Volumetric and Sedimentation Survey of JOE POOL LAKE

April – May 2022

Texas Water Development Board

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Trinity River Authority

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Executive summary

In December 2021, the Texas Water Development Board (TWDB) entered into an agreement with the Trinity River Authority (TRA) to perform a volumetric and sedimentation survey of Joe Pool Lake (Dallas, Tarrant, and Ellis counties, Texas). Surveying was performed using a multi-frequency (208 kHz, 50 kHz, and 12 kHz), sub-bottom profiling depth sounder. Sediment core samples were collected and correlated with sub-bottom acoustic profiles to estimate sediment accumulation thicknesses and sedimentation rates.

Joe Pool Dam, impounding Joe Pool Lake, is located on Mountain Creek, a tributary of the West Fork of the Trinity River, adjacent to Grand Prairie, Texas and approximately 10 miles southwest of Dallas, Texas. The conservation pool elevation of Joe Pool Lake is 522.0 feet above mean sea level (NGVD29). The TWDB collected bathymetric data for Joe Pool Lake between April 13 and May 12, 2022, while daily average water surface elevations ranged between 520.03 and 520.16 feet NGVD29.

The 2022 TWDB volumetric survey indicates Joe Pool Lake has a total reservoir capacity of 150,999 acre-feet and encompasses 6,680 acres at conservation pool elevation (522.0 feet NGVD29). Previous capacity estimates at elevation 522.0 feet include the original design estimate of 176,895 acre-feet. Because of differences in past and present survey methodologies, direct comparison of volumetric surveys to others to estimate loss of area and capacity can be unreliable. Information from past surveys is presented here for informational purposes only.

The 2022 TWDB sedimentation survey measured 8,868 acre-feet of sediment. The sedimentation survey indicates sediment accumulation is greatest in the river channels with heavy accumulation in the submerged floodplains of the main channel and tributaries. The TWDB recommends that a similar methodology be used to resurvey Joe Pool Lake in 10 years or after a major high flow 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. Texas Water Code Section 15.804 authorizes the TWDB to perform surveys to determine reservoir storage capacity, sedimentation levels, rates of sedimentation, and projected water supply availability.

In December 2021, the TWDB entered into an agreement with the Trinity River Authority (TRA), to perform a volumetric and sedimentation survey of Joe Pool Lake (Dallas, Tarrant, and Ellis Counties, Texas) (Texas Water Development Board, 2021). This report provides an overview of the survey methods, analysis techniques, and associated results. Also included are the following contract deliverables: (1) an elevation-area-capacity table of the reservoir acceptable to the Texas Commission on Environmental Quality (Appendices A and B), (2) a bottom contour map (Figure 6), (3) a shaded relief plot of the reservoir bottom (Figure 4), and (4) an estimate of sediment accumulation and location (Figure 9).

Joe Pool Lake general information

Joe Pool Dam, impounding Joe Pool Lake, is located on Mountain Creek, a tributary of the West Fork of the Trinity River in Dallas County, adjacent to the city of Grand Prairie and approximately 10 miles southwest of Dallas, Texas (Figure 1). Joe Pool Lake is owned and operated by the United States Army Corps of Engineers (USACE). Construction of Joe Pool Dam and Joe Pool Lake began on December 6, 1979, and the dam was completed in May 1986. Deliberate impoundment of water began on January 7, 1986 (U.S. Army Corps of Engineers, 2023a). The reservoir was built primarily for flood control and municipal water supply purposes and is also used for recreational purposes. (Us. Army Corps of Engineers, 2023b, Trinity River Authority, 2023). Joe Pool Dam is an integral part of flood control and water conservation in the Trinity River Basin along with seven additional major flood control projects: Benbrook Dam, Bardwell Dam, Grapevine Dam, Lavon Dam, Lewisville Dam, Navarro Mills Dam, and Ray Roberts Dam (U.S. Army Corps of Engineers, 2019). Additional pertinent data about Joe Pool Dam and Joe Pool Lake can be found in Table 1.

Water rights for Joe Pool Lake have been appropriated to the TRA through Certificate of Adjudication No. 08-3404 and Amendment to Certificate of Adjudication Nos. 08-3404A, 08-3404B, 08-3404C, and 08-3404D (Texas Commission on Environmental Quality, 2023). The complete certificates are on file at the Texas Commission on Environmental Quality (TCEQ).

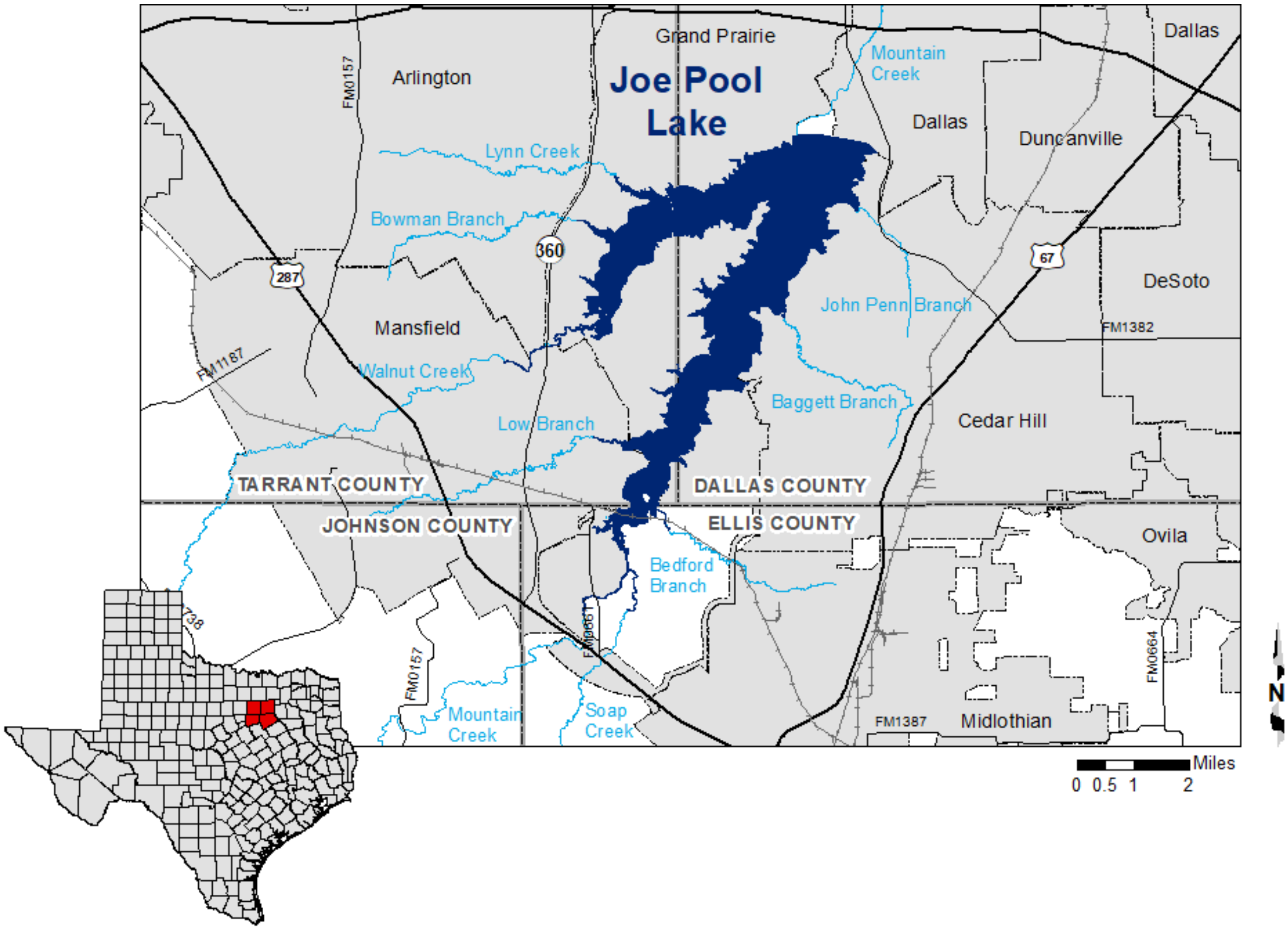

Figure 1. **Location map.**

Table 1. Pertinent Data for Joe Pool Dam and Joe Pool Lake

Owner(s)	
United States (U.S.) Government	
Operator(s)	
U.S. Army Corps of Engineers (USACE), Fort Worth District	
Location	
Mountain Creek, a tributary to the West Fork of the Trinity River, in Dallas, Tarrant, and Ellis counties, approximately ten miles southwest of Dallas, Texas	
Purpose	
Flood control and water supply	
Drainage Area	
Total Drainage Area	232 square miles
Dam	
Type	Rolled earthfill
Total Length (including spillway)	24,340 feet
Maximum Height	108.5 feet
Top Width	30.0 feet
Spillway	
Crest Elevation	541.0 feet NGVD29
Length	50.0 feet net at crest
Type	Broad crested
Outlet Works	
Type	One conduit with two gated inlets
Dimensions	10.5 feet diameter conduit
Invert elevation	466.0 feet NGVD29
Control	2 Service gates, 4.75 feet by 10.5 feet
Low Flow Outlet	
Type	One transition conduit
Size	2 feet by 5 feet
Invert elevation	486.0 feet, 495.0 feet, 504.0 feet, 513.0 feet NGVD29
Control	4 selector gates, 3 feet by 5 feet

Reservoir Data (Based on 2022 TWDB survey)

Feature	Elevation (feet above mean sea level[a])	Capacity (acre-feet)	Area (acres)
Top of dam	564.5	695,099	20,453
Max. Design Water Surface	559.4	596,085	18,335
Spillway Crest	541.0	322,608	11,884
Top of Flood Control Pool	536.0	267,703	10,114
Top of conservation pool	522.0	150,999	6,680
Outlet works invert elevation	466.0	1,370	149
Conservation storage capacity[b]	—	149,629	—

Sources: U.S. Army Corps of Engineers, 2023a.

a. Mean sea level indicates a reference to USGS National Geodetic Vertical Datum 1929 (NGVD29).

b. Usable conservation storage equals total capacity at conservation pool elevation minus dead pool capacity. Dead pool refers to water that cannot be drained by gravity through the dam outlet works.

Volumetric and sedimentation survey of Joe Pool Lake

Datum

The vertical datum used during this survey is the National Geodetic Vertical Datum 1929 (NGVD29). This datum is utilized by the United States Geological Survey (USGS) for the reservoir elevation gage *USGS 08049800 Joe Pool Lk nr Duncanville, TX* (U.S. Geological Survey, 2022). Elevations herein are reported in feet relative to the NGVD29 datum. Volume and area calculations in this report are referenced to water levels reported 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 North Central Zone (feet).

TWDB bathymetric and sedimentation data collection

The TWDB collected bathymetric data for Joe Pool Lake between April 13 and May 12, 2022, while daily water surface elevations ranged from 520.03 and 520.16 feet NGVD29. For data collection, the TWDB used a Specialty Devices, Inc. (SDI), single-beam, multi-frequency (208 kHz, 50 kHz, and 12 kHz) sub-bottom profiling depth sounder integrated with differential global positioning system (DGPS) equipment. Data were collected along pre-planned survey lines oriented perpendicular to the assumed location of the original river channels and spaced approximately 500 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. Each speed of sound profile, or velocity cast, is saved for further data processing. Figure 2 shows the data collection locations for the 2022 TWDB survey.

All sounding data were collected and reviewed before sediment core sampling sites were selected. Sediment core samples are collected throughout the reservoir to assist with interpretation of the sub-bottom acoustic profiles. After analyzing the sounding data, the TWDB selected 17 locations to collect sediment core samples (Figure 2). Sediment cores were collected on November 1-2, 2022, with a custom-coring boat and an SDI VibeCore system.

Sediment cores are collected in 3-inch diameter aluminum tubes. A sediment core extends from the current reservoir-bottom surface, through the accumulated sediment, and into the pre-impoundment surface. After the sample is retrieved, the core tube is cut to the level of the sediment core. The tube is capped, labeled, and transported to TWDB headquarters for further analysis.

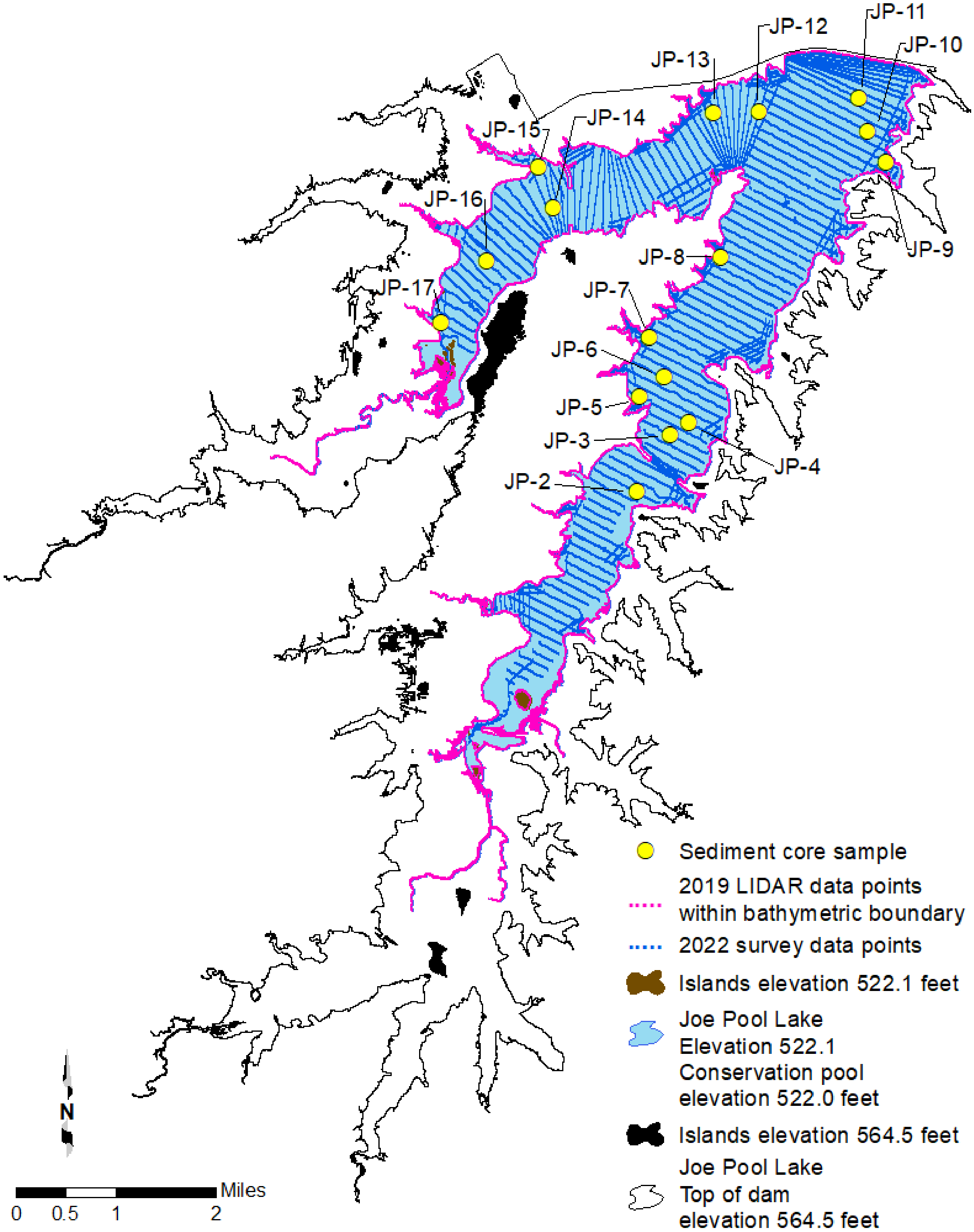

Figure 2. **2022 TWDB sounding data (*blue dots*), sediment coring locations (*yellow circles*), and 2019 LIDAR data for bathymetric model (*pink dots*).**

