survey	<>	<>	<>	144,275[b]
2011 volumetric survey	124,661	124,661	124,661	124,661
Volume difference (acre-feet)	33,892 (21.4%)	22,108 (15.1%)	11,720(8.6%)	19,614 (13.6%)
Number of years	57	46	17	57
Capacity loss rate (acre-feet/year)	595	481	689	344

[a] Source: (Ambursen Engineering Corporation, 1966), note: Lake Houston Dam was completed and deliberate impoundment began on April 9, 1954.
[b] 2011 TWDB surveyed capacity of 124,661 acre-feet plus 2011 TWDB surveyed sediment volume of 19,614 acre-feet

Recommendations

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

TWDB contact information

More information about the Hydrographic Survey Program can be found at:

http://www.twdb.texas.gov/surfacewater/surveys/index.asp

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Appendix A

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD
CAPACITY IN ACRE-FEET
ELEVATION INCREMENT IS ONE TENTH FOOT

December 2011 Survey
Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION in Feet	-0.1	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0.00
-0.3	0	0	0	0	0	0	0	0	0	0
-0.2	0	0	0	0	0	0	0	0	0	0
-0.1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0
0.3	0	0	0	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0
0.6	0	0	0	0	0	0	0	0	0	0
0.7	0	0	0	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0	0	0	0
0.9	0	0	0	0	0	0	0	0	0	0
1.0	0	0	0	0	0	0	0	0	0	0
1.1	0	0	0	0	0	0	0	0	0	0
1.2	0	0	0	0	0	0	0	0	0	1
1.3	1	1	1	1	1	1	1	1	1	1
1.4	1	1	1	1	1	1	1	1	1	1
1.5	1	1	1	1	1	1	1	1	1	1
1.6	1	1	1	1	1	1	1	1	1	1
1.7	2	2	2	2	2	2	2	2	2	2
1.8	2	2	2	2	2	2	2	2	2	2
1.9	2	2	2	2	2	3	3	3	3	3
2.0	3	3	3	3	3	3	3	3	3	3
2.1	3	3	3	3	3	3	4	4	4	4
2.2	4	4	4	4	4	4	4	4	4	4
2.3	4	4	4	4	4	5	5	5	5	5
2.4	5	5	5	5	5	5	5	5	5	5
2.5	5	5	5	6	6	6	6	6	6	6
2.6	6	6	6	6	6	6	6	6	6	7
2.7	7	7	7	7	7	7	7	7	7	7
2.8	7	7	7	7	8	8	8	8	8	8
2.9	8	8	8	8	8	8	8	8	9	9
3.0	9	9	9	9	9	9	9	9	9	9
3.1	10	10	10	10	10	10	10	10	10	10
3.2	10	10	11	11	11	11	11	11	11	11
3.3	11	11	11	12	12	12	12	12	12	12
3.4	12	12	12	13	13	13	13	13	13	13
3.5	13	13	13	14	14	14	14	14	14	14
3.6	14	14	15	15	15	15	15	15	15	15
3.7	15	16	16	16	16	16	16	16	16	16
3.8	17	17	17	17	17	17	17	17	17	18
3.9	18	18	18	18	18	18	18	19	19	19

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
4.0	19	19	19	19	19	20	20	20	20	20
4.1	20	20	21	21	21	21	21	21	21	21
4.2	22	22	22	22	22	22	23	23	23	23
4.3	23	23	23	24	24	24	24	24	24	24
4.4	25	25	25	25	25	25	26	26	26	26
4.5	26	26	27	27	27	27	27	27	28	28
4.6	28	28	28	28	29	29	29	29	29	30
4.7	30	30	30	30	30	31	31	31	31	31
4.8	32	32	32	32	32	32	33	33	33	33
4.9	33	34	34	34	34	34	35	35	35	35
5.0	35	36	36	36	36	37	37	37	37	37
5.1	38	38	38	38	38	39	39	39	39	40
5.2	40	40	40	40	41	41	41	41	42	42
5.3	42	42	42	43	43	43	43	44	44	44
5.4	44	45	45	45	45	45	46	46	46	46
5.5	47	47	47	47	48	48	48	48	49	49
5.6	49	49	50	50	50	50	51	51	51	52
5.7	52	52	52	53	53	53	53	54	54	54
5.8	54	55	55	55	56	56	56	56	57	57
5.9	57	58	58	58	58	59	59	59	60	60
6.0	60	60	61	61	61	62	62	62	63	63
6.1	63	63	64	64	64	65	65	65	66	66
6.2	66	67	67	67	68	68	68	69	69	69
6.3	70	70	70	71	71	72	72	72	73	73
6.4	73	74	74	74	75	75	76	76	76	77
6.5	77	78	78	78	79	79	80	80	80	81
6.6	81	82	82	82	83	83	84	84	85	85
6.7	85	86	86	87	87	88	88	88	89	89
6.8	90	90	91	91	92	92	92	93	93	94
6.9	94	95	95	96	96	97	97	98	98	99
7.0	99	100	100	101	101	101	102	102	103	103
7.1	104	104	105	105	106	106	107	108	108	109
7.2	109	110	110	111	111	112	112	113	113	114
7.3	114	115	116	116	117	117	118	118	119	119
7.4	120	121	121	122	122	123	124	124	125	125
7.5	126	127	127	128	128	129	130	130	131	131
7.6	132	133	133	134	135	135	136	137	137	138
7.7	139	139	140	141	141	142	143	143	144	145
7.8	145	146	147	147	148	149	150	150	151	152
7.9	152	153	154	155	155	156	157	158	158	159
8.0	160	160	161	162	163	163	164	165	166	167
8.1	167	168	169	170	170	171	172	173	174	174
8.2	175	176	177	178	178	179	180	181	182	182
8.3	183	184	185	186	186	187	188	189	190	191
8.4	192	192	193	194	195	196	197	197	198	199
8.5	200	201	202	203	204	204	205	206	207	208
8.6	209	210	211	211	212	213	214	215	216	217
8.7	218	219	220	221	221	222	223	224	225	226
8.8	227	228	229	230	231	232	233	234	235	236
8.9	236	237	238	239	240	241	242	243	244	245
9.0	246	247	248	249	250	251	252	253	254	255
9.1	256	257	258	259	260	261	262	263	264	265
9.2	266	267	269	270	271	272	273	274	275	276
9.3	277	278	279	280	281	282	283	284	286	287
9.4	288	289	290	291	292	293	294	295	297	298
9.5	299	300	301	302	303	304	305	307	308	309
9.6	310	311	312	313	315	316	317	318	319	320
9.7	321	323	324	325	326	327	329	330	331	332
9.8	333	334	336	337	338	339	340	342	343	344
9.9	345	347	348	349	350	351	353	354	355	356

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
10.0	358	359	360	361	363	364	365	366	368	369
10.1	370	372	373	374	375	377	378	379	381	382
10.2	383	384	386	387	388	390	391	392	394	395
10.3	396	398	399	400	402	403	404	406	407	409
10.4	410	411	413	414	415	417	418	420	421	422
10.5	424	425	427	428	430	431	432	434	435	437
10.6	438	440	441	442	444	445	447	448	450	451
10.7	453	454	456	457	459	460	462	463	465	466
10.8	468	469	471	472	474	475	477	478	480	482
10.9	483	485	486	488	489	491	493	494	496	497
11.0	499	501	502	504	505	507	509	510	512	513
11.1	515	517	518	520	522	523	525	527	528	530
11.2	532	533	535	537	538	540	542	544	545	547
11.3	549	550	552	554	556	557	559	561	563	564
11.4	566	568	570	572	573	575	577	579	581	582
11.5	584	586	588	590	592	593	595	597	599	601
11.6	603	605	607	608	610	612	614	616	618	620
11.7	622	624	626	628	630	632	633	635	637	639
11.8	641	643	645	647	649	651	653	655	657	659
11.9	661	663	666	668	670	672	674	676	678	680
12.0	682	684	686	688	690	692	694	697	699	701
12.1	703	705	707	709	711	713	716	718	720	722
12.2	724	726	728	731	733	735	737	739	742	744
12.3	746	748	750	753	755	757	759	761	764	766
12.4	768	770	773	775	777	779	782	784	786	788
12.5	791	793	795	797	800	802	804	807	809	811
12.6	814	816	818	821	823	825	828	830	833	835
12.7	837	840	842	845	847	849	852	854	857	859
12.8	861	864	866	869	871	874	876	879	881	884
12.9	886	889	891	894	896	899	901	904	906	909
13.0	911	914	916	919	921	924	927	929	932	934
13.1	937	939	942	945	947	950	952	955	958	960
13.2	963	966	968	971	973	976	979	981	984	987
13.3	989	992	995	998	1,000	1,003	1,006	1,008	1,011	1,014
13.4	1,017	1,019	1,022	1,025	1,027	1,030	1,033	1,036	1,039	1,041
13.5	1,044	1,047	1,050	1,052	1,055	1,058	1,061	1,064	1,066	1,069
13.6	1,072	1,075	1,078	1,081	1,083	1,086	1,089	1,092	1,095	1,098
13.7	1,101	1,104	1,106	1,109	1,112	1,115	1,118	1,121	1,124	1,127
13.8	1,130	1,133	1,136	1,138	1,141	1,144	1,147	1,150	1,153	1,156
13.9	1,159	1,162	1,165	1,168	1,171	1,174	1,177	1,180	1,183	1,186
14.0	1,189	1,192	1,195	1,199	1,202	1,205	1,208	1,211	1,214	1,217
14.1	1,220	1,223	1,226	1,230	1,233	1,236	1,239	1,242	1,245	1,249
14.2	1,252	1,255	1,258	1,261	1,265	1,268	1,271	1,274	1,278	1,281
14.3	1,284	1,287	1,291	1,294	1,297	1,300	1,304	1,307	1,310	1,314
14.4	1,317	1,320	1,324	1,327	1,330	1,334	1,337	1,340	1,344	1,347
14.5	1,350	1,354	1,357	1,361	1,364	1,368	1,371	1,374	1,378	1,381
14.6	1,385	1,388	1,392	1,395	1,399	1,402	1,406	1,409	1,413	1,417
14.7	1,420	1,424	1,427	1,431	1,434	1,438	1,442	1,445	1,449	1,453
14.8	1,456	1,460	1,464	1,467	1,471	1,475	1,478	1,482	1,486	1,490
14.9	1,493	1,497	1,501	1,505	1,508	1,512	1,516	1,520	1,523	1,527
15.0	1,531	1,535	1,539	1,542	1,546	1,550	1,554	1,558	1,562	1,566
15.1	1,570	1,573	1,577	1,581	1,585	1,589	1,593	1,597	1,601	1,605
15.2	1,609	1,613	1,617	1,621	1,625	1,629	1,633	1,637	1,641	1,645
15.3	1,649	1,653	1,657	1,661	1,665	1,669	1,674	1,678	1,682	1,686
15.4	1,690	1,694	1,698	1,702	1,707	1,711	1,715	1,719	1,723	1,728
15.5	1,732	1,736	1,740	1,744	1,749	1,753	1,757	1,761	1,766	1,770
15.6	1,774	1,779	1,783	1,787	1,791	1,796	1,800	1,804	1,809	1,813
15.7	1,818	1,822	1,826	1,831	1,835	1,839	1,844	1,848	1,853	1,857
15.8	1,862	1,866	1,871	1,875	1,880	1,884	1,889	1,893	1,898	1,902
15.9	1,907	1,911	1,916	1,920	1,925	1,929	1,934	1,939	1,943	1,948

