US Army Corps
of Engineers®
Fort Worth District

COLORADO RIVER
COLORADO RIVER BASIN, TEXAS

MANSFIELD (MARSHALL FORD) DAM AND LAKE TRAVIS

WATER CONTROL MANUAL

September 2013

MANSFIELD (MARSHALL FORD) DAM AND LAKE TRAVIS
COLORADO RIVER
COLORADO RIVER BASIN, TX

WATER CONTROL MANUAL

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
TEXAS

REVISED SEPTEMBER 2013

MANSFIELD DAM

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be used in looseleaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is Southwestern Division's approval date.

NOTE ON VERTICAL DATUM:

The project vertical datum for Mansfield Dam and Lake Travis was originally established referenced to the National Geodetic Vertical Datum of 1929 (NGVD29). In 2006 the LCRA discovered a 0.40-foot discrepancy between the project datum, hereafter called the LCRA Legacy Datum (also known as the Hydromet Datum), and the historically referenced NGVD29. In the interest of consistency with historic records, project structural elevations and pool elevations will continue to be referenced to the LCRA Legacy Datum. The relationship of the LCRA Legacy Datum to the most commonly referenced vertical datums are:

NGVD29 = LCRA Legacy Datum + 0.40
NAVD88 = LCRA Legacy Datum + 0.60

All elevations in this manual are referenced to the LCRA Legacy Datum unless noted otherwise (e.g., NGVD or NAVD). In this manual the presence of any form of the mean sea level acronym (msl, MSL, m.s.l, or M.S.L) indicates a reference to the LCRA Legacy Datum.

Division of Responsibilities. As a result of Section 7 of the Flood Control Act of 1944 (see Exhibit I), the Corps of Engineers is responsible for prescribing a formal water control plan for regulation of the Lake Travis storage space allocated for flood control (elevation 681.0 feet to elevation 714.0 feet), and documenting the water control plan in a water control manual. This responsibility is executed in accordance with Engineering Regulation (ER) 1110-2-241, *Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects* (24 May 1990) (see Exhibit N). The project owner, the Lower Colorado River Authority (LCRA), is responsible for specification of the plans of regulation for the storage space below elevation 681.0 feet (conservation storage) and above elevation 714.0 feet (surcharge storage).

By agreement with the Corps of Engineers (see Exhibit O), the LCRA is responsible for day-to-day (real time) implementation of the Corps of Engineers prescribed water control plan of regulation for the Lake Travis flood storage space. As per ER 1110-2-241, consultation and assistance will be provided by the Corps of Engineers when appropriate and to the extent possible. During an emergency that affects flood control, the Corps of Engineers may temporarily prescribe regulation of flood control storage space on a real-time basis without request of the project owner. When the Corps of Engineers is prescribing regulation of flood control storage space on a real-time basis, cooperation of the project owner to the extent possible will be expected. Special requests by the project owner are preferred before the Corps of Engineers offers advice on real-time regulation during surcharge storage utilization. The LCRA is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be used at the discretion of the LCRA, and does not relieve the LCRA of the responsibility for safety of the project.

In the interest of effective and efficient operation of this multi-purpose project, over its entire pool elevation range of operation, Chapter 7 of the Mansfield Dam and Lake Travis Water Control Manual includes both the Corps of Engineers regulation plan for the flood control storage space, and references to the LCRA plans of regulation for the remaining storage space.

EMERGENCY REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during duty hours and at various hours during weekends and holidays, contact can be made by telephone to the Water Management Section, Fort Worth District Office, at (817) 886-1551 or the Lower Colorado River Authority River Operations Center at (512) 473-3333 ext. 2538. The Fort Worth District Afterhours Regulator Phone number is (817) 791-0973. If the above offices cannot be contacted, assistance can be achieved by contacting, in the order listed, one of the persons shown below. Chapter VII of this manual contains detailed instructions for emergency regulation. All project personnel associated with regulation of the project must be thoroughly familiar with this and the procedure outlined in Exhibit M.

EMERGENCY PERSONNEL LIST

Name	Title	Telephone
SWF Office Personnel		
Redacted PII	Forecaster, Water Management Section	(817)866-1548(O) Redacted PII
Redacted PII	Chief, Water Resources Branch	(817)886-1549(O) Redacted PII
LCRA Office Personnel		
Redacted PII	Supervisor, LCRA ROCC	(512) 473-3200 (O) ext.2381 Redacted PII
Redacted PII	Manager, LCRA River Operations	(512) 473-3200 (O) ext.4060 Redacted PII
SWD Office Personnel		
Redacted PII	Chief, Water Management Branch, SWD	(469)487-7096(O) Redacted PII
Redacted PII	Water Management Branch, SWD	(469)487-7090(O) Redacted PII

Mansfield Dam
(Marshall Ford Dam)
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Water Control Manual

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PERTINENT DATA – MANSFIELD DAM (MARSHALL FORD DAM) AND LAKE TRAVIS

(See Exhibit A for Supplementary Data)

LOCATION OF DAM:

In Travis County, R.M. 322.2 on the Colorado River approximately 12 miles N.W. of Austin, TX

DRAINAGE AREA ABOVE MANSFIELD DAM:

Contributing Area:	27,352 sq. mi.
1 inch of runoff:	1,458,773 ac-ft
Non-contributing Area:	11,403 sq. mi.
Total Drainage Area:	38,755 sq. mi.

DAM:

Type:	Earth fill & concrete gravity
Length:	7,336 feet
Max. Height:	278 feet
Top Width:	28.5 – 35 feet

SPILLWAY:

Type:	Concrete Ogee, Uncontrolled
Length:	700 feet with 5-140' overflow bays
Crest Elev.:	714 feet

OUTLET WORKS:

No. and Type:	24 double-gated conduits
Dimension:	8.5 feet diameter
Invert Elevation:	535.75 feet
Discharge Control:	
Service gates:	Paradox type
Emergency gates:	Ring-follower type

POWER FEATURE:

No. of Units:	3 turbines and 3 generators
Capacity:	Total of 116,000 kilowatts
Penstocks:	3-16' dia w/hoist operated Broom type, slide gates
Invert Elevation:	552 feet

UNCONTROLLED DRAINAGE AREA ABOVE DOWNSTREAM KEY CONTROL POINT (USGS GAGING STATIONS):

Austin	(08158000)	256 sq. mi.
Bastrop	(08159200)	1,226 sq. mi.
Columbus	(08161000)	2,887 sq. mi.

Feature	Elevation (Feet)	Lake Area (Acres)	Reservoir Capacity Incremental (ac-ft)	Reservoir Capacity Accumulative (ac-ft)	Reservoir Capacity Runoff (inches)	Outlet Works Capacity (cfs)
Top of Dam	750					
Max Design Water Surface	745	41,979	1,091,318	3,013,049	2.05	
Spillway Crest	714	29,160	580,506	1,921,731	1.31	131,300
Top of Joint Use Pool	691	21,845	206,269	1,341,225	0.91	126,470
Top of Conservation Pool	681	19,297	796,538	1,134,956	0.77	123,250
Bottom of Power Pool	618	7,662	338,418	333,418	0.23	96,540
Streambed	490					

MANSFIELD DAM AND LAKE TRAVIS
WATER CONTROL MANUAL

I - INTRODUCTION

1-01. Authorization. This manual is submitted as required by ER 1110-2-240 "Water Control Management", (October 1982, revised April 1987); and prepared in accordance with EM 1110-2-3600 "Management of Water Control Systems", (November 1987) and ER 1110-2-8156 "Preparation of Water Control Manuals", (August 1995).

1-02. Purpose and Scope. The purpose of this manual is to document the Mansfield Dam regulation plan, to present detailed information to higher authority, and to give guidance to personnel who will become concerned with or responsible for the regulation of Mansfield Dam during the life of the project. This manual includes data and information pertinent to the regulation of Mansfield Dam. Mansfield Dam was originally named Marshall Ford Dam.

1-03. Related Manuals and Reports. The plan of operation for flood control at Mansfield Dam was published in Regulations Governing the Operation and Maintenance of Marshall Ford Dam by the Bureau of Reclamation (BOR) of the U.S. Department of the Interior in May 1944. The BOR also published the manual titled Standard Operating Procedures for Marshall Ford Dam and Reservoir on 13 October 1981, and revised August 1993.

The Fort Worth District (SWF) of the United States Army Corps of Engineers (USACE) submitted a draft water control manual for Marshall Ford Dam and Reservoir to the Southwestern Division (SWD) for review in 1979. In 1999, SWF submitted an updated Marshall Ford Dam Water Control Manual to SWD which was approved on 14 September 1999, subject to several comments. The manual was subsequently modified to incorporate the comments. In addition, the USACE has published flood control regulations for Marshall Ford Dam (Lake Travis) in the Federal Register as follows: (16 FR 4543, 16 May 1951), (41 FR 15005, 9 April 1976), and (44 FR 24551, 26 April 1979). An Environmental Impact Assessment was prepared by the Fort Worth District USACE in November 1978.

There have been numerous other studies and reports associated with Mansfield Dam and the Colorado River Basin as documented in Sections 3-05 and 8-12. The Lower Colorado River Authority (LCRA) has developed the LCRA Highland Lakes Operating Guidelines (30 June 2012), which includes additional information related to the regulation and operation of Mansfield Dam.

1-04. Project Owner. Mansfield (Marshall Ford) Dam was funded, planned, and built by the BOR (see Exhibit I). The LCRA acquired the land for the project and paid for the majority of the costs related to the hydroelectric power facilities. The

BOR was the owner while LCRA was paying on the planning and construction loan. The loan was paid off in May 1997, and the BOR relinquished all rights and obligations to the project (see Exhibit G).

1-05. Operating Agency. By the authority of a March 1941 contract between the LCRA and the United States, supplemented in 1948, the Secretary of Interior designated the LCRA as the agent to operate and maintain Mansfield Dam. All physical operations of Mansfield Dam are performed by the LCRA. Gate operation for conservation and flood control purposes are directed by the LCRA River Operations Control Center (ROCC) in Austin, Texas. During emergencies, the ROCC is staffed continuously.

1-06. Regulating Agencies. The State of Texas granted the LCRA a permit to appropriate public water. This permit establishes the regulations governing the use of conservation storage in Lake Travis. The conservation storage is used for hydroelectric power generation and water supply for irrigation and other beneficial uses. When the lake level is below elevation 681.0, all operations are directed by the LCRA.

A provision contained in Section 7 of the Flood Control Act of 1944 requires that the USACE provide the regulations governing the use of flood control storage in Lake Travis. The Water Management Section of the Engineering and Construction Division, Fort Worth District, prescribes the flood control regulations for the project. The LCRA operates the project in accordance with the regulations. In unusual situations where it may be desirable to operate differently, LCRA may request a deviation from the regulations. The Water Management Section forwards deviation requests to the Southwestern Division Water Management Branch for review and approval or rejection.

During flood situations, the LCRA coordinates closely with the SWF Water Management Section. When the project is in flood control operation, LCRA operating personnel will closely monitor the project and downstream conditions at designated control points. Locations of these control points and allowable flows are shown on Plate 1-1 and listed in Table 1-1.

TABLE 1-1
CONTROL POINTS FOR MANSFIELD DAM OPERATION

Control Point	Gauge Number	Allowable Flow (cfs)
Colorado River at Austin	08158000	30,000[1/]
Colorado River at Bastrop	08159200	45,000[1/]
Colorado River at Columbus	08161000	50,000

[1/] Allowable flow increases to 50,000 cfs when Lake Travis pool is above or forecasted to exceed elevation 710.0.

On 30 May 1997, contractual agreements between LCRA and the BOR were terminated (Exhibit G). As a result of the contractual termination, the BOR is no longer responsible for the safety of the dam or for regulation of the project during utilization of the surcharge storage above elevation 714.0 feet. Operations above elevation 714.0 feet are now the responsibility of the LCRA. The regulating agencies and their addresses are listed in Table 1-2.

TABLE 1-2
REGULATING AGENCIES

Agency	Office Address & Telephone Number	Authority
Lower Colorado River Authority	River Operations 3601 Lake Austin Blvd. Austin, Texas 78767 (512) 578-2538	Project Owner (See Exhibit E and Exhibit G)
Dept. of the Army Corps of Engineers	Fort Worth District Water Management Section 819 Taylor Street Fort Worth, Texas 76102 (817) 886-1551	Flood Control Responsibility (Section 7 of the Flood Control Act of 1944) (See Exhibit I)

II - DESCRIPTION OF PROJECT

2-01. Location. Mansfield (Marshall Ford) Dam is located at river mile 322.2 on the Colorado River in Travis County about 12 miles northwest of Austin, Texas. Lake Travis, which is formed by Mansfield Dam, extends from Travis County into Burnet County. Water is impounded approximately 64.5 river miles upstream of the dam to the downstream face of Max Starcke Dam (Lake Marble Falls), another LCRA Highland Lakes project. The next downstream project is Tom Miller Dam (Lake Austin) which is owned and operated by LCRA. F.M. Highway 620 crosses the Colorado River immediately downstream of Mansfield Dam. The location of the project is shown on Plate 2-1. Additional information on Mansfield Dam is provided in Exhibit A, Supplementary Pertinent Data.

2-02. Purpose. Mansfield (Marshall Ford) Dam is a multi-purpose project which is used for flood control, water supply, hydropower, recreation, and fish and wildlife. Section 3 of the Rivers and Harbors Act of 1937, which authorized construction of Mansfield Dam, stated that the purpose of the dam would be for improving navigation, controlling floods, regulating the flow of streams, providing storage and delivery of stored waters for the reclamation of lands and other beneficial uses, and for the generation of hydroelectric energy.

On 25 May 1938, the Board of Water Engineers for the State of Texas granted permit No. 1260 (see Exhibit H) to the LCRA with the right to appropriate and use public waters from the Colorado River. Certificate of Adjudication 14-5478 allowed LCRA to divert and have a combined use not to exceed 1,500,000 acre-feet of water per year from Lake Travis and Lake Buchanan for domestic and municipal uses, irrigation, mining and recovery of minerals, and hydroelectric power. The 1,500,000 acre-feet appropriation was reduced by 102,000 acre-feet to 1,398,000 acre-feet per annum by an order from the Texas Water Rights Commission, 24 February 1976. Certificate of Adjudication 14-5482 was issued on 28 June 1989, again authorizing the LCRA to divert and consumptively use water up to 1,500,000 acre-feet per year from Lakes Buchanan and Travis for municipal, industrial, irrigation and mining purposes, and to release water through the dam for hydroelectric generation. Mansfield Dam is the fifth reservoir in the chain of LCRA Highland Lakes which includes: Buchanan Dam, Inks Dam, Wirtz Dam, Starcke Dam, Mansfield Dam, and Tom Miller Dam. Longhorn Dam (owned and operated by the City of Austin) is located downstream of Tom Miller Dam. Mansfield (Marshall Ford) Dam is the only project in the system with flood control purposes. The other projects are utilized for water supply (Buchanan), hydropower generation, and recreation.

2-03. Physical Components. Mansfield Dam consists of twenty-four 8.5 foot diameter outlet conduits, an uncontrolled spillway, and a hydroelectric power plant with three turbines. The dam was constructed as a low dam initially, followed by a high dam, as summarized in Section 3-05.

a. Embankment. The dam consists of a concrete gravity section across the river, flanked on both ends by earth and rock fill embankments. The top of the dam is at elevation 750.0, and extends to elevation 754.0 with the parapet wall. The concrete gravity section has a maximum height of 278 feet and a length of 2,423 feet, making it one of the largest gravity type dams in the United States. The left embankment is 2,403 feet long and curves into the concrete section from the northeast. The right embankment is shorter at 260 feet in length. The upstream sides of both embankment sections have a 1V:3H slope and are protected by a uniform riprap blanket, 3 feet thick. The downstream sides of both embankment sections have a 1V:2H slope and are covered by rock fill which tapers in thickness from bottom to top.

In addition, there is a saddle dam beyond each end of the structure. The left abutment saddle dam is approximately 1,450 feet long and the right abutment saddle dam is approximately 800 feet long. The crest elevation of both saddle dams is 754.0. The plan, elevation, and section views of the dam are shown on Plate 2-2.

b. Spillway. The spillway is an ungated ogee type weir with a crest elevation of 714.0. The spillway is formed into part of the concrete portion of the dam and has a net length of 700 feet. Concrete piers support a steel girder bridge above the spillway dividing the spillway into five bays, each with a length of 140 feet. The center line of the old F.M. Highway 620 along the bridge is at elevation 750.0. In January 1995, a re-routed new F.M. Highway 620 was completed just downstream of the dam. Access across Mansfield Dam is now closed to the public and open only to LCRA service vehicles. Flows over the weir are discharged into the main channel of the Colorado River. Photographic views of the spillway are shown in the foreword (page ii). Section views of the spillway are shown on Plate 2-2. Plate 7-3 shows the spillway discharge rating curve.

c. Outlet Works. The outlet works, located under the spillway portion of the concrete dam, consist of trashrack structures, twenty-four 8.5 foot diameter conduits, and a stilling basin for release of floodwaters. Each conduit has an invert elevation of 535.75. Twenty-three (23) conduits are provided with a ring-follower gate and a paradox gate. There is also one (1) conduit with a ring-follower gate and a jet valve. Table 7-3 (page T7.3-1) is a tabulation of the discharge rating curve for one conduit gate. Plate 7-2 shows the conduit discharge rating curve.

Control equipment for opening and closing the ring-follower and paradox gates and jet valve are located in two separate galleries that are on the same level within the dam. The galleries both have a floor elevation of 555.92 and extend parallel to the length of the dam. Twenty-three of the gates are not suited for operation at partial openings and are operated either fully open or fully closed. One of the conduit gates has been converted to a partial-flow jet valve gate which may be operated at various flow settings for use as a regulating gate. A view of the outlet works and controls are shown on Plate 2-2.

1. Ring-Follower Emergency Gates. There are 24 numbered ring-follower gates on the upstream side of the dam. The ring-follower gates are raised and lowered by hydraulic cylinders acting on a vertical stem attached to the upper portion of the gate. There is no positive water seal when the gate is closed. The ring-follower gates are intended to control the flow though the conduits when the paradox gates or jet valve are malfunctioning. Both gates provide practically unbroken flow through the conduit. The location of the ring-follower emergency gate is shown on Plate 2-2.

2. Paradox Service Gates. There are 23 numbered paradox gates on the downstream side of the dam. The paradox gate was developed by the BOR for opening or closing off flow through large conduits with a head of up to 600 feet. The paradox gate has a number of features in common with the ring-follower gate. It is relatively watertight when closed. The raising and lowering of the gate is accomplished by electric motors located in the gate operating gallery. Location of the paradox service gates is indicated on Plate 2-2.

3. Jet Valve. One of the conduit gates has been converted to a partial-flow jet valve gate which may be operated at various flow settings for use as a regulating gate. This allows for more precise control of flood releases such that maximum release can be made without exceeding the downstream control points.

d. Hydroelectric Power Facilities. The hydroelectric power facility was constructed during the same time period as the dam. However, the first hydropower unit came on line in January 1941, which was 16 months before the completion of the high dam. The high dam (elevation 750.0) was completed in May 1942.

The powerhouse is located on the downstream toe of the concrete section of the dam, left of the spillway. The switchyard is nearby on an excavated shelf on the left bank of the Colorado River. Power intakes consist of three penstocks 16 feet in diameter with an invert elevation of 552.0. Each penstock has a steel slide gate used to control water flow through its turbine.

The three vertical Francis turbines drive three generating units. Units 1 and 3 have an installed capacity of 37,000 kilowatts each, and Unit 2 has an installed capacity of 42,000 kilowatts for a total capacity of 116 megawatts. Photographs of the powerhouse and switchyard are in the foreword (page ii). A sectional view of a penstock is shown on Plate 2-2 and a diagrammatic representation of the hydroelectric plant and associated features is shown on Plate 2-3.

2-04. Related Control Facilities. Tom Miller Dam (Lake Austin) and Longhorn Dam (Lady Bird Lake) are located immediately downstream of Mansfield Dam, as shown on Plate 2-1. Two hydroelectric generators, owned by LCRA at Tom Miller Dam, have a total capacity of 16,000 kilowatts. The hydroelectric power generation at Tom Miller Dam is coordinated with the hydroelectric turbine discharges from the power plant at Mansfield Dam. Water is diverted from Lake Austin by the City of Austin and others for municipal and domestic supply. Water discharged from Lake Austin through Tom Miller Dam passes immediately into Lady Bird Lake, which is owned and operated by the City of Austin (Austin Energy).

2-05. Real Estate Acquisition. It was the intent of the LCRA to acquire the real estate needed for construction of the dam by fee simple title. It was also the intent of the LCRA to acquire flowage easements to occasionally and intermittently flood and submerge lands affected by the operation of the project. The LCRA was not completely successful in acquiring all of the real estate which is submerged by the lake at high stages. A right-of-way survey conducted in 1937 determined that 40,325 acres of land lay below elevation 740.0. The LCRA obtained flowage easements (including fee simple title) on 34,345 acres in the reservoir.

a. Land Purchased by LCRA. It was determined that to build Mansfield Dam and Lake Travis the LCRA would need to acquire real estate from streambed to elevation 715.0. The acquisition of real estate would be done through fee simple title. However, some landowners only conveyed ownership to the portion of their land below elevation 715.0. Other landowners, with land extending below elevation 715.0, would only convey their entire ownership which resulted in the purchase of land above elevation 715.0. Still other landowners, with land below elevation 715.0, would only grant flowage easements on their land.

b. Flowage Easements Obtained by LCRA. Flowage easement rights have been acquired by the LCRA from most of the landowners for operating the reservoir up to elevation 715.0. Landowners are restricted from building habitable structures below elevation 715.0. The LCRA has also acquired the right to flood the area above the spillway (elevation 714.0) with the intent of flooding the land for only a brief period of time. The duration of this period is the time required for the floodwater to pass over the spillway.

Although the easements restrict the construction of habitable structures below elevation 715.0, the 1% annual chance exceedance (ACE) floodplain elevation at Lake Travis is 722.0. In accordance with the National Flood Insurance Program (NFIP) regulations and Travis and Burnet County floodplain ordinances, construction of new habitable structures is prohibited below elevation 722.0 at Lake Travis. There are numerous existing structures below elevation 722.0.

2-06. Public Facilities. Listed below are seventeen (17) public use areas on the shoreline of Lake Travis owned by LCRA or Travis County. The location of these areas is shown on Plate 2-4. All public use areas are accessible by paved roads. In addition, LCRA and Travis County have public boat ramps at ten locations around the lake.

a. Pace Bend Recreation Area. This large area has 420 campsites (20 with water, sewer, and electric) with access provided to Lake Travis for swimming, fishing, and boating. Hiking, biking, and equestrian trails are also provided. Facilities include grills, toilets, and potable water.

b. Arkansas Bend Park. This 323-acre area is developed for camping, hiking, and picnicking. It is also provides a boat launching ramp.

c. Sandy Creek Park. This 25-acre area provides campsites and access to Lake Travis for swimming and fishing activities as well as a boat ramp. Picnic facilities, drinking water, toilets, and a sanitary disposal station are also provided. The park is home to several rare bird and plant species.

d. Cypress Creek Park. The primary purpose of this small area is to provide for public boat launching. Fishing, swimming, and picnicking are also popular.

e. Mansfield Dam Park. Facilities include picnic areas, toilets, drinking water, concession facility, and a boat launching ramp (4 lane). Access to Lake Travis is also provided for swimming and scuba diving.

f. Hippie Hollow. This is a day use only area for swimming and hiking.

g. Bob Wentz at Windy Point. This area has facilities which are used for picnicking, sailing, and swimming.

h. Camp Creek. This area has overnight camping with one waterless toilet but no potable water or electricity. A boat ramp is also provided.

i. Shaffer Bend Recreation Area. This 523-acre area has overnight camping with one waterless toilet but no potable water or electricity. Numerous trails are available for hiking, biking, and horseback riding.

j. Narrows Recreation Area. This area has one public boat ramp and provides access for boating and fishing. The access road to the park crosses Alligator Creek at a low-water crossing which may be impassable during heavy rainstorms.

k. Grelle Recreation Area. This 400-acre area has overnight camping but no facilities are provided. A two-mile hiking trail winds through the area's hills. Swimming and fishing are also popular at this site.

l. Turkey Bend Recreation Area. This 400-acre area provides unimproved camping and fishing opportunities. It is a popular location to put canoes and kayaks into the lake.

m. Muleshoe Bend Recreation Area. This area features a 6.5-mile mountain bike trail. Horseback riding, tent camping, fishing, and swimming are also popular.

n. Gloster Bend. This 586-acre area features a boat ramp and is used for day use only.

o. Westcave Preserve. This 30-acre preserve includes a cave formation with waterfalls and deep pools. A 3,000 square foot learning center, the Warren Skarren Environmental Learning Center, was opened in 2003.

p. Dink Pearson Park. This 3.6-acre park includes a limestone outcrop. The park is covered with dense juniper/oak woodlands.

q. Tom Hughes Park. This park includes primitive trails and is an excellent location to swim or watch the sunset over Lake Travis.

III - HISTORY OF PROJECT

3-01. Authorization. The Emergency Relief Appropriation Act of 1935, Public Resolution No. 11, 74th Congress, approved 08 April 1935 (see Exhibit B), appropriated funds to be used for public works. Construction of Marshall Ford Dam was later authorized by Section 3 of the Rivers and Harbors Act of 1937, 75th Congress, Session I, Ch. 832, 26 August 1937 (see Exhibit C). The dam was built across a canyon near the settlement of Marshall Ford. The dam name was changed in 1941 to Mansfield Dam in honor of United States Representative J.J. Mansfield who assisted in the development of the project. The reservoir behind Mansfield (Marshall Ford) Dam is named Lake Travis.

3-02. Planning and Design. On 01 June 1935, the Secretary of Interior entered into a cooperative agreement (see Exhibit D) with LCRA to construct a unified series and system of dams to provide flood control, irrigation, hydroelectric power, and other beneficial uses. In this agreement the LCRA was to provide all lands and water rights necessary for the accomplishment of the project.

The LCRA planned, designed, and financed the hydroelectric generating facilities at Mansfield Dam. The BOR planned and designed the flood control and conservation features of the dam and lake. A sum of $5,000,000 was allocated to the Department of Interior, BOR, from funds made available to the President of the United States by the Emergency Relief Appropriation Act of 1935. The funds were to aid in financing that portion of the project relating to flood control.

3-03. Construction. A two-stage construction plan was developed for Mansfield (Marshall Ford) Dam. The first stage was designed with special provisions for enlargements, and the second stage to be added when funds became available. The first stage, “low” dam, was to be constructed with the spillway crest at 640.0 and the top of the dam at elevation 670.0. The second stage, “high” dam, raised the spillway to elevation 714.0 and the top of the dam to elevation 750.0.

The main intent of the Mansfield Dam “low” dam was hydroelectric power generation and to provide some flood control. The primary purpose of the “high” dam was for controlling the floods of the Colorado River below the dam. The “low” dam provided limited downstream flood control protection. A detailed study of the “high” dam costs/benefits in conjunction with damages from the 1938 floods, provided justification for the construction of the “high” dam. Construction of the “high” dam began in September 1939 immediately following completion of the "low” dam construction in August 1939. A summary of significant events during the construction of Mansfield (Marshall Ford) Dam is presented in Table 3-1.

TABLE 3-1
SUMMARY OF CONSTRUCTION ACTIVITIES

Activity	Date
Construction Started	February 1937
Completion of Low Dam (Elevation 670.0)	August 1939
Construction of High Dam Began	September 1939
Deliberate Impoundment Began	September 1940
First Power Unit in Operation	January 1941
Completion of High Dam (Elevation 750.0)	May 1942
Conservation Pool Filled	September 1942
Relocation of FM 620 Began	September 1992
Relocation of FM 620 Completed	January 1995

3-04. Related Projects. Within the Colorado River Basin, there are 31 lakes with a storage capacity of 5,000 acre-feet or more. Four of these lakes are federal projects which provide flood control protection: Twin Buttes, O.C. Fisher, Hords Creek, and Lake Travis. Due to the considerable distance and large intervening area separating Mansfield Dam and the three federal flood control projects in the upper basin, no significant benefits are gained by coordinating releases to control the flow into Lake Travis.

Mansfield Dam is one of six tandem projects on the Colorado River operated by the LCRA. The six projects are known as the Highland Lakes and are listed in downstream order in Table 3-2. The LCRA regulates Mansfield Dam in coordination with the five other projects for hydropower generation and for supplying water for municipal, industrial, and irrigation purposes. Mansfield Dam is the only one of the six LCRA projects which has dedicated flood storage. Location of the six LCRA projects is shown on Plate 2-1.

Lady Bird Lake (formerly Town Lake) and Longhorn Dam are located downstream of Tom Miller Dam and are owned and operated by the City of Austin and Austin Energy. The dam was constructed in 1960 to provide cooling water for Austin's Holly Street Power Plant.

TABLE 3-2
LOWER COLORADO RIVER AUTHORITY PROJECTS

Dam	Lake	Deliberate Impoundment Began	Conservation Storage (Ac-Ft)[1/]
Buchanan Dam	Lake Buchanan	May 1937	886,626
Roy Inks Dam	Lake Inks	June 1938	14,074
Alvin Wirtz Dam	Lake Lyndon B. Johnson	May 1951	133,090
Max Starcke Dam	Lake Marble Falls	July 1951	7,486
Mansfield Dam	Lake Travis	September 1940	1,134,956
Tom Miller (Present Dam)	Lake Austin	1939	24,644

[1/] As reported in TWDB Volumetric Surveys (2006-2008).

3-05. Modification of Regulations.

a. Flood Control by Marshall Ford - 1937. This was the first published hydrologic and hydraulic design study for Mansfield (Marshall Ford) Dam that was completed by the BOR in 1937. The study established lake levels for the varying frequency storms from the 4% ACE event to the Probable Maximum Flood (PMF). The lake levels were based on a 36-hour forecast and a pre-release of 108,000 cfs. The pre-release operation lowered the level of Lake Travis and then allowed the lake to rise as inflows increased. The 1% annual chance exceedance (ACE) event elevation at Lake Travis was published as 715.0.

b. Contract of 1941. The original plan of operation for Mansfield Dam was established by Article 4 of a contract between the LCRA and the United States Department of Interior dated 13 March 1941 (see Exhibit E). In this contract, the LCRA was designated as the agent to operate and maintain Mansfield Dam for regulating the flow of the Colorado River below the dam.

c. Regulations of May 1944. In response to a request by LCRA that Mansfield Dam be turned over to LCRA, the BOR issued regulations governing the operations and maintenance of Mansfield Dam (see Exhibit F).

d. Flood Control Act of 1944. In December 1944, Section 7 of the Flood Control Act of 1944 directed the Secretary of War to prescribe flood control regulations for all reservoirs constructed wholly or in part with federal funds provided on the basis of a flood control purpose or navigation (see Exhibit I).

e. Regulations of May 1951. In 1948, the LCRA contended that the 1944 regulations were contrary to the March 1941 contract. The USACE continued the coordination of the flood operation with the BOR. In 1951, the USACE issued flood control regulations for Mansfield Dam in the Federal Register 4543, 16 May 1951. A copy of the regulation is included in Exhibit J. Plan 61, as it was referenced, established a 50,000 cfs regulating flow at Columbus and a 1% ACE elevation of 732.0 at Lake Travis.

f. Interim Regulations of April 1976. During the period of October 1973 to February 1974, following four years of mild drought, deviations to the 1951 Regulations were approved by the USACE based on the energy crisis. From October 1974 to May 1975, three notices of deviations from the regulation plan were issued to the LCRA by the Fort Worth District. Following a preliminary study, the flood control regulations for Mansfield Dam were revised by the USACE and were published in Federal Register 41 FR 15005 on 09 April 1976. A copy of the regulation (Plan 63) is presented in Exhibit K. The revision was needed to reflect potential damages, both in the Lake Travis area and downstream floodplain, and to be responsive in the conservation of hydroelectric energy.

Plan 63 added the stream gauging stations at Austin and Bastrop to the Columbus gauging station as key control points with controlling discharges of 30,000 and 45,000 cfs, respectively. Also, the requirement to maintain a minimum release of 5,000 cfs was revised to allow a minimum release rate of 3,000 cfs, when the lake is between 681.0 and 683.0. This revision would increase the hydroelectric power benefits without significantly lowering the flood protection provided by the project. The revised regulations were assigned an interim status so as to provide a trial period for completion of detailed studies required for development of the manual. The 1% ACE water surface elevation at Lake Travis was determined to be 732.0 based on analyses performed during this time period.

g. Regulations of April 1979. The operations of 13 major lakes in the Colorado River Basin were simulated using a hydrologic computer model and the historical stream flow records for a 45-year period from 01 January 1930 through 31 December 1974. Upon completion of the simulation of 14 different proposed regulation plans for Mansfield Dam, the results were presented by the Fort Worth District Engineer at a public meeting in Austin, Texas, on 05 January 1978. As a result of comments received from the public at the meeting, plus subsequent workshops and technical meetings, additional regulation plans were developed and analyzed. This led to the development of a revised plan which was presented at a second public meeting in Austin on 19 December 1978.

The revised regulation plan (Plan 93') resulted in a significant increase of the flood protection without a significant decrease in hydropower generation. Major changes included the specification of a 3,000 cfs maximum release should the pool be forecast to rise into the 681.0-683.0 range, and the specification of a 5,000 cfs maximum release should the pool be forecast to rise into the 683.0 to 685.0 range. Another change included the implementation of a seasonal release scheme for forecasted pool elevations from 685.0 to 691.0. This plan also met current downstream water supply demands, lowered the 1% ACE water surface elevation at Lake Travis to 716.0, and lowered the 1% ACE water surface profile downstream of the dam through Austin. This did not cause a significant adverse impact on the environment. This revised regulation plan was jointly supported by the USACE, the BOR, and the LCRA. The plan was published in the Federal Register 44 FR 24551, and a copy is included in Exhibit L. The revised plan includes regulating discharges and stages at Austin, Bastrop, and Columbus.

h. Termination of Contracts. On 30 May 1997, the BOR, U.S. Department of Interior and the LCRA mutually agreed to terminate the existing contracts relating to Mansfield Dam. The BOR agreed to accept a discounted prepayment from the LCRA on the remaining unpaid reimbursable amount of the loan, provided that the title to the dam remained with the LCRA. In this agreement (see Exhibit G) the BOR relinquished all rights and obligations of the administration, operation, and oversight of all activities at Mansfield Dam to the LCRA.

i. Colorado River Flood Damage Evaluation Project. In response to the June 1997 flood on the Highland Lakes, the LCRA initiated steps to review flood management of the Colorado River, including a critique of reservoir operations and the initiation of a USACE flood damage evaluation feasibility study. The flood damage evaluation feasibility study was initiated in July 2000 and resulted in the development and evaluation of alternatives for implementing solutions to water resource-related problems within the Lower Colorado River Basin. The study included a detailed update of existing hydrologic and hydraulic conditions for 482 mainstem Colorado River miles from above Lake Buchanan to Matagorda Bay. The study utilized the latest available topographic data, field survey, gauge frequency analyses, period-of-record (70 years) analyses, HEC-HMS hydrologic modeling, reservoir operations simulations, and unsteady HEC-RAS hydraulic modeling. In addition to defining new existing conditions floodplain elevations and inundation maps along the Colorado River, the study looked at economic impacts as well as an inventory of existing basinwide environmental resources conditions, cultural resources, and an assessment of recreational amenities and needs within the basin.

One of the major results from the basinwide feasibility study was the increase of the 1% ACE flood pool elevation at Lake Travis from 716.0 to 722.0 using the current regulation plan (Plan 93'). As a result of this increase at Lake

Travis and increases to the floodplain in other areas, a series of subsequent studies were completed to evaluate the feasibility of flood damage reduction alternatives such as the construction of new reservoirs and changes to the Mansfield Dam regulation plan. Based on the studies and alternatives analyses, it was decided to only make minor variations to the current Mansfield Dam operating plan. Due to channel movement, datum shifts, channel topography and vegetation changes, the stages currently published in the official regulation plan (Exhibit L) for Mansfield Dam are more restrictive than the controlling discharges at Austin, Bastrop, and Columbus (30,000 cfs, 45,000 cfs, and 50,000 cfs, respectively). The revised plan will update the published stages so the regulating discharges control as originally intended. More details related to these changes are in Chapter VII.

3-06. Principal Complaints or Mishaps. In 1975, the USACE conducted a detailed field investigation in the Lake Travis area from elevation 681.0 to 703.0 and along the Colorado River downstream from Mansfield Dam to a point several miles downstream from the southeastern outskirts of Austin, Texas. The problems associated with flood control regulation of Lake Travis have been the result of increased urban development in the lake area and the downstream floodplain of the Colorado River. Development has only further increased since 1975 as discussed in Section 4-12.

As part of the Colorado River Flood Damage Evaluation Project (Section 3-05(h)), damages were updated to reflect 2000-2003 development conditions at Lake Travis and the greater Austin area below the dam. These damages were further updated in selected areas in the mid to late 2000s.

a. Lake Travis Area. A large number of residential, recreational, and commercial facilities have been constructed in the lake area. Development is expected to continue. Significant property damages were found to begin at elevation 690.0. A rise of the water level to elevation 714.0, the crest of the spillway, would cause over $140 million in damages (2012 dollars). It was also estimated that a further rise of the lake level to elevation 722.0 (1% ACE) would cause over $300 million in property damages (2012 dollars). The total damages at elevation 732.0 approaches $700 million. Plate 4-26 shows the shoreline damages in millions of dollars versus the pool elevation. Numerous complaints concerning high damaging lake levels have been brought to the attention of the USACE since 1973.

During flood events, homes, properties, and businesses around Lake Travis are impacted. The Graveyard Point area of Lake Travis includes homes that are flooded by pool elevations below 691.0. Flood storage and operations can also impact recreation by forcing the closure of parks and boat ramps around the lake.

Other complaints include periodic low lake levels at Lake Travis due to drought and the impacts these have on recreational interests. LCRA completed a Highland Lakes Recreation Impact Study in 2006 to evaluate the impact of alternative reservoir operating plans on Lake Buchanan and Lake Travis conservation pool water surface elevations, the Highland Lakes water supply mission, and the Highland Lakes flood control operations.

b. Downstream of Lake Travis Areas. Areas downstream of Lake Travis (particularly metro Austin and Bastrop County) have and continue to experience rapid growth and development. There have been few complaints by residents of Austin as a result of past flood control releases from the project. However, the maximum discharge since the construction of Mansfield Dam has only been 41,000 cfs, which occurred during the 1957 flood. Since the 1957 flood, the Colorado River floodplain in the Austin area has experienced considerable development.

Based on current development, a release of 30,000 cfs (lowest downstream control discharge) from Mansfield Dam would result in over $1 million in damages along the shoreline of Lake Austin. A 90,000 cfs release (2% ACE) would result in over $12 million in damages through Lake Austin. There are an estimated $8 million in structural damages along Lady Bird Lake and downstream to the Austin/Bastrop county line. Below Bastrop, agricultural damages increase significantly.

Hydrilla and other seasonal vegetation within the Colorado River channel have impacted operations of Mansfield Dam and water surface elevations through Lake Austin and Lady Bird Lake. LCRA is currently working with the City of Austin and the Texas Parks and Wildlife Department in an attempt to control the hydrilla growth and its impacts on hydraulic conveyance. The hydrilla results in higher water surface elevations for a given discharge and can impact gate operation decisions.

IV - WATERSHED CHARACTERISTICS

4-01. Characteristics.

a. General. The Colorado River Basin extends diagonally from a northwesterly to a southeasterly direction, rising in Chaves and Lea Counties in southeastern New Mexico, and continuing to the Central Texas Gulf Coast near Matagorda, Texas. A map of the basin is shown on Plate 1-1. The basin lies between latitudes 28° 22' and 33° 58' and between longitudes 95° 57' and 103° 31' and is approximately 595 miles long. It is geographically bounded on the north and east by the Brazos River Basin, on the south by the Nueces, Guadalupe, and Lavaca-Navidad River Basins, and on the west by the Rio Grande River Basin.

The basin width is about 70 miles in the High Plains region and increases to about 110 miles near Colorado City, Texas. The maximum width is about 160 miles in the vicinity of Concho and McCulloch Counties. From there it tapers to about 30 miles wide at Austin and down to 15 miles wide at Columbus. The basin encompasses a drainage area of 42,240 square miles above Bay City, of which 11,403 square miles are considered to be noncontributing in the hydrologic sense. The total contributing drainage area to Mansfield Dam is approximately 27,350 square miles.

b. Tributaries. The Colorado River system consists of the main stream and six principal tributaries: Beals Creek, Concho River, Pecan Bayou, San Saba River, Llano River, and the Pedernales River. All of these major tributaries enter the Colorado River above Lake Travis from the right (western) bank except Pecan Bayou which enters from the left bank. With the exception of Pecan Bayou and Beals Creek, the major tributaries are spring-fed streams which originate in the Edwards Plateau region. Pecan Bayou originates in central Callahan County southeast of Abilene, Texas, and Beals Creek originates at the Salt Lake, east of Big Spring, Texas. The tributaries enter the Colorado River at the following river miles: Beals Creek, 769.8; Concho River, 628.9; Pecan Bayou, 513.1; San Saba River, 479.8; Llano River, 405.1; and Pedernales River, 358.9.

4-02. Topography. The Colorado River Basin extends across three basic physiographic provinces: The Great Plains, the North Central Plains, and the Gulf Coastal Plains.

a. The Great Plains. The upper portion of the basin traverses the Texas-New Mexico High Plains area of the Great Plains (Staked Plains). It is a gently undulating plain with a regional slope to the southeast. The general land elevation of this area falls gently from about 4,000 feet NGVD along the New Mexico State border to less than 2,700 feet NGVD near Lake J. B. Thomas. In the northern part of the Staked Plains, the eastern boundary of these plains is marked by a sharp rough escarpment. This escarpment is known as the Caprock Escarpment and is several hundred feet high. Toward the south end of the Staked Plains, the Caprock Escarpment is less marked. On the southeastern border, where the High Plains adjoin the North Central Plains, there is little difference in topography and elevation between the two areas.

Most of the Staked Plains portion of the basin (approximately 6,400 square miles) contributes no runoff to the Colorado River as the precipitation tends to soak into the sandy soil or drain into playa lakes without surface outlets.

b. <u>The North Central Plains</u>. The middle portion of the Colorado River Basin crosses the North Central Plains between Big Spring and Austin, northwest of the Edwards Plateau. This portion of the river basin is characterized by areas that are gently sloped to steep rolling hills and eroded areas. The surface topography of the Edwards Plateau area is rugged, with steep hills and numerous streams. The general land elevation varies from about 2,600 feet NGVD on the northwest to less than 1,000 feet NGVD along the southeastern edge where it meets the Balcones Escarpment. Most of the lakes in the Colorado River Basin lie within this portion of the basin, including Lake Travis.

c. <u>The Gulf Coastal Plains</u>. The Gulf Coastal Plains extend from the Balcones Escarpment near Austin to the Gulf of Mexico. The surface topography of this section varies from a rolling hilly relief near Austin to a flat featureless relief near the coast. The surface elevations range from about 700 feet NGVD to sea level at the coast.

4-03. <u>Geology, Soils, and Ground Water</u>.

a. <u>Geology</u>. The general surface geology of the basin, like most of Texas, reflects a variety of complex strata-graphic and structural controls.

The High Plains consists primarily of the Phorine formation (Ogallala sand and gravel). In and contiguous to the Balcones fault zone, Pre-Cambrian granites, gneiss and schist occur in the area of the Llano Uplift and intrusive rocks are exposed. Sedimentary formations of the Cambrian, Ordovician, Pennsylvanian, Permian and Triassic systems outcrop in Central Texas. Cretaceous (Comanche series) formations dominate the Edwards Plateau, while the Gulf Coastal Plain is comprised of Cretaceous (Gulf Series), Eocene, Pliocene, Miocene, Oligocene and Quaternary formations.

The upper portion of Lake Travis flows over Paleozoic limestone and shale formed from shallow sea disposition on top of Precambrian rock. Just upstream of the mouth of the Pedernales River, the lake crosses onto the flat lying Cretaceous sandstones, conglomerates, and some shale and limestone, which contact the underlying Pennsylvanian deposits with an angular unconformity. The Cretaceous formations in order of their occurrence downstream are the Sycamore Sand, Hamate Shale, Cow Creek Limestone, and the Hansel Sand.

At Volente, the lake crosses onto alternating marl, dolomite, and limestone strata of the Glen Rose Formation. These deposits continue past Mansfield Dam to just upstream of Tom Miller Dam where the Edwards Limestone surfaces. Along the Colorado River downstream of Tom Miller Dam to the Gulf Coast, alluvium and terrace deposits cover the bedrock formations.

b. Soils. Soil cover in the Lake Travis vicinity is generally thin, less than 2 feet, and is similar in nature to the underlying bedrock. The thin soil cover is due to: (1) the dominant limestone parent material which weathers by dissolution leaving little material to form soil, (2) the high stream dissection associated with steep slopes and high erosion rates, and (3) the sub-humid climate of the area. Thicker dark soils occur on flat areas below steep slopes and thin light soils are common on slopes and hilltops. There are also many areas where the barren bedrock is at the surface with no soil cover.

c. Groundwater. Aquifers in the area of Lake Travis supply only small amounts of groundwater for domestic or livestock-watering purposes. A number of wells produce from the Trinity Group which includes the lowermost Cretaceous strata of the Glen Rose Formation and the Hensel and Sycamore sands. Other available groundwater occurs in the Edwards Limestone and the Ellenberger aquifer. Wells into the Trinity Group range in depth from 15 to 450 feet to the Glen Rose Formation, and 100 to 1,200 feet to the Hensel-Sycamore sands. The quality of the usable groundwater ranges from fresh to slightly saline.

4-04. Sediment. Erosion in the watershed is slight, due to the portion of range land with a fair to good cover of grass. The most active erosion occurs in the valley troughs on the Permian and Trinity outcrop areas and gravel terraces. Some erosion is caused by undercutting of channel banks. Due to the presence of the Highland Lakes on the mainstem of the Colorado River, the Pedernales River is the only major uncontrolled drainage area depositing sediment into Lake Travis. The sediment deposition within the lake is not significant and is not expected to cause any problems for a number of years. Based on the 2008 Texas Water Development Board (TWDB) volumetric survey of Lake Travis, the reservoir loses on average 250 acre-feet of capacity to sedimentation each year.

4-05. Climate. Climatological conditions over the watershed are generally mild and vary from subtropical along the Gulf Coast to semiarid in the upper headwater regions. The rainfall decreases rather uniformly from the Gulf of Mexico to the headwaters. At San Angelo in the upper Colorado River Basin, the average annual rainfall is approximately 24 inches. The average annual rainfall over the Highland Lakes and Lake Travis is approximately 33 inches, while Bay City, Texas receives approximately 46 inches annually. The Balcones escarpment and steep surrounding terrain can trigger intense rainfall when warm moist air from the Gulf of Mexico meets cooler air from the north. The average annual temperatures over the Basin are generally moderate, with the highest at the Gulf and decreasing gradually with the increase in latitude and elevation. Winter months are generally mild, but occasional cold periods of short duration result from the rapid movement of cold high-pressure air masses from the northwest. Snowfall and subfreezing temperatures are rare in the lower portion of the Basin near the Gulf, but are experienced occasionally during the winter season in the northerly parts of the Basin. Summer temperatures are high throughout the Basin.

a. Temperature. The average temperatures over the watershed are moderate, ranging from 63^o F at Colorado City to 69^o F at Austin. The maximum summer temperatures vary from 109^o F to 117^o F and the minimum winter temperatures from -9^o F to -2^o F. Table 4-1 shows the average monthly and annual temperatures at representative National Weather Service Stations, in downstream order. In the lake area, temperatures fall below freezing on an average of less than 25 days each year. Cold fronts during the winter months bring strong northerly winds accompanied by sharp drops in temperature, but cold spells rarely last more than 2 days.

b. Precipitation. The primary form of precipitation in the watershed is rainfall. The mean annual precipitation ranges from about 16 inches in the northwestern part of the watershed to 33 inches at Austin. Table 4-2 shows the average monthly and annual precipitation throughout the watershed. Heaviest rainfalls occur during the late spring and early autumn. Late summer and throughout the winter are the periods of least rainfall.

c. Snowfall. Snowfall is heaviest in the upper portion of the basin, but does not contribute a significant amount of runoff. It comes at infrequent intervals and melts rapidly. Snowfall is very rare in the southern area near the coast.

d. Evaporation. The average annual evaporation from Lake Travis is approximately 54.0 inches per year. At this rate the annual loss to evaporation is about 83,430 acre-feet per year. Approximately two-thirds of the annual evaporation occurs during the April through September period. Table 4-3 shows the monthly and annual evaporation at Austin.

e. Winds. The prevailing winds in the watershed are from the south or southeast during all but the winter months. During the winter months high pressure systems from Canada and the Northwest cause the prevailing wind direction to shift to the north over much of the watershed. Table 4-3 also shows the average wind velocity and the fastest velocity recorded at Austin.

TABLE 4-1
AVERAGE MONTHLY AND ANNUAL TEMPERATURES IN DEGREES FAHRENHEIT
COLORADO RIVER BASIN

Years of Record[1/]	Big Spring 1948-2011	Colorado City 1981-2010	San Angelo WSO-AP 1981-2010	Ballinger 1 SW 1981-2010	Coleman 1981-2010	Llano 1981-2010	Fredericksburg 1981-2010	Austin 1981-2010
Jan	43.7	42.7	44.2	45.0	46.4	47.7	47.1	51.5
Feb	47.8	46.5	48.3	49.0	49.8	51.7	50.6	55.0
Mar	55.3	54.9	55.8	56.6	56.8	58.7	57.2	61.7
Apr	64.6	63.6	64.1	65.6	65.6	66.9	65.4	69.2
May	72.9	72.6	73.1	73.9	73.6	75.5	72.9	76.6
Jun	80.0	78.8	79.6	80.2	80.2	81.8	78.5	82.2
Jul	82.7	82.2	82.2	82.9	83.5	84.9	81.1	85.0
Aug	81.8	81.4	82.0	82.8	83.7	84.9	81.3	85.8
Sep	75.1	74.0	74.9	75.8	76.7	78.1	75.3	80.0
Oct	65.4	64.3	65.4	66.1	66.9	68.5	66.6	71.2
Nov	53.5	52.6	54.5	55.3	56.3	57.6	56.1	61.0
Dec	45.7	42.9	44.8	45.2	47.1	48.6	47.8	52.5
Annual	64.0	63.1	64.1	64.9	65.6	67.1	65.1	69.4

[1/]Some weather stations may have periods of missing data in the years of record shown. All stations have longer periods of record than shown here.

TABLE 4-2
MONTHLY AND ANNUAL PRECIPITATION IN INCHES

Years of Record[1/]	Big Spring 1948-2010	Colorado City 1898-2008	San Angelo WSO-AP 1947-2010	Ballinger 1 SW 1897-2010	Coleman 1896-2010	Llano 1896-2010	Fredericksburg 1896-2010	Austin 1938-2010
Jan	0.64	0.67	0.89	1.00	1.29	1.34	1.34	1.97
Feb	0.78	0.86	1.19	1.18	1.45	1.69	1.74	2.28
Mar	0.86	1.17	2.25	1.32	1.64	1.74	1.96	2.22
Apr	1.42	1.99	1.47	2.12	2.64	2.66	2.83	2.89
May	2.69	2.88	2.02	3.49	4.12	3.63	3.60	4.16
Jun	2.29	2.3	2.69	2.52	3.27	2.71	3.11	3.60
Jul	1.81	2.22	1.61	1.59	2.14	1.79	2.15	1.98
Aug	2.18	2.28	3.78	2.18	2.34	1.87	2.58	2.26
Sep	2.75	2.58	2.58	2.89	3.13	2.79	3.14	3.29
Oct	1.75	2.16	2.81	2.48	2.74	2.64	3.24	3.38
Nov	0.76	1.15	0.88	1.37	1.70	1.94	2.09	2.54
Dec	0.58	0.81	0.57	1.08	1.33	1.58	1.66	2.27
Annual	18.65	21.24	24.21	23.18	27.68	27.11	29.59	33.04

[1/] Some weather stations may have periods of missing data in the years of record shown.

TABLE 4-3
MONTHLY AND ANNUAL EVAPORATION AND
WIND DATA AT AUSTIN, TEXAS

EVAPORATION			WIND VELOCITY[3/]			
Month	Years of Record[1/]	Avg. Evap.[2/] From Lake Surface (inches)	Years of Records	Average m.p.h.	Years of Records	Fastest Mile
Jan	71	2.41	70	8.5	32	37
Feb	71	2.51	70	9.0	32	39
Mar	71	3.83	70	9.7	32	36
Apr	71	4.60	70	9.5	32	46
May	71	5.49	70	9.0	32	52
Jun	71	6.58	70	8.5	32	41
Jul	71	7.30	70	7.9	32	40
Aug	71	7.22	70	7.4	32	35
Sep	71	5.15	70	7.1	32	52
Oct	71	4.04	70	7.4	32	33
Nov	71	2.74	70	8.1	32	36
Dec	71	2.11	70	8.2	32	44
Annual	71	53.98	70	8.4	32	52

[1/] 1941-2011
[2/] 1941-2007 from SUPER input data. 2008-2011 LCRA Daily Values.
[3/] ncdc.noaa.gov

4-06. Storms and Floods. The sudden rise of the Edwards Plateau west of Austin creates an environment that when combined with the right atmospheric conditions will produce heavy storm events. This part of Texas has experienced some of the highest 24-hour rainfall accumulations in the world.

a. Storms. The watershed above Mansfield Dam experiences three general types of storms: thunderstorms, frontal storms, and cyclonic storms. About three-fourths of the precipitation on the watershed results from thunderstorms and frontal storms with the remaining one-fourth attributed to cyclonic type storms. Precipitation from major storms that have occurred on the middle Colorado River Basin are summarized in Table 4-4.

TABLE 4-4
MAJOR STORMS ON COLORADO RIVER BASIN, 1900-2011[1/]
STORM PRECIPITATION IN INCHES

Storm Date[2/]	San Angelo	Llano	Fredericksburg[3/]	Austin
1900, April 5-8	-	4.65	4.81	7.10
1913, Dec. 1-5	1.35	4.68	6.65	14.07
1915, April 20-26	5.25	4.53	4.40	19.08
1921, Sept. 8-10	Tr.	1.79	3.50	19.26
1929, May 24-31	1.70	5.64	7.69	10.99
1932, June 30-Jul 2	0.26	2.05	6.89	0.09
1935, June 10-18	4.34	6.89	9.00	4.41
1936, Sept. 14-19	25.19	10.47	10.84	2.98
1936, Sept. 25-28	2.07	3.94	5.98	3.03
1938, July 19-25	3.65	10.19	2.52	1.42
1952, Sept. 9-11	0.27	15.68	15.90	2.40
1957, April-May	11.10	12.90	14.65	17.31
1959, Oct. 1-6	5.13	7.64	7.20	3.64
1969, Oct. 4-12	4.89	4.39	7.27	1.70
1973, Oct. 11-16	1.97	3.58	2.52	7.59
1978, Aug. 2-3	1.44	3.58	10.31	1.44
1980, Sept. 7-8	6.66	1.47	6.73	2.57
1981, Oct. 6-14	2.28	2.37	4.96	5.32
1984, Dec. 18-24	0.64	1.19	2.02	1.88
1991, Dec. 18-23	2.72	10.54	14.64	12.11
1997, June 20-22	0.02	3.20	7.67	3.27
2002, July 1-7	-	4.57	12.15	4.07
2004, November	6.22	6.00	5.77	14.10
2007, June - July	7.42	9.84	15.15	15.24

[1/] The storm center is usually not located on the four precipitation stations shown. Therefore, the isohyetal map for the specific storm generally shows a higher rainfall amount at another location within the basin than was reported above. Also refer to specific storm paragraph descriptions for higher rainfall totals.
[2/] In some storm events the rainfall amounts may have been caused by more than one weather system.
[3/] Precipitation reported at Fredericksburg from 1921 through 1938 were actually measured at the Carr Ranch in Gillespie County. Carr Ranch is located approximately 14 miles southwest of Fredericksburg, TX.

1. Thunderstorms. Thunderstorms in the watershed are sometimes accompanied by excessive rainfall for periods of up to 8 hours, but rarely produce excessive rainfall over an extensive area. Thunderstorms cause flash flooding in streams and are especially damaging to crops, because they frequently occur during the growing season.

2. Frontal Storms. The frontal storms result from warm moisture-laden air masses rising from the western Gulf of Mexico and converging with a tropical or polar air mass. These storms may occur in the late summer months and tend to last for several days. Some of the most severe storms on record that have occurred on the watershed are of the frontal type. These type of storms occurred on 19-25 July 1938 and 9-11 September 1952.

3. Cyclonic Storms. The cyclonic storms originate in the Mid-Atlantic Ocean, the Gulf of Mexico, and the Pacific Ocean. When tropical air masses, brought ashore by hurricanes, converge with a cold air mass, torrential rains occur. June through November is considered to be Atlantic hurricane season in the United States.

b. Floods. The topography, soils, and typical rainfall patterns of the Colorado River Basin lead to rapid runoff and sharp-crested flood hydrographs. Floods occur frequently and at most any time of the year. Between 1833 and impoundment of Mansfield Dam in 1940, the flood of 10-18 June 1935 had the largest recorded peak flow (481,000 cfs) at Austin and the flood of 19-25 July 1938 the second largest flow (276,000 cfs). The flow through Austin during the flood of 1869 is believed to have been higher than the two mentioned above, but there is little documentation.

No devastating floods have been experienced on the Colorado River at Austin since the construction of Mansfield Dam. However, the floods of 1952, 1957, 1991, 1997 and 2007, which originated upstream of Lake Travis, would have been disastrous to the City of Austin had Mansfield Dam not been there to detain the flood waters. Table 4-5 (pages T4.5-1 through T4.5-2) shows descriptions of the largest storms and floods in the watershed and the resulting flows at river gauging stations. Additional information on floods relating to the design and operation of Mansfield Dam may be found in Section 8-02 of this manual. Table 4-6 (page T4.6-1) is a summary of the stages and flows recorded at USGS gauges as a result of major floods in the Colorado River Basin prior to the impoundment of Mansfield Dam.

Table 4-7 is a summary of the stages and flows recorded at USGS gauges as a result of major floods in the Colorado River Basin after the impoundment of Mansfield Dam.

TABLE 4-7
MAJOR FLOODS IN THE COLORADO RIVER BASIN, 1940-2011
PERTINENT GAUGE DATA FOLLOWING IMPOUNDMENT
OF MANSFIELD DAM – SEPT. 1940

	Colorado River Near San Saba		Llano River At Llano		Pedernales River Near Johnson City		Colorado River At Austin[1/]	
Date	Stage/ Discharge (Feet)	(CFS)	Stage/ Discharge (Feet)	(CFS)	Stage/ Discharge (Feet)	(CFS)	Stage/ Discharge (Feet)	(CFS)
Apr-May 1941	26.18	42,600	12.64	26,700	12.83	21,100	18.55	47,600
Sept 1952	38.36	69,000	32.60	232,000	42.50	441,000	4.59	3,720
Apr-May 1957	37.34	66,200	16.36	47,200	24.80	125,000	-	-
Jun 1957	-	-	-	-	-	-	17.60	40,800
Oct 1959	30.56	44,500	27.02	154,000	-	-	-	-
Jun 1961	-	-	18.87	57,600	-	-	-	-
Jan-Feb 1968	-	-	16.22	44,400	-	-	-	-
Oct 1969	30.56	44,500	27.002	154,000	-	-	-	-
Oct 1973	31.35	46,200	26.98	154,000	-	-	14.54	16,800
Nov 1974	-	-	-	-	21.95	90,100	20.31	29,400
Apr 1977	-	-	18.66	67,500	22.60	98,100	22.23	34,300
Aug 1978	-	-	25.61	139,000	24.90	127,000	-	-
Jun 1979	-	-	-	-	19.75	64,200	-	-
Sept 1980	26.60	36,000	31.11	210,000	-	-	-	-
Oct 1981	-	-	23.79	116,000	16.67	32,300	-	-
Dec 1984	27.59	38,200	24.00	119,000	-	-	-	-
Oct 1985	-	-	16.47	47,100	20.59	74,000	-	-
Jun-Jul 1987	-	-	14.04	35,200	17.98	44,800	23.86	38,300
Jul 1988	-	-	19.21	72,100	-	-	-	-
Apr-May 1990	31.14	46,200	20.94	87,900	15.75	24,600	8.67	6,590
Dec 1991	31.60	47,400	20.48	83,500	21.32	82,700	26.40	38,700
Feb 1992	-	-	20.51	83,700	-	-	-	-
May 1995	-	-	-	-	-	83,400	18.23	24,000
Jun 1997	34.00	54,700	38.6	328,000	25.00	130,600	21.90	31,800
Jul 2002	19.82	23,400	-	-	26.00	108,000	-	-
Nov 2004	25.21	33,100	22.7	79,600	17.74	30,100	26.04	38,000
Jun-Jul 2007	24.74	28,100	20.46	72,700	-	-	21.60	28,700

[1/]River stages at the Austin gauge and other gauges downstream of Austin were affected by the reduced flows due to the impoundment of Mansfield Dam in September 1940.