Data processing

Model boundary

The topographic and bathymetric model boundaries of the reservoir were generated with Light Detection and Ranging (LIDAR) data available from the Texas Natural Resource Information System (TNRIS). These data were collected on March 16, 2019, and March 18, 2019, while the daily average water surface elevation of the reservoir measured between 521.99 feet, and 522.00 feet. The LIDAR data files (.las) were imported into an LAS Dataset and the dataset was converted to a raster using a cell size of 1.0 meters by 1.0 meters. The horizontal datum of the LIDAR data is North American Datum 1983 (NAD83; meters) and the projection is Universal Transverse Mercator (UTM) Zone 14. The vertical datum is North American Vertical Datum 1988 (NAVD88; meters). Contours representing the top of the dam elevation of 172.0856 meters NAVD88, equivalent to 564.5 feet NGVD29, and 159.162293 meters NAVD88, equivalent to 522.1 feet NGVD29, were extracted from the raster. The vertical datum transformation offset of 0.026 meters, was used to convert from meters NAVD88 to meters NGVD29 before converting to feet NGVD29. The vertical datum transformation offset for the conversion from NAVD88 to NGVD29 was determined by applying the National Oceanic and Atmospheric Administration National Geodetic Survey's NADCON software (National Geodetic Survey, 2022a) and Coordinate Conversion and Transformation Tool (NCAT) (National Geodetic Survey, 2022b) to a single reference point in the vicinity of the survey, the reservoir elevation gage *USGS 08049800 Joe Pool Lk nr Duncanville, TX Latitude 32º38'36" N, Longitude 97º00'03" W NAD27.* Horizontal coordinate transformations to NAD83 State Plane Texas North Central Zone (feet) coordinates were applied using the ArcGIS Project tool.

The topographic model contour was edited to close the contour across the dam and remove other artifacts. Where LIDAR data were insufficient for a complete contour at elevation 522.1 feet, the bathymetric model boundary of the reservoir was edited by referencing aerial photographs, also known as digital orthophoto quarter-quadrangle images (DOQQs), obtained through the Texas Imagery Service. The Texas Natural Resources Information System (TNRIS) manages the Texas Imagery Service, allowing public organizations in the State of Texas to access high resolution imagery as a service using Environmental Systems Research Institute's ArcGIS software (Texas Natural Resources Information System, 2022). DOQQs photographed on March 19, 2018, while the daily average water surface elevation measured 522.07 feet, were referenced.

LIDAR data points

To utilize the LIDAR data in the reservoir bathymetric and topographic models, the LIDAR data files (.las) were converted to a multipoint feature class in an Environmental Systems Research Institute's ArcGIS file geodatabase filtered to include only data classified as ground points. A topographical model of the data was generated. The ArcGIS tool Terrain to Points was used to extract points from the Terrain, or topographical model of the reservoir. The Terrain was created using the z-tolerance Pyramid Type. Points were extracted from the terrain at the z-tolerance level of 0.25 meters. New attribute fields were added to convert the elevations from meters NAVD88 to meters NGVD29, then feet NGVD29 for compatibility with the bathymetric survey data. LIDAR data outside of the 564.5-foot contour were deleted and the feature class projected to NAD83 State Plane Texas North Central Zone (feet).

Triangulated Irregular Network model

Following completion of data collection, the raw data files collected by the TWDB were edited to remove data anomalies. The current bottom surface of the reservoir is automatically determined by the data acquisition software. Hydropick software, developed by TWDB staff, was used to display, interpret, and edit the multi-frequency data by manually removing data anomalies in the current bottom surface and to manually edit the pre-impoundment surfaces. The speed of sound profiles, also known as velocity casts, were used to further refine the measured depths. For each location velocity casts are collected, the harmonic mean sound speed of all the casts is calculated. From this, depths collected using one average speed of sound are corrected with an overall optimum speed of sound for each specific depth (Specialty Devices, Inc., 2018).

All data were 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.* 2011a). The resulting point file 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 (Environmental Systems Research Institute, 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 bathymetry 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 artifacts may 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, the 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 (DRGs), hypsography files (the vector format of USGS 7.5-minute quadrangle map contours), and historical aerial photographs, when available. Using the survey data, polygons are created to partition the reservoir into segments with centerlines defining the directionality of interpolation within each segment. 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 reservoir bathymetry and sediment accumulation throughout the reservoir. Specific details of this interpolation technique can be found in the HydroTools manual (McEwen and others, 2011a) and in McEwen and others (2011b).

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 (McEwen and others, 2011a). Although LIDAR was utilized, linear interpolation was necessary to accurately model features in the areas between survey data and LIDAR data. Linear interpolation results in improved elevation-capacity and elevation-area calculations.

Figure 3 illustrates typical results from application of the anisotropic interpolation as applied to Joe Pool Lake. In Figure 3A, deeper channels and 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 elevation-capacity (Appendices A and E) and elevation-area (Appendices B and F) tables.

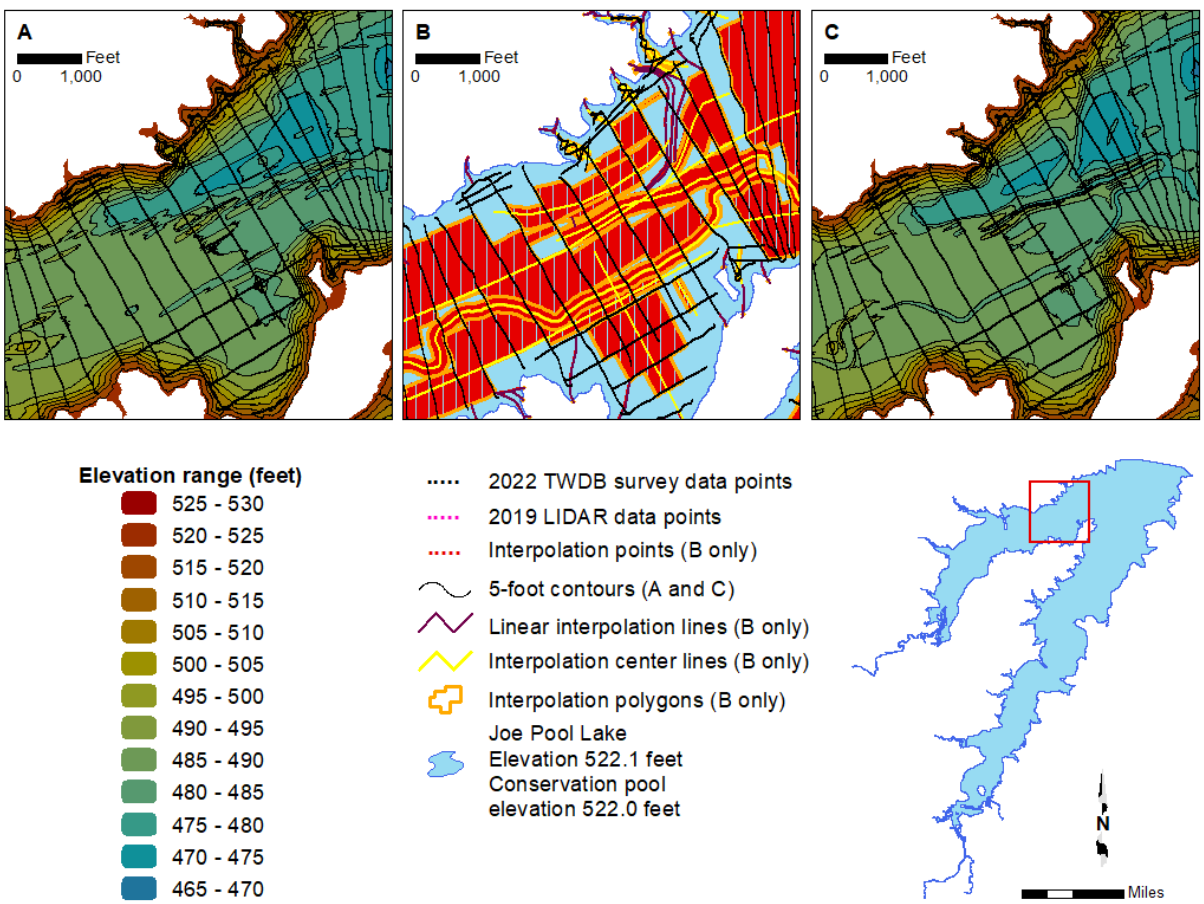

Figure 3. **Anisotropic spatial interpolation as applied to Joe Pool Lake sounding data: A) bathymetric contours without interpolated points; B) sounding points (*black*) and interpolated points (*red*); C) bathymetric contours with interpolated points.**

Area, volume, and contour calculation

Volumes and areas were computed for the entire reservoir at 0.1-foot intervals, from 445.2 to 522.1 feet for the bathymetric TIN model, and from 445.2 to 564.5 feet for the bathymetric and topographic TIN model. The bathymetric elevation-capacity table and bathymetric elevation-area table, based on the 2022 survey and analysis, are presented in Appendices A and B, respectively. The bathymetric capacity curve is presented in Appendix C, and the bathymetric area curve is presented in Appendix D. The topographic elevation-capacity table and topographic elevation-area table developed from the 2022 survey and analysis are presented in Appendices E and F, respectively. The topographic capacity curve is presented in Appendix G, and the topographic area curve is presented in Appendix H.

The topographic and bathymetric volumetric TIN models were converted to a raster representation using a cell size of 2 feet by 2 feet. The raster data then were used to produce three figures: (1) an elevation relief map representing the topography of the reservoir bottom (Figure 4); (2) a depth range map showing depth ranges for Joe Pool Lake (Figure 5); and (3) a 5-foot contour map (Figure 6).

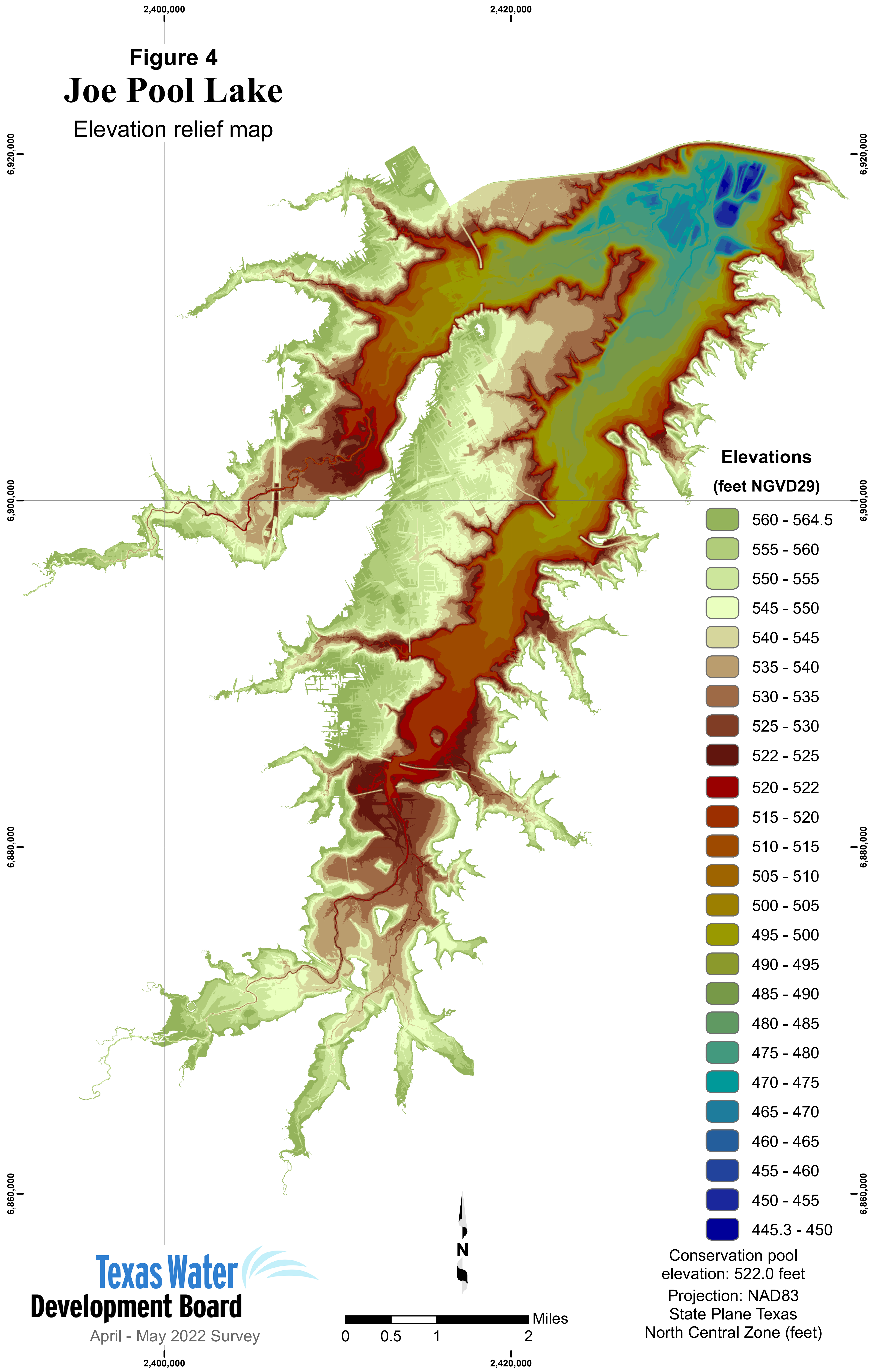
Figure 4
Joe Pool Lake
Elevation relief map
2,400,000
2,420,000
6,920,000
6,900,000
6,880,000
6,860,000
Elevations
(feet NGVD29)
560 - 564.5
555 - 560
550 - 555
545 - 550
540 - 545
535 - 540
530 - 535
525 - 530
522 - 525
520 - 522
515 - 520
510 - 515
505 - 510
500 - 505
495 - 500
490 - 495
485 - 490
480 - 485
475 - 480
470 - 475
465 - 470
460 - 465
455 - 460
450 - 455
445.3 - 450
Conservation pool elevation: 522.0 feet
Projection: NAD83
State Plane Texas
North Central Zone (feet)
N
Miles
0 0.5 1 2
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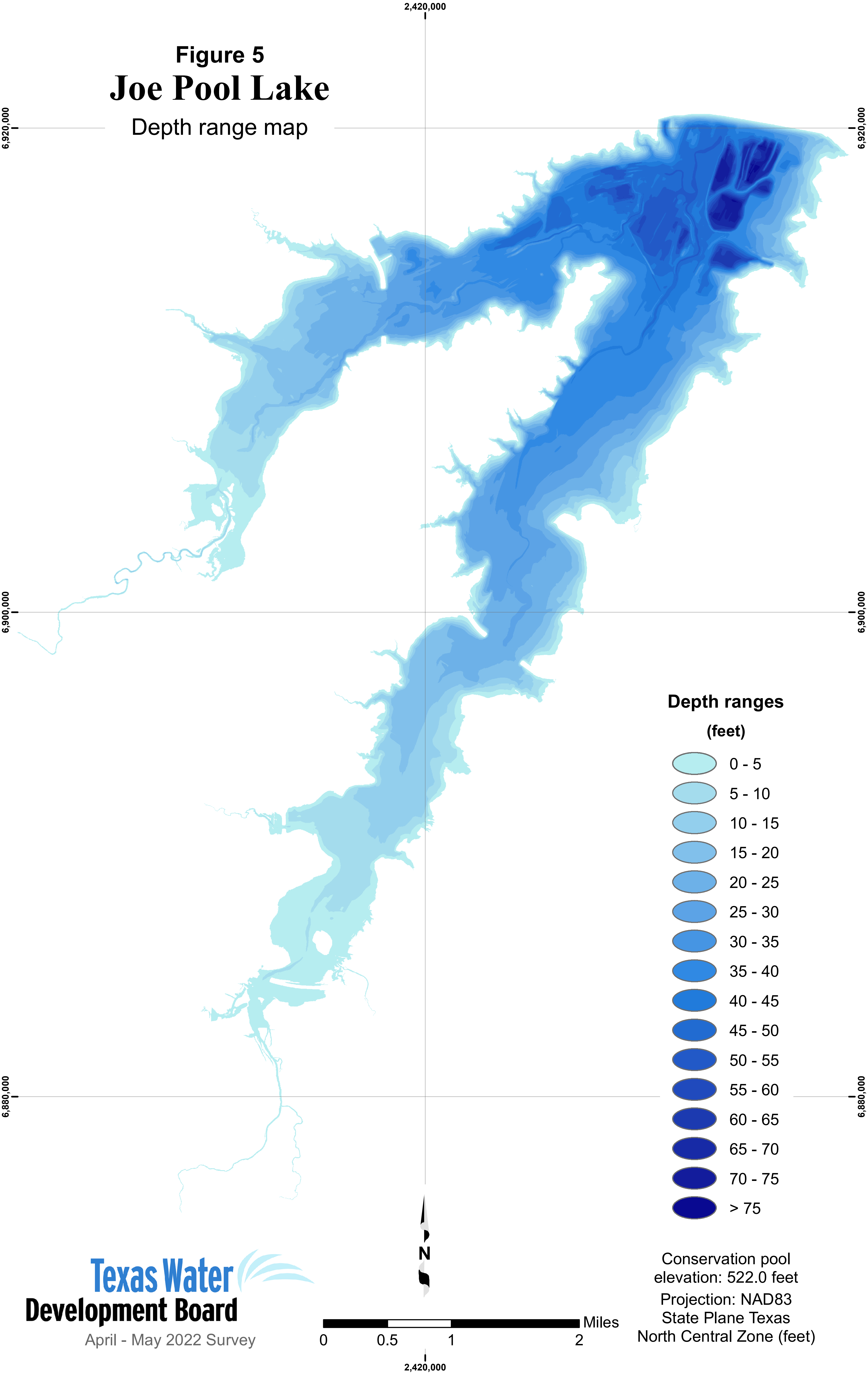
Figure 5

