HIGHLAND LAKES AND
LOWER COLORADO RIVER

—

FLOOD GUIDE

LCRA
ENERGY • WATER • COMMUNITY SERVICES

MANAGING THE COLORADO RIVER

More than 85 years ago, the Texas Legislature created the Lower Colorado River Authority to help curtail frequent flooding along the Colorado River, which runs from West Texas to the Gulf Coast and cuts through one of the most flood-prone regions in the United States.

LCRA answered the call by building six dams along the river to help protect Austin and other downstream communities. The dams created the Highland Lakes, now the source of water for more than a million people.

LCRA can help manage floods along the Highland Lakes, but it cannot prevent them. Everyone in Flash Flood Alley should stay alert to changing weather conditions and the potential for flash floods, and be ready to take action to protect people and property when floods threaten. LCRA, the National Weather Service, local news media and local emergency officials all provide valuable information during floods.

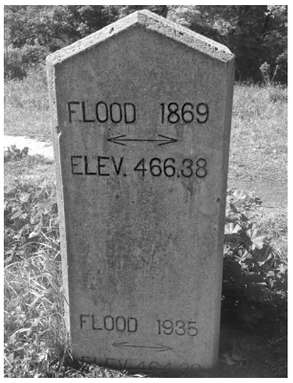
"FLASH FLOOD ALLEY"

The Colorado River flows through an area of the Texas Hill Country known as "Flash Flood Alley'' because it has one of the greatest risks for flash floods in the United States. The area is prone to flash floods because it has:

- **A landscape with thin soils and steep slopes.** Heavy rains can quickly saturate the rocky soil, creating runoff that cascades down steep hills and canyons. The runoff can cause rapid rises on creeks and tributaries that flow into the Colorado River.
- **A large drainage area.** The Highland Lakes watershed covers 14,700 square miles. Consequently, the Highland Lakes can receive storm runoff from many miles away.
- **Intense rainfall.** The Hill Country and Central Texas are at the crossroads of converging weather systems impacted by the uplift of the Balcones Escarpment, a fault that separates the Hill Country from the coastal plains of Texas. Moist air often flows from the Gulf of Mexico over the escarpment, and as a result, this region holds many of the nation's extreme rainfall records.

MAJOR FLOODS ON THE COLORADO RIVER

Major floods have occurred in the lower Colorado River basin in every decade since the 1840s, including:



JULY 1869

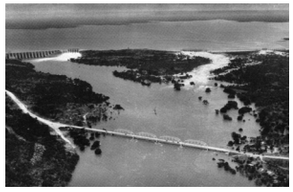
The 1869 flood is the flood of record on the Colorado River at Austin, Bastrop and La Grange. A concrete marker in downtown Austin shows where the Colorado River crested at 51 feet.

DECEMBER 1913

The 1913 flood is the flood of record on the Colorado River at Smithville, Columbus, Wharton and Bay City. Floodwaters joined the Colorado and Brazos rivers below Columbus, forming a single river 65 miles wide and flooding half a million acres.

W00778

W01106



1930s

Major floods occurred in 1935, 1936 and 1938. The 1935 flood is the flood of record on the Llano River at Llano. It destroyed bridges in the Hill Country and cut Austin in half. The 1938 flood is the flood of record on the San Saba River at San Saba. LCRA opened a record 22 floodgates at the newly completed Buchanan Dam to pass the 1938 flood.

SEPTEMBER 1952

The 1952 flood is the flood of record on the Pedernales River at Johnson City, where it washed out the U.S. 281 bridge. Lakes LBJ and Marble Falls rose to their all-time highs at Wirtz and Starcke dams. Inflows from the Pedernales and Colorado rivers made Lake Travis rise 57 feet in 14 hours. The flood came in the middle of a decade-long historic drought, and Lake Travis was so low it held the entire flood without opening a single floodgate at Mansfield Dam.

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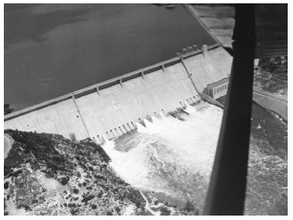
W00885



MAY 1957

A series of storms in spring 1957 brought more than 3 million acre-feet of runoff to the Colorado River basin and finally broke the historic drought of the 1940s and 1950s. LCRA opened eight floodgates at Buchanan Dam and a record six floodgates at Mansfield Dam. Lake Travis rose to its second highest level of 707.38 feet msl on May 18.