The following descriptions of the floods of 1869, 1935, 1936, 1938, 1952, 1957, 1991, 1997, and 2007 are based on newspaper accounts, records of the USGS, the National Weather Service, and other historical records.

1. Storm of 6-7 July 1869. Probably the greatest flood on the Colorado River at Austin since at least 1833. The following excerpt is from an unpublished manuscript in the University of Texas library entitled Annals of

Travis County and All of the City of Austin by Frank Brown. This narrative describes this great flood.

"The highest and probably the most disastrous flood that ever came down the Colorado within a hundred years occurred in early July (1869). Certainly none such ever occurred within the memory of oldest inhabitants of the white race. The floods of 1833, 1836, 1843, 1852 and 1870 did not approach it in volume, by eight or ten feet. Early in the first week of July rains commenced falling and so continued at short intervals for several days. The stream commenced gradually rising, but no apprehension was felt of the heavy overflow. On the 6th, a tremendous flood suddenly came down in solid walls, overflowing all the lowlands and spreading over the valleys to the hills. The river rose to the top of the bluffs. The people thought the highest was reached, but the water continued to rise rapidly, and much alarm was felt. The river reached its highest mark on the evening of 7 July at about 9 o'clock. The rise was estimated at forty-six feet. The mass of water rushed down from the narrow and confined channel between the mountains above, to the wider one below, with such fearful velocity that the middle of the stream was higher than the sides, and the aspect it presented was appalling. During the night a slight fall occurred, and by morning the river had gone down several feet. From that time it gradually fell, and in about three days could be safely ferried. Such a flood may not occur again for a century to come, maybe never, for it will require a combination of circumstances as unlikely to occur as any that can be imagined."

2. Storm of 10-18 June 1935. This storm produced major flooding in the central and lower Colorado River Basin. The heaviest rainfall occurred on the Llano River and the upper portion of the San Saba River watersheds. The storm was centered near Segovia in the Llano Basin. The total rainfall near Segovia during the storm period was 19.1 inches, of which 14.3 inches fell within 18 hours. The South Llano and Llano Rivers set record stages, the former stream being 3 feet higher at Junction and the latter 3.6 feet higher near Castell than the previous maximum stages recorded in 1889.

The runoff peaks from the Llano and Pedernales Rivers nearly coincided as they contributed to flows in the Colorado River. This caused the stage at Austin to peak at 41.2 feet with a corresponding discharge of 481,000 cfs on 15 June 1935. This peak was about one foot lower than the peak stage in July 1869, which was the highest river stage known. This flood was the second largest flood since at least 1833 on the Colorado River. Peak discharges for this storm are shown on Table 4-5.

The total volume of this 9-day flood was 1,526,000 acre-feet and the flood damages in the Colorado River Basin were estimated to be $12,735,000 in 1935 dollars.

3. Storm of 14-28 September 1936. Two large storms in September 1936 resulted in massive flooding throughout the upper and middle

Colorado River Basin. The 14-18 September storm was a basinwide event with the largest rainfall concentrated in the Concho River Basin and headwaters of the San Saba, Llano, and Pedernales River Basins. Areas near San Angelo received near 30 inches of rainfall with widespread basinwide amounts exceeding 10 inches. The 25-28 September storm added an additional 2 to 7 inches of rainfall basinwide, further adding to the widespread flooding.

The average daily discharge on the Concho River at San Angelo exceeded 70,000 cfs for four days during this period. The peak flow was estimated to be 230,000 cfs. At Paint Rock, the Concho River peaked at over 300,000 cfs. Over 2 million acre-feet of runoff passed the Colorado River near San Saba gauge. In Austin, the flow peaked at 234,000 cfs on 18 September and a total of over 3.2 million acre-feet of runoff passed through Austin between 10 September and 10 October. If Mansfield Dam had been in place during this event, it would have been the highest recorded inflow volume to the reservoir within the historical period of record.

4. Storm of 19-25 July 1938. Destructive floods occurred in the Colorado River Basin in late July and early August 1938. These floods were caused by heavy rains over the watersheds of the San Saba River, South Concho River, and Brady Creek with the center of the storm near Christoval. The heaviest 1-day rain total reported was 13 inches at two locations, 8 and 10 miles north of Eldorado, on 23 July. During the period of 19-25 July, 30 inches of rain was reported at a gauge located 10 miles north of Eldorado and 20 inches or more was reported at 70 locations for the same period.

The flood waters in the Colorado River came principally from the San Saba River. The highest known stage height on the San Saba River gauge at San Saba was recorded during this storm. The gauge height was 45.18 feet with a corresponding discharge of 203,000 cfs on 23 July 1938. The flood waters from the Concho River joining the Colorado River reached the mouth of the San Saba River about 30 hours after the San Saba River peak had passed. The Concho River flood waters contributed little to the flood peak, however, this water did help sustain the high discharge in the Colorado River.

The peak stage height on the Colorado River at Austin was 32.1 feet with a corresponding discharge of 276,000 cfs on 25 July 1938. This was the second highest discharge during the period of record at the Austin gauge. The peak discharges from this storm are shown on Table 4-5. The 19-day volume of this flood was 2,439,000 acre-feet. Lake Buchanan, which was filled prior to the storm, had little regulatory effect on the flood.

Portions of 12 counties were inundated, 6 people were reported drowned, and property and crop losses were estimated at $5,600,000 in 1938 dollars.

5. Storm of 9-11 September 1952. The flood of September 1952 exceeded all known floods at many locations in the San Saba, lower Llano,

and Pedernales Rivers. Before the flood, central Texas was suffering from a severe and prolonged drought with many creeks and streams at their lowest levels or having completely dried up.

During the period 9-11 September, 2 to 26 inches of rain fell on an area 100 miles wide and 250 miles long, from Corpus Christi toward the northwest. The most extreme rainfall was 26 inches falling in two days on the Pedernales River near Hye. This rainfall caused the Pedernales River to reach its highest peak ever at Johnson City. The peak stage at Johnson City was 42.5 feet with a corresponding flow of 441,000 cfs.

On 11 September 1952, Lake Travis rose 56 feet in less than 24 hours, with an estimated peak inflow of 803,000 cfs. Prior to the flood, the water level at Lake Travis had fallen to elevation 619.33 with corresponding conservation storage of 374,000 acre-feet, or only 30 percent full. Because of the low lake level, Lake Travis was able to completely contain the 6-day volume of 720,400 acre-feet, thus preventing a catastrophe in the Austin Metropolitan area and further downstream. Had the lake level been at the top of conservation pool prior to the flood, the 720,400 acre-feet inflow would have raised the lake level above the spillway crest, elevation 714.0. The water stored during the 1952 flood helped supply water users at and downstream of Austin through the long drought of the 1950s.

Peak flows during this flood are shown on Table 4-5. During the flood, 5 persons lost their lives, 17 homes were totally destroyed, and another 454 homes were damaged. The total estimated damages in the Colorado River Basin were $4,729,000 dollars in 1952.

6. <u>Floods of April-June 1957</u>. Rainfall in the Colorado River Basin during the last half of April varied from 2 to 6 inches in the northwestern portion to 16 inches in the Lake Travis area. On 24 April, Lake Travis rose 13 feet in 24 hours with a computed peak inflow of 471,000 cfs. The lake stored about a quarter-million acre-feet of the flood runoff and prevented major damages downstream.

Below Austin, rainfall varied from about 12 inches in Austin and Smithville to about 6 inches near the coast. The heavy rains produced the first flood stages that occurred at Columbus and Wharton since the construction of Mansfield Dam. The initial flood crest passed Columbus on 29 April with a peak discharge of 61,600 cfs and Wharton on 30 April with a peak discharge of 54,000 cfs. Peak discharges recorded during this flood are shown on Table 4-5.

Heavy rainfall continued throughout the month of May with the heaviest amounts occurring in the central basin area from Ballinger to Austin. Monthly totals in this area ranged from 6 to 12 inches, while above Ballinger the totals ranged from 2 to 10 inches. Severe flooding occurred in the central basin area in the Concho River watershed where a peak discharge of 84,000 cfs was observed at Christoval on the South Concho River. Peak discharges on the main stem of the Concho River were 106,000 cfs near San Angelo on 09 May and 79,300 cfs near Paint Rock on 10 May.

Below Austin, the May rainfall amounts varied from about 4 to 8 inches and high flow continued in the river as a result of this rainfall. This downstream flooding restricted the evacuation of flood water from Lake Travis and caused the pool level to rise to a maximum elevation of 707.38. The maximum flood volume stored in the lake was 800,000 acre-feet with a maximum release from the dam of 35,000 cfs.

During May and June, two additional high inflows into Lake Travis occurred. The first peaked at 206,000 cfs on 26 May and the second peaked at 176,000 cfs on 12 June. The 3-month long flood produced an estimated inflow volume of 3,029,000 acre-feet. An estimated $3,455,000 in damages was caused by this flood in the Colorado River Basin, compared to an estimated $14,367,000 in damages prevented by the dams on the Colorado River.

7. Storm of 18-23 December 1991. An upper level low over Arizona forced the jet streams through Mexico and into Texas drawing moisture out of the Pacific Ocean. The moist air in the middle and upper layers of the system was the catalyst for the rains that occurred over the next several days. This resulted in some 100,000 square miles in the eastern-half of Texas receiving in excess of 4 inches of rainfall. The heaviest rainfall totals fell along the Edwards Plateau where 12 to 16 inch amounts were common. Austin received a record 14.16 inches in the month of December, 12.1 inches above normal, and a record annual 52.21 inches for 1991.

December saw one of its largest floods in terms of water volume. Major flooding occurred along the Pedernales and Llano Rivers. The river gauge near Fredericksburg on the Pedernales River recorded a stage height of 32.09 feet with a discharge of 49,900 cfs. The gauge near Johnson City recorded a stage height of 21.86 feet and a discharge of 89,000 cfs. The river gauge at Llano on the Llano River recorded a stage of 20.48 feet and a discharge of 83,500 cfs.

The hourly maximum inflow rate into Lake Travis based on change in water surface elevation was estimated at 258,000 cfs just before noon on 21 December. Due to downstream flooding, releases were delayed until 23 December. The lake continued to rise until 26 December when it reached a historic maximum elevation of 710.44. At this high elevation the lake contained approximately 1,850,000 acre-feet of storage.

Mansfield Dam reduced the peak flows at downstream locations. However, flood stages were recorded in the Austin area as well as downstream where several homes were flooded. The river gauges at Bastrop and Columbus recorded peak stages of 37.48 and 41.28 feet corresponding to flows of 70,600 and 72,800 cfs, respectively. Without Mansfield Dam the flow in the Colorado

River at Austin and downstream would have exceeded 200,000 cfs. Mansfield Dam prevented an estimated $ 62,700,000 in damages in 1991 dollars.

8. Storm of 20-22 June 1997. Beginning on 20 June, a moist tropical weather system moved into central Texas from south Texas and for the next two days began dropping large amounts of rain. Most of this rain fell in the central Colorado River and the Guadalupe River Basins. Most rainfall totals from the Colorado Basin area exceeded 5 inches for the period 20-22 June. Several areas within Mason and Kimble Counties reported from 10 to 14 inches of rain in this period. These higher rainfall totals were found primarily in the Llano River Basin, which was hardest hit during the flooding.

The Llano River at Llano reached a peak flow of 328,000 cfs on 23 June. This flood peak traveled quickly to Lake LBJ, a "run-of-the-river" reservoir with no flood storage capacity. When the flood waters arrived at Lake LBJ, all ten of the dam's floodgates were opened to pass the flow. Flood damage was reported along the Llano River from Castell to Kingsland, and on the upper and developed areas of Lake Marble Falls. While the Llano River was most severely affected by the storm event, other tributaries in the Colorado and Guadalupe River Basin also experienced flows above flood stage.

Six to nine inches of rain fell in the upper Pedernales River basin causing the gauge at Johnson City to peak at 130,000 cfs on 22 June. As the storm system slowly moved northward, additional rain fell in the San Saba, Pecan Bayou, and the upper Colorado watersheds. Peak flows on these tributaries occurred on 23 June.

Lake Travis began to slowly rise the evening of June 21 due to local rainfall. As flood water began to arrive from the Pedernales River on June 22, the lake began to rise faster, at a rate of 0.2 to 0.4 foot per hour. Later, when the floodwaters from the Llano River arrived, Lake Travis would rise at a maximum rate of about one foot per hour. The estimated peak inflow into Lake Travis was 340,000 cfs. Between 21 June through 11 July, the total inflow volume of the flood was computed at 1,020,000 acre-feet.

Lake Travis rose from an elevation of 684.0 on 21 June to a peak elevation of 705.11 on 26 June. This was Lake Travis' third highest level since the impoundment began in September 1940. Lake Travis' flood pool was used to hold the floodwaters while controlled releases were made for 31 days to draw the lake down to the conservation pool level of 681.0. The maximum release rate from Mansfield Dam during the June 1997 flood was approximately 30,000 cfs.

9. Storm of June-July 2007. A series of heavy rainfall events occurred across the state of Texas during June and July of 2007. Marble Falls, roughly an hour from Austin and just upstream of Lake Travis, received 19 inches of rain in a 24-hour period. Over 100 homes were damaged in Marble

Falls by the subsequent flash flooding event. The combination of this event and the additional rainfall that occurred during the summer resulted in Lake Travis reaching an elevation of 701.51, the fifth highest recorded stage since impoundment. The Llano River at Llano, Pedernales River at Johnson City, and Sandy Creek near Kingsland were all at flood stages at least once during the summer of 2007. The Llano River at Llano crested at a stage of 20.46 feet with a peak discharge of 72,700 cfs.

4-07. Runoff Characteristics. The Lake Travis drainage area is capable of producing a high runoff volume particularly if the soil moisture is above normal. Studies of historical storms indicate that from 0.4 to 2.0 inches of rainfall is needed for runoff to begin. The computed monthly and annual inflows to Lake Travis are shown in Table 4-8 (pages T4.8-1 through T4.8-3).

Tabulation of lake inflow volume for the median, 20%, 10%, 4%, 2%, and 1% ACE frequencies are shown in Table 4-9 (page T4.9-1). The monthly inflow frequency curves for the project are shown on Plates 4-2 through 4-13. The (a) series plots represent observed inflows from 1940-2011. The (b) series plots show the SUPER period-of-record simulation results (1930-2007). A plot of the period of record pool elevation is shown on Plate 8-6.

4-08. Water Quality. There are few significant water quality problems in the Colorado River Basin. The water quality in the San Saba, Concho, Llano, and Pedernales Rivers is excellent with sporadic dissolved oxygen standard violations and elevated fecal coliform bacteria levels. The Concho River near Paint Rock has very high concentrations of nitrate nitrogen. The O.H. Ivie Reservoir contains moderate concentrations of total dissolved solids and nitrates.

Cases of water quality degradation by mineral salts from natural sources and oil field operations are concentrated in the upper part of the basin. Other sources of stream contamination are industrial discharges, land disposal operations, irrigation return flows, storm runoff, and lake front contamination which can all be found to some degree in the basin. These other sources are insignificant when compared with problems caused by effluent-dominated streams and mineral salt contamination.

The Highland Lakes exhibit excellent water quality. The water in Lake Travis is considered to be one of the clearest of any reservoir in Texas. In general, the runoff is of good chemical quality and is suitable for municipal, industrial, and agricultural purposes.

4-09. Channel and Floodway Characteristics. A diagram indicating approximate flood crest travel times between key points along the lower Colorado River is presented on Plate 4-1. Stage-discharge curves for the downstream control points at Austin, Bastrop, La Grange, Columbus, and Wharton are shown on Plates 4-14 through 4-18. The rating curves are periodically adjusted by the

USGS for changing conditions to reflect the current flow-discharge relationships at the gauges.

Non-agricultural (structural) damage centers are concentrated in the reach of the Colorado River near Austin. The City of Wharton also experiences significant structural damage from floods. Agricultural damages occur along most of the Colorado River from the southern edge of Austin to the Gulf of Mexico. See Plates 4-19 through 4-25 for discharge vs. damage curves along the Colorado River from Mansfield Dam to the Gulf of Mexico.

a. Mansfield Dam to Tom Miller Dam. Within this reach, the Colorado River is confined within a narrow, steep-sided valley winding its way through rough, hilly terrain. Tom Miller Dam forms Lake Austin which extends up the valley to Mansfield Dam. The river channel is normally filled to an elevation of 492.8 by the waters of Lake Austin. Many residences, resorts, and recreational facilities are located on the shoreline of Lake Austin. The discharge-damage curve for this reach is shown on Plate 4-19, based on 2012 prices and 2008 development. Boat docks and other features along the shoreline of Lake Austin begin to be impacted by discharges of 5,000 cfs from Mansfield Dam.

b. Tom Miller Dam to Longhorn Dam. The Colorado River valley within this reach gradually widens and the sides gradually flatten until the river enters the low rolling hills of the Gulf Coastal Plain on the southeast edge of Austin. The river channel is normally filled to an elevation of 428.25 by the waters of Lady Bird Lake which is formed by Longhorn Dam. The shoreline of Lady Bird Lake has been extensively developed with commercial, industrial, residential, and recreational facilities. The discharge-damage curve for this reach is shown on Plate 4-20.

c. Longhorn Dam to Columbus, Texas. Within this reach, the Colorado River meanders through a moderately wide valley bounded by low to moderately rolling hills. For a few miles below Longhorn Dam, the floodplain has been developed with commercial, industrial, residential, and educational facilities, most of which are within the city limits of Austin. The remainder of the floodplain within this reach is being used primarily for agriculture. The city of Bastrop has experienced significant development along the Colorado River over the last several years. Discharge vs. damage curves for this area is shown on Plates 4-21 through 4-23.

d. Columbus, Texas to Gulf of Mexico. The Colorado River within this reach flows down a broad valley of very low relief. The floodplain is almost entirely used for agricultural purposes. The city of Wharton is located within the floodplain of the Colorado River near river mile 64.5 and includes significant structural damages. The discharge vs. damage curves for this reach is shown on Plates 4-24 and 4-25.

4-10. Upstream Structures. There are four tandem structures above Mansfield Dam that have a direct influence on Lake Travis. The LCRA regulates these structures for municipal, industrial, irrigation water supply and for the generation of hydroelectric energy. These structures and their corresponding drainage area and storage capacity are listed in Table 4-10. In addition to the LCRA Highland Lakes above Lake Travis, O.H. Ivie Reservoir is located on the Colorado River mainstem in Concho and Coleman counties, approximately 290 river miles upstream of Mansfield Dam. O.H. Ivie Reservoir is owned by the Colorado River Municipal Water District and provides water supply to several West Texas communities. Brady Creek Reservoir is located in the San Saba River watershed in McCulloch County. Lake Clyde, Lake Coleman, Lake Brownwood, and Hords Creek Lake are located in the Pecan Bayou watershed above Lake Travis. Hords Creek Lake is owned and operated by the USACE, Fort Worth District, and provides localized flood control in the Pecan Bayou watershed.

TABLE 4-10
HIGHLAND LAKES ABOVE MANSFIELD DAM

Structure	Impoundment	Contributing Drainage Area	Regulating Agency	Conservation Pool Storage
		(sq. mi.)		(AC-FT)[1/]
Buchanan Dam	Lake Buchanan	20,512	LCRA	886,626
Roy Inks Dam	Lake Inks	20,552	LCRA	14,074
Alvin Wirtz Dam	Lake Lyndon B. Johnson	25,523	LCRA	133,090
Max Starcke Dam	Lake Marble Falls	25,605	LCRA	7,486

[1/] TWDB Volumetric Surveys (2006-2008).

4-11. Downstream Structures. There are two structures in tandem that are directly influenced by releases from Mansfield Dam. The first, Tom Miller Dam is maintained by the LCRA for the generation of hydroelectric power, and water supply for municipal, industrial, and irrigation uses. The second, Longhorn Dam, is maintained by the City of Austin for municipal, industrial, and recreational use. Table 4-11 lists these structures and their corresponding drainage area. LCRA also owns and operates a small inflatable weir structure at Bay City to provide water supply for nearby irrigation districts.

TABLE 4-11
STRUCTURES BELOW
MANSFIELD DAM

Structure	Impoundment	Contributing Drainage Area (sq. mi.)	Regulating Agency	Conservation Pool Storage (AC-FT)[1/]
Tom Miller Dam	Lake Austin	27,443	LCRA	24,644
Longhorn Dam	Lady Bird Lake	27,600	City of Austin	7,013

[1/] TWDB Volumetric Surveys (2006-2008)

4-12. Economic Data. The economic data in this section are based on the 2010 U.S. Census and 2007 USDA Agriculture Census.

a. Population. The majority of the drainage area of the middle Colorado River watershed comprises parts of fourteen counties. The City of Austin, located southeast of Mansfield Dam is the largest population center in the middle watershed area. The 2010 population of the metropolitan area of Austin was over 1,716,280. Table 4-12 gives the 2010 populations of the fourteen counties located within the middle Colorado River Basin. Table 4-13 shows the growth rate of the Lake Travis/Austin area population for the last 60 years.

b. Agriculture. The predominant use of land in the Lake Travis watershed is for agriculture and ranching, although residential and commercial development is prevalent in the immediate vicinity of the lake. Major agricultural products for the five counties near Lake Travis are sorghum, cotton, small grains, pecans, and hay. Approximately 60 percent of the land is range and unimproved pasture land for cattle, sheep, and goats. Some hogs and poultry are also raised in this area. Table 4-14 gives the total agricultural acreage, the quantity of livestock and milk production, and the agricultural income for each county.

c. Industry. Services, trade, manufacturing, and construction are the primary industries in the three county areas around Lake Travis. Table 4-15 gives the estimated number of people employed in various industries in each county, as compiled by the United States Census Bureau in the 2006-2010 American Community Survey. Although the agricultural sector is the primary land use of the Colorado River Watershed, there is significant industrial and manufacturing development, centered in the urban and metropolitan areas.

TABLE 4-12
2010 POPULATION OF COUNTIES WITHIN THE MIDDLE COLORADO RIVER BASIN[1/]

County	2010 Populations
Blanco	10,497
Brown	38,109
Burnet	42,750
Coleman	8,895
Gillespie	24,837
Hays	157,107
Lampasas	19,677
Llano	19,307
Mason	4,012
McCulloch	8,283
Mills	4,936
San Saba	6,131
Travis	1,024,266
Williamson	422,679

[1/]2010 U.S. Census Bureau

TABLE 4-13
POPULATION DATA

Area	Census 1950	Census 1970	Census 1990	Census 2010	Growth 1990-2010
Williamson	38,853	37,305	139,551	422,679	303%
Austin MSA[1/]	162,333	297,027	846,227	1,716,289	203%
Travis County	160,980	295,516	576,407	1,024,266	178%
Burnet County	10,356	11,420	22,677	42,750	189%
Bastrop County	19,622	17,297	38,263	74,171	194%

[1/] Austin MSA is the population around the Austin metro area.

d. Flood Damages. Since 1975, Mansfield Dam has prevented over $332,500,000 in damages throughout the lower Colorado River basin. An average of $55,100 annual damages were incurred in the reaches of the Colorado Basin below Mansfield Dam from May 1965 through May 1975. Curves showing discharge vs. damages for the reaches of the Colorado Basin below Mansfield Dam are shown on Plates 4-19 through 4-25. The curves on Plates 4-19 through 4-21 are based on 2008 survey data and January 2012 prices. The curves on Plates 4-22 through 4-25 are based on 2003 survey data and January 2012 prices.

e. Potential Lake Travis Shoreline Damages. Information obtained from field surveys made in the 2000s along the Lake Travis' shoreline indicates that significant damages to property development begin when the lake elevation exceeds 690.0 (Graveyard Point). Plate 4-26 shows the shoreline damages in millions of dollars vs. the lake elevation.

TABLE 4-14
2007 AGRICULTURAL PRODUCTION OF COUNTIES LOCATED NEAR THE MANSFIELD DAM (LAKE TRAVIS) AREA[1/]

Product	Blanco County	Burnet County	Hays County	Travis County	Williamson County
	Acres Planted (in thousands)				
Oats	D*	2.5	D*	0.4	0.9
Sorghum	n/a	-	9.4	11.3	21.5
Wheat	D*	-	1.7	2.2	7.7
Peanuts	n/a	n/a	n/a	n/a	D*
Cotton	n/a	n/a	D*	2.4	21.2
Hay	9.4	14.4	10.0	18.9	47.0
Cropland Acres	9.9	15.5	15.6	49.1	182.5
# of Farms & Ranches planted in cropland	261.0	410.0	223.3	462.0	1,306.0
Cattle (1000 head)	20.7	32.6	16.3	24.2	79.1
Crop Income ($1000)	9,389	2,225	4,787	15,411	54,513
Livestock Income ($1000)	7,487	8,512	4,096	6,123	134,303
Total Agricultural Income ($1000)	16,876	10,762	8,883	21,534	188,816

*D-Withheld to avoid disclosing data for individual operations.
[1/] www.agcensus.usda.gov

TABLE 4-15
EMPLOYMENT IN COUNTIES WITHIN THE LAKE TRAVIS/AUSTIN AREA[1/]

Industry	Burnet County	Travis County	Williamson County
Agriculture, Forestry, Fishing, Hunting, and Mining	817	2,230	1,683
Transportation, Warehousing, and Utilities	822	15,381	7,115
Construction	2,696	46,342	13,460
Manufacturing	1,319	45,082	24,061
Trade	3,068	66,479	31,558
Information	462	14,407	4,824
Finance	1,312	37,376	15,505
Professional, Scientific, and Management	1,741	78,475	26.372
Education, Health, and Social Services	3,350	102,857	38,475
Arts, Entertainment, Recreation	1,726	53,983	13,766
Accommodation, and Food Services Public Administration	882	33,435	11,778
Other	822	26,136	8,442
Total	19,019	522,183	197,039

[1/]2006-2010 American Community Survey by the U.S. Census Bureau

V - DATA COLLECTION AND COMMUNICATION NETWORK

5-01. Hydrometeorological Stations.

a. Facilities. The U.S. Army Corps of Engineers (USACE), National Weather Service (NWS), U.S. Geological Survey (USGS), and the Lower Colorado River Authority (LCRA) cooperate in the collection and dissemination of hydrometeorological data related to the Colorado River Basin. The primary means used in transmission of data by the USACE and the USGS is the Data Collection Platform (DCP). Data from the DCPs are relayed via the Geostationary Orbiting Environmental Satellite (GOES) to the Wallops Island, Virginia downlink and into the National Oceanic and Atmospheric Administration (NOAA) computer. The data are processed and then re-transmitted over the Domestic Satellite System (DOMSAT). Data are received at the SWF Office and then processed and stored in the Corps Water Management System (CWMS) for use by the Water Resources Branch in routine and emergency water management activities. The SWF USACE also receives data directly from LCRA and the NWS.

Plate 5-1 shows the locations of pertinent stream gauges in the Colorado River Basin. The hydrologic gauge network for the Colorado River Basin is shown on Plate 5-2.

1. Precipitation Gauges. The LCRA maintains a hydrometeorological monitoring system (Hydromet) network of 239 automated reporting rain gauges. Of the 238 automated rain gauges, 66 are co-located at stream gauge stations and 10 are co-located with lake level gauge stations. The NWS utilizes an additional 70 NWS COOP gauges and 419 Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) precipitation gauges in the Colorado River Basin. The LCRA Hydromet precipitation data are provided to the NWS in the Standard Hydrologic Exchange Format (SHEF) every hour (15-minute values) via a ftp site. The Fort Worth District obtains the LCRA Hydromet data from the NWS in the SHEF format. In the past, LCRA also had cooperative rainfall observers, but that program has been discontinued by LCRA. Many of the previous cooperative rainfall observers are now part of the CoCoRaHS network.

2. Stream Gauges. The USGS maintains 71 stream gauges in the Colorado River Basin. Of these 71 gauges, 49 are located below O.H. Ivie Reservoir within the middle and lower Colorado River Basin. LCRA owns and maintains an additional 43 stream gauges throughout the middle and lower Colorado River Basin as part of the Hydromet system. The stream gauges designated as key stations for regulating purposes are shown on Table 5-1. The USGS gauges, including the key stations summarized in Table 5-1 transmit via DCP and GOES to the SWF USACE as outlined in Section 5-01(a). The LCRA owned stream gauges are transmitted to the NWS in SHEF format every hour

(15-minute values) via a ftp site and then obtained from that agency by the Fort Worth District Water Resources Branch.

TABLE 5-1
KEY REGULATING STATIONS

Station Number	Station	Method of Reporting
8177000	Colorado River near San Saba	DCP
8151500	Llano River at Llano	DCP
8153500	Pedernales River near Johnson City	DCP
8158000	Colorado River at Austin	DCP
8159200	Colorado River at Bastrop	DCP
8161000	Colorado River at Columbus	DCP
8162000	Colorado River at Wharton	DCP
8162500	Colorado River near Bay City	DCP

3. Weather Radar and Gridded Rainfall. The NWS maintains twelve Doppler radar sites distributed across Texas, with an additional five sites located in adjacent states near the Texas state line. In addition, the NWS cooperates with the Department of Defense to obtain radar information from four military sites in Texas.

The NWS provides multisensory precipitation estimates (MPE) to the Fort Worth District Water Resources Branch in a gridded XMRG format. This data is received directly from the NWS Southern Region Headquarters and also via a ftp transfer from the NWS Western Gulf River Forecast Center (NWS-WGRFC) in Fort Worth. Plans are underway to develop a Local Data Manager (LDM) to transmit this data. LCRA also receives the MPE product in a gridded XMRG format directly from the NWS.

b. Reporting. Stage (streamflow) and rainfall data are collected by the LCRA Hydromet and reported via ftp to the NWS-WGRFC. The data are distributed from the NWS-WGRFC to the USACE and to other NWS regional weather forecast offices. Additionally, the data are posted to LCRA's internet Hydromet page, http://hydromet.lcra.org, upon receipt for public access.

Real-time data from the NWS rainfall stations are reported by observers to the NWS. The reports are then obtained by USACE Water Management from a NOAAPORT ground receive station. In 1999 the old Automated Field Observation Service (AFOS) was replaced with the NOAAPORT satellite system for disseminating data. The NOAA Advanced Weather Interactive Processing System (AWIPS) Network Control Facility (NCF) sends thousands of types of data each day over this signal consisting of items such as observer and automated rainfall reports, river summaries and forecasts, flood warnings, severe weather statements, graphical display of weather patterns and precipitation, and point source DCP environmental data from the NOAA DCS (Data Collection System) Automated Processing System (DAPS). The NOAAPORT is the primary data link between the USACE and the NWS.

Data from Mansfield Dam including daily weather observations, pan evaporation, headwater and tailwater elevation, releases, and gate settings are provided by LCRA to the Fort Worth District Water Resources Branch. A website form is used to transmit the data from LCRA to the USACE, where it is written into SHEF files and stored in the USACE database. Gate settings are recorded manually by the LCRA River Operations Control Center (ROCC). Corresponding gate releases are then calculated based on headwater elevation levels. Turbine releases are automatically recorded. Evaporation is recorded from a pan at Mansfield Dam by LCRA personnel. River stages, headwater and tailwater elevations, gate settings, spillway discharges, and turbine discharges for Mansfield Dam are reported to the NWS and USACE. The DCPs are furnished by and are maintained either by the USACE, USGS, or LCRA to assure reliable transmission of real-time data.

The rainfall, project data, and river stage data from the above sources are automatically processed and stored in data files within the CWMS and used by the Water Resources Branch in routine and emergency water management activities. Once in these files the data are then utilized for checking project status, defining basin conditions, forecasting river flows, and disseminating information to other USACE elements. Data from these files serve as a historical record of stages and discharges from which Water Management functions are carried out. The data are stored in HEC-DSS (Data Storage System) format files, and most processing of these data are by internal computer software programs based on the DSS developed by the USACE Hydrologic Engineering Center (HEC) at Davis, California.

c. Maintenance. Maintenance and repair of the LCRA Hydromet system is the responsibility of the LCRA. As part of a cooperative operating agreement between the USGS and the LCRA, the LCRA also performs maintenance on the key regulating stations in Table 5-1. Maintenance and repair of NWS weather station instrumentation is the responsibility of the NWS.

Malfunctions of automated DCP rainfall or stream gauge stations are reported to the Fort Worth District Water Resources Branch personnel responsible for coordination with the USGS and with stream gauge personnel who maintain the project gauges. The funding for maintenance of USGS gauges is provided through interagency funding between the USACE, USGS, and LCRA.

5-02. Water Quality Stations. LCRA has an active water quality sampling program which gathers and stores data for several sites on Lake Travis and throughout the Colorado River Basin. In addition to LCRA water quality monitoring, the Upper Colorado River Authority (UCRA), Colorado River Municipal Water District (CRMWD), City of Austin, and TCEQ also maintain gauges and monitoring equipment throughout the basin. Water quality data is available at http://waterquality.lcra.org/.

5-03. Sediment Stations. There are no historical sedimentation or degradation ranges established for sediment studies at Lake Travis. However, the TWDB performed a volumetric and sedimentation survey in 2008 and recommended a follow-up survey using similar technology in about 10 years, or after a major flood event. Bathymetric data was collected along pre-planned range lines approximately 500 feet apart and oriented perpendicular to the original river channels. The bathymetric data was augmented with high resolution LiDAR data for computation of reservoir capacities. TWDB does not recommend comparison of the 2008 survey results to previous survey results due to differences in the methodologies used for the respective surveys.

5-04. Recording Hydrologic Data. Hydrologic information is recorded as it is received by the Water Resources Branch, Fort Worth District USACE. Recording procedures for each type of data are as follows:

a. River and Stream Stages. River stage data are collected by DCPs. The data are transmitted every hour by the DCPs via the GOES satellite system. The hydrologic data are captured and processed at the district office in Fort Worth, where the data are stored in CWMS. The recorded data and monthly data summaries are kept in the Water Resources Branch files.

As LCRA Hydromet river gauge data are returned to the ROCC, the data are transmitted to the NWS-WGRFC via ftp. The river gauge data are subsequently transmitted to the NWS weather field offices and to the USACE Water Resources Branch. Monthly and annual reports are compiled for each of the LCRA Hydromet system river gauges.

Hourly stage data from the Colorado River and the tributaries identified in Table 5-1 are received via DCP and processed. After the data are checked and corrected, hourly stage data are converted to discharge with a stage discharge rating curve. The hourly discharge data are stored into CWMS. The USGS maintains records for some of these stations.

b. Lake Elevations and Gated Releases. Lake Travis' elevation is measured by a tape and float stilling well system at Mansfield Dam and transmitted to the LCRA ROCC. Hourly data are captured and stored in the Hydromet database at the ROCC. Once stored in the database, the lake elevation data are transmitted to the NWS-WGRFC via ftp. The lake level data are subsequently transmitted to the NWS weather field offices and to the USACE Water Resources Branch.

Flood gate operations are relayed from the project to the ROCC, where the operations are recorded in a log book. Instantaneous and mean daily floodgate discharges are also transmitted to the Water Resources Branch in a daily report.

c. Precipitation. As LCRA Hydromet precipitation gauge data are returned to the ROCC, the data are transmitted to the NWS-WGRFC via ftp. The precipitation data are subsequently transmitted to the NWS weather field offices and to the USACE Water Resources Branch. Monthly and annual reports are compiled for each of the LCRA Hydromet system precipitation gauges.

d. Weather Reports. The Water Resources Branch receives real time weather information including radar images from commercial weather services by cable TV. This information is used primarily for short-term decision making. The weather reports are updated throughout the day by the NWS.

e. Hydropower Production and Releases. Instantaneous hydropower generation values are recorded at the project and transmitted to the ROCC. At the ROCC, a discharge rate is associated with the hydropower generation setting. A hydropower generation output and discharge is calculated hourly and recorded in a database. The daily totals are transmitted to the Water Resources Branch via the NWS-WGRFC.

5-05. Communication Network. Communication between the LCRA and the USACE Fort Worth District is conducted by local and long distance commercial telephone service, cellular phones, fax, and e-mail. Telephone numbers are shown for each office in Table 5-2. The project office has radio repeaters and radios used mainly by the LCRA rangers, the project office, and law enforcement. Should communication between Mansfield Dam and the LCRA ROCC be disrupted, the on-site LCRA project personnel will initiate flood control regulations in accordance with the emergency rules in paragraph 7-05 and Exhibit M of this manual.

5-06. Communication with Mansfield Dam. There is no scheduled or set communications between the Water Resources Branch and the project. Normal data channels are through the DCP network. LCRA internally communicates between the project and ROCC as outlined in the following sections. Most communications are related to hydropower operations and flood control releases when required. During a flood event LCRA is in contact with the USACE Water Resources Branch and NWS via telephone and e-mail. Plate 5-3 shows the lines of communication.

a. LCRA River Operations Control Center (ROCC) with Project Office. The normal mode of communication between the LCRA ROCC and Mansfield Dam Office is by private LCRA telephone line, with a trunking voice radio (900

MHZ) system as a backup.

b. Between LCRA and Others. Communications to warn of possible flood conditions, etc. are made through the National Weather Service. LCRA makes press releases to the local media, commercial radio, television and newspaper during heavy rain storms. Emergency Official Notification summarizing the river conditions is distributed by the LCRA Emergency Management Office to local emergency managers and law enforcement personnel when there are high flows in the Colorado River. In addition, LCRA emergency hotlines are established to relay the most recent river level and forecast information to persons or agencies on an as requested basis.

The LCRA Operations Project Manager is responsible for alerting people that might be adversely impacted by project operations such as large changes in release rates and changing pool stages, especially when pool stages are approaching the limits of the reservoir boundary. This warning will be accomplished by the most expedient and effective means of communication available. Currently, LCRA operates a Floodgate Operations Notification Service to notify individual subscribers by email or phone that floodgate operations are expected to begin or have begun. Additionally, LCRA maintains a Flood Situation Report web page (http://floodstatus.lcra.org/) to advise the public of lake level forecasts and flood operations on the Highland Lakes. When adequate time exists, information to be passed to the general public will be accomplished in coordination with and through the Public Affairs Office. Before a gate operation change is made, a warning by use of a siren shall be given to alert persons downstream. Reconnaissance by vehicle of areas downstream from the dam may be made to notify fishermen and others if unusual releases are made.

TABLE 5-2
TABULATION OF OFFICE TELEPHONE NUMBERS

Office	Telephone Number	Location	Personnel
Water Resources Branch - USACE	817-886-1549	Fort Worth	Jerry Cotter
LCRA – ROCC Plans Section	512-578-2538	Austin	Dan Yates
LCRA – ROCC Hydro Controls Section	512-578-3058	Austin	Scott Hausmann
NWS - WGRFC	817-831-3289	Fort Worth	Tom Donaldson

TABLE 5-2
TABULATION OF OFFICE TELEPHONE NUMBERS
(continued)

Office	Telephone Number	Location	Personnel
NWS - WFO	830-606-3617	New Braunfels	Joe Arellano
Austin/San Antonio USGS	512-873-3002	Austin	Joseph Capesius
Hydrology and Hydraulics Branch - USACE	409-766-3113	Galveston	Charles Scheffler

5-07. Project Reporting Instructions. Hydrologic data are routinely reported by the project via the LCRA ROCC to the NWS and USACE Water Resources Branch. However, in the event of a failure in the automated data system (CWMS), the LCRA project personnel will furnish headwater, tailwater, rainfall, turbine releases, and gate operations data to the Water Resources Branch by telephone, fax, or e-mail. LCRA shall furnish the USACE, Fort Worth District, and Water Resources Branch by 0900 daily, with the following:

1. Lake Travis information:

   (a). Lake elevations at 1600, midnight, and 0800.

   (b). Flood-control conduits and turbine releases: At 0800, in cubic feet per second and total discharge, in day-second-feet, for the previous 24 hours ending at midnight.

   (c). Precipitation and evaporation measured at the dam, in inches, for the previous 24 hours ending at 0800.

   (d). Summary of streamflow and channel conditions at gauges named in paragraphs 7-03 and 7-05 (a).

2. Lake Buchanan information:

   (a). Lake Buchanan's pool elevation at 0800.

   (b). The Water Resources Branch or the District Engineer may request additional data during flood surveillance and flood control operations.

5-08. Warnings. In the event of a major flood at Mansfield Dam, the LCRA Emergency Management Office should contact emergency management officials. The law enforcement agencies shown in Table 5-3 may be contacted to assist in warning the public and if necessary evacuating the areas of potential flooding.

TABLE 5-3
LAW ENFORCEMENT AGENCIES

Agency	Telephone Numbers
Texas DPS - Austin, TX	(512) 424-2000
LCRA Public Safety Dispatch	(512) 482-6322
Austin City Police	(512) 974-5750 or 9-1-1
City of Austin EOC	(512) 974-5253
Travis County Sheriff's Dispatcher	(512) 854-9770 or 9-1-1

Flood emergency warnings and other information that need to be passed to the general public will be made by newspapers, radio, Internet, and television to the extent adequate time exists. These announcements are coordinated by the Public Affairs Office for the general public and by the Emergency Operations Office for distribution through emergency communication channels required by ER500-1-1 and OM 500-1-1 at the USACE.

These USACE offices rely on LCRA to alert them of a developing situation that requires warnings or information releases outside the USACE channels.

In rapidly changing situations where time frames are inadequate for dissemination of information through the above procedure, the LCRA or other personnel authorized by the LCRA will provide warnings or alerts to people in the immediate areas of potential impact. The Project Office should maintain a current list of people, properties, and public use areas that would be endangered or adversely impacted by pool levels outside normal limits or by sudden or large changes in releases. Notifications to individuals on this list would be by the most appropriate means in response to the situation which is developing. This could include telephone, commercial radio and television, marine radio, employee visits for warnings to specific remote areas, and alerts to and use of law enforcement, civil defense, and other local agencies. In addition to these warnings, a warning siren should be sounded prior to each change in release as a warning for downstream users in the immediate area.

Studies have been made to determine the possible downstream flood conditions and inundated areas that could exist in the event of a large project release caused by a dam failure. Results of these studies and actions to be taken are contained in the *LCRA Emergency Management Master Plan, Annex E –*

Emergency Action Plan for Highland Lakes and Power Plant Dams, dated December 2010.

5-09. Routine Information for Public Release. Information on current headwater and tailwater elevations, flow conditions, and selected stream stages are made available to the public via the Fort Worth District website (www.swf-wc.usace.army.mil/) or the LCRA website (www.lcra.org).

VI - HYDROLOGIC FORECASTS

6-01. General. Streamflow forecasts are needed on the Colorado River and its major tributaries for real-time project operations, planning and scheduling future operations, and hydropower scheduling. Stage forecasts are generally needed in conjunction with high flow situations where high stages are expected to cause flooding.

a. Role of Corps of Engineers. The Fort Worth District Water Management Section coordinates with LCRA on the regulation of the flood pool of Mansfield Dam. LCRA is primarily responsible for making the forecasts with assistance from the USACE as needed. The Public Affairs and Emergency Management Offices of both the USACE and LCRA coordinate during flood events to ensure that press releases to the news media and general public are consistent.

b. Role of LCRA. The LCRA makes inflow and corresponding lake elevation forecasts for use in the regulation of Mansfield Dam using data detailed in Chapter V. During flood events, LCRA utilizes their flood forecasting system capabilities, as discussed in Section 6-02. Daily inflow forecasts are also required for water supply operation decisions and hydropower scheduling during non-flood events. LCRA has a meteorologist on staff to assist with weather and precipitation forecasts.

c. Role of Other Agencies. The NWS-WGRFC provides information about river flow and flood forecasts to the USACE, the LCRA, and the general public. They prepare the official forecasts for public dissemination in the form of stage forecasts for key river stations. The USACE and LCRA utilize the NWS forecasts during flood events to respond to public inquiries and as additional information for forecasting project inflows and releases. The National Weather Service issues routine scheduled reports/products containing the following information:

1. Weather forecasts (daily forecast, severe weather forecasts, and five-day extended forecasts).

2. Quantitative Precipitation Forecasts: Five day forecasts consisting of 6 hour totals are updated every 12 hours. These forecasts may be updated every 6 hours when conditions warrant.

3. Five-day synoptic time river stage forecasts from the River Forecast Center. These forecasts are issued twice daily and can be issued more frequently when conditions warrant. The forecasts are based on NWS action/flood stage criteria.

4. Urgent priority messages such as severe weather warnings, severe weather watches and statements, and instructions from Civil Defense centers during emergency situations.

5. Other information reports, on a periodic basis:

(a). Winter weather and road conditions.

(b). River and flood warning bulletins.

(c). Damage Reports.

(d). Thirty-day weather forecasts.

6-02. Flood Condition Forecasts.

a. Requirements. Flood condition forecasts are necessary whenever substantial rainfall has fallen above or below the reservoir and inflows have the potential to cause the reservoir to rise into the flood pool.

b. Methods.

1. LCRA. The LCRA ROCC operates a real-time flood forecasting model as a decision support tool in making reservoir operation decisions. The LCRA utilizes the HEC-CWMS modeling software package to support final operational decisions. The models and system were developed and deployed at LCRA in the early to mid- 2000s and have been updated periodically since that time. The system includes several components:

(a). Data Acquisition Module. This module allows LCRA to review the status and quality of the data being received, including: point rainfall gauges, gridded MPE, streamflow gauges, reservoir levels, etc.., as detailed in Chapter V.

(b). Data Visualization Module. This module allows LCRA to check the current state of the hydrometeorological data prior to making a forecast.

(c). Hydrologic Modeling. HEC-CWMS utilizes a HEC-HMS hydrologic model to forecast runoff within the Colorado River Basin. The HEC-HMS hydrologic model includes over 18,300 square miles of area from O.H. Ivie Reservoir to Matagorda Bay. LCRA can utilize either the Hydromet rainfall gauges or the NWS gridded MPE product within HEC-CWMS to make a forecast. The system allows LCRA the ability to adjust hydrologic modeling parameters during an event.

(d). Reservoir Simulation. HEC-CMWS utilizes a HEC-ResSim reservoir simulation model which includes the Highland Lakes and the current Mansfield Dam operation plan as discussed in Chapter VII. The system allows LCRA to model reservoir release decisions using rule-based simulations or specified operational plans.

(e). River Hydraulic Simulation. Hydraulic studies of the Colorado River have been completed to analyze the effects of releases on the water surface elevations of the Highland Lakes and the Colorado River downstream of Tom Miller Dam.

Results from the LCRA HEC-CWMS generated forecasts are used by the ROCC as a decision support tool for reservoir release decisions. Once the ROCC has determined a desired reservoir release, the ROCC makes the corresponding changes in floodgate and/or turbine settings in coordination with staff located at each plant. LCRA provides the observed and forecasted releases from the Highland Lakes to the NWS and USACE so the NWS can make the official river stage forecasts at key points in the lower basin.

Flows from the Colorado River, the Llano River (entering the Colorado River between Inks Lake and Lake Lyndon B. Johnson) and the Pedernales River (entering the Colorado River between Lake Marble Falls and Lake Travis) constitute the bulk of inflows entering into Lake Travis. Key stream gauge stations and the time of travel from each gauge to Lake Travis are listed in Table 6-1. The method of data collection is explained in Chapter V of this manual.

2. National Weather Service. The NWS-WGRFC in Fort Worth prepares hydrologic and hydraulic model simulation runs using the NWS Community Hydrologic Prediction System (CHPS). All available data including observed and forecasted precipitation are collected, quality controlled, and processed. Six-hour increment synoptic time stage and flow forecasts are issued 5 days into the future. Forecasts can be extended further into the future as required.

(a). Precipitation. Precipitation estimates are available to NWS forecasters from three main sources: precipitation gauges, radar, and satellite. These data sources are combined to create the MPE gridded rainfall product. Data from these sources are used by the NWS to produce a suite of hydrologic forecasts. Weather Surveillance Radar-1988 Doppler (WSR-88D), also known as Next Generation Weather Radars (NEXRAD), observe the presence and calculate the speed and direction of severe weather.

(b). Runoff. Once the areal pattern and depth of the storm rainfall have been determined, the Sacramento Soil Moisture Accounting (SACSMC) Model is used to estimate the surface runoff. The estimated runoff, in inches, is averaged over each sub-basin and applied to a pre-determined catchment unit hydrograph for each sub-basin that contributes inflow.

(c). Unit Hydrographs. The Colorado River Basin has been divided into sub-basins of a few hundred square miles each. Unit hydrographs representing one inch of runoff have been developed at six-hour intervals for each of the sub-basins. Forecast hydrographs, at six-hour time intervals, are then computed by multiplying the unit hydrograph discharges by the predicted runoff for each area.

(d). Routing Sub-area Hydrographs to Downstream Points. Flood Routing is accomplished by the Variable Lag and K Storage Method. Lag and storage functions for each reach have been determined by empirical evaluations of past floods.

(e). Hydrograph Summation. Inflow forecasts are made by routing each sub-area's hydrograph using the Lag and K Storage Method and then summing the resultant hydrograph discharges. Observations of river stages and rate of change in the reservoir storage are also used to verify the forecasted inflows.

(f). Reservoir Simulation. Reservoir simulations are made using inflow forecasts and observed and forecasted releases.

3. Fort Worth District. The Fort Worth District Water Management Section does not routinely make forecasts for Mansfield Dam since LCRA operates the dam.

6-03. Conservation Purpose Forecasts. The LCRA is the regulating agency for the water in the conservation pool in Lake Travis. The water in the conservation pool is used for irrigation, municipal water supply, recreation, hydropower generation, and improvement of navigation. LCRA must routinely make releases from the conservation pool at Lake Travis to meet downstream contractual water supply demands and environmental flow requirements. These releases are typically coordinated with hydropower generation schedules. LCRA uses daily forecasting and accounting models, including RiverWare, for water supply operations.

6-04. Long-Range Forecasts. Long-range weather forecasts are available in the NWS publication, "Average Monthly Weather Outlook". Due to the rapid runoff of rainfall and short travel distances in the Colorado River Basin, long range hydrologic forecasts of more than a week are not feasible.

6-05. Drought Forecast. LCRA's Drought Contingency Plan (Chapter 4 of the TCEQ approved Water Management Plan for the Lower Colorado River Basin) provides information on historical droughts in the basin and methods used to determine the severity of a drought. Drought forecasts are prepared to establish a controlled means for providing a response to worsening drought conditions. Drought conditions will increase demands on streamflow in the Colorado River and it may become necessary to revise project operations based on the LCRA Water Management Plan and Drought Contingency Plan. In general the three factors used to forecast the severity of a drought are the lake content, lake inflow, and Palmer Drought Severity Index (PDSI).

The Palmer Index reflects the cumulative excess of deficiency in moisture relative to seasonal norms and typically ranges from +4 to –4 but may exceed these values. A -4 value indicates that abnormally dry conditions have prevailed. The NWS publishes the PDSI about once a week.

TABLE 6-1
FLOOD CREST TRAVEL TIMES

LCRA & USGS Stream Gauges	Approximate Time of Peak Travel
COLORADO RIVER	
Ballinger	
	1 day
Winchell	
	1 day
San Saba	
	18 hours
Buchanan Reservoir	
	9 hours
Lake Travis	
SAN SABA RIVER	
Menard	
	6 hours
Brady	
	18 hours
San Saba	
	6 hours
San Saba (Colorado River)	
LLANO RIVER	
Junction	
	12 hours
Mason	
	18 hours
Llano	
	9 hours
Lake Travis	
PEDERNALES RIVER	
Fredericksburg	
	6 hours
Johnson City	
	6 hours
Lake Travis	

VII - WATER CONTROL PLAN

NOTE ON VERTICAL DATUM:

The project vertical datum for Mansfield Dam and Lake Travis was originally established referenced to the National Geodetic Vertical Datum of 1929 (NGVD29). In 2006 the LCRA discovered a 0.40-foot discrepancy between the project datum, hereafter called the LCRA Legacy Datum (also known as the Hydromet Datum), and the historically referenced NGVD29. In the interest of consistency with historic records, project structural elevations and pool elevations will continue to be referenced to the LCRA Legacy Datum. The relationship of the LCRA Legacy Datum to the most commonly referenced vertical datums are:

NGVD29 = LCRA Legacy Datum + 0.40
NAVD88 = LCRA Legacy Datum + 0.60

7-00. Division of Responsibilities. As a result of Section 7 of the Flood Control Act of 1944, the USACE is responsible for prescribing a formal water control plan for regulation of the Lake Travis storage space allocated for flood control (elevation 681.0 feet to elevation 714.0 feet), and documenting the water control plan in a water control manual. This responsibility is executed in accordance with Engineering Regulation (ER) 1110-2-241, *Use of Storage Allocated for Flood Control and Navigation at Non-Corps Projects* (24 May 1990). The project owner, the LCRA, is responsible for specification of the plans of regulation for the storage space below elevation 681.0 feet (conservation storage) and above elevation 714.0 feet (surcharge storage).

By agreement with the USACE, the LCRA is responsible for day-to-day (real time) implementation of the USACE prescribed water control plan of regulation for the Lake Travis flood storage space. As per ER 1110-2-241, consultation and assistance will be provided by the USACE when appropriate and to the extent possible. During an emergency that affects flood control, the USACE may temporarily prescribe regulation of flood control storage space on a real-time basis without request of the project owner. When the USACE is prescribing regulation of flood control storage space on a real-time basis, cooperation of the project owner to the extent possible will be expected. Special requests by the project owner are preferred before the USACE offers advice on real-time regulation during surcharge storage utilization. The LCRA is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Any assistance provided by the USACE concerning surcharge regulation is to be used at the discretion of the LCRA, and does not relieve the LCRA of the responsibility for safety of the project.

In the interest of effective and efficient operation of this multi-purpose project, over its entire pool elevation range of operation, Chapter VII of the Mansfield Dam and Lake Travis Water Control Manual includes both the USACE regulation plan for the flood control storage space, and references to the LCRA plans of regulation for the remaining storage space.

7-01. General Objectives. The objectives of Lake Travis are flood control, stream regulation, hydroelectric power generation, irrigation, water supply, and recreation use.

7-02. Project Constraints. The 700 foot long uncontrolled spillway crest is at elevation 714.0 and the top of the dam is at elevation 750.0. A concrete parapet wall with top elevation 754.0 sits atop the dam. Storage space in Lake Travis is allocated as follows:

Below EL 681.0	Conservation (Water Supply and Hydropower)
EL 681.0 – 691.0	Joint Use (Flood Control and Hydropower)
EL 691.0 – 714.0	Flood Control
Above EL 714.0	Surcharge

The intake invert elevation of the hydroelectric power penstocks is 552.0 Combined generation capacity of the three turbines is 116 megawatts, which produces a combined discharge of about 7,400 cfs when the pool is at elevation 681.0; and 6,500 cfs when the pool is at elevation 714.0.

Each of the 24 gated flood control conduits have an intake invert elevation of 535.75. Twenty-three of the 24 conduit gates are designed to be operated either fully open or completely closed. In the interest of minimizing downstream impacts, for so long as the lake level is forecast to remain below elevation 714.0, opening or closing of these 23 conduit gates shall generally be performed at a maximum rate of one conduit gate per hour. Exceptions to this general rule may be required in the event of occurrence of a dam safety issue, or a forecast indicating the lake level may be expected to rise into surcharge above elevation 714.0.

One of the conduit gates has been converted to a partial-flow valve gate which may be operated at various flow settings for use as a regulating gate. When the lake is at elevation 681.0, each conduit gate will discharge about 5,250 cfs, and the partial-flow valve gate will discharge its maximum of about 2,500 cfs, making possible a 24-gate combined total release of approximately 123,000 cfs. Each conduit gate will discharge about 5,600 cfs when the lake is at elevation 714.0, making possible a 24-gate combined total release of about 131,000 cfs.

7-03. Overall Plan for Water Control. Within the Colorado River Basin, Texas, four projects built by or with the assistance of the Federal Government provide downstream flood control protection: Twin Buttes, O.C. Fisher, Hords Creek, and Mansfield Dam (Lake Travis). The considerable distance (328 river miles) and large intervening drainage area (23,100 square miles) separating Lake Travis and the three upper basin flood-control projects prevent realizing any significant benefits from coordinating releases to control the inflow into Lake Travis.

Lake Travis is the fifth project in a series of six lakes operated and controlled by the LCRA for the generation of hydroelectric power, water supply, flood management, and economic development. Recreation is an ancillary benefit actively supported by the LCRA. These six projects in downstream order are: Lake Buchanan, Inks Lake, Lake Lyndon B. Johnson (Alvin Wirtz Dam), Lake Marble Falls (Max Starcke Dam), Lake Travis (Mansfield Dam) and Lake Austin (Tom Miller Dam). The releases from each of the six projects are closely coordinated by the LCRA ROCC. Four of the projects (Lakes Inks, Lyndon B. Johnson, Marble Falls, and Austin) are run-of-the-river projects. Lady Bird Lake (formerly Town Lake), located downstream of Lake Austin, is owned and operated by the City of Austin. Lady Bird Lake does not contain any hydroelectric facilities.

The capability of the four upstream lakes to control the inflow of flood water into Lake Travis depends on their antecedent lake elevations, as they were not designed to provide flood control. The majority of inflows to Lake Travis are comprised of the mainstem flows of the Colorado River, the tributary flows of the Llano River (entering the Colorado River between Inks Lake and Lake Lyndon B. Johnson) and the unregulated tributary flows of the Pedernales River (entering between Lake Marble Falls and Lake Travis). During flood conditions, the following upstream USGS gauging stations are used as indicators of the magnitude of inflows to Lake Travis:

Gauge #470 - Colorado River nr San Saba (USGS #08147000)
Gauge #515 - Llano River at Llano (USGS #08151500)
Gauge #535 - Pedernales River nr Johnson City (USGS #08153500)

The gauges are shown on the Watershed Map on Plate 5-1, identified by the “Gauge #” shown above to the left of the gauge name. These three gauges collectively monitor runoff from 24,900 (91%) of the 27,400 square mile total contributing drainage area above Mansfield Dam.

7-04. Standing Instructions to the LCRA.

a. Normal Operations in the Conservation Pool. When the reservoir is in the conservation pool, below elevation 681.0, the LCRA will manage the lake according to their plan of regulation in the Water Management Plan, dated 27 January 2010, as it may be amended from time to time.

b. Normal Operations in the Flood Pool. When the reservoir level is in the 681.0 to 714.0 range, Lake Travis will be regulated in accordance with the normal flood control regulations as presented in paragraph 7-05 of this manual and illustrated on Plate 7-1.

c. Unusually High Lake Level or Questionable Dam Safety Conditions. By design, and in coordination with the LCRA, the normal flood control regulations provide for a transition from normal operations in the flood pool to surcharge operations directed by and at the discretion of the LCRA. This transition occurs when the pool is forecasted to peak in the 714.0 to 722.0 range in elevation, an event for which releases are specified in the normal flood control regulations, and upon the occurrence of which the LCRA will notify the USACE Fort Worth District Water Resources Branch as soon as reasonably practicable.

As the lake level actually rises into surcharge, above top of flood pool elevation 714.0, or has been forecasted to exceed elevation 722.0, or if the structural integrity of the dam is at any time in question, the LCRA will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure to the maximum extent possible, and will notify the USACE Fort Worth District Water Resources Branch as soon as reasonably practicable.

d. During Communication Outage. In the event of a communication outage between the USACE and the LCRA, the LCRA will become solely responsible for regulation of the Lake Travis flood control storage space. The LCRA will rely on the Flood Control Regulation Plan as presented in paragraph 7-05 of this manual, summarized in Table 7-2 (pages T7.2-1 through T7.2-3), and illustrated on Plate 7-1 to make changes in the rate of release. Every effort will be made by both agencies to re-establish communications.

e. During Emergency Events. If an emergency (an unexpected occurrence or situation requiring prompt action outside the scope of normal operations) occurs when the reservoir is in the conservation pool, refer to current LCRA Highland Lakes Operating Guidelines, and notify the USACE Fort Worth District Water Resources Branch as soon as reasonably practicable. Although emergencies occurring during conservation operations do not constitute deviations from the flood control regulation plan (as described in Section 7-15), the USACE shall be notified and consulted for assessment of any possible impacts to the flood control functionality of the project.