Joe Pool Lake

Depth range map



Conservation pool elevation: 522.0 feet

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

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Analysis of sediment data from Joe Pool Lake

Sedimentation in Joe Pool 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 used to determine the current bathymetric surface, the 208 kHz, 50 kHz, and 12 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 bathymetry and the pre-impoundment surface bathymetry yields a sediment thickness value at each sounding location.

Sediment cores were analyzed at TWDB headquarters in Austin. Each core was split longitudinally and analyzed to identify the location of the pre-impoundment surface. The pre-impoundment surface was identified within the sediment core using 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) recording changes in texture from well sorted, relatively fine-grained sediment to poorly sorted mixtures of coarse and fine-grained materials; and, (3) identifying variations in the physical properties of the sediment, particularly sediment water content and penetration resistance with depth (Van Metre and others, 2004). Total sediment core length, post impoundment sediment thickness, and pre-impoundment thickness were recorded. Physical characteristics of the sediment core, such as Munsell soil color, texture, relative water content, and presence of organic materials are presented in Table 2.

Table 2. Sediment core sample analysis data.

Sediment core sample	Easting[a] (feet)	Northing[a] (feet)	Total core sample / post-impoundment sediment length (inches)	Sediment core description[b]		Munsell soil color
JP-1	2416087.58	6890713.97	N/A	N/A	No recovery, submerged obstructions, non-navigable waters	N/A
JP-2	2421754.59	6897365.17	120.0 / 116.0	post-impoundment	0.0–10.0” very high water content, fine silt, soupy, smooth	5Y 2.51 black
					10.0–116.0” high to moderate water content, water content decreases with depth, silty clay, pudding to peanut butter like consistency with increases in depth, smooth, sticky, uniform texture throughout	5Y 4/2 olive gray with bands of black (5Y 2.5/1)
				pre-impoundment	116.0–120.0” low water content, clay, dense, malleable, easily fractures by hand, mottled coloration, organic material present throughout (fibrous roots)	5Y 5/1 gray 5Y 5/2 olive gray
JP-3	2423520.02	6900371.78	7.0 / 4.0	post-impoundment	0.0−3.0” very high water content, fine silt with up to medium grain size bits of clay present, milkshake consistency	5Y 4/2 olive gray
					3.0–4.0” high water content, silty clay with fine to very coarse grain size bits of clay, sticky, granular to the touch	5Y 2.5/1 black
				pre-impoundment	4.0–7.0” moderate to low water content, water content decreases with depth, clay, dense, malleable, easily fractures by hand, organic material present throughout (fibrous/dendritic roots)	5Y 2.5/1 black
JP-4	2424473.38	6901018.41	5.0 / 0.0	pre-impoundment	0.0–5.0” low water content, clay with a thin film of fine silt on top of layer, malleable, dense, malleable, easily fractures by hand, organic material present throughout (fibrous/dendritic roots)	2.5Y 5/3 light olive gray
JP-5	2421913.32	6902369.50	27.0 / 7.0	post-impoundment	0.0–5.0” very high water content, fine silt, soupy, smooth	5Y 3/2 dark olive gray
					5.0−7.0” high water content, silty clay pudding like with fine grain size bits of clay, uniform consistency and texture throughout	5Y 3/1 very dark gray

[a.] Coordinates are based on NAD83 State Plane Texas North Central System (feet).
[b.] Sediment core samples are measured in inches with zero representing the current bottom surface.

Table 2 (continued). Sediment core sample analysis data.

Sediment core sample	Easting[a] (feet)	Northing[a] (feet)	Total core sample / post-impoundment sediment length (inches)	Sediment core description[b]		Munsell soil color
JP-5 (continued)	2421913.32	6902369.50	27.0 / 7.0	pre-impoundment	7.0–18.0” moderate to low water content, water content decreases with depth, loamy soil with small grain gravel and bits of clay mixed throughout, peanut butter like, sticky, malleable, density increases with depth, organic material present (fibrous roots, stems, and woody debris)	5Y 3/1 very dark gray
					18.0–27.0” low water content, clay with small to large size gravel present throughout, malleable, easily fractures by hand, rocks mixed throughout	5Y 2.5/2 black
JP-6	2423189.10	6903386.88	16.0 / 12.0	post-impoundment	0.0–6.0” very high water content, silty clay, soupy, smooth, uniform consistency and texture throughout	5Y 2.5/1 black
					6.0–12.0” high to moderate water content, water content decreases with depth, silty clay, smooth, pudding like, sticky, uniform consistency and texture throughout	5Y 3/1 very dark gray
				pre-impoundment	12.0–16.0” low water content, clay, density increases with depth, malleable, easily fractures by hand, organic material present throughout (fibrous/dendritic roots)	5Y 3/1 very dark gray with band of black (5Y 2.5/1) from 12-13”
JP-7	2422395.14	6905465.84	4.0 / 2.0	post-impoundment	0.0–2.0” moderate water content, silt sand, fine sand with sparse bits of clay, peanut butter like, sticky, organic material present (twig)	5Y 4/2 olive gray
				pre-impoundment	2.0–4.0” low water content, clay, dense, malleable, easily fractures by hand, organic material present near top of layer (roots)	5Y 6/3 pale olive
JP-8	2426174.95	6909716.42	73.0 / 69.0	post-impoundment	0.0–4.0” very high water content, fine silt, soupy, smooth	5Y 2.5/1 black
					4.0–62.0” high to moderate water content, water content decreases with depth, silty clay, pudding to peanut butter like consistency with increases in depth, smooth, sticky, density increases with depth	5Y 2.5/1 black
					62.0–69.0” moderate water content, silty clay with coarse grain size bits of clay, peanut butter like, sticky, organic material present (woody debris, roots at bottom of layer)	5Y 3/1 very dark gray

a. Coordinates are based on NAD83 State Plane Texas North Central System (feet).
b. Sediment core samples are measured in inches with zero representing the current bottom surface.

Table 2 (continued). Sediment core sample analysis data.

Sediment core sample	Easting[a] (feet)	Northing[a] (feet)	Total core sample / post-impoundment sediment length (inches)	Sediment core description[b]		Munsell soil color
JP-8 (continued)	2426174.95	6909716.42	73.0 / 69.0	pre-impoundment	69.0−73.0” low water content, clay, malleable, more dense than previous layer, crumbles when pulled, can form ribbons when rolled, organic material present throughout (fibrous/dendritic roots, twig, woody debris)	5Y 4/1 dark gray
JP-9	2434934.88	6914744.63	31.0 / N/A	post-impoundment	0.0–1.0” very high water content, fine silt, soupy, smooth	5Y 4/2 olive gray
					1.0−9.0” high water content, silty clay, pudding like, smooth, density changes throughout layer, uniform texture	5Y 4/1 dark gray
					9.0–23.0” moderate water content, silty clay, peanut butter like, smooth, sticky, more dense than previous layer	5Y 3/1 very dark gray
					23.0–31.0” moderate water content, silty clay, peanut butter like, smooth, more dense than previous layer, high density clay fragments throughout, organic material present at the bottom of the layer (roots and woody debris)	5Y 2.5/1 black
JP-10	2433956.04	6916382.82	10.0 / 2.0	post-impoundment	0.0–2.0” very high water content, fine silt with very fine bits of clay present, soupy	5Y 4/3 olive
				pre-impoundment	2.0–10.0” low water content, clay, dense, malleable, easily fractures by hand, organic material present throughout (fibrous roots)	5Y 4/1 dark gray
JP-11	2433524.52	6918114.00	44.0 / N/A	post-impoundment	0.0–2.0” very high water content, fine silt, soupy, smooth, mottled coloration	5Y 2.5/1 black 5Y 3/2 dark olive gray
					2.0–44.0” high water content, silty clay, pudding like, smooth, sticky, uniform consistency and texture throughout, mottled coloration	5Y 3/2 dark olive gray 5Y 2.5/1 black
JP-12	2428244.25	6917414.03	120.0 / 116.0	post-impoundment	0.0–116.0” very high to low water content, water content decreases with depth, silty clay, pudding to peanut butter like consistency with increases in depth, smooth, sticky, density increases with depth especially after 100 inches uniform texture	5Y 2.5/1 black
				pre-impoundment	116.0–120.0” low water content, clay, malleable, loosely packed at 116 inches, easily fractures by hand but crumbles	2.5Y 5/3 light olive brown

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

b. Sediment core samples are measured in inches with zero representing the current bottom surface.

Table 2 (continued). Sediment core sample analysis data.

Sediment core sample	Easting[a] (feet)	Northing[a] (feet)	Total core sample / post-impoundment sediment length (inches)	Sediment core description[b]		Munsell soil color
JP-13	2425830.27	6917375.73	16.0 / 9.0	post-impoundment	0.0–1.0” high water content, fine silt, soupy, smooth	5Y 3/1 very dark gray
					1.0–9.0” moderate water content, sandy clay, pudding like, sticky	5Y 3/1 very dark gray
				pre-impoundment	9.0–16.0” low water content, sandy clay with coarse grain sand present, dense, malleable, easily fractures by hand, few gravel pieces present, organic material present throughout (fibrous roots)	5Y 2.5/1 black
JP-14	2417359.57	6912313.13	58.0 / N/A	post-impoundment	0.0–3.0” very high water content, fine silt, soupy, smooth	5Y 3/2 dark olive gray
					3.0–55.0” high to moderate water content, water content decreases with depth, silty clay, pudding to peanut butter like consistency with increases in depth, sticky, density increases with depth	5Y 2.5/1 black
					55.0–58.0” moderate water content, silty clay with bits of clay, small rocks and pebbles present, peanut butter like, organic material present (fibrous roots)	5Y 3/1 very dark gray
JP-15	2416549.43	6914485.80	70.0 / 68.0	post-impoundment	0.0–2.0” very high, fine silt, soupy, smooth, organic material present (several pieces of vegetation)	5Y 3/2 dark olive gray
					2.0–8.0” high water content, silty clay, pudding like, sticky, organic material present (fibrous roots and vegetation)	5Y 3/2 dark olive gray
					8.0–37.0” moderate water content, silty clay, peanut butter like, sticky, smooth	5Y 2.5/1 black
					37.0–46.0” moderate water content, sandy silty clay, sticky with a sandy grit, more dense than previous layer	5Y 2.5/1 black
					46.0–68.0” moderate to low water content, water content less than previous layer, silty sandy clay, density increases with depth, organic material present throughout (fibrous roots, woody debris)	5Y 3/1 very dark gray
				pre-impoundment	68.0–70.0” low water content, clay, dense, malleable, easily fractured by hand but crumbles, organic material present (fibrous roots)	5Y 4/3 olive

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

[b.] Sediment core samples are measured in inches with zero representing the current bottom surface.

Table 2 (continued). Sediment core sample analysis data.