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
16.0	1,952	1,957	1,962	1,966	1,971	1,976	1,980	1,985	1,990	1,994
16.1	1,999	2,004	2,008	2,013	2,018	2,023	2,027	2,032	2,037	2,042
16.2	2,046	2,051	2,056	2,061	2,066	2,070	2,075	2,080	2,085	2,090
16.3	2,095	2,100	2,104	2,109	2,114	2,119	2,124	2,129	2,134	2,139
16.4	2,144	2,149	2,154	2,159	2,164	2,169	2,174	2,179	2,184	2,189
16.5	2,194	2,199	2,204	2,209	2,214	2,219	2,224	2,229	2,234	2,239
16.6	2,244	2,249	2,255	2,260	2,265	2,270	2,275	2,280	2,286	2,291
16.7	2,296	2,301	2,306	2,312	2,317	2,322	2,327	2,333	2,338	2,343
16.8	2,348	2,354	2,359	2,364	2,370	2,375	2,380	2,386	2,391	2,396
16.9	2,402	2,407	2,412	2,418	2,423	2,429	2,434	2,439	2,445	2,450
17.0	2,456	2,461	2,467	2,472	2,478	2,483	2,489	2,494	2,500	2,505
17.1	2,511	2,516	2,522	2,528	2,533	2,539	2,544	2,550	2,556	2,561
17.2	2,567	2,572	2,578	2,584	2,589	2,595	2,601	2,607	2,612	2,618
17.3	2,624	2,629	2,635	2,641	2,647	2,652	2,658	2,664	2,670	2,676
17.4	2,681	2,687	2,693	2,699	2,705	2,711	2,717	2,723	2,728	2,734
17.5	2,740	2,746	2,752	2,758	2,764	2,770	2,776	2,782	2,788	2,794
17.6	2,800	2,806	2,812	2,818	2,825	2,831	2,837	2,843	2,849	2,855
17.7	2,861	2,867	2,874	2,880	2,886	2,892	2,898	2,905	2,911	2,917
17.8	2,923	2,930	2,936	2,942	2,949	2,955	2,961	2,968	2,974	2,980
17.9	2,987	2,993	3,000	3,006	3,013	3,019	3,025	3,032	3,038	3,045
18.0	3,052	3,058	3,065	3,071	3,078	3,084	3,091	3,098	3,104	3,111
18.1	3,118	3,124	3,131	3,138	3,144	3,151	3,158	3,165	3,171	3,178
18.2	3,185	3,192	3,199	3,205	3,212	3,219	3,226	3,233	3,240	3,247
18.3	3,254	3,261	3,268	3,275	3,282	3,289	3,296	3,303	3,310	3,317
18.4	3,324	3,331	3,338	3,346	3,353	3,360	3,367	3,374	3,382	3,389
18.5	3,396	3,404	3,411	3,418	3,426	3,433	3,440	3,448	3,455	3,463
18.6	3,470	3,478	3,485	3,493	3,500	3,508	3,515	3,523	3,530	3,538
18.7	3,546	3,553	3,561	3,569	3,576	3,584	3,592	3,600	3,607	3,615
18.8	3,623	3,631	3,639	3,646	3,654	3,662	3,670	3,678	3,686	3,694
18.9	3,702	3,710	3,718	3,726	3,734	3,742	3,750	3,758	3,767	3,775
19.0	3,783	3,791	3,799	3,807	3,816	3,824	3,832	3,840	3,849	3,857
19.1	3,865	3,874	3,882	3,890	3,899	3,907	3,916	3,924	3,933	3,941
19.2	3,950	3,958	3,967	3,975	3,984	3,993	4,001	4,010	4,018	4,027
19.3	4,036	4,045	4,053	4,062	4,071	4,080	4,089	4,097	4,106	4,115
19.4	4,124	4,133	4,142	4,151	4,160	4,169	4,178	4,187	4,197	4,206
19.5	4,215	4,224	4,234	4,243	4,252	4,262	4,271	4,280	4,290	4,299
19.6	4,309	4,318	4,328	4,337	4,347	4,357	4,366	4,376	4,386	4,396
19.7	4,405	4,415	4,425	4,435	4,445	4,454	4,464	4,474	4,484	4,494
19.8	4,504	4,514	4,524	4,534	4,544	4,554	4,565	4,575	4,585	4,595
19.9	4,605	4,616	4,626	4,636	4,646	4,657	4,667	4,678	4,688	4,698
20.0	4,709	4,719	4,730	4,740	4,751	4,761	4,772	4,783	4,793	4,804
20.1	4,815	4,825	4,836	4,847	4,858	4,868	4,879	4,890	4,901	4,912
20.2	4,923	4,934	4,945	4,956	4,967	4,978	4,989	5,000	5,011	5,022
20.3	5,034	5,045	5,056	5,067	5,078	5,090	5,101	5,112	5,124	5,135
20.4	5,146	5,158	5,169	5,181	5,192	5,204	5,215	5,227	5,238	5,250
20.5	5,261	5,273	5,284	5,296	5,308	5,319	5,331	5,343	5,354	5,366
20.6	5,378	5,390	5,402	5,413	5,425	5,437	5,449	5,461	5,473	5,485
20.7	5,497	5,509	5,521	5,533	5,545	5,557	5,569	5,581	5,593	5,605
20.8	5,618	5,630	5,642	5,654	5,667	5,679	5,691	5,703	5,716	5,728
20.9	5,740	5,753	5,765	5,778	5,790	5,803	5,815	5,828	5,840	5,853
21.0	5,865	5,878	5,891	5,903	5,916	5,929	5,941	5,954	5,967	5,980
21.1	5,992	6,005	6,018	6,031	6,044	6,057	6,070	6,083	6,096	6,109
21.2	6,122	6,135	6,148	6,161	6,174	6,187	6,200	6,213	6,227	6,240
21.3	6,253	6,266	6,280	6,293	6,306	6,320	6,333	6,346	6,360	6,373
21.4	6,387	6,400	6,414	6,427	6,441	6,454	6,468	6,481	6,495	6,509
21.5	6,522	6,536	6,550	6,564	6,577	6,591	6,605	6,619	6,633	6,647
21.6	6,661	6,675	6,688	6,702	6,717	6,731	6,745	6,759	6,773	6,787
21.7	6,801	6,815	6,830	6,844	6,858	6,872	6,887	6,901	6,915	6,930
21.8	6,944	6,959	6,973	6,988	7,002	7,017	7,032	7,046	7,061	7,076
21.9	7,090	7,105	7,120	7,135	7,149	7,164	7,179	7,194	7,209	7,224