7-05. Flood Control Regulation.

a. General. Lake Travis will be regulated to reduce flooding on the Colorado River below the dam. Flood control storage in Lake Travis will be evacuated as rapidly as downstream channel capacity permits in order to provide flood protection against future storms. Hydroelectric power shall be produced, to the extent possible, during the evacuation of flood water. Hydroelectric turbine releases may be used to regulate discharges to prevent the project from contributing to an exceedance of downstream control discharges. Forecasted reservoir inflows, and observed and forecasted rates of flow at the following upstream USGS gauging stations will be considered when scheduling flood releases:

(i) Colorado River near San Saba (08147000)
(ii) Llano River at Llano (08151500)

(iii) Pedernales River near Johnson City (08153500)

Until such time as the lake level exceeds, or is forecast to exceed, elevation 714.0 (top of flood pool), releases from Lake Travis will be made at a rate which, when combined with downstream inflows to the Colorado River, will not cause the control discharges shown in Table 7-1 to be exceeded. Control discharges will not be modified due to minor shifts in the respective control point stage-discharge relationships, but will be reassessed if significant shifts indicate the possibility of negative impacts.

TABLE 7-1
CONTROL DISCHARGE AT KEY DOWNSTREAM CONTROL POINTS

Station	USGS Station ID	Control Stage (ft)	Control Discharge (cfs)
*Austin	08158000	33.0	30,000
		NA [1/]	50,000
Bastrop	08159200	27.2	45,000
		NA [1/]	50,000
Columbus	08161000	35.5 [1/]	50,000

[1/] No downstream control stages when pool elevation 710.0 is forecast to be exceeded; control is discharge only.

*Prior to 1 Jan 2012, the Austin control point gauge (USGS Station ID 08158000) was located about 1,400 feet upstream from the northbound U.S. Highway 183 bridge. Effective 1 Jan 2012, the gauge was officially relocated and activated at its present site, about 3,200 feet downstream from the northbound U.S. Highway 183 bridge. At the time of relocation, the discharge associated with a stage of 33.0 feet at the new gauge site was determined to be equivalent to the discharge associated with a 24.0 foot stage at the old gauge site.

b. Normal Flood Control Regulations. This regulation plan will govern flood control releases from Mansfield Dam and is as follows:

1. Elevation 681-683. If the lake level is forecast to rise above elevation 681.0 (top of conservation pool), but not to exceed elevation 683.0, the rate of release, subject to the downstream control discharges specified in Table 7-1, shall be increased to a minimum daily average of 3,000 cfs and maintained until the lake level recedes to elevation 681.0. The maximum daily average rate of release shall not exceed 7,500 cfs.

2. Elevation 683-685. If the lake level is forecast to rise above elevation 683.0, but not to exceed elevation 685.0, the rate of release, subject to

the downstream control discharges specified in Table 7-1, shall be increased to a minimum of 5,000 cfs and maintained until the lake level recedes below elevation 683.0. The maximum rate of release shall not exceed 30,000 cfs.

3. Elevation 685-691 (Seasonal Operation).

(a). During the months of January through April, July through August, and November through December: If the lake level is forecast to rise above elevation 685.0, but not to exceed elevation 691.0, the rate of release, subject to the downstream control discharges specified in Table 7-1, shall be increased to a minimum of 5,000 cfs and maintained until the lake level recedes below elevation 683.0. The maximum rate of release shall not exceed 30,000 cfs.

(b). During the months of May, June, September, and October: If the lake level is forecast to rise above elevation 685.0, but not to exceed elevation 691.0, the rate of release, subject to the downstream control discharges specified in Table 7-1, shall be increased to a maximum of 30,000 cfs, and maintained until the lake level recedes below elevation 685.0.

4. Elevation 691-710. If the lake level is forecast to rise above elevation 691.0 (the top of the joint use pool), but not to exceed elevation 710.0, the rate of release, subject to the downstream control discharges specified in Table 7-1, shall be increased to 30,000 cfs and maintained until the lake level recedes below elevation 691.0.

5. Elevation 710-714. If the lake level is forecast to rise above elevation 710.0, but not to exceed elevation 714.0, the rate of release, subject to the downstream control discharges specified in Table 7-1, shall be increased to 50,000 cfs and maintained until the lake level recedes below elevation 710.0.

6. Elevation 714-722. If the lake level is forecast to rise above elevation 714.0 (top of flood pool), but not to exceed elevation 722.0, the rate of release shall be increased to the lesser of 90,000 cfs or the forecasted peak rate of inflow. Downstream stage or flow controls will not apply when the pool exceeds, or is forecast to exceed, elevation 714.0. As the lake level exceeds elevation 714.0, the LCRA will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure to the maximum extent possible.

7. Elevation 722 and Above. If the lake level is forecast to rise above elevation 722.0, the LCRA will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure to the maximum extent possible. In accordance with the LCRA's surcharge operation plan, opening of the remaining closed conduit gates will proceed until:

a) A revised forecast indicates the pool will peak at or below elevation 722.0, at which time opening of additional conduit gates will cease.

Or,

b) The LCRA directs an alternative course of action for protecting the safety of the structure.

The normal flood control regulations for given lake levels and downstream river conditions are summarized in Table 7-2 (pages T7.2-1 throughT7.2-3) and illustrated on Plate 7-1.

c. Emergency Flood Control Regulations. When communications between the ROCC, and the LCRA personnel at Mansfield Dam are disrupted, the dam personnel will, on their own initiative, direct regulation of the lake in accordance with the Emergency Lake Regulation as described in Exhibit M until communications are restored. Exhibit M outlines instructions to the Dam Tender.

7-06. Recreation. The authorizing Congressional legislation does not include recreation as a project purpose, and there is no storage or release of water specifically designated for recreation. However, recreation is an ancillary benefit actively supported by the LCRA.

a. Upstream Recreation. The Lake Travis public facilities for recreation purposes are described in Section 2-06.

b. Downstream Recreation. Requests for special releases will be considered as the situation warrants. The LCRA will coordinate the releases made from Lake Travis for recreational purposes.

7-07. Water Quality. The authorizing Congressional legislation does not include water quality control as a project purpose, and the Mansfield Dam outlet works do not have a multilevel withdrawal system. However, the LCRA has added equipment to Mansfield Dam to oxygenate releases to Lake Austin for environmental purposes. Upstream of the dam, the quality of water in Lake Travis is within the standards set by the TCEQ for domestic raw water supply; and contact and non-contact recreation uses.

7-08. Fish and Wildlife. The authorizing Congressional legislation does not include propagation of fish and wildlife as a project purpose and there are no special provisions required for this purpose. The quality of the impounded and released water is within the TCEQ standards for fisheries and wildlife.

7-09. Water Supply. Lake Travis contains 1,134,956 acre-feet of conservation storage below elevation 681.0. The LCRA controls and manages the conservation storage to satisfy the requirements of streamflow regulation, industrial, municipal, irrigation, recreation, and hydroelectric power generation demands. The irrigation season is 15 March to 15 October. The TCEQ has granted the LCRA the right to divert and use 1,500,000 acre-feet of water annually from lakes Buchanan and Travis combined (see Exhibit H), subject to the terms and conditions of the TCEQ-approved Water Management Plan.

7-10. Hydroelectric Power. The turbines at Mansfield Dam are capable of making releases at a maximum rate of approximately 7,400 cfs when the pool is at elevation 681.0. In order to fully utilize the generating capacity of downstream Tom Miller Dam, generation from Mansfield Dam is normally limited to an average daily release of approximately 3,000 cfs. During flood control operations, when Lake Travis is above elevation 683.0, turbine releases may be made at full power. See Plates 7-4(a) and 7-4(b) for the Turbine Performance curves.

7-11. Navigation. Under the 404 permitting process, the Colorado River is considered to be navigable up to Longhorn Dam. Currently, the Colorado River is navigable for barge traffic for the initial 22.8 miles. This portion of the river is under the jurisdiction of the Galveston District. The possibility of navigation as far upstream as Austin has been investigated. The studies indicate that navigation that far upstream is not economically feasible.

Releases greater than 10,000 cfs affects barge traffic on the Gulf Intracoastal Waterway near the mouth of the Colorado River. During evacuation of flood water from Lake Travis, the Galveston District is notified of forecasted flow exceeding 10,000 cfs.

7-12. Colorado River Basin Drought Contingency Plan. When there is a water shortage refer to the LCRA Drought Contingency Plan and the LCRA Water Management Plan for the Lower Colorado River Basin (as it may be amended from time to time). The LCRA Drought Contingency Plan presents a broad outline of actions necessary to manage the water resources in the river basin during the time of a shortage. The LCRA's Water Management Plan includes a chapter entitled "Drought Management Plan and Drought Contingency Plan". The overall goals of the LCRA Plan are to extend available water supplies; preserve essential uses of water; protect public health and safety during extreme shortages; and equitably distribute among the LCRA’s water customers any adverse economic, social, and environmental impacts associated with drought-induced water shortages.

7-13. Flood Operations Emergencies. The Flood Operations section of the LCRA Highland Lakes Operating Guidelines contains detailed instructions and procedures to be followed by the LCRA personnel at Mansfield Dam, power plant, and reservoir to aid the project dam personnel during an emergency situation.

7-14. Other. There are no other issues associated with this project.

7-15. Deviation From Normal Flood Control Regulation. There are occasions when it is necessary or desirable to deviate from the water control plan for short periods of time. Prior approval of a deviation by the USACE Southwestern Division Water Management Office is normally required. The requirement for prior approval may be suspended in emergencies.

The USACE Fort Worth District Water Resources Branch will serve as the LCRA point of contact for any deviation from the water control plan of regulation for flood control. Insofar as practicable, requests shall be submitted in writing and approval received prior to initiating a deviation action. Requests for deviation shall describe lake and watershed conditions, flood potential and planned response, possible alternative measures, expected benefits, and possible effects on other authorized project purposes. The Fort Worth District Water Resources Branch will review deviation requests and coordinate with the Southwestern Division Water Management Office for approval. The record of deviations will be stored in electronic format. Deviation requests usually fall into the following categories:

a. Emergencies. Temporary deviation from the water control plan may be necessary in the event of an emergency. Necessary action under emergency conditions is taken immediately unless such action would create equal or worse conditions. Possible reasons for an emergency include: drowning, accidents, failure of operating facilities, flushing of pollution, and protecting the safety of the dam. The Fort Worth District Water Resources Branch shall be informed of emergency deviations as soon as practicable by the quickest means available. Written documentation describing the nature of the emergency, subsequent response, and pending conditions shall follow as soon as practicable. Continuation of the deviation will require approval of the Southwestern Division Water Management Office.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan. These unplanned instances are not considered emergencies and require prior approval for deviations. Construction accounts for the majority of unplanned deviations. Possible reasons for unplanned deviations include stream crossings of pipelines, bridge work, embankment repair, utility placement, and other major construction contracts. Requests for changing release rates can vary from a few hours to a few days.

Each request is analyzed on its own merit. Consideration is given to upstream and downstream watershed conditions, potential flood threats, conditions of the lake, and possible alternative measures. In the interest of maintaining good public relations, the requests for deviation are usually approved, provided that there are no adverse effects on the overall operation of the project, or other projects.

c. Unplanned Major Deviations. There are unplanned instances that create a temporary need for major deviations from the normal regulation plan. These unplanned instances are not considered emergencies and require prior approval for deviations. Requests for changes in release rates generally involve short time periods ranging from a few hours to a few days in an effort to minimize damages or optimize benefits. Flood control releases account for the major portion of these incidents and typical examples include project pre-releases or exceeding downstream channel capacity.

Each request is analyzed on its own merit. In evaluating the proposed deviation, consideration must be given to the upstream and downstream watershed conditions, potential flood threats, condition of the lakes, and possible alternative measures that can be taken.

d. Planned Deviations. Anticipated or planned deviations from the regulation plan will be jointly investigated by the LCRA and the USACE. Each proposed deviation will be evaluated on the basis of flood potential, lake and watershed conditions, and expected benefits to ensure that the flood protection provided by Mansfield Dam is not unduly compromised.

7-16. Operation Curves. Conduit discharge rating and spillway discharge rating curves are shown on Plates 7-2 and 7-3, respectively. The turbine performance curves are shown on Plates 7-4(a) and 7-4(b). The tailwater rating curve is shown on Plate 7-5. Table 7-3 (page T7.3-1) is a tabulation of the discharge for one open conduit gate vs. elevation. Table 7-4(a) (pages T7.4a-1 through T7.4a-8) and Table 7-4(b) (pages T7.4b-1 through T7.4b-8) show reservoir elevation vs. capacity and area data, respectively. Stage versus discharge rating curves for key downstream control points are shown on Plates 4-14 through 4-18.

VIII - EFFECT OF WATER CONTROL PLAN

8-01. General. Mansfield Dam is the only flood control project on the main stem of the Colorado River. The dam is the fifth in a series of six hydroelectric power generation projects operated by the LCRA. Some of the key provisions of the Water Control Plan are to provide flood control, water supply, hydroelectric power, and recreation.

In addition, LCRA operates lakes Buchanan and Travis and the Colorado River as a single system in accordance with the state-approved "Water Management Plan for the Lower Colorado River Basin" (Water Management Plan). The Water Management Plan is not a static document. The Texas Commission on Environmental Quality (TCEQ) requires that LCRA develop and periodically revise the Water Management Plan for review and approval by TCEQ. The Water Management Plan was originally approved on 20 September 1989. Subsequent revisions were approved on 01 March 1999, and 27 January 2010. The latest proposed revision to the Water Management Plan was submitted to TCEQ for review in April 2012, and is pending approval as of January 2013.

8-02. Flood Control.

a. Spillway Design Flood. The BOR (Robert Lowry) completed a report in May 1937, *Flood Control by Marshall Ford*, for Mansfield Dam. The BOR analyzed forecasting times and transposition of historical storms. The study developed lake levels for varying storm frequencies ranging from the 4% annual chance exceedance (ACE) event to the Maximum Flood. The study assumed a 36-hour forecast period with a pre-release of 108,000 cfs. The BOR study shows the maximum flood to have a peak inflow rate of 900,000 cfs and an inflow volume of 3,118,000 acre-feet. The design storm to produce this 900,000 cfs is a storm that has a contributing area of 26,200 square miles with precipitation totaling 12 inches in 3 days. This was based on the June 1899 storm centered over the Brazos River Basin.

b. Probable Maximum Flood. In 1945, the USACE prepared an inflow design flood to test the adequacy of the spillway at Mansfield Dam. The design storm transposed patterns of the July 1933, the September 1936, and the July 1938 storms. With the effects of upstream dams considered, the study produced an inflow design flood having a peak of 957,300 cfs and a 10-day volume of 5,300,000 acre-feet.

An inflow design flood for Lake Travis, prepared by the USACE in October 1944, had a peak discharge of 957,300 cfs and a 10-day volume of 6,143,800 acre-feet. When this flood was routed through the reservoir, Lake Travis reached a maximum elevation of 748.8 and the maximum discharge from the reservoir was 706,000 cfs. This flood was developed on the basis that San Angelo, a modified Brownwood, San Saba, Winchell, Buchanan, and Marble Falls Reservoirs were in operation.

The BOR developed a new inflow design flood for Mansfield Dam, approved in August 1972, having a peak inflow of 821,000 cfs and a 10-day volume of 4,100,000 acre-feet based on the 8-10 September 1921 Thrall, Texas storm. Lake Travis peaked at elevation 738.8 with a maximum release of 479,000 cfs. The inflow design flood does not include an estimated base flow of 1,570 cfs in the Colorado River.

A new probable maximum flood was approved for Mansfield Dam by memorandum, dated 03 January 1986. The new calculated PMF shows the peak inflow rate to be 931,000 cfs and a 30-day inflow volume of 6,036,700 acre-feet. With the initial water surface for the routings at elevation 681.0 and all of the outlet gates closed during the PMF, the maximum reservoir water surface was estimated to be at elevation 750.28, which would be 0.28 feet above the dam crest, but 3.72 feet below the parapet wall. The reservoir water surface elevation would remain above the dam crest for a period of approximately 9 hours. The maximum peak discharge during the PMF was estimated to be 602,210 cfs.

The PMF can be passed through the dam at the maximum design water surface elevation of 746.0 with the combined discharge of the spillway and 10 of the 102-inch paradox gates open. With all flood gates closed and 85% of the PMF having occurred, it is estimated that the lake would reach an elevation of 746.0 and there would be four feet of freeboard to the dam crest.

In 1991, the PMF was re-evaluated for Mansfield Dam by LCRA. The Inflow Design Storm rainfall above Mansfield Dam was determined in accordance with the method described in Hydrometeorological Report No. 51 and Hydrometeorological Report No. 52. The 1991 study assumed an antecedent storm event that resulted in a Lake Travis pool elevation of 699.3 at the onset of the PMF event. An 18-hour forecast was utilized and all conduits were assumed fully opened once the forecasted pool elevation exceeded 722.0. The results of this PMF analysis resulted in a peak inflow of 1,109,031 cfs with a total 19-day inflow volume (including the antecedent event) of 5,876,333 acre-feet. The pool peaked at elevation 752.7 with a maximum release of 806,015 cfs. Plate 8-1 shows the 1991 PMF hydrographs for Lake Travis.

c. Standard Project Flood. The standard project storm was developed from the storm of 27 June through 01 July 1940 transposed 130 miles upstream to a critical area centering above Mansfield Dam. Rainfall excesses were computed by subtracting adopted loss rates from the rainfall rates. Flood hydrographs were computed by applying the appropriate rainfall-excess to the appropriate unit hydrograph. All reservoirs were assumed to be at top of conservation pool at the beginning of the standard project storm. Outflow from the upstream lakes were routed downstream using the Straddle-Stagger Method and progressively combined with local downstream hydrographs. The resulting standard project flood inflow hydrograph for Mansfield Dam has a peak discharge of 926,000 cfs and a total volume of 3,506,000 acre-feet. The maximum water surface elevation was 731.0 with a peak discharge of 309,000 cfs.

8-03. Recreation. Lake Travis and other areas around the Highland Lakes and lower Colorado River Basin receive considerable recreational use from boaters, fishermen, park visitors, swimmers, and windsurfers from all over Texas and the Southwestern United States. Significant economies have developed around these areas, particularly Lake Travis and the other Highland Lakes. Low lake levels have adverse impacts on these recreational interests. One of the major goals of the state-approved Water Management Plan is to conserve the water stored in lakes Buchanan and Travis. This is accomplished, for example, by reducing the amounts of water available for interruptible supply during droughts. Therefore, operation of the Highland Lakes in accordance with the Water Management Plan mitigates the adverse impacts of low lake levels on recreation, consistent with the overall and competing demands on the system.

8-04. Water Quality. The water quality in Lake Travis is good overall. Some problems concerning Lake Travis and other Highland Lakes are point source discharges into the lake(s). Point source pollution in the lake areas usually consists of community sewage treatment discharges or industrial contamination. This pollution can present a serious problem because of the reduced assimilative capacity of the lakes. LCRA is working with communities which discharge into the lakes to develop land application and irrigation projects to eliminate such discharges.

Non-point source (NPS) pollution is usually transported by runoff from urban and agricultural areas. NPS pollution may consist of soil erosion and leakages from faulty septic tanks. The quality of water in the Highland Lakes chain (including Lake Travis) is of great concern because they serve as the source of drinking water for over a million residents in the Austin metro area.

During the summer months there are some problems with low levels of dissolved oxygen in Lake Travis. This is due to the stratifying of the lake during the warmer months combined with the extreme depths of the intakes to the turbines and flood gates. Sometimes the passage of water with low dissolved oxygen levels from one Highland Lake into another will cause a fish kill in the downstream reservoir. The instream flow requirements as discussed in Section 8-05 provide for water quality protection.

8-05. Fish and Wildlife. The state-approved Water Management Plan sets requirements for Instream flows along the lower Colorado River below Mansfield Dam and freshwater inflows to the Matagorda Bay and Estuary system. The goal of the plan is to maintain and where reasonably possible, improve fish and wildlife resources in the lower Colorado River Basin. Successive revisions to the Water Management Plan rely on the most recent scientific studies to develop criteria for environmental flows.

Under the current Water Management Plan, criteria for Instream flows and freshwater inflow volumes are determined for the entire year based on storage on 01 January. Monthly criteria for Instream flows are defined at “critical” or “target” levels. Monthly criteria for freshwater inflow volumes are defined at “critical”, “intermediate”, or “target” levels. LCRA has set aside 33,440 acre-feet per year of its firm supply from lakes Buchanan and Travis for environmental flow purposes.

The pending Water Management Plan relied upon the most recent Matagorda Bay Health Evaluation (MBHE) study. If approved, the pending Water Management Plan would make a number of significant revisions to the current criteria for environmental flow requirements. Applicable environmental flow criteria will be determined on two dates for different periods of the year, rather than only 01 January as with the current plan.

For Instream flows, the pending Water Management Plan defines criteria for “subsistence”, “base-dry”, and “base-average” levels. Criteria in place from March through June would be based on the storage on 01 January, and the criteria in place from July through February would be based on storage on 01 June. When the combined storage is above 1.96 million acre-feet on either of the two dates, the “base-average” levels would apply. When the combined storage is between 1.96 million acre-feet and 1.90 million acre-feet, the “base-dry” levels would be applicable. When the combined storage of the reservoirs is less than 1.90 million acre-feet, “subsistence” levels would apply. Table 8-1 provides more details concerning the Instream flow criteria.

For freshwater inflows, the pending Water Management Plan includes criteria for five levels based upon the MBHE study. Instead of the monthly requirement used in the current plan, the MBHE three-month “spring” and “fall” and six-month “intervening” flow total will be used with the 2012 WMP. Table 8-2 shows the operational criteria for Colorado River inflows to Matagorda Bay. Table 8-3 provides the inflow triggers and flow levels for the current demand conditions. As demands increase, the inflow triggers and flow levels will change.

8-06. Water Supply. The TCEQ has authorized the LCRA to divert and use water for irrigation and hydroelectric power (see Exhibit H). In addition, the reservoir provides water for improvement of navigation, regulating streamflow, storage and delivery of stored waters, land recreation, domestic and municipal uses, and recreation, both upstream and downstream.

LCRA is required by contract to supply water to downstream rice farmers and other municipal users. Irrigation represents the largest demand of water on the lower Colorado River system (including run-of-river water from the Colorado River as well as stored water from lakes Buchanan and Travis) constituting about 70 percent of the total annual use (2000 – 2010). Most of the rice farming and other agricultural operations, irrigated by Colorado River water, are concentrated in four irrigation districts. Much of the water supplied from lakes Buchanan and Travis is interruptible and can be curtailed or cut-off based on reservoir storage capacity and trigger points. The number of acres irrigated is highly dependent upon the federal allocation program for rice as well as the world market demand. Currently, about 95 percent of rice farmers in the LCRA service area participate in government support programs.

In developing the pending Water Management Plan, total firm demands for water supply from lakes Buchanan and Travis were projected to be approximately 288,606 acre-feet per year in 2010. By 2020, the firm demands were projected to increase to 416,000 acre-feet per year.

TABLE 8-1
SCHEDULE OF RECOMMENDED INSTREAM FLOWS FOR THE COLORADO RIVER
DOWNSTREAM OF AUSTIN (cfs)[1/]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Austin												
Subsistence	50	50	50	50	50	50	50	50	50	50	50	50
Bastrop												
Subsistence	208	274	274	184	275	202	137	123	123	127	180	186
Base-Dry	313	317	274	287	579	418	347	194	236	245	283	311
Base-Average	433	497	497	635	824	733	610	381	423	433	424	450
Columbus												
Subsistence	340	375	375	299	425	534	342	190	279	190	202	301
Base-Dry	487	590	525	554	966	967	570	310	405	356	480	464
Base-Average	828	895	1020	977	1316	1440	895	516	610	741	755	737
Wharton												
Subsistence	315	303	204	270	304	371	212	107	188	147	173	202
Base-Dry	492	597	531	561	985	984	577	314	410	360	486	470
Base-Average	838	906	1036	1011	1397	1512	906	522	617	749	764	746

[1/] Daily average flow rates (cfs) as per pending Water Management Plan described in paragraph 8-05.

TABLE 8-2
SCHEDULE OF RECOMMENDED COLORADO RIVER FRESHWATER INFLOW VOLUMES TO MATAGORDA BAY

Inflow Category[1/]	Operational Criteria Applicable in the Individual Months (ac-ft)			Monthly (ac-ft)
	Spring (March-June)	Fall (July-Oct.)	Intervening (Nov.-Feb.)	N/A
OP-4	289,000	205,000	133,000	N/A
OP-3	164,000	117,000	76,000	N/A
OP-2	112,000	80,000	52,000	N/A
OP-1	76,000	54,000	35,000	N/A
Threshold	N/A	N/A	N/A	15,000

[1/]As per pending Water Management Plan described in paragraph 8-05. See Table 8-3 for definition of Inflow Categories. (OP=Operational Criteria)

TABLE 8-3
CURRENT DEMAND PHASE FRESHWATER INFLOW TRIGGERS AND FLOW LEVELS

When Combined Storage is….	On this date….	Freshwater Inflow Criteria
Greater than 1.95 MAF[1/]	Jan. 1 or June 1	OP-4
Less than 1.95 MAF	Jan. 1 or June 1	OP-3
Less than 1.50 MAF	Jan. 1 or June 1	OP-2
Less than 1.30 MAF	Jan. 1 or June 1	OP-1
Less than 1.00 MAF	Jan. 1 or June 1	Threshold Only

[1/]As per pending Water Management Plan described in paragraph 8-05. (MAF=Million Acre-Feet) (OP=Operational Criteria)

8-07. Hydroelectric Power. The power facility at Mansfield Dam consists of three units, two with an upgraded capacity of 37,000 kilowatts each, and a third with an upgraded capacity of 42,000 kilowatts, for a total capacity of 116,000 kilowatts. This plant represents 39.3 percent of the hydroelectric generating capacity and 3.81 percent of the total generating capacity of the LCRA. The hydroelectric power production from Mansfield Dam has been subordinated, except in emergencies, to be a by-product of the release of water for other purposes or when hydropower generation will not impair LCRA's ability to satisfy all stored water demands. To the maximum extent possible, releases of water are made in a manner to take maximum advantage of the energy produced by those releases.

8-08. Navigation. The initial 22.8 miles of the lower Colorado River is navigable for barge traffic. Flows of more than 10,000 cfs will affect barge traffic on the Gulf Intracoastal Waterway near the mouth of the Colorado River. The Galveston District is notified of any flows expected to exceed 10,000 cfs.

8-09. Drought Management Plan. The purpose of a Drought Management Plan (DMP) is to provide a basic reference for water management decisions and responses to a water shortage in the middle and lower Colorado River Basin. This manual provides a plan for implementing actions necessary for conservation of water supply and water quality storage depending on the severity of the drought. Other key elements of the plan include establishing a criteria for water supply curtailments which protect firm water demands, establish a reserve storage pool, and provide for gradual curtailment of water in order to protect the full demand of the first rice crop in all years of the critical drought. The new proposed Water Management Plan that is currently being reviewed by TCEQ will address these issues.

8-10. Flood Emergency Action Plans. The Flood Emergency Plan contains detailed information and procedures taken by LCRA personnel in the event of an imminent emergency. The plan provides the reporting sequence to use should an emergency situation or unusual condition occur. This plan also contains inundation maps showing the downstream area that would be flooded in the event of a dam breach. The extent of inundation shown was based on dam failure occurring at the peak of a PMF, an event which is extremely unlikely and is the worst possible case that could occur. Should critical conditions develop which may lead to failure of a facility or result in a large, uncontrolled release of water, LCRA is authorized to commit immediately all available resources to prevent structural damage and to minimize loss of life and property.

8-11. Frequencies. Since Mansfield Dam includes flood control storage, the project has a direct impact on flows and elevation both upstream and downstream of the dam. Each of the following frequency curves are the results of a 78-year period-of-record (01 January 1930 through 31 December 2007) reservoir regulation computer simulation of the Colorado River Basin. The computer program and the river basin model are described in Section 8-12 of this manual.

a. Inflow Frequency. Plate 8-2 shows the average maximum daily inflow frequency curve for Lake Travis. The largest simulated daily inflow to Lake Travis was 384,540 cfs occurring in September 1952. The annual inflow frequency curve for historical computed inflow (1940-2011) is shown in Plate 8-3(a). Plate 8-3(b) shows the annual inflow frequency curve based on the period-of-record (1930-2007). The maximum simulated annual inflow to Lake Travis is 5,548,620 acre-feet in 1936, and the minimum simulated annual inflow to Lake Travis is 152,020 acre-feet in 1963.

b. Pool Elevation Duration and Frequency. The annual pool elevation duration curves are shown on Plates 8-4(a) and 8-4(b), and indicates that the 50th percentile elevation of Lake Travis is 673.0 based on the historical record from 1942-2011. The pool elevation probability curve is shown on Plate 8-5. Lake Travis historic pool levels beginning in October 1942 is displayed on Plate

8-6. The maximum observed elevation was 710.4 during the December 1991 flood and the minimum observed elevation was 614.18 during the August 1951 drought. Lake Travis reached elevation 626.1 in November 2011.

c. Key Control Points. The key control points used for the evacuation of flood control storage in Lake Travis are the USGS gauges at Austin, Bastrop, and Columbus. The stage-discharge rating curves for each of the key control points are shown on Plates 4-14, 4-15 and 4-17.

8-12. Other Studies. A reservoir regulation computer program (SUPER), developed by the Southwestern Division of the USACE, was used in developing the water control plan. The computer program, as shown on Plate 8-7, was used to simulate the daily operation of 10 existing reservoirs and the streamflow at 13 gauges within the Colorado River Basin for the historical period from 01 January 1930 through 31 December 2007. The Fort Worth District USACE Water Resources Branch is in the process of developing a RiverWare model to replace the SUPER model for future updates and analyses.

Various regimes of operating Mansfield Dam were compared for hydropower generation benefits, lake damages, and downstream damages in developing the water control plan. The USGS daily streamflow records were used to determine the daily inflow into each lake and the daily runoff from the intervening area between control points. Water consumption rates, evaporation losses, mandatory irrigation releases, and hydroelectric generation demands were accounted for in the day-to-day simulated operation of each of the lakes.

a. Examples of Regulation. Descriptions of the following floods are based on the simulated results of the SUPER model. Descriptions of the historical floods are in Section 4-06(b). Instantaneous peaks are frequently much larger than daily inflows noted in the following sections.

1. Flood of 1935. The 1935 flood resulted in three different peak daily inflows: On 19 May, an estimated 97,077 cfs was computed; on 07 June, 33,702 cfs was computed; and 216,280 cfs was computed on 15 June. The total 62-day volume inflow was 3,227,687 acre-feet, tabulated from 16 May through 16 July.

The water surface elevation at the beginning of the flood was 655.81 (May 4) and reached a maximum of 714.01, with a peak release of 65,547 cfs.

2. Flood of 1936. The 1936 flood resulted in a peak daily inflow of 123,349 cfs on 22 September. The total 58-day volume was 4,297,228 acre-feet, tabulated from 15 September through 11 November. The water surface elevation at the beginning of the flood was 679.95 on 14 September and reached a maximum elevation of 716.90 on 02 October with a peak release of 29,969 cfs

on 22 September.

3. Flood of 1938. The 1938 flood resulted in a peak daily inflow of 215,455 cfs on 25 July. The total 44-day volume inflow was 2,669,272 acre-feet, tabulated from 20 July through 01 September. The water surface elevation at the beginning of the flood was 680.17 on 19 July and reached a maximum of 720.63 on 28 July with a peak release of 90,002 cfs on 25 July.

4. Floods of 1957. Two separate floods occurred during 1957, one in the spring and one in the fall. The spring flood produced two different peak daily inflows: the first one was 126,714 cfs on 24 April and the second one was 50,271 cfs on 15 May. The total 71-day volume inflow was 2,723,689 acre-feet, tabulated from 23 April through 02 July. The water surface elevation at the beginning of the spring flood was 654.96 on 22 April and reached a maximum of 692.38 on 06 June with a peak release of 30,000 cfs on 06 June.

The fall flood produced a peak daily inflow of 62,257 cfs on 16 October. The total 58-day volume inflow was 952,550 acre-feet, tabulated from 14 October through 10 December. The water surface elevation at the beginning of the fall flood was 676.70 on 13 October and reached a maximum of 696.27 on 18 October with a peak release of 30,000 cfs on 20 October.

b. 1% ACE Frequency Flood. As part of the Flood Damage Evaluation Project (Section 3-05), frequency pool elevations were determined for Lake Travis with period-of-record (SUPER) and joint probability analyses. The SUPER model was used to generate regulated period-of-record water surface elevations at Lake Travis for the 78-year period-of-record extending from 1930 to 2007. The SUPER model allows for the simulation of the historic floods from the 1930s that occurred prior to Mansfield Dam construction. The maximum annual pool elevations for Lake Travis were then plotted. Annual high inflow volume-duration frequency curves were developed for Lake Travis for 1 through 10 day durations. These data were then used to construct balanced 10-day hypothetical frequency inflows to Lake Travis for selected probabilities. Historical Lake Travis pool elevations were analyzed to create a pool elevation duration curve and probability curve.

The balanced hypothetical inflow hydrographs were routed through Lake Travis using the current operating plan and a 12-hour forecast time for a range of initial lake level conditions. The set of maximum lake elevation versus probability of the inflow flood values generated for each initial pool level define a conditional probability curve for that initial level. There are multiple conditional reservoir elevation probability curves for each initial lake level considered. The probability of each initial elevation is taken from the reservoir elevation duration curve by approximating the fraction of time that elevation prevails. The total reservoir elevation probability at a given reservoir elevation is determined by summing for all the conditional probability curves, the product of the conditional probability at that elevation and the probability of the initial pool. The resulting joint probability curves along with the maximum annual peak pool elevations from the SUPER simulation were plotted together to determine frequency pool elevations at Lake Travis.

The 1% ACE frequency pool elevation for Lake Travis was determined to be 721.5. This pool elevation has been mapped on the current effective Travis County Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) (September 2008) for the Lake Travis area. The 2% ACE frequency pool elevation for Lake Travis was determined to be 716.4.

IX - WATER CONTROL MANAGEMENT

9-01. Responsibility and Organization.

a. Bureau of Reclamation. Mansfield Dam was originally financed and owned by the U.S. Government through the BOR. A 13 March 1941 Contract (see Exhibit E) between the LCRA and the BOR of the United States Department of Interior designated the LCRA as the agency to operate and maintain the dam for regulating the flow of the Colorado River and controlling the floods on the river. The operational responsibilities along with allocated costs were included in the contract supplement, dated 09 December 1948 (see Exhibit E).

The BOR made periodic examinations of the dam and related facilities, and advised the LCRA of necessary upgrades or maintenance. By terms of an agreement signed 30 May 1997, between the LCRA and the BOR, LCRA's remaining reimbursable obligation to the United States was satisfied, and the BOR relinquished all rights and obligations to the project. The BOR is no longer responsible for operation, maintenance, or oversight of Mansfield Dam.

b. Corps of Engineers. The role of the USACE is to prescribe regulations for the use of flood control storage, between elevations 681.0 and 714.0, by authority of Section 7 of the Flood Control Act of 1944 (Exhibit I). Reports of flooding conditions are made to the Southwestern Division and the Office, Chief of Engineers, and followed by flood situation reports. An "Organization Chart for Flood Control Regulation" is shown on Plate 9-1.

The USACE, in compliance with ER 1110-2-241 (see Appendix N), is responsible for preparing and publishing a Water Control Manual for Mansfield Dam. The manual includes the approved flood storage space water control plan for the project, which plan is used at all times except when superseded by an approved deviation as provided in Chapter VII. The Southwestern Division Water Management Branch is responsible for reviewing and determining the acceptability of the recommended water control plan and deviation requests as needed.

c. Lower Colorado River Authority. By contract with the United States, 13 March 1941, the LCRA is designated as the agent to operate and maintain Mansfield Dam, at its own expense, for the purposes of regulating the flow of the river and controlling floods on the river. The LCRA forecasts inflows and directs water releases. The LCRA also collects, reports, and records reservoir level, temperature, and weather condition data.

The LCRA is responsible for the operation and maintenance of the dam and facilities and for the overall operation of the hydroelectric power generating facilities and equipment. When the reservoir level is between elevation 681.0

and 714.0 (flood storage space), the LCRA regulates the project in accordance with the flood control plan as developed by the USACE and provided in Chapter VII. The LCRA is responsible for specifying and scheduling releases when the reservoir level is below elevation 681.0 (conservation storage space) or above elevation 714.0 (surcharge storage space), or if the structural integrity of the dam is at any time in question.

d. Other Federal Agencies. The NWS provides weather and river forecast information which is used to make real-time operation decisions for Mansfield Dam and Lake Travis. The USGS also provides streamflow data to aid in real-time operation decisions.

e. State and County Agencies. These agencies have no direct responsibility in the operation and regulation of the project. The Texas Commission on Environmental Quality (TCEQ) does oversee water rights and instream/environmental flow requirements which indirectly impact operation of Mansfield Dam, primarily in the conservation pool.

f. Private Organizations. Private organizations have no responsibility in the operation and regulation of the project.

9-02. Interagency Coordination.

a. Local Press and Bulletins. The USACE, LCRA, and the NWS coordinate in forecasting flood stages. Local agencies are provided flood forecasts issued by the NWS. These forecasts are supplemented by the LCRA and the USACE with information on observed conditions for local flood protection and rescue and relief requirements. In addition, the LCRA and the USACE, through their Public Affairs and Emergency Management Offices, make press releases of flood emergency situations for the news media in the area of interest.

b. National Weather Service. The NWS, LCRA, and the USACE exchange hydrometeorologic data and reports in obtaining and disseminating data.

c. United States Geological Survey. The USGS develops the stage versus discharge curves for the stream gauges and maintains the stream gauges (except for those entirely owned and operated by LCRA). Water quality data, both upstream and downstream from Mansfield Dam, are also collected at select stream gauge locations.

d. Power Marketing Agency. The LCRA is the agency responsible for generating and marketing hydroelectric power from Mansfield Dam in conjunction with the Electric Reliability Council of Texas (ERCOT).

e. Other Federal, State or Local Agencies. The BOR designed and constructed Mansfield Dam and made periodic inspections of the operational facilities and the structure. After the loan from the BOR was reimbursed, the BOR is no longer involved with Mansfield Dam, and the LCRA has developed a dam safety inspection program.

9-03. Interagency Agreements. Provisions contained in Section 7 of the Flood Control Act of 1944 require that the USACE prescribe the regulations governing the flood control operations of Mansfield Dam (see Exhibit I).

9-04. Commissions, River Authorities, Compacts and Committees. The LCRA conducts the water control activities of the Colorado River Basin directly affecting the operation of Lake Travis. The function of the LCRA is stated in Texas State Senate Bill #115, 64th Legislature, Regular Session, signed by the Governor, 28 April 1975, cited as the Lower Colorado River Authority Act. The TCEQ issues and regulates permits for the use of water in the Colorado River Basin.

9-05. Reports. Table 9-1 describes the following reports, when the report is required, the regulation requiring the report, and the plate number of an example report.

a. Daily Report. The daily report is prepared by the Water Resources Branch. It contains water control information of most of the major lakes in the Fort Worth District. An example of the daily Report is shown on Plate 9-2. A copy of the report is sent to subscribing offices and agencies. The daily report is also available on the Internet at the following Uniform Resource Locator (URL) address: http://www.swf-wc.usace.army.mil

b. Monthly Reports. The Water Resources Branch, in accordance with ER 1110-2-240, prepares monthly reservoir reports. These reports are monthly tabular records (Plate 9-3) of reservoir operation for all reservoirs that are under the supervision of, or of direct interest to, the Fort Worth District.

c. Flood Situation Reports. The USACE Emergency Operation Center (EOC) submits situation reports during floods in accordance with ER 500-1-1. This report contains reservoir pertinent data, name of reservoir, reservoir stage, predicted maximum stage and anticipated date, rates of inflow and outflow in cfs, percent of flood control storage utilized to date, and any special information pertinent to the flood situation.

d. Post Flood Reports. Post flood reports may be prepared by the USACE SWF EOC, in accordance with ER 500-1-1, when a flood has caused major damage. The report describes flood emergency operations performed by the USACE, LCRA, and other agencies and includes available hydrologic information, damage estimates, and other engineering data considered essential for flood control and floodplain studies. The report is prepared using information compiled and prepared by the Water Resources Branch and is completed within approximately three months of the time of flooding, including statement of final damage costs.

e. Annual Report. This report is prepared by the Fort Worth District's Water Management Section for the Southwestern Division, Water Management Branch. The report contains a summation of the general conditions of the river basins and the activities and accomplishments of the Water Resources Branch for the preceding year.

TABLE 9-1
TABULATION OF REPORTS

Name of Report	When Required	Regulation Requiring Report	Plate
Morning Report	Daily		9-2
Monthly Reservoir Report	Monthly	ER 1110-2-240	9-3
Flood Situation Report	During Floods	ER 500-1-1	
Post Flood Reports	Following a Flood Causing Major Damage	ER 500-1-1	
Annual Reports	Annually	ER 1110-2-240	

Tables

<u>TABLE 4-5</u>
<u>MAJOR STORMS AND FLOODS, COLORADO RIVER BASIN</u>

Date of Storm	Storm Center	Duration (days)	Peak Rainfall (inches)	River Gauge Location	Peak Discharge (cfs)	Routed Peak Discharge (cfs)	Date of Peak	Flood Volume (ac-ft)	Flood Volume (inches)
Jul 1869	-	-	-	Austin	520,000	-	Jul 7	-	-
Apr 1900	-	-	-	Austin	236,000[1/]	-	Apr 7	-	-
Dec 1913	Austin	5	14.07	Austin	164,000	-	Dec 4	1,907,900	1.36
Jun 1935	Segovia	8	18.30	San Saba	64,000	-	Jun 15	98,200	0.61
				Llano	388,000	-	Jun 14	-	-
				Austin	481,000	60,000[2/]	Jun 15	3,290,000	2.34
				Smithville	305,000	-	Jun 16	-	-
				Columbus	177,000	-	Jun 19	2,944,800	1.90
Sep 1936	Ft. McKavett	3	30.00	San Saba	219,000	-	Sep 21	2,147,000	2.19
				Austin	234,000	150,000[2/]	Sep 28	3,247,800	2.31
				Smithville	148,000	-	Sep 29	-	-
				Columbus	123,000	-	Oct 2	3,333,900	2.13
Jul 1938	Sloan	6	21.24	San Saba	224,800	-	Jul 23	2,062,100	2.09
				Austin	276,000	157,000[2/]	Jul 25	2,439,500	1.74
				Smithville	209,000	-	Jul 27	-	-
				Columbus	156,000	-	Jul 29	2,063,600	1.33

TABLE 4-5
MAJOR STORMS AND FLOODS, COLORADO RIVER BASIN
(CONTINUED)

Date of Storm	Storm Center	Duration (days)	Peak Rainfall (inches)	River Gauge Location	Peak Discharge (cfs)	Routed Peak Discharge (cfs)	Date of Peak	Flood Volume (ac-ft)	Flood Volume (inches)
Sep 1952	Near Blanco	3	28.80	San Saba	69,000	-	Sep 11	219,900	0.22
				Llano	232,000	-	Sep 10	231,500	1.03
				Johnson City	441,000	-	Sep 11	370,000	7.33
				Austin	3,720	803,000[3/]	Sep 17	-	-
Apr-Jun 1957	(Various Locations)	120	-	San Saba	66,200	-	May 14	1,587,600	1.61
				Llano	47,200	-	May 27	401,800	1.78
				Austin	40,800	426,000[3/]	Jun 4	-	-
Dec 1991	Medina	6	15.59	San Saba	26,000	-	Dec 20	50,300	0.31
				Llano	83,500	-	Dec 20	183,500	0.82
				Johnson City	89,000	-	Dec 21	192,400	4.01
				Austin	-	260,000[3/]	Dec 21	-	-
Jun 1997	Bandera	3	19.72	San Saba	19,000	-	Jun 23	-	-
				Llano	328,000	-	Jun 23	254,000	1.41
				Johnson City	94,900	-	Jun 22	122,400	2.55
				Austin	32,000	340,000[3/]	Jun 23	-	-

[1/]Discharge was caused by the failure of the Austin Dam.
[2/]Estimated discharges that would have occurred if the upstream reservoirs had been in operation at the time the flood occurred.
[3/]Estimated discharges that would have occurred if the upstream reservoirs had not been constructed.

TABLE 4-6
MAJOR FLOODS IN COLORADO RIVER BASIN, 1869-1940
DATA PRIOR TO MANSFIELD DAM IMPOUNDMENT – SEPT. 1940

Date	Colorado River Near San Saba[1/] Stage/Discharge (Feet)	Colorado River Near San Saba[1/] Stage/Discharge (CFS)	Llano River At Llano[2/] Stage/Discharge (Feet)	Llano River At Llano[2/] Stage/Discharge (CFS)	Pedernales River Near Johnson City[3/] Stage/Discharge (Feet)	Pedernales River Near Johnson City[3/] Stage/Discharge (CFS)	Colorado River At Austin Stage/Discharge (Feet)	Colorado River At Austin Stage/Discharge (CFS)
Jul 1869	-	-	-	-	40.40	155,000	51.00	520,000
Jun 1899	-	-	-	-	-	-	23.80	113,000
Apr 1900	-	-	-	-	-	-	33.50	236,000
Sep 1900	58.40	184,000	-	-	-	-	-	15,000
Apr 1908	-	-	-	-	-	-	21.60	164,000
Dec 1913	-	-	-	-	-	-	27.00	164,000
Sep 1915	-	-	-	-	-	-	21.00	98,000
Sep 1921	-	-	-	-	-	-	19.43	77,600
Spring 1922	-	163,000	-	-	-	-	22.60	120,000
May 1929	-	-	-	-	40.40	155,000	27.35	132,000
Oct 1930	39.90	78,900	22.30	122,000	12.60	13,900	22.50	97,600
May 1935	41.00	86,000	-	-	-	-	-	150,000
Jun 1935	-	71,000	37.00	388,000	32.00	105,000	41.20	487,000
Sep 1935	56.70	179,000	22.90	130,000	28.40	85,300	31.40	234,000
May 1936	-	-	-	-	-	-	-	69,300
Sep 1936	56.70	179,000	22.90	130,000	28.40	85,300	31.40	234,000
Jul 1938	63.20	224,000	21.43	110,000	-	-	32.10	276,000
Jul 1940	-	-	-	-	-	-	17.44	45,700

[1/] Near Chadwick 1915-1922. Near Tow 1923-1930.
[2/] Near Castell 1923-1939.
[3/] Near Spicewood 1923-1939.

TABLE 4-8
MANSFIELD DAM AND LAKE TRAVIS
COMPUTED MONTHLY AND ANNUAL INFLOW
VOLUME IN THOUSANDS OF ACRE-FEET

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1940									141.90	80.14	261.13	367.34	849.80
1941	136.49	243.25	375.58	625.71	997.13	604.65	264.38	116.55	104.52	282.25	151.56	79.69	3981.76
1942	79.61	86.41	54.81	183.89	351.93	174.14	48.71	168.42	254.86	365.12	165.69	104.25	2037.83
1943	68.92	91.34	137.57	111.20	92.73	161.47	58.51	21.11	24.48	43.38	41.36	62.85	914.91
1944	77.05	74.35	159.72	80.43	335.84	180.62	68.06	190.51	167.42	55.77	79.20	97.97	1566.84
1945	143.72	135.64	168.45	192.47	84.83	90.60	335.09	67.86	93.76	78.92	48.24	82.05	1521.63
1946	108.46	138.63	129.85	174.34	149.87	66.23	84.52	62.72	57.86	75.45	158.75	124.49	1331.17
1947	190.47	63.41	102.27	73.90	50.83	56.43	56.71	56.24	45.11	63.23	63.09	51.01	872.70
1948	41.46	62.99	53.48	77.02	60.90	213.52	140.18	67.51	61.47	30.43	14.51	45.79	869.26
1949	41.69	72.86	41.08	138.38	359.00	137.41	94.77	62.28	83.86	46.62	44.42	23.11	1145.47
1950	9.38	18.91	31.02	56.31	55.26	63.38	37.02	43.61	43.75	10.07	20.85	11.10	400.65
1951	1.38	35.36	19.78	29.25	44.99	71.40	118.68	119.03	79.48	33.71	13.36	4.05	570.47
1952	10.33	1.86	3.08	22.46	56.61	58.03	123.41	126.75	767.33	4.53	18.41	94.01	1286.81
1953	54.68	28.31	22.15	30.59	81.74	37.18	10.22	41.39	58.43	75.81	19.52	18.24	478.25
1954	35.07	11.67	12.92	22.81	264.60	89.42	62.11	22.33	17.43	12.99	0.11	1.57	553.03
1955	13.16	27.21	5.83	7.05	406.01	298.65	170.74	130.22	139.42	100.30	54.63	23.03	1376.25
1956	38.80	3.14	0.21	12.95	294.47	65.07	17.18	22.49	31.15	7.86	26.98	20.83	541.13
1957	14.05	22.92	36.14	691.10	1716.69	813.04	85.36	99.65	83.39	611.86	226.76	131.17	4532.13
1958	172.86	339.66	235.14	147.11	256.63	299.32	132.63	48.82	107.61	69.73	73.60	81.87	1964.97
1959	61.61	33.25	38.36	78.43	50.79	175.71	193.45	114.84	41.25	877.39	93.75	162.16	1920.99
1960	198.29	210.00	115.28	128.16	77.05	108.07	91.65	144.16	28.25	82.19	42.18	135.67	1360.95
1961	118.14	211.01	138.64	89.23	70.02	368.19	165.14	109.11	89.06	102.76	67.31	87.55	1616.15
1962	79.41	49.14	6.27	33.21	27.86	51.53	42.92	69.13	105.27	150.84	14.64	9.26	639.48
1963	17.86	25.64	4.64	17.95	5.46	3.18	3.76	6.15	12.25	3.90	28.31	22.92	152.02

TABLE 4-8
MANSFIELD DAM AND LAKE TRAVIS
COMPUTED MONTHLY AND ANNUAL INFLOW
VOLUME IN THOUSANDS OF ACRE-FEET
(CONTINUED)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	15.24	35.22	49.65	40.40	84.92	77.00	72.87	45.49	231.49	27.97	52.07	14.38	746.71
1965	21.48	161.62	35.21	31.46	745.53	166.14	24.39	53.17	131.97	56.75	46.28	95.64	1569.63
1966	35.49	40.12	34.04	142.31	201.95	54.01	59.52	30.41	157.43	50.17	7.29	12.81	825.55
1967	10.60	54.67	19.50	8.83	59.44	46.31	76.18	60.80	85.67	55.11	34.36	22.51	533.96
1968	616.91	171.08	397.59	290.48	508.86	201.38	68.23	49.00	28.37	17.06	16.24	24.85	2390.04
1969	18.27	24.21	41.26	106.63	233.15	91.11	80.09	69.84	47.26	286.51	129.84	101.13	1229.40
1970	134.96	105.62	430.96	123.14	143.60	185.31	51.72	50.16	147.07	17.39	5.64	10.96	1406.53
1971	16.42	9.37	8.49	7.65	2.36	56.77	108.47	185.95	107.41	406.04	113.11	76.57	1098.61
1972	90.00	38.21	18.61	43.81	164.57	96.38	50.81	42.32	48.62	54.55	35.74	36.96	720.57
1973	95.04	42.33	61.04	64.13	118.09	98.48	136.15	82.18	55.24	315.28	41.49	34.49	1143.94
1974	42.16	26.18	22.95	19.57	165.35	29.95	20.29	342.58	338.35	294.36	388.23	99.78	1789.75
1975	141.29	388.45	113.98	147.48	549.92	272.86	98.89	64.72	28.52	41.75	19.25	22.10	1889.21
1976	29.17	18.52	24.27	97.11	99.88	96.53	313.89	45.96	95.42	58.52	116.71	41.08	1037.04
1977	70.87	61.91	96.71	690.54	324.52	94.82	31.67	29.77	26.52	18.63	19.28	7.00	1472.23
1978	19.72	21.94	17.02	16.75	32.79	104.27	96.95	318.32	76.61	15.17	37.29	21.45	778.27
1979	63.70	89.80	100.26	129.16	98.81	192.85	47.69	74.42	39.27	6.13	14.78	15.04	871.81
1980	16.87	18.66	21.23	60.78	140.21	96.07	46.25	38.36	155.95	149.87	22.83	31.60	798.68
1981	33.72	25.56	138.51	111.89	90.43	570.91	99.63	54.04	44.48	295.21	90.24	45.51	1600.11
1982	24.99	38.39	48.48	61.05	156.96	184.88	154.75	59.18	13.77	4.86	24.60	11.34	783.25
1983	18.05	39.38	75.68	25.96	167.91	94.73	26.84	30.67	53.76	16.45	15.71	23.73	588.86
1984	14.90	15.29	7.33	19.68	44.77	91.50	73.09	58.44	69.06	153.06	27.52	118.93	693.57
1985	217.71	96.87	117.93	56.53	45.71	50.48	40.90	41.12	42.08	192.81	49.27	77.22	1028.62
1986	35.46	89.54	30.17	22.16	103.08	259.12	28.51	30.93	161.30	344.21	160.01	304.69	1569.18
1987	166.88	17.71	266.26	76.49	235.74	1115.28	179.34	58.82	131.45	24.12	53.22	53.13	2378.44
1988	47.19	33.38	42.44	40.13	50.61	108.21	137.51	88.56	83.85	65.52	10.58	12.20	720.17

TABLE 4-8
MANSFIELD DAM AND LAKE TRAVIS
COMPUTED MONTHLY AND ANNUAL INFLOW
VOLUME IN THOUSANDS OF ACRE-FEET
(CONTINUED)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1989	47.94	40.87	33.37	23.87	102.67	118.21	19.70	78.15	61.26	6.81	5.35	2.44	540.54
1990	9.25	19.16	53.41	73.09	429.08	53.16	117.25	70.56	171.13	30.49	23.85	18.82	1069.25
1991	65.11	56.68	46.04	78.62	107.72	137.81	19.28	43.02	97.89	42.68	51.81	1160.24	1906.88
1992	424.77	1350.86	648.11	277.51	289.94	465.32	2.24	39.65	81.58	49.61	71.50	56.79	3757.88
1993	60.64	73.61	150.41	118.71	96.73	78.37	36.27	26.11	56.79	28.26	20.95	28.14	774.98
1994	32.47	59.85	31.92	57.96	232.96	101.35	27.51	84.46	405.74	28.51	19.70	28.91	1111.22
1995	31.20	59.30	35.30	58.61	22.00	116.11	25.31	86.61	999.6	49.70	71.50	56.81	1611.80
1996	60.60	73.60	150.40	11.87	96.71	71.70	36.31	26.11	54.70	215.09	45.83	87.44	930.33
1997	62.50	253.26	486.51	422.78	272.98	1180.2	166.91	38.58	15.14	54.81	21.59	45.39	3020.65
1998	65.41	111.17	349.65	122.96	18.407	15.32	78.60	144.15	72.97	172.42	129.77	72.51	1353.34
1999	40.10	19.47	78.26	31.07	92.89	45.47	57.65	74.52	1.38	4.28	2.82	11.71	459.64
2000	20.21	18.54	16.10	13.22	40.37	23.92	46.98	79.66	56.95	113.26	504.34	58.02	991.61
2001	99.81	86.76	148.01	104.44	115.59	23.86	32.57	39.61	44.10	42.09	325.47	63.08	1125.38
2002	51.90	12.63	29.73	23.80	7.47	91.14	999.20	61.21	37.41	76.28	58.98	87.12	1536.91
2003	60.49	128.16	103.41	51.81	41.34	133.91	57.54	48.21	54.30	53.14	16.62	14.59	763.53
2004	54.50	39.38	50.30	208.49	70.58	372.24	81.98	120.04	36.26	45.67	723.33	135.98	1938.86
2005	117.41	162.79	305.81	115.04	82.08	86.98	43.02	98.56	54.11	3.56	5.37	9.74	1084.57
2006	24.30	21.20	30.71	53.87	101.23	42.32	27.75	27.74	35.55	33.37	8.81	16.65	423.60
2007	40.90	9.00	268.79	80.42	299.22	811.73	692.36	253.41	134.35	32.55	23.74	25.77	2672.28
2008	51.70	16.81	24.90	35.02	66.39	8.68	39.64	42.80	49.30	31.43	14.22	6.43	387.39
2009	7.21	2.73	41.60	59.97	58.11	46.41	42.05	56.61	46.30	208.54	83.47	52.38	705.40
2010	119.01	227.31	119.62	109.11	68.13	20.85	46.23	13.26	114.57	5.52	2.55	9.47	855.63
2011	21.40	9.32	3.92	0	27.85	79.50	26.01	50.26	27.64	15.31	11.32	20.63	293.18
Total	5279.19	6503.30	7318.24	7590.27	13200.84	12747.07	7252.04	5519.33	7748.54	7575.98	5502.59	5226.12	90613.70
Avg.	74.35	91.60	103.07	108.43	185.93	179.54	102.14	77.74	107.62	105.22	76.43	72.59	1276.25

TABLE 4-9
MANSFIELD DAM AND LAKE TRAVIS
INFLOW VOLUME FREQUENCY

Frequency of Occurrence (years)	Monthly Inflow Volume in Thousands of Acre-Feet											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
5	102	123	152	151	262	240	138	106	138	148	100	96
10	160	202	241	241	407	385	210	146	216	256	173	158
25	260	341	393	399	649	652	335	209	361	454	313	267
50	360	475	536	555	874	927	456	267	515	653	463	374
100	485	640	709	748	1140	1284	603	335	719	903	662	507
Median	47	40	47	69	97	95	59	59	60	50	36	35

Note: Monthly frequencies were determined by graphical analysis of inflow volumes. The inflow volumes were computed based on change in reservoir storage for the period October 1940 to September 2011.

TABLE 7-2
MANSFIELD DAM AND LAKE TRAVIS
NORMAL FLOOD CONTROL REGULATIONS SCHEDULE

Condition	Reservoir Level (ft)	Release [1/] (cfs)	Controlling Stages and Discharges at Downstream Control Points	
Pool Rising or Falling	Below 681	As Specified by the Authority	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin – USGS Gauge 08158500 (45,000 cfs) at Bastrop – USGS Gauge 0815920 (50,000 cfs) at Columbus – USGS Gauge 08161000
Pool Rising	Forecast: 681-683	3,000 [2/] to 7,500	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Rising	Forecast: 683-685	5,000 to 30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Rising	Forecast: 685-691 (a) During January, February, March, April, July, August, November, December.	5,000 to 30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
	(b) During May, June, September, October	30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Rising	Forecast: 691-710	30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus

TABLE 7-2
MANSFIELD DAM AND LAKE TRAVIS
NORMAL FLOOD CONTROL REGULATIONS SCHEDULE
(CONTINUED)

Pool Rising	Forecast: 710-714	50,000	No Stage Control No Stage Control No Stage Control	(50,000 cfs) at Austin (50,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Rising	Forecast: 714-722 [3/]	90,000 [3/]	No controls. See footnote 3.	
Pool Rising	Forecast: above 722	In accordance with the LCRA's surcharge operation plan, opening of the remaining closed conduit gates will proceed until: a) A revised forecast indicates the pool will peak at or below elevation 722 feet, at which time opening of additional conduit gates will cease. Or, b) The LCRA directs an alternative course of action for protecting the safety of the structure.		
Pool Falling	Above 722 to 714	In accordance with the LCRA's surcharge operation plan, no additional conduit gates will be opened. Previously opened conduit gates will remain open until the pool has receded to elevation 714 feet or the LCRA directs an alternative course of action for protecting the safety of the structure.		
Pool Falling	714-710	50,000	No Stage Control No Stage Control No Stage Control	(50,000 cfs) at Austin (50,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Falling	710-691	30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus

TABLE 7-2
MANSFIELD DAM AND LAKE TRAVIS
NORMAL FLOOD CONTROL REGULATIONS SCHEDULE
(CONTINUED)

Pool Falling	691-685: (a) During May, June, September, October.	30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
	(b) During January, February, March, April, July, August, November, December.	5,000 to 30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Falling	685-683	5,000 to 30,000	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus
Pool Falling	683-681	3,000 [2/] to 7,500	33.0 ft 27.2 ft 35.5 ft	(30,000 cfs) at Austin (45,000 cfs) at Bastrop (50,000 cfs) at Columbus

[1/] Subject to the specified controlling discharges at downstream control points. Releases from the dam, when combined with downstream inflows to the Colorado River, shall not contribute to an exceedance of the specified controlling discharges. Normal hydroelectric turbine releases may be reduced only to prevent them from contributing to an exceedance of downstream control discharges. Control discharges will not be modified due to minor shifts in the respective control point stage-discharge relationships, but will be reassessed if significant shifts indicate the possibility of negative impacts.
[2/] Minimum daily average release. Release need not be continuous throughout the day.
[3/] Release shall be the lessor of 90,000 cfs or the forecast peak rate of reservoir inflow. As the reservoir level exceeds elevation 714 feet, or is forecast to exceed elevation 722 feet, the LCRA will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure to the maximum extent possible.