Sediment core sample	Easting[a] (feet)	Northing[a] (feet)	Total core sample / post-impoundment sediment length (inches)	Sediment core description[b]		Munsell soil color
JP-16	2413814.05	6909560.24	4.0 / 1.0	post-impoundment	0.0–1.0” very high water content, silty clay with fine grain size bits of clay, soupy, organic material present (woody debris)	5Y 2.5/1 black
				pre-impoundment	1.0–4.0” low water content, clay, dense, malleable, easily fractures by hand, holds shape, organic material present throughout (fibrous roots and leaf litter)	5Y 2.5/1 black
JP-17	2411438.85	6906269.49	49.0 / 42.0	post-impoundment	0.0–2.0” high water content, sandy silty clay, sticky, fine grit	5Y 3/2 dark olive gray
					2.0–3.0” high water content, sandy clay, more dense than previous layer, organic material present at bottom of layer (fibrous roots)	5Y 3/2 dark olive gray
					3.0–29.0” high water content, silty clay, pudding like, smooth, sticky, uniform consistency throughout	2.5Y 2.5/1 black
					29.0–30.0” moderate water content, sandy clay, milkshake consistency, sticky, gritty, organic material present (woody debris and twigs)	2.5Y 2.5/1 black
					30.0–42.0” moderate water content, silty clay with medium to coarse grain size bits of clay present, peanut butter like, organic material present (woody debris)	5Y 3/1 very dark gray
				pre-impoundment	42.0–49.0” low water content, clay, malleable, crumbles when fractured, density increases with depth, mottled coloration, organic material present throughout (fibrous roots)	5Y 4/3 olive 5Y 3/2 dark olive gray

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

b. Sediment core samples are measured in inches with zero representing the current bottom surface.

Several criteria determine sediment core locations. Locations are dispersed throughout the reservoir, are selected to represent the various acoustic signatures seen in the data, and are chosen to represent various depths and topographical features such as the submerged river channels, floodplains, shallow slopes, and deep basins. The pre-impoundment surface is identified by matching each sediment core with the acoustic signal returns. This information then serves as a guide for identifying the pre-impoundment surface along cross-sections where sediment core samples were not collected.

A photograph of sediment core JP-6 (for location, refer to Figure 2) is shown in Figure 7. The base, or deepest part of the sample, is denoted by the blue line. The pre-impoundment boundary (yellow line closest to the base) was evident within this sediment core sample at 12 inches and identified by the change in color, texture, moisture, porosity, and structure. Identification of the pre-impoundment surface for each sediment core followed a similar procedure.

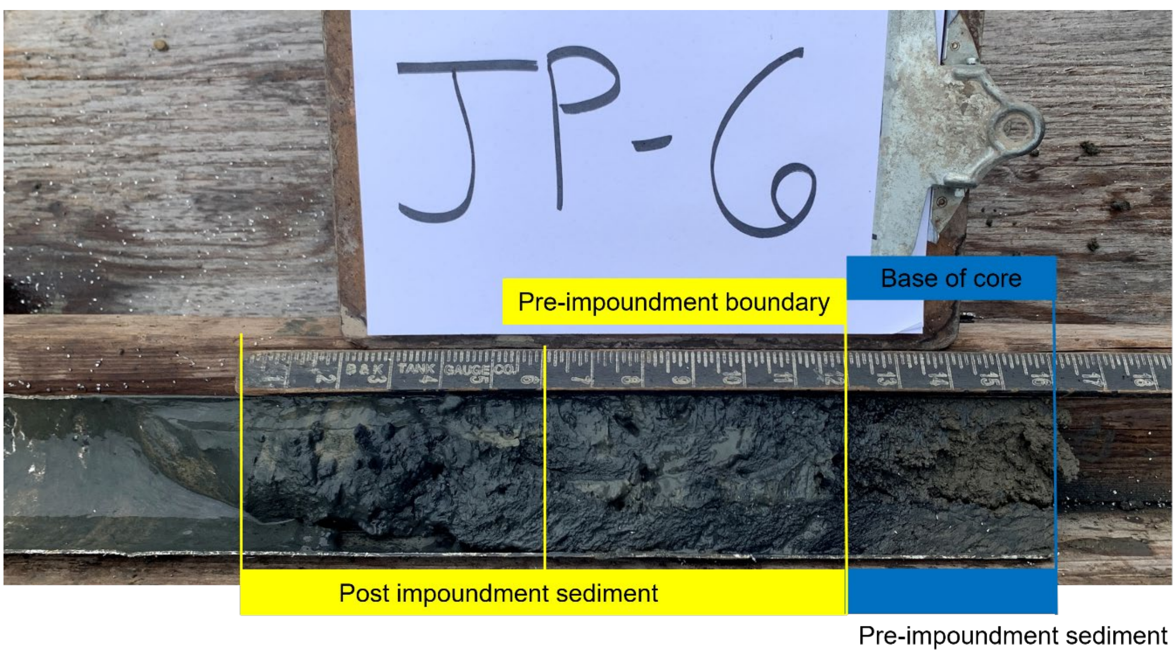


Figure 7. **Sediment core JP-6. Post-impoundment sediment layers occur in the top 12 inches of this sediment core (identified by the yellow box). Pre-impoundment sediment layers were identified and are defined by the blue box.**

Figure 8 illustrates the relationships between acoustic signal returns and the depositional layering seen in sediment cores. In this example, sediment core JP-6 is shown correlated with each frequency: 208 kHz, 50 kHz, and 12 kHz. The current bathymetric surface is determined based on signal returns from the 208 kHz transducer as 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 12 kHz signals to the location of the pre-impoundment surface of the sediment core sample. Many layers of sediment may be identified during analysis based on changes in observed characteristics such as water content, organic matter content, and sediment particle size, and each layer is classified as either post-impoundment or pre-impoundment. Yellow boxes represent post-impoundment sediments identified in the sediment core. Blue boxes indicate pre-impoundment sediments. In this example, the pre-impoundment boundary in sediment core JP-6 most closely aligned with the different layers picked up by the 50 kHz acoustic returns (Figure 8 B).

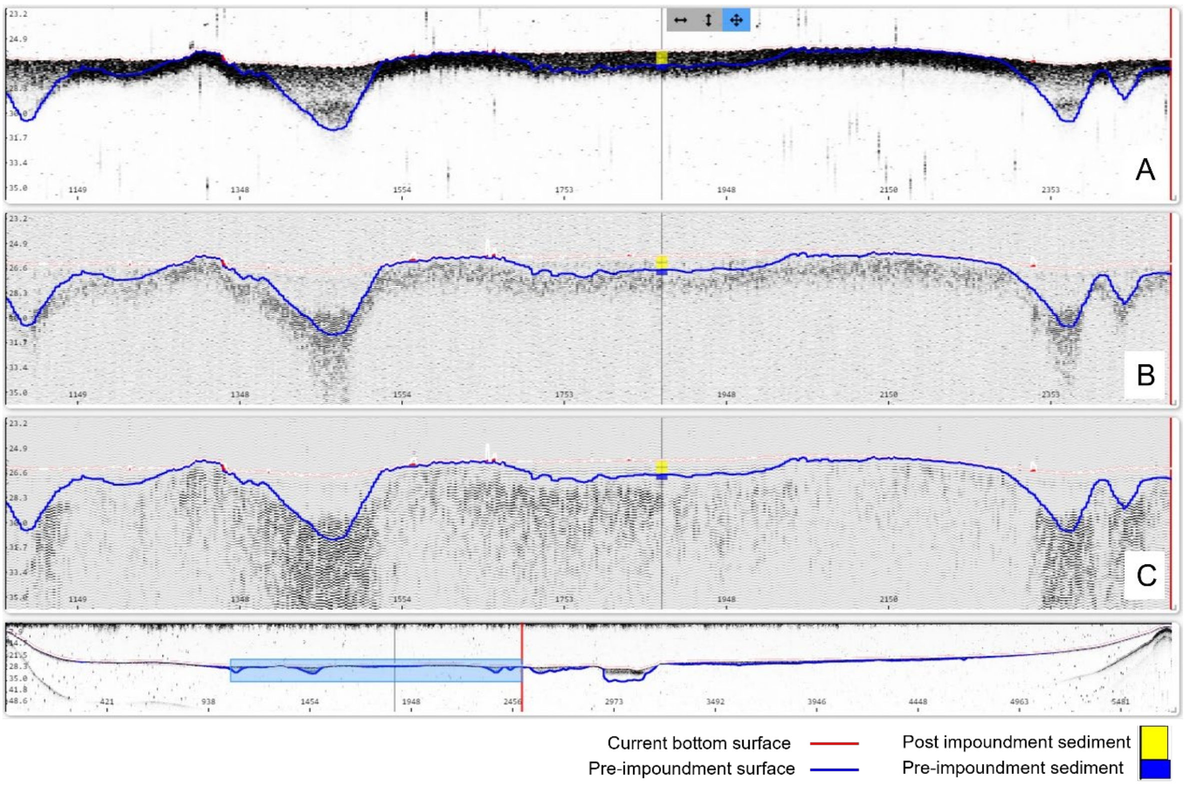
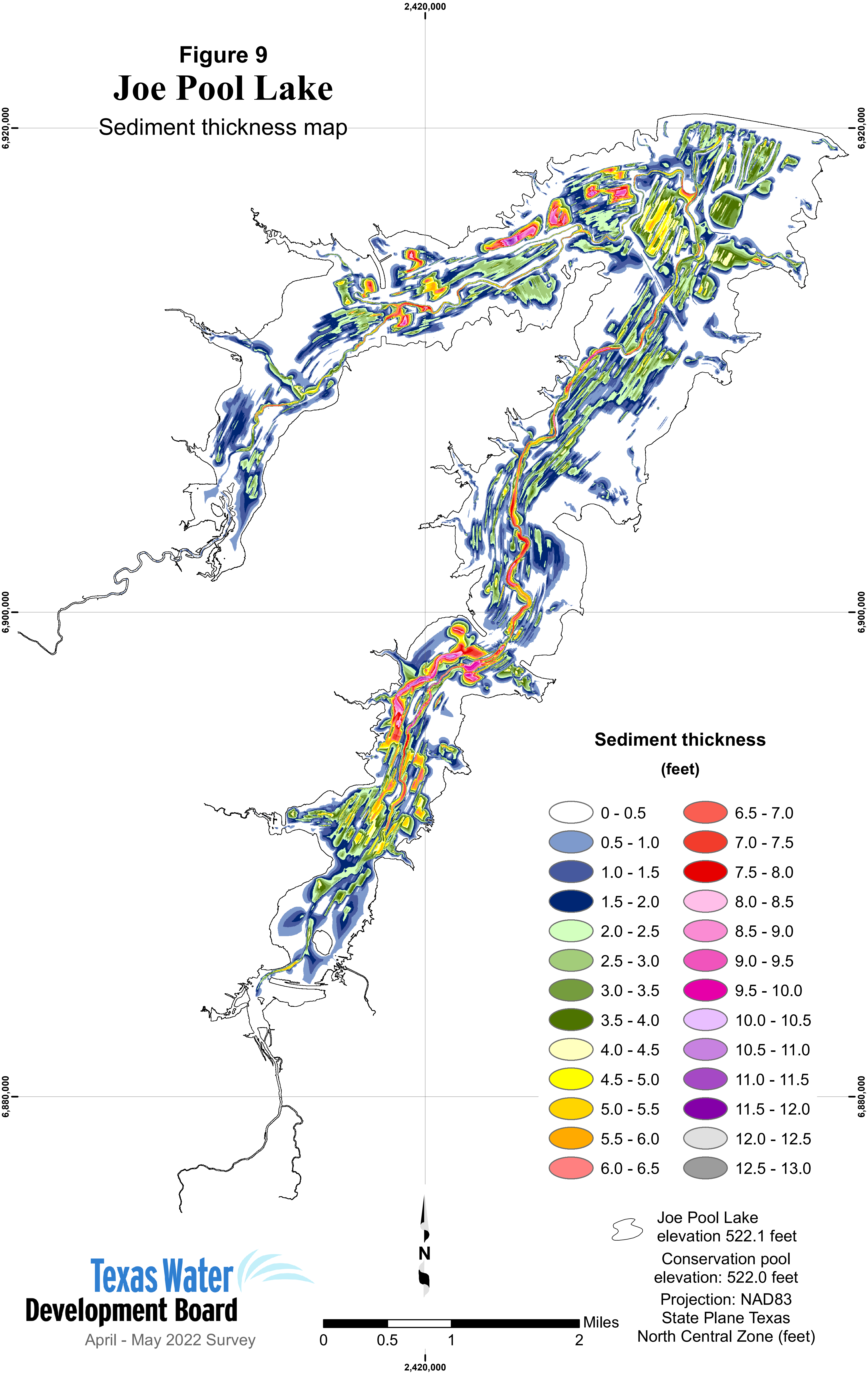


Figure 8. **Sediment core sample JP-6 compared with acoustic signal returns: A) 208 kHz frequency, B) 50 kHz frequency, and C) 12 kHz frequency.**

After the pre-impoundment surface for all cross-sections is identified, a pre-impoundment TIN model and a sediment thickness TIN model are created. Pre-impoundment elevations and sediment thicknesses are interpolated between surveyed cross-sections using HydroTools with the same interpolation definition file used for bathymetric interpolation. For the purposes of TIN model creation, the TWDB assumed the sediment thickness for each LIDAR point and the reservoir boundary was zero feet (defined as the 522.1-foot elevation contour). The sediment thickness TIN model was converted to a raster representation using a cell size of 5 feet by 5 feet and was used to produce a sediment thickness map (Figure 9). Elevation-capacity and elevation-area tables were computed from the pre-impoundment TIN model for the purpose of calculating the total volume of accumulated sediment.

Figure 9
Joe Pool Lake
Sediment thickness map



Survey results

Volumetric survey

The 2022 TWDB volumetric survey indicates that Joe Pool Lake has a total reservoir capacity of 150,999 acre-feet and encompasses 6,680 acres at conservation pool elevation (522.0 feet NGVD29). Previous capacity estimates of Joe Pool Lake include the original design estimate of 176,895 acre-feet (Institute for Water Resources, 2016). Current area and capacity estimates are compared to previous area and capacity estimates at different elevations in Table 3. Comparison of capacity estimates of Joe Pool Lake derived using differing methodologies are provided in Table 4 for sedimentation rate calculation. Because of differences in past and present survey methodologies, direct comparison of volumetric surveys to others to estimate loss of area and capacity can be unreliable.

Table 3. Previous and current survey estimates.

Survey	Surface Area (acres)	Total Capacity (acre-feet)	Conservation Pool Elevation[a]	Source
U.S. Army Corps of Engineers original design	7,470	176,900	522.0	U.S. Army Corps of Engineers, 2023a
U.S. Army Corps of Engineers original design	6,707	176,895	522.0	U.S. Army Corps of Engineers, 2019 Institute for Water Resources, 2016
TWDB 2022	6,680	150,999	522.0	

[a.] Feet above mean sea level, National Geodetic Vertical Datum 1929 (NGVD29).

Table 4. Average annual capacity loss comparisons.