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
22.0	7,239	7,254	7,269	7,284	7,299	7,314	7,329	7,345	7,360	7,375
22.1	7,390	7,405	7,421	7,436	7,451	7,467	7,482	7,497	7,513	7,528
22.2	7,544	7,559	7,575	7,591	7,606	7,622	7,637	7,653	7,669	7,684
22.3	7,700	7,716	7,732	7,748	7,764	7,779	7,795	7,811	7,827	7,843
22.4	7,859	7,875	7,892	7,908	7,924	7,940	7,956	7,972	7,989	8,005
22.5	8,021	8,038	8,054	8,071	8,087	8,104	8,120	8,137	8,153	8,170
22.6	8,187	8,203	8,220	8,237	8,254	8,271	8,288	8,305	8,321	8,338
22.7	8,356	8,373	8,390	8,407	8,424	8,441	8,459	8,476	8,493	8,511
22.8	8,528	8,546	8,563	8,581	8,598	8,616	8,633	8,651	8,669	8,687
22.9	8,704	8,722	8,740	8,758	8,776	8,794	8,812	8,830	8,848	8,866
23.0	8,884	8,903	8,921	8,939	8,957	8,976	8,994	9,013	9,031	9,050
23.1	9,068	9,087	9,106	9,124	9,143	9,162	9,180	9,199	9,218	9,237
23.2	9,256	9,275	9,294	9,313	9,332	9,351	9,370	9,390	9,409	9,428
23.3	9,447	9,467	9,486	9,506	9,525	9,545	9,564	9,584	9,604	9,623
23.4	9,643	9,663	9,683	9,703	9,723	9,743	9,763	9,783	9,803	9,823
23.5	9,843	9,863	9,884	9,904	9,924	9,945	9,965	9,985	10,006	10,026
23.6	10,047	10,068	10,088	10,109	10,130	10,151	10,171	10,192	10,213	10,234
23.7	10,255	10,276	10,297	10,319	10,340	10,361	10,382	10,403	10,425	10,446
23.8	10,468	10,489	10,511	10,532	10,554	10,575	10,597	10,619	10,641	10,662
23.9	10,684	10,706	10,728	10,750	10,772	10,794	10,816	10,838	10,860	10,883
24.0	10,905	10,927	10,950	10,972	10,994	11,017	11,040	11,062	11,085	11,107
24.1	11,130	11,153	11,176	11,198	11,221	11,244	11,267	11,290	11,313	11,336
24.2	11,359	11,383	11,406	11,429	11,452	11,476	11,499	11,522	11,546	11,569
24.3	11,593	11,617	11,640	11,664	11,688	11,711	11,735	11,759	11,783	11,807
24.4	11,831	11,855	11,879	11,903	11,927	11,951	11,975	12,000	12,024	12,048
24.5	12,073	12,097	12,122	12,146	12,171	12,195	12,220	12,245	12,270	12,294
24.6	12,319	12,344	12,369	12,394	12,419	12,444	12,469	12,495	12,520	12,545
24.7	12,570	12,596	12,621	12,647	12,672	12,698	12,724	12,749	12,775	12,801
24.8	12,827	12,853	12,879	12,905	12,931	12,957	12,983	13,010	13,036	13,062
24.9	13,089	13,115	13,142	13,169	13,195	13,222	13,249	13,276	13,303	13,330
25.0	13,357	13,384	13,411	13,438	13,465	13,493	13,520	13,547	13,575	13,602
25.1	13,630	13,658	13,685	13,713	13,741	13,769	13,797	13,825	13,853	13,881
25.2	13,909	13,937	13,965	13,994	14,022	14,050	14,079	14,107	14,136	14,165
25.3	14,193	14,222	14,251	14,280	14,309	14,338	14,367	14,396	14,425	14,454
25.4	14,483	14,512	14,542	14,571	14,601	14,630	14,660	14,689	14,719	14,748
25.5	14,778	14,808	14,838	14,868	14,898	14,928	14,958	14,988	15,018	15,048
25.6	15,079	15,109	15,139	15,170	15,200	15,231	15,261	15,292	15,323	15,354
25.7	15,384	15,415	15,446	15,477	15,508	15,539	15,570	15,601	15,633	15,664
25.8	15,695	15,727	15,758	15,790	15,821	15,853	15,884	15,916	15,948	15,980
25.9	16,011	16,043	16,075	16,107	16,139	16,171	16,204	16,236	16,268	16,300
26.0	16,333	16,365	16,398	16,430	16,463	16,496	16,528	16,561	16,594	16,627
26.1	16,660	16,693	16,726	16,759	16,792	16,825	16,859	16,892	16,925	16,959
26.2	16,992	17,026	17,059	17,093	17,127	17,161	17,194	17,228	17,262	17,296
26.3	17,330	17,364	17,399	17,433	17,467	17,501	17,536	17,570	17,605	17,639
26.4	17,674	17,709	17,743	17,778	17,813	17,848	17,883	17,918	17,953	17,988
26.5	18,023	18,058	18,094	18,129	18,164	18,200	18,235	18,271	18,307	18,342
26.6	18,378	18,414	18,450	18,485	18,521	18,557	18,593	18,630	18,666	18,702
26.7	18,738	18,775	18,811	18,847	18,884	18,920	18,957	18,994	19,030	19,067
26.8	19,104	19,141	19,177	19,214	19,251	19,288	19,325	19,363	19,400	19,437
26.9	19,474	19,512	19,549	19,586	19,624	19,662	19,699	19,737	19,774	19,812
27.0	19,850	19,888	19,926	19,964	20,001	20,039	20,078	20,116	20,154	20,192
27.1	20,230	20,268	20,307	20,345	20,384	20,422	20,461	20,499	20,538	20,576
27.2	20,615	20,654	20,693	20,731	20,770	20,809	20,848	20,887	20,926	20,965
27.3	21,004	21,044	21,083	21,122	21,161	21,201	21,240	21,280	21,319	21,358
27.4	21,398	21,438	21,477	21,517	21,557	21,597	21,636	21,676	21,716	21,756
27.5	21,796	21,836	21,876	21,916	21,957	21,997	22,037	22,077	22,118	22,158
27.6	22,198	22,239	22,279	22,320	22,360	22,401	22,442	22,482	22,523	22,564
27.7	22,605	22,646	22,686	22,727	22,768	22,809	22,851	22,892	22,933	22,974
27.8	23,015	23,056	23,098	23,139	23,181	23,222	23,263	23,305	23,347	23,388
27.9	23,430	23,472	23,513	23,555	23,597	23,639	23,681	23,723	23,765	23,807

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
28.0	23,849	23,891	23,933	23,976	24,018	24,060	24,102	24,145	24,187	24,230
28.1	24,272	24,315	24,358	24,400	24,443	24,486	24,529	24,571	24,614	24,657
28.2	24,700	24,743	24,786	24,829	24,873	24,916	24,959	25,002	25,046	25,089
28.3	25,133	25,176	25,220	25,263	25,307	25,350	25,394	25,438	25,482	25,526
28.4	25,569	25,613	25,657	25,701	25,746	25,790	25,834	25,878	25,922	25,967
28.5	26,011	26,055	26,100	26,144	26,189	26,233	26,278	26,322	26,367	26,412
28.6	26,457	26,501	26,546	26,591	26,636	26,681	26,726	26,771	26,816	26,861
28.7	26,907	26,952	26,997	27,042	27,088	27,133	27,179	27,224	27,270	27,315
28.8	27,361	27,406	27,452	27,498	27,544	27,590	27,635	27,681	27,727	27,773
28.9	27,819	27,865	27,912	27,958	28,004	28,050	28,097	28,143	28,189	28,236
29.0	28,282	28,329	28,375	28,422	28,469	28,515	28,562	28,609	28,656	28,703
29.1	28,750	28,796	28,844	28,891	28,938	28,985	29,032	29,079	29,127	29,174
29.2	29,221	29,269	29,316	29,364	29,411	29,459	29,506	29,554	29,602	29,650
29.3	29,697	29,745	29,793	29,841	29,889	29,937	29,986	30,034	30,082	30,130
29.4	30,178	30,227	30,275	30,324	30,372	30,420	30,469	30,518	30,566	30,615
29.5	30,664	30,712	30,761	30,810	30,859	30,908	30,957	31,006	31,055	31,104
29.6	31,153	31,202	31,252	31,301	31,350	31,400	31,449	31,499	31,548	31,598
29.7	31,647	31,697	31,747	31,796	31,846	31,896	31,946	31,996	32,046	32,096
29.8	32,146	32,196	32,246	32,296	32,347	32,397	32,447	32,498	32,548	32,599
29.9	32,649	32,700	32,750	32,801	32,852	32,902	32,953	33,004	33,055	33,106
30.0	33,157	33,208	33,259	33,310	33,361	33,412	33,463	33,515	33,566	33,617
30.1	33,669	33,720	33,772	33,823	33,875	33,927	33,978	34,030	34,082	34,134
30.2	34,186	34,238	34,290	34,342	34,394	34,446	34,498	34,550	34,603	34,655
30.3	34,707	34,760	34,812	34,865	34,917	34,970	35,023	35,076	35,128	35,181
30.4	35,234	35,287	35,340	35,393	35,446	35,499	35,552	35,606	35,659	35,712
30.5	35,766	35,819	35,873	35,926	35,980	36,033	36,087	36,141	36,195	36,248
30.6	36,302	36,356	36,410	36,464	36,518	36,573	36,627	36,681	36,735	36,790
30.7	36,844	36,899	36,953	37,008	37,062	37,117	37,172	37,226	37,281	37,336
30.8	37,391	37,446	37,501	37,556	37,611	37,666	37,722	37,777	37,832	37,887
30.9	37,943	37,998	38,054	38,109	38,165	38,221	38,276	38,332	38,388	38,444
31.0	38,500	38,556	38,612	38,668	38,724	38,780	38,836	38,893	38,949	39,005
31.1	39,062	39,118	39,175	39,232	39,288	39,345	39,402	39,459	39,515	39,572
31.2	39,629	39,686	39,743	39,801	39,858	39,915	39,972	40,030	40,087	40,144
31.3	40,202	40,259	40,317	40,375	40,432	40,490	40,548	40,606	40,664	40,722
31.4	40,780	40,838	40,896	40,954	41,012	41,070	41,129	41,187	41,245	41,304
31.5	41,362	41,421	41,480	41,538	41,597	41,656	41,715	41,773	41,832	41,891
31.6	41,950	42,009	42,068	42,128	42,187	42,246	42,305	42,365	42,424	42,483
31.7	42,543	42,602	42,662	42,722	42,781	42,841	42,901	42,961	43,021	43,081
31.8	43,141	43,201	43,261	43,321	43,381	43,442	43,502	43,562	43,623	43,683
31.9	43,744	43,805	43,865	43,926	43,987	44,048	44,108	44,169	44,230	44,291
32.0	44,353	44,414	44,475	44,536	44,598	44,659	44,720	44,782	44,844	44,905
32.1	44,967	45,029	45,090	45,152	45,214	45,276	45,338	45,400	45,462	45,524
32.2	45,586	45,649	45,711	45,773	45,836	45,898	45,961	46,023	46,086	46,149
32.3	46,211	46,274	46,337	46,400	46,463	46,526	46,589	46,652	46,715	46,778
32.4	46,842	46,905	46,968	47,032	47,095	47,159	47,222	47,286	47,350	47,413
32.5	47,477	47,541	47,605	47,669	47,733	47,797	47,861	47,925	47,989	48,053
32.6	48,118	48,182	48,246	48,311	48,375	48,440	48,504	48,569	48,634	48,698
32.7	48,763	48,828	48,893	48,958	49,023	49,088	49,153	49,218	49,283	49,348
32.8	49,414	49,479	49,544	49,610	49,675	49,741	49,807	49,872	49,938	50,004
32.9	50,069	50,135	50,201	50,267	50,333	50,399	50,465	50,531	50,598	50,664
33.0	50,730	50,796	50,863	50,929	50,996	51,062	51,129	51,196	51,262	51,329
33.1	51,396	51,463	51,530	51,597	51,664	51,731	51,798	51,865	51,932	52,000
33.2	52,067	52,134	52,202	52,269	52,337	52,404	52,472	52,540	52,607	52,675
33.3	52,743	52,811	52,879	52,947	53,015	53,083	53,151	53,219	53,287	53,356
33.4	53,424	53,492	53,561	53,629	53,698	53,766	53,835	53,904	53,972	54,041
33.5	54,110	54,179	54,248	54,317	54,386	54,455	54,524	54,593	54,662	54,732
33.6	54,801	54,870	54,940	55,009	55,079	55,148	55,218	55,288	55,357	55,427
33.7	55,497	55,567	55,637	55,706	55,776	55,847	55,917	55,987	56,057	56,127
33.8	56,197	56,268	56,338	56,408	56,479	56,549	56,620	56,691	56,761	56,832
33.9	56,903	56,973	57,044	57,115	57,186	57,257	57,328	57,399	57,470	57,541