DECEMBER 1991

Heavy December rains caused extensive flooding upstream and downstream of the Highland Lakes. Lake Buchanan rose to its all-time high of 1,021.4 feet msl – about 1 foot above the Buchanan Dam spillway. Lake Travis rose to its all-time high of 710.44 feet msl – less than 4 feet below the Mansfield Dam spillway. LCRA opened six floodgates at Buchanan Dam, five floodgates at Wirtz Dam and five floodgates at Mansfield Dam.

W01314

W01363

JUNE 1997

Intense rainfall caused a basin-wide flash flood that pushed the level of Lake Travis to 705.11 feet msl – its third-highest level on record. LCRA opened all 10 gates at Wirtz Dam for the first time since the 10th gate was added to the dam in 1971. LCRA opened six floodgates at Buchanan Dam and four floodgates at Mansfield Dam.

JUNE 2007

An extremely intense storm that dropped 18 inches of rain in six hours in the Marble Falls area caused flash flooding from Lake Buchanan to Lake Travis. LCRA opened four floodgates at Buchanan Dam, four floodgates at Wirtz Dam and four floodgates at Mansfield Dam. Lake Travis temporarily held the water from the flash flood, minimizing flooding in Austin and other downstream communities. Lake Travis rose to 701.52 feet msl.

W01013

MAY 2016

After years of record-breaking drought, a prolonged rainy period refilled the Highland Lakes. In May 2016, floodgate operations occurred simultaneously at Mansfield and Buchanan dams for the first time in almost nine years. LCRA opened four floodgates at Buchanan Dam, two floodgates at Wirtz Dam and four floodgates at Mansfield Dam. Lake Travis rose to 692.17 feet msl.

OCTOBER 2018

Back-to-back floods caused significant flooding throughout the Highland Lakes. Areas along the Llano River and lakes LBJ and Marble Falls were especially hard hit. The FM 2900 bridge at Kingsland was destroyed. LCRA opened eight floodgates at Buchanan Dam, 10 floodgates at Wirtz Dam and four floodgates at Mansfield Dam. Lake Travis rose to 704.39 feet msl – its fifth highest level on record.

AUGUST 2017

Hurricane Harvey churned along the coastal plains of Texas for four days and brought major flooding to the Colorado River from Bastrop to Matagorda Bay. The river jumped its banks and found new flow paths through Columbus and Wharton, causing severe damage. However, the heavy rainfall did not extend to the Hill Country, and no flood releases were made from the Highland Lakes.

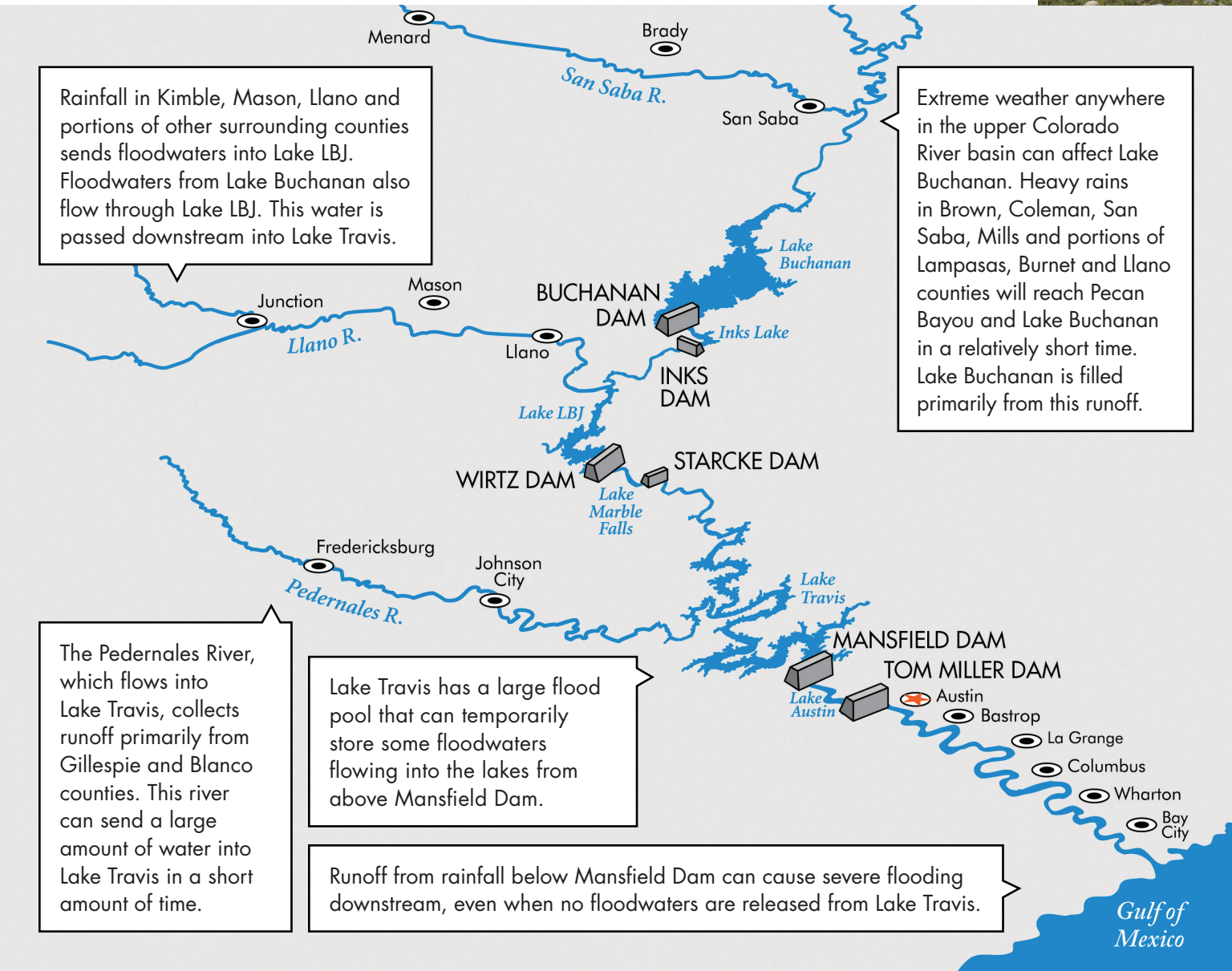
All timeline photos:
LCRA Corporate Archives