U.S. Army Corps of Engineers original design versus TWDB 2022	TWDB 2022 pre-impoundment estimate versus TWDB 2022	Survey comparisons
176,895	159,867	Total capacity (acre-feet) at top of conservation pool elevation 522.0 feet[a]
150,999	150,999	
25,896	8,868	Volume difference (acre-feet)
14.6	5.5	Percent change
719	246	Capacity loss rate (acre-feet/year)[b]
3.1	1.1	Capacity loss rate (acre-feet per square mile of drainage area of 232 square miles per year)

[a.] Feet above mean sea level, National Geodetic Vertical Datum 1929 (NGVD29).
[b.] Note: Average annual capacity loss rate based on 36 years between surveys. Joe Pool Dam was completed in May 1986, and deliberate impoundment began on 7 January1986.

Sedimentation survey

The 2022 TWDB sedimentation survey measured 8,868 acre-feet of sediment. The sedimentation survey indicates sediment accumulation is greatest in the river channels and floodplains. The 2022 sediment estimate may be an underestimate of total sediment accumulation particularly in the river channels and shallow upstream areas.

Joe Pool Lake is prone to periods of high inflow as well as periods of drought (U.S. Army Corps of Engineers, 2019). Identification of the pre-impoundment surface can be made more challenging by fluctuating water levels. Low water levels lead to the desiccation of any exposed sediment, for example, between July 2, 1995, and February 12, 1997, the water surface elevation of the reservoir measured up to 5.23 feet below conservation pool, reaching a record low elevation of 516.77 feet on October 20, 1996. Upon inundation and re-saturation, exposed sediment will not return to its original high level of water content (Dunbar and Allen, 2003). Drying of sediment in exposed areas create hard surfaces that cannot be penetrated with gravity coring techniques, and compressive stresses on the sediments may also increase sediment density, inhibiting the measurement of the original, pre-impoundment surface. Density stratification in the sediment layers can also scatter and attenuate acoustic return signals of the multi-frequency depth sounder (U.S. Army Corps of Engineers, 2013).

The 2022 TWDB sedimentation survey indicates Joe Pool Lake has lost capacity at an average of 246 acre-feet per year since impoundment due to sedimentation below conservation pool elevation (522.0 feet NGVD29) (Table 4). Any changes to the hydrologic system that contributes runoff to the reservoir, including changes in vegetative cover, land use, or frequency and intensity of rainfall events, can impact the local rate of sedimentation. Because methodological and technological changes from one survey to the next yield inconsistencies in capacity loss rates, long term capacity calculations, computed by plotting all capacity estimates and calculating a linear regression line, reduces the effect of individual survey error. As illustrated in Figure 10, long-term trends indicate Joe Pool Lake loses capacity at an average of 483 acre-feet per year since impoundment due to sedimentation below conservation pool elevation (522.0 feet NGVD29).

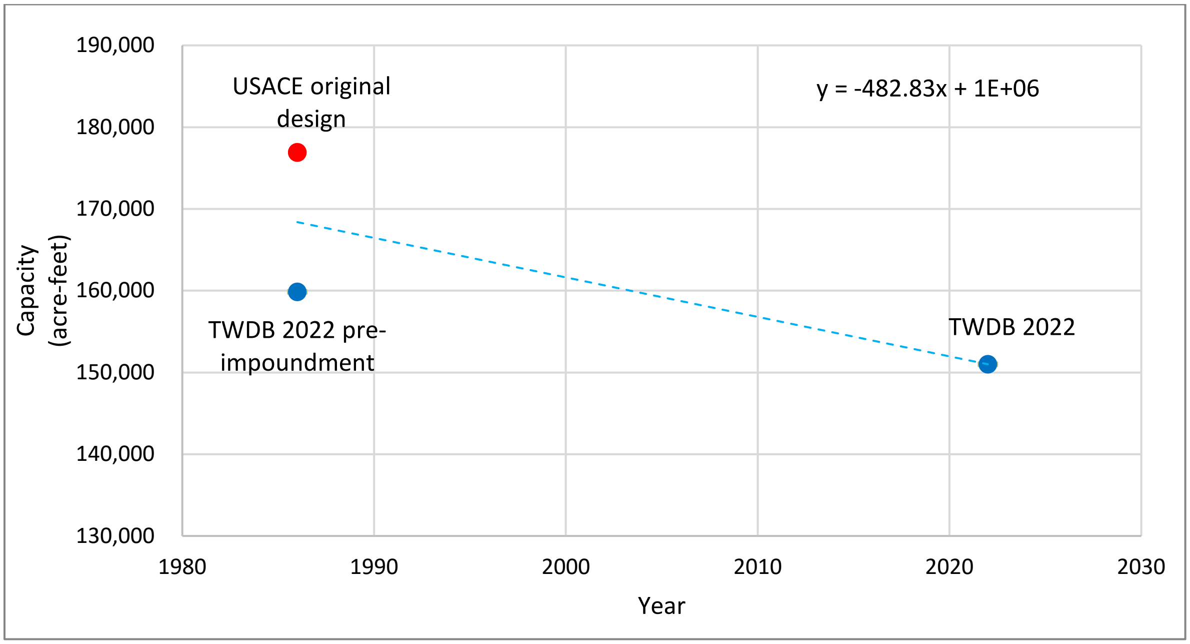


Figure 10. **Plot of current and previous capacity estimates (acre-feet). Capacity estimates for each TWDB survey plotted as blue dots and other surveys as red dots. The blue trend line illustrates the total average loss of capacity through 2022.**

Recommendations

The TWDB recommends a detailed analysis of sediment deposits in the areas where exposure of the lake bottom may have led to identification of a false pre-impoundment using augured-coring techniques, as well as a volumetric and sedimentation survey in 10 years or after a major high flow event to further improve estimates of sediment accumulation rates.

TWDB contact information

For more information about the TWDB Hydrographic Survey Program, visit www.twdb.texas.gov/surfacewater/surveys. Any questions regarding the TWDB Hydrographic Survey Program or this report may be addressed to: Hydrosurvey@twdb.texas.gov.

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Appendix A

JOE POOL LAKE

RESERVOIR BATHYMETRIC CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — April - May 2022 Survey

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 522.0 feet NGVD29

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
445	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	0	0	0	0	1
447	1	1	1	2	2	3	3	3	4	5
448	5	6	6	7	8	9	9	10	11	12
449	13	14	15	16	18	19	20	22	23	24
450	26	27	29	31	32	34	36	38	40	43
451	45	48	50	53	56	59	62	65	68	71
452	75	79	82	86	90	95	99	103	108	112
453	117	122	127	132	137	142	148	153	158	164
454	170	175	181	187	193	199	205	211	217	223
455	229	236	242	249	255	262	269	275	282	289
456	296	303	310	317	325	332	339	347	354	362
457	370	377	385	393	401	409	417	425	433	441
458	449	458	466	475	483	492	500	509	518	527
459	536	545	554	563	572	581	591	600	610	619
460	629	639	649	658	668	678	689	699	709	719
461	730	741	751	762	773	784	795	806	818	829
462	841	852	864	876	888	900	912	924	936	949
463	961	974	986	999	1,011	1,024	1,037	1,050	1,063	1,076
464	1,089	1,102	1,116	1,129	1,142	1,156	1,170	1,183	1,197	1,211
465	1,225	1,239	1,253	1,267	1,282	1,296	1,311	1,325	1,340	1,355
466	1,370	1,384	1,399	1,415	1,430	1,445	1,460	1,476	1,492	1,507
467	1,523	1,540	1,556	1,572	1,589	1,606	1,623	1,640	1,658	1,676
468	1,694	1,713	1,732	1,751	1,771	1,791	1,811	1,832	1,853	1,874
469	1,896	1,918	1,941	1,963	1,987	2,010	2,034	2,059	2,084	2,109
470	2,134	2,160	2,186	2,212	2,238	2,265	2,292	2,320	2,347	2,375
471	2,403	2,432	2,460	2,489	2,519	2,548	2,578	2,608	2,639	2,669
472	2,701	2,732	2,764	2,796	2,828	2,861	2,894	2,928	2,962	2,996
473	3,031	3,066	3,102	3,138	3,174	3,211	3,249	3,286	3,325	3,363
474	3,403	3,443	3,483	3,524	3,566	3,608	3,651	3,695	3,739	3,784
475	3,831	3,878	3,925	3,974	4,024	4,074	4,126	4,178	4,230	4,284
476	4,339	4,395	4,452	4,510	4,569	4,628	4,689	4,750	4,813	4,876
477	4,941	5,006	5,073	5,141	5,210	5,279	5,350	5,421	5,493	5,566
478	5,639	5,713	5,788	5,864	5,941	6,018	6,097	6,176	6,257	6,338
479	6,421	6,504	6,589	6,675	6,762	6,850	6,939	7,030	7,121	7,213
480	7,306	7,400	7,494	7,590	7,686	7,783	7,881	7,980	8,080	8,180
481	8,282	8,384	8,487	8,591	8,695	8,800	8,906	9,012	9,120	9,228
482	9,337	9,446	9,557	9,668	9,779	9,892	10,004	10,118	10,232	10,347
483	10,462	10,578	10,696	10,814	10,934	11,054	11,175	11,298	11,421	11,545
484	11,670	11,796	11,923	12,051	12,179	12,309	12,439	12,571	12,704	12,837
485	12,972	13,107	13,244	13,383	13,522	13,663	13,805	13,949	14,095	14,242
486	14,391	14,541	14,693	14,846	15,000	15,156	15,314	15,473	15,633	15,794
487	15,957	16,120	16,285	16,451	16,617	16,785	16,954	17,124	17,295	17,467
488	17,640	17,813	17,988	18,164	18,340	18,518	18,696	18,875	19,055	19,237
489	19,419	19,602	19,786	19,970	20,156	20,343	20,531	20,720	20,909	21,100
490	21,291	21,484	21,677	21,872	22,068	22,264	22,462	22,660	22,860	23,061

Appendix A

JOE POOL LAKE

RESERVOIR BATHYMETRIC CAPACITY TABLE (continued)

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

April - May 2022 Survey
Conservation Pool Elevation 522.0 feet NGVD29

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
491	23,263	23,466	23,671	23,876	24,083	24,291	24,500	24,710	24,921	25,134
492	25,348	25,563	25,779	25,996	26,215	26,435	26,656	26,879	27,102	27,327
493	27,553	27,779	28,007	28,236	28,466	28,697	28,929	29,162	29,397	29,632
494	29,869	30,107	30,346	30,587	30,829	31,072	31,317	31,564	31,811	32,060
495	32,310	32,561	32,814	33,067	33,322	33,579	33,836	34,094	34,354	34,615
496	34,876	35,140	35,404	35,670	35,937	36,205	36,474	36,745	37,017	37,290
497	37,564	37,839	38,116	38,393	38,671	38,951	39,231	39,513	39,795	40,079
498	40,364	40,651	40,938	41,227	41,518	41,809	42,102	42,397	42,693	42,991
499	43,290	43,591	43,893	44,197	44,502	44,809	45,117	45,427	45,738	46,052
500	46,367	46,684	47,003	47,324	47,645	47,969	48,294	48,620	48,948	49,277
501	49,607	49,939	50,272	50,607	50,943	51,281	51,620	51,961	52,303	52,646
502	52,991	53,337	53,685	54,034	54,384	54,735	55,088	55,442	55,797	56,153
503	56,511	56,871	57,232	57,595	57,959	58,326	58,694	59,064	59,436	59,809
504	60,184	60,559	60,937	61,315	61,695	62,076	62,459	62,843	63,228	63,614
505	64,001	64,390	64,780	65,171	65,563	65,957	66,352	66,748	67,145	67,543
506	67,943	68,344	68,747	69,150	69,555	69,962	70,369	70,778	71,188	71,600
507	72,012	72,426	72,841	73,257	73,674	74,092	74,512	74,933	75,355	75,778
508	76,202	76,628	77,055	77,483	77,913	78,344	78,776	79,210	79,645	80,082
509	80,520	80,959	81,400	81,843	82,286	82,732	83,178	83,626	84,075	84,526
510	84,978	85,432	85,887	86,344	86,802	87,262	87,723	88,186	88,650	89,116
511	89,583	90,052	90,523	90,996	91,470	91,946	92,424	92,902	93,383	93,865
512	94,348	94,833	95,318	95,806	96,294	96,785	97,277	97,771	98,268	98,766
513	99,266	99,767	100,271	100,775	101,282	101,789	102,299	102,809	103,322	103,835
514	104,350	104,867	105,384	105,904	106,424	106,946	107,470	107,995	108,522	109,050
515	109,579	110,110	110,643	111,177	111,712	112,249	112,787	113,327	113,869	114,411
516	114,956	115,502	116,050	116,599	117,149	117,701	118,255	118,810	119,368	119,927
517	120,488	121,050	121,615	122,182	122,750	123,321	123,893	124,467	125,043	125,621
518	126,200	126,781	127,364	127,948	128,535	129,123	129,713	130,304	130,897	131,493
519	132,089	132,688	133,289	133,891	134,495	135,101	135,710	136,320	136,932	137,546
520	138,162	138,780	139,400	140,023	140,648	141,275	141,904	142,536	143,170	143,807
521	144,446	145,088	145,733	146,381	147,032	147,687	148,345	149,005	149,667	150,332
522	150,999	151,668								