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
34.0	57,612	57,684	57,755	57,826	57,898	57,969	58,041	58,112	58,184	58,255
34.1	58,327	58,399	58,471	58,542	58,614	58,686	58,758	58,830	58,902	58,974
34.2	59,046	59,119	59,191	59,263	59,335	59,408	59,480	59,553	59,625	59,698
34.3	59,771	59,843	59,916	59,989	60,062	60,135	60,208	60,281	60,354	60,427
34.4	60,500	60,573	60,646	60,720	60,793	60,867	60,940	61,014	61,087	61,161
34.5	61,234	61,308	61,382	61,456	61,530	61,604	61,678	61,752	61,826	61,900
34.6	61,974	62,048	62,123	62,197	62,271	62,346	62,420	62,495	62,569	62,644
34.7	62,719	62,793	62,868	62,943	63,018	63,093	63,168	63,243	63,318	63,393
34.8	63,468	63,543	63,618	63,694	63,769	63,844	63,920	63,995	64,071	64,146
34.9	64,222	64,298	64,373	64,449	64,525	64,601	64,677	64,753	64,828	64,905
35.0	64,981	65,057	65,133	65,209	65,285	65,362	65,438	65,514	65,591	65,667
35.1	65,744	65,820	65,897	65,973	66,050	66,127	66,204	66,280	66,357	66,434
35.2	66,511	66,588	66,665	66,742	66,819	66,896	66,973	67,051	67,128	67,205
35.3	67,282	67,360	67,437	67,515	67,592	67,670	67,747	67,825	67,903	67,980
35.4	68,058	68,136	68,214	68,292	68,370	68,448	68,526	68,604	68,682	68,760
35.5	68,838	68,916	68,994	69,073	69,151	69,229	69,308	69,386	69,465	69,543
35.6	69,622	69,700	69,779	69,858	69,936	70,015	70,094	70,173	70,252	70,331
35.7	70,410	70,489	70,568	70,647	70,726	70,805	70,884	70,963	71,043	71,122
35.8	71,201	71,281	71,360	71,440	71,519	71,599	71,678	71,758	71,838	71,917
35.9	71,997	72,077	72,157	72,237	72,317	72,397	72,477	72,557	72,637	72,717
36.0	72,797	72,877	72,957	73,038	73,118	73,198	73,279	73,359	73,439	73,520
36.1	73,600	73,681	73,762	73,842	73,923	74,004	74,085	74,165	74,246	74,327
36.2	74,408	74,489	74,570	74,651	74,732	74,814	74,895	74,976	75,057	75,139
36.3	75,220	75,302	75,383	75,465	75,546	75,628	75,710	75,791	75,873	75,955
36.4	76,037	76,119	76,201	76,283	76,365	76,447	76,529	76,611	76,694	76,776
36.5	76,858	76,941	77,023	77,106	77,188	77,271	77,354	77,437	77,519	77,602
36.6	77,685	77,768	77,851	77,934	78,017	78,100	78,183	78,266	78,350	78,433
36.7	78,516	78,600	78,683	78,766	78,850	78,933	79,017	79,101	79,184	79,268
36.8	79,352	79,435	79,519	79,603	79,687	79,771	79,855	79,939	80,023	80,107
36.9	80,191	80,275	80,359	80,443	80,528	80,612	80,696	80,781	80,865	80,950
37.0	81,034	81,119	81,203	81,288	81,373	81,457	81,542	81,627	81,712	81,797
37.1	81,881	81,966	82,051	82,136	82,221	82,307	82,392	82,477	82,562	82,647
37.2	82,733	82,818	82,903	82,989	83,074	83,160	83,245	83,331	83,416	83,502
37.3	83,587	83,673	83,759	83,845	83,930	84,016	84,102	84,188	84,274	84,360
37.4	84,446	84,532	84,618	84,704	84,790	84,876	84,962	85,048	85,135	85,221
37.5	85,307	85,394	85,480	85,566	85,653	85,739	85,826	85,912	85,999	86,085
37.6	86,172	86,259	86,345	86,432	86,519	86,606	86,692	86,779	86,866	86,953
37.7	87,040	87,127	87,214	87,301	87,388	87,475	87,562	87,649	87,736	87,823
37.8	87,911	87,998	88,085	88,172	88,260	88,347	88,434	88,522	88,609	88,697
37.9	88,784	88,872	88,959	89,047	89,134	89,222	89,310	89,397	89,485	89,573
38.0	89,661	89,748	89,836	89,924	90,012	90,100	90,188	90,276	90,364	90,452
38.1	90,540	90,628	90,716	90,804	90,892	90,980	91,068	91,157	91,245	91,333
38.2	91,421	91,510	91,598	91,686	91,775	91,863	91,952	92,040	92,129	92,217
38.3	92,306	92,395	92,483	92,572	92,661	92,749	92,838	92,927	93,016	93,104
38.4	93,193	93,282	93,371	93,460	93,549	93,638	93,727	93,816	93,905	93,994
38.5	94,083	94,173	94,262	94,351	94,440	94,530	94,619	94,708	94,798	94,887
38.6	94,976	95,066	95,155	95,245	95,334	95,424	95,513	95,603	95,693	95,782
38.7	95,872	95,962	96,052	96,141	96,231	96,321	96,411	96,501	96,591	96,681
38.8	96,771	96,861	96,951	97,041	97,131	97,221	97,312	97,402	97,492	97,582
38.9	97,673	97,763	97,853	97,944	98,034	98,124	98,215	98,305	98,396	98,487
39.0	98,577	98,668	98,758	98,849	98,940	99,031	99,121	99,212	99,303	99,394
39.1	99,485	99,576	99,667	99,758	99,849	99,940	100,031	100,122	100,213	100,304
39.2	100,396	100,487	100,578	100,669	100,761	100,852	100,943	101,035	101,126	101,218
39.3	101,309	101,401	101,493	101,584	101,676	101,767	101,859	101,951	102,043	102,135
39.4	102,226	102,318	102,410	102,502	102,594	102,686	102,778	102,870	102,962	103,054
39.5	103,147	103,239	103,331	103,423	103,516	103,608	103,700	103,793	103,885	103,978
39.6	104,070	104,163	104,255	104,348	104,440	104,533	104,626	104,719	104,811	104,904
39.7	104,997	105,090	105,183	105,276	105,369	105,462	105,555	105,648	105,741	105,834
39.8	105,927	106,021	106,114	106,207	106,300	106,394	106,487	106,581	106,674	106,768
39.9	106,861	106,955	107,048	107,142	107,236	107,329	107,423	107,517	107,611	107,705

Appendix A (continued)

Lake Houston

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
40.0	107,799	107,893	107,987	108,081	108,175	108,269	108,363	108,457	108,551	108,645
40.1	108,740	108,834	108,928	109,023	109,117	109,212	109,306	109,401	109,495	109,590
40.2	109,684	109,779	109,874	109,969	110,063	110,158	110,253	110,348	110,443	110,538
40.3	110,633	110,728	110,823	110,918	111,013	111,109	111,204	111,299	111,394	111,490
40.4	111,585	111,681	111,776	111,872	111,967	112,063	112,158	112,254	112,350	112,446
40.5	112,541	112,637	112,733	112,829	112,925	113,021	113,117	113,213	113,309	113,405
40.6	113,502	113,598	113,694	113,790	113,887	113,983	114,080	114,176	114,273	114,369
40.7	114,466	114,563	114,659	114,756	114,853	114,950	115,046	115,143	115,240	115,337
40.8	115,434	115,531	115,629	115,726	115,823	115,920	116,017	116,115	116,212	116,310
40.9	116,407	116,505	116,602	116,700	116,797	116,895	116,993	117,091	117,188	117,286
41.0	117,384	117,482	117,580	117,678	117,776	117,874	117,973	118,071	118,169	118,267
41.1	118,366	118,464	118,563	118,661	118,760	118,858	118,957	119,055	119,154	119,253
41.2	119,352	119,451	119,550	119,649	119,748	119,847	119,946	120,045	120,144	120,243
41.3	120,343	120,442	120,541	120,641	120,740	120,840	120,940	121,039	121,139	121,239
41.4	121,338	121,438	121,538	121,638	121,738	121,838	121,938	122,038	122,139	122,239
41.5	122,339	122,440	122,540	122,640	122,741	122,842	122,942	123,043	123,144	123,244
41.6	123,345	123,446	123,547	123,648	123,749	123,850	123,951	124,053	124,154	124,255
41.7	124,357	124,458	124,560	124,661	124,763	124,865	124,966	125,068	125,170	125,272
41.8	125,374	125,476	125,578	125,680	125,782	125,885	125,987	126,089	126,192	126,294
41.9	126,397	126,499	126,602	126,705	126,808	126,910	127,013	127,116	127,219	127,323
42.0	127,426	127,529	127,632	127,736	127,839	127,943	128,046	128,150	128,254	128,358
42.1	128,461	128,565	128,669	128,773	128,878	128,982	129,086	129,190	129,295	129,399
42.2	129,504	129,609	129,713	129,818	129,923	130,028	130,133	130,239	130,344	130,449
42.3	130,555	130,660								