LCRA'S HYDROMET MONITORS RIVER, WEATHER CONDITIONS

Hydrologists and engineers in LCRA's River Operations Control Center in Austin use near real-time data from LCRA's Hydromet to manage floods along the Highland Lakes. The Hydromet is a system of more than 275 automated weather and river gauges throughout the 18,000 square miles of the lower Colorado River basin. LCRA shares information from the Hydromet with the public, public officials and partner agencies such as the National Weather Service at hydromet.lcra.org.

FLOOD MANAGEMENT IN THE LOWER COLORADO RIVER BASIN

As the Colorado River flows toward the Gulf of Mexico, it receives rainfall and storm runoff from the Hill Country upstream of Austin, and from Travis, Hays, Bastrop, Fayette, Colorado, Wharton and Matagorda counties downstream of Mansfield Dam.



Rainfall in Kimble, Mason, Llano and portions of other surrounding counties sends floodwaters into Lake LBJ. Floodwaters from Lake Buchanan also flow through Lake LBJ. This water is passed downstream into Lake Travis.

Extreme weather anywhere in the upper Colorado River basin can affect Lake Buchanan. Heavy rains in Brown, Coleman, San Saba, Mills and portions of Lampasas, Burnet and Llano counties will reach Pecan Bayou and Lake Buchanan in a relatively short time. Lake Buchanan is filled primarily from this runoff.

The Pedernales River, which flows into Lake Travis, collects runoff primarily from Gillespie and Blanco counties. This river can send a large amount of water into Lake Travis in a short amount of time.

Lake Travis has a large flood pool that can temporarily store some floodwaters flowing into the lakes from above Mansfield Dam.

Runoff from rainfall below Mansfield Dam can cause severe flooding downstream, even when no floodwaters are released from Lake Travis.

MANAGING FLOODWATERS

During a flood, LCRA operates the Highland Lakes dams to reduce the severity of flooding downstream by managing the flow of floodwaters through the lakes and river system.

LCRA conducts flood operations at Buchanan, Inks, Wirtz and Starcke dams according to a 1990 agreement between LCRA and the Federal Emergency Management Agency (FEMA). LCRA built Tom Miller Dam on property leased from the City of Austin, and operates and maintains the dam under a long-term lease agreement. LCRA conducts flood operations at Mansfield Dam according to the U.S. Army Corps of Engineers (USACE) Water Control Manual for Mansfield Dam and Lake Travis. (See Key Elevations for Lake Travis.) FEMA and local officials – not LCRA – designate floodplains and control development of property in floodplain areas.