TABLE 7-3
DISCHARGE (cfs) vs. ELEVATION FOR ONE OPEN FLOOD CONDUIT
MANSFIELD DAM

Elevation	0	1	2	3	4	5	6	7	8	9
540						588	774	1296	1384	1467
550	1545	1619	1690	1758	1823	1886	1946	2004	2061	2116
560	2169	2221	2272	2321	2370	2417	2463	2508	2552	2595
570	2638	2679	2720	2760	2800	2838	2877	2914	2951	2987
580	3023	3058	3093	3122	3161	3195	3228	3260	3292	3324
590	3355	3386	3416	3446	3476	3506	3535	3563	3592	3620
600	3648	3675	3702	3729	3756	3782	3808	3834	3860	3885
610	3910	3935	3960	3984	4008	4032	4056	4079	1403	1426
620	4149	4171	4194	4216	4238	4260	4282	4303	4324	4346
630	4367	4387	4408	4428	4449	4469	4489	4509	4528	4548
640	4567	4586	4606	4624	4643	4662	4680	4699	4717	4735
650	4753	4771	4789	4806	4824	4841	4858	4875	4892	4909
660	4926	4942	4959	4975	4991	5007	5023	5039	5055	5071
670	5086	5102	5117	5132	5147	5162	5177	5192	5207	5222
680	5236	5251	5265	5279	5294	5308	5322	5335	5349	5363
690	5377	5390	5404	5417	5430	5443	5456	5470	5482	5495
700	5508	5521	5533	5346	5558	5571	5583	5595	5607	5619
710	5631	5643	5655	5667	5679	5690	5702	5713	5724	5736
720	5747									

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
500					0	0	0	0	0	0
501	0	1	1	1	1	1	2	3	4	6
502	8	11	14	17	21	25	30	35	40	45
503	51	57	63	70	78	85	93	102	110	119
504	128	138	148	158	169	180	191	203	215	228
505	241	254	268	283	298	313	330	346	364	382
506	400	418	438	457	477	497	518	539	560	582
507	605	628	652	677	702	727	753	779	806	834
508	862	890	918	948	977	1,007	1,037	1,067	1,098	1,129
509	1,160	1,192	1,224	1,256	1,288	1,321	1,354	1,387	1,420	1,454
510	1,488	1,522	1,557	1,592	1,627	1,662	1,698	1,733	1,770	1,806
511	1,843	1,880	1,917	1,955	1,993	2,031	2,070	2,109	2,148	2,188
512	2,227	2,268	2,308	2,349	2,390	2,431	2,473	2,515	2,557	2,600
513	2,642	2,685	2,729	2,772	2,816	2,860	2,904	2,949	2,994	3,039
514	3,084	3,130	3,176	3,222	3,268	3,314	3,361	3,408	3,456	3,504
515	3,552	3,601	3,650	3,700	3,750	3,800	3,850	3,901	3,953	4,004
516	4,056	4,108	4,161	4,214	4,267	4,320	4,374	4,428	4,482	4,536
517	4,591	4,647	4,703	4,759	4,816	4,874	4,931	4,989	5,048	5,107
518	5,166	5,226	5,286	5,347	5,408	5,469	5,531	5,593	5,656	5,719
519	5,782	5,846	5,911	5,975	6,040	6,106	6,172	6,238	6,304	6,371
520	6,438	6,506	6,574	6,642	6,710	6,779	6,848	6,917	6,986	7,056
521	7,126	7,196	7,266	7,337	7,408	7,479	7,551	7,623	7,695	7,768
522	7,841	7,915	7,990	8,065	8,140	8,216	8,292	8,369	8,446	8,524
523	8,602	8,681	8,760	8,840	8,920	9,001	9,082	9,163	9,245	9,328
524	9,411	9,494	9,578	9,662	9,747	9,832	9,917	10,003	10,089	10,175
525	10,262	10,349	10,436	10,524	10,612	10,700	10,788	10,877	10,966	11,056
526	11,146	11,236	11,326	11,416	11,507	11,598	11,689	11,781	11,873	11,966
527	12,059	12,152	12,246	12,340	12,434	12,529	12,624	12,720	12,816	12,912
528	13,009	13,106	13,203	13,301	13,399	13,497	13,596	13,695	13,794	13,894
529	13,994	14,094	14,194	14,295	14,396	14,498	14,599	14,701	14,803	14,906
530	15,009	15,112	15,216	15,319	15,424	15,528	15,633	15,738	15,844	15,950
531	16,056	16,162	16,269	16,376	16,483	16,590	16,698	16,806	16,914	17,023
532	17,132	17,241	17,350	17,460	17,570	17,680	17,790	17,901	18,012	18,123

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
533	18,234	18,346	18,458	18,571	18,683	18,796	18,909	19,022	19,136	19,250
534	19,364	19,478	19,593	19,708	19,823	19,939	20,055	20,172	20,289	20,406
535	20,524	20,643	20,762	20,881	21,001	21,122	21,243	21,364	21,486	21,608
536	21,730	21,853	21,977	22,101	22,225	22,350	22,475	22,601	22,727	22,854
537	22,981	23,108	23,236	23,364	23,493	23,622	23,751	23,881	24,012	24,142
538	24,274	24,405	24,537	24,670	24,803	24,936	25,070	25,203	25,338	25,473
539	25,608	25,743	25,879	26,015	26,152	26,289	26,426	26,563	26,701	26,840
540	26,978	27,117	27,257	27,396	27,537	27,677	27,818	27,959	28,100	28,242
541	28,384	28,526	28,669	28,812	28,956	29,099	29,244	29,388	29,533	29,678
542	29,823	29,969	30,115	30,262	30,409	30,556	30,704	30,852	31,001	31,150
543	31,299	31,449	31,599	31,750	31,901	32,052	32,204	32,356	32,508	32,661
544	32,814	32,968	33,122	33,276	33,431	33,586	33,742	33,898	34,055	34,212
545	34,370	34,528	34,688	34,848	35,008	35,170	35,332	35,494	35,657	35,820
546	35,984	36,148	36,313	36,479	36,645	36,812	36,979	37,147	37,315	37,484
547	37,653	37,823	37,993	38,164	38,335	38,507	38,679	38,852	39,025	39,198
548	39,372	39,547	39,722	39,897	40,072	40,248	40,425	40,602	40,779	40,956
549	41,134	41,313	41,492	41,671	41,851	42,031	42,212	42,393	42,574	42,756
550	42,939	43,122	43,306	43,490	43,675	43,860	44,046	44,232	44,418	44,606
551	44,793	44,982	45,170	45,360	45,550	45,740	45,931	46,122	46,314	46,507
552	46,699	46,893	47,087	47,281	47,476	47,672	47,868	48,064	48,261	48,458
553	48,656	48,855	49,054	49,253	49,453	49,654	49,855	50,056	50,259	50,461
554	50,664	50,867	51,071	51,275	51,480	51,685	51,891	52,097	52,303	52,510
555	52,717	52,925	53,133	53,342	53,551	53,760	53,970	54,180	54,391	54,602
556	54,814	55,026	55,239	55,452	55,665	55,879	56,093	56,308	56,523	56,738
557	56,954	57,171	57,388	57,605	57,823	58,041	58,260	58,479	58,699	58,919
558	59,139	59,360	59,582	59,804	60,026	60,249	60,472	60,696	60,921	61,147
559	61,372	61,599	61,826	62,054	62,282	62,511	62,741	62,971	63,202	63,433
560	63,665	63,897	64,130	64,363	64,597	64,832	65,067	65,303	65,539	65,776
561	66,013	66,251	66,490	66,730	66,971	67,212	67,454	67,697	67,940	68,184
562	68,429	68,675	68,921	69,168	69,415	69,663	69,912	70,161	70,411	70,662
563	70,913	71,165	71,418	71,671	71,925	72,179	72,434	72,689	72,946	73,202
564	73,460	73,718	73,977	74,236	74,496	74,756	75,017	75,279	75,541	75,804
565	76,068	76,332	76,596	76,862	77,128	77,394	77,661	77,928	78,197	78,465

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
566	78,734	79,004	79,275	79,546	79,817	80,089	80,362	80,636	80,910	81,185
567	81,461	81,737	82,014	82,292	82,571	82,851	83,131	83,412	83,694	83,977
568	84,260	84,544	84,829	85,115	85,401	85,687	85,975	86,263	86,552	86,842
569	87,132	87,423	87,715	88,007	88,301	88,595	88,889	89,185	89,481	89,778
570	90,075	90,374	90,673	90,973	91,273	91,574	91,877	92,179	92,483	92,788
571	93,093	93,399	93,706	94,013	94,322	94,631	94,941	95,251	95,563	95,875
572	96,187	96,501	96,816	97,132	97,449	97,766	98,085	98,405	98,726	99,047
573	99,369	99,693	100,017	100,342	100,667	100,994	101,322	101,650	101,979	102,309
574	102,640	102,972	103,305	103,639	103,973	104,308	104,644	104,981	105,319	105,657
575	105,997	106,337	106,679	107,021	107,364	107,708	108,052	108,398	108,745	109,092
576	109,440	109,789	110,139	110,490	110,842	111,194	111,548	111,903	112,258	112,614
577	112,972	113,330	113,690	114,051	114,412	114,775	115,139	115,503	115,869	116,236
578	116,604	116,973	117,344	117,715	118,087	118,461	118,836	119,211	119,588	119,965
579	120,344	120,723	121,104	121,485	121,868	122,251	122,636	123,021	123,407	123,794
580	124,181	124,570	124,960	125,351	125,742	126,135	126,528	126,922	127,318	127,714
581	128,110	128,508	128,907	129,306	129,706	130,107	130,509	130,912	131,316	131,720
582	132,126	132,532	132,939	133,347	133,756	134,165	134,575	134,986	135,398	135,811
583	136,224	136,638	137,053	137,469	137,885	138,302	138,720	139,138	139,557	139,977
584	140,398	140,819	141,241	141,664	142,087	142,511	142,937	143,362	143,789	144,215
585	144,643	145,072	145,501	145,931	146,362	146,793	147,225	147,658	148,092	148,526
586	148,961	149,397	149,834	150,271	150,709	151,148	151,588	152,028	152,469	152,911
587	153,353	153,797	154,241	154,686	155,132	155,579	156,028	156,477	156,927	157,378
588	157,830	158,284	158,738	159,194	159,650	160,108	160,567	161,027	161,488	161,951
589	162,414	162,879	163,344	163,811	164,279	164,748	165,218	165,689	166,162	166,635
590	167,110	167,586	168,063	168,541	169,019	169,499	169,980	170,461	170,944	171,427
591	171,911	172,396	172,882	173,368	173,856	174,344	174,833	175,323	175,814	176,306
592	176,798	177,291	177,785	178,280	178,776	179,272	179,770	180,268	180,767	181,267
593	181,767	182,268	182,770	183,273	183,777	184,281	184,787	185,293	185,800	186,307
594	186,815	187,324	187,834	188,345	188,856	189,368	189,882	190,395	190,910	191,425
595	191,941	192,459	192,977	193,496	194,015	194,535	195,057	195,579	196,102	196,626
596	197,151	197,676	198,203	198,730	199,258	199,786	200,316	200,847	201,378	201,910
597	202,443	202,977	203,512	204,048	204,585	205,122	205,661	206,201	206,741	207,283
598	207,825	208,369	208,913	209,458	210,005	210,552	211,100	211,649	212,199	212,750

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
599	213,301	213,854	214,408	214,963	215,518	216,074	216,632	217,190	217,750	218,310
600	218,871	219,434	219,997	220,562	221,127	221,693	222,261	222,829	223,398	223,968
601	224,539	225,111	225,684	226,258	226,833	227,409	227,986	228,563	229,142	229,722
602	230,303	230,885	231,469	232,054	232,640	233,228	233,817	234,407	234,999	235,591
603	236,185	236,780	237,375	237,973	238,571	239,170	239,771	240,372	240,975	241,579
604	242,184	242,791	243,398	244,007	244,616	245,227	245,840	246,453	247,068	247,683
605	248,300	248,919	249,539	250,160	250,782	251,406	252,031	252,657	253,285	253,914
606	254,544	255,176	255,809	256,444	257,080	257,717	258,356	258,996	259,638	260,280
607	260,925	261,570	262,217	262,865	263,514	264,165	264,817	265,470	266,124	266,779
608	267,435	268,092	268,751	269,410	270,071	270,732	271,395	272,058	272,723	273,388
609	274,055	274,722	275,391	276,060	276,731	277,402	278,074	278,748	279,422	280,097
610	280,774	281,451	282,129	282,808	283,488	284,169	284,852	285,535	286,220	286,905
611	287,591	288,278	288,967	289,656	290,346	291,038	291,730	292,424	293,118	293,814
612	294,511	295,209	295,908	296,609	297,310	298,012	298,716	299,421	300,127	300,834
613	301,542	302,252	302,962	303,674	304,387	305,100	305,816	306,532	307,250	307,968
614	308,688	309,409	310,131	310,855	311,579	312,305	313,032	313,760	314,489	315,219
615	315,950	316,683	317,417	318,152	318,888	319,625	320,363	321,102	321,843	322,585
616	323,327	324,071	324,816	325,563	326,310	327,058	327,807	328,558	329,309	330,062
617	330,816	331,571	332,327	333,084	333,842	334,602	335,363	336,125	336,888	337,652
618	338,418	339,185	339,953	340,722	341,492	342,264	343,037	343,811	344,586	345,363
619	346,140	346,920	347,700	348,483	349,266	350,051	350,838	351,626	352,416	353,208
620	354,000	354,795	355,590	356,387	357,185	357,985	358,786	359,588	360,392	361,197
621	362,003	362,811	363,620	364,430	365,242	366,055	366,869	367,685	368,502	369,321
622	370,140	370,962	371,784	372,608	373,433	374,259	375,087	375,916	376,746	377,578
623	378,410	379,245	380,080	380,917	381,755	382,594	383,434	384,275	385,118	385,962
624	386,806	387,653	388,500	389,348	390,197	391,048	391,899	392,752	393,606	394,461
625	395,317	396,174	397,032	397,892	398,753	399,615	400,479	401,343	402,209	403,076
626	403,944	404,814	405,685	406,558	407,431	408,306	409,182	410,059	410,938	411,818
627	412,699	413,582	414,466	415,351	416,237	417,125	418,014	418,904	419,795	420,688
628	421,581	422,476	423,372	424,270	425,169	426,068	426,970	427,872	428,776	429,681
629	430,586	431,494	432,402	433,312	434,223	435,135	436,049	436,964	437,881	438,798
630	439,717	440,638	441,559	442,483	443,407	444,333	445,260	446,189	447,119	448,050
631	448,983	449,917	450,853	451,790	452,728	453,667	454,608	455,551	456,494	457,439

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY1/
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
632	458,385	459,333	460,282	461,233	462,185	463,138	464,093	465,049	466,006	466,965
633	467,925	468,887	469,850	470,815	471,781	472,748	473,717	474,687	475,659	476,632
634	477,606	478,583	479,560	480,539	481,519	482,500	483,483	484,467	485,453	486,439
635	487,427	488,417	489,407	490,398	491,391	492,385	493,380	494,376	495,374	496,372
636	497,372	498,374	499,376	500,380	501,385	502,390	503,398	504,406	505,417	506,427
637	507,439	508,453	509,468	510,484	511,501	512,520	513,540	514,561	515,583	516,607
638	517,631	518,658	519,685	520,714	521,744	522,775	523,808	524,842	525,878	526,914
639	527,952	528,991	530,032	531,074	532,117	533,161	534,208	535,255	536,304	537,353
640	538,404	539,457	540,511	541,567	542,624	543,682	544,742	545,803	546,866	547,930
641	548,996	550,063	551,132	552,202	553,273	554,346	555,421	556,497	557,575	558,654
642	559,734	560,817	561,901	562,986	564,073	565,161	566,252	567,343	568,436	569,531
643	570,627	571,725	572,825	573,926	575,029	576,133	577,239	578,347	579,456	580,567
644	581,679	582,794	583,909	585,027	586,146	587,267	588,391	589,515	590,644	591,776
645	592,912	594,051	595,193	596,337	597,484	598,632	599,784	600,937	602,092	603,249
646	604,408	605,570	606,733	607,898	609,065	610,233	611,405	612,577	613,752	614,928
647	616,106	617,286	618,467	619,651	620,836	622,023	623,212	624,403	625,595	626,789
648	627,985	629,183	630,382	631,583	632,786	633,990	635,197	636,405	637,615	638,826
649	640,040	641,256	642,472	643,692	644,912	646,134	647,359	648,585	649,814	651,043
650	652,275	653,509	654,744	655,982	657,221	658,461	659,704	660,948	662,195	663,443
651	664,693	665,945	667,198	668,454	669,711	670,970	672,232	673,494	674,759	676,026
652	677,294	678,564	679,836	681,110	682,386	683,663	684,943	686,224	687,508	688,792
653	690,079	691,368	692,659	693,952	695,246	696,542	697,841	699,140	700,442	701,746
654	703,051	704,358	705,667	706,979	708,291	709,605	710,922	712,240	713,560	714,882
655	716,205	717,531	718,858	720,188	721,518	722,851	724,187	725,523	726,862	728,203
656	729,545	730,890	732,236	733,584	734,934	736,286	737,641	738,996	740,355	741,714
657	743,075	744,440	745,805	747,173	748,542	749,914	751,288	752,663	754,041	755,421
658	756,802	758,187	759,572	760,961	762,350	763,742	765,137	766,532	767,931	769,331
659	770,732	772,137	773,543	774,952	776,361	777,773	779,188	780,603	782,022	783,442
660	784,863	786,288	787,713	789,142	790,571	792,003	793,437	794,873	796,312	797,751
661	799,193	800,638	802,084	803,533	804,983	806,435	807,890	809,347	810,806	812,267
662	813,730	815,197	816,664	818,135	819,607	821,081	822,558	824,037	825,518	827,001
663	828,487	829,975	831,465	832,958	834,452	835,949	837,448	838,949	840,452	841,957
664	843,464	844,974	846,486	848,000	849,515	851,033	852,554	854,076	855,601	857,127

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
665	858,656	860,188	861,721	863,257	864,795	866,335	867,878	869,423	870,971	872,520
666	874,072	875,627	877,184	878,744	880,306	881,870	883,438	885,007	886,580	888,155
667	889,732	891,313	892,895	894,481	896,069	897,658	899,252	900,846	902,445	904,044
668	905,647	907,253	908,860	910,471	912,083	913,698	915,317	916,936	918,560	920,185
669	921,812	923,443	925,075	926,711	928,348	929,987	931,631	933,275	934,923	936,572
670	938,224	939,880	941,536	943,197	944,858	946,523	948,190	949,859	951,532	953,206
671	954,883	956,563	958,244	959,929	961,615	963,304	964,996	966,689	968,387	970,085
672	971,786	973,490	975,196	976,905	978,615	980,328	982,044	983,761	985,482	987,204
673	988,929	990,656	992,386	994,118	995,853	997,589	999,329	1,001,071	1,002,816	1,004,563
674	1,006,312	1,008,065	1,009,819	1,011,577	1,013,337	1,015,099	1,016,864	1,018,632	1,020,403	1,022,175
675	1,023,950	1,025,730	1,027,510	1,029,294	1,031,080	1,032,868	1,034,660	1,036,453	1,038,250	1,040,048
676	1,041,849	1,043,653	1,045,459	1,047,268	1,049,079	1,050,892	1,052,709	1,054,527	1,056,348	1,058,171
677	1,059,997	1,061,826	1,063,656	1,065,490	1,067,325	1,069,163	1,071,004	1,072,846	1,074,691	1,076,538
678	1,078,388	1,080,240	1,082,094	1,083,951	1,085,810	1,087,671	1,089,535	1,091,401	1,093,270	1,095,140
679	1,097,013	1,098,889	1,100,766	1,102,647	1,104,529	1,106,413	1,108,301	1,110,189	1,112,082	1,113,975
680	1,115,871	1,117,770	1,119,670	1,121,574	1,123,478	1,125,385	1,127,295	1,129,207	1,131,121	1,133,037
681	1,134,956	1,136,888	1,138,824	1,140,764	1,142,706	1,144,652	1,146,602	1,148,554	1,150,509	1,152,467
682	1,154,427	1,156,392	1,158,358	1,160,328	1,162,301	1,164,276	1,166,256	1,168,237	1,170,222	1,172,209
683	1,174,198	1,176,191	1,178,185	1,180,183	1,182,183	1,184,184	1,186,190	1,188,197	1,190,207	1,192,219
684	1,194,233	1,196,251	1,198,271	1,200,294	1,202,318	1,204,344	1,206,375	1,208,406	1,210,441	1,212,477
685	1,214,515	1,216,557	1,218,600	1,220,647	1,222,695	1,224,745	1,226,799	1,228,854	1,230,913	1,232,973
686	1,235,035	1,237,101	1,239,168	1,241,239	1,243,311	1,245,386	1,247,464	1,249,543	1,251,626	1,253,709
687	1,255,796	1,257,885	1,259,976	1,262,071	1,264,167	1,266,265	1,268,366	1,270,469	1,272,576	1,274,683
688	1,276,793	1,278,907	1,281,021	1,283,140	1,285,259	1,287,381	1,289,507	1,291,633	1,293,764	1,295,895
689	1,298,029	1,300,166	1,302,305	1,304,447	1,306,590	1,308,736	1,310,886	1,313,036	1,315,191	1,317,346
690	1,319,504	1,321,666	1,323,829	1,325,996	1,328,163	1,330,334	1,332,508	1,334,683	1,336,862	1,339,042
691	1,341,225	1,343,412	1,345,599	1,347,791	1,349,983	1,352,179	1,354,378	1,356,578	1,358,782	1,360,988
692	1,363,196	1,365,408	1,367,621	1,369,838	1,372,056	1,374,276	1,376,501	1,378,727	1,380,957	1,383,188
693	1,385,422	1,387,659	1,389,898	1,392,141	1,394,386	1,396,633	1,398,884	1,401,136	1,403,392	1,405,650
694	1,407,910	1,410,174	1,412,440	1,414,710	1,416,981	1,419,254	1,421,532	1,423,811	1,426,094	1,428,379
695	1,430,666	1,432,958	1,435,250	1,437,547	1,439,846	1,442,147	1,444,452	1,446,758	1,449,069	1,451,381
696	1,453,696	1,456,015	1,458,335	1,460,660	1,462,986	1,465,315	1,467,648	1,469,982	1,472,321	1,474,661
697	1,477,004	1,479,351	1,481,699	1,484,051	1,486,405	1,488,762	1,491,123	1,493,485	1,495,852	1,498,219

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
698	1,500,590	1,502,966	1,505,342	1,507,723	1,510,106	1,512,492	1,514,882	1,517,274	1,519,670	1,522,067
699	1,524,468	1,526,873	1,529,280	1,531,691	1,534,104	1,536,519	1,538,939	1,541,361	1,543,787	1,546,214
700	1,548,645	1,551,080	1,553,517	1,555,958	1,558,400	1,560,846	1,563,297	1,565,749	1,568,205	1,570,663
701	1,573,124	1,575,590	1,578,057	1,580,529	1,583,002	1,585,478	1,587,959	1,590,442	1,592,929	1,595,417
702	1,597,909	1,600,405	1,602,903	1,605,406	1,607,910	1,610,417	1,612,930	1,615,443	1,617,962	1,620,482
703	1,623,005	1,625,533	1,628,062	1,630,596	1,633,132	1,635,670	1,638,214	1,640,759	1,643,309	1,645,861
704	1,648,415	1,650,975	1,653,536	1,656,102	1,658,670	1,661,241	1,663,817	1,666,395	1,668,978	1,671,562
705	1,674,150	1,676,743	1,679,338	1,681,938	1,684,540	1,687,145	1,689,755	1,692,367	1,694,984	1,697,603
706	1,700,225	1,702,852	1,705,482	1,708,116	1,710,752	1,713,392	1,716,037	1,718,684	1,721,336	1,723,990
707	1,726,647	1,729,310	1,731,975	1,734,645	1,737,316	1,739,992	1,742,672	1,745,355	1,748,042	1,750,732
708	1,753,425	1,756,123	1,758,823	1,761,529	1,764,236	1,766,947	1,769,663	1,772,381	1,775,104	1,777,830
709	1,780,558	1,783,292	1,786,028	1,788,770	1,791,513	1,794,260	1,797,012	1,799,766	1,802,526	1,805,288
710	1,808,053	1,810,824	1,813,597	1,816,375	1,819,155	1,821,939	1,824,728	1,827,519	1,830,315	1,833,114
711	1,835,916	1,838,724	1,841,533	1,844,348	1,847,165	1,849,986	1,852,813	1,855,641	1,858,475	1,861,310
712	1,864,150	1,866,995	1,869,842	1,872,694	1,875,548	1,878,406	1,881,270	1,884,135	1,887,006	1,889,879
713	1,892,755	1,895,637	1,898,521	1,901,410	1,904,302	1,907,197	1,910,097	1,912,999	1,915,907	1,918,817
714	1,921,731	1,924,650	1,927,570	1,930,497	1,933,425	1,936,357	1,939,294	1,942,233	1,945,178	1,948,125
715	1,951,075	1,954,030	1,956,988	1,959,951	1,962,916	1,965,885	1,968,859	1,971,836	1,974,818	1,977,802
716	1,980,790	1,983,783	1,986,778	1,989,779	1,992,782	1,995,789	1,998,801	2,001,815	2,004,835	2,007,856
717	2,010,881	2,013,912	2,016,945	2,019,984	2,023,024	2,026,068	2,029,117	2,032,169	2,035,226	2,038,285
718	2,041,347	2,044,416	2,047,486	2,050,562	2,053,639	2,056,721	2,059,807	2,062,896	2,065,991	2,069,087
719	2,072,187	2,075,293	2,078,401	2,081,514	2,084,629	2,087,748	2,090,872	2,093,998	2,097,130	2,100,264
720	2,103,402	2,106,546	2,109,692	2,112,843	2,115,997	2,119,154	2,122,318	2,125,483	2,128,654	2,131,827
721	2,135,004	2,138,186	2,141,371	2,144,561	2,147,754	2,150,950	2,154,152	2,157,357	2,160,567	2,163,779
722	2,166,995	2,170,217	2,173,440	2,176,670	2,179,902	2,183,137	2,186,378	2,189,622	2,192,871	2,196,122
723	2,199,377	2,202,638	2,205,901	2,209,170	2,212,441	2,215,716	2,218,997	2,222,280	2,225,569	2,228,860
724	2,232,155	2,235,456	2,238,759	2,242,068	2,245,379	2,248,694	2,252,015	2,255,338	2,258,668	2,261,999
725	2,265,334	2,268,676	2,272,020	2,275,370	2,278,721	2,282,078	2,285,440	2,288,804	2,292,174	2,295,547
726	2,298,923	2,302,306	2,305,690	2,309,081	2,312,474	2,315,870	2,319,273	2,322,678	2,326,089	2,329,503
727	2,332,920	2,336,343	2,339,769	2,343,201	2,346,634	2,350,072	2,353,516	2,356,963	2,360,415	2,363,869
728	2,367,328	2,370,792	2,374,259	2,377,732	2,381,207	2,384,686	2,388,171	2,391,658	2,395,152	2,398,647
729	2,402,147	2,405,654	2,409,162	2,412,677	2,416,194	2,419,715	2,423,242	2,426,772	2,430,308	2,433,846
730	2,437,388	2,440,937	2,444,488	2,448,045	2,451,605	2,455,168	2,458,738	2,462,310	2,465,888	2,469,468

TABLE 7-4(a)
LAKE TRAVIS ELEVATION-CAPACITY[1/]
CONTENTS IN ACRE-FEET

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
731	2,473,052	2,476,643	2,480,235	2,483,834	2,487,435	2,491,040	2,494,652	2,498,265	2,501,885	2,505,506
732	2,509,132	2,512,764	2,516,398	2,520,038	2,523,680	2,527,327	2,530,979	2,534,634	2,538,295	2,541,959
733	2,545,626	2,549,300	2,552,975	2,556,658	2,560,342	2,564,030	2,567,725	2,571,422	2,575,125	2,578,830
734	2,582,540	2,586,256	2,589,974	2,593,698	2,597,425	2,601,155	2,604,893	2,608,632	2,612,379	2,616,127
735	2,619,879	2,623,639	2,627,400	2,631,168	2,634,938	2,638,712	2,642,493	2,646,276	2,650,066	2,653,858
736	2,657,654	2,661,457	2,665,263	2,669,074	2,672,888	2,676,707	2,680,532	2,684,359	2,688,192	2,692,028
737	2,695,869	2,699,716	2,703,565	2,707,421	2,711,279	2,715,141	2,719,011	2,722,882	2,726,760	2,730,641
738	2,734,525	2,738,417	2,742,311	2,746,211	2,750,114	2,754,021	2,757,935	2,761,851	2,765,774	2,769,699
739	2,773,628	2,777,564	2,781,503	2,785,448	2,789,396	2,793,348	2,797,307	2,801,268	2,805,236	2,809,206
740	2,813,181	2,817,162	2,821,146	2,825,137	2,829,129	2,833,126	2,837,131	2,841,137	2,845,150	2,849,165
741	2,853,185	2,857,211	2,861,240	2,865,275	2,869,313	2,873,355	2,877,404	2,881,454	2,885,512	2,889,572
742	2,893,636	2,897,708	2,901,781	2,905,861	2,909,943	2,914,030	2,918,124	2,922,219	2,926,322	2,930,426
743	2,934,535	2,938,652	2,942,770	2,946,895	2,951,022	2,955,153	2,959,292	2,963,432	2,967,580	2,971,729
744	2,975,883	2,980,044	2,984,207	2,988,377	2,992,549					

[1/] Data from 2008 TWDB Survey

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
500					0	0	0	0	0	0
501	0	0	1	2	3	4	7	11	17	21
502	24	28	33	36	40	43	46	49	52	56
503	59	63	67	71	76	79	81	84	87	91
504	94	97	101	104	108	111	115	120	125	129
505	133	138	143	148	154	159	165	171	176	180
506	185	189	193	197	201	205	209	212	217	222
507	230	236	242	247	252	257	262	267	272	276
508	280	285	289	293	296	299	302	305	308	311
509	314	317	320	323	326	328	330	333	336	338
510	341	344	347	349	352	355	357	360	363	366
511	370	373	375	378	381	384	388	391	394	397
512	400	403	406	410	412	415	418	421	424	427
513	429	431	434	437	440	443	445	447	450	452
514	454	456	459	461	463	467	471	474	478	482
515	486	490	493	497	501	504	508	511	515	518
516	521	524	527	529	532	535	537	540	544	548
517	552	558	563	567	571	574	578	583	587	592
518	596	600	604	608	612	615	619	624	628	633
519	638	642	646	650	653	656	660	664	667	670
520	673	676	679	682	685	687	690	692	695	698
521	701	703	706	708	711	714	718	722	727	732
522	736	741	747	752	756	761	765	769	773	779
523	785	791	796	800	805	809	813	818	822	827
524	832	836	840	844	848	852	855	859	862	865
525	868	872	875	878	881	884	887	890	893	896
526	898	901	904	906	909	912	915	919	923	927
527	931	936	940	943	947	950	954	958	961	965
528	968	972	975	979	982	985	988	991	994	997
529	1,000	1,003	1,006	1,009	1,012	1,015	1,018	1,021	1,024	1,027
530	1,030	1,034	1,037	1,041	1,044	1,047	1,050	1,053	1,056	1,059
531	1,062	1,065	1,068	1,071	1,074	1,076	1,079	1,081	1,084	1,087
532	1,090	1,092	1,095	1,097	1,100	1,103	1,105	1,108	1,111	1,113
533	1,116	1,119	1,122	1,124	1,127	1,130	1,132	1,135	1,138	1,140

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
534	1,143	1,146	1,148	1,152	1,155	1,159	1,164	1,168	1,173	1,177
535	1,182	1,187	1,192	1,197	1,202	1,207	1,211	1,215	1,219	1,223
536	1,228	1,232	1,237	1,242	1,247	1,251	1,255	1,259	1,264	1,268
537	1,272	1,276	1,280	1,284	1,288	1,293	1,297	1,302	1,306	1,310
538	1,315	1,319	1,323	1,327	1,330	1,334	1,338	1,342	1,346	1,349
539	1,353	1,357	1,360	1,364	1,367	1,370	1,374	1,378	1,381	1,385
540	1,389	1,392	1,396	1,399	1,403	1,406	1,409	1,413	1,416	1,419
541	1,423	1,426	1,429	1,433	1,436	1,439	1,443	1,446	1,450	1,453
542	1,457	1,460	1,464	1,468	1,472	1,476	1,480	1,484	1,488	1,492
543	1,496	1,500	1,504	1,507	1,511	1,514	1,518	1,522	1,526	1,530
544	1,534	1,538	1,542	1,547	1,551	1,555	1,559	1,563	1,568	1,575
545	1,584	1,591	1,598	1,604	1,610	1,615	1,621	1,626	1,631	1,637
546	1,642	1,647	1,652	1,658	1,664	1,670	1,675	1,681	1,686	1,691
547	1,696	1,701	1,706	1,710	1,715	1,720	1,724	1,728	1,733	1,737
548	1,742	1,746	1,750	1,754	1,758	1,762	1,766	1,770	1,774	1,778
549	1,782	1,787	1,791	1,795	1,799	1,803	1,808	1,813	1,819	1,824
550	1,830	1,835	1,840	1,845	1,850	1,854	1,859	1,864	1,869	1,874
551	1,880	1,886	1,891	1,896	1,901	1,906	1,912	1,917	1,922	1,927
552	1,932	1,937	1,942	1,947	1,952	1,957	1,962	1,967	1,972	1,977
553	1,983	1,988	1,993	1,998	2,003	2,008	2,013	2,018	2,022	2,027
554	2,031	2,036	2,040	2,045	2,049	2,053	2,058	2,062	2,066	2,071
555	2,075	2,080	2,084	2,088	2,093	2,097	2,101	2,106	2,110	2,114
556	2,118	2,123	2,127	2,132	2,136	2,140	2,145	2,149	2,154	2,158
557	2,162	2,167	2,171	2,176	2,180	2,185	2,189	2,194	2,198	2,203
558	2,207	2,212	2,217	2,222	2,227	2,232	2,238	2,244	2,251	2,256
559	2,262	2,268	2,275	2,281	2,287	2,293	2,298	2,304	2,310	2,315
560	2,321	2,326	2,331	2,337	2,342	2,348	2,354	2,359	2,365	2,372
561	2,379	2,387	2,395	2,403	2,410	2,417	2,423	2,430	2,437	2,444
562	2,451	2,458	2,465	2,472	2,478	2,484	2,490	2,497	2,503	2,510
563	2,516	2,522	2,528	2,534	2,540	2,546	2,552	2,558	2,565	2,571
564	2,578	2,584	2,590	2,596	2,602	2,608	2,614	2,620	2,626	2,632
565	2,638	2,644	2,650	2,655	2,661	2,667	2,672	2,678	2,684	2,689
566	2,695	2,701	2,707	2,713	2,719	2,725	2,731	2,738	2,746	2,754
567	2,761	2,769	2,776	2,784	2,792	2,800	2,807	2,815	2,823	2,831

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
568	2,838	2,844	2,851	2,858	2,865	2,871	2,878	2,885	2,892	2,899
569	2,907	2,915	2,923	2,929	2,936	2,943	2,950	2,957	2,965	2,972
570	2,980	2,988	2,995	3,002	3,010	3,017	3,025	3,032	3,041	3,049
571	3,057	3,064	3,072	3,080	3,087	3,095	3,102	3,110	3,117	3,125
572	3,134	3,143	3,153	3,163	3,173	3,183	3,193	3,202	3,211	3,219
573	3,227	3,236	3,245	3,253	3,262	3,271	3,280	3,289	3,298	3,306
574	3,315	3,323	3,331	3,340	3,348	3,356	3,364	3,373	3,382	3,391
575	3,400	3,408	3,417	3,426	3,435	3,443	3,452	3,460	3,469	3,478
576	3,486	3,495	3,504	3,513	3,523	3,532	3,541	3,550	3,559	3,568
577	3,579	3,591	3,602	3,612	3,622	3,632	3,642	3,653	3,664	3,675
578	3,686	3,697	3,709	3,719	3,730	3,740	3,750	3,761	3,771	3,780
579	3,791	3,801	3,810	3,820	3,829	3,838	3,847	3,856	3,865	3,874
580	3,883	3,892	3,902	3,912	3,921	3,930	3,938	3,947	3,956	3,964
581	3,973	3,981	3,990	3,998	4,007	4,016	4,024	4,033	4,041	4,049
582	4,058	4,066	4,075	4,083	4,091	4,099	4,107	4,114	4,122	4,129
583	4,137	4,144	4,152	4,159	4,166	4,174	4,181	4,188	4,195	4,203
584	4,210	4,217	4,224	4,231	4,238	4,246	4,253	4,260	4,267	4,274
585	4,281	4,289	4,296	4,303	4,311	4,318	4,325	4,333	4,340	4,348
586	4,355	4,362	4,370	4,377	4,384	4,392	4,399	4,407	4,415	4,423
587	4,431	4,439	4,447	4,456	4,466	4,476	4,486	4,496	4,506	4,517
588	4,528	4,539	4,550	4,561	4,572	4,584	4,595	4,607	4,619	4,630
589	4,641	4,651	4,662	4,672	4,683	4,695	4,706	4,718	4,730	4,742
590	4,753	4,764	4,774	4,784	4,793	4,802	4,811	4,820	4,828	4,837
591	4,845	4,854	4,862	4,871	4,879	4,887	4,896	4,904	4,912	4,921
592	4,929	4,937	4,945	4,953	4,961	4,969	4,977	4,985	4,993	5,001
593	5,009	5,017	5,025	5,033	5,041	5,049	5,056	5,064	5,072	5,079
594	5,087	5,095	5,103	5,110	5,118	5,126	5,134	5,142	5,150	5,159
595	5,167	5,175	5,184	5,192	5,201	5,209	5,218	5,226	5,234	5,243
596	5,251	5,259	5,267	5,276	5,284	5,293	5,301	5,310	5,318	5,326
597	5,335	5,344	5,353	5,363	5,373	5,382	5,391	5,400	5,410	5,419
598	5,429	5,439	5,449	5,459	5,468	5,477	5,486	5,495	5,504	5,513
599	5,522	5,531	5,541	5,550	5,559	5,569	5,579	5,589	5,599	5,609
600	5,619	5,630	5,640	5,649	5,659	5,668	5,677	5,687	5,696	5,706
601	5,715	5,725	5,735	5,744	5,754	5,763	5,773	5,783	5,793	5,804

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
602	5,816	5,830	5,843	5,858	5,871	5,884	5,896	5,907	5,919	5,931
603	5,942	5,954	5,965	5,977	5,988	6,000	6,011	6,022	6,034	6,046
604	6,057	6,068	6,080	6,092	6,104	6,116	6,128	6,140	6,153	6,165
605	6,178	6,191	6,204	6,217	6,230	6,243	6,257	6,270	6,284	6,298
606	6,311	6,325	6,338	6,351	6,366	6,381	6,396	6,409	6,423	6,436
607	6,449	6,461	6,474	6,487	6,499	6,512	6,523	6,535	6,546	6,557
608	6,568	6,578	6,589	6,600	6,610	6,620	6,631	6,640	6,650	6,660
609	6,670	6,680	6,690	6,700	6,709	6,719	6,729	6,738	6,748	6,758
610	6,768	6,777	6,787	6,797	6,806	6,817	6,828	6,838	6,848	6,858
611	6,868	6,878	6,888	6,898	6,908	6,919	6,929	6,940	6,952	6,963
612	6,975	6,986	6,997	7,009	7,021	7,032	7,043	7,054	7,065	7,077
613	7,088	7,099	7,110	7,122	7,134	7,145	7,156	7,168	7,180	7,192
614	7,205	7,217	7,229	7,240	7,251	7,263	7,274	7,285	7,297	7,309
615	7,320	7,332	7,343	7,355	7,366	7,377	7,389	7,400	7,411	7,422
616	7,433	7,444	7,455	7,466	7,477	7,488	7,499	7,510	7,521	7,532
617	7,544	7,555	7,567	7,579	7,590	7,602	7,614	7,626	7,638	7,650
618	7,662	7,674	7,686	7,698	7,710	7,722	7,735	7,747	7,760	7,773
619	7,786	7,800	7,814	7,830	7,845	7,859	7,875	7,890	7,905	7,920
620	7,935	7,949	7,963	7,977	7,990	8,003	8,017	8,030	8,043	8,056
621	8,070	8,083	8,096	8,110	8,124	8,137	8,151	8,164	8,178	8,191
622	8,205	8,218	8,231	8,244	8,258	8,271	8,284	8,296	8,309	8,322
623	8,335	8,348	8,361	8,373	8,385	8,397	8,408	8,420	8,431	8,443
624	8,454	8,466	8,477	8,488	8,499	8,510	8,521	8,532	8,544	8,555
625	8,567	8,579	8,591	8,603	8,615	8,628	8,640	8,652	8,665	8,678
626	8,690	8,703	8,716	8,729	8,742	8,755	8,768	8,780	8,793	8,806
627	8,819	8,832	8,845	8,857	8,870	8,882	8,895	8,907	8,919	8,932
628	8,944	8,956	8,968	8,981	8,993	9,005	9,018	9,030	9,042	9,054
629	9,067	9,079	9,092	9,104	9,117	9,130	9,143	9,156	9,170	9,184
630	9,198	9,211	9,225	9,237	9,251	9,265	9,280	9,294	9,308	9,321
631	9,335	9,348	9,362	9,376	9,389	9,402	9,416	9,429	9,443	9,456
632	9,470	9,484	9,498	9,512	9,526	9,540	9,554	9,568	9,582	9,596
633	9,610	9,624	9,638	9,652	9,667	9,681	9,696	9,710	9,724	9,738
634	9,752	9,766	9,780	9,794	9,808	9,822	9,836	9,848	9,861	9,873
635	9,885	9,897	9,909	9,921	9,933	9,945	9,957	9,969	9,981	9,994

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
636	10,006	10,018	10,030	10,043	10,055	10,067	10,080	10,092	10,104	10,117
637	10,129	10,141	10,154	10,167	10,179	10,192	10,205	10,217	10,230	10,243
638	10,255	10,268	10,281	10,294	10,307	10,320	10,333	10,347	10,360	10,373
639	10,386	10,400	10,413	10,426	10,439	10,452	10,465	10,479	10,492	10,506
640	10,520	10,534	10,547	10,562	10,576	10,591	10,606	10,621	10,635	10,650
641	10,664	10,679	10,694	10,709	10,724	10,739	10,754	10,769	10,784	10,799
642	10,814	10,830	10,845	10,861	10,877	10,892	10,908	10,924	10,940	10,956
643	10,972	10,988	11,004	11,020	11,036	11,052	11,068	11,084	11,100	11,117
644	11,133	11,150	11,167	11,184	11,202	11,220	11,240	11,264	11,306	11,343
645	11,375	11,403	11,430	11,454	11,478	11,500	11,521	11,542	11,563	11,583
646	11,602	11,621	11,641	11,660	11,679	11,698	11,717	11,735	11,754	11,772
647	11,790	11,808	11,826	11,844	11,862	11,880	11,898	11,915	11,932	11,950
648	11,967	11,984	12,001	12,019	12,037	12,055	12,073	12,091	12,109	12,127
649	12,145	12,162	12,180	12,198	12,216	12,235	12,253	12,272	12,291	12,309
650	12,327	12,345	12,363	12,382	12,399	12,417	12,436	12,454	12,472	12,491
651	12,509	12,528	12,547	12,565	12,583	12,601	12,619	12,637	12,655	12,674
652	12,692	12,711	12,729	12,748	12,767	12,786	12,804	12,823	12,842	12,861
653	12,879	12,898	12,917	12,935	12,954	12,972	12,990	13,009	13,027	13,045
654	13,063	13,081	13,099	13,118	13,136	13,154	13,173	13,191	13,209	13,227
655	13,246	13,264	13,283	13,302	13,321	13,340	13,359	13,378	13,397	13,416
656	13,435	13,454	13,473	13,492	13,511	13,531	13,550	13,569	13,588	13,608
657	13,627	13,647	13,667	13,686	13,706	13,726	13,746	13,767	13,787	13,808
658	13,829	13,849	13,869	13,890	13,910	13,930	13,951	13,971	13,991	14,011
659	14,032	14,052	14,071	14,091	14,111	14,131	14,151	14,171	14,190	14,210
660	14,229	14,249	14,269	14,289	14,310	14,330	14,350	14,370	14,391	14,411
661	14,431	14,452	14,473	14,494	14,515	14,537	14,558	14,580	14,602	14,624
662	14,646	14,668	14,690	14,712	14,734	14,756	14,779	14,801	14,824	14,846
663	14,869	14,891	14,913	14,935	14,957	14,978	14,999	15,021	15,042	15,063
664	15,085	15,106	15,127	15,148	15,170	15,192	15,213	15,235	15,257	15,279
665	15,301	15,324	15,346	15,369	15,392	15,415	15,438	15,462	15,486	15,510
666	15,534	15,559	15,584	15,609	15,634	15,660	15,685	15,711	15,737	15,763
667	15,789	15,814	15,840	15,865	15,890	15,914	15,939	15,964	15,990	16,015
668	16,040	16,065	16,090	16,115	16,140	16,165	16,190	16,215	16,240	16,265
669	16,290	16,314	16,339	16,364	16,388	16,413	16,437	16,461	16,486	16,510

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
670	16,535	16,560	16,584	16,609	16,634	16,658	16,683	16,708	16,732	16,757
671	16,781	16,805	16,830	16,854	16,879	16,904	16,928	16,952	16,976	17,001
672	17,025	17,048	17,072	17,096	17,120	17,143	17,166	17,190	17,213	17,237
673	17,260	17,284	17,309	17,333	17,359	17,384	17,409	17,434	17,459	17,484
674	17,509	17,535	17,560	17,586	17,612	17,638	17,664	17,690	17,717	17,744
675	17,770	17,797	17,823	17,849	17,874	17,899	17,924	17,950	17,975	18,000
676	18,024	18,049	18,073	18,098	18,123	18,147	18,172	18,197	18,222	18,247
677	18,272	18,296	18,320	18,344	18,368	18,391	18,415	18,438	18,461	18,485
678	18,508	18,531	18,555	18,578	18,602	18,625	18,649	18,672	18,696	18,719
679	18,742	18,766	18,789	18,812	18,836	18,859	18,882	18,904	18,927	18,950
680	18,972	18,995	19,017	19,040	19,062	19,084	19,107	19,130	19,153	19,176
681	19,297	19,339	19,377	19,413	19,446	19,477	19,507	19,536	19,565	19,594
682	19,623	19,652	19,682	19,713	19,745	19,775	19,803	19,831	19,857	19,883
683	19,909	19,935	19,960	19,985	20,011	20,036	20,061	20,086	20,111	20,136
684	20,161	20,185	20,210	20,235	20,259	20,283	20,307	20,330	20,354	20,377
685	20,400	20,424	20,447	20,471	20,495	20,519	20,544	20,568	20,593	20,617
686	20,641	20,665	20,689	20,713	20,737	20,761	20,785	20,808	20,832	20,856
687	20,879	20,903	20,926	20,950	20,974	20,997	21,021	21,045	21,069	21,093
688	21,116	21,140	21,164	21,188	21,212	21,236	21,260	21,283	21,307	21,331
689	21,355	21,379	21,402	21,426	21,450	21,475	21,499	21,524	21,548	21,573
690	21,598	21,623	21,647	21,672	21,696	21,721	21,745	21,770	21,795	21,820
691	21,845	21,870	21,895	21,920	21,945	21,971	21,996	22,021	22,047	22,072
692	22,098	22,123	22,149	22,174	22,200	22,226	22,252	22,278	22,304	22,330
693	22,356	22,382	22,409	22,435	22,462	22,488	22,515	22,542	22,568	22,595
694	22,622	22,648	22,675	22,702	22,729	22,756	22,783	22,810	22,837	22,865
695	22,892	22,920	22,947	22,974	23,002	23,029	23,057	23,085	23,112	23,140
696	23,168	23,196	23,224	23,252	23,280	23,308	23,336	23,364	23,392	23,419
697	23,447	23,475	23,502	23,530	23,558	23,586	23,614	23,642	23,671	23,699
698	23,729	23,758	23,788	23,818	23,848	23,878	23,908	23,938	23,968	23,998
699	24,027	24,057	24,087	24,117	24,147	24,177	24,207	24,236	24,266	24,296
700	24,327	24,357	24,388	24,418	24,449	24,479	24,510	24,540	24,571	24,601
701	24,632	24,663	24,693	24,724	24,754	24,785	24,816	24,846	24,877	24,908
702	24,938	24,970	25,001	25,032	25,064	25,096	25,127	25,159	25,191	25,222
703	25,253	25,284	25,316	25,347	25,379	25,410	25,442	25,474	25,506	25,537

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
704	25,570	25,602	25,635	25,667	25,700	25,734	25,768	25,802	25,835	25,869
705	25,904	25,938	25,972	26,006	26,041	26,075	26,109	26,144	26,178	26,212
706	26,247	26,281	26,316	26,351	26,387	26,422	26,457	26,493	26,528	26,564
707	26,600	26,635	26,671	26,707	26,743	26,778	26,813	26,848	26,884	26,920
708	26,955	26,991	27,026	27,062	27,098	27,133	27,169	27,205	27,241	27,277
709	27,312	27,348	27,384	27,421	27,458	27,494	27,531	27,568	27,605	27,642
710	27,679	27,716	27,753	27,790	27,827	27,863	27,900	27,936	27,973	28,010
711	28,047	28,084	28,122	28,159	28,197	28,234	28,271	28,309	28,346	28,383
712	28,420	28,457	28,495	28,532	28,569	28,606	28,643	28,679	28,716	28,753
713	28,790	28,827	28,864	28,901	28,938	28,976	29,013	29,050	29,087	29,124
714	29,160	29,197	29,234	29,271	29,308	29,344	29,381	29,418	29,454	29,491
715	29,527	29,564	29,602	29,639	29,677	29,714	29,753	29,791	29,828	29,866
716	29,904	29,941	29,979	30,017	30,054	30,092	30,130	30,167	30,205	30,242
717	30,279	30,317	30,354	30,391	30,429	30,466	30,503	30,541	30,578	30,615
718	30,652	30,690	30,727	30,765	30,802	30,840	30,878	30,915	30,953	30,990
719	31,028	31,065	31,102	31,139	31,177	31,214	31,252	31,290	31,328	31,367
720	31,406	31,446	31,485	31,524	31,563	31,602	31,640	31,679	31,717	31,756
721	31,795	31,834	31,873	31,913	31,952	31,991	32,031	32,070	32,109	32,148
722	32,187	32,226	32,265	32,304	32,343	32,382	32,421	32,460	32,500	32,539
723	32,579	32,618	32,658	32,697	32,737	32,777	32,818	32,858	32,898	32,938
724	32,978	33,019	33,059	33,099	33,139	33,179	33,220	33,260	33,301	33,342
725	33,383	33,424	33,466	33,507	33,548	33,589	33,630	33,671	33,712	33,752
726	33,793	33,834	33,874	33,915	33,956	33,997	34,037	34,078	34,119	34,161
727	34,202	34,243	34,285	34,326	34,367	34,408	34,449	34,490	34,531	34,572
728	34,613	34,654	34,695	34,737	34,778	34,819	34,860	34,902	34,945	34,987
729	35,029	35,071	35,113	35,156	35,198	35,241	35,283	35,326	35,369	35,411
730	35,454	35,496	35,539	35,581	35,623	35,665	35,706	35,748	35,789	35,831
731	35,872	35,914	35,955	35,997	36,039	36,080	36,121	36,162	36,203	36,245
732	36,286	36,327	36,369	36,411	36,452	36,494	36,536	36,577	36,619	36,661
733	36,703	36,746	36,788	36,830	36,872	36,914	36,956	36,998	37,040	37,082
734	37,125	37,167	37,210	37,253	37,296	37,339	37,382	37,426	37,469	37,513
735	37,557	37,600	37,644	37,688	37,731	37,775	37,819	37,862	37,906	37,950
736	37,994	38,038	38,082	38,126	38,170	38,214	38,258	38,302	38,346	38,391
737	38,435	38,479	38,523	38,568	38,612	38,656	38,701	38,746	38,790	38,835

TABLE 7-4(b)
LAKE TRAVIS ELEVATION-AREA[1/]
SURFACE AREA IN ACRES

Elevation (feet)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
738	38,880	38,924	38,969	39,013	39,058	39,102	39,147	39,192	39,237	39,282
739	39,327	39,372	39,417	39,462	39,508	39,553	39,598	39,643	39,688	39,733
740	39,778	39,824	39,869	39,914	39,959	40,004	40,049	40,094	40,139	40,184
741	40,228	40,273	40,318	40,362	40,407	40,452	40,496	40,541	40,586	40,631
742	40,675	40,720	40,765	40,810	40,854	40,899	40,944	40,989	41,033	41,078
743	41,123	41,168	41,213	41,258	41,302	41,347	41,392	41,437	41,482	41,526
744	41,571	41,617	41,662	41,708	41,754					

[1/] Data from 2008 TWDB Survey

Exhibits

Exhibit A

EXHIBIT A
SUPPLEMENTARY PERTINENT DATA

TABLE OF CONTENTS

1. GENERAL INFORMATION

Item	Description
Other Names for Project	Marshall Ford Dam and Lake Travis. In 1941, the LCRA Board of Directors named the dam Mansfield honoring Representative Joseph J. Mansfield from Columbus, Texas.
Location	Colorado River Basin, Texas, Travis County, 12 miles northwest of Austin, River Mile 322.2.
Type of Project	Multi-purpose Dam and Lake
Objectives of Regulations	Primary: Flood control, irrigation, and hydroelectric generation. Secondary: Navigation, streamflow regulation, recreation, fish and wildlife, and domestic water supply.
Project Owner	Lower Colorado River Authority
Operating Agency	Lower Colorado River Authority
Regulating Agency	The Corps of Engineers prescribes regulation of the flood control space. The project owner (LCRA) specifies and schedules regulation of the conservation storage space, the surcharge storage space, and at any time the structural integrity of the project is in question.
Code of Federal Regulations, Title 33	44 FR 24551, 26 April 1979; 41 FR 15005, 9 April 1976; 16 FR 4543, 16 May 1951.
Water Supply Contracts	The LCRA maintains the water supply contracts for Mansfield Dam and Lake Travis.
Water Rights	Water rights are regulated by the TCEQ.
Project Cost	$28,709,948 (dam, powerplant, and related facilities)
Deliberate Impoundment	September 1940

2. LAKE INFORMATION

Features	Elevation (Feet)	Lake Area (Acres)	Reservoir Capacity		
			Incremental (Ac-Ft.)	Total Storage (Ac-Ft.)	Runoff (inches)
Top of Dam	750				
Spillway Crest (Top of Flood Control Pool)	714	29,160	580,506	1,921,731	1.31
Top of Joint Use Pool	691	21,845	206,269	1,341,225	0.91
Conservation Pool	681	19,297	796,538	1,134,956	0.77
Bottom of Power Pool	618	7,662	338,418	333,418	0.23
Streambed	490	-	-	-	-

Item	Description
Real Estate Taking Line for Fee Title	Elevation 715.0. In some cases the landowners would only convey their entire ownership, which resulted in the purchase of land above elevation 715.0. In other cases, landowners would only convey fee title to elevation 670.0 and flowage easement to elevation 715.0.
Real Estate Taking Line	Flowage easements up to elevation 715.0 were obtained, to occasionally flood and submerge. In many easements, the LCRA has obtained a release of liability for flood damage above elevation 715.0.

2. LAKE INFORMATION (Continued)

Item	Description
Range of Clearing	Elevation 545.0 to 685.0
Pool elevation corresponding to discharge capability of maximum non-damaging flow rate downstream	Invert elevation of 24 - 8.5 foot conduits is 535.75. Release of 30,000 cfs is possible at elevation 546.0 and above. Maximum non-damaging channel capacities: Austin: 30,000 cfs Bastrop: 45,000 cfs Columbus: 50,000 cfs
Lake length at top of conservation pool	65 miles
Shoreline length at top of conservation pool	270 miles
Safety aspects, possibly requiring warning	At varying elevations upstream and downstream there are some low water crossings and access roads that are inundated. The project engineer makes every effort to contact the proper public authority during these conditions.
Emergency Drawdown	Discharging at the maximum non-damaging rate of 30,000 cfs with an inflow equal to the 77-year average of four consecutive months (Apr-Jul), the drawdown from top of flood pool, elevation 714.0, to top of conservation pool, elevation 681.0, requires 14 days. The drawdown from the top of conservation pool, elevation 681.0 to elevation 593.0 requires an additional 18 days. Discharging at the highest rate possible, with all 23 gates open, the drawdown is: 3.2 days from elevation 714.0 to 681.0. 5 days from elevation 681.0 to 593.0.

3. HYDROLOGY

Item	Description
Drainage Area	Above Mansfield Dam: 27,352 square miles contributing 11,403 square miles non-contributing 38,755 square miles total area
Climate	Moderate, hot summers, cool winters. Mean annual temperature: 69°F Mean annual rainfall: 33 inches
One-inch runoff	1,458,773 Acre-Feet
Storm types	Thunderstorms, frontal storms, cyclonic storms.
Flood seasons	April through June and September through October; however, floods have been known to occur at any time of the year.
Low flow season	January to March
Minimum daily inflow and date of occurrence	0; frequently (1898-2011)
Minimum monthly inflow and date of occurrence	110 acre-feet; November 1954 (1898-2011)
Minimum annual inflow and date	152,029 acre-feet; 1963 (1898-2011)
Average annual inflow	1,276,250 acre-feet (1940-2011)
Maximum annual inflow and date of occurrence	5,191,720 acre-feet; 1935 (1898-2011)
Maximum daily inflow and date of occurrence	351,467 cfs, 11 September 1952 (1898-2011)
Maximum instantaneous inflow and date of occurrence	840,000 cfs, 11 September 1952 (1898-2011)
Maximum flood volume and date of occurrence	3,241,442 acre-feet; 15 September to 11 November 1936 (1898-2011)

3. HYDROLOGY (Continued)

Item	Description
Name and location of key streamflow stations:	
Upstream	Colorado River near San Saba, Texas (08147000) Llano River at Llano, Texas (08153500) Pedernales River near Johnson City, Texas (08153500)
Downstream	Colorado River at Austin, Texas (08158000) Colorado River at Bastrop, Texas (08159200) Colorado River at Columbus, Texas (08161000)
Type of hydrometeorologic data recorded at damsite	Maximum and minimum temperature, rainfall, evaporation, wind, pool elevation, tailwater elevation
Number of Hydromet precipitation stations used in hydrologic forecasting	239

4. SPILLWAY

Item	Description
Location	The center of the dam, spanning the river channel.
Type	Uncontrolled, ogee weir
Crest Elevation	714.0
Net overflow length	700 feet (5 bays at 140 ft. each).
Maximum Discharge Capacity	609,000 cfs at elevation 750.0
Type energy dissipater	Stilling basin
Recurrence interval of pool attaining crest elevation	Approximately 35 years
Spillway activation	Throughout the history of the project, to date (1940-2011), the lake level has yet to reach the spillway crest.