Appendix B

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	-0.1	-0.08	-0.07	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0.00
-0.3	0	0	0	0	0	0	0	0	0	0
-0.2	0	0	0	0	0	0	0	0	0	0
-0.1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0	0	0	0	0	0	0	0	0	0
0.1	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0
0.3	0	0	0	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0
0.6	0	0	0	0	0	0	0	0	0	0
0.7	0	0	0	0	0	0	0	0	0	0
0.8	0	0	0	0	0	0	0	0	1	1
0.9	1	1	1	1	1	1	1	1	1	1
1.0	1	1	1	1	1	1	1	1	1	1
1.1	1	1	1	1	1	1	1	1	1	1
1.2	1	1	1	1	1	1	1	1	1	1
1.3	1	1	1	1	2	2	2	2	2	2
1.4	2	2	2	2	2	2	2	2	2	3
1.5	3	3	3	3	3	3	3	3	3	3
1.6	3	3	3	3	3	3	3	3	3	4
1.7	4	4	4	4	4	4	4	4	4	4
1.8	4	4	4	4	4	4	4	4	4	4
1.9	4	4	4	4	4	4	4	4	4	5
2.0	5	5	5	5	5	5	5	5	5	5
2.1	5	5	5	5	5	5	5	5	5	5
2.2	5	5	5	5	5	5	5	5	5	5
2.3	5	5	5	5	5	6	6	6	6	6
2.4	6	6	6	6	6	6	6	6	6	6
2.5	6	6	6	6	6	6	6	6	6	6
2.6	6	6	6	6	6	6	6	6	6	6
2.7	6	6	6	6	6	7	7	7	7	7
2.8	7	7	7	7	7	7	7	7	7	7
2.9	7	7	7	7	8	8	8	8	8	8
3.0	8	8	8	8	8	8	8	8	8	8
3.1	8	8	8	9	9	9	9	9	9	9
3.2	9	9	9	9	9	9	9	9	9	9
3.3	9	9	9	9	10	10	10	10	10	10
3.4	10	10	10	10	10	10	10	10	10	10
3.5	10	10	10	10	10	10	11	11	11	11
3.6	11	11	11	11	11	11	11	11	11	11
3.7	11	11	11	11	11	11	11	12	12	12
3.8	12	12	12	12	12	12	12	12	12	12
3.9	12	12	12	12	12	12	12	12	13	13

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
4.0	13	13	13	13	13	13	13	13	13	13
4.1	13	13	14	14	14	14	14	14	14	14
4.2	14	14	14	14	15	15	15	15	15	15
4.3	15	15	15	15	15	15	15	16	16	16
4.4	16	16	16	16	16	16	16	16	16	16
4.5	17	17	17	17	17	17	17	17	17	17
4.6	17	17	17	18	18	18	18	18	18	18
4.7	18	18	18	18	18	18	18	19	19	19
4.8	19	19	19	19	19	19	19	19	19	20
4.9	20	20	20	20	20	20	20	20	20	20
5.0	21	21	21	21	21	21	21	21	21	21
5.1	21	21	21	22	22	22	22	22	22	22
5.2	22	22	22	22	22	22	22	23	23	23
5.3	23	23	23	23	23	23	23	23	23	23
5.4	24	24	24	24	24	24	24	24	24	24
5.5	25	25	25	25	25	25	25	25	25	25
5.6	26	26	26	26	26	26	26	26	26	26
5.7	26	27	27	27	27	27	27	27	27	27
5.8	27	27	28	28	28	28	28	28	28	28
5.9	28	28	29	29	29	29	29	29	29	29
6.0	29	29	30	30	30	30	30	31	31	31
6.1	31	31	32	32	32	32	32	32	33	33
6.2	33	33	33	33	34	34	34	34	34	34
6.3	35	35	35	35	35	36	36	36	36	37
6.4	37	37	37	38	38	38	38	39	39	39
6.5	39	39	40	40	40	40	40	41	41	41
6.6	41	41	42	42	42	42	42	43	43	43
6.7	43	43	43	44	44	44	44	44	44	45
6.8	45	45	45	45	45	46	46	46	46	46
6.9	46	47	47	47	47	47	47	48	48	48
7.0	48	48	48	49	49	49	49	49	50	50
7.1	50	50	51	51	51	51	51	52	52	52
7.2	52	52	53	53	53	53	54	54	54	54
7.3	55	55	55	56	56	56	56	57	57	57
7.4	58	58	58	59	59	59	59	60	60	60
7.5	60	61	61	61	62	62	62	62	63	63
7.6	63	63	64	64	64	64	65	65	65	66
7.7	66	66	66	67	67	68	68	68	69	69
7.8	69	70	70	70	71	71	71	71	72	72
7.9	72	72	73	73	73	73	74	74	74	74
8.0	75	75	75	75	76	76	76	76	77	77
8.1	77	77	78	78	78	78	78	79	79	79
8.2	79	80	80	80	80	81	81	81	81	82
8.3	82	82	82	83	83	83	83	84	84	84
8.4	84	85	85	85	85	85	86	86	86	86
8.5	86	87	87	87	87	88	88	88	88	88
8.6	89	89	89	89	90	90	90	90	91	91
8.7	91	91	91	92	92	92	92	93	93	93
8.8	93	94	94	94	94	95	95	95	96	96
8.9	96	97	97	97	97	98	98	98	98	99
9.0	99	99	99	99	100	100	100	100	101	101
9.1	101	101	102	102	102	102	103	103	103	103
9.2	103	104	104	104	105	105	105	106	106	106
9.3	106	107	107	107	107	108	108	108	108	109
9.4	109	109	109	110	110	110	110	111	111	111
9.5	111	111	112	112	112	112	113	113	113	113
9.6	114	114	114	115	115	115	115	116	116	116
9.7	116	117	117	117	118	118	118	118	119	119
9.8	119	119	120	120	120	121	121	121	121	122
9.9	122	122	122	123	123	123	123	124	124	124

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
10.0	125	125	125	126	126	126	126	127	127	127
10.1	128	128	128	128	129	129	129	129	130	130
10.2	130	131	131	131	132	132	132	133	133	134
10.3	134	134	135	135	135	136	136	136	137	137
10.4	137	138	138	138	139	139	139	140	140	141
10.5	141	141	142	142	142	143	143	144	144	144
10.6	145	145	145	146	146	146	147	147	147	148
10.7	148	149	149	149	150	150	150	151	151	151
10.8	152	152	153	153	153	154	154	155	155	155
10.9	156	156	157	157	157	158	158	158	159	159
11.0	160	160	161	161	162	162	162	163	163	164
11.1	164	164	165	165	166	166	166	167	167	168
11.2	168	168	169	170	170	170	171	171	172	172
11.3	173	173	174	174	174	175	175	176	176	177
11.4	177	178	178	179	179	180	180	181	181	182
11.5	183	183	184	184	185	185	186	186	187	187
11.6	188	188	189	189	190	190	191	191	192	193
11.7	193	194	194	195	195	196	197	197	198	198
11.8	199	199	199	200	200	201	201	202	202	202
11.9	203	203	204	204	204	205	205	206	206	207
12.0	207	207	208	208	209	209	209	210	210	211
12.1	211	211	212	212	213	213	214	214	214	215
12.2	215	216	216	217	217	217	218	218	219	219
12.3	220	220	221	221	221	222	222	223	223	223
12.4	224	224	224	225	225	226	226	226	227	227
12.5	228	228	229	230	230	231	231	232	233	233
12.6	234	234	235	235	236	236	237	237	238	238
12.7	239	239	240	240	241	241	242	242	243	243
12.8	244	244	245	245	246	246	246	247	247	248
12.9	249	249	250	250	251	251	252	252	253	253
13.0	254	254	255	255	256	256	257	257	257	258
13.1	258	259	259	260	260	261	262	262	262	263
13.2	263	264	264	265	265	266	266	267	267	268
13.3	268	269	269	270	270	271	271	271	272	272
13.4	273	273	274	274	275	275	276	276	277	277
13.5	278	278	279	279	280	280	281	281	282	282
13.6	283	283	284	284	285	285	286	286	287	287
13.7	288	288	289	289	290	290	291	291	292	292
13.8	293	293	294	294	295	295	296	296	297	297
13.9	298	299	299	300	301	302	302	303	304	304
14.0	305	306	307	308	308	309	310	310	311	312
14.1	312	313	314	314	315	316	316	317	318	318
14.2	319	320	320	321	322	322	323	324	324	325
14.3	325	326	327	327	328	329	329	330	331	331
14.4	332	333	333	334	335	336	336	337	338	339
14.5	340	341	342	342	343	344	345	346	347	347
14.6	348	349	350	351	351	352	353	354	355	356
14.7	357	358	359	360	361	362	363	364	364	365
14.8	366	367	367	368	369	370	371	371	372	373
14.9	374	374	375	376	377	377	378	379	380	380
15.0	381	382	383	384	385	386	386	387	388	389
15.1	390	391	391	392	393	394	394	395	396	397
15.2	397	398	399	400	401	401	402	403	404	405
15.3	405	406	407	408	409	410	410	411	412	413
15.4	414	414	415	416	417	417	418	419	420	420
15.5	421	422	423	424	424	425	426	427	427	428
15.6	429	430	431	431	432	433	434	434	435	436
15.7	437	438	438	439	440	441	442	443	444	444
15.8	445	446	447	448	449	450	450	451	452	453
15.9	454	455	456	456	457	458	459	460	460	461