All the Highland Lakes dams have the capacity to generate hydroelectricity, and all but Inks Dam have floodgates. Inks Dam is designed for floodwaters to pass over its spillway. LCRA generally passes small amounts of storm runoff through the hydroelectric power stations at the dams. When necessary, LCRA partially or fully opens floodgates to pass larger amounts of floodwaters downstream.

LAKE TRAVIS

Lake Travis, formed by Mansfield Dam, is the only one of the six Highland Lakes designed to capture and store floodwaters. Lake Travis is considered full for water supply purposes at 681 feet above mean sea level (feet msl). However, after reaching that level, the lake has the capacity to hold an additional 33 feet or 787,000 acre-feet of water in its flood pool.

Lake Travis' flood storage capability helps protect Austin and downstream communities, but it cannot prevent flooding along creeks and streams that are tributaries to the Colorado River, or from rain that falls downstream of Mansfield Dam.

LAKE BUCHANAN

Unlike Lake Travis, Lake Buchanan has no room to store floodwaters after it is full. Under an agreement with FEMA, LCRA manages Lake Buchanan to a maximum level of 1,018 feet msl from May through October, and to a maximum level of 1,020 feet msl the rest of the year. LCRA currently is limiting storage year-round to a maximum of 1,018 feet msl while upgrades to the dam's floodgates are underway.

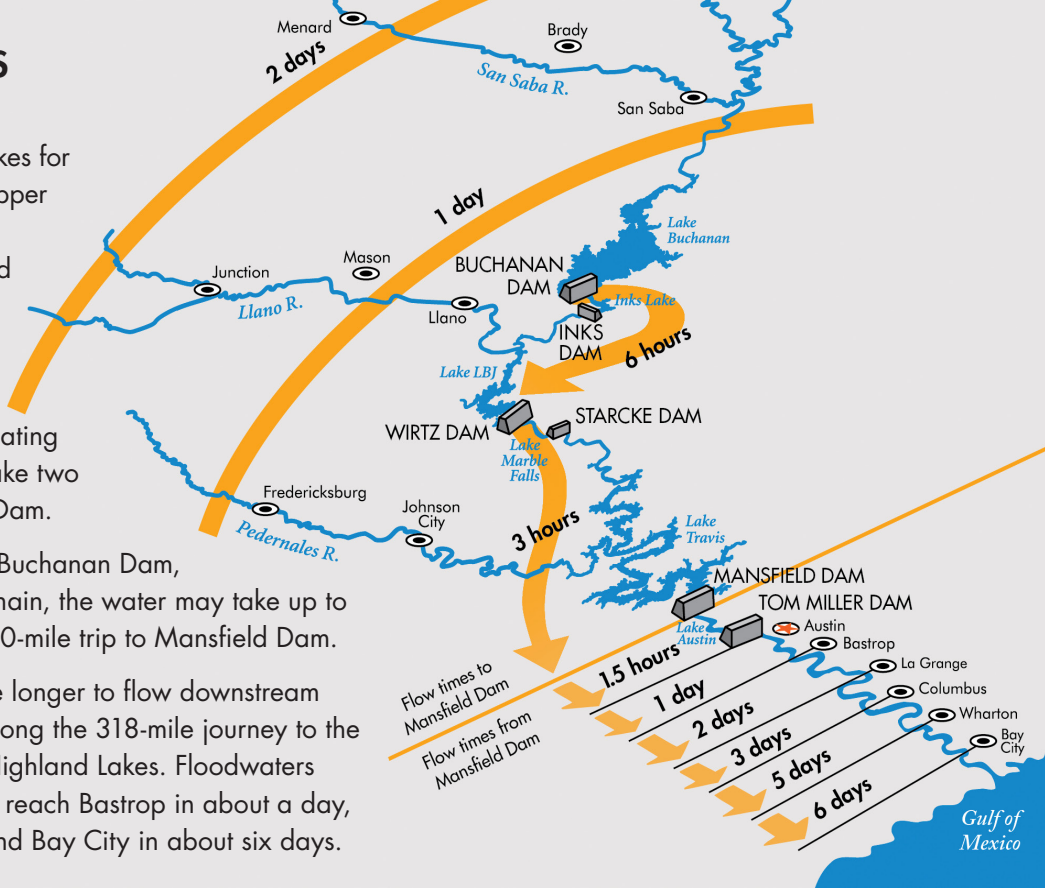
PASS-THROUGH LAKES

The smaller, pass-through lakes — Inks, LBJ, Marble Falls and Austin — have no capacity to store floodwaters. These lakes are not "constant level." While they typically are operated within a relatively small range of about a foot, the lakes can rise well above their normal ranges during floods. Lake levels can vary even along the length of each lake.