5. OUTLET FACILITIES

Item	Description
Location	Beneath the spillway
Purpose	Flood control, irrigation, and stream flow regulation
Type of outlet	24 circular conduits, each with double-gated control. 1 conduit is partial-flow valve gate.
Type of service gates	Electrically-operated Paradox
Type of emergency gates	Hydraulically-operated Ring-Follower
Number and size of gates	24 - 8.5 ft. Paradox type, each with a respective 8.5 ft. ring-follower gate.
Entrance invert elevation	535.75
Maximum discharge at pertinent elevations	Elevation 714.0: 131,300 cfs (Top of Flood Control) Elevation 691.0: 126,470 cfs Elevation 681.0: 123,250 cfs (Top of Conservation)
Minimum time required to open/close service gates	7 minutes from closed to full open
Minimum time required for emergency closure	7 minutes from full open to closed

6. HYDROELECTRIC POWER FACILITIES

Item	Description	
Location	In the concrete section of the dam immediately to the left of the spillway.	
Type	Peaking Power	
Installed Capacity	116,000 Kilowatts	
Number and type of units	3 Vertical Francis Turbines.	
Overload Ratio	1.00	
Plant Efficiency	0.91	
Power on-line dates	#1-27 January 1941 #2-02 March 1941 #3-13 June 1941	
Number and size of penstocks	3 penstocks, each 16 feet in diameter.	
Invert elevation of penstocks	552.0	
Turbine discharge with 3 units	Elevation 681.0	Discharge 7400 cfs
Maximum gross head for power	220 feet	
Dependable capacity	#1 - 37,000 kw #2 - 42,000 kw #3 - 37,000 kw	
Critical tailwater elevation	Maximum – 535.0	

7. CONTROL POINTS

Item	Description
a. USGS Gauge, Colorado River at Austin	
Location	In Austin, on right bank, 3200 feet downstream from northbound U.S. Highway 183 bridge. 2.3 miles downstream from Longhorn Dam and 2.8 miles upstream from Walnut Creek.
Purpose of Control	To indicate total flow at the gauge including releases from Mansfield Dam and local runoff.
Channel Description	The bed is sand, rocks and gravel and is subject to shift. The banks are sand, gravel, and clay and are subject to only minor shifts. Gravel mining operations have and will continue to alter the overbanks.
Uncontrolled Drainage Area	165 square miles from Tom Miller Dam 7.6 river miles upstream.
Treatment of Uncontrolled Runoff	Contributes to flood control target flow.
Target Flow Rate	30,000 cfs
Time of Water Travel	2 hours from Mansfield Dam through Lake Austin.
Monitoring Provisions	Recording river gauge. Data Collection Platform.

7. CONTROL POINTS (Continued)

Item	Description
b. USGS Gauge, Colorado River at Bastrop	
Location	Downstream side of State Highway 71 bridge in Bastrop on left bank, 0.3 miles upstream from Gills Creek, also 1.2 miles downstream from Piney Creek, and at river mile 237.5.
Purpose of Control	To indicate total flow at the gauge including releases from Mansfield Dam and local runoff.
Channel Description	The bed is sand and gravel with banks of sandy loam and slightly wooded. Shifts can be expected due to the collection of debris, and shifting of a gravel bar, about 2,000 feet downstream from the gage, during medium and high water. No shifts are expected at extreme high stages. There is an overflow channel (Gills Creek) about 1,600 feet to the left of the main channel that may overflow if a large flood should occur.
Uncontrolled Drainage Area	1,135 square miles from Tom Miller Dam, 63.7 river miles upstream.
Treatment of Uncontrolled Runoff	Must be accounted for when making releases for flood control.
Target Flow Rates	Flow rates are used in regulating the releases from Mansfield Dam to control floods and to provide seasonal irrigation.
Time of Water Travel	20-26 hours for flood crest from Mansfield Dam. 48 hours for normal releases (5,000 cfs).
Monitoring Provisions	Recording river gauge. Data Collection Platform.

7. CONTROL POINTS (continued)

Item	Description
c. USGS Gauge, **Colorado River at Columbus**	
Location	Downstream right bank side of bridge on U.S. Highway 90 at eastern edge of Columbus, TX, 340 ft. downstream from Southern Pacific Railroad bridge, also 2.6 mi. downstream from Cummins Creek, and at river mile 133.9.
Purpose of Control	To indicate total flow at the gauge including releases from Mansfield Dam and local runoff.
Channel Description	The bed is sand and subject to shift at all stages. There is one channel up to about a 42-foot stage (90,000 cfs). The channel is straight for about 800 feet below and 200 feet upstream of the gage. The right bank is high and will not be overflowed. The left bank will overflow at about a 42-foot stage. At extremely high stages (45 feet), water begins to overflow the right bank about 8 or 9 miles above the gauge. This water re-enters the river about 2 or 3 miles below the gauge.
Uncontrolled drainage area	2,796 square miles from Tom Miller Dam, 167.3 river miles upstream.
Treatment of Uncontrolled runoff	Contributes to flood control and conservation target flows.
Target flow rates	Flow rates are used in regulating the releases from Mansfield Dam to provide control of floods.
Time of Water Travel	56 - 68 hours for flood crest from Mansfield Dam. 42 hours from Bastrop.
Monitoring Provisions	Recording river gauge. Data Collection Platform.

8. DOWNSTREAM CONTROL STRUCTURES

Item	Description of Tom Miller Dam
Location	Tom Miller Dam in Austin, TX, river mile 301.2 on the Colorado River.
Purpose	Hydroelectric power, municipal and industrial water supply, recreation.
Type	Concrete gravity overflow, piers and slab
Outlet Control	Five 51 x 12 feet tainter gates and four 51 x 18 feet tainter gates. Two hydroelectric generation units: 8,000 kw each.
Flow Passage Invert	Penstocks: 462.0 Large Gates Spillway: 475.0 Small Gates Spillway: 480.0 Uncontrolled Spillway: 492.8
Pertinent Discharge Capacity (at elevation 492.8)	Total discharge: 107,865 cfs Two turbines at: 1,900 cfs each Five small gates at: 8,585 cfs each Four large gates at: 15,285 cfs each
Operating Agency	LCRA

8. DOWNSTREAM CONTROL STRUCTURES

Item	Description of Longhorn Dam
Location	Longhorn Dam in Austin, TX, at river mile 295.2 on the Colorado River.
Purpose	Electric plant cooling water (originally), municipal and industrial water supply, recreation.
Type	Concrete with earthen approach
Outlet Control	2-Bascule automatic gates, each 8 x 50 feet. 7-vertical lift gates, each 13 x 50 feet.
Flow passage invert	Automatic gates spillway: 420.0 Vertical lift gate spillway: 416.0
Pertinent discharge	Total discharge:
(at elevation 428.25)	44,405 cfs
(at elevation 434.0)	57,200 cfs
(at elevation 439.5)	98,700 cfs
(at elevation 442.9)	138,890 cfs
Operating Agency	City of Austin (Austin Energy).

Exhibit B

EXHIBIT B

Emergency Relief Appropriation Act of 1935

(74th Congress, Session I, Ch. 48; 8 April 1935)

Emergency Relief Appropriation Act, 1935

shall pass and be authenticated, the same seal at their pleasure to break, alter, or devise a new one.

Exclusive right to name.

SEC. 7. No institution of learning hereafter incorporated in the District of Columbia shall use in or as its title, in whole or in part the words "Trinity College."

Rights reserved.

SEC. 8. Nothing in this Act contained shall be so construed as to prevent Congress from altering, amending, or repealing the same.

Approved, April 8, 1935.

[CHAPTER 48.]

JOINT RESOLUTION

Making appropriations for relief purposes.

April 8, 1935.
[H. J. Res. 117.]
[Pub. Res., No. 11.]

Emergency Relief Appropriation Act of 1935.
Post, p. 1134.
Purpose.
Use and availability.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to provide relief, work relief and to increase employment by providing for useful projects, there is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be used in the discretion and under the direction of the President, to be immediately available and to remain available until June 30, 1937, the sum of $4,000,000,000, together with the separate funds established for particular areas by proclamation of the President pursuant to section 15 (f) of the Agricultural Adjustment Act (but any amounts thereof shall be available for use only for the area for which the fund was established); not exceeding $500,000,000 in the aggregate of any savings or unexpended balances in funds of the Reconstruction Finance Corporation; and not exceeding a total of $380,000,000 of such unexpended balances as the President may determine are not required for the purposes for which authorized, of the following appropriations, namely: The appropriation of $3,300,000,000 for national industrial recovery contained in the Fourth Deficiency Act, fiscal year 1933, approved June 16, 1933 (48 Stat. 274); the appropriation of $950,000,000 for emergency relief and civil works contained in the Act approved February 15, 1934 (48 Stat. 351); the appropriation of $899,675,000 for emergency relief and public works, and the appropriation of $525,000,000 to meet the emergency and necessity for relief in stricken agricultural areas, contained in the Emergency Appropriation Act, fiscal year 1935, approved June 19, 1934 (48 Stat. 1055); and any remainder of the unobligated moneys referred to in section 4 of the Act approved March 31, 1933 (48 Stat. 22): *Provided*, That except as to such part of the appropriation made herein as the President may deem necessary for continuing relief as authorized under the Federal Emergency Relief Act of 1933, as amended, or for restoring to the Federal Emergency Administration of Public Works any sums which after December 28, 1934, were, by order of the President impounded or transferred to the Federal Emergency Relief Administration from appropriations heretofore made available to such Federal Emergency Administration of Public Works (which restoration is hereby authorized), this appropriation shall be available for the following classes of projects, and the amounts to be used for each class shall not, except as hereinafter provided, exceed the respective amounts stated, namely: (a) Highways, roads, streets, and grade-crossing elimination, $800,000,000; (b) rural rehabilitation and relief in stricken agricultural areas, and water conservation, trans-mountain water diversion and irrigation and reclamation, $500,000,000; (c) rural electrification, $100,000,000; (d) housing, $450,000,000; (e) assistance for educational, professional and clerical persons, $300,000,000; (f) Civilian Conservation Corps, $600,000,000; (g) loans or grants,

Amount.

Vol. 48, p. 675.

Funds specified.

Vol. 48, p. 275.

Vol. 48, p. 351.

Vol. 48, p. 1056.
Vol. 48, p. 23.

Provisos.
Allocation of appropriation.

Projects designated.
Limitation on amount for each class.

Post, p. 596.

Increased amount authorized.

Expenditure for munitions, warships, etc., prohibited.

or both, for projects of States, Territories, Possessions, including subdivisions and agencies thereof, municipalities, and the District of Columbia, and self-liquidating projects of public bodies thereof, where, in the determination of the President, not less than twenty-five per centum of the loan or the grant, or the aggregate thereof, is to be expended for work under each particular project, $900,000,000; (h) sanitation, prevention of soil erosion, prevention of stream pollution, sea coast erosion, reforestation, forestation, flood control, rivers and harbors and miscellaneous projects, $350,000,000: *Provided further*, That not to exceed 20 per centum of the amount herein appropriated may be used by the President to increase any one or more of the foregoing limitations if he finds it necessary to do so in order to effectuate the purpose of this joint resolution: *Provided further*, That no part of the appropriation made by this joint resolution shall be expended for munitions, warships, or military or naval matériel; but this proviso shall not be construed to prevent the use of such appropriation for new buildings, reconstruction of buildings and other improvements in military or naval reservations, posts, forts, camps, cemeteries, or fortified areas, or for projects for nonmilitary or nonnaval purposes in such places.

Public highways and related projects.
Apportionment of allocations.

Vol. 48, p. 203.

Expenditure by State highway departments.
Vol. 42, p. 212; Vol. 48, p. 993.
U. S. C., p. 969.

Provisos.
Amounts for grade crossing elimination.

Apportionment provisions.
Post, p. 1134.

Expenditure.
Vol. 42, p. 212; Vol. 48, p. 993.
U. S. C., p. 969.
Matching funds not required.

Alaska, Puerto Rico, Virgin Islands.

Allotments for highways.

Rules and regulations.

Preference in labor employment.

Except as hereinafter provided, all sums allocated from the appropriation made herein for the construction of public highways and other related projects (except within or adjacent to national forests, national parks, national parkways, or other Federal reservations) shall be apportioned by the Secretary of Agriculture in the manner provided by section 204 (b) of the National Industrial Recovery Act for expenditure by the State highway departments under the provisions of the Federal Highway Act of November 9, 1921, as amended and supplemented, and subject to the provisions of section 1 of the Act of June 18, 1934 (48 Stat. 993): *Provided*, That any amounts allocated from the appropriation made herein for the elimination of existing hazards to life at railroad grade crossings, including the separation or protection of grades at crossings, the reconstruction of existing railroad grade crossing structures, and the relocation of highways to eliminate grade crossings, shall be apportioned by the Secretary of Agriculture to the several States (including the Territory of Hawaii and the District of Columbia), one-half on population as shown by the latest decennial census, one-fourth on the mileage of the Federal-aid highway system as determined by the Secretary of Agriculture, and one-fourth on the railroad mileage as determined by the Interstate Commerce Commission, to be expended by the State highway departments under the provisions of the Federal Highway Act of November 9, 1921, as amended and supplemented, and subject to the provisions of section 1 of such Act of June 18, 1934 (48 Stat. 993); but no part of the funds apportioned to any State or Territory under this joint resolution for public highways and grade crossings need be matched by the State or Territory: *And provided further*, That the President may also allot funds made available by this joint resolution for the construction, repair, and improvement of public highways in Alaska, Puerto Rico, and the Virgin Islands, and money allocated under this joint resolution to relief agencies may be expended by such agencies for the construction and improvement of roads and streets: *Provided, however*, That the expenditure of funds from the appropriation made herein for the construction of public highways and other related projects shall be subject to such rules and regulations as the President may prescribe for carrying out this paragraph and preference in the employment of labor shall be given (except in executive, administrative, supervisory, and highly skilled positions) to persons receiving relief, where they are qualified, and the President is hereby authorized to predetermine for each State the hours of work and the rates of wages to be paid to skilled, intermediate, and unskilled labor engaged in such construction therein: *Provided further*, That rivers and harbors projects, reclamation projects (except the drilling of wells, development of springs and subsurface waters), and public buildings projects undertaken pursuant to the provisions of this joint resolution shall be carried out under the direction of the respective permanent Government departments or agencies now having jurisdiction of similar projects.

Hours of work; rates of wages.

Government direction of certain public works.

Funds made available by this joint resolution may be used, in the discretion of the President, for the purpose of making loans to finance, in whole or in part, the purchase of farm lands and necessary equipment by farmers, farm tenants, croppers, or farm laborers. Such loans shall be made on such terms as the President shall prescribe and shall be repaid in equal annual installments, or in such other manner as the President may determine.

Loans to finance purchase of farms, equipment.

Terms; repayment.

Funds made available by this joint resolution may be used, in the discretion of the President for the administration of the Agricultural Adjustment Act, as amended, during the period of twelve months after the effective date of this joint resolution.

Agricultural Adjustment Act.
Funds available for administration of.

SEC. 2. The appropriation made herein shall be available for use only in the United States and its Territories and possessions. The provisions of the Act of February 15, 1934 (48 Stat. 351), relating to disability or death compensation and benefits shall apply to those persons receiving from the appropriation made herein, for services rendered as employees of the United States, security payments in accordance with schedules established by the President: *Provided*, That so much of the sum herein appropriated as the United States Employees' Compensation Commission, with the approval of the President, estimates and certifies to the Secretary of the Treasury will be necessary for the payment of such compensation and administrative expenses shall be set aside in a special fund to be administered by the Commission for such purposes; and after June 30, 1936, such special fund shall be available for these purposes annually in such amounts as may be specified therefor in the annual appropriation Acts. The provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) shall not apply to any purchase made or service procured in carrying out the provisions of this joint resolution when the aggregate amount involved is less than $300.

Availability limited.

Disability or death compensation.
Vol. 48, p. 351.
Benefits of, extended.
Post, p. 1601.

Proviso.
Special fund created.

Administration.

Availability.

Purchases without advertising.
R. S., sec. 3709, p. 733; U. S. C., p. 1803.

SEC. 3. In carrying out the provisions of this joint resolution the President may (a) authorize expenditures for contract stenographic reporting services; supplies and equipment; purchase and exchange of law books, books of reference, directories, periodicals, newspapers and press clippings; travel expenses, including the expense of attendance at meetings when specifically authorized; rental at the seat of government and elsewhere; purchase, operation, and maintenance of motor-propelled passenger-carrying vehicles; printing and binding; and such other expenses as he may determine necessary to the accomplishment of the objectives of this joint resolution; and (b) accept and utilize such voluntary and uncompensated services, appoint, without regard to the provisions of the civil-service laws, such officers and employees, and utilize such Federal officers and employees, and, with the consent of the State, such State and local officers and employees, as may be necessary, prescribe their authorities, duties, responsibilities, and tenure, and, without regard to the Classification Act of 1923, as amended, fix the compensation of any officers and employees so appointed.

Contingent expenses.

Rent.

Printing and binding.

Personal services.

Classification Act not to apply.

Administrator, officers. Appointment.

Any Administrator or other officer, or the members of any central board, or other agency, named to have general supervision at the seat of Government over the program and work contemplated under the appropriation made in section 1 of this joint resolution and receiving a salary of $5,000 or more per annum from such appropriation, and any State or regional administrator receiving a salary of $5,000 or more per annum from such appropriation (except persons now serving as such under other law), shall be appointed by the President, by and with the advice and consent of the Senate: *Provided*, That the provisions of section 1761 of the Revised Statutes shall not apply to any such appointee and the salary of any person so appointed shall not be increased for a period of six months after confirmation.

Confirmation.

Proviso. Salary restriction. R. S., sec. 1761, p. 313. U. S. C., p. 38.

President to prescribe duties, etc., of necessary agencies.

SEC. 4. In carrying out the provisions of this joint resolution the President is authorized to establish and prescribe the duties and functions of necessary agencies within the Government.

Real property; right to acquire, etc.

SEC. 5. In carrying out the provisions of this joint resolution the President is authorized (within the limits of the appropriation made in section 1) to acquire, by purchase or by the power of eminent domain, any real property or any interest therein, and improve, develop, grant, sell, lease (with or without the privilege of purchasing), or otherwise dispose of any such property or interest therein.

Rules, etc., to be prescribed.

Punishment for violation.

SEC. 6. The President is authorized to prescribe such rules and regulations as may be necessary to carry out this joint resolution, and any willful violation of any such rule or regulation shall be punishable by fine of not to exceed $1,000.

Rates of pay.

SEC. 7. The President shall require to be paid such rates of pay for all persons engaged upon any project financed in whole or in part, through loans or otherwise, by funds appropriated by this joint resolution, as will in the discretion of the President accomplish the purposes of this joint resolution, and not affect adversely or otherwise tend to decrease the going rates of wages paid for work of a similar nature.

Proviso. Government building construction.

Vol. 46, p. 1494; U. S. C., p. 1788.

The President may fix different rates of wages for various types of work on any project, which rates need not be uniform throughout the United States: *Provided, however*, That whenever permanent buildings for the use of any department of the Government of the United States, or the District of Columbia, are to be constructed by funds appropriated by this joint resolution, the provisions of the Act of March 3, 1931 (U. S. C., Supp. VII, title 40, sec. 276a), shall apply but the rates of wages shall be determined in advance of any bidding thereon.

Private enterprise facilities.

SEC. 8. Wherever practicable in the carrying out of the provisions of this joint resolution, full advantage shall be taken of the facilities of private enterprise.

Fraud, etc. Punishment for.

SEC. 9. Any person who knowingly and with intent to defraud the United States makes any false statement in connection with any application for any project, employment, or relief aid under the provisions of this joint resolution, or diverts, or attempts to divert, or assists in diverting for the benefit of any person or persons not entitled thereto, any moneys appropriated by this joint resolution, or any services or real or personal property acquired thereunder, or who knowingly, by means of any fraud, force, threat, intimidation, or boycott, deprives any person of any of the benefits to which he may be entitled under the provisions of this joint resolution, or attempts so to do, or assists in so doing, shall be deemed guilty of a misdemeanor and shall be fined not more than $2,000 or imprisoned not more than one year, or both.

Federal Emergency Relief Act of 1933. Vol. 48, p. 55.

SEC. 10. Until June 30, 1936, or such earlier date as the President by proclamation may fix, the Federal Emergency Relief Act of 1933, as amended, is continued in full force and effect.

Administrative expenses, restriction.

SEC. 11. No part of the funds herein appropriated shall be expended for the administrative expenses of any department, bureau, board, commission, or independent agency of the Government if such administrative expenses are ordinarily financed from annual appropriations, unless additional work is imposed thereupon by reason of this joint resolution.

Public Works Administration. Continuance, functions, etc. Vol. 48, p. 200.

Availability of sums appropriated.

Sale of securities.

Proceeds.

SEC. 12. The Federal Emergency Administration of Public Works established under title II of the National Industrial Recovery Act is hereby continued until June 30, 1937, and is authorized to perform such of its functions under said Act and such functions under this joint resolution as may be authorized by the President. All sums appropriated to carry out the purposes of said Act shall be available until June 30, 1937. The President is authorized to sell any securities acquired under said Act or under this joint resolution and all moneys realized from such sales shall be available to the President, in addition to the sums heretofore appropriated under this joint resolution, for the making of further loans under said Act or under this joint resolution.

Articles, etc., of American manufacture. Contracts, etc., subject to existing provisions. Vol. 47, p. 1520.

SEC. 13. (a) The acquisition of articles, materials, and supplies for the public use, with funds appropriated by this joint resolution, shall be subject to the provisions of section 2 of title III of the Treasury and Post Office Appropriation Act, fiscal year 1934; and all contracts let pursuant to the provisions of this joint resolution shall be subject to the provisions of section 3 of title III of such Act.

(b) Any allocation, grant, or other distribution of funds for any project, Federal or non-Federal, from the appropriation made by this joint resolution, shall contain stipulations which will provide for the application of title III of such Act to the acquisition of articles, materials and supplies for use in carrying out such project.

Unemployment Relief Act; continuance. Vol. 48, p. 22, amended.

SEC. 14. The authority of the President under the provisions of the Act entitled "An Act for the relief of unemployment through the performance of useful public work, and for other purposes", approved March 31, 1933, as amended, is hereby continued to and including March 31, 1937.

Annual reports to Congress.

SEC. 15. A report of the operations under this joint resolution shall be submitted to Congress before the 10th day of January in each of the next three regular sessions of Congress, which report shall include a statement of the expenditures made and obligations incurred, by classes and amounts.

Short title.

SEC. 16. This joint resolution may be cited as the "Emergency Relief Appropriation Act of 1935."

Approved, April 8, 1935, 4 p. m.

[CHAPTER 49.]

JOINT RESOLUTION

April 8, 1935. [H. J. Res. 174.] [Pub. Res., No. 12]

To permit articles imported from foreign countries for the purpose of exhibition at the California Pacific International Exposition, San Diego, California, to be admitted without payment of tariff, and for other purposes.

California Pacific International Exposition, San Diego, Calif. Dutiable articles imported for exhibition, etc., purposes, admitted free, under regulations. *Ante*, pp. 40, 50.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That all articles which shall be imported from foreign countries for the purpose of exhibition at the international exposition to be held at San Diego, California, beginning in May 1935, by the California Pacific International Exposition Company, or for use in constructing, installing, or maintaining foreign buildings or exhibits at the said exhibition,

Exhibit C

EXHIBIT C

Section 3, Rivers and Harbors Act of 1937

(75th Congress, Session I, Ch. 832; 26 August 1937)

Section 3 of Rivers and Harbors Act, '37.

Juneau, Alaska.

Juneau Harbor, Alaska; House Document Numbered 249, Seventy-fifth Congress;

Wake Island.

Wake Island; House Document Numbered 84, Seventy-fifth Congress;

Welles, Midway Island.

Welles Harbor, Midway Island; House Document Numbered 49 and Rivers and Harbors Committee Document Numbered 9, Seventy-fifth Congress;

San Juan, P. R.

San Juan Harbor, Puerto Rico; Rivers and Harbors Committee Document Numbered 42, Seventy-fifth Congress;

Arecibo, P. R.

Arecibo Harbor, Puerto Rico; Rivers and Harbors Committee Document Numbered 43, Seventy-fifth Congress;

Guayanes, P. R.

Guayanes Harbor, Puerto Rico; House Document Numbered 243, Seventy-fifth Congress;

Saint Thomas, Virgin Islands.

Saint Thomas Harbor, Virgin Islands; House Document Numbered 200, Seventy-fifth Congress.

Central Valley project, Calif.
Transfer of jurisdiction.
49 Stat. 1038, 1622.

SEC. 2. That the $12,000,000 recommended for expenditure for a part of the Central Valley project, California, in accordance with the plans set forth in Rivers and Harbors Committee Document Numbered 35, Seventy-third Congress, and adopted and authorized by the provisions of section 1 of the Act of August 30, 1935 (49 Stat. 1028, at 1038), entitled "An Act authorizing the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes", shall, when appropriated, be available for expenditure in accordance with the said plans by the Secretary of the Interior instead of the Secretary of War: *Provided*, That the transfer of authority from the Secretary of War to the Secretary of the Interior shall not render the expenditure of this fund reimbursable under the reclamation law: *Provided further*, That the entire Central Valley project, California, heretofore authorized and established under the provisions of the Emergency Relief Appropriation Act of 1935 (49 Stat. 115) and the First Deficiency Appropriation Act, fiscal year 1936 (49 Stat. 1622), is hereby reauthorized and declared to be for the purposes of improving navigation, regulating the flow of the San Joaquin River and the Sacramento River, controlling floods, providing for storage and for the delivery of the stored waters thereof, for the reclamation of arid and semiarid lands and lands of Indian reservations, and other beneficial uses, and for the generation and sale of electric energy as a means of financially aiding and assisting such undertakings and in order to permit the full utilization of the works constructed to accomplish the aforesaid purposes: *Provided further*, That, except as herein otherwise specifically provided, the provisions of the reclamation law, as amended, shall govern the repayment of expenditures and the construction, operation, and maintenance of the dams, canals, power plants, pumping plants, transmission lines, and incidental works deemed necessary to said entire project, and the Secretary of the Interior may enter into repayment contracts, and other necessary contracts, with State agencies, authorities, associations, persons, and corporations, either public or private, including all agencies with which contracts are authorized under the reclamation law, and may acquire by proceedings in eminent domain, or otherwise, all lands, rights-of-way, water rights, and other property necessary for said purposes: *And provided further*, That the said dam and reservoirs shall be used, first, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses; and, third, for power.

Provisos.
Expenditure of fund not reimbursable.

Project reauthorized.
49 Stat. 115, 1622.

Purposes declared.

Repayments authorized.

Uses specified.

Marshall Ford Dam, Colorado River project, Tex.

SEC. 3. That for the purpose of improving navigation, controlling floods, regulating the flow of streams, providing for storage and for delivery of stored waters, for the reclamation of lands, and other beneficial uses, and for the generation of electric energy as a means of financially aiding and assisting such undertaking, the project known as "Marshall Ford Dam", Colorado River project, in Texas, is hereby authorized and adopted and all contracts and agreements which have been executed in connection therewith are hereby validated and ratified, and the Secretary of the Interior, acting through such agents as he may designate, is hereby authorized to construct, operate, and maintain all structures and incidental works necessary to such project, and in connection therewith to make and enter into any and all necessary contracts including contracts amendatory of or supplemental to those hereby validated and ratified.

Contracts and agreements.

Construction, operation, etc., of structures.

SEC. 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, the cost thereof to be paid from appropriations heretofore or hereafter made for such purposes: *Provided*, That no preliminary examination, survey, project, or estimate for new works other than those designated in this or some prior Act or joint resolution shall be made: *Provided further*, That after the regular or formal reports made as required by law on any examination, survey, project, or work under way or proposed are submitted no supplemental or additional report or estimate shall be made unless authorized by law: *And provided further*, That the Government shall not be deemed to have entered upon any project for the improvement of any waterway or harbor mentioned in this Act until the project for the proposed work shall have been adopted by law:

Preliminary examinations and surveys authorized.

Provisos. Restriction.

Reports.

Adoption.

Surveys designated.

Northeast Harbor, Maine.

Presumpscot River, Maine.

Portland Harbor, Maine, north of House Island, to determine advisability of removing shoal.

Inland waterway between Merrimack River, Massachusetts, and Hampton Harbor, New Hampshire, by way of Black Rock Creek and Blackwater River.

Harbor of refuge at or in the vicinity of Swampscott, Massachusetts.

Ipswich River, Massachusetts.

Boston Harbor, Massachusetts.

Scituate Harbor, Massachusetts.

Saugus River, Massachusetts.

Nantasket (Hull) Gut, Massachusetts.

Wellfleet Harbor, Massachusetts.

Padanaram Harbor, at South Dartmouth, Massachusetts.

Warren River and Barrington Harbor, Rhode Island.

Connecticut River, below Hartford, Connecticut, including North Cove in the town of Old Saybrook.

Clinton Harbor, Connecticut.

Mianus River, Connecticut.

Westcott Cove, Connecticut.

Norwalk Harbor, Connecticut.

Greenwich Harbor, Connecticut.

Orowoc Creek, New York.

Huntington Harbor, New York.

Northport Harbor, New York.

Bronx Kills and Harlem River, New York.

Rondout Harbor, New York.

Waterway from Albany to Schenectady, New York, by way of Hudson and Mohawk Rivers, with a view to securing a depth of twenty-seven feet and suitable width.

Exhibit D

EXHIBIT D

Cooperative Agreement Between United States

and the Lower Colorado River Authority

(1 June 1935)

Amendment and Supplement

(18 September 1935)

Ilr-805

COOPERATIVE AGREEMENT BETWEEN UNITED STATES BY SECRETARY OF INTERIOR AND AUTHORITY

1. THIS AGREEMENT, dated as of June 1, 1935, between the UNITED STATES OF AMERICA, acting by Harold L. Ickes as Secretary of the Interior, hereinafter referred to as the Secretary, pursuant to (1) the act of June 17, 1902, 32 Stat., 388, and acts amendatory thereof or supplementary thereto, and particularly the act. of March 4, 1921, 41 Stat. 1404, and (2) the Emergency Relief Appropriation Act of 1935, Public Resolution No. 11, 74th Congress, approved April 8, 1935, and the LOWER COLORADO RIVER AUTHORITY created by an act of the Legislature of Texas, approved November 13, 1934, hereinafter referred to as the Authority.

DEFINITIONS

2. "The Project" means that of the Lower Colorado River Authority (Texas) for the improvement of that River to reduce floods and utilize its waters for useful purposes; described more specifically it consists of (a) the completion of the incomplete dam, reservoir and appurtenant works at and near Bluffton, Llano County, Texas, as provided by a contract (herein called the "Fegles' Contract") entered into on or about April 15, 1931, between the Central Texas Hydroelectric Company (a corporation of the State of Delaware) and the Fegles Construction Company, Limited (a corporation of the Dominion of Canada), as amended, (b) the acquisition of water rights, property and construction and incomplete dam by the exercise of certain options available to the Authority under an agreement entered into between the United States of America and the Colorado River Company (a corporation of the State of Texas), dated April 1, 1935, necessary for the impounding at said location of waters of the Colorado River for such purposes, (c) the completion of construction of said incomplete dam and other works with such additions as may be provided by plans submitted by the Bureau of Reclamation and approved by the Authority; (d) the construction of a unified series and system of dams including and below said incomplete dam as determined by general plans approved by the Bureau of Reclamation and by the Authority, and such impounding reservoirs and other works (as shall be provided for by plans so approved) and found convenient and economical to provide for flood control and irrigation, (e) provision (as may be determined by the Authority with the approval of the Administrator) for the utilization of falling waters for the generation of electrical energy, transmission lines and other appurtenances.

By "Bureau" is meant the Bureau of Reclamation under the general supervision of the Secretary.

RECITALS

3. WHEREAS, said Act of March 4, 1921, 41 Stat. 1404, provides as follows:

"All moneys hereafter received from any State, municipality, corporation, association, firm, district, or individual for investigations, construction work, surveys or other development work incident thereto involving operations similar to those provided for by the reclamation law shall be covered into the reclamation fund and shall be available for expenditure for the purposes for which contributed in like manner as if said sums had been specifically appropriated for said purposes".

and

4. WHEREAS, on May 21, 1935, the President and the Advisory Committee on Allotments adopted the following resolution:

"WHEREAS, the project of the Lower Colorado River Authority (Texas) for the improvement of that River will control substantially its flood waters and reclaim many thousands of acres now subject to destructive floods, as more fully appears by the report of the Army Engineers (House Document 361, 71st Cong., 2d Sess.) and by memorandum dated April 26, 1935, signed by the Acting Deputy Administrator of Public Works;

"WHEREAS, the project as submitted to the Federal Emergency Administration of Public Works by the Authority includes the completion of the incomplete dam, reservoir and other works at and near Bluffton, Llano County, Texas (Hamilton Dam), a unified system and series of dams at and below that site, impounding reservoirs, hydroelectric works, works for irrigation and other uses, transmission lines and other appurtenances;

"WHEREAS, it appears from the records of the Texas Relief Commission, period April 1, 1934, to November 30, 1934, that the total number of relief cases within a fifty mile radius of Hamilton Dam, plus Bexar County, Texas, during said period was 23,997, that the number of persons dependent on relief therein aggregated 95,442, and it is estimated that the man hours required at sites for the accomplishment of the project amount to 15,000,000 and the total number of men employed at any one time will be 4,400 and not less than 80% of the total cost of the project will be expended by July 1, 1936, and the remaining 20% will be applied to finance contracts for the fabrication of materials, under which contracts men will be put to work prior to July 1, 1936;

"WHEREAS, the estimated cost of said project is $20,000,000 as more fully appears by said memorandum and an aggregate allocation of that amount is recommended by the Secretary of the Interior and the Federal Emergency Administrator of Public Works;

"RESOLVED, that the President and this Board allocate to the Department of the Interior, Bureau of Reclamation, the sum of $5,000,000 to aid in financing that portion of the project relating to flood control from funds made available to the President by Section 1 (h) of the Emergency Relief Appropriation Act of 1935;

"RESOLVED FURTHER that the President and this Board allocate to the Federal Emergency Administration of Public Works $15,000,000 to finance that portion of the cost of the project not provided for by the above allocation. This allocation is from funds made available to the President by Section 1 (g) of said Act. Such allotment therefrom as may be made by the said Administrator to the Authority is to be by loan and grant; the grant not to exceed 30% of the cost of labor and materials employed upon the project (except that part apportioned to flood control); the loan to be by purchase of the revenue bonds of the Authority, subject to the execution of a contract, satisfactory to the Administrator, between the U.S. of America and the Authority.

"Said contract is to provide that the plans, specifications and construction of the project in so far as they relate to flood control shall be subject to the approval of the Commissioner of Reclamation, as shall also vouchers for expenditures against the allocation for flood control.

"The President and this Board find upon the basis of said memorandum that not less than 25% of such loan and grant is to be expended for work under the said project."

5. WHEREAS, the Federal Emergency Administrator of Public Works, in partial effectuation of the above resolution, has caused to be prepared a loan and grant agreement whereby, among other things, the Authority has agreed to acquire the property and water rights now held by the Colorado River Company and by C. G. Malott;

6. WHEREAS, the accomplishment of flood control and irrigation contemplated by said resolution as well as economy and expedition will be furthered by placing the construction of the project (as determined by general plans and estimates of construction cost prepared by the Bureau and adopted by the Authority) under the direction of the Bureau;

7. WHEREAS, it is intended that the Authority shall acquire and finance the cost of acquisition of lands, flowage and other rights and easements necessary for the accomplishment of the project and finance the cost of construction thereof to the extent that such cost is not provided for by said allocation of $5,000,000 to the Bureau;

8. WHEREAS, economy and expedition require that the accomplishment of the project should be divided between the Authority and the Bureau substantially as follows:

(1) The Authority to provide all lands, flowage and other rights necessary for the accomplishment of the projcdt as shown by plans submitted by the Bureau and approved by the Authority;

(2) The Bureau to prepare and submit to the Authority for its approval general plans and estimates of construction costs for the construction of dams, impounding reservoirs and other works in so far as said structures relate to irrigation and flood control, and, upon the approval of said plans and estimates by the Authority, the Bureau to construct said works as provided thereby, in so far as the cost of such works may be financed by the $5,000,000 allotted directly to the Bureau and by funds advanced to it by the Authority;

(3) The Authority to finance and construct such hydroelectric works as it shall deem necessary for the beneficial use of such falling water as may be available and for the accomplishment of that portion of the project;

NOW, THEREFORE, in effectuation of the purposes of said resolution, in consideration of the above recitals and of the execution of the loan and grant agreement, the parties hereto agree:

9. The Secretary agrees that the Bureau by the use of the $5,000,000 allotted to it by said resolution and by the Secretary and by the use of the funds advanced by the Authority will prepare and submit to the Authority for its approval general plans and estimates of construction costs for the accomplishment of the project in so far as it relates to flood control and irrigation.

10. The Authority agrees that it will cause to be deposited to the credit of the Bureau, from the proceeds of the bonds or of the grant provided for in said loan and grant agreement, the amount of $5,000,000 as its initial cash contribution toward the accomplishment of the project in so far as it relates to flood control and irrigation. The Authority further agrees that it will from time to time thereafter advance to the Bureau on its request additional funds as and when required to finance the cost of the construction work to be done by the Bureau hereunder; provided, however, that the aggregate amount of all such advances to be made by the Authority to the Bureau shall not exceed $10,000,000.

11. The Authority agrees that it will acquire all lands and flowage and other rights necessary for the accomplishment of the project as shown by plans submitted by the Bureau and approved by the Authority.

12. The Bureau will, with the funds so advanced to the Authority and said $5,000,000, construct all that portion of the project relating to irrigation and flood control in accordance with plans and specifications approved by the Authority, not including the construction of Hamilton Dam for which provision is now made in the Fegles' contract, as amended, unless the Secretary and the Authority for purposes of economy and expedition shall determine to include such construction. In that event the obligations of the Bureau and the Authority in that regard shall be as provided by an agreement supplementary hereto. Said supplementary agreement may provide for such additions to the work prescribed by the Fegles' contract as may be recommended by the Bureau and approved by the Authority for the purpose of effectuating greater provision for irrigation, flood control and other uses.

13. If the Authority shall so request, the Bureau will also construct such works, including pressure tunnels, penstocks and other appurtenant structures, which the Authority deems necessary or desirable to be included as a part of this agreement. Such appurtenant structures shall be so constructed that subsequent installation of diversion, outlet works or power plant structures and equipment shall be possible in the most feasible and economical manner. Such construction where not determined to be flood control and irrigation work shall be paid for by additional funds advanced to the Bureau by the Authority.

14. The $5,000,000 fund allocated to the Bureau by the President and the Secretary, and the maximum of $10,000,000 to be advanced to the Bureau by the Authority, shall be used (in that order or priority) in paying the cost of the proposed works (relating to flood control and irrigation), which cost shall be deemed to be (a) the cost of the preparation of plans and specifications for the accomplishment of said portion of the project, (b) the actual cost of all construction work, and (c) the overhead and general expense (as conclusively determined by the Secretary of the Interior) incurred by the Bureau in carrying out this contract.

15. Upon the completion of so much of the project as is to be constructed by the Bureau under this agreement all unexpended funds advanced by the Authority and remaining in the hands of the Bureau hereunder shall be returned and paid over to the Authority.

All equipment, materials and supplies acquired for the project with funds advanced by the Authority shall be turned over to it and become its property.

16. All plans, designs and specifications for all construction or other work done by the Bureau hereunder shall be approved in writing by the General Manager and the Chief Engineer of the Authority prior to performance thereof or the letting of contracts therefor. The Bureau in carrying out the proposed work hereunder and in purchasing supplies, materials and equipment therefor may proceed either by force account or by construction contract. The Bureau will furnish to the Authority a copy of all plans, specifications and contracts adopted by it in connection with the work, and as it progresses a copy of reports of the engineers, inspectors, auditors and other personnel assigned to the work by the Bureau. The Bureau will also furnish the Authority with such general reports as it is accustomed to make under like cooperative agreements. The Bureau will give the Authority access at all reasonable times to the records of the Bureau in order that it may ascertain the progress of the work, the state of the funds available for its accomplishment and such other information as the Authority may reasonably require. For the purpose of aiding the Authority to prepare its requisitions for the grant provided for in the loan and grant agreement, the Bureau will require the personnel assigned to the work to submit reports conforming to those required by the Administrator in relation to the grant.

17. Upon reasonable notice from the Bureau of the completion of the works provided for herein, or any feature thereof, (the Authority will assume the care, operation and maintenance of said works.) Thereafter the Authority (as provided by the loan and grant agreement) shall at its own cost and without expense to the United States care for, operate and maintain the same in such manner that such works shall remain in as good and efficient condition and of equal capacity for the diversion, carriage and distribution of water as when received from the United States. After the care, operation and maintenance of the aforesaid works shall have been assumed by the Authority, the Authority will save the United States and its officers and employees harmless as to any and all injury and damage to persons and property which may arise by reason of the construction, operation and maintenance, or control of said project thereafter.

18. When said general plans submitted by the Bureau shall have been approved by the Authority, it will with all expedition prepare plans for the hydroelectric portion of the project and will proceed to advertise for construction contracts in connection with the hydroelectric portion of said project

19. This agreement is subject to such rules as may be prescribed by the President or the Administrator to effectuate the purposes of the Emergency Relief Act of 1935 or of other pertinent Acts.

MEMBER OF CONGRESS CLAUSE

20. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise therefrom.

LIMITATION ON EXPENDITURES BY BUREAU OF RECLAMATION

21. Nothing herein contained is to obligate the Bureau to incur any expense except out of said $5,000,000 allocated to the Bureau or out of sums advanced to the Bureau by the Authority.

LOWER COLORADO RIVER AUTHORITY

By /s/ Roy Fry
Chairman

SEAL

Attest:

/s/ S. Raymond Brooks
Secretary

UNITED STATES OF AMERICA

By /s/ Harold L. Ickes
Secretary of the Interior.

AGREEMENT AMENDING AND SUPPLEMENTING COOPERATIVE AGREEMENT BETWEEN THE UNITED STATES OF AMERICA BY THE SECRETARY OF THE INTERIOR AND THE LOWER COLORADO RIVER AUTHORITY.

This Agreement dated as of Sept. 18, 1935, between the United States of America, acting by Harold L. Ickes as Secretary of the Interior, hereinafter referred to as the Secretary, and the Lower Colorado River Authority, created by an Act of the Legislature of Texas approved November 13, 1934, hereinafter referred to as the Authority, WITNESSETH:

WHEREAS, the parties desire to amend and supplement the Cooperative Agreement dated as of June 1, 1935:

The parties agree to and with each other that the said Cooperative Agreement shall be and is amended and supplemented as follows:

By striking out paragraph 12 thereof and substituting the following:

"12. (a) The Bureau will with the funds so advanced by the Authority and said $5,000,000 construct all that portion of the project relating to irrigation and flood control in accordance with plans and specifications approved by the Authority, including the construction of Hamilton Dam.

(b) The Authority agrees forthwith to terminate its agreement with Fegles Construction Company, Ltd., dated as of June 1, 1935, pursuant to paragraph 23b thereof, and pursuant to paragraph 23c thereof to exercise its right to use said Company's equipment as described in Schedule A of said agreement, and, if the Bureau shall so request, to exercise the Authority's option for the use of said equipment after October 1, 1936, as provided by paragraph 23d of said agreement.

(c) The Authority agrees forthwith to exercise its right to terminate its agreement with the Fargo Engineering Company dated August 15, 1935.

(d) The Authority agrees to make said equipment available to the Bureau for use in connection with the construction of Hamilton Dam for the period from the date hereof to October 1, 1936.

(e) The Authority further agrees to make said equipment available to the Bureau, if it shall so request, for use in connection with the construction of Hamilton Dam during the period from October 1, 1936, to October 1, 1937.

(f) The Bureau agrees to rehabilitate said equipment to the extent agreed to be necessary by the Bureau and the Authority and to maintain said equipment in such rehabilitated condition, and, at the termination of the work, to meet the expense of dismantling and loading said equipment upon railroad cars at the site.

(g) In the event that the Authority shall upon recommendation of the Bureau exercise its option for the use of said equipment after October 1, 1936, and until October 1, 1937, the Authority agrees to pay said Fegles Construction Company, Ltd., as rent for the use thereof the sum of $7,500 each month or part of month pro rata said equipment is retained by the Authority."

In Witness Whereof the United States of America and the Lower Colorado River Authority have respectively caused this agreement to be duly executed as of the day and year first above written.

UNITED STATES OF AMERICA

By Harold L. Ickes
Secretary of the Interior.

LOWER COLORADO RIVER AUTHORITY

By Roy Fry
Chairman

(Seal)

Attest:
Raymond Brooks
Secretary.

Exhibit E

EXHIBIT E

Contract Between Lower Colorado River Authority

and the United States

(13 March 1941)

Supplement

(9 December 1948)

CONTRACT BETWEEN LOWER COLORADO RIVER AUTHORITY OF TEXAS AND THE UNITED STATES CONCERNING THE OPERATION AND MAINTENANCE OF MARSHALL FORD DAM, AND THE PARTIAL REIMBURSEMENT OF THE UNITED STATES FOR EXPENDITURES THEREON

COLORADO RIVER PROJECT, TEXAS

This contract, made this 13 day of March, 1941, by and between the Lower Colorado River Authority of Texas, a corporate body created by laws of Texas, acting in this matter under the authority of the Lower Colorado River Authority Act (Chap. 7, 43d Leg. 4th Called Session, State of Texas) as amended and supplemented, and the United States, acting by and through the Secretary of the Interior and pursuant to the Act of August 26, 1937 (50 Stat. 844, 850) as amended and supplemented,

WITNESSETH THAT

2. The parties hereto agree and covenant as follows:

Operation and Maintenance of the Dam.
Articles 3 to 9, inclusive.

Designation of Authority as Agent
Purposes therefor

3. Subject to the provisions of the contract of June 1, 1935 (Symbol Ilr-805), between the Secretary and the Authority, and of the existing contracts amendatory thereof and supplemental thereto, except to the extent that those provisions are inconsistent with or expressly amended hereby, the Secretary, acting pursuant to the authority granted him by the Act of August 26, 1937 (50 Stat. 844, 850), hereby designates the Authority

as his agent to operate and maintain the Marshall Ford Dam on its completion solely for the purposes of regulating the flow of the Colorado River below the dam and controlling the floods of the river; and the Authority hereby agrees that, acting as the Secretary's agent solely for the purposes specified in this Article, it will operate and maintain the dam at its own expense in accordance with the terms of this agreement.

Plan of Dam and Reservoir Operation

4. The dam and reservoir, in keeping with the purposes of this agreement, shall be operated by the Authority substantially as follows:

(a) Under normal conditions when there is no flood in progress in the river system above the dam, storage capacity in the reservoir above elevation 681 feet above sea level (U.S.G.S datum) shall be available primarily for flood control and stream regulation, and such capacity below this elevation shall be primarily for power production: Provided, That the water surface elevation in the reservoir at the dam shall never, under ordinary conditions when no such flood is in progress, exceed 691 feet above sea level (U.S.G.S. datum).

(b) The operation of the reservoir in keeping with the primary objectives stated in subsection (a) of this Article will require, from time to time, the release of stored waters in the reservoir in anticipation of floods originating on the watershed of the Colorado River above the dam. The Authority agrees that it will be responsible for reservoir operations in keeping with said primary objectives and, to this end, will be responsible for the time and manner of releasing stored waters in anticipation of floods, and will give due regard to channel capacities of the River below the dam in making such releases.

Records of Operation of Dam

5. The Authority agrees to keep adequate records of its operation of the dam for flood control and stream regulating purposes, and to permit the Secretary, or his authorized representatives, to have access to such records at all reasonable times. The Authority shall also prepare a summary report of its operations for these purposes for each calendar year reasonably soon after the close of that year and shall submit such report promptly to the Secretary after its preparation.

Rain and Storm Reporting and Stream Gaging

6. In order that the dam can be efficiently operated as a flood control and stream regulating facility, the Authority agrees that it will provide and use, or arrange for the use of, a rain and storm reporting and stream gaging system or systems adequate to this end.

Maintenance of the Dam

7. The Authority agrees that it will keep the dam and related facilities in good operating condition and make such replacements in said facilities as may be necessary to the end that the dam and said facilities shall operate efficiently for the purposes stated in this agreement.

Inspection of the Facilities and Operations

8. The Secretary, or his authorized representatives, shall have the right at all reasonable times to inspect the dam and related facilities and services and the method of their operation by the Authority, for the purpose of determining whether this agreement is being carried out according to its terms.

United States to be Held Harmless

9. The Authority agrees to hold and save the United States, its officers and employees, harmless from any and all damages or claims of damages caused, or claimed to have been caused, to any person or property by reason of the Authority's operations of the dam or reservoir or any part thereof pursuant to the terms of this agreement.

Provisions Concerning Partial Reimbursement of the United States. Articles 10 to 13, inclusive

Secretary to Determine Amount of Reimbursement

10. It is hereby agreed that the Federal statutes relating to the Marshall Ford Dam contemplate that the United States will be reimbursed in part for the expenditures made by it in the construction of the dam to the extent and in the manner determined by the Secretary, subject to possible questions as to limitations on the Secretary's authority in this regard.

When Determination to be Made What Allocations to be Considered Reimbursable

11. (a) The Secretary agrees that no determination of the amount

to be repaid by the Authority will be made by him until the dam and related facilities being built by the Bureau of Reclamation have been completed and have been transferred to the Authority pursuant to existing contracts between the Authority and the Secretary.

(b) It is agreed that in determining the amount to be reimbursed to the United States by the Authority the expenditures made by the United States, through the Bureau of Reclamation, on the dam shall be fairly and equitably allocated among these things:

(i) Improvement of navigation, flood control and stream regulation;

(ii) Generation of power; and

(iii) Irrigation uses.

The allocation hereunder shall be made in the first instance by the Secretary, after consultation with the Authority, and shall be final unless the Authority files a written protest with the Secretary within thirty (30) days after it has notice of the allocation. If such a protest is filed by the Authority, a committee of three shall be selected to make a study and recommendations to the Secretary of what it would consider fair and equitable allocations hereunder among items (i), (ii) and (iii) above. The Committee shall comprise one member selected by the Secretary and one selected by the Authority, these selections to be made within sixty (60) days after the Authority's protest is filed and a third member selected by the first two members; provided, that if the first two members fail to make the selection of the third member within thirty (30) days after their selection, the third member shall be selected by the President of the United States. After the Committee's recommendations have been submitted to him, the Secretary shall make a final allocation hereunder. After the final allocation shall have been made, the Secretary, in determining the amount to be reimbursed, shall consider only the expenditures allocated to (ii) and (iii), it being understood and agreed that nothing in this agreement is intended to place, or shall be construed as placing, an interpretation on the Secretary's legal authority to determine the proportion to be reimbursed of expenditures allocated to (ii) and (iii).

Term and Manner of Repayment

12. The Secretary and the Authority agree that the term and manner of payment of the amount determined to be reimbursed shall be as follows:

(a) The amount determined to be reimbursable, when so determined shall not bear interest until the first repayment instalment is due. The Secretary shall hereafter determine, after consultation with the Authority, whether the reimbursable amount should bear interest during the repayment period after the first instalment comes due: Provided, That in no event shall the interest exceed three (3%) percent per annum on the unpaid balance.

(b) The principal amount shall be paid by the Authority in 35 equal annual instalments, or whatever fewer number of annual instalments may be mutually agreed on.

(c) The first instalment shall be payable on (i) June 1 of the calendar year immediately following the year in which becomes due the last instalment of any bonds issued by the Authority under the trust indenture dated June 1, 1939, as amended by the amendatory indenture dated October 1, 1940, entered into between the Authority and The American National Bank of Austin, as trustee, or issued under any amendatory or new trust indenture, or (ii) June 1 of the calendar year following the year in which all of said bonds have been paid or canceled or both; whichever date is the earlier: Provided, That the first instalment shall in any event become due not later than June 1, 1975.

(d) The obligations hereunder shall be subordinate (i) to bonds of the Authority which have been issued or which may hereafter be issued under the terms of the trust indenture described in subsection (b) of this Article amounting in the aggregate to twenty-five million ($25,000,000) dollars; (ii) to bonds issued in replacement of bonds issued under said indenture, except as to any such bond maturing on or after July 1, 1975, and (iii) to any original issue of bonds with maturities prior to July 1, 1975, which are issued under a revised or new indenture in lieu of an amount of bonds authorized but not issued under the existing indenture.

Subject to the provisions of (d) above, the obligations under this agreement shall have priority over other bonds or evidences of indebtedness issued by the Authority only as to the revenues from which these obligations are to be paid as provided in Article 13.

Source of Repayment Revenues

13. (a) The obligations of the Authority set out in this agreement shall be payable only out of the rates and charges for the use of power and energy produced at the Marshall Ford Power plant and for the use of water from the reservoir after paying the costs of operation thereof; and the Authority agrees that it will, during the repayment period as established in Article 12, fix its rates and charges for the use of power and energy produced at the Marshall Ford power plant and for the use of water from the reservoir such that revenues which are derived from the sale of energy produced at such plant and the water sold from such reservoir, after paying the costs of operation thereof, will be adequate to meet the obligations under this contract.

(b) The Authority also agrees that, during the repayment period, the Secretary may at any reasonable time, but not oftener than once each calendar year, examine the records of the Authority to determine that the provisions of this article are being met.

General and Miscellaneous Provisions
Articles 14 to 17, inclusive

Term of Contract

14. The parties agree that this agreement represents a tentative solution of problems concerning operation and maintenance of the dam and concerning partial reimbursement of the United States for the cost of the dam, and that, reasonably soon after the completion of the dam and

the assumption of its care, operation and maintenance by the Authority, negotiations will be undertaken to incorporate the substance of the provisions of this agreement in a more complete contract which will have as its object providing procedures for matters incompletely covered by, or not included in this agreement, but without changing the general plan and objectives agreed on in the present contract. This contract shall continue in effect until such permanent contract has been executed.

Officials not to Benefit

15. No member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

Contract not Assignable

16. No assignment or transfer by the Authority of its duties or obligations under this contract shall be valid unless approved by the Secretary in writing.

Title

17. Nothing contained herein shall be construed as having any effect whatsoever upon the title to the Marshall Ford Dam, and it is expressly recognized that the relative rights of the parties hereto to title, whatever they may be, shall remain as they are now.

IN WITNESS WHEREOF, the parties hereto have signed their names, by their duly authorized officers, the day and year first above written.

THE UNITED STATES OF AMERICA

By____________________
Secretary of the Interior

ATTEST: Raymond Brooks
Secretary

THE LOWER COLORADO RIVER AUTHORITY

By Max Starcke
General Manager

Exhibit F

EXHIBIT F

Bureau of Reclamation

Regulations Governing the Operation and

Maintenance of Marshall Ford Dam

(2 May 1944)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

REGULATIONS GOVERNING THE OPERATION AND MAINTENANCE OF MARSHALL FORD DAM - COLORADO RIVER PROJECT, TEXAS

I. Statutory Authority. Section 3 of the Act of August 26, 1937 (50 Stat. 844, 850), provides as follows:

"Sec. 3. ('Marshall Ford Dam' Colorado River project in Texas authorized - Construction authorized.) - That for the purpose of improving navigation, controlling floods, regulating the flow of streams, providing for storage and for delivery of stored waters, for the reclamation of lands, and other beneficial uses, and for the generation of electric energy as a means of financially aiding and assisting such undertaking, the project known as 'Marshall Ford Dam,' Colorado River project, in Texas, is hereby authorized and adopted and all contracts and agreements which have been executed in connection therewith are hereby validated and ratified, and the Secretary of the Interior, acting through such agents as he may designate, is hereby authorized to construct, operate, and maintain all structures and incidental works necessary to such project, and in conn ection therewith to make and enter into any and all necessary contracts including contracts amendatory of or supplemental to those hereby validated and ratified."

II. Scope of Regulations. The construction of the Marshall Ford Dam, Colorado River Project, Texas, herein called the dam, having been substantially completed within the purview of the said Act of Congress of August 26, 1937, and Article 3 of the contract of March 13, 1941 (Symbol No. Ilr-1262), between the United States and the Lower Colorado River Authority, herein called the Authority, the said Act of August 26, 1937 and Acts amendatory thereof and supplementary thereto, the said contract of March 13, 1941, and these regulations, as the same hereafter may be modified, amended, or extended, shall govern the operation and maintenance of the dam by the Authority, as agent of the Secretary of the Interior, herein called the Secretary, for the purposes of regulating the flow of the Colorado River below the dam and controlling the floods of the river, except as herein otherwise provided, without cost to the United States.

III. Minor, Future Construction Work. Notwithstanding the assumption by the Authority of the operation and maintenance of the dam and subject to the availability of funds and approval by the Secretary, the United States will: (a) at such time as the Chief Engineer of the Bureau of Reclamation, herein called the Chief Engineer, shall have determined that equipment and materials, now classed as critical war materials, properly may be procured and made available therefor (1) provide a gantry crane and install the same on the crest of the dam: (2) repair paradox gates numbered 7, 10 to 14, both inclusive, and 18 to 20 both inclusive; (3) provide and install wiring and related equipment for parapet lighting, and (4) provide oil for topping the roadway over the dam; and (b) when and to the extent that the Chief Engineer may determine the same to be necessary and desirable and compatible with good engineering practice, grout the contraction joints in the dam and provide measures calculated to minimize excessive condensation in the gate operating galleries of the dam structure, and install certain minor improvements to all twenty-four of the paradox gates.

IV. Access to Dam and Appurtenant Works. The United States and its officers and agents shall at all times have access to the dam and appurtenant works as well as access to and occupancy, without charge, of such camp buildings and related facilities as the Chief Engineer may determine to be necessary or convenient for the performance of the minor construction work described in Article III hereof: Provided, however, That the Authority may charge Bureau of Reclamation employees a rental for the occupancy of camp buildings as living quarters at rates which shall not exceed the rate charged by the Authority to its employees for like accommodations.

V. Plan of Operation. To the end that the dam may provide the greatest possible flood control as contemplated by said Act of August 26, 1937 and contracts made pursuant thereto, the Authority shall operate the gates in said dam as nearly as practicable, and until there shall have been provided further regulations or instructions, in accordance with detailed operating instructions which from time to time may be prescribed by the Chief Engineer and in accordance with a general plan as follows:

(a) With reservoir levels at or below elevation 681.0, during periods of ordinary river flow, the power plant operations may proceed without regard for flood control.

(b) With reservoir levels between elevations 681.0 and 691.0 the power plant shall be operated at full capacity, or, an equivalent release of water shall be attained by operations of the river outlet gates.

(c) During periods of impending floods, and regardless of reservoir levels, power water releases shall be augmented by river outlet releases to such extent that the estimated inflow from such floods will result in reservoir levels not exceeding elevation 691.0, except as major floods unavoidably result in higher levels, and, in event of such higher levels, the reservoir shall be restored to elevation 691.0 as rapidly as downstream conditions permit.

(d) Reservoir releases shall at all times be coordinated with downstream conditions to the end that such water will pass to the gulf with a minimum of damage.

VI. The Authority shall assume the operation of the river outlet gates in the following manner:

(a) The Authority shall forthwith assume directive control of all outlet control gates, except the nine paradox gates numbered 7, 10 to 14, both inclusive, and 18 to 20, both inclusive.

(b) In assuming such control the Authority shall delegate one of its employees as river outlet gate operator, whose duties as such shall include that of familiarizing himself under the direction and instruction of a representative of the United States with the operation of such gates.

(c) When the Chief Engineer of the Bureau of Reclamation is satisfied that such operator for the Authority is familiar with such gate operation, said operator in behalf of the Authority shall assume exclusive control thereof.

(d) If at the time indicated in the preceding subparagraph, or at any subsequent time, as any of paradox gates numbered 7, 10 to 14, both inclusive, and 18 to 20, both inclusive, are completed, their operation also shall be assumed exclusively by said gate operator of the Authority for and on its behalf.

VII. Maintenance-Protection of Dam. Maintenace of the dam and related facilities including such facilities as may be provided by the United States as set forth in Article III hereof, shall be effected by the Authority in accordance with the provisions of Article 4 of the said contract of March 13, 1941. The Authority, at all times and without cost to the United States, shall take reasonable steps for protection of the dam and appurtenant structures, and during periods of wars or impending wars involving the United States, shall provide such guard service as the Secretary may direct.

VIII. Data to be Reported. The Authority shall at all times and at its own expense read and report to the Chief Engineer of the Bureau of Reclamation (1) monthly, all uplift pressure gauge and drainage weir measurements, and (2) semi-annually, settlement readings in the left wing embankment. The Authority shall also immediately report to said Chief Engineer any unusual seepage appearing in the dam or its abutments.

IX. Alterations of or Additions to Dam. The Authority shall not make, or permit to be made, any alteration of, or addition to, the dam or its appurtenances, other than alterations of, or additions to, the power plants or their appurtenances, except upon the written consent of the Secretary.

X. Reservations. Within the scope of his authority under the Act of August 26, 1937, and the provisions of the contract of March 13, 1941, there is reserved to the Secretary the right from time to time to modify, amend, or extend these regulations. There is also reserved to the Secretary the right in the event of the failure of the Authority to operate and maintain the dam for flood control purposes in accordance with said Act of August 26, 1937, said contract of March 13, 1941, and these regulations, to resume the operation and maintenance of the dam for such purposes. Any such resumption shall be only on written notice given by the Secretary to the Authority.

Approved: May - 2, 1944

(Signed)
H. L. I.
Secretary of the Interior.

(Signed)
H. W. Bashore
Commissioner,
Bureau of Reclamation.