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
16.0	462	463	464	465	465	466	467	468	469	469
16.1	470	471	472	473	473	474	475	476	477	478
16.2	478	479	480	481	482	482	483	484	485	486
16.3	486	487	488	489	490	490	491	492	493	494
16.4	495	495	496	497	498	499	500	501	501	502
16.5	503	504	505	506	506	507	508	509	510	511
16.6	512	513	514	515	515	516	517	518	519	520
16.7	521	521	522	523	524	525	525	526	527	528
16.8	529	529	530	531	532	533	533	534	535	536
16.9	537	538	538	539	540	541	542	543	544	545
17.0	546	547	548	549	550	551	551	552	553	554
17.1	555	556	557	558	559	560	561	561	562	563
17.2	564	565	566	567	568	569	569	570	571	572
17.3	573	574	575	576	577	578	579	580	581	582
17.4	583	584	585	586	587	588	590	591	592	593
17.5	594	595	596	597	598	599	600	602	603	604
17.6	605	606	607	608	609	610	611	613	614	615
17.7	616	617	618	619	620	622	623	624	625	626
17.8	627	629	630	631	632	633	635	636	638	639
17.9	640	642	643	644	645	647	648	650	651	652
18.0	653	655	656	657	659	660	661	663	664	666
18.1	667	668	670	671	672	674	675	677	678	680
18.2	681	682	684	685	687	688	689	691	693	694
18.3	696	697	699	701	702	704	706	708	710	711
18.4	713	715	716	718	720	721	723	725	726	728
18.5	730	731	733	735	736	738	740	741	743	745
18.6	746	748	750	751	753	755	757	758	760	762
18.7	764	766	768	770	771	773	775	777	779	781
18.8	782	784	786	787	789	791	792	794	796	798
18.9	800	801	803	805	807	808	810	812	813	815
19.0	817	819	820	822	824	826	827	829	831	833
19.1	834	836	838	840	841	843	845	847	849	851
19.2	852	854	856	858	860	862	863	865	867	869
19.3	871	873	875	878	880	882	885	887	890	892
19.4	895	898	901	904	907	910	913	916	918	921
19.5	924	927	930	932	935	938	940	943	946	949
19.6	951	954	956	959	962	965	967	970	972	975
19.7	977	979	982	984	986	989	991	993	996	998
19.8	1,000	1,003	1,005	1,008	1,010	1,012	1,014	1,017	1,019	1,021
19.9	1,023	1,026	1,028	1,030	1,032	1,034	1,037	1,039	1,041	1,043
20.0	1,046	1,048	1,051	1,053	1,056	1,058	1,060	1,063	1,065	1,067
20.1	1,070	1,072	1,075	1,077	1,080	1,082	1,085	1,087	1,090	1,092
20.2	1,095	1,097	1,100	1,102	1,105	1,107	1,109	1,112	1,114	1,116
20.3	1,118	1,120	1,122	1,124	1,126	1,128	1,130	1,132	1,134	1,136
20.4	1,138	1,140	1,142	1,144	1,146	1,148	1,150	1,152	1,154	1,156
20.5	1,158	1,160	1,162	1,164	1,166	1,168	1,170	1,172	1,174	1,176
20.6	1,178	1,180	1,182	1,184	1,186	1,188	1,190	1,192	1,194	1,196
20.7	1,198	1,200	1,202	1,204	1,206	1,208	1,210	1,212	1,214	1,216
20.8	1,218	1,220	1,222	1,225	1,227	1,229	1,231	1,233	1,235	1,237
20.9	1,239	1,241	1,243	1,245	1,247	1,249	1,251	1,253	1,255	1,257
21.0	1,260	1,262	1,264	1,266	1,268	1,271	1,273	1,275	1,277	1,279
21.1	1,281	1,283	1,286	1,288	1,290	1,292	1,295	1,297	1,299	1,301
21.2	1,303	1,306	1,308	1,310	1,312	1,314	1,316	1,318	1,321	1,323
21.3	1,325	1,327	1,329	1,331	1,333	1,335	1,338	1,340	1,342	1,344
21.4	1,346	1,349	1,351	1,353	1,355	1,358	1,360	1,362	1,364	1,367
21.5	1,369	1,372	1,374	1,377	1,379	1,382	1,384	1,387	1,389	1,392
21.6	1,394	1,397	1,399	1,401	1,404	1,406	1,408	1,411	1,413	1,415
21.7	1,418	1,420	1,423	1,426	1,429	1,432	1,435	1,438	1,441	1,444
21.8	1,446	1,449	1,452	1,455	1,457	1,460	1,462	1,465	1,468	1,471
21.9	1,473	1,476	1,478	1,481	1,484	1,486	1,489	1,491	1,494	1,497

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
22.0	1,499	1,502	1,504	1,507	1,510	1,512	1,515	1,517	1,520	1,522
22.1	1,525	1,527	1,530	1,532	1,535	1,537	1,540	1,542	1,545	1,548
22.2	1,550	1,553	1,556	1,558	1,561	1,564	1,566	1,569	1,572	1,574
22.3	1,577	1,580	1,583	1,585	1,588	1,591	1,594	1,597	1,600	1,603
22.4	1,606	1,609	1,612	1,614	1,617	1,620	1,623	1,626	1,629	1,632
22.5	1,636	1,639	1,642	1,646	1,649	1,653	1,656	1,660	1,663	1,667
22.6	1,670	1,674	1,678	1,681	1,685	1,689	1,692	1,696	1,700	1,704
22.7	1,707	1,711	1,715	1,719	1,722	1,726	1,730	1,734	1,737	1,741
22.8	1,744	1,748	1,752	1,755	1,759	1,762	1,766	1,770	1,773	1,777
22.9	1,781	1,784	1,788	1,792	1,796	1,800	1,804	1,808	1,812	1,816
23.0	1,819	1,823	1,827	1,831	1,835	1,839	1,843	1,847	1,851	1,854
23.1	1,858	1,862	1,866	1,870	1,874	1,877	1,881	1,885	1,888	1,892
23.2	1,896	1,899	1,903	1,907	1,911	1,915	1,919	1,922	1,926	1,930
23.3	1,935	1,939	1,943	1,948	1,952	1,957	1,962	1,966	1,970	1,974
23.4	1,978	1,982	1,987	1,991	1,995	1,999	2,003	2,007	2,012	2,016
23.5	2,020	2,024	2,028	2,032	2,036	2,040	2,044	2,048	2,052	2,056
23.6	2,061	2,065	2,069	2,074	2,078	2,082	2,086	2,090	2,095	2,099
23.7	2,103	2,107	2,111	2,115	2,119	2,123	2,127	2,131	2,136	2,140
23.8	2,145	2,149	2,153	2,158	2,162	2,166	2,170	2,174	2,178	2,182
23.9	2,186	2,191	2,195	2,199	2,203	2,208	2,212	2,217	2,221	2,225
24.0	2,229	2,234	2,238	2,242	2,247	2,251	2,255	2,260	2,264	2,269
24.1	2,273	2,277	2,281	2,286	2,290	2,294	2,298	2,302	2,306	2,310
24.2	2,314	2,318	2,322	2,327	2,331	2,335	2,339	2,344	2,348	2,352
24.3	2,356	2,361	2,365	2,369	2,373	2,378	2,382	2,386	2,391	2,395
24.4	2,399	2,404	2,408	2,412	2,416	2,421	2,425	2,429	2,434	2,438
24.5	2,442	2,447	2,451	2,456	2,460	2,465	2,469	2,474	2,479	2,483
24.6	2,488	2,492	2,497	2,502	2,507	2,511	2,516	2,521	2,526	2,531
24.7	2,536	2,542	2,547	2,553	2,558	2,564	2,569	2,575	2,580	2,586
24.8	2,591	2,597	2,603	2,608	2,614	2,620	2,625	2,631	2,637	2,643
24.9	2,649	2,655	2,660	2,666	2,672	2,678	2,684	2,690	2,695	2,701
25.0	2,707	2,712	2,718	2,723	2,729	2,734	2,739	2,745	2,750	2,755
25.1	2,761	2,766	2,772	2,777	2,783	2,789	2,794	2,800	2,805	2,811
25.2	2,816	2,822	2,827	2,833	2,839	2,844	2,850	2,855	2,861	2,867
25.3	2,872	2,877	2,883	2,888	2,893	2,899	2,904	2,909	2,914	2,919
25.4	2,925	2,930	2,935	2,941	2,946	2,951	2,957	2,962	2,967	2,973
25.5	2,978	2,983	2,989	2,994	2,999	3,004	3,010	3,015	3,020	3,025
25.6	3,030	3,035	3,040	3,046	3,051	3,056	3,062	3,067	3,073	3,078
25.7	3,084	3,089	3,094	3,100	3,105	3,110	3,115	3,120	3,125	3,130
25.8	3,135	3,140	3,146	3,151	3,156	3,161	3,166	3,171	3,176	3,182
25.9	3,187	3,193	3,198	3,203	3,209	3,214	3,219	3,225	3,230	3,236
26.0	3,241	3,247	3,252	3,258	3,264	3,269	3,275	3,280	3,286	3,291
26.1	3,297	3,302	3,308	3,313	3,319	3,324	3,330	3,336	3,341	3,347
26.2	3,353	3,359	3,364	3,370	3,376	3,381	3,387	3,393	3,398	3,404
26.3	3,409	3,414	3,420	3,426	3,431	3,437	3,442	3,448	3,453	3,459
26.4	3,464	3,469	3,475	3,481	3,487	3,492	3,498	3,504	3,509	3,515
26.5	3,520	3,526	3,532	3,537	3,543	3,548	3,554	3,559	3,564	3,570
26.6	3,576	3,581	3,587	3,592	3,597	3,602	3,608	3,613	3,618	3,624
26.7	3,629	3,634	3,639	3,644	3,649	3,654	3,660	3,665	3,670	3,675
26.8	3,681	3,686	3,691	3,696	3,701	3,707	3,712	3,717	3,722	3,727
26.9	3,732	3,736	3,741	3,746	3,751	3,756	3,761	3,766	3,770	3,775
27.0	3,780	3,784	3,789	3,794	3,798	3,803	3,807	3,812	3,817	3,821
27.1	3,826	3,831	3,835	3,840	3,845	3,849	3,854	3,858	3,863	3,867
27.2	3,872	3,876	3,880	3,885	3,889	3,893	3,898	3,902	3,906	3,911
27.3	3,915	3,919	3,923	3,928	3,932	3,936	3,940	3,945	3,949	3,954
27.4	3,958	3,963	3,967	3,972	3,976	3,980	3,985	3,989	3,993	3,998
27.5	4,002	4,006	4,011	4,015	4,019	4,023	4,027	4,031	4,035	4,039
27.6	4,043	4,047	4,051	4,055	4,060	4,064	4,068	4,072	4,076	4,080
27.7	4,084	4,088	4,092	4,096	4,100	4,105	4,109	4,113	4,117	4,121
27.8	4,125	4,130	4,134	4,138	4,142	4,147	4,151	4,156	4,160	4,164
27.9	4,169	4,173	4,177	4,182	4,186	4,191	4,195	4,200	4,204	4,208