Appendix B

JOE POOL LAKE

RESERVOIR BATHYMETRIC AREA TABLE

TEXAS WATER DEVELOPMENT BOARD
AREA IN ACRES
ELEVATION INCREMENT IS ONE TENTH FOOT

April - May 2022 Survey
Conservation Pool Elevation 522.0 feet NGVD29

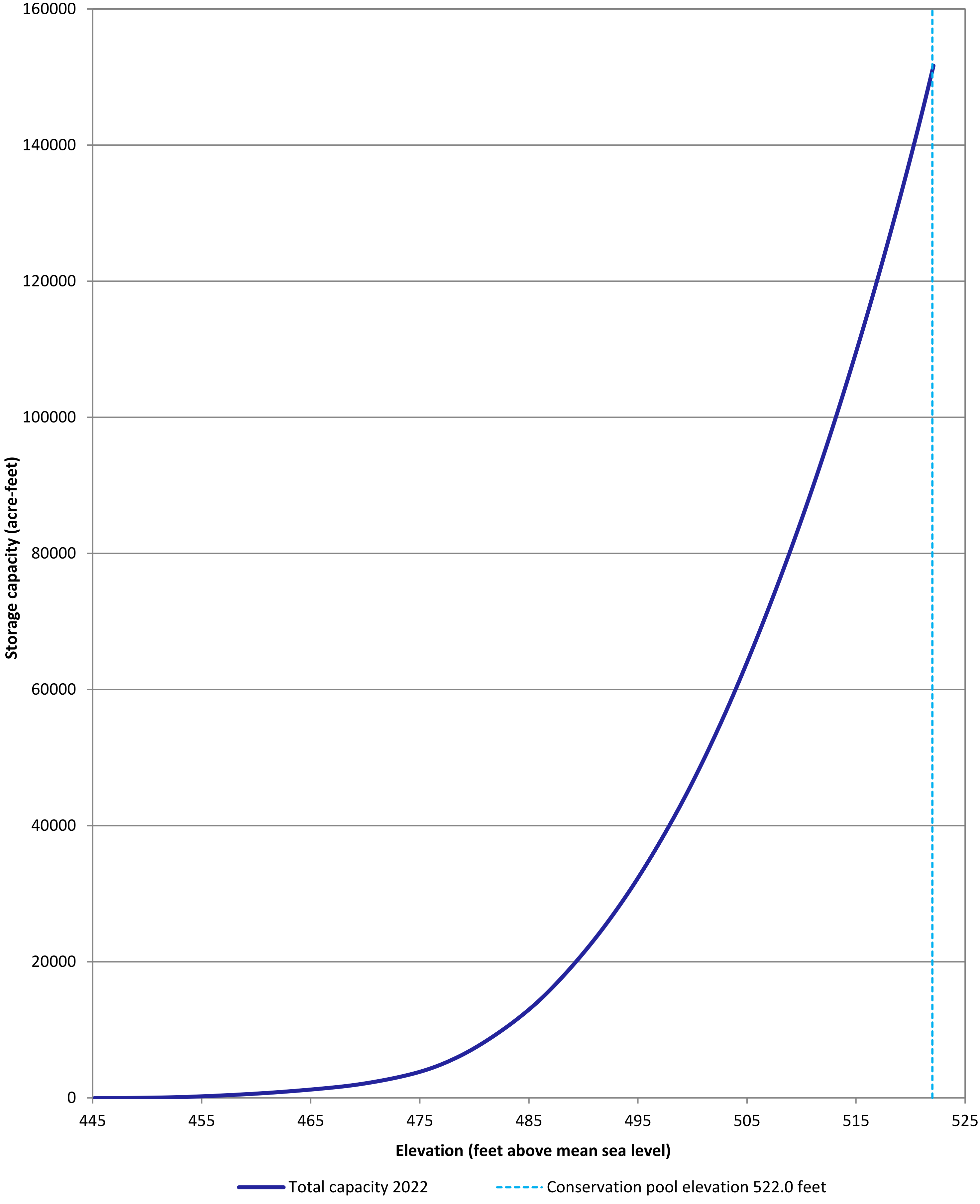
ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
445	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	1	1	1	2	2
447	2	3	3	4	4	4	5	5	6	6
448	6	6	7	7	7	8	8	9	9	10
449	10	11	11	12	12	13	13	14	14	15
450	15	16	16	17	18	19	20	21	22	23
451	24	25	26	28	29	30	31	32	33	34
452	36	37	39	40	41	42	44	45	46	47
453	48	49	50	51	52	52	53	54	55	55
454	56	57	58	58	59	60	61	61	62	63
455	63	64	65	65	66	67	68	68	69	70
456	70	71	71	72	73	73	74	75	75	76
457	77	77	78	79	79	80	81	81	82	83
458	83	84	84	85	86	86	87	88	88	89
459	90	90	91	92	92	93	94	95	96	96
460	97	98	98	99	100	101	102	103	104	105
461	106	106	107	109	110	111	112	113	114	115
462	116	117	118	119	119	120	121	122	123	124
463	124	125	126	126	127	128	129	129	130	131
464	132	133	133	134	135	136	137	138	138	139
465	140	141	142	143	144	144	145	146	147	148
466	149	150	151	151	152	153	154	156	158	159
467	160	162	163	165	168	170	173	175	177	181
468	184	188	191	195	198	202	205	209	213	216
469	220	223	227	231	235	239	243	246	249	252
470	255	258	261	264	267	270	272	275	277	280
471	283	285	288	291	294	297	300	303	307	310
472	313	316	319	323	327	330	334	338	342	346
473	350	354	358	362	366	371	376	380	385	391
474	396	402	407	414	420	427	433	441	448	456
475	465	475	484	492	500	508	516	525	534	544
476	554	564	574	583	592	601	610	619	630	640
477	652	662	673	682	691	700	708	716	724	731
478	739	747	754	762	770	779	789	800	811	821
479	831	842	854	865	875	886	897	906	916	926
480	934	943	951	960	967	975	983	992	1,001	1,010
481	1,018	1,026	1,034	1,042	1,048	1,055	1,061	1,068	1,076	1,085
482	1,092	1,100	1,107	1,113	1,120	1,126	1,131	1,137	1,143	1,150
483	1,158	1,169	1,180	1,190	1,199	1,209	1,219	1,228	1,236	1,246
484	1,255	1,264	1,273	1,282	1,291	1,301	1,311	1,320	1,330	1,340
485	1,351	1,364	1,377	1,389	1,401	1,416	1,432	1,447	1,462	1,479
486	1,496	1,510	1,524	1,539	1,554	1,568	1,582	1,596	1,608	1,619
487	1,630	1,641	1,651	1,662	1,673	1,684	1,694	1,704	1,714	1,724
488	1,733	1,743	1,751	1,760	1,769	1,779	1,788	1,797	1,807	1,816
489	1,825	1,835	1,845	1,854	1,863	1,873	1,882	1,892	1,902	1,911
490	1,920	1,930	1,940	1,950	1,961	1,971	1,982	1,993	2,004	2,015

JOE POOL LAKE

RESERVOIR BATHYMETRIC AREA TABLE (continued)

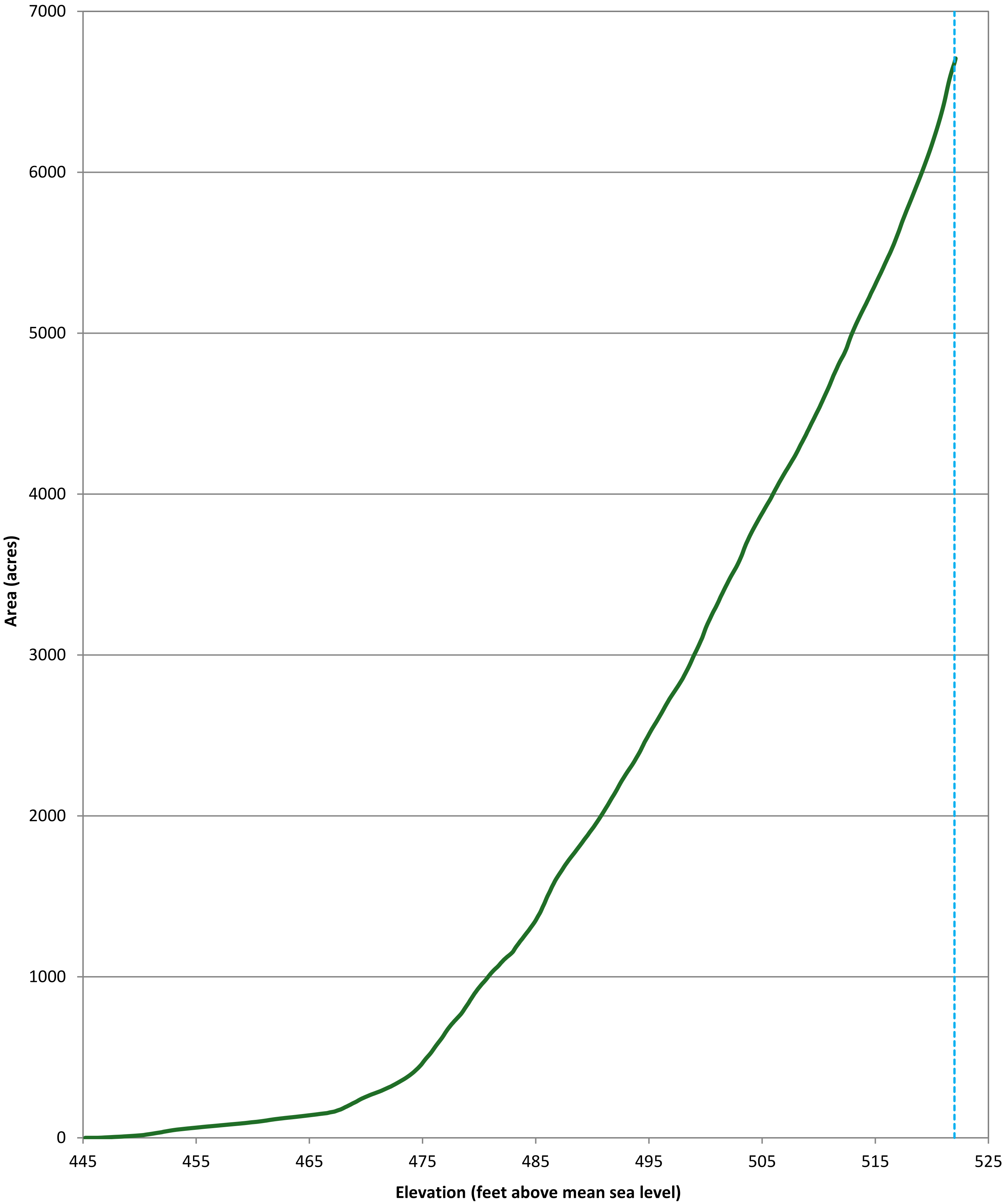
TEXAS WATER DEVELOPMENT BOARD | April - May 2022 Survey
AREA IN ACRES | Conservation Pool Elevation 522.0 feet NGVD29
ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
491	2,026	2,038	2,049	2,060	2,072	2,084	2,096	2,108	2,120	2,131
492	2,143	2,155	2,168	2,181	2,194	2,206	2,218	2,230	2,241	2,252
493	2,263	2,274	2,284	2,295	2,305	2,315	2,326	2,338	2,350	2,362
494	2,374	2,386	2,399	2,412	2,427	2,441	2,456	2,469	2,481	2,494
495	2,507	2,519	2,532	2,544	2,555	2,567	2,578	2,590	2,602	2,614
496	2,626	2,638	2,650	2,663	2,676	2,689	2,701	2,713	2,725	2,736
497	2,747	2,757	2,768	2,778	2,789	2,800	2,810	2,821	2,833	2,844
498	2,856	2,870	2,883	2,897	2,910	2,924	2,938	2,954	2,970	2,986
499	3,001	3,015	3,029	3,044	3,059	3,075	3,090	3,106	3,125	3,144
500	3,164	3,181	3,197	3,211	3,226	3,241	3,256	3,270	3,283	3,296
501	3,310	3,325	3,340	3,356	3,371	3,385	3,399	3,414	3,428	3,441
502	3,455	3,469	3,483	3,495	3,508	3,520	3,532	3,544	3,558	3,572
503	3,587	3,603	3,619	3,638	3,658	3,676	3,693	3,707	3,723	3,738
504	3,752	3,766	3,780	3,793	3,806	3,818	3,831	3,844	3,856	3,869
505	3,881	3,893	3,905	3,917	3,929	3,941	3,953	3,965	3,978	3,991
506	4,005	4,018	4,031	4,044	4,057	4,070	4,083	4,095	4,107	4,119
507	4,131	4,143	4,154	4,166	4,178	4,189	4,201	4,213	4,225	4,237
508	4,250	4,263	4,277	4,291	4,306	4,318	4,331	4,345	4,358	4,372
509	4,388	4,401	4,416	4,430	4,445	4,458	4,472	4,487	4,501	4,515
510	4,529	4,543	4,559	4,574	4,590	4,605	4,620	4,635	4,651	4,666
511	4,683	4,701	4,718	4,735	4,751	4,766	4,781	4,797	4,812	4,826
512	4,839	4,852	4,865	4,880	4,896	4,913	4,933	4,954	4,973	4,991
513	5,007	5,024	5,040	5,055	5,070	5,085	5,100	5,115	5,129	5,143
514	5,157	5,171	5,184	5,199	5,214	5,228	5,245	5,259	5,273	5,287
515	5,302	5,317	5,332	5,347	5,361	5,376	5,391	5,406	5,422	5,438
516	5,453	5,468	5,483	5,497	5,513	5,530	5,546	5,563	5,582	5,600
517	5,618	5,637	5,656	5,677	5,696	5,714	5,732	5,750	5,768	5,785
518	5,802	5,819	5,836	5,854	5,872	5,890	5,907	5,925	5,942	5,960
519	5,978	5,996	6,015	6,033	6,052	6,071	6,091	6,110	6,130	6,150
520	6,171	6,193	6,215	6,237	6,259	6,282	6,305	6,329	6,354	6,380
521	6,406	6,435	6,465	6,498	6,530	6,561	6,588	6,614	6,637	6,659
522	6,680	6,708								



Joe Pool Lake
April - May 2022 Survey
Prepared by: TWDB

Appendix C: 2022 Bathymetric capacity curve



Joe Pool Lake
April - May 2022 Survey
Prepared by: TWDB

Appendix D: 2022 Bathymetric area curve

Appendix E

JOE POOL LAKE

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC CAPACITY TABLE

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

April - May 2022 Survey
Conservation pool elevation 522.0 feet NGVD29
Top of dam elevation 564.5 feet NGVD29