Exhibit G

EXHIBIT G

Termination of Contracts

30 MAY 1997

98012

United States Department of the Interior
BUREAU OF RECLAMATION
Great Plains Region
AUSTIN RECLAMATION OFFICE
300 East 8th Street, Room 801
Austin, Texas 78701-8225

PM
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IN REPLY
REFER TO:

FEB -6 1997
98

Colonel James S. Weller
District Engineer
U.S. Army Corps of Engineers
P.O. Box 17300
819 Taylor Street 3A32
Fort Worth, Texas 76102-0300

Subject: Termination of Existing Contracts Between the Lower Colorado River Authority (LCRA) and the United States of America, Marshall Ford (Mansfield) Dam, Colorado River Project, Texas

Dear Colonel Weller:

By the terms in an agreement signed May 30, 1997, between the LCRA and Bureau of Reclamation (Reclamation), the LCRA's remaining reimbursable obligation to the United States was satisfied. Under this agreement, all rights and obligations of the LCRA and Reclamation under the existing contracts were terminated. As such, Reclamation's role in the administration, operation, and oversight of any and all activities at Mansfield Dam have ceased. This includes all flood control operations and dam safety oversight and regulatory activities.

Reclamation will no longer have operational rights and/or responsibilities associated with the project. Specifically, Reclamation will no longer be involved with dam safety oversight and regulatory functions. Please revise your water control manual and any other regulatory documents accordingly. By copy of this letter, the Texas Natural Resources Conservation Commission is being notified of Reclamation's termination of responsibilities.

Also by copy of this letter, other offices that are believed to have an interest in operations at Mansfield Dam are being notified of the subject termination.

Please feel free to contact Leon Esparza at 405-945-6912 if you have any questions.

Sincerely,

for Elizabeth Cordova-Harrison
Area Manager

cc: Mr. Mark Rose
General Manager
Lower Colorado River Authority
P.O. Box 220
Austin, Texas 78767-0220

Mr. Tony Grigsby
Executive Director
Texas Natural Resource Conservation Commission
P.O. Box 13087, Capitol Station
Austin, Texas 78711-3087

Mr. Tom Millwee
Director, Emergency Management Division
Texas Department of Public Safety
5805 N. Lamar Blvd., Box 4087
Austin, Texas 78773-0001

Mr. Al Dreumont
Meteorologist-In-Charge
National Weather Service
2090 Airport Road
New Braunfels, Texas 78130

Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231

Travis County Sheriff
1010 Lavaca Street
Austin, TX 78701

U.S.Geological Survey
Water Resources Division
8011-A Cameron Road
Austin, TX 78754-3898

Environmental Protection Agency
Regional Administrator
1445 Ross Avenue
Dallas, Texas 75270-2733

Texas Parks and Wildlife
4200 Smith School Road
Austin, TX 78744

Leon Esparza, Oklahoma City Field Office, OKC

DUPLICATE ORIGINAL

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Marshall Ford Dam and Reservoir
Colorado River Project, Texas

AGREEMENT BETWEEN THE UNITED STATES OF AMERICA
AND THE LOWER COLORADO RIVER AUTHORITY
FOR TERMINATION OF EXISTING CONTRACTS

THIS AGREEMENT, made this 30th day of May, 1997, pursuant to the Act of June 17, 1902 (32 Stat. 388), and all acts amendatory thereof and supplemental thereto, collectively referred to as the Federal Reclamation Laws, and in particular the Act of August 26, 1937 (50 Stat. 850), is between the UNITED STATES OF AMERICA, hereinafter referred to as the "United States," acting through the Department of the Interior, Bureau of Reclamation, represented by the contracting officer executing this contract, hereinafter referred to as the "Contracting Officer," and the LOWER COLORADO RIVER AUTHORITY, organized pursuant to the laws of the State of Texas, with its principal place of business in Austin, Texas, hereinafter referred to as the "Authority."

WITNESSETH:

WHEREAS, the following preliminary statements are made for the purpose of explanation:

EXPLANATORY RECITALS:

WHEREAS, the Colorado River Project, Texas, (Project) was authorized pursuant to the Rivers and Harbors Act of August 26, 1937, to provide flood control and to regulate streamflow to improve navigation and provide storage for irrigation and power development; and

WHEREAS, the parties hereto have entered into Contract No. Ilr-805, dated June 1, 1935, as amended and supplemented, and Contract No. Ilr-1262, dated March 13, 1941, as supplemented, (existing contracts), for the construction, operation and maintenance, and repayment of the Project; and

WHEREAS, the existing contracts (specifically, Article 17 of the contract dated June 1, 1935), provides that title to the Marshall Ford Dam shall remain with the Authority; and

WHEREAS, under the existing contracts (specifically, Article 12 of the contract dated December 9, 1948) the Authority's reimbursable obligation to be repaid to the United

States was established at $5,510,500, which amount was to have been repaid in 35 annual installments without interest with the initial payment due June 1, 1985; and

WHEREAS, beginning June 1, 1985 and continuing through June 1, 1996, the Authority has repaid $1,889,314.20 of its reimbursable obligation, leaving an unpaid balance of $3,621,185.80; and

WHEREAS, the existing contracts (specifically, Article 13 of the contract dated December 9, 1948) provides that the Authority may request prepayment of its reimbursable obligation and allows the Authority and the United States to negotiate a mutually acceptable discounted prepayment of the Authority's remaining unpaid reimbursable amount, or any part thereof, of not less than $500,000; and

WHEREAS, the Authority has requested prepayment of its remaining reimbursable obligation and the parties hereto have agreed to a discounted prepayment in the amount of $1,910,149, which amount the United States has agreed to accept as full satisfaction for the Authority's remaining reimbursable amount; and

WHEREAS, this agreement is necessary to acknowledge full satisfaction of the Authority's remaining reimbursable obligation to the United States under the existing contracts, relinquishment of all rights and obligations of the contracting entities under the existing contracts, and termination of the existing contracts.

NOW, THEREFORE, in consideration of the premises and the mutual and dependent covenants contained herein, the parties hereto agree as follows:

SCOPE AND PURPOSE OF AGREEMENT

1. The purpose of this agreement is to acknowledge: (1) payment in full of the Authority's reimbursable obligation to the United States under the existing contracts, (2) relinquishment of any and all rights and interests by the contracting parties under the existing contract, and (3) termination of the existing contracts.

SATISFACTION OF AUTHORITY'S REIMBURSABLE OBLIGATION

2. The United States hereby accepts the Authority's discounted prepayment in the amount of $1,910,149 as full and complete satisfaction of the Authority's remaining unpaid reimbursable obligation of $3,621,185.80 payable to the United States under the existing contract.

RELINQUISHMENT OF INTERESTS BY CONTRACTING PARTIES

3. The United States and the Authority hereby disclaim and relinquish any and all rights, claims and interests in, to and under the existing contracts.

TERMINATION OF THE EXISTING CONTRACT

4. Contract No. Ilr-805 dated June 1, 1935, together with all supplements thereto and amendments thereof, and Contract No. Ilr-1262, as supplemented, are hereby terminated in their entirety and all rights and obligations of the parties thereunder are hereby terminated as of the date of execution of this agreement.

IN WITNESS WHEREOF, then parties hereto have executed this agreement the day and year first above written.

THE UNITED STATES OF AMERICA

By____________________
Regional Director
Great Plains Region
Bureau of Reclamation

LOWER COLORADO RIVER AUTHORITY

ATTEST:

By____________________
Manager of Corporate Finance and
Treasurer

Glen E. Taylor
Secretary

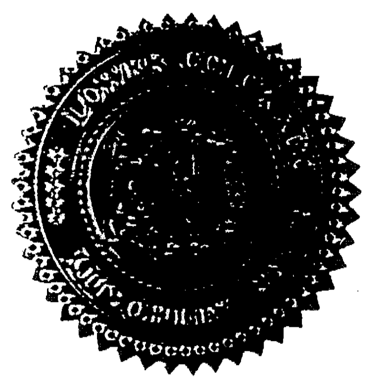

Exhibit H

EXHIBIT H

Texas Board of Water Engineers Permit 1260

(25 May 1938)

Amendment

(24 February 1976)

PERMIT

TO

APPROPRIATE PUBLIC WATERS

OF THE

STATE OF TEXAS

No. 1260.

WHEREAS, Lower Colorado River Authority, the post office address of which is Austin, Texas, did on the 7th day of March, A. D. 1938, file with the Board of Water Engineers for the State of Texas, its Application, No. 1346, for a permit to appropriate from the public resources of the State of Texas sufficient water for certain statutory purposes set out in its application.

WHEREAS, the said Board of Water Engineers, after giving notice thereof for the length of time, and in the manner provided by law, did on the 25th day of April, A. D. 1938, at its office in Austin, Texas, hold a public hearing, as prescribed by law, at which hearing all the evidence affecting said application was duly heard and considered, and in pursuance thereof did make and cause to be entered an order granting said permit.

NOW, THEREFORE, the Board of Water Engineers for the State of Texas, does by these presents GRANT THIS PERMIT unto the said Lower Colorado River Authority, to impound, divert, appropriate and use from the source of supply, to wit: The Colorado River, by means hereinafter described, an amount of the public waters of the State, to consist of the ordinary and storm and flood flow of the Colorado River, in Travis County, Texas, not to exceed One Million Five Hundred Thousand (1,500,000) acre-feet per annum, or so much thereof as may be necessary, when beneficially used, for the following purposes, to wit: Domestic and municipal uses, water to be used in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, irrigation, mining and recovery of minerals, and hydro-electric power.

PROVIDED, that the said Lower Colorado River Authority, the beneficiary under this permit, is authorized to construct a dam in and across the Colorado River, in Travis County, Texas, as fully described in its application, the same being a concrete straight gravity type dam, approximately One Hundred Eighty (180) feet in height from the lowest point in the foundation, and about Two Thousand Three Hundred Twenty-five (2,325) feet long at the crest, with a surface area of approximately Eleven Thousand (11,000) acres, and a storage capacity of approximately Six Hundred Thousand (600,000) acre-feet of water, the said dam being located in the William P. Moore, C. B. Townsend, John S. Chote No. 461, and the D. & W. Survey No. 69, and more accurately located by starting at a point in the southeast corner of the Wiley Hudson Survey No. 472, and proceeding S. 87 degrees 47' East a distance of 176.3' to a point; Thence proceeding N. 60 degrees 23' East a distance of 300' to a point; thence proceeding South 85 degrees 56' East a distance of 360.6' to station No. 7 on the base line of the Dam, as shown by plans filed with this Board, and accompanying said application; and to impound in said reservoir, and divert therefrom not to exceed One Million Five Hundred Thousand (1,500,000) acre-feet of water per annum for the purposes herein stated; said dam being known as the MARSHALL FORD DAM.

PROVIDED, that the said Lower Colorado River Authority, the beneficiary under this permit, be allowed to divert said water by means of the gates, penstocks and turbines described in its application, and thus to appropriate not to exceed One Million Five Hundred Thousand (1,500,000) acre-feet of water per annum, for the purposes herein stated; the measurement of the water herein permitted to be used is to be made at the points of diversion herein described, of which amount One Million Three Hundred Ninety-one Thousand Five Hundred Thirty (1,391,530) acre-feet have heretofore been granted under Permits, Nos. 951 and 952, the total amount to be appropriated under all such permits not to exceed One Million Five Hundred Thousand (1,500,000) acre-feet per annum.

PROVIDED, that the Lower Colorado River Authority, the beneficiary under this permit, is authorized to use the banks and bed of the Colorado River for the purpose of conveying and delivering water impounded and stored by its said dam, from the place of storage to points of diversion downstream from said dam for use for the purposes hereinabove stated, and to divert and use such impounded and stored water so conveyed in the bed of said stream by means of dams, headgates, intakes, pumping plants, ditches, canals and other works constructed and to be constructed by the Lower Colorado River Authority, and by those who may be entitled to use such waters, for the purposes above set out, the allowance as to quantity being based on the beneficial use of not to exceed One Million Five Hundred Thousand (1,500,000) acre-feet per annum.

PROVIDED, that the said grantee shall be permitted to impound and use said waters of said stream, subject to all the rights of those having prior right to the use of same, and said grantee shall, from time to time, by means of the gates and valves shown on the plans filed with this Board, release to those below said dam having a prior right thereto any part of the waters of said stream so impounded, to which those having prior rights may be entitled, when and to the extent the same is required, and to the extent of the right of those having such prior right.

The dam for which this permit is granted is being constructed by virtue and under the terms of Permits, Nos. 951 and 952, heretofore granted by this Board to the Syndicate Power Company of Dallas, Texas, and the alterations and modifications thereof heretofore set out by declarations filed with this Board, as prescribed by Statute, and this permit shall be cumulative of and in addition to Permits, Nos. 951 and 952, and of the rights covered by said permits; provided, that the total quantity of water to be impounded, diverted and appropriated shall not exceed the quantity set out in paragraph four of this permit.

Unless the time be extended by the Board, construction on the herein described works will be completed within five (5) years from date hereof.

Given under the hand and seal of the Board of Water Engineers for the State of Texas, this the 25th day of May, A. D. 1938.

C. S. Clark

A. H. Dunlap

John W. Pritchett

BOARD OF WATER ENGINEERS.

ATTEST: A. P. McDonald

Secretary.

TEXAS WATER RIGHTS COMMISSION

AN ORDER forfeiting, revoking, and cancelling, in part, Permit No. 1260 of the LOWER COLORADO RIVER AUTHORITY.

On February 24, 1976, there came on to be considered before the Texas Water Rights Commission pursuant to notice being given as required by law, the matter of forfeiting, revoking, and cancelling, in part, Permit No. 1260 of the Lower Colorado River Authority, hereafter referred to as "district."

The district appeared through its attorneys and general manager. After hearing and considering the matter of forfeiting, revoking, and cancelling, in part, Permit No. 1260 pursuant to Water Code §5.036, the Commission makes the following findings of fact and conclusions of law:

FINDINGS OF FACT

1. Notice was issued relative to this proceeding as required by law.

2. The district owns Permit No. 1260 which authorized the construction of a dam on the Colorado River, known as the Marshall Ford Dam, and impound thereby approximately 600,000 acre-feet of water, and to divert and use therefrom not to exceed 1,500,000 acre-feet of water per annum for the following purposes: Domestic and municipal uses, water to be used in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, irrigation, mining and recovery of minerals, and hydroelectric power.

3. The district has wilfully abandoned 102,000 acre-feet of water out of its 1,500,000 acre-foot appropriation during the last three successive years.

CONCLUSIONS OF LAW

4. Jurisdiction to cancel Permit No. 1260 is vested in the Commission.

5. The wilful abandonment of any lawful appropriation or use of state water during any three successive years mandates a forfeiture of the right to use the water abandoned.

6. Permit No. 1260 should be forfeited, revoked and cancelled to the extent of the right to divert and use 102,000 acre-feet per annum.

NOW, THEREFORE, BE IT ORDERED BY THE TEXAS WATER RIGHTS COMMISSION that Permit No. 1260 be and the same is hereby forfeited, revoked, and cancelled to the extent of the quantity abandoned, viz., the right to divert and use 102,000 acre-feet of water per annum.

The Secretary of the Commission is directed to forward a certified copy of this order to the County Clerk of the county or counties in which Permit No. 1260 is recorded and to the district.

Executed and entered of record, this the 24th day of February, 1976.

TEXAS WATER RIGHTS COMMISSION

Joe D. Carter

Joe D. Carter, Chairman

Joe R. Carroll, Commissioner

Dorsey B. Hardeman, Commissioner

ATTEST:

Mary Ann Hefner

Mary Ann Hefner, Secretary

Exhibit I

EXHIBIT I

Section 7, Flood Control Act of 1944

(58 Stat. 890; 33 U.S.C. 709 22 December 1944)

at the time of his enlistment or induction a resident thereof and who (a) was lawfully admitted into the United States, including its Territories and possessions, or (b) having entered the United States, including its Territories and possessions, prior to September 1, 1943, being unable to establish lawful admission into the United States serves honorably in such forces beyond the continental limits of the United States or has so served".

(b) By inserting after the words "no declaration of intention" the following: ", no certificate of arrival for those described in group (b) hereof,".

Sec. 2. The proviso to section 702 of the Nationality Act of 1940, as amended, is amended to read as follows: "*Provided*, That the record of any proceedings hereunder, together with a copy of the certificate of citizenship shall be forwarded to and filed by the clerk of a naturalization court in the district designated by the petitioner and be made a part of the record of the court". 56 Stat. 183. 8 U. S. C., Supp. III, § 1002. Record of proceedings.

Approved December 22, 1944.

[CHAPTER 663]

AN ACT

To repeal the prohibition against the filling of a vacancy in the office of district judge in the district of New Jersey. December 22, 1944 [H. R. 3732] [Public Law 532]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the proviso in subsection (a) of section 2 of the Act approved May 24, 1940 (54 Stat. 219; U. S. C. 1940, title 28, sec. 1, note), entitled "An Act to provide for the appointment of additional district and circuit judges", be, and it is hereby, amended to read as follows: "(a) *Provided*, That the first vacancy occurring in the office of district judge in each of said districts, except the district of New Jersey, shall not be filled." U. S. courts. District judge, New Jersey.

Sec. 2. That subsection (d) of the Act approved April 28, 1942 (56 Stat. 247, U. S. C. 1940, Supp., title 28, sec. 1, note), is hereby repealed.

Approved December 22, 1944.

[CHAPTER 664]

AN ACT

To amend section 33 of the Act of September 7, 1916, as amended (39 Stat. 742). December 22, 1944 [H. R. 4159] [Public Law 533]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 33 of the Act of September 7, 1916, as amended and extended (39 Stat. 742, and the following), is hereby amended by adding thereto the following new paragraph: U. S. Employees' Compensation Act, amendment. 39 Stat. 749. 5 U. S. C. § 784.

"The provisions of section 41 of the Act of March 4, 1927 (ch. 509, 44 Stat. 1424), as amended, shall, insofar as not inapplicable, apply in the same manner and to the same extent as though such provisions were incorporated in this Act." Safety investigations. 44 Stat. 1444. 33 U. S. C. § 941.

Approved December 22, 1944.

[CHAPTER 665]

AN ACT

Authorizing the construction of certain public works on rivers and harbors for flood control, and for other purposes. December 22, 1944 [H. R. 4485] [Public Law 534]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, In connection with the exercise of jurisdiction over the rivers of the Nation through the construction of works of improvement, for navigation or flood control, Navigation and flood control. Declaration of policy.

as herein authorized, it is hereby declared to be the policy of the Congress to recognize the interests and rights of the States in determining the development of the watersheds within their borders and likewise their interests and rights in water utilization and control, as herein authorized to preserve and protect to the fullest possible extent established and potential uses, for all purposes, of the waters of the Nation's rivers; to facilitate the consideration of projects on a basis of comprehensive and coordinated development; and to limit the authorization and construction of navigation works to those in which a substantial benefit to navigation will be realized therefrom and which can be operated consistently with appropriate and economic use of the waters of such rivers by other users.

In conformity with this policy:

Submission of plans, reports, etc.

(a) Plans, proposals, or reports of the Chief of Engineers, War Department, for any works of improvement for navigation or flood control not heretofore or herein authorized, shall be submitted to the Congress only upon compliance with the provisions of this paragraph (a). Investigations which form the basis of any such plans, proposals, or reports shall be conducted in such a manner as to give to the affected State or States, during the course of the investigations, information developed by the investigations and also opportunity for consultation regarding plans and proposals, and, to the extent deemed practicable by the Chief of Engineers, opportunity to cooperate in the investigations. If such investigations in whole or part are concerned with the use or control of waters arising west of the ninety-seventh meridian, the Chief of Engineers shall give to the Secretary of the Interior, during the course of the investigations, information developed by the investigations and also opportunity for consultation regarding plans and proposals, and to the extent deemed practicable by the Chief of Engineers, opportunity to cooperate in the investigations. The relations of the Chief of Engineers with any State under this paragraph (a) shall be with the Governor of the State or such official or agency of the State as the Governor may designate. The term "affected State or States" shall include those in which the works or any part thereof are proposed to be located; those which in whole or part are both within the drainage basin involved and situated in a State lying wholly or in part west of the ninety-eighth meridian; and such of those which are east of the ninety-eighth meridian as, in the judgment of the Chief of Engineers, will be substantially affected. Such plans, proposals, or reports and related investigations shall be made to the end, among other things, of facilitating the coordination of plans for the construction and operation of the proposed works with other plans involving the waters which would be used or controlled by such proposed works. Each report submitting any such plans or proposals to the Congress shall set out therein, among other things, the relationship between the plans for construction and operation of the proposed works and the plans, if any, submitted by the affected States and by the Secretary of the Interior. The Chief of Engineers shall transmit a copy of his proposed report to each affected State, and, in case the plans or proposals covered by the report are concerned with the use or control of waters which rise in whole or in part west of the ninety-seventh meridian, to the Secretary of the Interior. Within ninety days from the date of receipt of said proposed report, the written views and recommendations of each affected State and of the Secretary of the Interior may be submitted to the Chief of Engineers. The Secretary of War shall transmit to the Congress, with such comments and recommendations as he deems appropriate, the proposed report together with the submitted views and recommendations of affected States and

Interests of affected States.

Waters arising west of 97th meridian.

Representative for State.

"Affected State or States."

Coordination with other plans.

Transmittal of proposed report to States, etc.

Views and recommendations.

Transmittal of proposed report to Congress.

of the Secretary of the Interior. The Secretary of War may prepare and make said transmittal any time following said ninety-day period. The letter of transmittal and its attachments shall be printed as a House or Senate document.

(b) The use for navigation, in connection with the operation and maintenance of such works herein authorized for construction, of waters arising in States lying wholly or partly west of the ninety-eighth meridian shall be only such use as does not conflict with any beneficial consumptive use, present or future, in States lying wholly or partly west of the ninety-eighth meridian, of such waters for domestic, municipal, stock water, irrigation, mining, or industrial purposes.

Use of waters of western States for navigation.

(c) The Secretary of the Interior, in making investigations of and reports on works for irrigation and purposes incidental thereto shall, in relation to an affected State or States (as defined in paragraph (a) of this section), and to the Secretary of War, be subject to the same provisions regarding investigations, plans, proposals, and reports as prescribed in paragraph (a) of this section for the Chief of Engineers and the Secretary of War. In the event a submission of views and recommendations, made by an affected State or by the Secretary of War pursuant to said provisions, sets forth objections to the plans or proposals covered by the report of the Secretary of the Interior, the proposed works shall not be deemed authorized except upon approval by an Act of Congress; and subsection 9 (a) of the Reclamation Project Act of 1939 (53 Stat. 1187) and subsection 3 (a) of the Act of August 11, 1939 (53 Stat. 1418), as amended, are hereby amended accordingly.

Irrigation works. Investigations and reports.

Objection by affected State, etc.; effect.

53 Stat. 1193. 43 U. S. C. § 485h (a). 54 Stat. 1120. 16 U. S. C. § 590z-1 (a); Supp. III, § 590z-1 (a).

Sec. 2. That the words "flood control" as used in section 1 of the Act of June 22, 1936, shall be construed to include channel and major drainage improvements, and that hereafter Federal investigations and improvements of rivers and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers, and Federal investigations of watersheds and measures for run-off and water-flow retardation and soil-erosion prevention on watersheds shall be under the jurisdiction of and shall be prosecuted by the Department of Agriculture under the direction of the Secretary of Agriculture, except as otherwise provided by Act of Congress.

"Flood control." 49 Stat. 1570. 33 U. S. C. § 701a.

Jurisdiction of Federal activities.

Sec. 3. That section 3 of the Act approved June 22, 1936 (Public, Numbered 738, Seventy-fourth Congress), as amended by section 2 of the Act approved June 28, 1938 (Public, Numbered 761, Seventy-fifth Congress), shall apply to all works authorized in this Act, except that for any channel improvement or channel rectification project provisions (a), (b), and (c) of section 3 of said Act of June 22, 1936, shall apply thereto, and except as otherwise provided by law: *Provided*, That the authorization for any flood-control project herein adopted requiring local cooperation shall expire five years from the date on which local interests are notified in writing by the War Department of the requirements of local cooperation, unless said interests shall within said time furnish assurances satisfactory to the Secretary of War that the required cooperation will be furnished.

State, etc., cooperation. 49 Stat. 1571; 52 Stat. 1215. 33 U. S. C. §§ 701c, 701c-1; Supp. III, § 701c note.

Time limitation.

Sec. 4. The Chief of Engineers, under the supervision of the Secretary of War, is authorized to construct, maintain, and operate public park and recreational facilities in reservoir areas under the control of the War Department, and to permit the construction, maintenance, and operation of such facilities. The Secretary of War is authorized to grant leases of lands, including structure or facilities

Recreational facilities in reservoir areas.

Leases.

Preference in granting of licenses.

thereon, in reservoir areas for such periods and upon such terms as he may deem reasonable: *Provided*, That preference shall be given to Federal, State, or local governmental agencies, and licenses may be granted without monetary consideration, to such agencies for the use of areas suitable for public park and recreational purposes, when the Secretary of War determines such action to be in the public interest.

Public use of water areas.

The water areas of all such reservoirs shall be open to public use generally, without charge, for boating, swimming, bathing, fishing, and other recreational purposes, and ready access to and exit from such water areas along the shores of such reservoirs shall be maintained for general public use, when such use is determined by the Secretary of War not to be contrary to the public interest, all under such rules and regulations as the Secretary of War may deem necessary. No use of any area to which this section applies shall be permitted which is inconsistent with the laws for the protection of fish and game of the State in which such area is situated. All moneys received for leases or privileges shall be deposited in the Treasury of the United States as miscellaneous receipts.

Disposal of electric power; rates.

SEC. 5. Electric power and energy generated at reservoir projects under the control of the War Department and in the opinion of the Secretary of War not required in the operation of such projects shall be delivered to the Secretary of the Interior, who shall transmit and dispose of such power and energy in such manner as to encourage the most widespread use thereof at the lowest possible rates to consumers consistent with sound business principles, the rate schedules to become effective upon confirmation and approval by the Federal Power Commission. Rate schedules shall be drawn having regard to the recovery (upon the basis of the application of such rate schedules to the capacity of the electric facilities of the projects) of the cost of producing and transmitting such electric energy, including the amortization of the capital investment allocated to power over a reasonable period of years.

Preference in sale of power.

Preference in the sale of such power and energy shall be given to public bodies and cooperatives. The Secretary of the Interior is authorized, from funds to be appropriated by the Congress, to construct or acquire, by purchase or other agreement, only such transmission lines and related facilities as may be necessary in order to make the power and energy generated at said projects available in wholesale quantities for sale on fair and reasonable terms and conditions to facilities owned by the Federal Government, public bodies, cooperatives, and privately owned companies. All moneys received from such sales shall be deposited in the Treasury of the United States as miscellaneous receipts.

Contracts for surplus water.

SEC. 6. That the Secretary of War is authorized to make contracts with States, municipalities, private concerns, or individuals, at such prices and on such terms as he may deem reasonable, for domestic and industrial uses for surplus water that may be available at any reservoir under the control of the War Department: *Provided*, That no contracts for such water shall adversely affect then existing lawful uses of such water. All moneys received from such contracts shall be deposited in the Treasury of the United States as miscellaneous receipts.

Regulations for use of storage at reservoirs.

SEC. 7. Hereafter, it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations:

Applicability to TVA.

Provided, That this section shall not apply to the Tennessee Valley Authority, except that in case of danger from floods on the Lower Ohio and Mississippi Rivers the Tennessee Valley Authority is directed to regulate the release of water from the Tennessee River into the Ohio River in accordance with such instructions as may be issued by the War Department.

Additional irrigation works.

Sec. 8. Hereafter, whenever the Secretary of War determines, upon recommendation by the Secretary of the Interior that any dam and reservoir project operated under the direction of the Secretary of War may be utilized for irrigation purposes, the Secretary of the Interior is authorized to construct, operate, and maintain, under the provisions of the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto), such additional works in connection therewith as he may deem necessary for irrigation purposes. Such irrigation works may be undertaken only after a report and findings thereon have been made by the Secretary of the Interior as provided in said Federal reclamation laws and after subsequent specific authorization of the Congress by an authorization Act; and, within the limits of the water users' repayment ability such report may be predicated on the allocation to irrigation of an appropriate portion of the cost of structures and facilities used for irrigation and other purposes. Dams and reservoirs operated under the direction of the Secretary of War may be utilized hereafter for irrigation purposes only in conformity with the provisions of this section, but the foregoing requirement shall not prejudice lawful uses now exisiting: *Provided*, That this section shall not apply to any dam or reservoir heretofore constructed in whole or in part by the Army engineers, which provides conservation storage of water for irrigation purposes.

43 U. S. C. § 485a (a). *Ante*, p. 279.

Prerequisites.

Nonapplicability.

Approval of designated plans.

Sec. 9. (a) The general comprehensive plans set forth in House Document 475 and Senate Document 191, Seventy-eighth Congress, second session, as revised and coordinated by Senate Document 247, Seventy-eighth Congress, second session, are hereby approved and the initial stages recommended are hereby authorized and shall be prosecuted by the War Department and the Department of the Interior as speedily as may be consistent with budgetary requirements.

Missouri River Basin.

52 Stat. 1218.

(b) The general comprehensive plan for flood control and other purposes in the Missouri River Basin approved by the Act of June 28, 1938, as modified by subsequent Acts, is hereby expanded to include the works referred to in paragraph (a) to be undertaken by the War Department; and said expanded plan shall be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers.

Reclamation and power developments.

(c) Subject to the basin-wide findings and recommendations regarding the benefits, the allocations of costs and the repayments by water users, made in said House and Senate documents, the reclamation and power developments to be undertaken by the Secretary of the Interior under said plans shall be governed by the Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto), except that irrigation of Indian trust and tribal lands, and repayment therefor, shall be in accordance with the laws relating to Indian lands.

43 U. S. C. § 485a (a). *Ante*, p. 279.

Additional sums authorized.

(d) In addition to previous authorizations there is hereby authorized to be appropriated the sum of $200,000,000 for the partial accomplishment of the works to be undertaken under said expanded plans by the Corps of Engineers.

(e) The sum of $200,000,000 is hereby authorized to be appropriated for the partial accomplishment of the works to be undertaken under said plans by the Secretary of the Interior.

Projects authorized.

Sec. 10. That the following works of improvement for the benefit of navigation and the control of destructive flood waters and other purposes are hereby adopted and authorized in the interest of the national security and with a view toward providing an adequate reservoir of useful and worthy public works for the post-war construction program, to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein: *Provided*, That the necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this Act to be constructed by the War Department during the war, with funds from appropriations heretofore or hereafter made for flood control, so as to be ready for rapid inauguration of a post-war program of construction: *Provided further*, That when the existing critical situation with respect to materials, equipment, and manpower no longer exists, and in any event not later than immediately following the cessation of hostilities in the present war, the projects herein shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements: *And provided further*, That penstocks and other similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the War Department when approved by the Secretary of War on the recommendation of the Chief of Engineers and the Federal Power Commission.

Preparation for post-war construction.

Initiation of projects.

Installation of penstocks.

LAKE CHAMPLAIN BASIN

Modifications of certain dams.

Modifications of the existing Waterbury, Wrightsville, and East Barre Dams in the Winooski River Basin, Vermont, are hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 629, Seventy-eighth Congress, second session, at an estimated cost of $2,120,000.

BLACKSTONE RIVER BASIN

West Hill Reservoir, Mass.

The project for the West Hill Reservoir on the West River, Massachusetts, for flood control and other purposes in the Blackstone River Basin is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 624, Seventy-eighth Congress, second session, at an estimated cost of $1,070,000.

Worcester, Mass.

The project on Blackstone River for local flood protection at Worcester, Massachusetts, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 624, Seventy-eighth Congress, second session, at an estimated cost of $2,232,000.

Woonsocket, R. I.

The project on Blackstone River for local flood protection at Woonsocket, Rhode Island, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 624, Seventy-eighth Congress, second session, at an estimated cost of $803,000.

Pawtucket, R. I.

The project on Seekonk River, for local flood protection at Pawtucket, Rhode Island, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 624, Seventy-eighth Congress, second session, at an estimated cost of $82,000.

CONNECTICUT RIVER BASIN

Local protection works.
Additional appropriations authorized.
52 Stat. 1216; 55 Stat. 639.
West River, Vt.

In addition to previous authorizations, there is hereby authorized to be appropriated the sum of $30,000,000 for the prosecution of the comprehensive plan approved in the Act of June 28, 1938, as modified by the Act approved August 18, 1941, for the Connecticut River Basin: *Provided*, Nothing in this Act or in any previous authorization shall

Exhibit J

EXHIBIT J

Federal Register

(16 FR 4543, 16 May 1951)

...'s leather production, for each calendar month commencing with the ... of May 1951, as well as such other information as may be called for by such ... Such form shall be filed with NPA ... before June 10, 1951, and on or before the 10th day of each month thereafter.

(c) Persons subject to this order shall make such records and submit such other reports to NPA as it shall require, subject to the terms of the Federal Reports Act of 1942 (5 U. S. C. 139-139F).

Sec. 8. *Records.* Each person participating in any transaction covered by this order shall retain in his possession for at least 2 years records of receipts, deliveries, inventories, and use, in sufficient detail to permit an audit that determines for each transaction that the provisions of this order have been met. This does not specify any particular accounting method and does not require alteration of the system of records customarily maintained, provided such records supply an adequate basis for audit. Records may be maintained in the form of microfilm or other photographic copies instead of the originals.

Sec. 9. *Audit and inspection.* All records required by this order shall be made available at the usual place of business where maintained for inspection and audit by duly authorized representatives of NPA.

Sec. 10. *Applications for adjustment or exception.* Any person affected by any provision of this order may file with NPA a request for adjustment or exception upon the ground that his business operation was commenced during the base period or prior to the effective date of this order, or because any such provision works an undue or exceptional hardship upon him not suffered generally by others in the same trade or industry, or that its enforcement against him would not be in the interest of national defense or in the public interest. In considering requests for adjustment which claim that the public interest is prejudiced by the application of any provision of this order, consideration will be given to the requirements of public health and safety, civilian defense, and dislocation of labor and resulting unemployment that would impair the defense program. Each such request shall be in writing, shall set forth all pertinent facts, the nature of the relief sought, and the justification therefor.

Sec. 11. *Communications.* All communications or reports concerning this order shall be addressed to the National Production Authority, Washington 25, D. C., Ref: M-62.

Sec. 12. *Violations.* Any person who wilfully violates any provision of this order or any other order or regulation of the NPA, or who wilfully conceals a material fact or furnishes false information in the course of operation under this order, is guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both. In addition, administrative action may be taken against any such person to suspend his privilege of making or receiving further deliveries of materials or using facilities under priority or allocation control and to deprive him of further priorities assistance.

NOTE: All reporting and record-keeping requirements of this order have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

This order shall take effect on May 16, 1951.

NATIONAL PRODUCTION AUTHORITY,
MANLY FLEISCHMANN,
Administrator.

[F. R. Doc. 51-5772; Filed, May 16, 1951; 11:51 a. m.]

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, Department of the Army

PART 208—FLOOD CONTROL REGULATIONS

MARSHALL FORD DAM AND RESERVOIR, COLORADO RIVER, TEXAS

Pursuant to the provisions of section 7 of the act of Congress approved December 22, 1944 (58 Stat. 890; 33 U. S. C. 709), the following regulations are hereby prescribed to govern the use of flood-control storage in the Marshall Ford Reservoir on the Colorado River, Texas, and the operation of the Marshall Ford Dam for flood-control purposes. The reservoir storage above elevation 681.0 feet m. s. l. is expressly reserved primarily for flood-control purposes and regulations for the use of this storage are provided herein.

§ 208.19 *Marshall Ford Dam and Reservoir, Colorado River, Texas.* The Secretary of the Interior through his agent, the Lower Colorado River Authority (hereinafter referred to as the Authority), charged with the operation of the Marshall Ford Dam, shall operate the dam and reservoir in the interest of flood control as follows:

(a) At all times reservoir releases shall be coordinated with downstream conditions so that the flow of the Colorado River at Columbus, Texas, does not exceed 50,000 cubic feet per second (equivalent to a stage of 21.0 feet on the official U. S. Geological Survey gage designated as Colorado River at Columbus, Texas) by virtue of controlled releases from the reservoir, except that no curtailment of normal power plant releases shall result thereby at any time.

(b) During periods when the reservoir level is above elevation 681 the minimum total release from the reservoir shall be at a rate of 5,000 cubic feet per second, or, subject to downstream conditions, at such greater rate as necessary, on a basis of known storage and estimated inflow, to provide for release of water stored between elevations 681 and 691 within 30 days.

(c) Regardless of reservoir levels, if forecasts indicate that the estimated inflow will result in the reservoir level rising above elevation 691, total release shall be increased, subject to downstream conditions, to the rate necessary to prevent the reservoir level from exceeding elevation 691, if possible, except that if the reservoir level is below elevation 681 drawdown below the initial level shall not be required and that such release shall not lower the reservoir level below elevation 681 at the close of the flood control operations.

(d) If excessive inflow unavoidably results in the reservoir level rising above elevation 691, the combined controlled and uncontrolled releases from the reservoir shall be made at the maximum rate possible without exceeding a discharge of 50,000 cubic feet per second in the Colorado River at Columbus, Texas, by virtue of controlled releases from the reservoir, until the reservoir level falls to elevation 691, except that no curtailment of normal power plant releases shall result thereby.

(e) Releases made in accordance with the regulations of this section are subject to the condition that releases shall not be made at rates or in a manner that would be inconsistent with requirements for protecting the dam and reservoir from major damage. Should the reservoir level exceed elevation 722 due to excessive rates of inflow, the Authority may utilize the capacity of the flood control outlets in increasing the rate of discharge to the extent considered necessary for protecting the dam and appurtenances from major damage.

(f) The Authority shall furnish the District Engineer, Corps of Engineers, Department of the Army, in charge of the locality, daily, on forms provided for this purpose, a report showing the elevation of the reservoir pool; uncontrolled spillway, flood-control conduit, and power releases; storage; reservoir inflow; and precipitation in inches and discharge in cubic feet per second, as shown by the pertinent gages in the Colorado River Basin.

(g) Whenever the reservoir level reaches elevation 681.0 at the Marshall Ford Dam and flood releases are necessary or appear imminent, the Authority shall report at once to the District Engineer, Corps of Engineers, Department of the Army, in charge of the Locality, by telephone, telegraph or radio, and unless otherwise instructed, once daily thereafter until the reservoir level falls to elevation 681.0. These daily reports shall reach the District Engineer by 9:00 a. m. each day.

(h) The regulation of this section for the operation of the flood control facilities at the Marshall Ford Dam and Reservoir are subject to temporary modification in time of flood by the District Engineer if found desirable on a basis of conditions at the time.

[Regs. April 12, 1951—ENGWB] (58 Stat. 890; 33 U. S. C. 709)

[SEAL] EDWARD F. WITSELL,
Major General, U. S. Army,
The Adjutant General.

[F. R. Doc. 51-[illegible]; Filed, May 16, 1951; 8:46 a. m.]

Exhibit K

EXHIBIT K

Federal Register

(41 FR 15005, 9 April 1976)

~~harm could result from a hazard dis-~~closed during the consultative visit, the revised regulation provides that the consultant must immediately notify the employer of such conditions and afford him a reasonable time to eliminate the conditions. Where the consultant is not satisfied through a further consultative visit, documentary evidence or otherwise, that such elimination has taken place, he must notify the OSHA Regional Administrator.

The revised provisions will ensure that serious hazards disclosed during consultative visits will be eliminated and, at the same time, that an undue abatement burden would not be imposed on employers who are subject to a consultative visit.

The new § 1908.5(c)(7) 29 CFR 1908.5(c)(7) includes interpretative changes and procedures which are designed to clarify the requirements of the paragraph it replaces. Such interpretations do not require a public comment period prior to becoming effective (5 U.S.C. 553(b)(3)(A)). In addition the Assistant Secretary of Labor for Occupational Safety and Health, in accordance with 5 U.S.C. 553(b)(3)(B), finds that good cause exists for not delaying the effective date of this regulation as it merely clarifies the regulation it replaces and does not substantively alter previous requirements.

Therefore, pursuant to the authority contained in sections 7(c)(1), 8(g)(2), and 21(c) of the Act, 29 CFR 1908.5(c)(7) is amended to read as follows. The amendment shall be effective April 9, 1976.

§ 1908.5 **Making of agreements.**

* * * * *

(c) *Contents of the agreement.* * * *

(7) A statement that consultants shall notify the OSHA Regional Administrator under the following circumstances:

(i) Where an employer fails immediately to eliminate an imminent danger disclosed during a consultative visit, the consultant shall immediately notify the affected employees and advise the Regional Administrator.

(ii) If there is substantial probability that death or serious physical harm could result from conditions disclosed during a consultative visit, the consultant shall immediately notify the employer of such conditions and afford the employer a reasonable time to eliminate such conditions. Where the consultant is not satisfied through a further consultative visit, documentary evidence, or otherwise that such elimination has taken place, the consultant shall notify the OSHA Regional Administrator.

* * * * *

(Secs. 7(c)(1), 8(g)(2), 21(c), Pub. L. 91-596, 84 Stat. 1600, 1608 (29 U.S.C. 657(g)(2)))

Signed at Washington, D.C. this 31st day of March 1976.

MORTON CORN,
Assistant Secretary of Labor.

~~[FR Doc.76-[illegible] Filed 4-8-76;8:45 am]~~

~~PART 1952—APPROVED STATE PLANS~~ FOR ENFORCEMENT OF STATE STANDARDS

Utah Plan—Approval of Utah Review Commission Rules of Procedure

1. *Background.* Part 1953 of Title 29, Code of Federal Regulations, provides procedures under section 18 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 667) (hereinafter referred to as the Act) for review of changes and progress in the development and implementation of State Plans which have been approved in accordance with section 18(c) of the Act and Part 1902 of this chapter. On January 10, 1973, notice was published in the FEDERAL REGISTER (38 FR 1178) of the approval of the Utah plan and of the adoption of Subpart E of Part 1952 containing the decision of approval.

On January 19, 1976, the State of Utah submitted a supplement to the plan involving developmental changes. The change supplement consists of Utah Review Commission's Rules of Procedure. These rules set forth procedural guidelines for the review commission to follow in its conduct of administrative appellate proceedings. The State rules of procedure incorporate provisions essentially identical to the Federal review commission's rules.

2. *Location of the plan and its supplements for inspection and copying.* A copy of the supplement, along with the approved plan, may be inspected and copied during normal business hours at the following locations: Office of the Associate Assistant Secretary for Regional Programs, Room N-3112, Department of Labor Building, 200 Constitution Avenue N.W., Washington, D.C. 20210; Office of the Regional Administrator, Occupational Safety and Health Administration, Room 15010, Federal Building, 1961 Stout Street, Denver, Colorado 80202; Utah Industrial Commission, Occupational Safety and Health Division, 448 South 400 East, Salt Lake City, Utah 84111.

3. *Public participation.* Under 29 CFR 1953.2(c) of this chapter, the Assistant Secretary of Labor for Occupational Safety and Health (hereinafter called the Assistant Secretary) may prescribe alternative procedures to expedite the review process or for any other good cause which may be consistent with applicable law. The Assistant Secretary finds that the Utah review commission rules of procedure incorporate provisions essentially identical to the Federal rules. Therefore, further public notice and comment would be unnecessary.

4. *Decision.* After careful consideration, the Utah plan supplement is hereby approved under Part 1953. This decision incorporates the requirements of the Act and implementing regulations applicable to State plans generally. In accordance with the above, Subpart E of Part 1952 is amended by adding a new § 1952.~~114(e) which reads as follows:~~

~~§ 1952.114 Completed developmental steps.~~

* * * * *

(e) The State has developed and implemented rules of procedure for its review commission, consistent with present law.

(Sec. 18, Pub. L. 91-596, 84 Stat. 1608 (29 U.S.C. 667))

Signed at Washington, D.C. this 31st day of March 1976.

MORTON CORN,
Assistant Secretary of Labor.

~~[FR Doc.76-10005 Filed 4-8-76;8:45 am]~~

Title 33—Navigation and Navigable Waters

CHAPTER II—CORPS OF ENGINEERS, DEPARTMENT OF THE ARMY

PART 208—FLOOD CONTROL REGULATIONS

Marshall Ford Dam and Reservoir, Colorado River, Texas

On 26 January 1976 notice was published in the FEDERAL REGISTER (41 FR 3740) that the Corps of Engineers was proposing interim regulations prescribing the use of flood control storage in the Marshall Ford Reservoir on the Colorado River, Texas, and the operation of the Marshall Ford Dam for flood control purposes. Interested persons were given until 15 February 1976 to submit written comments. Although some comments were received after the due date, full and careful consideration was given to all written comments received. The final interim Regulation has been revised to reflect the applicable comments.

(a) *Summary of comments.* (1) The Travis County, Texas, engineering staff requested confirmation that the final Regulation would be subject to change and that the plans for further study would include the effects of the regulation policy in conjunction with flood information and rate studies for the Federal Flood Insurance Program for the Travis County portion of Lake Travis.

Prompt promulgation of the revised Regulation is considered essential for effective regulation/operation of the Marshall Ford project for flood control. However, this final Regulation has interim status, so as to provide a test period and to permit time for completion of detailed studies. The interim period, extending to about 1 June 1977, will be used for development of a new water control manual and to accomplish coordination of the adopted regulation plan with the owner, the designated operating agency and others having vested interests in the project.

Detailed studies are currently being made to evaluate increased rates of discharge beyond 30,000 c.f.s. as the lake level approaches elevation 714 feet m.s.l. The study results will be used in the development of the final plan of regulation and could provide information for the regulation policy in conjunction with flood information and rate studies for the Federal Flood Insurance Program.

(2) Comments furnished by the Bureau of Reclamation, U.S. Department of the Interior, recommended minor revisions of § 208.19 (c) and (g) to include references to reservoir inflow forecasting and to a more precise definition of flood conditions.

The wording of the respective paragraphs has been retained for the following reasons:

Section 208.19(c) requires that the total release from the project shall be increased as necessary to delay as long as possible the lake level from exceeding elevation 691 feet m.s.l. As indicated in paragraph (c) of the preamble published 26 January 1976, the inflow forecast procedure has been strengthened by the requirement to recognize measured flows at upstream gaging stations. The stations are located far enough upriver to provide several hours of response time at Mansfield Dam. The object of utilizing additional upstream gaging station monitoring is to reduce, but not entirely eliminate, reliance on rainfall-runoff estimates (forecasts). This should minimize the risk of making unwarranted and possibly damaging releases.

Section 208.19(g) requires the Authority to report at once to the District Engineer, Fort Worth District, whenever flood conditions are imminent, or stages of 16 feet or more at the Austin gage have been reached. Although the Authority will be required to make a determination as to the imminence of flood conditions, the Corps of Engineeers feels that a report should be made regardless of the current pool level. Hopefully, an upgrading of the water data network and communication system in the Colorado River basin will evolve over the years. All water agencies will then continuously monitor hydrometeorological stations and the current status of water resource projects simultaneously.

Section 208.19(i) permits the Authority to deviate temporarily from the Regulation for emergency reasons to protect the safety of the dam with appropriate notification to the Fort Worth District Engineer. As noted in the Bureau's letter, the Corps of Engineers understands that the Regional Director and technical consultants at the Bureau of Reclamation's Engineering and Research Center are available for consultation whenever emergency conditions of this nature develop.

(3) Comments furnished by the Lower Colorado River Authority, the designated project operating agency, requested a change from 0800 to 0900 in the time for making the daily report to the Corps of Engineers. They also requested further consideration of the regulation plan relating to minimum release rate of 3,000 c.f.s. when the Marshall Ford pool is between elevations 683 and 685 feet m.s.l.

Section 208.19(f) has been revised to accommodate the operating agency's request. The daily report will henceforth be made by 0900 to the Fort Worth District Engineer, in lieu of 0800 hours as proposed.

Section 208.19(b) has been retained as proposed. Hydrologic studies conducted to date indicate that minimum release of 3,000 c.f.s. between elevations 681 and 683 feet m.s.l. does not materially affect the Marshall Ford project capabilities to regulate larger inflows, although there are a few days' extension of the period that the pool level will be above elevation 681 feet m.s.l. To increase this zone up to elevation 685 feet m.s.l. would not be desirable at this time. Supporting studies to evaluate effects of such a change will be one of the alternatives studied in the development of the final regulation plan.

(4) Comments furnished by the Texas Water Rights Commission indicated their staff's concurrence in the proposed modified Flood Control Regulations for the Mansfield (Marshall Ford) Dam and Lake project. In addition, their staff made further comments expressing uncertainty concerning the total impacts resulting from the proposed operational change. Through misinterpretation, they concluded that the change in specification of the *minimum* release rate, whenever the Marshall Ford pool is between elevations 681 and 683 feet m.s.l., would increase the top of the power storage water elevation in Lake Travis. Consequently, the staff stated that the Lower Colorado River Authority should receive from the Texas Water Rights Commission amendments to its permit on Lake Travis (Permit No. 1260) as mandated by Section 5.1211 of the Texas Water Code. The staff also stated that assurances be given that the capacity between elevations 683.0 feet m.s.l. and 714.0 feet m.s.l. is reserved for flood control without further presumption of the need for other uses.

The current revision of the Flood Control Regulations, which were published in the FEDERAL REGISTER on 15 May 1951, does not change the flood control reservation in the Marshall Ford project. As in the previously published Regulation, this Regulation relates to the reservoir storage above elevation *681.0* m.s.l., which is reserved primarily for flood control purposes.

This interim Regulation does not change the flood control reservation in Marshall Ford reservoir. Thus, there is no need for the project owner or the designated operating agency to request amendments to Permit No. 1260 from the Commission.

For the reasons stated in the paragraph above and the specification of the flood control reservation through applicable Federal statutes which authorized the Secretary of the Interior to expend Federal funds for construction of the project and designate his agent to operate and maintain Marshall Ford Dam, the giving of further assurances is considered inappropriate. If significant reallocation of storage is considered desirable and recommended by a consensus of involved interests at some future date, a report of impacts will provide the basis for action by the Congress. Federal statutes prohibit the executive branch of the government from arbitrarily reallocating storage reserved for flood control and navigation without the expressed consent of Congress.

In revising the regulation plan by reducing the *minimum* release to 3,000 c.f.s. when the pool level is between elevations 681 and 683 feet m.s.l., the Corps of Engineers recognizes a minimum increase of about 2–3 days in time that the pool would reside within this range over that resulting from the present 5,000 c.f.s. minimum rate of release. However, note that this requirement specifies only the *minimum* release and that § 208.19 (h) states that the regulations for the operation of the flood control facilities at the project are subject to temporary modification in time of flood by the District Engineer (Fort Worth District) if found desirable on a basis of conditions at the time. Further, by § 208.19(g), the Lower Colorado River Authority is required to report specified data on storms, floods and project status at prescribed intervals to the District Engineer for the duration of flood surveillance and control operations. The purpose of these requirements is to permit the Corps of Engineers to monitor the flood control operations at the project in real-time to assure that the Regulation and Corps of Engineers provide satisfactory guidance to the operating agency, and that flood control effectiveness is maximized in the portion of the Colorado River basin influenced by the project.

(5) Ludlum & Ludlum, Attorneys-at-Law, furnished comments for their clients, the Sponberg-Price Group. The members of the Group are parties who own or live on and use waterfront property which adjoins or abuts Lake Travis. Their comments included the following items:

Modification of the required minimum release rate when the Marshall Ford pool is between elevations 681 and 683 feet m.s.l. from 5,000 c.f.s. to 3,000 c.f.s. Citing the basis for adopting of the lower minimum release rate (to coordinate the 3,000 c.f.s. rate with the turbine capacity of the Tom Miller Dam for maximizing the hydropower production from Mansfield Dam and Tom Miller Dam), the Group made the following statements in protest of the reduced minimum release rate:

> "That is not a primary flood control objective, but, to the contrary will have a deleterious effect on flood control."

The increased importance of conservation of nonrenewable energy sources required adoption of a plan of regulation with the objectives of obtaining more hydroelectric power benefits, without significantly lowering the level of protection from flood hazards. Studies show that evacuation of the lower zone of the flood water storage pool can be done in a manner advantageous to hydropower generation without appreciably compromising the present level of capability to reduce downstream inundation, nor significantly increase the frequency of filling of the flood water storage pool during moderate to large floods which originate upstream of the project. The duration of the flood water storage pool between elevations 681 and 683 m.s.l. may increase by a few days if the minimum release rate is strictly adhered to when there is little or no likelihood of prolonged or recurrent flooding in the basin.

Elimination of the requirement of release of flood water between elevations 681 and 691 feet m.s.l. within 30 days, subject to downstream conditions. The Group objects to this change. This requirement was initially included in the Regulation to permit a reasonable use of the intermediate storage, between elevation 681 and 691 feet m.s.l., for power. At the same time, it established a reasonable expectancy that an appreciable portion of the intermediate storage would be available in anticipation of floods. Application of the 30-day drawdown rule has, however, presented serious difficulties in real-time operation of the project. The beginning of the counting period is dependent upon the accuracy of the inflow estimates. Therefore, precise determination is not practical.

The Group suggested that the resolution of administrative mechanics of the rule application is easily remedied.

Their suggested method is dependent upon the forecast of daily inflow which is the case of experienced difficulty. In order to meet the objective of the rule, the operating agency must have a look-ahead capability for the succeeding 30 days, otherwise the release rate for the current day is not accurately determined. In real-time operation, this rule could require extreme daily fluctuation of the release rate and thereby subject the operating agency to severe criticism from downstream interests and involve management problems. Also, strict enforcement of the rule could result in unnecessary and wasteful spillage on the basis of expected rainfall and runoff conditions which may not materialize. This latter condition is a very real possibility with the present hydrometeorological network and communication systems within the basin, and the state-of-the-art of quantitative precipitation forecasting. Hopefully, improvements will evolve in these areas over time and some of the current difficulties of applying such a rule will diminish, resulting in greater efficiency in the use of this water resource and improve overall effectiveness of the project facilities for all purposes.

Addition of the Austin and Bastrop gaging stations as indices for determining total release rates from the Marshall Ford project. The Sponberg-Price Group noted this change in the Regulation for use of flood control storage, but withholds any comments at this time pending future circumstances.

The Austin and Bastrop stations were added to the now referenced Columbus control station to more accurately reflect potential damages along the entire river. Field reconnaissance and surveys indicate that there are hazards to property and to human life associated with flows approaching 30,000 c.f.s. at Austin gage. The maximum releases from the Marshall Ford project are coordinated with downstream river flows as determined at the specified index stations.

(b) *Revisions of proposed Regulation prior to promulgation.* (1) Correct first paragraph of existing regulations published in the FEDERAL REGISTER (Title 33, Part 208, § 208.19, page 4543, dated 16 May 1951) by inserting "Lake Travis" and "Mansfield" as shown.

(2) Change time of daily report by the Authority to the District Engineer in § 208.19(f) from "0800" to "0900" as shown.

(c) *Effective date:* These regulations are effective April 1, 1976.

Dated: March 1976.

ERNEST GRAVES,
Major General, USA,
Director of Civil Works.

Pursuant to the provisions of section 7 of the act of Congress approved December 22, 1944 (58 Stat. 890; 33 U.S.C. 709), the following regulations are hereby prescribed to govern the use of flood-control storage in the Lake Travis (Marshall Ford Reservoir) on the Colorado River, Texas, and the operation of the Mansfield (Marshall Ford) Dam for flood-control purposes. The reservoir storage above elevation 681.0 feet m.s.l. is expressly reserved primarily for flood-control purposes and regulations for the use of this storage are provided herein.

§ 208.19 Mansfield (Marshall Ford) Dam and (Reservoir) Lake Travis, Colorado River, Texas.

The Secretary of the Interior, through his agent, the Lower Colorado River Authority (referred to in this section as the Authority) shall operate the Mansfield Dam and Lake Travis (referred to in this section as the Project) in the interest of flood control as follows:

(a) At all times, Project releases shall be coordinated such that the Colorado River, Texas, will be controlled when possible, to remain below flood stages at downstream official U.S. Geological Survey (USGS) gaging stations; except that no curtailment of normal hydroelectric turbine releases shall result thereby at any time. Those USGS river stations and their control stages are as follows:

Station	Control stage (feet)	Equivalent cubic feet per second (ft³/s)
Austin (08158000)	20	30,000
Bastrop (08159500)	25	45,000
Columbus (08161000)	25	50,000

(b) During periods when the Project lake level is between elevation 681 and 691, the minimum total release from the Project shall be at the rates specified below, unless otherwise constrained by downstream conditions prescribed in paragraph (a) of this section.

Lake elevation (feet m.s.l.):	Release rate (c/s)
681–683	3,000
683–691	5,000

(c) Regardless of Project lake levels, if upstream inflows would otherwise result in that level rising above elevation 691, total release shall be increased, as necessary to delay as long as possible the lake level from exceeding elevation 691, such maximum releases to be constrained by downstream conditions, as specified in paragraph (a) of this section. Releases shall be controlled so that the lake level will not be drawn below 681 at the close of flood control operations, unless for the purpose of hydropower generation. The above stated upstream inflows will consider as a minimum those flows measured at upstream USGS gaging stations including:

Pedernales River near Johnson City (08153500).
Llano River at Llano (08151500).
Colorado River near San Saba (08147000).

(d) If excessive inflow results in the lake level rising above elevation 691, the combined controlled and uncontrolled releases from the Project shall be made at the maximum rate possible, subject to downstream conditions, as specified in paragraph (a) of this section, until the lake level falls to elevation 691, except that no curtailment of normal power releases shall result thereby.

(e) Releases made in accordance with the regulations of this section are subject to the condition that releases shall not be made at rates or in a manner that would be inconsistent with requirements for protecting the Project from major damage. Should the lake level exceed elevation 722 due to excessive rates of inflow, the Authority may utilize the capacity of the flood-control outlets in increasing the rate of discharge to the extent considered necessary for protecting the dam and appurtenances from major damage.

(f) The Authority shall furnish the District Engineer, Fort Worth District, U.S. Army Corps of Engineers, by 0900 hours daily, with the following:

(1) Project information.

(i) Lake elevations at midnight and 0800 hours.

(ii) Uncontrolled spillway, flood-control conduits, and turbine releases: Cubic feet per second at 0800 hours, and day-second-feet average for the previous 24 hours, ending at midnight.

(iii) Computed average inflow, in day-second-feet for the previous 24 hours, ending at midnight.

(iv) Total precipitation in inches for the previous 24 hours at the dam, ending at 0800 hours.

(v) Summary of streamflow and channel conditions at gages named in paragraphs (a) and (c) of this section.

(2) Lake Buchanan pool elevation at 0800 hours.

(g) Whenever flood conditions are imminent, or stages of 16 feet (20,000 cfs) or more at the Austin gage have been reached, the Authority shall report at once to the District Engineer by the fastest means of communications available. Data listed in paragraph (f) of this section shall be reported to, and at intervals prescribed by the District Engineer for the duration of flood surveillance and control operations.

(h) The regulations of this section for the operation of the flood-control facilities at the Project are subject to temporary modification in time of flood by the District Engineer if found desirable on a basis of conditions at the time.

(i) The Authority may temporarily deviate from the regulation of this section in the event an immediate short term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such action shall be immediately reported by the fastest means of communication available and confirmed in writing the same day to the Fort Worth District Engineer, including justification for the action. Continuation of the deviation will require the express approval of the District Engineer.

(Sec. 7, Pub. L. 78-534, 58 Stat. 890 (33 U.S.C. 709))

[FR Doc.76-10177 Filed 4-8-76;8:45 am]

~~Title 36—Parks, Forests, and Public~~ Property

CHAPTER I—NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR

PART 7—SPECIAL REGULATIONS, AREAS OF THE NATIONAL PARK SYSTEM

Assateague Island National Seashore, Maryland and Virginia; Operation of Oversand Vehicles

Notice is hereby given that pursuant to the authority contained in Section 3 of the Act of August 25, 1916 (39 Stat. 535, as amended; 16 U.S.C. 3); Section 6 of the Act of September 21, 1965 (79 Stat. 826; 16 U.S.C. 459f-5); 245 DM 1 (34 FR 13879) as amended; National Park Service Order No. 77 (38 FR 7478) as amended; and Regional Director, Mid-Atlantic Region Order No. 1 (39 FR 3694) as amended; 36 CFR § 7.65(b) is amended as set forth below.

The purposes of this amendment are to delete geographic references to Seashore lands which lie within the Chincoteague National Wildlife Refuge, to authorize the establishment of a system of special recreation permits and permit fees for oversand vehicles, to clarify standards in the existing regulation which are used to determine whether a vehicle qualifies for an oversand permit; and to incorporate in the regulation a previously unpublished restriction limiting the use of towed travel trailers on oversand routes.