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
28.0	4,213	4,217	4,221	4,226	4,230	4,234	4,239	4,243	4,247	4,252
28.1	4,256	4,260	4,265	4,269	4,273	4,278	4,283	4,287	4,292	4,297
28.2	4,301	4,306	4,311	4,315	4,319	4,324	4,328	4,333	4,337	4,342
28.3	4,346	4,351	4,356	4,360	4,365	4,369	4,374	4,378	4,383	4,387
28.4	4,392	4,396	4,401	4,405	4,409	4,414	4,418	4,422	4,427	4,431
28.5	4,435	4,439	4,444	4,448	4,452	4,457	4,461	4,466	4,470	4,474
28.6	4,479	4,483	4,487	4,491	4,496	4,500	4,504	4,509	4,513	4,517
28.7	4,522	4,526	4,530	4,534	4,539	4,543	4,547	4,551	4,555	4,559
28.8	4,564	4,568	4,573	4,577	4,581	4,585	4,590	4,594	4,598	4,602
28.9	4,607	4,611	4,615	4,620	4,624	4,629	4,633	4,637	4,642	4,646
29.0	4,651	4,655	4,660	4,664	4,668	4,673	4,677	4,682	4,686	4,691
29.1	4,695	4,699	4,704	4,708	4,712	4,717	4,721	4,726	4,730	4,735
29.2	4,739	4,744	4,749	4,753	4,758	4,763	4,768	4,772	4,777	4,782
29.3	4,787	4,791	4,796	4,800	4,805	4,809	4,814	4,818	4,822	4,827
29.4	4,831	4,835	4,840	4,844	4,849	4,853	4,857	4,862	4,866	4,870
29.5	4,875	4,879	4,883	4,887	4,892	4,896	4,900	4,904	4,909	4,913
29.6	4,918	4,922	4,927	4,931	4,936	4,940	4,945	4,949	4,954	4,958
29.7	4,963	4,968	4,972	4,977	4,982	4,986	4,991	4,995	5,000	5,004
29.8	5,009	5,013	5,018	5,023	5,027	5,032	5,036	5,040	5,045	5,049
29.9	5,053	5,058	5,062	5,067	5,071	5,076	5,080	5,085	5,090	5,094
30.0	5,099	5,104	5,108	5,113	5,118	5,122	5,127	5,132	5,136	5,141
30.1	5,145	5,150	5,155	5,160	5,164	5,169	5,174	5,178	5,183	5,188
30.2	5,192	5,197	5,202	5,207	5,211	5,216	5,221	5,226	5,231	5,236
30.3	5,241	5,246	5,251	5,256	5,261	5,266	5,271	5,276	5,281	5,286
30.4	5,291	5,296	5,301	5,306	5,311	5,316	5,321	5,327	5,332	5,337
30.5	5,342	5,347	5,352	5,356	5,361	5,366	5,371	5,376	5,381	5,386
30.6	5,391	5,397	5,402	5,407	5,412	5,417	5,423	5,428	5,433	5,438
30.7	5,444	5,449	5,454	5,459	5,464	5,470	5,475	5,480	5,484	5,489
30.8	5,494	5,499	5,504	5,508	5,513	5,518	5,523	5,529	5,534	5,539
30.9	5,544	5,549	5,554	5,559	5,564	5,569	5,574	5,579	5,584	5,589
31.0	5,594	5,600	5,605	5,610	5,616	5,621	5,627	5,632	5,638	5,644
31.1	5,649	5,654	5,659	5,664	5,669	5,675	5,680	5,685	5,690	5,695
31.2	5,700	5,705	5,710	5,716	5,721	5,726	5,731	5,736	5,741	5,746
31.3	5,751	5,756	5,761	5,767	5,772	5,777	5,782	5,787	5,792	5,798
31.4	5,803	5,808	5,813	5,818	5,823	5,828	5,833	5,838	5,843	5,848
31.5	5,853	5,858	5,863	5,868	5,873	5,878	5,883	5,888	5,893	5,898
31.6	5,903	5,907	5,912	5,917	5,922	5,927	5,932	5,937	5,942	5,947
31.7	5,953	5,958	5,963	5,968	5,973	5,978	5,983	5,988	5,994	5,999
31.8	6,005	6,010	6,015	6,021	6,026	6,031	6,036	6,042	6,047	6,053
31.9	6,059	6,065	6,070	6,076	6,081	6,087	6,093	6,098	6,104	6,109
32.0	6,115	6,120	6,126	6,131	6,137	6,142	6,148	6,153	6,159	6,164
32.1	6,169	6,175	6,180	6,186	6,191	6,197	6,202	6,207	6,213	6,218
32.2	6,223	6,229	6,234	6,239	6,245	6,250	6,255	6,261	6,266	6,271
32.3	6,276	6,282	6,287	6,292	6,298	6,303	6,308	6,313	6,318	6,323
32.4	6,328	6,333	6,339	6,344	6,349	6,354	6,359	6,365	6,369	6,374
32.5	6,379	6,384	6,389	6,394	6,399	6,404	6,409	6,415	6,420	6,425
32.6	6,430	6,435	6,440	6,445	6,450	6,456	6,461	6,466	6,471	6,476
32.7	6,481	6,486	6,491	6,496	6,501	6,506	6,511	6,516	6,521	6,526
32.8	6,531	6,536	6,541	6,546	6,551	6,557	6,562	6,567	6,572	6,577
32.9	6,582	6,587	6,592	6,597	6,601	6,606	6,612	6,617	6,622	6,627
33.0	6,632	6,637	6,642	6,647	6,652	6,658	6,663	6,668	6,673	6,679
33.1	6,684	6,689	6,695	6,700	6,705	6,710	6,716	6,721	6,726	6,731
33.2	6,737	6,742	6,747	6,752	6,757	6,762	6,767	6,771	6,776	6,781
33.3	6,786	6,791	6,795	6,800	6,805	6,810	6,815	6,820	6,825	6,829
33.4	6,834	6,839	6,844	6,849	6,854	6,859	6,864	6,869	6,874	6,879
33.5	6,884	6,890	6,895	6,900	6,905	6,910	6,915	6,920	6,925	6,930
33.6	6,935	6,939	6,944	6,949	6,954	6,958	6,963	6,968	6,973	6,978
33.7	6,983	6,988	6,992	6,997	7,002	7,006	7,011	7,015	7,020	7,024
33.8	7,029	7,033	7,038	7,043	7,047	7,052	7,056	7,061	7,066	7,070
33.9	7,075	7,080	7,084	7,089	7,094	7,098	7,103	7,108	7,113	7,117

Appendix B (continued)

Lake Houston

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
34.0	7,122	7,127	7,131	7,136	7,141	7,146	7,151	7,156	7,161	7,166
34.1	7,170	7,175	7,180	7,184	7,189	7,193	7,198	7,203	7,208	7,212
34.2	7,217	7,222	7,226	7,231	7,236	7,241	7,247	7,252	7,257	7,263
34.3	7,268	7,273	7,278	7,283	7,288	7,293	7,298	7,303	7,309	7,314
34.4	7,320	7,325	7,330	7,335	7,340	7,345	7,351	7,356	7,361	7,366
34.5	7,371	7,376	7,381	7,386	7,391	7,396	7,400	7,405	7,410	7,415
34.6	7,420	7,426	7,431	7,435	7,440	7,446	7,451	7,455	7,460	7,465
34.7	7,470	7,474	7,479	7,484	7,489	7,493	7,498	7,503	7,507	7,512
34.8	7,517	7,521	7,526	7,531	7,536	7,540	7,545	7,550	7,554	7,559
34.9	7,564	7,568	7,573	7,578	7,582	7,587	7,592	7,596	7,601	7,605
35.0	7,609	7,614	7,618	7,622	7,627	7,631	7,635	7,640	7,644	7,648
35.1	7,652	7,657	7,661	7,665	7,669	7,673	7,677	7,681	7,686	7,690
35.2	7,694	7,699	7,703	7,707	7,711	7,715	7,719	7,723	7,727	7,732
35.3	7,736	7,740	7,744	7,748	7,752	7,757	7,761	7,765	7,769	7,773
35.4	7,777	7,781	7,786	7,790	7,794	7,798	7,802	7,806	7,810	7,814
35.5	7,818	7,822	7,826	7,831	7,835	7,839	7,843	7,847	7,851	7,855
35.6	7,859	7,863	7,867	7,871	7,875	7,879	7,883	7,887	7,891	7,894
35.7	7,898	7,902	7,906	7,910	7,914	7,918	7,922	7,926	7,930	7,934
35.8	7,938	7,942	7,946	7,950	7,954	7,957	7,961	7,965	7,969	7,974
35.9	7,978	7,982	7,986	7,990	7,994	7,997	8,001	8,005	8,009	8,012
36.0	8,016	8,020	8,024	8,028	8,032	8,035	8,039	8,043	8,047	8,051
36.1	8,055	8,060	8,064	8,068	8,072	8,077	8,081	8,085	8,089	8,094
36.2	8,098	8,102	8,107	8,111	8,116	8,120	8,125	8,129	8,133	8,139
36.3	8,144	8,148	8,153	8,157	8,162	8,167	8,172	8,176	8,181	8,186
36.4	8,191	8,196	8,200	8,205	8,210	8,215	8,220	8,225	8,230	8,235
36.5	8,241	8,246	8,251	8,257	8,262	8,267	8,272	8,277	8,281	8,286
36.6	8,290	8,295	8,299	8,303	8,308	8,312	8,316	8,320	8,324	8,329
36.7	8,333	8,337	8,341	8,345	8,349	8,353	8,357	8,361	8,365	8,369
36.8	8,373	8,377	8,381	8,385	8,389	8,393	8,397	8,401	8,405	8,409
36.9	8,413	8,417	8,421	8,425	8,429	8,433	8,437	8,441	8,445	8,449
37.0	8,453	8,457	8,461	8,465	8,469	8,473	8,477	8,481	8,485	8,488
37.1	8,492	8,496	8,500	8,504	8,508	8,511	8,515	8,519	8,523	8,526
37.2	8,530	8,534	8,538	8,541	8,545	8,549	8,552	8,556	8,559	8,563
37.3	8,566	8,569	8,573	8,576	8,579	8,583	8,586	8,589	8,592	8,596
37.4	8,599	8,602	8,606	8,609	8,612	8,615	8,619	8,622	8,625	8,628
37.5	8,632	8,635	8,638	8,641	8,644	8,648	8,651	8,654	8,657	8,660
37.6	8,664	8,667	8,670	8,673	8,676	8,679	8,682	8,685	8,688	8,690
37.7	8,693	8,696	8,699	8,702	8,704	8,707	8,710	8,713	8,716	8,719
37.8	8,722	8,725	8,728	8,731	8,733	8,736	8,739	8,741	8,744	8,747
37.9	8,750	8,753	8,755	8,758	8,761	8,763	8,766	8,769	8,772	8,774
38.0	8,777	8,780	8,782	8,785	8,788	8,790	8,793	8,796	8,799	8,801
38.1	8,804	8,807	8,810	8,813	8,815	8,818	8,821	8,824	8,826	8,829
38.2	8,832	8,835	8,837	8,840	8,843	8,846	8,848	8,851	8,854	8,857
38.3	8,859	8,862	8,865	8,868	8,871	8,873	8,876	8,879	8,882	8,884
38.4	8,887	8,890	8,893	8,896	8,898	8,901	8,904	8,907	8,910	8,912
38.5	8,915	8,918	8,921	8,924	8,927	8,929	8,932	8,935	8,938	8,941
38.6	8,944	8,947	8,950	8,952	8,955	8,958	8,961	8,964	8,967	8,970
38.7	8,973	8,976	8,979	8,981	8,984	8,987	8,990	8,993	8,996	8,999
38.8	9,002	9,005	9,008	9,011	9,014	9,017	9,019	9,022	9,025	9,028
38.9	9,031	9,034	9,037	9,040	9,043	9,046	9,049	9,052	9,055	9,058
39.0	9,061	9,064	9,067	9,070	9,073	9,076	9,079	9,082	9,085	9,088
39.1	9,091	9,094	9,098	9,101	9,104	9,107	9,110	9,113	9,116	9,119
39.2	9,123	9,126	9,129	9,132	9,135	9,138	9,141	9,145	9,148	9,151
39.3	9,154	9,157	9,160	9,164	9,167	9,170	9,173	9,176	9,180	9,183
39.4	9,186	9,189	9,193	9,196	9,199	9,202	9,206	9,209	9,212	9,215
39.5	9,219	9,222	9,225	9,229	9,232	9,235	9,239	9,242	9,245	9,249
39.6	9,252	9,255	9,259	9,262	9,266	9,269	9,272	9,276	9,279	9,283
39.7	9,286	9,289	9,293	9,296	9,300	9,303	9,307	9,310	9,314	9,317
39.8	9,321	9,324	9,328	9,331	9,335	9,338	9,342	9,345	9,349	9,352
39.9	9,356	9,360	9,363	9,367	9,370	9,374	9,378	9,381	9,385	9,389