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
445	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	0	0	0	0	1
447	1	1	1	2	2	3	3	3	4	5
448	5	6	6	7	8	9	9	10	11	12
449	13	14	15	16	18	19	20	22	23	24
450	26	27	29	31	32	34	36	38	40	43
451	45	48	50	53	56	59	62	65	68	71
452	75	79	82	86	90	95	99	103	108	112
453	117	122	127	132	137	142	148	153	158	164
454	170	175	181	187	193	199	205	211	217	223
455	229	236	242	249	255	262	269	275	282	289
456	296	303	310	317	325	332	339	347	354	362
457	370	377	385	393	401	409	417	425	433	441
458	449	458	466	475	483	492	500	509	518	527
459	536	545	554	563	572	581	591	600	610	619
460	629	639	649	658	668	678	689	699	709	719
461	730	741	751	762	773	784	795	806	818	829
462	841	852	864	876	888	900	912	924	936	949
463	961	974	986	999	1,011	1,024	1,037	1,050	1,063	1,076
464	1,089	1,102	1,116	1,129	1,142	1,156	1,170	1,183	1,197	1,211
465	1,225	1,239	1,253	1,267	1,282	1,296	1,311	1,325	1,340	1,355
466	1,370	1,384	1,399	1,415	1,430	1,445	1,460	1,476	1,492	1,507
467	1,523	1,540	1,556	1,572	1,589	1,606	1,623	1,640	1,658	1,676
468	1,694	1,713	1,732	1,751	1,771	1,791	1,811	1,832	1,853	1,874
469	1,896	1,918	1,941	1,963	1,987	2,010	2,034	2,059	2,084	2,109
470	2,134	2,160	2,186	2,212	2,238	2,265	2,292	2,320	2,347	2,375
471	2,403	2,432	2,460	2,489	2,519	2,548	2,578	2,608	2,639	2,669
472	2,701	2,732	2,764	2,796	2,828	2,861	2,894	2,928	2,962	2,996
473	3,031	3,066	3,102	3,138	3,174	3,211	3,249	3,286	3,325	3,363
474	3,403	3,443	3,483	3,524	3,566	3,608	3,651	3,695	3,739	3,784
475	3,831	3,878	3,925	3,974	4,024	4,074	4,126	4,178	4,230	4,284
476	4,339	4,395	4,452	4,510	4,569	4,628	4,689	4,750	4,813	4,876
477	4,941	5,006	5,073	5,141	5,210	5,279	5,350	5,421	5,493	5,566
478	5,639	5,713	5,788	5,864	5,941	6,018	6,097	6,176	6,257	6,338
479	6,421	6,504	6,589	6,675	6,762	6,850	6,939	7,030	7,121	7,213
480	7,306	7,400	7,494	7,590	7,686	7,783	7,881	7,980	8,080	8,180
481	8,282	8,384	8,487	8,591	8,695	8,800	8,906	9,012	9,120	9,228
482	9,337	9,446	9,557	9,668	9,779	9,892	10,004	10,118	10,232	10,347
483	10,462	10,578	10,696	10,814	10,934	11,054	11,175	11,298	11,421	11,545
484	11,670	11,796	11,923	12,051	12,179	12,309	12,439	12,571	12,704	12,837
485	12,972	13,107	13,244	13,383	13,522	13,663	13,805	13,949	14,095	14,242
486	14,391	14,541	14,693	14,846	15,000	15,156	15,314	15,473	15,633	15,794
487	15,957	16,120	16,285	16,451	16,617	16,785	16,954	17,124	17,295	17,467
488	17,640	17,813	17,988	18,164	18,340	18,518	18,696	18,875	19,055	19,237
489	19,419	19,602	19,786	19,970	20,156	20,343	20,531	20,720	20,909	21,100
490	21,291	21,484	21,677	21,872	22,068	22,264	22,462	22,660	22,860	23,061
491	23,263	23,466	23,671	23,876	24,083	24,291	24,500	24,710	24,921	25,134
492	25,348	25,563	25,779	25,996	26,215	26,435	26,656	26,879	27,102	27,327
493	27,553	27,779	28,007	28,236	28,466	28,697	28,929	29,162	29,397	29,632
494	29,869	30,107	30,346	30,587	30,829	31,072	31,317	31,564	31,811	32,060
495	32,310	32,561	32,814	33,067	33,322	33,579	33,836	34,094	34,354	34,615
496	34,876	35,140	35,404	35,670	35,937	36,205	36,474	36,745	37,017	37,290
497	37,564	37,839	38,116	38,393	38,671	38,951	39,231	39,513	39,795	40,079
498	40,364	40,651	40,938	41,227	41,518	41,809	42,102	42,397	42,693	42,991
499	43,290	43,591	43,893	44,197	44,502	44,809	45,117	45,427	45,738	46,052
500	46,367	46,684	47,003	47,324	47,645	47,969	48,294	48,620	48,948	49,277
501	49,607	49,939	50,272	50,607	50,943	51,281	51,620	51,961	52,303	52,646

Appendix E

JOE POOL LAKE

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC CAPACITY TABLE (continued)

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

April - May 2022 Survey
Conservation pool elevation 522.0 feet NGVD29
Top of dam elevation 564.5 feet NGVD29

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
502	52,991	53,337	53,685	54,034	54,384	54,735	55,088	55,442	55,797	56,153
503	56,511	56,871	57,232	57,595	57,959	58,326	58,694	59,064	59,436	59,809
504	60,184	60,559	60,937	61,315	61,695	62,076	62,459	62,843	63,228	63,614
505	64,001	64,390	64,780	65,171	65,563	65,957	66,352	66,748	67,145	67,543
506	67,943	68,344	68,747	69,150	69,555	69,962	70,369	70,778	71,188	71,600
507	72,012	72,426	72,841	73,257	73,674	74,092	74,512	74,933	75,355	75,778
508	76,202	76,628	77,055	77,483	77,913	78,344	78,776	79,210	79,645	80,082
509	80,520	80,959	81,400	81,843	82,286	82,732	83,178	83,626	84,075	84,526
510	84,978	85,432	85,887	86,344	86,802	87,262	87,723	88,186	88,650	89,116
511	89,583	90,052	90,523	90,996	91,470	91,946	92,424	92,902	93,383	93,865
512	94,348	94,833	95,318	95,806	96,294	96,785	97,277	97,771	98,268	98,766
513	99,266	99,767	100,271	100,775	101,282	101,789	102,299	102,809	103,322	103,835
514	104,350	104,867	105,384	105,904	106,424	106,946	107,470	107,995	108,522	109,050
515	109,579	110,110	110,643	111,177	111,712	112,249	112,787	113,327	113,869	114,411
516	114,956	115,502	116,050	116,599	117,149	117,701	118,255	118,810	119,368	119,927
517	120,488	121,050	121,615	122,182	122,750	123,321	123,893	124,467	125,043	125,621
518	126,200	126,781	127,364	127,948	128,535	129,123	129,713	130,304	130,897	131,493
519	132,089	132,688	133,289	133,891	134,495	135,101	135,710	136,320	136,932	137,546
520	138,162	138,780	139,400	140,023	140,648	141,275	141,904	142,536	143,170	143,807
521	144,446	145,088	145,733	146,381	147,033	147,687	148,345	149,005	149,667	150,332
522	150,999	151,669	152,342	153,018	153,695	154,374	155,055	155,738	156,423	157,111
523	157,801	158,493	159,187	159,883	160,582	161,282	161,985	162,690	163,397	164,106
524	164,818	165,532	166,248	166,966	167,687	168,409	169,134	169,861	170,590	171,321
525	172,055	172,791	173,529	174,269	175,012	175,758	176,506	177,256	178,009	178,765
526	179,523	180,283	181,047	181,812	182,580	183,351	184,124	184,899	185,677	186,457
527	187,240	188,025	188,813	189,603	190,395	191,190	191,987	192,787	193,589	194,393
528	195,200	196,009	196,820	197,633	198,449	199,268	200,088	200,911	201,737	202,564
529	203,395	204,227	205,062	205,899	206,738	207,580	208,424	209,270	210,119	210,970
530	211,823	212,679	213,536	214,397	215,259	216,124	216,992	217,861	218,734	219,608
531	220,486	221,366	222,248	223,133	224,021	224,911	225,804	226,700	227,598	228,498
532	229,402	230,308	231,216	232,128	233,042	233,960	234,880	235,803	236,728	237,656
533	238,587	239,521	240,457	241,395	242,337	243,280	244,226	245,175	246,126	247,079
534	248,035	248,993	249,953	250,916	251,882	252,850	253,821	254,794	255,771	256,750
535	257,731	258,716	259,703	260,693	261,686	262,682	263,680	264,682	265,686	266,693
536	267,703	268,716	269,732	270,751	271,772	272,797	273,825	274,856	275,891	276,929
537	277,970	279,014	280,062	281,113	282,168	283,226	284,288	285,353	286,422	287,495
538	288,571	289,650	290,733	291,820	292,911	294,005	295,103	296,205	297,311	298,421
539	299,534	300,652	301,774	302,899	304,029	305,163	306,301	307,443	308,588	309,737
540	310,890	312,047	313,206	314,370	315,537	316,707	317,881	319,058	320,238	321,421
541	322,608	323,798	324,991	326,188	327,388	328,591	329,797	331,006	332,218	333,433
542	334,652	335,873	337,098	338,326	339,556	340,789	342,025	343,264	344,505	345,749
543	346,996	348,245	349,498	350,752	352,010	353,271	354,534	355,800	357,069	358,340
544	359,615	360,892	362,172	363,455	364,740	366,029	367,320	368,614	369,911	371,210
545	372,513	373,818	375,126	376,437	377,751	379,068	380,388	381,711	383,037	384,365
546	385,697	387,032	388,369	389,710	391,054	392,401	393,751	395,104	396,461	397,821
547	399,185	400,553	401,923	403,297	404,673	406,053	407,437	408,823	410,212	411,605
548	413,001	414,400	415,802	417,208	418,616	420,028	421,443	422,861	424,282	425,706
549	427,133	428,564	429,999	431,436	432,877	434,322	435,769	437,221	438,675	440,133
550	441,595	443,060	444,529	446,001	447,477	448,957	450,441	451,928	453,418	454,912
551	456,411	457,912	459,418	460,927	462,440	463,957	465,477	467,002	468,530	470,062
552	471,597	473,136	474,679	476,226	477,777	479,332	480,891	482,453	484,020	485,590
553	487,164	488,743	490,325	491,910	493,500	495,093	496,690	498,291	499,895	501,503
554	503,115	504,731	506,351	507,974	509,601	511,232	512,867	514,505	516,148	517,794
555	519,444	521,098	522,757	524,419	526,085	527,756	529,431	531,109	532,792	534,479
556	536,169	537,864	539,563	541,265	542,972	544,683	546,398	548,117	549,840	551,567
557	553,298	555,033	556,772	558,516	560,263	562,015	563,771	565,531	567,295	569,063
558	570,835	572,612	574,392	576,177	577,965	579,758	581,555	583,356	585,162	586,972
559	588,786	590,604	592,427	594,254	596,085	597,921	599,761	601,605	603,454	605,307
560	607,164	609,025	610,891	612,760	614,635	616,513	618,396	620,283	622,174	624,070
561	625,970	627,874	629,782	631,695	633,612	635,533	637,458	639,388	641,321	643,259
562	645,201	647,148	649,098	651,053	653,012	654,976	656,943	658,915	660,891	662,871
563	664,855	666,843	668,836	670,832	672,833	674,838	676,846	678,859	680,876	682,896
564	684,920	686,948	688,980	691,016	693,056	695,099				

Appendix F

JOE POOL LAKE

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC AREA TABLE

TEXAS WATER DEVELOPMENT BOARD
AREA IN ACRES
ELEVATION INCREMENT IS ONE TENTH FOOT

April - May 2022 Survey
Conservation pool elevation 522.0 feet NGVD29
Top of dam elevation 564.5 feet NGVD29

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
445	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	1	1	1	2	2
447	2	3	3	4	4	4	5	5	6	6
448	6	6	7	7	7	8	8	9	9	10
449	10	11	11	12	12	13	13	14	14	15
450	15	16	16	17	18	19	20	21	22	23
451	24	25	26	28	29	30	31	32	33	34
452	36	37	39	40	41	42	44	45	46	47
453	48	49	50	51	52	52	53	54	55	55
454	56	57	58	58	59	60	61	61	62	63
455	63	64	65	65	66	67	68	68	69	70
456	70	71	71	72	73	73	74	75	75	76
457	77	77	78	79	79	80	81	81	82	83
458	83	84	84	85	86	86	87	88	88	89
459	90	90	91	92	92	93	94	95	96	96
460	97	98	98	99	100	101	102	103	104	105
461	106	106	107	109	110	111	112	113	114	115
462	116	117	118	119	119	120	121	122	123	124
463	124	125	126	126	127	128	129	129	130	131
464	132	133	133	134	135	136	137	138	138	139
465	140	141	142	143	144	144	145	146	147	148
466	149	150	151	151	152	153	154	156	158	159
467	160	162	163	165	168	170	173	175	177	181
468	184	188	191	195	198	202	205	209	213	216
469	220	223	227	231	235	239	243	246	249	252
470	255	258	261	264	267	270	272	275	277	280
471	283	285	288	291	294	297	300	303	307	310
472	313	316	319	323	327	330	334	338	342	346
473	350	354	358	362	366	371	376	380	385	391
474	396	402	407	414	420	427	433	441	448	456
475	465	475	484	492	500	508	516	525	534	544
476	554	564	574	583	592	601	610	619	630	640
477	652	662	673	682	691	700	708	716	724	731
478	739	747	754	762	770	779	789	800	811	821
479	831	842	854	865	875	886	897	906	916	926
480	934	943	951	960	967	975	983	992	1,001	1,010
481	1,018	1,026	1,034	1,042	1,048	1,055	1,061	1,068	1,076	1,085
482	1,092	1,100	1,107	1,113	1,120	1,126	1,131	1,137	1,143	1,150
483	1,158	1,169	1,180	1,190	1,199	1,209	1,219	1,228	1,236	1,246
484	1,255	1,264	1,273	1,282	1,291	1,301	1,311	1,320	1,330	1,340
485	1,351	1,364	1,377	1,389	1,401	1,416	1,432	1,447	1,462	1,479
486	1,496	1,510	1,524	1,539	1,554	1,568	1,582	1,596	1,608	1,619
487	1,630	1,641	1,651	1,662	1,673	1,684	1,694	1,704	1,714	1,724
488	1,733	1,743	1,751	1,760	1,769	1,779	1,788	1,797	1,807	1,816
489	1,825	1,835	1,845	1,854	1,863	1,873	1,882	1,892	1,902	1,911
490	1,920	1,930	1,940	1,950	1,961	1,971	1,982	1,993	2,004	2,015
491	2,026	2,038	2,049	2,060	2,072	2,084	2,096	2,108	2,120	2,131
492	2,143	2,155	2,168	2,181	2,194	2,206	2,218	2,230	2,241	2,252
493	2,263	2,274	2,284	2,295	2,305	2,315	2,326	2,338	2,350	2,362
494	2,374	2,386	2,399	2,412	2,427	2,441	2,456	2,469	2,481	2,494
495	2,507	2,519	2,532	2,544	2,555	2,567	2,578	2,590	2,602	2,614
496	2,626	2,638	2,650	2,663	2,676	2,689	2,701	2,713	2,725	2,736
497	2,747	2,757	2,768	2,778	2,789	2,800	2,810	2,821	2,833	2,844
498	2,856	2,870	2,883	2,897	2,910	2,924	2,938	2,954	2,970	2,986
499	3,001	3,015	3,029	3,044	3,059	3,075	3,090	3,106	3,125	3,144
500	3,164	3,181	3,197	3,211	3,226	3,241	3,256	3,270	3,283	3,296
501	3,310	3,325	3,340	3,356	3,371	3,385	3,399	3,414	3,428	3,441