ESTIMATED FLOW TIMES FOR FLOODWATERS

This map shows the estimated time it takes for water to flow to Mansfield Dam from upper basin locations, and for water to reach downstream locations after it is released from Mansfield Dam. Water travel times can be shorter during floods and longer during times of low flow.

- River flows and storm runoff originating upstream of Lake Buchanan can take two days or more to reach Mansfield Dam.
- When LCRA makes releases from Buchanan Dam, at the top of the Highland Lakes chain, the water may take up to nine hours to make the roughly 100-mile trip to Mansfield Dam.
- Releases from Mansfield Dam take longer to flow downstream because the terrain is less steep along the 318-mile journey to the Gulf of Mexico than through the Highland Lakes. Floodwaters released from Mansfield Dam can reach Bastrop in about a day, Columbus in roughly three days and Bay City in about six days.

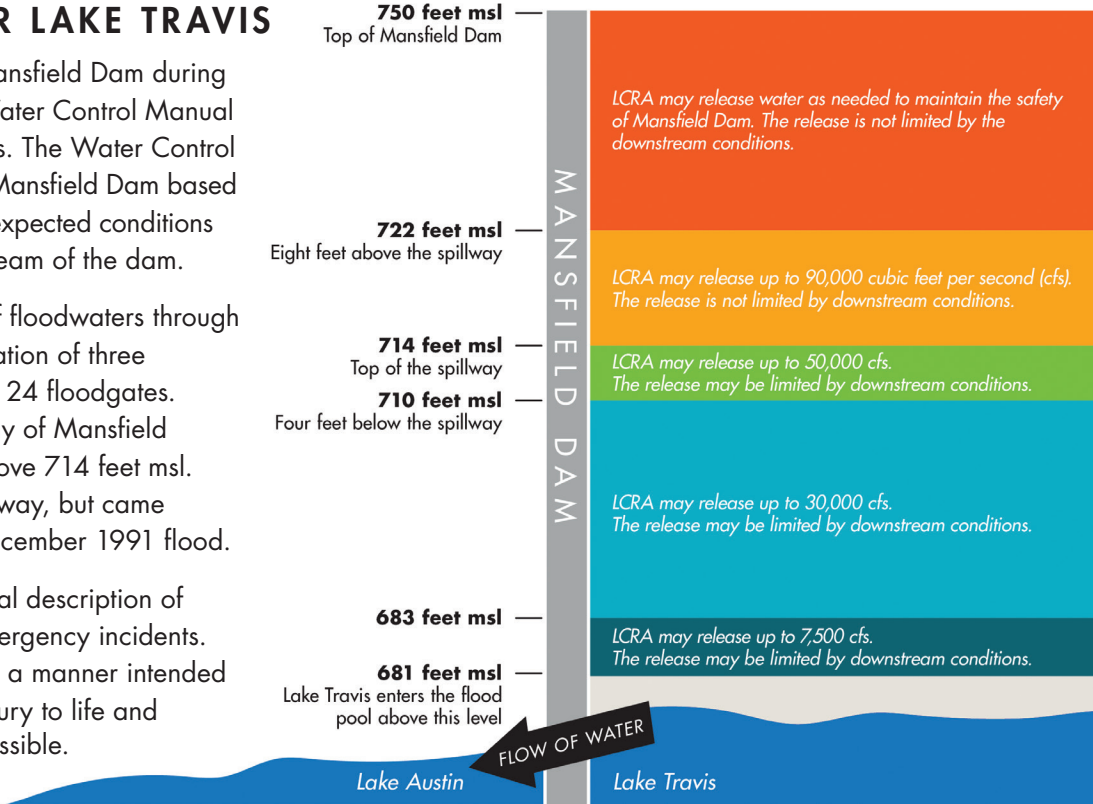


KEY ELEVATIONS FOR LAKE TRAVIS

LCRA operates Lake Travis and Mansfield Dam during floods according to the USACE Water Control Manual for Mansfield Dam and Lake Travis. The Water Control Manual limits flood releases from Mansfield Dam based on key Lake Travis elevations and expected conditions along the Colorado River downstream of the dam.

LCRA makes controlled releases of floodwaters through Mansfield Dam using any combination of three hydroelectric generating units and 24 floodgates. Water would flow over the spillway of Mansfield Dam if Lake Travis were to rise above 714 feet msl. Water has never reached the spillway, but came within 4 feet of it in the historic December 1991 flood.