The deletion of references to lands within the Chincoteague National Wildlife Refuge is a clarification necessary to comply with the requirements of recent legislation. Public Law 94-223 (90 Stat. 199) enacted February 27, 1976, requires that all lands, waters, and interests within areas of the National Wildlife Refuge System shall be administered by the Secretary of the Interior through the United States Fish and Wildlife Service. Accordingly, within Assateague Island National Seashore, the oversand vehicle regulation amended herein and other regulations contained in Parts 1 through 7 of Title 36, Code of Federal Regulations, apply only to lands and waters which are under the administration of the National Park Service. These regu~~lations are not applicable to the Chincoteague National Wildlife Refuge in Vir~~ginia and the Assateague State Park in Maryland. These areas are subject to the appropriate regulations of the U.S. Fish and Wildlife Service and the State of Maryland, respectively.

The specific changes in the existing oversand vehicle regulation which are necessary to clarify the applicability of the regulation are the deletion of paragraphs (i)(B) and (iii)(C) of § 7.65(b)(3) in their entirety and the deletion of certain other references to Maryland and/or Virginia in paragraphs (i), (iii), and (v) of § 7.65(b)(3).

The establishment of special recreation permits and special recreation permit fees is authorized by Section 4(b)(2) of the Land and Water Conservation Fund Act of 1965, as amended June 7, 1974 (88 Stat. 192-194; 16 U.S.C. A. 460l-6a (Supp. 1975)). Department of the Interior regulations implementing the 1974 amendment to the Land and Water Conservation Fund Act were published in the "Federal Register" on September 16, 1974 (39 FR 33217), after publication of the Assateague Island National Seashore regulation dealing with oversand vehicles on August 30, 1974 (39 FR 31633). The process of issuing annual permits for oversand vehicles and the establishment of fees for these permits is now being conformed to the applicable Departmental regulations (43 CFR Part 18) by deleting § 7.65(b)(2)(i) and (ii) in their entirety and adding a new § 7.65(b)(2)(i) which authorizes the Superintendent to establish a system of special recreation permits and permit fees for oversand vehicles, consistent with the conditions and criteria of 43 CFR § 18.10.

Former § 7.65(b)(2)(iii) is renumbered as § 7.65(b)(2)(ii) and revised by inserting a series of quantifying standards in § 7.65(2)(ii)(D) which will be used to determine whether a vehicle qualifies for an oversand permit within the meaning of the regulation.

The new § 7.65(b)(2)(ii) eliminates the old written permit application requirement and substitutes a one-step visual-inspection permit issuance process at the park entrance. Thus visitors arriving in the area need no longer apply to the Superintendent in writing and wait for mail delivery of their oversand permits.

A new sentence is also added to § 7.65 (b)(3)(iii)(B) which will restrict towed travel trailers, being used as self-contained vehicles, to the 5-mile-long designated off-road zone between the end of the public road south of Assateague State Park and the original self-contained vehicle parking area. Publication of the rule became necessary with the designation of a second self-contained overnight parking site in an area which is not suitable for use by towed vehicle.

It is the policy of the Department of the Interior, whenever practicable, to afford the public an opportunity to participate in the rulemaking process prior to implementation of a substantive change in regulations. In this instance, ~~however, it has been found that the proposed rulemaking process is impract~~icable because existing oversand vehicle permits for Assateague Island National Seashore expire on April 14, 1976. It is, therefore, essential to orderly management of this activity that these amendments be effective on April 15, 1976, so that new permits may be properly issued on and after that date. There is insufficient time to allow for the proposed rulemaking process in this instance, and, for the same reasons, these amendments are being made effective in less than the 30 days normally required in such actions. However, interested persons who wish to provide written comments on these amendments may do so by submitting them to the Superintendent, Assateague Island National Seashore, Route 2, Box 294, Berlin, Maryland 21811. Comments will be accepted through May 15, 1976. Any comments received will be considered for the purpose of determining the desirability or need for making further amendments to this regulation.

Effective date: These amendments shall be effective on April 15, 1976.

Section 7.65 of Title 36, Code of Federal Regulations is amended as follows:

Former § 7.65(b)(2)(iii) is renumbered as § 7.65(b)(2)(ii) and revised by inserting a series of quantifying standards in § 7.65(b)(2)(ii)(D) which will be used to determine whether a vehicle qualifies for an oversand permit within the meaning of the regulation.

§ 7.65 Assateague Island National Seashore.

* * * * *

(b) *Operation of oversand vehicles.*

* * * * *

(2) *Oversand permits.* * * *

(i) The Superintendent is authorized to establish a system of special recreation permits for oversand vehicles and to establish special recreation permit fees for these permits, consistent with the conditions and criteria of 43 CFR § 18.10.

(ii) No permit will be issued for a vehicle:

* * * * *

(D) Which does not meet the following standards: On four-wheel-drive vehicles and trailers towed by any vehicle:

	Per unit
Maximum vehicle length	26 ft.
Maximum vehicle width	8 ft.
Minimum vehicle ground clearance	7 in.
Gross vehicle weight rating may not exceed	10,000 lb.
Maximum number of axles	2
Maximum number of wheels (per axle)	2

On two-wheel-drive vehicles, in addition to the six items listed immediately above: Minimum width of tire tread contact on sand, 8 in. each wheel. Tires with regular mud/snow grip tread, not acceptable. *Provided,* That the Superintendent may issue a single trip permit for a vehicle of greater weight or length when such use is not inconsistent with ~~the purposes of this regulation.~~

Exhibit L

EXHIBIT L

Federal Register

(44 FR 24551, 26 April 1979)

DEPARTMENT OF DEFENSE

Corps of Engineers, Department of the Army

33 CFR Part 208

Flood Control Regulations; Marshall Ford Dam and Reservoir, Colorado River, Tex.

AGENCY: U.S. Army Corps of Engineers, DoD.

ACTION: Final rule.

SUMMARY: On 9 April 1976 interim regulations were published in the Federal Register (41 FR 15005) to permit time for completion of detailed studies. Upon completion of a hydrologic computer model of the Colorado River Basin, the operation of thirteen of the major lakes of the basin were simulated using the historical streamflow records for the forty-five year period from 1 January 1930 through 31 December 1974. From this simulation study, the results of 14 different regulation plans for Marshall Ford Dam and Reservoir were presented by the District Engineer at a public meeting held in Austin, Texas, on 5 January 1978. As a result of comments received at that meeting plus subsequent workshops and technical meetings, additional regulation plans were analyzed, resulting in the development and presentation of the revised plan at a second public meeting in Austin, Texas, on 19 December 1978. The revised plan will result in a significant increase in overall flood protection without a significant decrease in the generation of hydroelectric energy. The revised regulation plan also meets current downstream water supply demands, will lower the 1% floodplain elevations both in the reservoir and downstream through Austin area, and will not have a significant adverse impact on the environment. This revised regulation plan is jointly supported by the Corps of Engineers, the Bureau of Reclamation, and the Lower Colorado River Authority.

EFFECTIVE DATE: This revision of Section 208.19 becomes effective on May 29, 1979.

ADDRESSES: HQDA (DAEN-CWE-HY) Washington, D.C. 20314.

FOR FURTHER INFORMATION CONTACT: Mr. Edgar P. Story, Engineering Division, Civil Works Directorate, Office of the Chief of Engineers, Washington, D.C. 20314 (202-693-7330).

Note.—The Chief of Engineers has determined that this rule does not contain a major proposal requiring preparation of an Inflation Impactment Statement under Executive Order 11821 and OMB (Circular A-107) (Statutory Authority Pub. L. 90-483).

SUPPLEMENTARY INFORMATION: Recognizing that increased urban development has occurred both within the reservoir area and downstream of the project, major factors considered in the derivation of the proposed plan included:

(a) The importance of hydroelectric power generation.

(b) The seasonal nature of floods in the Colorado River Basin.

(c) The ability to meet downstream water demands.

(d) An equitable balance of flood damage risks between upstream and downstream property owners.

(e) A preliminary environmental impact assessment of the flood regulation plan.

(f) The current ability to adequately forecast floods consistent with austere funding limitations and the current state-of-the-art technical developments.

(g) A coincident probability analysis of the 1% flood.

(h) The public input received in response to the public meeting and workshops.

The overall changes from the 1976 interim plan of regulation are as follows:

(a) Release rates shall continue to be 3,000 c.f.s. when the pool elevation is forecast to be between elevation 681 and 683 feet, m.s.l. and 5,000 c.f.s. when the pool elevation is forecast to be higher than elevation 683 feet, m.s.l., but less than 685 feet, m.s.l. When the pool elevation is forecast to be between 685 and 691 feet, m.s.l. a seasonal plan of regulation shall be followed: During the months of May, June, September, and October, the coordinated release rate shall be increased to the maximum amount which, when combined with local flows below the dam, does not exceed 30,000 c.f.s. (2[illegible].5 feet) at the Austin USGS gage, 45,000 c.f.s. (25.1 feet) at the Bastrop USGS gage, or 50,000 c.f.s. (25.5 feet) at the Columbus USGS gage. During the months of January through April, July, August, November, and December the release rate shall be 5,000 c.f.s.

(b) If conditions are such that the reservoir elevation is forecast to exceed elevation 710 feet, m.s.l. but not 714 (top of flood control pool) feet, m.s.l., the coordinated releases, when combined with downstream local flows, will not exceed the downstream control stage of 24.8 feet (50,000 c.f.s.) at the USGS gaging station at Austin.

(c) If the reservoir elevation is forecast to exceed elevation 714 feet, m.s.l. but not 722 feet, m.s.l. the rate of release shall not exceed the associated peak flood inflows into the reservoir or 90,000 c.f.s., whichever is the lesser. As the actual lake level exceeds elevation 714 feet, m.s.l., the Bureau of Reclamation assumes responsibility for determining releases to protect the safety of the structure.

Use of revised regulations prior to promulgation: The revised regulation will be used in the event of a flood in the Colorado River Basin which requires flood control regulation at Marshall Ford Dam, in lieu of the interim regulation plan of 1 April 1976.

Effective date: This revision of Section 208.19 becomes effective on May 29, 1979.

Dated: April 17, 1979.

Charles I. McGinnis,

Major General, USA, Director of Civil Works.

Accordingly, 33 CFR 208 is amended by revising Section 208.19 as set forth below.

§ 208.19 Marshall Ford Dam and Reservoir (Mansfield Dam and Lake Travis), Colorado River, Tex.

The Secretary of the Interior, through his agent, the Lower Colorado River Authority (LCRA) shall operate the Marshall Ford Dam and Reservoir in the interest of flood control as follows:

(a) *Water Control Plan*—(1) *General objectives.* The objectives of the Marshall Ford Reservoir (Lake Travis) are the improvement of navigation, flood control, stream regulation, generation of power, irrigation, water supply, and recreation uses.

(2) *Overall plan for water control.* Within the Colorado River Basin, four Federal projects provide flood control protection: Twin Buttes, O. C. Fisher, Hords Creek, Marshall Ford Reservoir. The considerable distance (328 river miles) and large intervening area (19,990 square miles) separating Marshall Ford Reservoir and the three upper basin flood-control projects prevent realizing any significant benefits from coordinating releases to control the inflow into Marshall Ford. Marshall Ford Reservoir is the fifth project in a tandem of six lakes operated and controlled by the Lower Colorado River Authority for the generation of hydroelectric power. These six projects in downstream order are: Lake Buchanan, Lake Inks, Lake Lyndon B. Johnson (Alvin Wirtz Dam), Lake Marble Falls (Max Starcke Dam), Marshall Ford Reservoir (Lake Travis and Mansfield Dam) and Lake Austin (Tom Miller Dam). The releases from each of the six projects are closely coordinated by the LCRA System Operation Control Center. Three of the projects (Lake Inks, Lake Marble Falls, and Lake Austin) are run-of-the-river projects. The capabiity of the four upstream lakes to control the inflow of flood water into Marshall Ford depends on their antecedent lake elevations. The majority of inflows to Marshall Ford are comprised of the mainstream flows of the Colorado River, the tributary flows of the Llano River (entering the Colorado River between Lakes Inks and Lyndon B. Johnson) and the unregulated tributary flows of the Pedernales River (entering between Lake Marble Falls and Marshall Ford Reservoir). During flood conditions, the following upstream U.S. Geological Survey gaging stations are used as indicators of the magnitude of the inflows to Marshall Ford Reservoir:

(i) Colorado River near San Saba (08147000).

(ii) Pedernales River near Johnson City (08153500).

(iii) Llano River at Llano (08151500).

(3) *Standing instructions to dam tender.* During normal conditions, the dam tender will regulate the project in accordance with instructions received from the LCRA System Operator. During flood conditions, when the Marshall Ford Reservoir level is within the flood control zone, the LCRA System Operator will regulate the project in accordance with instructions received from the Corps of Engineers. In the event of a communication outage, the LCRA System Operator will rely on the Emergency Release Schedule, to make changes in the rate of releases from the lake.

(4) *Flood control regulation*—(i) *General.* At all times, releases shall be coordinated such that the Colorado River, Texas, will be controlled when possible, to remain below control stages at downstream official U.S. Geological Survey (USGS) gaging stations; except that no curtailment of normal hydroelectric turbine releases shall result thereby at any time. The USGS river stations and their control stages are as follows:

KEY DOWNSTREAM CONTROL POINTS

Station	Control stage (feet)	Equivalent cubic feet per second (c.f.s.)
Austin (08158000)	20.5	30,000
	[1] 24.8	[1] 50,000
Bastrop (08159200)	25.1	45,000
	[1] 26.7	[1] 50,000
Columbus (08161000)	25.5	50,000

[1] Control stage when elevation 710 is forecast to be exceeded.

Forecasted reservoir inflows and the upstream USGS gaging stations Pedernales River near Johnson City (08153500), Llano River at Llano (08151500), and Colorado River near San Saba (08147000) will be considered when scheduling flood releases.

(ii) *Flood control release schedule.* Marshall Ford will be regulated to reduce flooding on the Colorado River below the dam. This plan of regulation will govern flood control releases from Marshall Ford Dam as follows:

(A) *Elevation 681-683.* If the reservoir level is forecast to rise above elevation 681 feet, m.s.l. (top of conservation pool) but not to exceed elevation 683 feet, m.s.l., the releases shall be increased to 3,000 c.f.s. and maintained until the reservoir level recedes to elevation 681 feet, m.s.l. These release rates may need to be reduced due to excessive downstream runoff to prevent exceeding the control stages specified in paragraph (a)(4)(i) of this section.

(B) *Elevation 683-685.* If the reservoir elevation is forecast to rise above elevation 683 feet, m.s.l. but not to exceed elevation 685 the releases shall be increased to 5,000 c.f.s. and maintained until the reservoir level recedes below 683 feet, m.s.l. These release rates may need to be reduced due to excessive downstream runoff to prevent exceeding the control stages specified in paragraph (a)(4)(i) of this section.

(C) *Elevation 685-691.* Seasonal. (*1*) During the months of January through April, July through August, and November through December: If the reservoir elevation is forecast to rise above elevation 685 feet, m.s.l. but not to exceed elevation 691, the releases shall be increased to 5,000 c.f.s. and maintained until the reservoir level recedes below 683 feet, m.s.l. These release rates may need to be reduced due to excessive downstream runoff to prevent exceeding the control stages specified in paragraph (a)(4)(i) of this section.

(*2*) During the months of May, June, September, and October: Should the reservoir elevation be forecast to exceed 685 feet, m.s.l. but not to exceed elevation 691 feet, m.s.l: Releases will be made at 30,000 c.f.s. from the project or at a rate such that, when combined with local inflows below the dam, will equal but not exceed downstream control stages on the Colorado River as specified in paragraph (a)(4)(i) of this section. These release rates will be maintained until the reservoir level falls below elevation 685 feet, m.s.l.

(D) *Elevation 691-710.* Should the reservoir elevation be forecast to exceed 691 feet, m.s.l. (the top of the joint use pool) but not to exceed elevation 710 feet, m.s.l: Releases will be made at 30,000 c.f.s. from the project or at a rate such that, when combined with local inflows below the dam, will equal but not exceed downstream control stages on the Colorado River as specified in paragraph (a)(4)(i) of this section. These release rates will be so controlled until the reservoir level falls below elevation 691 feet, m.s.l.

(E) *Elevation 710-714.* If the reservoir level is forecast to exceed 710 feet, m.s.l. but not to exceed elevation 714 feet, m.s.l: Releases will be made at 50,000 c.f.s. from the project or at a rate such that, when combined with local inflows below the dam, will equal but not exceed the downstream control stages on the Colorado River as specified in paragraph (a)(4)(i) of this section. These release rates will be maintained until the reservoir level falls below elevation 710 feet, m.s.l.

(F) *Elevation 714-722.* If the reservoir level is forecast to exceed 714 feet, m.s.l. but not to exceed 722 feet, m.s.l: Releases will be made at 90,000 c.f.s. from the project. Releases shall not exceed the associated peak flood reservoir inflow.

(G) *Elevation 722 and above.* If the reservoir level is forecast to exceed elevation 722 feet, m.s.l., the Bureau of Reclamation will schedule releases as required for the safety of the structure.

(iii) *Normal flood control regulation schedule.* The following table, Flood Control Regulation Schedule, summarizes the flood control releases schedule for given reservoir levels and river conditions:

Marshall Ford Dam and Reservoir Normal Flood Control Regulation Schedule

Condition	Reservoir level	Flood control release	Control points
Pool Rising	Forecast: 681–683 [1]	3,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Rising	Forecast: 683–685	5,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Rising	Forecast: 685–691: (a) During January, February, March, April, July, August, November, December.	5,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
	(b) During May, June, September, October.	30,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Rising	Forecast: 691–710	30,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Rising	Forecast: 710–714	50,000 c.f.s	50,000 c.f.s. (24.8 ft.) at Austin. 50,000 c.f.s. (26.7 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Rising	Forecast: 714–722 [2]	90,000 c.f.s	No controls.
Pool Rising	Forecast: above 722	The Bureau of Reclamation will specify the releases for safety of the structure.	
Pool Falling	Above 722	The Bureau of Reclamation will specify the releases for safety of the structure.	
Pool Falling	722–714 [2]	90,000 c.f.s	No controls.
Pool Falling	714–710	50,000 c.f.s	50,000 c.f.s. (24.8 ft.) at Austin. 50,000 c.f.s. (26.7 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Falling	710–691	30,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Falling	691–685: (a) During May, June, September, October.	30,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
	(b) During January, February, March, April, July, August, November, December.	5,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Falling	685–683	5,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.
Pool Falling	683–681	3,000 c.f.s	30,000 c.f.s. (20.5 ft.) at Austin. 45,000 c.f.s. (25.1 ft.) at Bastrop. 50,000 c.f.s. (25.5 ft.) at Columbus.

[1] During flood conditions, when the reservoir level is below elevation 681 ft., m.s.l., the Corps of Engineers will provide recommendations to the Lower Colorado River Authority on flood control releases.

[2] Releases shall not exceed the associated peak flood reservoir inflow.

NOTE: No curtailment of normal hydroelectric turbine releases shall be required due to flood control operations.

(5) *Deviation from normal regulation.* (i) There are occasions when it is necessary or desirable to deviate from the water control plan for short periods of time as indicated in the following paragraphs:

(A) The water control plan is subject to temporary modification by the Corps of Engineers, if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the project owner and shall include justification for the action.

(B) The project owner may temporarily deviate from the water control plan in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Chief of Engineers, or his duly authorized representative.

(C) Advance approval of the Chief of Engineers, or this duly authorized representative, is required prior to any deviation from the plan of regulation prescribed or approved by the Corps of Engineers in the interest of flood control and/or navigation, except in emergency situations provided for in paragraph (a)(5(i))(B) of this section. When conditions appear to warrant a prolonged deviation from the approved plan, the project owner and the Corps of Engineers will jointly investigate and evaluate the proposed deviation to insure that the overall intergrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Chief of Engineers, or his designated representative, to fully substantiate the deviations.

(ii) The Fort Worth District Corps of Engineers will serve as the LCRA contact point for any deviation from or modification of the water control plan. The communication network will be described in the Water Control Manual. The Fort Worth District will notify the Division Engineer, Southwestern Division, Corps of Engineers of any deviations or modifications of the water control plan and request his approval. The Division Engineer has been designated as the authorized representative of the Chief of Engineers in matters relating to projects within the Southwestern Division which are subject to provisions of Section 7 of the 1944 Flood Control Act.

(b) *Reports to the Corps of Engineers.* (1) The Authority shall furnish the District Engineer, Fort Worth District, U.S. Army Corps of Engineers, by 0900 hours daily, with the following:

(i) Project information.

(A) Lake elevations at midnight and 0800 hours.

(B) Uncontrolled spillway, flood-control conduits, and turbine releases: Cubic feet per second at 0800 hours, and day-second-feet average for the previous 24 hours, ending at midnight.

(C) Computed average inflow, in day-second-feet for the previous 24 hours, ending at midnight.

(D) Total precipitation in inches for the previous 24 hours at the dam, ending at 0800 hours.

(E) Summary of streamflow and channel conditions at gages named in paragraphs (a)(2) and (a)(4)(i) of this section.

(ii) Lake Buchanan Pool elevation at 0800 hours.

(2) Whenever flood conditions are imminent, or stages of 16 feet (20,000 c.f.s.) or more at the Austin gage have been reached, the Authority shall report at once to the District Engineer by the fastest means of communications available. Data listed in paragraph (b)(1) of this section shall be reported to, and at intervals prescribed by the District Engineer for the duration of flood surveillance and control operations.

(Sec. 7, Pub. L. 78-534, 58 Stat. 890 (33 U.S.C. 709))

[44 FR 24552, Apr. 26, 1979; 44 FR 29050, May 18, 1979]

~~§ 208.22 Twin Buttes Dam and Reservoir,~~ Middle and South Concho Rivers, Tex.

The Bureau of Reclamation, or its designated agent, shall operate the Twin Buttes Dam and Reservoir in the interest of flood control as follows:

(a) Whenever the Twin Buttes Reservoir level is between elevations 1,940.2 (top of conservation pool) and elevation 1,969.1 (top of flood control pool) the flood control discharge facilities shall be operated under the direction of the District Engineer, Corps of Engineers, Department of the Army, in charge of the locality, so as to reduce as much as practicable the flood damage below the reservoir. All flood control releases shall be made in amounts which, when combined with releases from San Angelo Reservoir on the North Concho River and local inflow below the dam, will not produce flows in excess of bankful capacities on the South Concho and Concho ~~Rivers downstream of the reservoir. In~~

Exhibit M

EXHIBIT M

STANDING INSTRUCTIONS TO DAM TENDER

MANSFIELD DAM

2012 Proposed Revisions
Draft No. 4
CEWSF-EC-H

EXHIBIT M
STANDING INSTRUCTIONS TO DAM TENDER
MANSFIELD DAM

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EXHIBIT M
STANDING INSTRUCTIONS TO DAM TENDER
MANSFIELD DAM

I - GENERAL

1. Instructions. Detailed flood control regulation instructions to the personnel at Mansfield Dam are presented below.

a. Regulation. During normal flood control operations the lake will be regulated in accordance with the normal flood control regulations as described in Chapter VII of the current Water Control Manual. Instructions for the storage and discharge of water will be issued in the following manner:

1. When the lake level is below elevation 681.0, the dam tender will regulate the project in accordance with instructions from the Lower Colorado River Authority's (LCRA) River Operations Control Center (ROCC) and Hydro Operations Control Center (HOCC).

2. When the lake level is between elevation 681.0 and elevation 714.0, or is forecast to peak between elevation 714.0 and elevation 722.0, the LCRA-ROCC will instruct the dam tender in accordance with the normal flood control regulations as described in Chapter VII of the current Water Control manual. The normal flood control regulations for given reservoir levels and downstream river conditions are summarized in Table 7-2 and illustrated on Plate 7-1.

3. In the event the lake level actually rises above elevation 714.0, or is forecast to exceed elevation 722.0, the LCRA will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure to the maximum extent practicable. The LCRA-ROCC will instruct the dam tender in accordance with release decisions made by LCRA.

b. Data Reporting. Routine reporting of the following measurements pertinent to the dam and reservoir operation shall be made to the LCRA-ROCC and relayed to the Corps of Engineers.

1. Reservoir Surface Elevation and Tailrace Elevation. The reservoir surface elevation and the tailrace elevation are read from dials located on the main control board in the powerhouse operating room. The elevations are read and recorded hourly by the power plant operators. Readings are reported hourly when the reservoir level is rising.

2. Reservoir Outflow. Reservoir outflow through the turbines is recorded hourly on form PS1011 by the power plant operators and is reported at

midnight, giving hourly average outflow for the previous 24 hours. If floodgate operations occurred during the reporting period, the time each floodgate was opened or closed is also reported.

3. Weather. The minimum and maximum temperature, precipitation, evaporation, wind, and atmospheric conditions are recorded daily by the power plant operators. Rainfall and evaporation are reported at 8:00 a.m. daily to the LCRA-ROCC and also to the National Weather Service (NWS) in Austin.

c. Reporting Unusual Events. Events or conditions not normally encountered in the routine operation of the dam and reservoir which might endanger the dam or necessitate temporary or permanent revision of the operating procedures shall be promptly reported to the LCRA HOCC and ROCC. Any changes to the outlet works or spillway including structural settlement, movement, cracking, or vibration; mechanical malfunction or failure shall be reported immediately to the HOCC and ROCC. Settlement, movement, or cracking of the embankment or abutments; unusual change in seepage rates or development of new seepage areas; landslides, rockslides, or indications of an impending movement should also be reported to the HOCC and ROCC. The reporting of the above mentioned situations will be relayed to the Corps of Engineers Fort Worth District Water Management Section. Reference the LCRA's current Highland Lakes Operating Guidelines should an event occur indicating any degree of jeopardy to the safety of the dam or to the safety of the public. Such an event shall be reported promptly to the LCRA management.

2. Public Notifications. The respective Public Affairs Offices of the Corps of Engineers and LCRA are responsible for press releases to the news media and general public regarding hydrologic situations during flood events.

3. Gate Changes. During low flow operations the releases will generally be made through the turbines. When required releases exceed turbine release capacity; gate changes will be directed by the LCRA-ROCC. Gate changes may be required frequently and at any time. The gates will be operated in a manner prescribed by the manufacturer and will be operated either fully open or fully closed, with the exception of the single partial-flow valve gate. When the pool level is falling and approaching elevation 685.0, the gate releases will normally be tapered down so the remainder of the flood water can be used to generate hydropower. A complete log of all conduit gate operations will be maintained at each conduit gate.

II – REGULATION PROCEDURES

1. Normal Regulation. Under normal procedures, instructions for storage and release of water will be issued by the LCRA. The implementations of the instructions are to be confirmed back to the LCRA Control Center (ROCC or

HOCC) from which the instructions were issued as soon as the required action is completed.

2. Emergency Regulation. In the event of potential flooding or other emergencies during disruption of the usual communication methods, the media and local law enforcement agencies should be contacted to assist in warning the public in downstream areas. Appropriate law enforcement officials and others concerned should occasionally be afforded the opportunity to review the structure and observe the downstream conditions and facilities so that contingency plans can be developed for evacuation of the downstream area in an emergency. The Flood Operations section of the *LCRA Highland Lakes Operating Guidelines* contains detailed instructions and procedures to be followed by LCRA personnel at the Mansfield Dam, power plant, and reservoir to aid the project dam tender during an emergency situation.

a. During Loss of Communication. Should communications with the LCRA-ROCC and the Corps of Engineers Fort Worth District be disrupted, the Dam Tender will, on his own initiative, direct the regulation of the dam. The dam tender will rely on the Emergency Flood Control Regulation Schedule as presented in Table M-1 to govern the flood control releases from Mansfield Dam until communications are restored. The Emergency Flood Control Regulation Schedule summarizes the emergency flood control releases for given reservoir levels and conditions.

b. During Emergency Events. Whenever a natural or unnatural incident is imminent or has happened, that threatens the effective operation or structural integrity of the dam or in any way produces a hazard to the public, prompt and effective action is paramount. Operating personnel should immediately take all possible precautionary and protective measures. The dam tender may temporarily deviate from the water control plan in the event an immediate short-term departure is necessary for emergency reasons to protect the safety of the dam, or to avoid serious hazards. Such actions shall be reported as soon as reasonably practicable. Actions shall be confirmed in writing as soon as practicable to the Corps of Engineers Fort Worth District Water Resources Branch and shall include justification for the action. Continuation of the deviation will require the express approval of the Corps of Engineers Southwestern Division Commander, or his duly authorized representative.

TABLE M-1
MANSFIELD DAM - EMERGENCY FLOOD CONTROL REGULATION SCHEDULE

Pool Elevation (ft.)	Pool Condition	Operations
Below 691	Rising, Standing, or Falling	If the Dam Tender has knowledge of significant rainfall or pending flood conditions on the Colorado River downstream of the dam, stop all releases. Otherwise, continue to make releases as previously instructed.
691 - 710	Rising Standing or Falling	Release 6,000 cfs Release 3,000 cfs
710 - 714	Rising Standing or Falling	Release 30,000 cfs Release 6,000 cfs
714 - 722	Rising, Standing, or Falling	Release 90,000 cfs
Above 722	Rising, Standing, or Falling	All conduit gates full open.

Exhibit N

CECW-EH-W Engineer Regulation 1110-2-241	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1110-2-241 24 May 1990
	Engineering and Design USE OF STORAGE ALLOCATED FOR FLOOD CONTROL AND NAVIGATION AT NON-CORPS PROJECTS	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

DEPARTMENT OF THE ARMY
U. S. Army Corps of Engineers
Washington, D. C. 20314-1000

ER 1110-2-241
33 CFR Part 208
Sec 208.11

CECW-EH-W

Regulation
No. 1110-2-241

24 May 1990

Engineering and Design
USE OF STORAGE ALLOCATED FOR FLOOD CONTROL
AND NAVIGATION AT NON-CORPS PROJECTS

1. Purpose. This regulation prescribes the responsibilities and general procedures for regulating reservoir projects for flood control or navigation and the use of storage allocated for such purposes. Excepted projects are those owned and operated by the Corps of Engineers; the International Boundary and Water Commission, United States and Mexico; and those under the jurisdiction of the International Joint Commission, United States and Canada, and the Columbia River Treaty. The intent of this regulation is to establish an understanding between project owners, operating agencies and the Corps of Engineers.

2. Applicability. This regulation applies to HQUSACE/OCE elements, major subordiante commands, districts, laboratories, and field operating activities (FOA) having Civil Works responsibilities.

3. References.

a. Section 7 of the Flood Control Act approved 22 December 1944 (58 Stat. 890; U.S.C. 709).

b. Section 9 of Public Law 43-83d Congress (68 Stat. 303).

c. The Federal Power Act, approved 10 June 1920, as amended (41 Stat. 1063; 16 U.S.C. 791(a)).

d. The Fish and Wildlife Coordination Act of 1958, Public Law 85-624.

e. The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500 (86 Stat. 816, 33 U.S.C. 1251).

f. The Federal Power Commission Order No. 540, issued 31 October 1975 and published 7 November 1975 (40 FR 51998), amending Section 2.9 of the Commission's General Policy and Interpretations prescribing Standardized Conditions (Forms) for Inclusion in Preliminary Permits and Licenses Issued under Part I of the Federal Power Act.

g. ER 1110-2-240

This regulation supercedes ER-1110-2-241, 8 December 1978

4. Responsibilities. The basic responsibilities of the Corps of Engineers regarding project operation are set out in the cited authority and described in the following paragraphs:

a. Section 7 of the Flood Control Act of 1944 (58 Stat. 890, 33 U.S.C. 709) directs the Secretary of the Army to prescribe regulations for flood control and navigation in the following manner:

"Hereafter, it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations: Provided, that this section shall not apply to the Tennessee Valley Authority, except that in case of danger from floods on the lower Ohio and Mississippi Rivers the Tennessee Valley Authority is directed to regulate the release of water from the Tennessee River into the Ohio River in the release of water from the Tennessee River into the Ohio River in accordance with such instructions as may be issued by the War Department."

b. Section 9 of Public Law 436-83d Congress (68 Stat. 303) provides for the development of the Coosa River, Alabama and Georgia, and directs the Secretary of the Army to prescribe rules and regulations for project operation in the interest of flood control and navigation as follows:

"The operation and maintenance of the dams shall be subject to reasonable rules and regulations of the Secretary of the Army in the interest of flood control and navigation."

NOTE. - This Regulation will also be applicable to dam and reservoir projects operated under provisions of future legislative acts wherein the Secretary of the Army is directed to prescribe rules and regulations in the interest of flood control and navigation. The Chief of Engineers, U.S. Army Corps of Engineers, is designated the duly authorized representative of the Secretary of the Army to exercise the authority set out in the Congressional Acts. This Regulation will normally be implemented by letters of understanding between the Corps of Engineers and project owner and will incorporate the provisions of such letters of understanding prior to the time construction renders the project capable of significant impoundment of water. A water control agreement signed by both parties will follow when deliberate impoundment first begins or at such time as the responsibilities of any Corps-owned projects may be transferred to another entity. Promulgation of this Regulation for a given project will occur at such time as the name of the project appears in the Federal Register in accordance with the requirements of paragraph 6k. When agreement on a water control plan cannot be reached between the Corps and the project owner after coordination with all interested parties, the project name will be entered in the Federal Register and the Corps of Engineers plan will be the official water control plan until such time as differences can be resolved.

c. Federal Energy Regulatory Commission (FERC), formerly Federal Power Commission (FPC), Licenses.

(1) Responsibilities of the Secretary of the Army and/or the Chief of Engineers in FERC licensing actions are set forth in reference 3c above and pertinent sections are cited herein. The Commission may further stipulate as a licensing conditions, that a licensee enter into an agreement with the Department of the Army providing for operation of the project during flood times, in accordance with rules and regulations prescribed by the Secretary of the Army.

(a) Section 4(e) of the Federal Power Act requires approval by the Chief of Engineers and the Secretary of the Army of plans of dams or other structures affecting the navigable capacity of any navigable waters of the Unites States, prior to issuance of a license by the Commission as follows:

"The Commission is hereby authorized and empowered to issue licenses to citizens...for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary or convenient for the development and improvement of navigation and for the development, transmission, and utilization of power across, along, from or in any of the streams or other bodies of water over which Congress has jurisdiction . . . Provided further, that no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of the Army."

(b) Sections 10(a) and 10(c) of the Federal Power Act specify conditions of project licenses including the following:

Section 10(a). "That the project adopted . . . shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, and for other beneficial public uses . . . ."

Section 10(c). "That the licensee shall . . . so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the Commission may from time to time prescribe for the protection of life, health, and property . . . ."

(c) Section 18 of the Federal Power Act directs the operation of any navigation facilities built under the provision of that Act, be controlled by rules and regulations prescribed by the Secretary of the Army as follows:

"The operation of any navigation facilities which many be constructed as part of or in connection with any dam or diversion structure built under the provisions of this Act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation; including the control of the pool caused by such dam or diversion structure as may be made from time to time by the Secretary of the Army, . . . "

(2) Federal Power Commission Order No. 540 issued 31 October 1975 and published 7 November 1975 (40 FR 51998), amending Section 2.9 of the Commission's General Policy and Interpretations prescribed Standardized Conditions (Forms) for Inclusion in Preliminary Permits and Licenses Issued Under Part I of the Federal Power Act. As an example, Article 12 of Standard Form L-3, titled: "Terms and Conditions of License for Constructed Major Projects Affecting Navigable Waters of the United States," sets forth the Commission's interpretation of appropriate sections of the Act, which deal with navigation aspects, and attendant responsibilities of the Secretary of the Army in licensing actions as follows:

"The United States specifically retains and safeguards to the right to use water in such amount, to be determined by the Secretary of the Army, as may be necessary for the purposes of navigation on the navigable waterway affected; and the operations of the Licensee, so far as they affect the use, storage and discharge from storage of waters affected by the license, shall at all times be controlled by such reasonable rules and regulations as the Secretary of the Army may prescribe in the interest of navigation, and as the Commission may prescribe for the protection of life, health, and property, . . . and the Licensee shall release water from the project reservoir at such rate . . . as the Secretary of the Army may prescribe in the interest of navigation, or as the Commission may prescribe for the other purposes hereinbefore mentioned."

5. Scope and Terminology. This regulation applies to Federal authorized flood control and/or navigation storage projects, and to non-Federal projects which require the Secretary of the Army to prescribe regulations as a condition of the license, permit or legislation, during the planning, design and construction phases, and throughout the life of the project. In compliance with the authority cited above, this regulation defines certain activities and responsibilities concerning water control management throughout the nation in the interest of flood control and navigation. In carrying out the conditions of this regulation, the owner and/or operating agency will comply with applicable provisions of Public Law 85-624, the Fish and Wildlife Coordination Act of 1958, and Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972. This regulation does not apply to local flood protection works governed by 33 Code of Federal Regulations (CFR) Part 208.10, or to navigation facilities and associated structures which are otherwise covered by 33 CFR Part 207 (Navigation Regulations). Small reservoirs, containing less than 12,500 acre-feet of flood control or navigation storage, may be excluded from this regulation and covered under 33 CFR Part 208.10, unless specifically required by law or conditions of the license or permit.

a. The terms "reservoir" and "project" as used herein include all water resource impoundment projects constructed or modified, including natural lakes, that are subject to this regulation.

b. The term "project owner" refers to the entity responsible for maintenance, physical operation, and safety of the project, and for carrying out the water control plan in the interest of flood control and/or navigation as prescribed by the Corps of Engineers. Special arrangements may be made by the project owner for "operating agencies" to perform these tasks.

c. The term "letter of understanding" as used herein includes statements which consummate this regulation for any given project and define the general provisions or conditions of the local sponsor, or owner, cooperation agreed to in the authorizing legislative document, and the requirements for compliance with Section 7 of the 1944 Flood Control Act, the Federal Power Act or other special Congressional Act. This information will be specified in the water control plan and manual. The letter of understanding will be signed by a duly authorized representative of the Chief of Engineers and the project owner. A "field working agreement" may be substituted for a letter of understanding, provided that the specified minimum requirements of the latter, as stated above, are met.

d. The term "water control agreement" refers to a compilation of water control criteria, guidelines, diagrams, release schedules, rule curves and specifications that basically govern the use of reservoir storage space allocated for flood control or navigation and/or release functions of a water control project for these purposes. In general, they indicate controlling or limiting rates of discharge and storage space required for flood control and/or navigation, based on the runoff potential during various seasons of the year.

e. For the purpose of this regulation, the term "water control plan" is limited to the plan of regulation for a water resources project in the interest of flood control and/or navigation. The water control plan must conform with proposed allocations of storage capacity and downstream conditions or other requirements to meet all functional objectives of the particular project, acting separately or in combination with other projects in a system.

f. The term "real-time" denotes the processing of current information or data in a sufficiently timely manner to influence a physical response in the system being monitored and controlled. As used herein the term includes information the analyses for and execution of water control decisions for both minor and major flood events and for navigation, based on prevailing hydrometeorological and other conditions and constraints, to achieve efficient management of water resource systems.

6. Procedures.

a. Conditions during Project Formulation. During the planning and design phases, the project owner should consult with the Corps of Engineers regarding the quantity and value of space to reserve in the reservoir for flood control and/or navigation purposes, and for utilization of the space, and other requirements of the license, permit or conditions of the law. Relevant matters that bear upon flood control and navigation accomplishment include: runoff potential, reservoir discharge capability, downstream channel characteristics, hydrometeorological data collection, flood hazard, flood damage characteristics, real estate acquisition for flowage requirements (fee and easement), and resources required to carry out the water control plan. Advice may also be sought on determination of and regulation for the probable maximum or other design flood under consideration by the project owner to establish the quantity of surcharge storage space, and freeboard and top of dam or embankment elevation for safety of the project.

b. Corps of Engineers Involvement. If the project owner is responsible for real-time implementation of the water control plan, consultation and assistance will be provided by the Corps of Engineers when appropriate and to the extent possible. During any emergency that affects flood control and/or navigation, the Corps of Engineers may temporarily prescribe regulation of flood control or navigation storage space on a day-to-day (real-time) basis without request of the project owner. Appropriate consideration will be given for other authorized project functions. Upon refusal of the project owner to comply with regulations prescribed by the Corps of Engineers, a letter will be sent to the project owner by the Chief of Engineers or his duly authorized representative describing the reason for the regulations prescribed, events that have transpired, and notification that the project owner is in violation of the Code of Federal Regulations. Should an impasse arise, in that the project owner or the designated operating entity persists in noncompliance with regulations prescribed by the Corps of Engineers, measures may be taken to assure compliance.

c. Corps of Engineers Implementation of Real-Time Water Control Decisions. The Corps of Engineers may prescribe the continuing regulation of flood control storage space for any project subject to this regulation on a day-to-day (real-time) basis. When this is the case, consultation and assistance from the project owner to the extent possible will be expected. Special requests by the project owner, or appropriate operating entity, are preferred before the Corps of Engineers offers advice on real-time regulation during surcharge storage utilization.

d. Water Control Plan and Manual. Prior to project completion, water control managers from the Corps of Engineers will visit the project and the area served by the project to become familiar with the water control facilities, and to insure sound formulation of the water control plan. The formal plan of regulation for flood control and/or navigation, referred to herein as the water control plan, will be developed and documented in a water control manual prepared by the Corps of Engineers. Development of the manual will be coordinated with the project owner to obtain the necessary pertinent information, and to insure compatibility with other project purposes and with surcharge regulation. Major topics in the manual will include: authorization and description of the project, hydrometeorology, data collection and communication networks, hydrologic forecasting, the water control plan, and water resource management functions, including responsibilities and coordination for water control decision-making. Special instructions to the damtenders or reservoir manager on data collection, reporting to higher Federal authority, and on procedures to be followed in the event of a communication outage under emergency conditions, will be prepared as an exhibit in the manual. Other exhibits will include copies of this regulation, letters of understanding consummating this regulation, and the water control agreements. After approval by the Chief of Engineers or his duly authorized representative, the manual will be furnished to the project owner.

e. Water Control Agreement.

(1) A water control diagram (graphical) will be prepared by the Corps of Engineers for each project having variable space reservation for flood control and/or navigation during the year; e.g., variable seasonal storage, joint-use space, or other rule curve designation. Reservoir inflow parameters will be included on the diagrams when appropriate. Concise notes will be included on the diagrams prescribing the use of storage space in terms of release schedules, runoff, nondamaging or other controlling flow rates downstream of the damsite, and other major factors as appropriate. A water control release schedule will be prepared in tabular form for projects that do not have variable space reservation for flood control and/or navigation. The water control diagram or release schedule will be signed by a duly authorized representative of the Chief of Engineers, the project owner, and the designated operating agency, and will be used as the basis for carrying out this regulation. Each diagram or schedule will contain a reference to this regulation.

(2) When deemed necessary by the Corps of Engineers, information given on the water control diagram or release schedule will be supplemented by appropriate text to assure mutual understanding on certain details or other important aspects of the water control plan not covered in this regulation, on the water control diagram or in the release schedule. This material will include clarification of any aspects that might otherwise result in unsatisfactory project performance in the interest of flood control and/or navigation. Supplementation of the agreement will be necessary for each project where the Corps of Engineers exercises the discretionary authority to prescribe the flood control regulation on a day-to-day (real-time) basis. The agreement will include delegation of the responsibility. The document should also cite, as appropriate, Section 7 of the 1944 Flood Control Act, the Federal

Power Act and/or other Congressional legislation authorizing construction and/or directing operation of the project.

(3) All flood control regulations published in the Federal Register under this Section (Part 208) of the Code prior to the date of this publication which are listed in paragraph 208.11(e) are hereby superseded.

(4) Nothing in this regulation prohibits the promulgation of specific regulations for a project in compliance with the authorizing Acts, when agreement on acceptable regulations cannot be reached between the Corps of Engineers and the owner.

f. Hydrometeorological Instrumentation. The project owner will provide instrumentation in the vicinity of the damsite and will provide communication equipment necessary to record and transmit hydrometeorological and reservoir data to all appropriate Federal authorities on a real-time basis unless there are extenuating circumstances or are otherwise provided for as a condition of the license or permit. For those projects where the owner retains responsibility for real-time implementation of the water control plan, the owner will also provide or arrange for the measurement and reporting of hydrometeorological parameters required within and adjacent to the watershed and downstream of the damsite, sufficient to regulate the project for flood control and/or navigation in an efficient manner. When data collection stations outside the immediate vicinity of the damsite are required, and funds for installation, observation, and maintenance are not available from other sources, the Corps of Engineers may agree to share the costs for such stations with the project owner. Availability of funds and urgency of data needs are factors which will be considered in reaching decisions on cost sharing.

g. Project Safety. The project owner is responsible for the safety of the dam and appurtenant facilities and for regulation of the project during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the project owner, and does not relieve the owner of the responsibility for safety of the project.

h. Notification of the General Public. The Corps of Engineers and other interested Federal and State agencies, and the project owner will jointly sponsor public involvement activities, as appropriate, to fully apprise the general public of the water control plan. Public meetings or other effective means of notification and involvement will be held, with the initial meeting being conducted as early as practicable but not later than the time the project first becomes operational. Notice of the initial public meeting shall be published once a week for three consecutive weeks in one or more newspapers of general circulation published in each county covered by the water control plan. Such notice shall also be used when appropriate to inform the public of modifications in the water control plan. If no newspaper is published in a county, the notice shall be published in one or more newspaper of general circulation within that county. For the purposes of this Section a newspaper is one qualified to publish public notices under applicable state law. Notice shall be given in the event significant problems are anticipated or experienced that will prevent carrying out the approved water control plan or in the event that an extreme water condition is expected that could produce severe damage to property or loss of life. The means for conveying this information shall be commensurate with the urgency of the situation. The water control manual will be made available for examination by the general public upon request at the appropriate office of the Corps of Engineers, project owner or designated operating agency.

i. Other Generalized Requirements for Flood Control and Navigation.

(1) Storage space in the reservoirs allocated for flood control and navigation purposes shall be kept available for those purposes in accordance with the water control agreement, and the plan of regulation in the water control manual.

(2) Any water impounded in the flood control space defined by the water control agreement shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; i.e., releases from reservoirs shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dam, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan or regulation may require releases to be completely curtailed in the interest of flood control or safety of the project.

(3) Nothing in the plan of regulation for flood control shall be construed to require or allow dangerously rapid changes in magnitudes of releases. Releases will be made in a manner consistent with requirements for protecting the dam and reservoir from major damage during passage of the maximum design flood for the project.

(4) The project owner shall monitor current reservoir and hydrometeorological conditions in and adjacent to the watershed and downstreamof the damsite, as necessary. This and any other pertinent information shall be reported to the Corps of Engineers on a timely basis, in accordance with standing instructions to the dam tenders or other means requested by the Corps of Engineers.

(5) In all cases where the project owner retains responsibility for real-time implementation of the water control plan, he shall make current determinations of: reservoir inflow, flood control storage utilized, and scheduled releases. He shall also determine storage space and releases required to comply with the water control plan prescribed by the Corps of

Engineers. The owner shall report this information on a timely basis as requested by the Corps of Engineers.

(6) The water control plan is subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest means of communication available. The action taken shall be confirmed in writing the same day to the project owner and shall include justification for the action.

(7) The project owner may temporarily deviate from the water control plan in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Chief of Engineers, or his duly authorized representative.

(8) Advance approval of the Chief of Engineers, or his duly authorized representative, is required prior to any deviation from the plan of regulation prescribed or approved by the Corps of Engineers in the interest of flood control and/or navigation, except in emergency situations provided for in paragraph 6i(7) above. When conditions appear to warrant a prolonged deviation from the approved plan, the project owner and the Corps of Engineers will jointly investigate and evaluate the proposed deviation to insure that the overall integrity of the plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Chiefs of Engineers or his designated representatives to fully substantiate the deviation.

j. Revisions. The water control plan and all associated documents will be revised by the Corps of Engineers as necessary, to reflect changed conditions that come to bear upon flood control and navigation, e.g., reallocation of reservoir storage space due to sedimentation or transfer of storage space to a neighboring project. Revision of the water control plan, water control agreement, water control diagram, or release schedule requires approval of the Chief of Engineers or his duly authorized representative. Each such revision shall be effective upon the date specified in the approval. The original (signed document) water control agreement shall be kept on file in the approprate Division or District Office, Corps of Engineers, Department of the Army. Copies of these agreements may be obtained from the office of the project owner, or by contacting the appropriate Division Commander, U.S Army Corps of Engineers.

k. Federal Register. The following information for each project subject to Section 7 on the 1944 Flood Control Act and other applicable Congressional acts shall be published in the Federal Register prior to the time the projects become operational and prior to any significant impoundment before project completion or . . . at such time as the responsibility for physical operation and maintenance of the Corps of Engineers owned projects is transferred to another entity: (a) dam and reservoir or lake names, (b) stream, county and state corresponding to the damsite location, (c) the maximum current active storage space in acre-feet to be reserved exclusively for flood control and/or navigation purposes, or any multiple-use space (intermingled) when flood control or navigation is one of the purposes, with corresponding elevations in feet above mean sea level, and area in acres, at the upper and lower limits of said space, (d) the name of the project owner, and (e) Congressional legislation authorizing the project for Federal participation.

7. List of Projects. Appendix A shows the pertinent data for projects which are subject to this regulation.

FOR THE COMMANDER:

1 Appendix
APP A - List of Projects

ALBERT J. GENETTI, JR.
Colonel, Corps of Engineers
Chief of Staff

Appendix A
LIST OF PROJECTS

Non-Corps projects with Corps Regulation Requirements

PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
Agency Valley Dam & Res	OR	Malheur	N Fork Malheur R	FICR	60.0	3340.0	3263.0	1900	0	PL 68-292	USBR
Alpine Dam	IL	Winnebago	Keith Cr	F	0.6	796.0	760.0	52	0	PWA Proj	Rkfd IL
Altus Dam & Res	OK	Jackson	N Fork Red R	F	19.6	1562.0	1559.0	6800	6260	PL 761	USBR
				INR	132.6	1559.0	1517.5	6260	735		
Anderson Ranch Dam & Res	ID	Elmore	S Fk Boise R	FEI	423.2	4196.0	4039.6	4740	1150	Act of 1939 53 Stat 1187	USBR
Arbuckle Dam & Res	OK	Murray	Rock Cr	F	36.4	885.3	872.0	3130	2350	PL 594	USBR
				MRC	62.5	872.0	827.0	2350	606		
Arrowrock Dam & Res	ID	Elmore	Boise R	FI	286.6	3216.0	2974.0	3100	200	Act of 1902 32 Stat 388	USBR
Bear Cr Dam	MO	Marion Ralls	Bear Cr	F	8.7	546.5	520.0	540	0	PL 83-780	Hnbl MO
Bear Swamp Fife Brook(Lo)	MA	Franklin	Deerfield R	E	6.9	870.0	830.0	152	115	FERC 2669	NEPC
Bear Swamp PS (Upper)	MA	Franklin	Deerfield R Trib	E	8.9	1600.0	1550.0	118	102	Fed Pwr Act	NEPC
Bellows Falls Dam & Lk	VT	Cheshire	Connecticut R	E	7.5	291.6	273.6	2804	836	FERC 1885	NEPC
Big Dry Creek and Div	CA	Fresno	Big Dry Cr & Dog Cr	F	16.2	425.0	393.0	1530	0	PL 77-228	Rclm B CA
Blue Mesa Dam & Res	CO	Gunnison	Gunnison R	FER	748.5	7519.4	7393.0	9180	2790	PL 84-485	USBR
Boca Dam & Res	CA	Nevada	Little Truckee R	I	32.8	5596.0	5521.0	873	52	PL 61-289	USBR
				FI	8.0	5605.0	5596.0	980	873	PL 68-292	
Bonny Dam & Res	CO	Yuma	S Fork Republi-can R	F	128.2	3710.0	3672.0	5036	2042	PL 78-534	USBR
				ICR	39.2	3672.0	3638.0	2042	331	PL 79-732	
Boysen Dam & Res	WY	Fremont	Wild R	F	150.4	4732.2	4725.0	22170	19560	PL 78-534	USBR
				FEIQ	146.1	4725.0	4717.0	19560	16960		
				EIQ	403.8	4717.0	4685.0	16960	9280		
Brantley Dam & Res	NM	Eddy	Pecos R	FIRQ	348.5	3283.0	3210.7	21294	38	PL 92-515	USBR
Brownlee Dam & Res	OR ID	Baker Washington	Snake R	FE	975.3	2077.0	1976.0	13840	6650	FERC No 1971-C	ID Pwr
Bully Cr Dam & Res	OR	Malheur	Bully Cr	FI	31.6	2516.0	2456.8	1082	140	PL 86-248	USBR
Camanche Dam & Res	CA	San Joaquin	Mokelumne R	FRIE	200.0	235.5	205.1	7600	5507	PL 86-645	EB-MUD
				RIE	230.9	205.1	92.0	5507	0		
Canyon Ferry Dam & Lk	MT	Lewis Clark	Missouri R	F	99.5	3800.0	3797.0	33535	32800	PL 78-534	USBR
				FEI	795.1	3797.0	3770.0	32800	24125		
				EI	711.5	3770.0	3728.0	24125	11480		
Cedar Bluff Dam & Res	KS	Trego	Smoky Hill R	F	191.9	2166.0	2144.0	10790	6869	PL 78-534	USBR
				IMCR	149.8	2144.0	2107.8	6869	2086		

Appendix A
LIST OF PROJECTS

Non-Corps projects with Corps Regulation Requirements

PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
Cheney Dam & Res	KS	Sedgwick	N Fork Ninnescah R.	F	80.9	1429.0	1421.6	12420	9540	PL 86-787	USBR
				MC	151.8	1421.6	1392.9	9540	1970		
					0.0	0.0	0.0	0	0		
Clark Canyon Dam & Res	MT	Beaverhead	Beaverhead R	F	79.1	5560.4	5546.1	5900	5160	PL 78-534	USBR
				FI	50.4	5546.1	5535.7	5160	4495		
				I	126.1	5535.7	5470.6	4495	220		
Del Valle Dam & Res	CA	Alameda	Alameda Cr	F	37.0	745.0	703.1	1060	710	PL 87-874	DWR CA
				FIM	1.0	703.1	702.2	710	700		
				IMR	29.0	702.2	635.0	700	275		
Don Pedro Dam & Lk	CA	Tuolumne	Tuolumne R	FEIR	340.0	830.0	802.0	12900	11260	PL 78-534	M&T Irr
				EIR	1381.0	802.0	600.0	11260	3520		
				IR	308.0	600.0	342.0	3520	29		
East Canyon Dam & Res	UT	Morgan	East Canyon Cr	FEIM	48.0	5705.5	5578.0	684	130	PL 81-273	USBR
Echo Dam & Res	UT	Summit	Weber R	FEIM	74.0	5560.0	5450.0	1455	0	PL 81-83	USBR
Emigrant Dam & Res	OR	Jackson	Emigrant Cr	FIR	39.0	2241.0	2131.5	801	80	PL 83-606	USBR
Enders Dam Res	NE	Chase	Frenchman Cr	F	30.0	3127.0	3112.3	2405	1707	PL 78-534	USBR
				ICR	34.5	3112.3	3082.4	1707	658	PL 84-505	
Folsom Dam Lk	CA	Sacramento	American R	FEIM	400.0	466.0	427.0	11450	9040		USBR
				EIM	610.0	427.0	210.0	9040	0		
Fort Cobb Dam & Res	OK	Caddo	Pond (Cobb) Cr	F	63.7	1354.8	1342.0	5980	4100	PL 419	USBR
				IMCR	78.3	1342.0	1300.0	4100	337		
Foss Dam & Res	OK	Custer	Washita R	F	180.6	1668.6	1652.0	13140	8800	PL 419	USBR
				IMRC	243.8	1652.0	1597.2	8800	1360		
Friant Dam & Millerton Lk	CA	Fresno	San Joaquin R	FEIM	390.5	578.0	466.3	4850	2101	PL 75-392 PL 76-868	USBR
Galesville Dam	OR	Douglas	Cow Cr	FEMCR	42.2	1881.5	1780.0	760	150	FERC No 71 61001	Dgls CO
Gaston Dam & Res	NC	Halifax Northampton	Roanoke R	FE	63.0	203.0	200.0	22500	20300	Fed Pwr Act	VA Pwr
Glen Elder Dam & Waconda Lk	KS	Mitchel	Solomon R	F	722.3	1488.3	1455.6	33682	12602	PL 78-534	USBR
				IM	204.8	1455.6	1428.0	12602	3341	PL 79-526	
Glendo Dam & Res	WY	Platte	N Platte R	F	271.9	4653.0	4635.0	17990	12370	PL 78-534	USBR
				EIM	454.3	4635.0	4570.0	12370	3130		
Grand Coulee Dam FDR Lk	WA	Okanogan Grant	Columbia R	FEI	5185.5	1290.0	1208.0	82280	45592	PL 89-561	USBR
H Neely Henry Dam & Res	AL	Calhoun St. Clair	Coosa R	FE	49.7	508.0	502.5	11235	7632	PL 83-436	AL Pwr
Harris Dam & Res	AL	Randolph	Tallapoosa R	FE	215.0	793.0	785.0	10661	9012	PL 89-789	AL Pwr
Heart Butte Dm & Lk Tschida	ND	Grant	Heart R	F	147.9	2094.5	2064.5	6580	3400	PL 78-534	USBR
				IQ	69.0	2064.5	2030.0	3400	810		
Hells Canyon Dam & Res	OR ID	Wallowa Adams	Snake R	EN	11.7	1688.0	1683.0	2380	2280	FERC No 1971-A	ID Pwr

Appendix A

LIST OF PROJECTS

Non-Corps projects with Corps Regulation Requirements

PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
Hoover Dam &	NV	Clark	Colorado R	F	1500.0	1229.0	1219.6	162700	156500	PL 70-642	USBR
Lk Mead	AZ	Mohave		FEIMCAR	15.8	1219.6	1083.0	156500	83500		
Hungry Horse	MT	Flathead	S Fork Flathead	FEI	2982.0	3560.0	3336.0	23800	5400	PL 78-329	USBR
Dam & Res			R								
Indian Valley	CA	Lake	N Fork Cache Cr	FIMR	40.0	1485.0	1474.0	3975	3734	PL 84-984	Yolo
Dam & Res				IMR	260.0	1474.0	1334.0	3734	308		FC&W
Jamestown Dam	ND	Stutsman	James R	F	185.4	1454.0	1429.8	13210	2090	PL 78-534	USBR
& Res				IQ	28.1	1429.8	1400.0	2090	160		
Jocassee Dam	SC	Pickens	Keowee R	PRFC	1160.0	1110.0	1080.0	7565	6815	FERC 2503	USBR
& Res											Pwr
Keowee Dam	SC	Pickens	Keowee R	FPMCAR	392.0	800.0	775.0	18372	13072	FERC 2503	Duke
& Lk											Pwr
Kerr Dam	MT	Lake	Flathead R	FER	1219.0	2893.0	2883.0	125560	120000	FERC No 5	MT
Flathead Lk											Pwr
Kerr Dam & Lk	OK	Mayes	Grand Neosho R	F	244.2	636.0	619.0	18800	10900	PL 76-476	GRD
Hudson(Markham				E	48.6	619.0	599.0	10900	4500		Auth
Ferry Project)											
Keyhole Dam &	WY	Crook	Belle Fourche R	F	140.5	4111.5	4099.3	13730	9410	PL 78-534	USBR
Res				IQ	185.8	4099.3	4051.0	9410	820		
Kirwin Dam &	KS	Phillips	N Fork Solomon	F	215.1	1757.3	1729.3	10640	5080	PL 78-534	USBR
Res			R	ICR	89.6	1729.2	1697.0	5080	1010	PL 79-732	
										PL 79-526	
L Thunderbird	OK	Cleveland	Little R	F	196.2	1064.7	1039.0	13850	8800	PL 86-529	USBR
(Norman Res)				M	0.0	0.0	0.0	0	0		
Lake Kemp Dam	TX	Wichita	Wichita R	F	234.9	1156.0	1144.0	23830	15590	SD 144	WF&C
& Res				MI	268.0	1144.0	1114.0	15590	3350		WID2
Leesville Dam	VA	Campbell	Roanoke R	EQ	37.8	613.0	600.0	3235	2400	Fed Pwr	Appl
& Res		Pttsylvnia								Act	Pwr
Lemon Dam &	CO	LA Plata	Florida R	FIM	39.0	8148.0	8023.0	622	62	PL 84-485	USBR
Res											
Lewis M Smith	AL	Walker	Sipsey Fork	F	280.6	522.0	510.0	25700	21200	Fed Pwr	AL
Dam & Res		Culmen	Black Warrior R	E	394.3	510.0	488.0	21200	15097	Act	Pwr
Little Wood	ID	Blain	Little Wood R	FI	30.0	5237.3	5127.4	572	0	PL 84-993	USBR
Logan Martin	AL	Talladega	Coosa R	F	245.3	477.0	465.0	26310	15260	PL 83-436	AL
Dam & Res				E	67.0	465.0	460.0	15263	11887		Pwr
Los Banos Dam	CA	Merced	Los Banos Cr	F	14.0	353.5	327.8	619	467	PL 86-488	USBR
& Detention				R	20.6	327.8	231.2	467	0		
Res											
Lost Creek Dam	UT	Morgan	Lost Cr	FEIM	20.0	6005.0	5912.0	365	93	PL 81-273	USBR
& Res											
Lovewell Dam	KS	Jewell	White Rock Cr	F	50.5	1595.3	1582.6	5025	2986	PL 78-534	USBR
& Res				ICR	24.9	1582.6	1571.7	2986	1704	PL 79-732	
Marshall Ford	TX	Travis	Colorado R	F	779.8	714.0	681.0	29060	18955	PL 73-392	USBR
Dam & Res				NEIM	810.5	681.0	618.0	18955	8050	PL 78-534	
Mayfield Dam	WA	Lewis	Cowlitz R	FER	21.4	425.0	415.0	2250	2030	FPC No	Tac
& Res										2016-A	WN