Appendix F

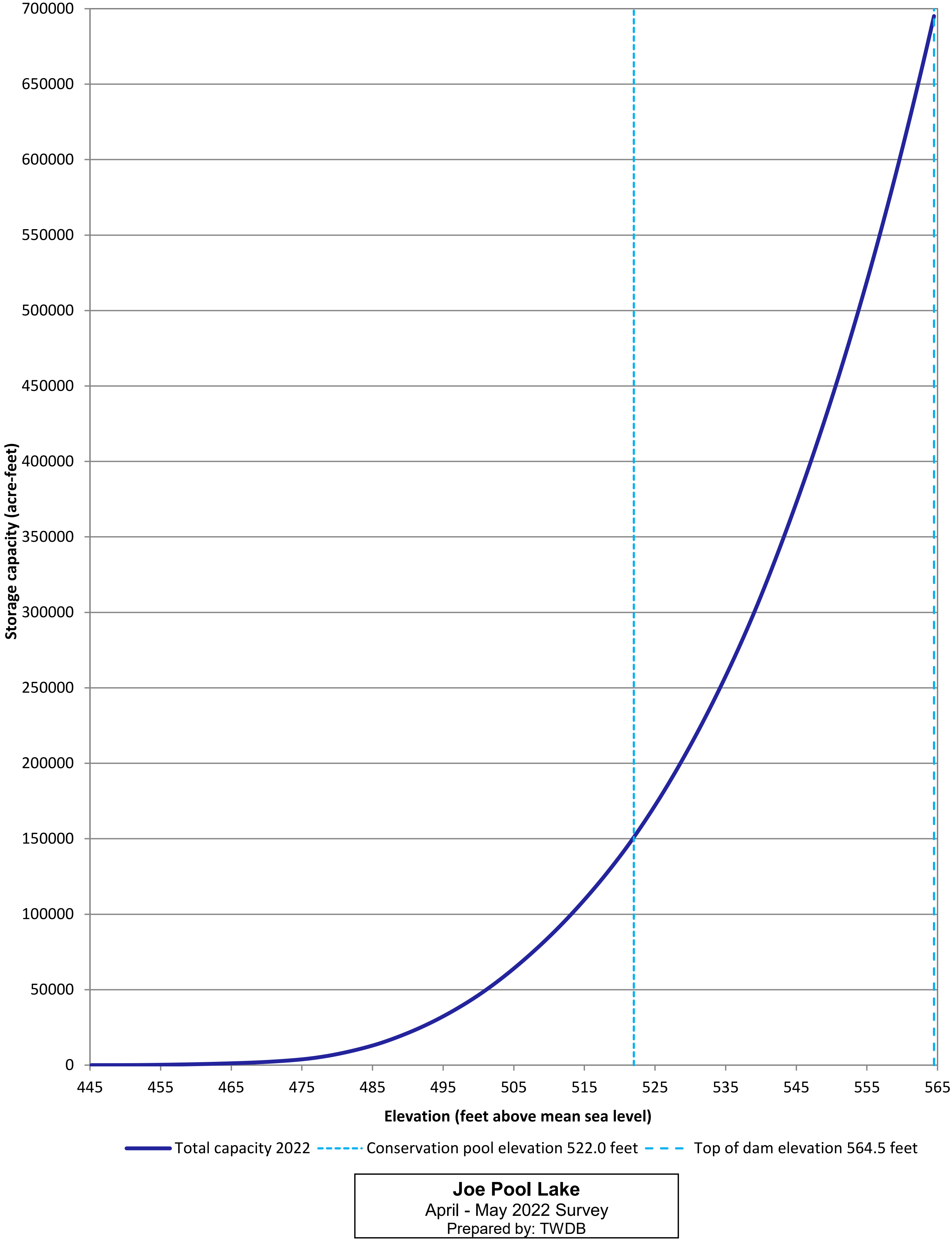
JOE POOL LAKE

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC AREA TABLE (continued)

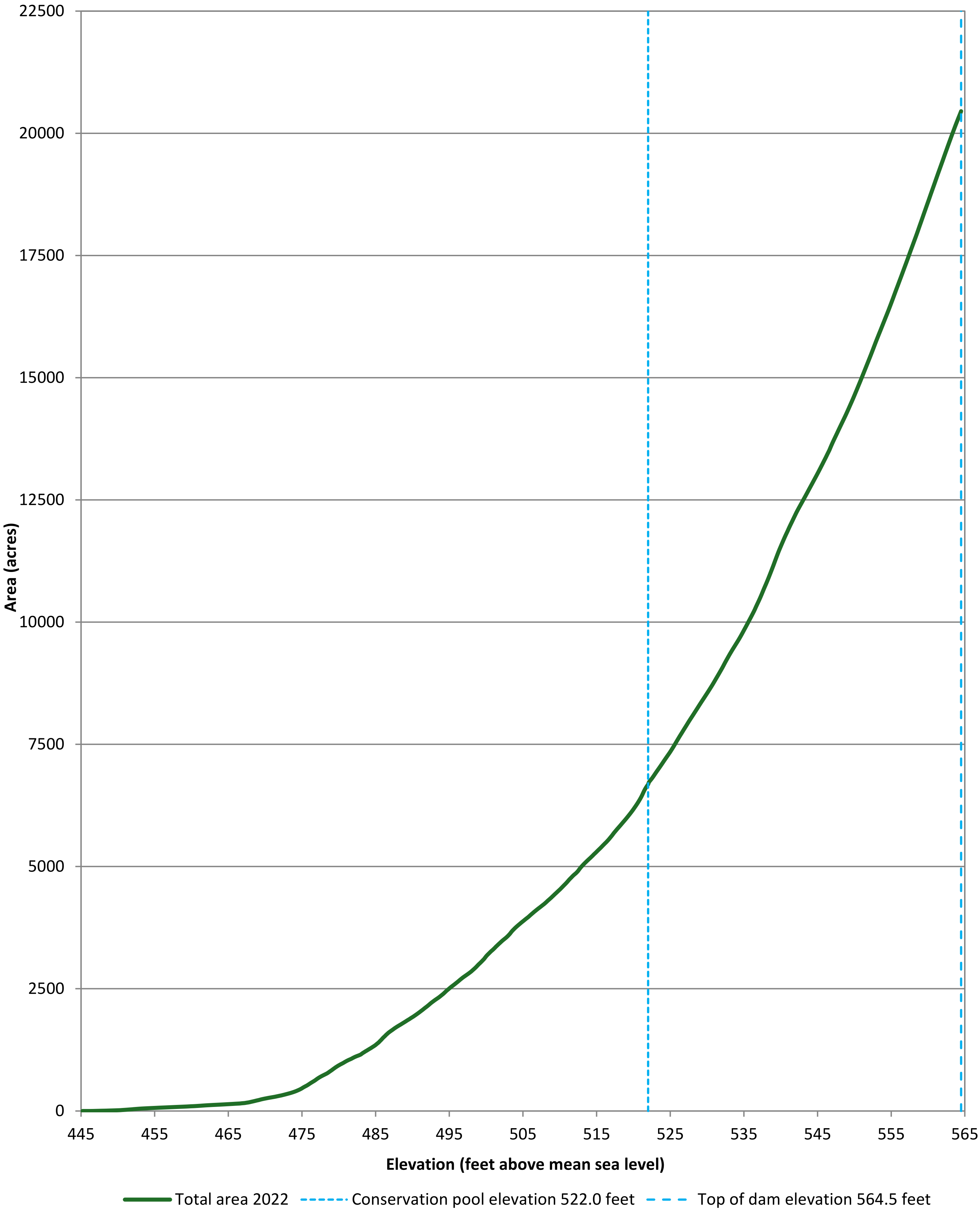
TEXAS WATER DEVELOPMENT BOARD
AREA IN ACRES
ELEVATION INCREMENT IS ONE TENTH FOOT

April - May 2022 Survey
Conservation pool elevation 522.0 feet NGVD29
Top of dam elevation 564.5 feet NGVD29

ELEVATION (feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
502	3,455	3,469	3,483	3,495	3,508	3,520	3,532	3,544	3,558	3,572
503	3,587	3,603	3,619	3,638	3,658	3,676	3,693	3,707	3,723	3,738
504	3,752	3,766	3,780	3,793	3,806	3,818	3,831	3,844	3,856	3,869
505	3,881	3,893	3,905	3,917	3,929	3,941	3,953	3,965	3,978	3,991
506	4,005	4,018	4,031	4,044	4,057	4,070	4,083	4,095	4,107	4,119
507	4,131	4,143	4,154	4,166	4,178	4,189	4,201	4,213	4,225	4,237
508	4,250	4,263	4,277	4,291	4,306	4,318	4,331	4,345	4,358	4,372
509	4,388	4,401	4,416	4,430	4,445	4,458	4,472	4,487	4,501	4,515
510	4,529	4,543	4,559	4,574	4,590	4,605	4,620	4,635	4,651	4,666
511	4,683	4,701	4,718	4,735	4,751	4,766	4,781	4,797	4,812	4,826
512	4,839	4,852	4,865	4,880	4,896	4,913	4,933	4,954	4,973	4,991
513	5,007	5,024	5,040	5,055	5,070	5,085	5,100	5,115	5,129	5,143
514	5,157	5,171	5,184	5,199	5,214	5,228	5,245	5,259	5,273	5,287
515	5,302	5,317	5,332	5,347	5,361	5,376	5,391	5,406	5,422	5,438
516	5,453	5,468	5,483	5,497	5,513	5,530	5,546	5,563	5,582	5,600
517	5,618	5,637	5,656	5,677	5,696	5,714	5,732	5,750	5,768	5,785
518	5,802	5,819	5,836	5,854	5,872	5,890	5,907	5,925	5,942	5,960
519	5,978	5,996	6,015	6,033	6,052	6,071	6,091	6,110	6,130	6,150
520	6,171	6,193	6,215	6,237	6,259	6,282	6,305	6,329	6,354	6,380
521	6,407	6,435	6,465	6,498	6,531	6,561	6,589	6,614	6,638	6,660
522	6,682	6,722	6,744	6,762	6,781	6,801	6,821	6,842	6,864	6,886
523	6,909	6,931	6,953	6,974	6,996	7,017	7,038	7,060	7,082	7,104
524	7,127	7,150	7,172	7,194	7,216	7,237	7,259	7,281	7,302	7,324
525	7,346	7,370	7,393	7,417	7,441	7,466	7,492	7,517	7,543	7,568
526	7,594	7,619	7,644	7,669	7,693	7,717	7,742	7,766	7,791	7,815
527	7,839	7,863	7,887	7,912	7,936	7,961	7,985	8,008	8,031	8,054
528	8,077	8,101	8,124	8,148	8,171	8,195	8,218	8,242	8,265	8,289
529	8,313	8,336	8,360	8,383	8,405	8,428	8,451	8,474	8,498	8,521
530	8,544	8,567	8,590	8,614	8,638	8,662	8,686	8,710	8,735	8,761
531	8,786	8,812	8,838	8,864	8,890	8,915	8,941	8,967	8,994	9,020
532	9,046	9,073	9,102	9,130	9,159	9,187	9,215	9,242	9,268	9,295
533	9,322	9,348	9,374	9,399	9,424	9,448	9,473	9,497	9,521	9,545
534	9,569	9,594	9,618	9,643	9,669	9,694	9,721	9,748	9,776	9,804
535	9,832	9,859	9,887	9,915	9,943	9,971	10,000	10,028	10,057	10,085
536	10,114	10,143	10,172	10,202	10,232	10,263	10,298	10,331	10,363	10,395
537	10,427	10,460	10,493	10,528	10,563	10,600	10,636	10,673	10,708	10,743
538	10,778	10,813	10,849	10,886	10,924	10,962	11,000	11,039	11,077	11,117
539	11,156	11,197	11,238	11,278	11,319	11,359	11,398	11,437	11,474	11,510
540	11,545	11,581	11,616	11,651	11,686	11,720	11,754	11,787	11,819	11,850
541	11,884	11,917	11,950	11,982	12,013	12,044	12,075	12,107	12,138	12,169
542	12,200	12,232	12,261	12,290	12,318	12,345	12,373	12,400	12,427	12,454
543	12,481	12,509	12,536	12,563	12,591	12,619	12,646	12,674	12,703	12,731
544	12,758	12,786	12,814	12,842	12,870	12,898	12,926	12,954	12,982	13,010
545	13,038	13,067	13,096	13,125	13,155	13,184	13,213	13,243	13,273	13,303
546	13,332	13,362	13,392	13,424	13,454	13,485	13,515	13,550	13,587	13,621
547	13,655	13,688	13,721	13,753	13,784	13,816	13,847	13,879	13,911	13,943
548	13,975	14,007	14,038	14,069	14,101	14,132	14,163	14,195	14,227	14,259
549	14,292	14,326	14,359	14,393	14,427	14,461	14,495	14,529	14,564	14,599
550	14,634	14,670	14,706	14,742	14,779	14,815	14,852	14,888	14,925	14,962
551	14,999	15,036	15,074	15,111	15,149	15,186	15,224	15,262	15,299	15,337
552	15,374	15,412	15,450	15,489	15,527	15,566	15,606	15,645	15,685	15,724
553	15,763	15,801	15,838	15,876	15,914	15,951	15,988	16,026	16,064	16,101
554	16,139	16,177	16,215	16,252	16,289	16,327	16,365	16,404	16,443	16,483
555	16,523	16,563	16,603	16,643	16,685	16,726	16,767	16,807	16,847	16,887
556	16,927	16,967	17,007	17,047	17,087	17,128	17,169	17,210	17,251	17,291
557	17,331	17,372	17,413	17,455	17,497	17,538	17,580	17,621	17,661	17,702
558	17,743	17,784	17,825	17,865	17,907	17,948	17,991	18,034	18,078	18,121
559	18,163	18,205	18,248	18,292	18,335	18,379	18,421	18,464	18,507	18,549
560	18,592	18,634	18,677	18,721	18,764	18,807	18,849	18,891	18,934	18,976
561	19,019	19,062	19,105	19,148	19,191	19,233	19,274	19,316	19,359	19,400
562	19,442	19,485	19,528	19,570	19,612	19,654	19,696	19,738	19,780	19,821
563	19,863	19,904	19,945	19,986	20,026	20,066	20,106	20,146	20,186	20,224
564	20,263	20,301	20,338	20,375	20,413	20,453				



Appendix G: 2022 Bathymetric and topographic capacity curve



Joe Pool Lake
April - May 2022 Survey
Prepared by: TWDB

Appendix H: 2022 Bathymetric and topographic area curve

Figure 6

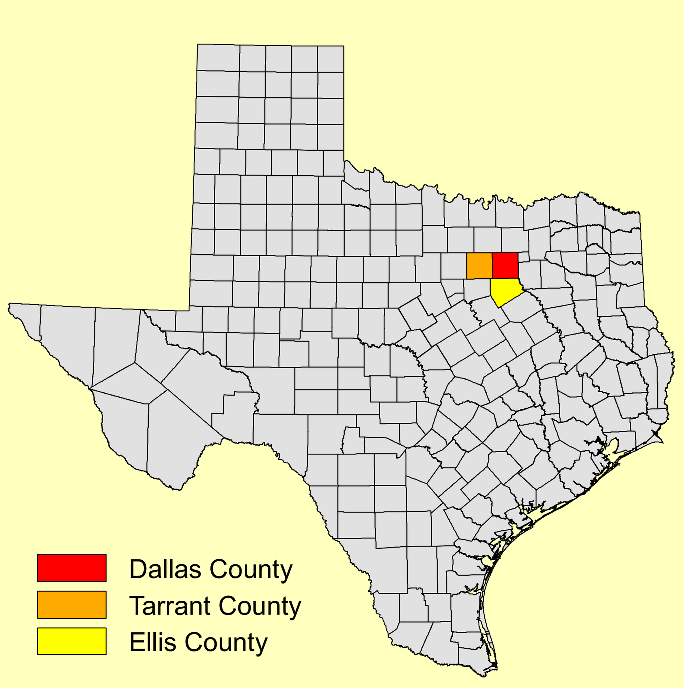
Contours
feet NGVD29

520
515
510
505
500
495
490
485
480
475
470
465
460
455
450

Islands

Joe Pool Lake
Elevation 522.1 feet
Conservation pool
elevation 522.0 feet
NGVD29

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



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