LCRA may deviate from this general description of flood operations to respond to emergency incidents. LCRA operations are conducted in a manner intended to minimize or avoid the risk of injury to life and property whenever reasonably possible.



LOWER COLORADO RIVER WATERSHED

MAP LEGEND

- 5 — Dam identifier
- 17 — Hydromet gauge identifier
- Hydromet gauge location
- Limited access highways
- U.S. highways
- State highways
- County boundaries
- LCRA water service area

0 5 10 miles 0 5 10 km

WATERSHED KEY

- Pecan Bayou
- Lake Buchanan
- Lake LBJ
- Lake Travis
- Austin
- Lower Basin
- Matagorda Bay

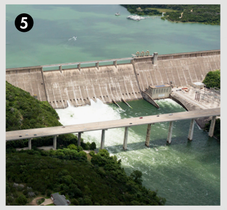
The map designates the lower Colorado River basin's major watersheds by color and includes locations of many of the LCRA Hydromet gauges that monitor streamflow and weather conditions.

Elevations are in feet above mean sea level (feet msl) and are based on LCRA "legacy datum" or benchmark elevations set at the time of construction of each dam. Lake levels reported by LCRA should not be used to determine first-floor elevations of buildings for compliance with floodplain regulations. Surveyors should refer to the LCRA High Accuracy Reference Network at harn.lcra.org for information about LCRA GPS control marks and benchmarks.

Lake volumes are measured in acre-feet. One acre-foot contains 325,851 gallons, or the amount of water needed to cover 1 acre 1 foot deep. Dam releases and river streamflows are measured in cubic feet per second (cfs). A flow rate of 100 cfs is equal to about 2.7 million gallons an hour or about 200 acre-feet a day.

THE HIGHLAND LAKES & DAMS

These listings include the amount of water each dam could release during a flood if all its floodgates were opened and its hydroelectric power stations were at full generation. While the smaller dams have released water at maximum capacity, this has never happened at Buchanan or Mansfield dams. The greatest number of gates opened simultaneously was 22 at Buchanan Dam in 1938 and six at Mansfield Dam in 1957. Discharge capabilities of the turbines, floodgates and spillways are approximate and will vary with lake levels at each dam. Longhorn Dam and Lady Bird Lake, located just downstream of Tom Miller Dam and Lake Austin, are owned and operated by Austin.



1 Buchanan Dam/Lake Buchanan

Lake Buchanan is one of LCRA's two major water supply reservoirs.

Year completed: 1938
Target range elevation:
May through October:
at or below 1,018 feet msl
November through April:
at or below 1,020 feet msl
Elevation of overflow spillway: 1,020.35 feet msl
Top of dam: 1,025.5 feet msl
Lake volume at 1,020 feet msl: 875,588 acre-feet
7 large floodgates at 18,800 cfs each
30 small floodgates at 7,030 cfs each
2 turbines at 2,090 cfs each
1 turbine at 1,760 cfs
Historic high: 1,021.4 feet msl (Dec. 20, 1991)
River miles from Gulf of Mexico: 414

2 Inks Dam/Inks Lake

Inks Lake passes through releases from Buchanan Dam and local inflows.

Year completed: 1938
Target range elevation:
886.9 to 887.7 feet msl
Elevation of overflow spillway: 888.32 feet msl
Top of dam: 922 feet msl
Lake volume at 887.7 feet msl: 13,668 acre-feet
There are no floodgates at Inks Dam.
1 turbine at 3,380 cfs
Historic high: 902.8 feet msl (July 25, 1938)
River miles from Gulf of Mexico: 409

3 Wirtz Dam/Lake LBJ

Lake LBJ passes through releases from upstream dams, local inflows and inflows from the Llano River and Sandy Creek.

Year completed: 1951
Target range elevation: 824.4 to 825 feet msl
Elevation of overflow spillway: 835.5 feet msl
Top of dam: 838.5 feet msl
Lake volume at 825 feet msl: 133,216 acre-feet
10 floodgates at 30,800 cfs each
2 turbines at 5,250 cfs each
Historic high: 836.2 feet msl (Sept. 11, 1952)
River miles from Gulf of Mexico: 387

5 Mansfield Dam/Lake Travis

Lake Travis is one of LCRA's two major water supply reservoirs and has a designated flood pool for storing floodwaters.