Appendix B (continued)

Lake Houston

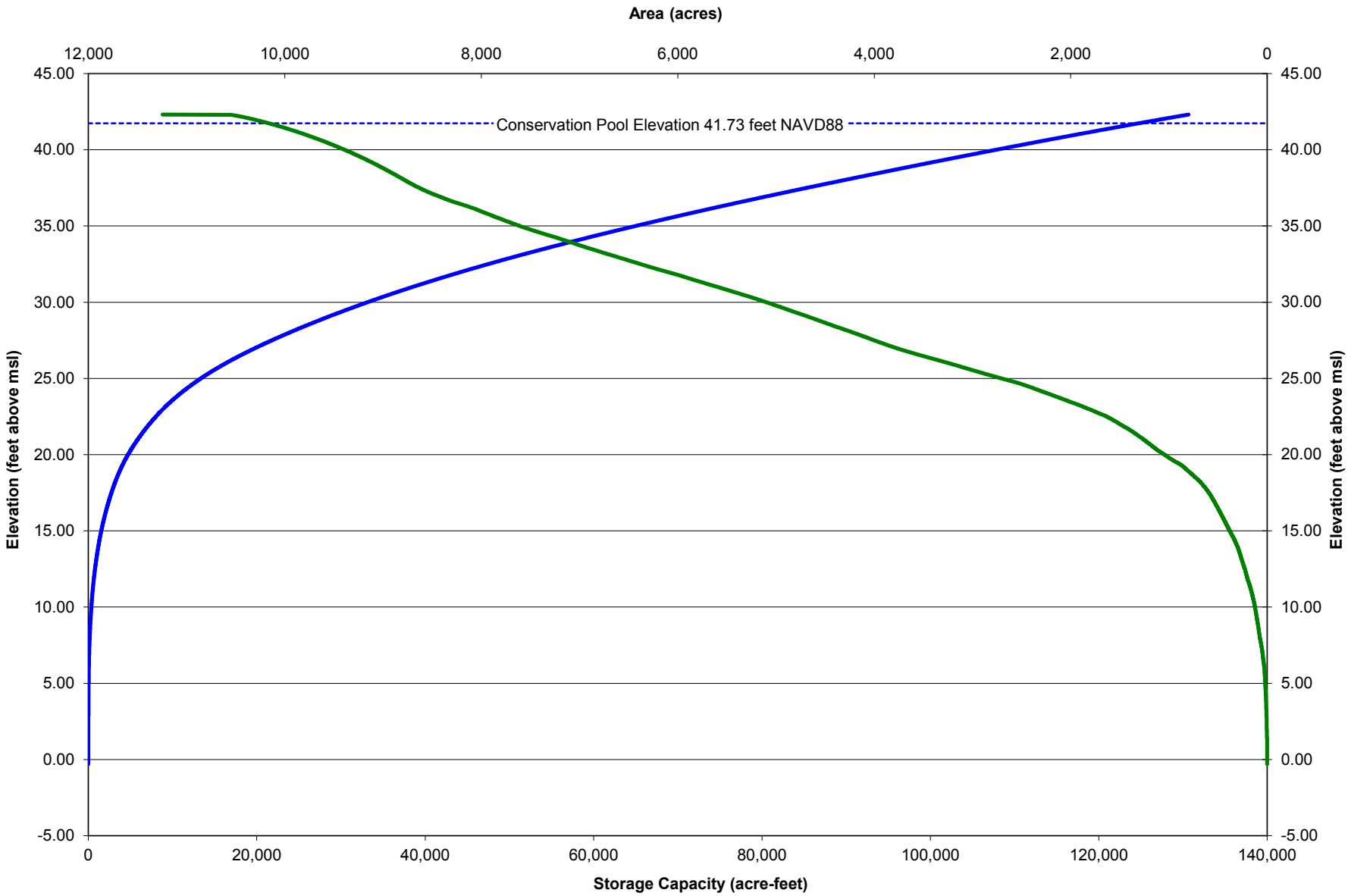
RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — December 2011 Survey

AREA IN ACRES — Conservation Pool Elevation 41.73 feet NAVD88

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
40.0	9,392	9,396	9,400	9,403	9,407	9,410	9,414	9,418	9,421	9,425
40.1	9,429	9,433	9,436	9,440	9,444	9,447	9,451	9,455	9,458	9,462
40.2	9,466	9,470	9,473	9,477	9,481	9,485	9,489	9,492	9,496	9,500
40.3	9,504	9,508	9,511	9,515	9,519	9,523	9,527	9,531	9,535	9,539
40.4	9,542	9,546	9,550	9,554	9,558	9,562	9,566	9,570	9,574	9,578
40.5	9,582	9,586	9,590	9,594	9,598	9,602	9,606	9,610	9,614	9,618
40.6	9,622	9,626	9,631	9,635	9,639	9,643	9,647	9,651	9,655	9,659
40.7	9,664	9,668	9,672	9,676	9,680	9,685	9,689	9,693	9,697	9,701
40.8	9,706	9,710	9,714	9,719	9,723	9,727	9,731	9,736	9,740	9,744
40.9	9,749	9,753	9,758	9,762	9,766	9,771	9,775	9,780	9,784	9,789
41.0	9,793	9,797	9,802	9,806	9,811	9,815	9,820	9,825	9,829	9,834
41.1	9,838	9,843	9,847	9,852	9,857	9,861	9,866	9,871	9,875	9,880
41.2	9,885	9,890	9,894	9,899	9,904	9,909	9,913	9,918	9,923	9,928
41.3	9,933	9,938	9,943	9,947	9,952	9,957	9,962	9,967	9,972	9,977
41.4	9,982	9,987	9,992	9,997	10,002	10,008	10,013	10,018	10,023	10,028
41.5	10,033	10,039	10,044	10,049	10,055	10,060	10,065	10,071	10,076	10,082
41.6	10,087	10,092	10,098	10,103	10,109	10,115	10,120	10,126	10,131	10,137
41.7	10,143	10,148	10,154	10,160	10,165	10,171	10,177	10,182	10,188	10,194
41.8	10,200	10,206	10,212	10,217	10,223	10,229	10,235	10,241	10,247	10,254
41.9	10,260	10,266	10,272	10,278	10,284	10,291	10,297	10,303	10,310	10,316
42.0	10,323	10,329	10,336	10,342	10,349	10,356	10,362	10,369	10,376	10,383
42.1	10,390	10,397	10,404	10,411	10,419	10,426	10,433	10,441	10,449	10,457
42.2	10,464	10,472	10,481	10,489	10,497	10,506	10,515	10,524	10,533	10,543
42.3	10,553	11,246								



Lake Houston
December 2011 Survey
Prepared by: TWDB

Appendix C: Area and Capacity Curves

Figure 6

Lake Houston

5' - contour map

Contours
(feet NAVD88)

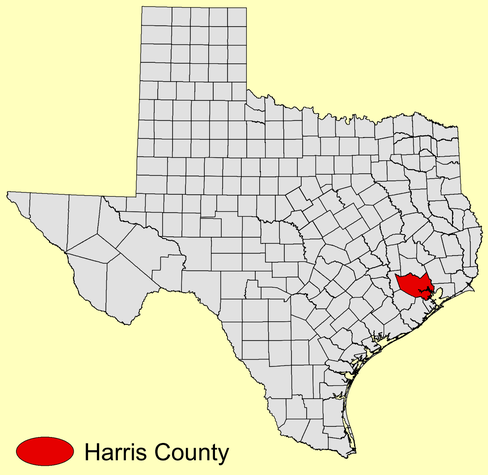
- 40
- 35
- 30
- 25
- 20
- 15
- 10
- 5
- 0

Lake Houston
Elevation 42.31 feet
NAVD88

Islands

Conservation
pool elevation
41.73 feet NAVD88

Projection: NAD83
State Plane Texas
South Central Zone (feet)



Harris 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 Lake Houston. The Texas Water Development Board makes no representations nor assumes any liability.

Texas Water Development Board

December 2011 Survey

0 0.75 1.5 3 Miles

3,175,000

3,200,000

13,950,000

13,925,000

13,900,000