Year completed: 1942
Target range elevation: at or below 681 feet msl
Elevation of overflow spillway: 714 feet msl
Top of dam: 750 feet msl
Lake volume at 681 feet msl: 1,134,956 acre-feet
23 floodgates at 5,250 cfs each
1 floodgate at 2,290 cfs
2 turbines at 2,530 cfs each
1 turbine at 2,520 cfs
Historic high: 710.4 feet msl (Dec. 25, 1991)
River miles from Gulf of Mexico: 318

4 Starcke Dam/Lake Marble Falls

Lake Marble Falls passes through releases from upstream dams and local inflows.

Year completed: 1951
Target range elevation: 736.2 to 737 feet msl
Top of dam: 761.5 feet msl
Lake volume at 737 feet msl: 7,186 acre-feet
10 floodgates at 9,020 cfs each
1 turbine at 5,500 cfs
1 turbine at 5,200 cfs
Historic high: 756.3 feet msl (Sept. 11, 1952)
River miles from Gulf of Mexico: 382

6 Tom Miller Dam/Lake Austin

LCRA operates Tom Miller Dam under an agreement with Austin. Lake Austin passes through releases from upstream dams and inflows from local creeks.

Year completed: 1940
Target range elevation:
491.8 to 492.8 feet msl
Elevation of overflow spillway: 492.8 feet msl
Top of dam: 517 feet msl
Lake volume at 492.8 feet msl:
24,644 acre-feet
4 large floodgates at 15,300 cfs each
5 small floodgates at 8,580 cfs each
1 turbine at 1,970 cfs
1 turbine at 1,750 cfs
Historic high: 495.2 feet msl (May 25, 1981)
River miles from Gulf of Mexico: 298

RIVER GAUGES UPSTREAM FROM AUSTIN

1 Colorado River at Winchell
Bankfull stage: 24 feet (1,288.9 feet msl)
Flood stage: 26 feet (1,290.9 feet msl)
Historic high: 62.2 feet (1,327.1 feet msl), Sept. 19, 1936
River miles from Gulf of Mexico: 561

2 Pecan Bayou near Mullin
Bankfull stage: 20 feet (1,222.9 feet msl)
Flood stage: 40 feet (1,242.9 feet msl)
Historic high: 42.2 feet (1,245.5 feet msl), April 27, 1990
River miles from the Colorado River: 14

3 San Saba River at Menard
Bankfull stage: 12 feet (1,875 feet msl)
Flood stage: 18 feet (1,881 feet msl)
Historic high: 23.3 feet (1,882.8 feet msl), June 6, 1899
River miles from the Colorado River: 116.3

4 San Saba River near Brady
Bankfull stage: 16 feet (1,547 feet msl)
Flood stage: 30 feet (1,561 feet msl)
Historic high: 33.8 feet (1,564.8 feet msl), July 23, 1938
River miles from the Colorado River: 73

5 San Saba River at San Saba
Bankfull stage: 20 feet (1,182.2 feet msl)
Flood stage: 24 feet (1,186.2 feet msl)
Historic high: 39.3 feet (1,201.5 feet msl), July 23, 1938
River miles from the Colorado River: 17

6 Colorado River near San Saba
Bankfull stage: 25 feet (1,121.2 feet msl)
Flood stage: 30 feet (1,126.2 feet msl)
Historic high: 62.2 feet (1,158.4 feet msl), July 23, 1938
River miles from Gulf of Mexico: 474

7 Llano River near Junction
Bankfull stage: 12 feet (1,648.32 feet msl)
Flood stage: 16 feet (1,652.32 feet msl)
Historic high: 41.1 feet (1,689.4 feet msl), June 14, 1935
River miles from the Colorado River: 114.8

8 Llano River near Mason
Bankfull stage: 6 feet (1,236.4 feet msl)
Flood stage: 13 feet (1,243.4 feet msl)
Historic high: 46 feet (1,276.4 feet msl), June 14, 1935
River miles from the Colorado River: 61

9 Llano River at Llano
Bankfull stage: 10 feet (980 feet msl)
Flood stage: 10 feet (980 feet msl)
Historic high: 41.5 feet (1,011.5 feet msl), June 14, 1935
River miles from the Colorado River: 29

10 Sandy Creek near Kingsland
Bankfull stage: 8 feet (870.3 feet msl)
Flood stage: 12 feet (874.3 feet msl)
Historic high: 34.2 feet (896.5 feet msl), Sept. 11, 1952
River miles from the Colorado River: 7

11 Pedernales River near Fredericksburg
Bankfull stage: 12 feet (1,577 feet msl)
Flood stage: 22 feet (1,587 feet msl)
Historic high: 41.6 feet (1,606.6 feet msl), Aug. 2, 1978
River miles from the Colorado River: 89

12 Pedernales River near Johnson City
Bankfull stage: 13 feet (1,109.7 feet msl)
Flood stage: 14 feet (1,110.7 feet msl)
Historic high: 42.5 feet (1,139.2 feet msl), Sept. 11, 1952
River miles from the Colorado River: 48

RIVER GAUGES DOWNSTREAM FROM AUSTIN

These listings include historic highs before and after Mansfield Dam was completed in 1942. Some stream gauges have been relocated and datums have changed over time.

13 Colorado River at Austin
Bankfull stage: 25 feet (417 feet msl)
Flood stage: 33 feet (425 feet msl)
Historic high before Mansfield Dam: 51 feet (466.38 feet msl), July 7, 1869
Historic high after Mansfield Dam: 34.09 feet (426.05 feet msl), May 26, 2015
River miles from Gulf of Mexico: 290

14 Colorado River at Bastrop
Bankfull stage: 14 feet (321.4 feet msl)
Flood stage: 23 feet (330.4 feet msl)
Historic high before Mansfield Dam: 60.3 feet (367.7 feet msl), July 7, 1869
Historic high after Mansfield Dam: 37.5 feet (344.9 feet msl), Dec. 22, 1991
River miles from the Gulf of Mexico: 237

15 Colorado River at Smithville
Bankfull stage: 10 feet (280.1 feet msl)
Flood stage: 20 feet (290.1 feet msl)
Historic high before Mansfield Dam: 47.4 feet (317.4 feet msl), Dec. 4, 1913
Historic high after Mansfield Dam: 34.8 feet (304.8 feet msl), Oct. 19, 1998
River miles from Gulf of Mexico: 212

16 Colorado River at La Grange
Bankfull stage: 19 feet (229 feet msl)
Flood stage: 26 feet (236 feet msl)
Historic high before Mansfield Dam: 56.7 feet (266.74 feet msl), July 9, 1869
Historic high after Mansfield Dam: 54.1 feet msl (264.14 feet msl), Aug. 28, 2017
River miles from Gulf of Mexico: 177

17 Colorado River at Columbus
Bankfull stage: 30 feet (175.5 feet msl)
Flood stage: 34 feet (179.5 feet msl)
Historic high before Mansfield Dam: 51.6 feet (197.1 feet msl), July 10, 1869, and Dec. 6, 1913
Historic high after Mansfield Dam: 48.17 feet msl (193.69 feet msl), Aug. 29, 2017
River miles from Gulf of Mexico: 135

18 Colorado River at Wharton
Bankfull stage: 20 feet (72.4 feet msl)
Flood stage: 39 feet (91.4 feet msl)
Historic high before Mansfield Dam: 51.9 feet (104.3 feet msl), Dec. 13, 1913
Historic high after Mansfield Dam: 52.42 feet (102.89 feet msl), Aug. 31, 2017
River miles from Gulf of Mexico: 67

19 Colorado River at Bay City
Bankfull stage: 23 feet (23 feet msl)
Flood stage: 44 feet (44 feet msl)
Historic high before Mansfield Dam: 56.1 feet (56.1 feet msl), Dec. 10, 1913
Historic high after Mansfield Dam: 46.6 feet (46.6 feet msl), June 26, 1960
River miles from Gulf of Mexico: 33

ABOUT LCRA

The Lower Colorado River Authority serves customers and communities throughout Texas by managing the lower Colorado River; generating and transmitting electric power; providing a clean, reliable water supply; and offering outdoor adventures at more than 40 parks along the Colorado River from the Texas Hill Country to the Gulf Coast. LCRA and its employees are committed to enhancing the lives of Texans through water stewardship, energy and community services. LCRA was created by the Texas Legislature in 1934.

KEEPING THE PUBLIC INFORMED

Flooding along the Highland Lakes and lower Colorado River can occur quickly and without warning. LCRA shares real-time information about lake conditions and the threat of flooding with the public, partner agencies and local officials to help keep people safe.

- Visit **lcra.org**.
- **Hydromet.lcra.org** provides real-time lake levels, streamflow and rainfall information.
- **Floodstatus.lcra.org** provides information about ongoing flood operations.
- Sign up for the LCRA Flood Operations Notification Service at **lcra.org/fons**. The service will call, text and/or email when flood operations at any of the dams along the Highland Lakes, or at Lake Bastrop, are imminent or underway.

LCRA also works closely with local media and emergency officials. Local officials make decisions about when to close roads or evacuate neighborhoods.

LOWER COLORADO RIVER AUTHORITY

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