Appendix A

LIST OF PROJECTS

Non-Corps projects with Corps Regulation Requirements

PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
McGee Creek	OK	Atoka	McGee Cr	F	85.3	595.5	577.1	5540	3810	PL 94-423	USBR
Dam & Res				MCR	108.0	577.7	515.1	3810	370		
Medicine Cr	NE	Frontier	Medicine Cr	F	52.7	2386.2	2366.1	3483	1840	PL 78-534	USBR
Dam Harry				ICR	26.8	2366.1	2343.0	1840	701	PL 84-505	
Strunk Lk											
Mossyrock Dam	WA	Lewis	Cowlitz R	FER	1397.0	778.5	600.0	11830	4250	FERC No	Tac
Davisson Lk										2016-B	WN
Mt Park Dam	OK	Kiowa	W Otter Cr	F	20.3	1414.0	1411.0	7130	6400	PL 90-503	USBR
Tom Steed Res				MRC	89.0	1411.0	1386.3	6400	1270		
Navajo Dam &	NM	San Juan	San Juan R	FEIRQ	1036.1	6085.0	5990.0	15610	7400	PL 84-485	USBR
Res		Rio Arriba									
New Bullards	CA	Yuba	Yuba R	FEIMR	170.0	1956.0	1918.3	4809	4225	PL 89-298	YCWA
Bar Dam & Res				EIMR	790.9	1918.3	1447.5	4225	129		
New Exchequer	CA	Tuolumne	Merced R	FEIR	400.0	867.0	799.7	7110	4849	PL 86-645	Mrcd
Dam & Lk				EIR	451.6	799.7	660.0	4849	1900		Irr
				IR	171.0	660.0	467.0	1900	150		
New Melones	CA	Tuolumne	Stanislaus R	FEIMR	450.0	1088.0	1049.5	12500	10900	PL 87-874	USBR
Dam & Lk		Calaveras		EIMR	1670.0	1049.5	808.0	10900	3500		
				IMR	300.0	808.0	540.0	3500	0		
Northfield Mt	MA	Franklin	Connecticut	E	14.0	965.0	938.0	196	134	FERC 1889	WMEC
(Up) PS											
Norton Dam &	KS	Norton	Prairie Dog Cr	F	98.8	2331.4	2304.3	5316	2181	PL 78-534	USBR
Kieth				IMRC	30.7	2304.3	2280.4	2181	587	PL 79-526	
Sebelius Lk										PL 79-732	
Ochoco Dam &	OR	Crook	Ochoco Cr	FICR	52.5	3136.2	0.0	1130	130	PL 84-992	USBR
Res											
Oroville Dam &	CA	Butte	Feather R	FEIMAR	750.0	900.0	848.5	15800	13346	PL 85-500	CA
Lk				EIMAR	2788.0	848.5	210.0	13346	0		
Pactola Dam &	SD	Pennington	Rapid Cr	F	43.1	4621.5	4580.2	1230	860	PL 78-534	USBR
Res				IM	55.0	4580.2	4456.1	860	100		
Palisades Dam	ID	Bonneville	Snake R	FIE	1202.0	5620.0	5452.0	16100	2170	PL 81-864	USBR
& Res											
Paonia Dam &	CO	Gunnision	Muddy Cr	FIR	17.0	6447.5	6373.0	334	120	PL 80-177	USBR
Res										PL 84-485	
Pensacola Dam	OK	Mayes	Grand(Neosho) R	F	525.0	755.0	745.0	59200	46500	PL 77-228	GRD
Grand Lake O'				E	1192.0	745.0	705.0	46500	17000		Auth
the Cherokees											
Pineview Dam &	UT	Weber	Odgen R	FEIM	110.0	4900.0	4818.0	2874	0	PL 81-273	USBR
Res											
Platoro Dam &	CO	Conejos	Conejos R	F	6.0	10034.0	10027.5	947	920	PL 76-640	USBR
Res				IR	54.0	10027.5	9911.0	920	0		
Priest Rapids	WA	Grant	Columbia R	FER	44.0	488.0	481.5	7600	6500	FERC No	Grnt
Dam & Res										2114-A	PUD
Prineville Dam	OR	Crook	Crooked R	FIRC	233.0	3257.9	3114.0	3997	140	PL-84-992	USBR
& Res											
Prosser Cr Dam	CA	Nevada	Prosser Cr	C	8.6	5703.7	5661.0	334	86	PL 84 858	USBR
& Res				FC	20.0	5761.0	5703.7	745	334	PL 85 706	

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LIST OF PROJECTS

Non-Corps projects with Corps Regulation Requirements

PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
Pueblo Dam & Res	CO	Pueblo	Arkansas R	F	93.0	4898.7	4880.5	5671	4640	PL 87-590	USBR
				IR	261.4	4880.5	4764.0	4640	421		
Red Willow Dam Hugh Butler Lk	NE	Frontier	Red Willow Cr	F	48.9	2604.9	2581.8	2682	1629	PL 78-534	USBR
				IRC	27.3	2581.8	2558.0	1629	787	PL 85-783 PL 84-505	
Ririe Dam & Res	ID	Bonneville	Willow Cr	FIRC	99.0	5119.0	5023.0	150	360	PL 87-874	USBR
Roanoke Rapids Dam & Res	NC	Halifax	Roanoke R	EC	16.8	132.0	128.0	4600	4100	FPC 2009	VA Pwr
Rocky Reach Dam Lk Entiat	WA	Chelan	Columbia R	FER	36.0	707.0	703.0	9920	9490	FERC No 2145	Chln PUD
Rocky River PS Lk Candlewood	CT	Litchfield	Housatonic R	E	142.5	430.0	418.0	5608	4692	FERC 2576	CLPC
Ross Dam & Res	WA	Whatcom	Skagit R	E	1052.0	1602.5	1475.0	11700	4450	FERC 553	Sttl
Sanford Dam & Lk Meredith	TX	Hutchison	Canadian R	F	462.1	2965.0	2941.3	21640	17320	PL 81-898	USBR
				IMCRQ	761.3	2941.3	2860.0	17320	4500		
Savage River Dam & Res	MD	Garrett	Savage R	FMA	20.0	1468.5	1317.0	366	0	PL 78-534	Ptmc Comm
Scoggins Dam Henry Hagg Lk			Scoggins Cr	FIR	56.3	305.8	235.3	116	4	PL 89-596	USBR
Shadehill Dam & Res	SD	Perkins	Grand R	F	218.3	2302.0	2271.9	9900	4800	PL 78-534	USBR
				IQ	80.9	2271.9	2250.8	4800	2800		
Shasta Dam Lk	CA	Shasta	Sacramento R	FEIA	1300.0	1067.0	1018.6	29570	23894	PL 75-392	USBR
				EIA	3241.0	1018.6	735.8	23894	2200		
Shepaug Dam & Lk	CT	Litchfield	Housatonic R	E	5.0	200.0	172.0	1882	1125	FERC 2576	CLPC
Smith Mtn Dam & Res	VA	Bedford Franklin Roanoke Pttsylvnia	Roanoke R	E	40.8	795.0	793.0	20600	20200	Fed Pwr Act	Appl Pwr
Stampede Dam & Res	CA	Sierra	Little Truckee R	FEM	22.0	5949.0	5942.1	3430	3230	PL 84-858	USBR
				EM	199.4	5942.0	5798.0	3230	210		
Starvation Dam and Res	UT	Duchesne	Strawberry R	FIM	165.3	5712.0	5595.0	3310	689	PL 84-485	USBR
Stevens Creek Dam & Res	GA	Columbia	Savannah River	P	10.5	187.5	183.0	4300	0	FERC 2535	SC E&G
Stevenson Dam Lk Zoar	CT	Litchfield	Housatonic R	E	5.0	108.0	80.0	1148	516	FERC 2576	CLPC
Summer Dam & Lk	NM	De Baca	Pecos R	FI	51.4	4261.0	4200.0	2835	0	PL 83-780	USBR
Tat Momolikot Dam & Lake	AZ	Pinal	Santa Rosa Wash	FIC	198.5	1539.0	1480.0	11790	0	PL 89-298	BIA
Tiber Dam & Res	MT	Libert Toole	Marias R	F	400.9	3012.5	2993.0	23150	17890	PL 78-534	USBR
				FIQ	268.0	2993.0	2976.0	17890	13790		
				IQ	121.7	2976.0	2966.4	13790	11710		
Trenton Dam & Res	NB	Hitchcock	Republican R	F	134.1	2773.0	2752.0	7940	4922	PL 78-534	USBR
				IRC	99.8	2752.0	2720.0	4922	1572	PL 84-505	

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PROJECT NAME /1	STATE/COUNTY		STREAM 1/	PROJECT PURPOSE 2/	STORAGE 1000 AF	ELEV LIMITS FEET, NGVD upper	lower	AREA IN ACRES upper	lower	AUTHORIZING LEGIS 3/	PROJ OWNER 4/
Col No 1	2	3	4	5	6	7	8	9	10	11	12
Turners Falls (Low) Dam & Lk	MA	Franklin	Connecticut R	E	8.7	185.0	176.0	2110	1880	FERC 1889	WMEC
Twin Buttes Dam & Lake	TX	Tom Green	Concho R	F	454.4	1969.1	1940.2	23510	23510	PL 85-152	USBR
				IM	150.0	1940.2	1885.0	9080	670	PL 78-534	
Twitchell Dam & Res	CA	Santa Barbara	Cuyama R	F	89.8	651.5	623.0	3671	2556	PL 83-774	USBR
				IM	135.6	623.0	504.0	2556	0		
Upper Baker Dam Baker Lk	WA	Whatcom	Baker R	FE	184.6	724.0	674.0	4985	2375	PL 89-298 FERC 2150B	Pgt P&L
Vallecito Dam & Res	CO	La Plata	Los Pinos R	FEI	125.4	7665.0	7582.5	2720	350	PL 61-288 PL 68-292	USBR
Vernon Dam & Lk	VT	Windham	Connecticut R	E	18.3	220.1	212.1	2550	1980	FERC 1904	NEPC
Wanapum Dam & Res	WA	Grant	Columbia R	FER	151.6	571.5	560.0	14300	13350	FERC No 2114-B	Grnt PUD
Wanship Dam & Rockport	UT	Summit	Weber R	FEIM	61.0	6037.0	5930.0	1077	121	PL 81-273	USBR
Warm Springs Dam & Res	OR	Malheur	Middle Fork Malheur R	FICR	191.0	3406.0	3327.0	460	90	PL 78-534	Vale USBR
Waterbury Dam & Res	VT	Washington	Little R	FP	27.7	617.5	592.0	1330	890	PL 78-534	VT
Webster Dam & Res	KS	Rocks	S Fork Solomon R	F	183.4	1923.7	1892.5	8480	3772	PL 78-534	USBR
				IRC	72.1	1892.5	1860.0	3772	906	PL 79-526 PL 79-732	
Weiss Dam & Res	AL	Cherokee	Coosa R	F	397.0	574.0	564.0	50000	30200	PL 83-436	AL Pwr
				E	148.4	564.0	558.0	30200	19545		
Wells Dam L Pateros	WA	Douglas	Columbia R	FER	74.0	781.0	771.0	10000	8000	FERC No 2149	Dgls PUD
Wilder Dam & Lk	VT	Windsor	Connecticut R	E	13.3	385.0	380.0	3100	2240	FERC 1893	NEPC
Yellowtail Dam & Bighorn Lk	MT	Big Horn	Bighorn R	F	258.3	3657.0	3640.0	17280	12600	PL 78-534	USBR PUD
				FEIQ	240.3	3640.0	3614.0	12600	6915		
				EIQ	336.1	3614.0	3547.0	6915	4150		

1. Cr - Creek; CS - Control Structure; Div - Diversion; DS - Drainage Structure; FG - Floodgate; Fk - Fork; GIWW - Gulf Intercoastal Waterway; Lk - Lake; L&D - Lock & Dam; PS - Pump Station; R - River; Res - Reservoir
2. F - Flood Control; N - Navigation; P - Corps Hydropower; E - Non Corps Hydropower; I - Irrigation; M - Municipal and/or Industrial Water Supply; C - Fish and Wildlife Conservation; A - Low Flow Augmentation or Pollution Abatement; R - Recreation; Q - Water Quality or Silt Control
3. FCA - Flood Control Act; FERC - Federal Energy Regulatory Comm; HD - House Document; PL - Public Law; PW - Public Works; RHA - River & Harbor Act; SD - Senate Document; WSA - Water Supply Act
4. Appl Pwr - Appalacian Power; Chln PUD - Chelan Cnty PUD 1; CLPC - CT Light & Power Co; Dgls PUD - Douglas Cnty PUD 1; DWR - Department of Water Resources; EB-MUD - East Bay Municipal Utility Dist; GRD - Grand River Dam Auth; Grnt PUD - Grant Cnty PUD 2; Hnbl - city of Hannibal; M&T Irr - Modesto & Turlock Irr; Mrcd Irr - Merced Irr; NEPC - New England Power Co; Pgnt P&L - Pugent Sound Power & Light; Ptmc Comm - Upper Potomac R Comm; Rclm B - Reclamation Board; Rkfd - city of Rockford; Sttl - city of Seattle; Tac - City of Tacoma; Vale USBR - 50% Vale Irr 50% USBR; WF&CWID - City of Wichita Falls and Wichita Cnty Water Improvement District No. 2; WMEC - Western MA Electric Co; YCWA - Yuba City Water Auth; Yolo FC&W - Yolo Flood Control & Water Conserv Dist

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Exhibit O

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1100 COMMERCE STREET, SUITE 831
DALLAS, TEXAS 75242-1317

CESWD-RBT

27 JAN 2014

MEMORANDUM FOR Commander, Fort Worth District

SUBJECT: Marshall Ford Dam (Mansfield Dam and Lake Travis), Colorado River, Texas – Letter of Understanding and Water Control Agreement

1. Reference memo, CESWF-PM-C, 10 January 2014, subject as above.

2. SWD has reviewed the referenced memo and enclosures and hereby recommends approval of the Letter of Understanding (Exhibit A) and the Water Control Agreement (Exhibit B) in regards to Marshall Ford Dam.

3. My points of contact for further questions on this matter are Mr. Fred Jensen, Hydraulic Engineer, (469) 487-7090, SWD, and Dr. Michael Sterling, Chief of Water Management/Infrastructure Safety, SWD, (469) 487-7096.

Thomas W. Kula

THOMAS W. KULA
Brigadier General, USA
Commanding

Encls
1. Letter of Understanding
2. Water Control Agreement

CF:
CESWF-PM-C

EXHIBIT O

LETTER OF UNDERSTANDING

MANSFIELD DAM AND LAKE TRAVIS

(MARSHALL FORD DAM AND RESERVOIR)

LETTER OF UNDERSTANDING

MANSFIELD DAM AND LAKE TRAVIS
(MARSHALL FORD DAM AND RESERVOIR)

The Corps of Engineers and the Lower Colorado River Authority, pursuant to Section 7 of the Flood Control Act of 1944, 33 U.S.C. § 709, hereby set forth this Letter of Understanding for the operation of the Mansfield Dam and Lake Travis.

WHEREAS, Mansfield Dam and Lake Travis (Marshall Ford Dam and Reservoir), located at river mile 318 on the Colorado River, Travis County, Texas, was authorized for a two stage construction by the Emergency Relief Appropriation Act of 1935 (49 Stat. 115), the Cooperative Agreement Between the United States and the Lower Colorado River Authority approved June 1, 1935, and the River and Harbor Act of 1937 (Public Law 75-392) and;

WHEREAS, the project was constructed by the Bureau of Reclamation, with 783,200 acre-feet of flood control storage which is regulated by the Corps of Engineers in accordance with Section 7 of the 1944 Flood Control Act, and;

WHEREAS, by contract between the Lower Colorado River Authority and the United States dated March 13, 1941 the Lower Colorado River Authority was designated as the agent to operate and maintain Mansfield Dam for regulating the flow of the Colorado River below the dam, and;

WHEREAS, Section 7 of the Flood Control Act of 1944, 33 U.S.C. 709, directs the Secretary of the Army to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds, and;

WHEREAS, 33 CFR 208.11 further prescribes the policy and procedures for regulating the use of storage allocated for flood control or navigation purposes at all reservoirs capable of such regulation and constructed wholly or in part with Federal funds provided on the basis of such purposes;

NOW THEREFORE, in addition to the responsibilities of the Lower Colorado River Authority (hereinafter called the Authority) and the Corps of Engineers (hereinafter called the

Corps) spelled out in paragraph 33 C.F.R. 208.11, it is agreed or understood that:

The Water Control Manual for Mansfield Dam and Lake Travis will contain the Water Control Agreement and this Letter of Understanding. In addition, the manual will contain instructions for reporting data necessary for flood control regulation of the project and communications procedures between the Authority and the Corps. The manual contains instructions to be followed for flood control regulation. The manual will serve as a detailed guide to personnel involved in the flood control regulation of Mansfield Dam and Lake Travis during the life of the project. Portions of the manual will be updated as conditions warrant. Revisions to the Water Control Manual and all associated documents will be in writing and in accordance with the provisions of 33 CFR 208.11 (d) (10). Should there be any difference between this Letter of Understanding and the Water Control Manual, the Manual shall control.

WITNESS OUR HANDS in the capacities shown below and effective either on the date of the adoption of amendments to 33 C.F.R. § 208.19 consistent with the revised Water Control Manual or on the date of the last signature, whichever is later.

Thomas W Kula	Rebecca S Motal
(Signature)	(Signature)
Thomas W. Kula Brigadier General, U.S. Army Commanding Southwestern Division Corps of Engineers	Rebecca S. Motal General Manager Lower Colorado River Authority
Jan 27, 2014	DEC. 9, 2013
(Date)	(Date)

EXHIBIT O

WATER CONTROL AGREEMENT

MANSFIELD DAM AND LAKE TRAVIS

(MARSHALL FORD DAM AND RESERVOIR)

WATER CONTROL AGREEMENT

MANSFIELD DAM AND LAKE TRAVIS (MARSHALL FORD DAM AND RESERVOIR)
COLORADO RIVER, TRAVIS COUNTY, TEXAS

Pursuant to section 7 of the Flood Control Act of 1944, 33 U.S.C. 709, and further prescribed in 33 CFR 208.11, the Corps of Engineers (hereinafter called the Corps) and the Lower Colorado River Authority (hereinafter called the Authority) hereby set forth this agreement to specify the roles and responsibilities of the respective organizations in the operation of Mansfield Dam and Lake Travis, Travis County, Texas.. The included water control release schedules will govern the use of the flood control storage space at Mansfield Dam and Lake Travis. It is agreed or understood that:

STORAGE AND RELEASE

a. The Authority is responsible for the physical operation of the flood control facilities and for directing real-time implementation of the Water Control Plan. Consultation and assistance will be provided by the Corps when appropriate and to the extent practicable.

b. The Authority is responsible for storing and releasing flood waters, in accordance with the Water Control Plan, when the lake level is between elevations 681.0 and 714.0 feet mean sea level (msl), the elevation limits of the flood control pool.

c. Appropriate consideration will be given for other authorized project functions.

d. The Authority is responsible for directing storage and release of all water when the lake level is above elevation 714.0 feet msl, the top of the flood control pool. The Corps may temporarily prescribe regulation of flood control storage space on a real-time basis without request of the Authority.

e. The Authority is responsible for directing storage and release of all waters when the lake level is in the conservation pool, below elevation 681.0 feet msl. The Authority will advise the Corps when inflow rates are anticipated which will raise the pool above elevation 681.0 feet msl at the dam.

f. The Water Control Manual, insofar as they govern the use of the flood control storage capacity between elevations 681.0 and 714.0 msl, are subject to temporary modification by the Corps in an emergency. The modification shall be communicated by the Corps to the representative of the Authority in immediate charge of operations at Mansfield Dam and Lake Travis by the best available means of communication. The modification shall be confirmed in writing the same day by the Corps to the Authority.

g. The Authority may temporarily deviate from the flood control regulations for emergency reasons to protect the safety of the dam or to avoid other serious hazards. In the event an immediate short-term departure is deemed necessary, such action shall be immediately reported to the Corps by the fastest means of communication available. Actions shall be confirmed in writing the same day by the Authority to the Corps and shall include justification for the action. Continuation of the deviation will require the express approval of the Corps. Advance approval of the Corps will be acquired prior to any deviation from the plan of regulation prescribed or approved by the Corps in the interest of flood control and/or navigation except in the emergency situation mentioned above. When conditions appear to warrant a prolonged deviation from the approved plan, the Authority and the Corps will jointly investigate and evaluate the proposed deviation from the approved plan to insure that the overall integrity of the water control plan would not be unduly compromised. Approval of prolonged deviations will not be granted unless such investigations and evaluations have been conducted to the extent deemed necessary by the Corps to fully substantiate the deviation.

h. At any lake level, the Authority is responsible for directing releases as required to ensure dam safety and structural integrity. The Corps will provide technical assistance if the Authority requests it. Any such assistance provided by the Corps is to be used at the discretion of the Authority, and does not relieve the Authority of the responsibility for safety of the project.

i. Flood control regulation will not restrict municipal or industrial uses, or releases for authorized downstream users as determined by the Authority or others.

j. Releases made in accordance with these regulations are subject to the condition that releases will not be made at rates or in a manner that would be inconsistent with emergency requirements for protecting the dam and/or reservoir from major damage.

MAINTENANCE

k. The Authority is responsible for the operation and maintenance of the flood control facilities and for all dam safety aspects of the project. The Authority shall maintain capabilities of the flood control facilities in accordance with the construction specifications and the "as built" drawings.

l. The Authority shall develop, maintain and execute forecast models for Lake Travis. The Authority shall provide the Corps inflow and pool elevation forecasts for Lake Travis on a near real-time basis.

DATA AND COMMUNICATION

m. The Authority shall provide observations required by the Corps for flood control regulation of Mansfield Dam and Lake Travis. The Authority will record and make available to the Corps hydrometeorological, streamflow and lake data on a real-time basis and will furnish a daily report, electronically, to the Corps office in Fort Worth, Texas. Data missing from weekend and holiday reports will be furnished on Monday or the day following the holiday unless otherwise instructed by the Corps. These reports shall be provided to the Corps office in Fort Worth, Texas, by 8:30 a.m. each day. This report will include the headwater elevation at 4:00 p.m. and midnight of the previous day and 8:00 a.m. of the day of the report; the number of gates in operation with their respective openings and releases; the 24-hour average power discharge; measured pan evaporation data; and, precipitation in inches for the preceding 24-hour period. Whenever the lake rises to elevation 681.0 feet msl and releases for flood regulation are necessary or appear imminent, the Authority shall report at once to the Fort Worth District Engineer or his duly authorized representative by telephone all gate changes and the time the gate change was made. This confirmation will include the head water elevation, the time of the gate change, the number of gates in operation, and the release rate.

n. The Corps and the Authority shall provide warnings that will start immediately when a water condition is expected that could produce severe damage to property or be potentially dangerous to life. The following paragraphs identify the action to be taken by each agency:

(1) Corps. In the event the lake level is projected to exceed elevation 681.0 feet msl, the Authority shall furnish the Corps with basin hydrologic data including projected lake levels and releases. The Corps will review, and at its discretion, modify the Authority's projections and proposed operations for use in warning the public within and below the project. In the event communications are lost between the agencies, the Corps shall dispatch personnel to Mansfield Dam, for the purpose of maintaining communications, as required by the Authority.

(2) Authority. In the event the lake level is projected to exceed elevation 714.0 feet msl, the Authority shall continue

to furnish the Corps with hydrologic data including projected lake levels and releases. The Authority shall initiate its flood warning plan at its discretion. The Authority shall be responsible for alerting the necessary public officials and agencies of the current and forecasted conditions. The Authority shall release information furnished by the Corps to the public in the lake area and will advise the public below the dam. The Authority shall provide the Corps with a copy of all information releases made to the public and news media.

o. The Authority is responsible for keeping current all data contained in its public flood warning plan.

p. Regulation schedules are shown in tabular form for both Normal Flood Control Regulation (Table 1) and Emergency Flood Control Regulation (Table 2), and are attached hereto and incorporated herein in compliance with the regulations.

WITNESS OUR HANDS in the capacities shown below and effective either on the date of the adoption of amendments to 33 C.F.R. § 208.19 consistent with the revised Water Control Manual or on the date of the last signature, whichever is later.

(Signature)	(Signature)
Thomas W. Kula Brigadier General, U.S. Army Commanding Southwestern Division Corps of Engineers Authorized Representative of the Chief of Engineers	Rebecca S. Motal General Manager Lower Colorado River Authority
Jan 27, 2014	DEC. 9, 2013
(Date)	(Date)

TABLE 1

Mansfield Dam and Lake Travis - Normal Flood Control Regulation Schedule

Condition	Reservoir Level [ft]	Release [1] [cfs]	Controlling Stages and Discharges at Downstream Control Points
Pool Rising or Falling	Below 681	As Specified by the Authority	33.0 ft (30,000 cfs) at Austin - USGS Gage 08158500 27.2 ft (45,000 cfs) at Bastrop - USGS Gage 08159200 35.5 ft (50,000 cfs) at Columbus - USGS Gage 08161000
Pool Rising	Forecast: 681-683	3,000 [2] to 7,500	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Rising	Forecast: 683-685	5,000 to 30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Rising	Forecast: 685-691 (a) During January, February, March, April, July, August, November, December.	5,000 to 30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
	(b) During May, June, September, October	30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Rising	Forecast: 691-710	30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Rising	Forecast: 710-714	50,000	No Stage Control (50,000 cfs) at Austin No Stage Control (50,000 cfs) at Bastrop No Stage Control (50,000 cfs) at Columbus

TABLE 1 (continued)

Mansfield Dam and Lake Travis - Normal Flood Control Regulation Schedule

Pool Rising	Forecast: 714-722 [3]	90,000 [3]	No controls. See footnote 3.
Pool Rising	Forecast: above 722	The Authority will specify and schedule releases as required to protect the safety of the structure.	
Pool Falling	Above 722	The Authority will specify and schedule releases as required to protect the safety of the structure.	
Pool Falling	722-714	The Authority will specify and schedule releases as required to protect the safety of the structure.	
Pool Falling	714-710	50,000	No Stage Control (50,000 cfs) at Austin No Stage Control (50,000 cfs) at Bastrop No Stage Control (50,000 cfs) at Columbus
Pool Falling	710-691	30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Falling	691-685: (a) During May, June, September, October. (b) During January, February, March, April, July, August, November, December.	30,000 5,000 to 30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus 33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Falling	685-683	5,000 to 30,000	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus
Pool Falling	683-681	3,000 [2] to 7,500	33.0 ft (30,000 cfs) at Austin 27.2 ft (45,000 cfs) at Bastrop 35.5 ft (50,000 cfs) at Columbus

[1] Subject to the specified controlling discharges at downstream control points. Releases from the dam, when combined with downstream inflows to the Colorado River, shall not contribute to an

exceedance of the specified controlling discharges. Normal hydroelectric turbine releases may be reduced only to prevent them from contributing to an exceedance of downstream control discharges. Control discharges will not be modified due to minor shifts in the respective control point stage-discharge relationships, but will be reassessed if significant shifts indicate the possibility of negative impacts.

[2] Minimum daily average release. Release need not be continuous throughout the day.

[3] Release shall be the lesser of 90,000 cfs or the forecasted peak rate of reservoir inflow. As the reservoir level exceeds elevation 714 feet, **or is forecast to exceed elevation 722 feet,** the Authority will assume responsibility for specifying and scheduling releases as required to protect the safety of the structure **to the maximum extent practicable**.

TABLE 2

Mansfield Dam and Lake Travis - Emergency Flood Control Regulation Schedule

Pool Elevation [ft]	Pool Condition	Operations
Below 691	Rising, Standing, or Falling	If the Dam Tender has knowledge of significant rainfall or pending flood conditions on the Colorado River downstream of the dam, stop all releases. Otherwise, continue to make releases as previously instructed.
691 - 710	Rising	Release 5,000 cfs
	Standing or Falling	Release 3,000 cfs
710 - 714	Rising	Release 30,000 cfs
	Standing or Falling	Release 5,000 cfs
714 - 722	Rising, Standing, or Falling	Release 90,000 cfs
Above 722	Rising, Standing, or Falling	All conduit gates full open.

Instructions During Emergency Operations

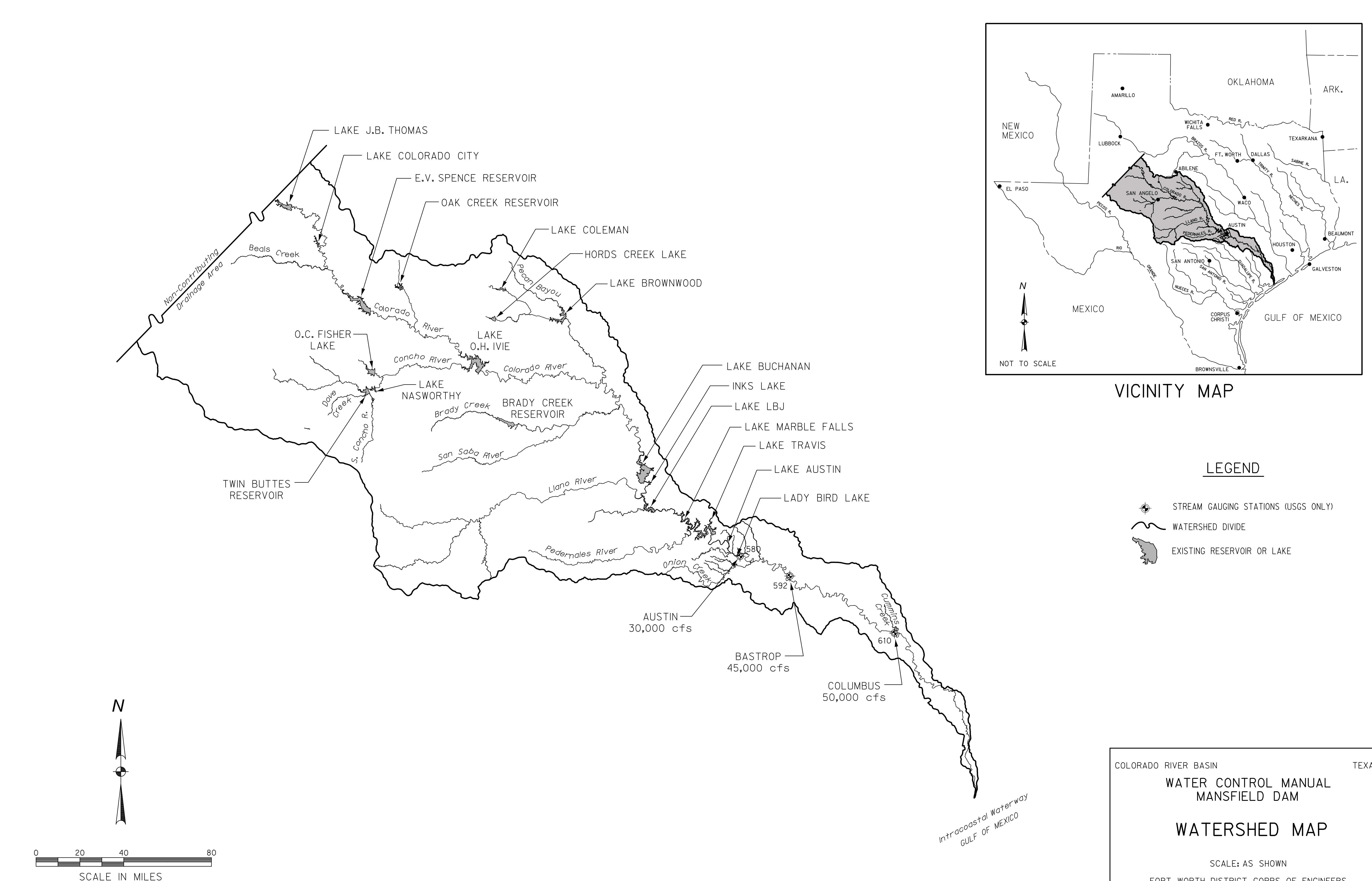
1. A complete log of all conduit gate operations will be maintained at each conduit gate.

2. The conduit gates will be operated as follows:
   a. Each conduit gate will be fully opened or closed.
   b. Conduit gates will be opened or closed at a maximum rate of one gate per hour.

3. When the lake level is receding and approaching elevation 681.0 feet (top of conservation pool), reduce conduit gate releases in such manner that all conduit gates are closed when the pool falls to elevation 681.0 feet.

4. No curtailment of normal hydroelectric turbine releases will be required due to flood control operations.

Plates



COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

WATERSHED MAP

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

PLATE 1-01

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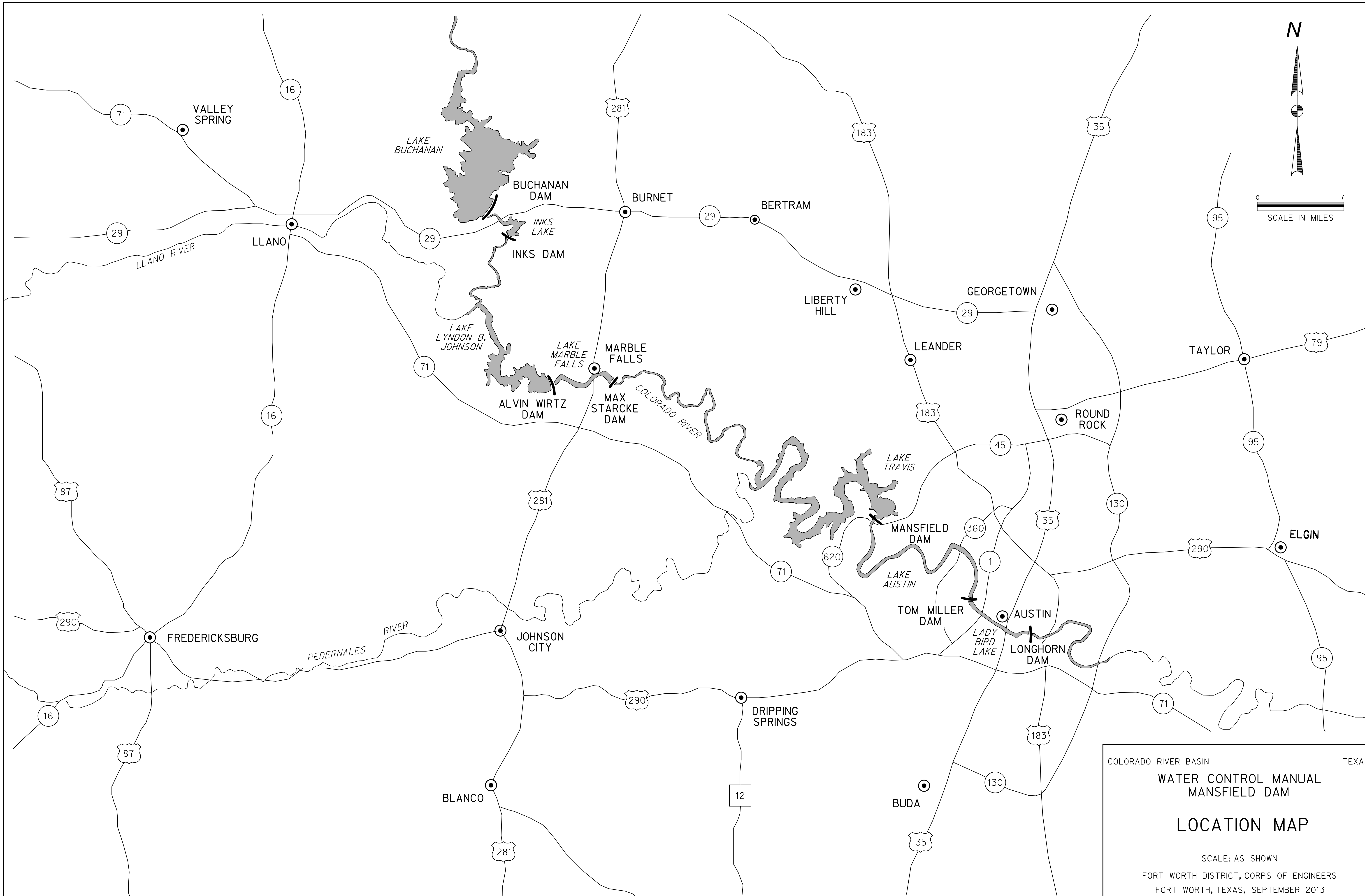


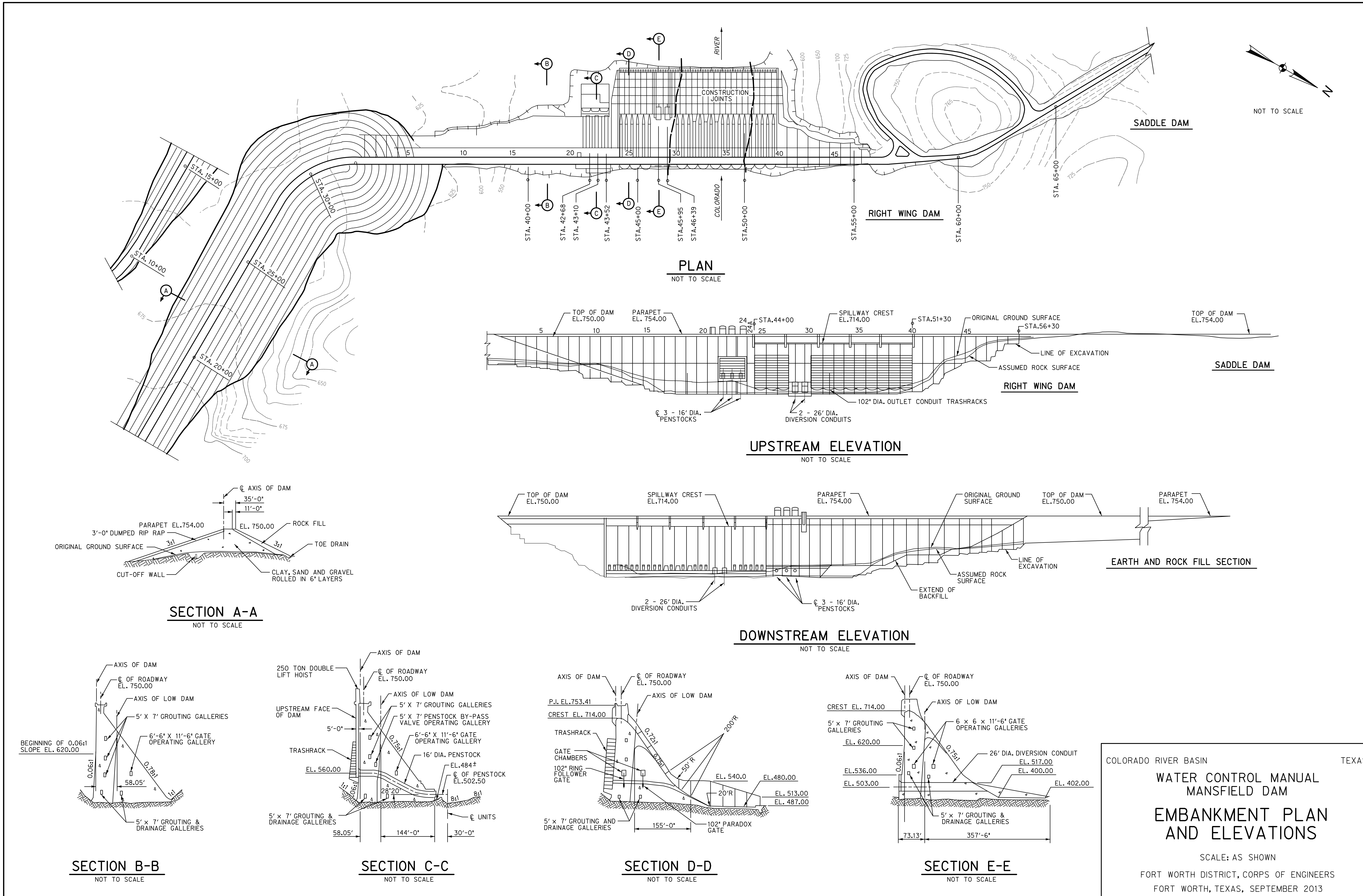
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

LOCATION MAP

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

EMBANKMENT PLAN AND ELEVATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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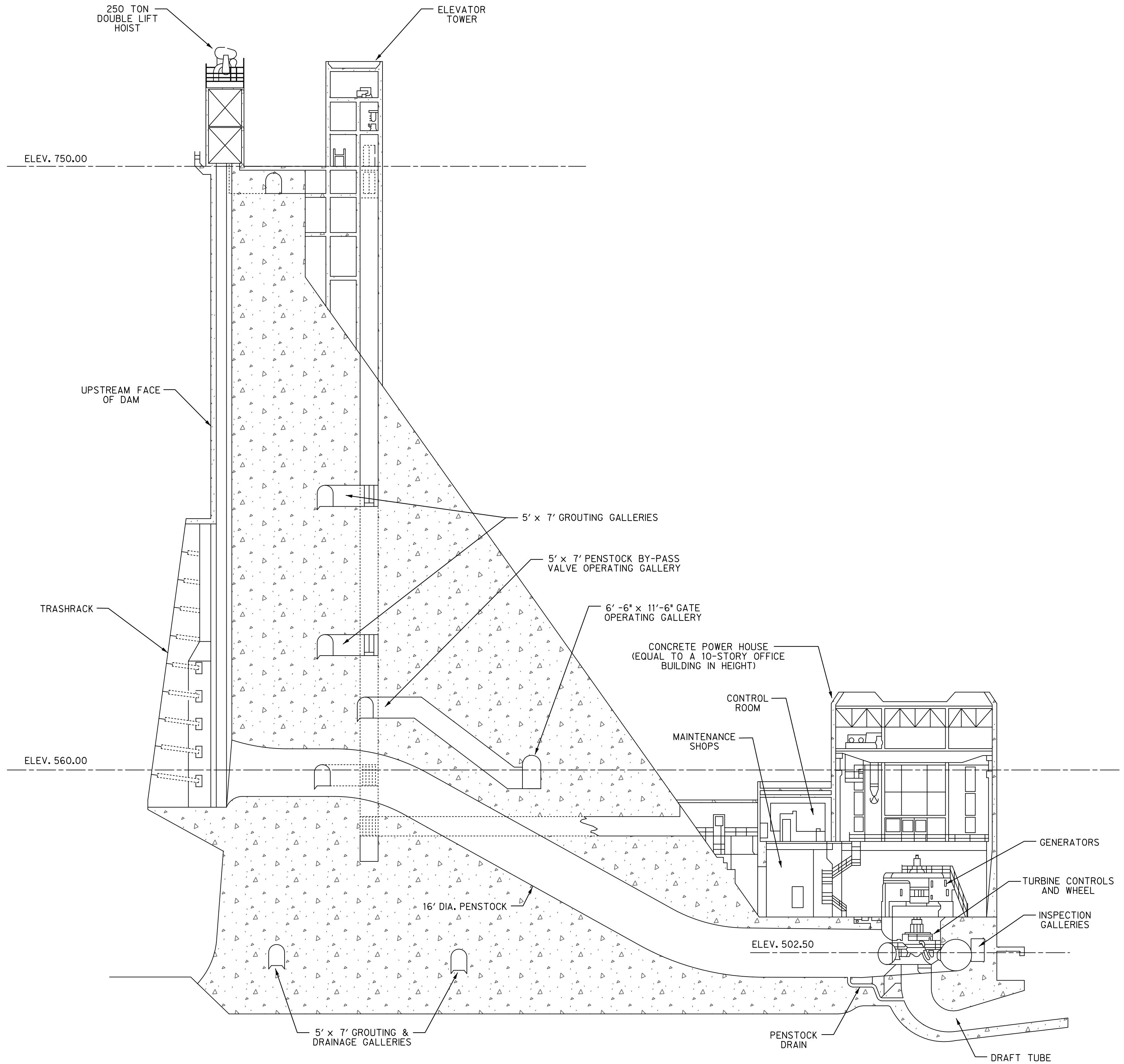

SECTION OF DAM AT POWER HOUSE

NOT TO SCALE

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

HYDROELECTRIC PLANT

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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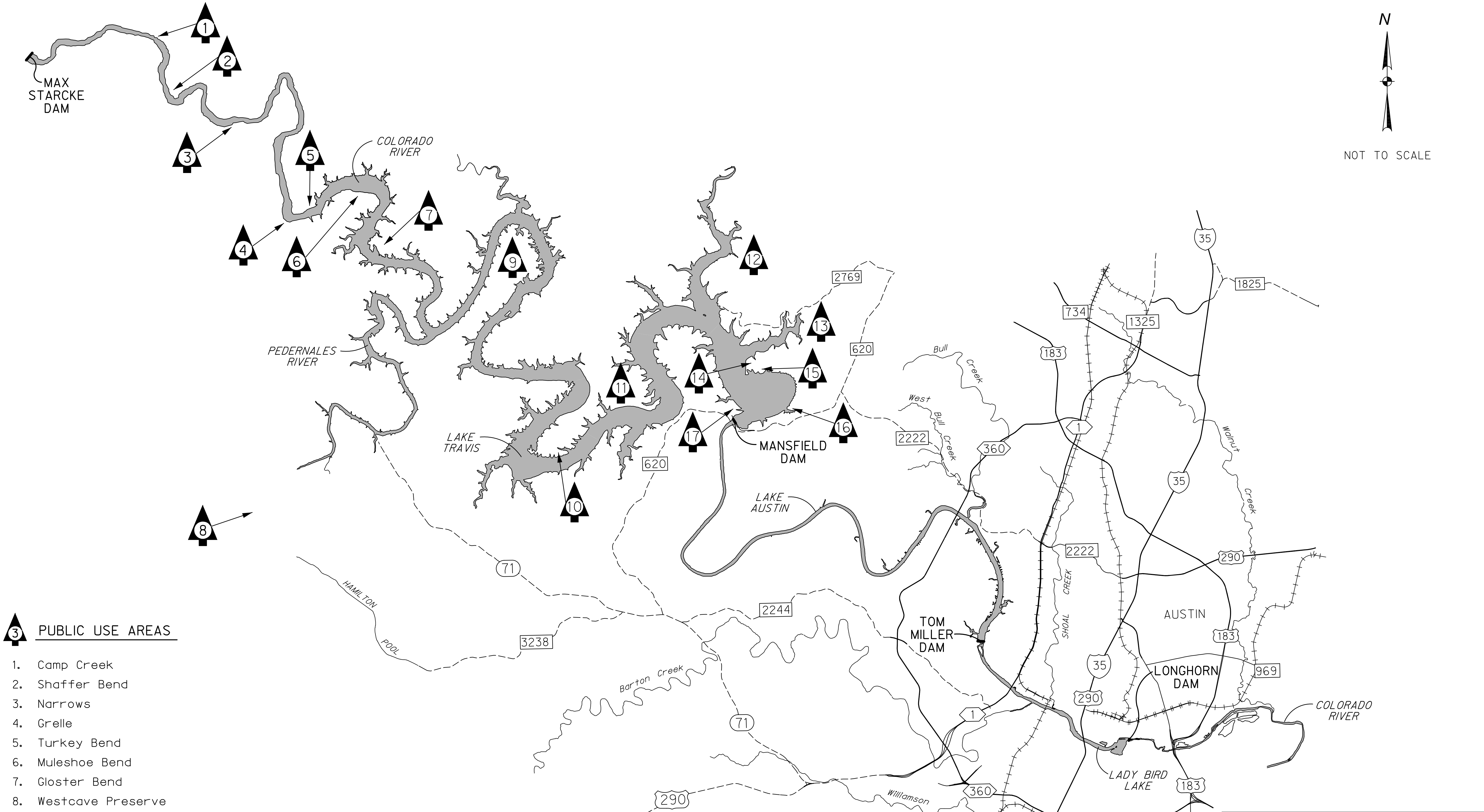

PUBLIC USE AREAS

1. Camp Creek
2. Shaffer Bend
3. Narrows
4. Grelle
5. Turkey Bend
6. Muleshoe Bend
7. Gloster Bend
8. Westcave Preserve
9. Pace Bend
10. Dink Pearson Park
11. Arkansas Bend
12. Sandy Creek
13. Cypress Creek
14. Bob Wentz at Windy Point
15. Hippie Hollow
16. Tom Hughes Park
17. Mansfield Dam Park

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

PUBLIC USE AREAS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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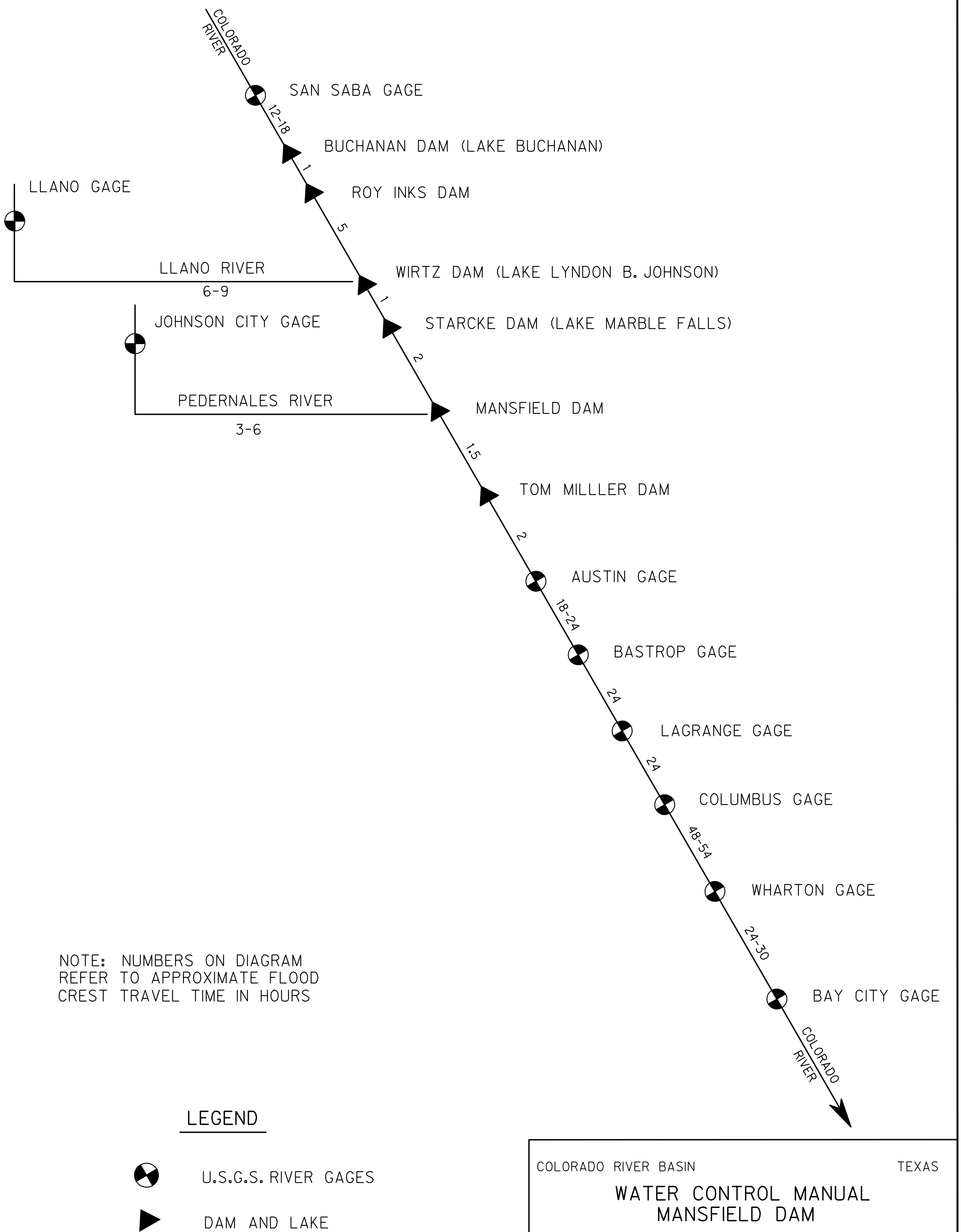

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

FLOOD CREST TRAVEL TIMES

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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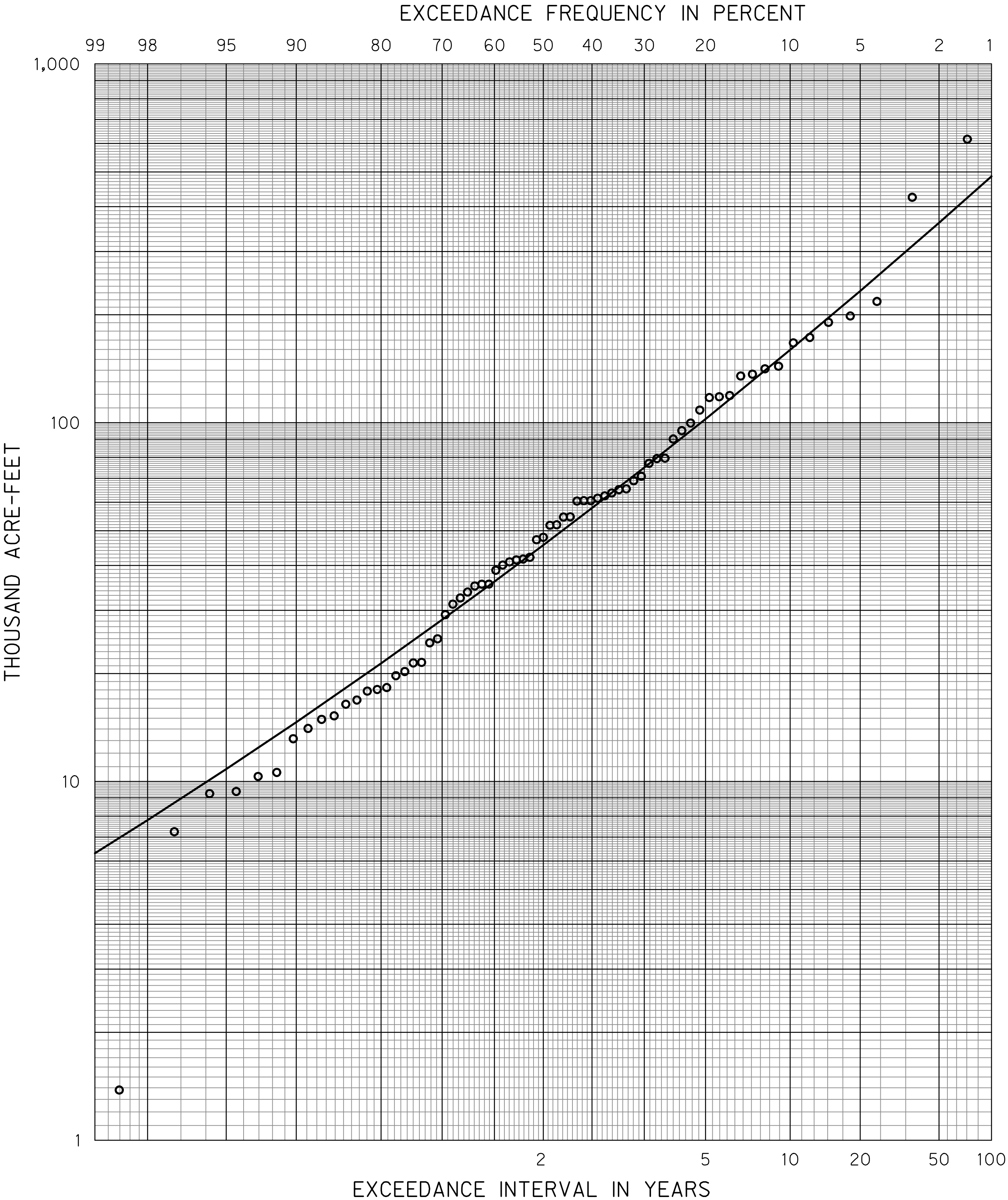


NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

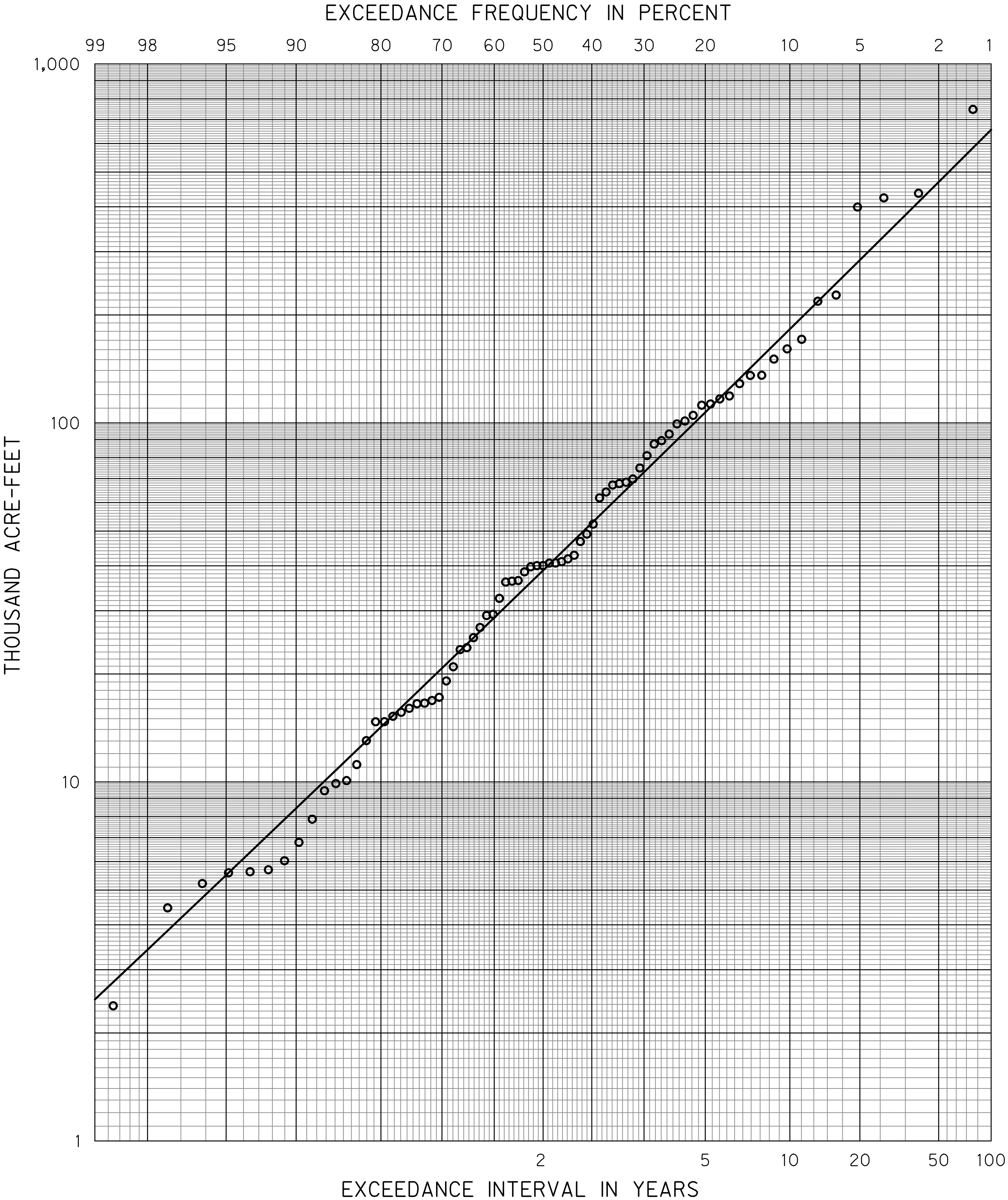
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JANUARY INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JANUARY INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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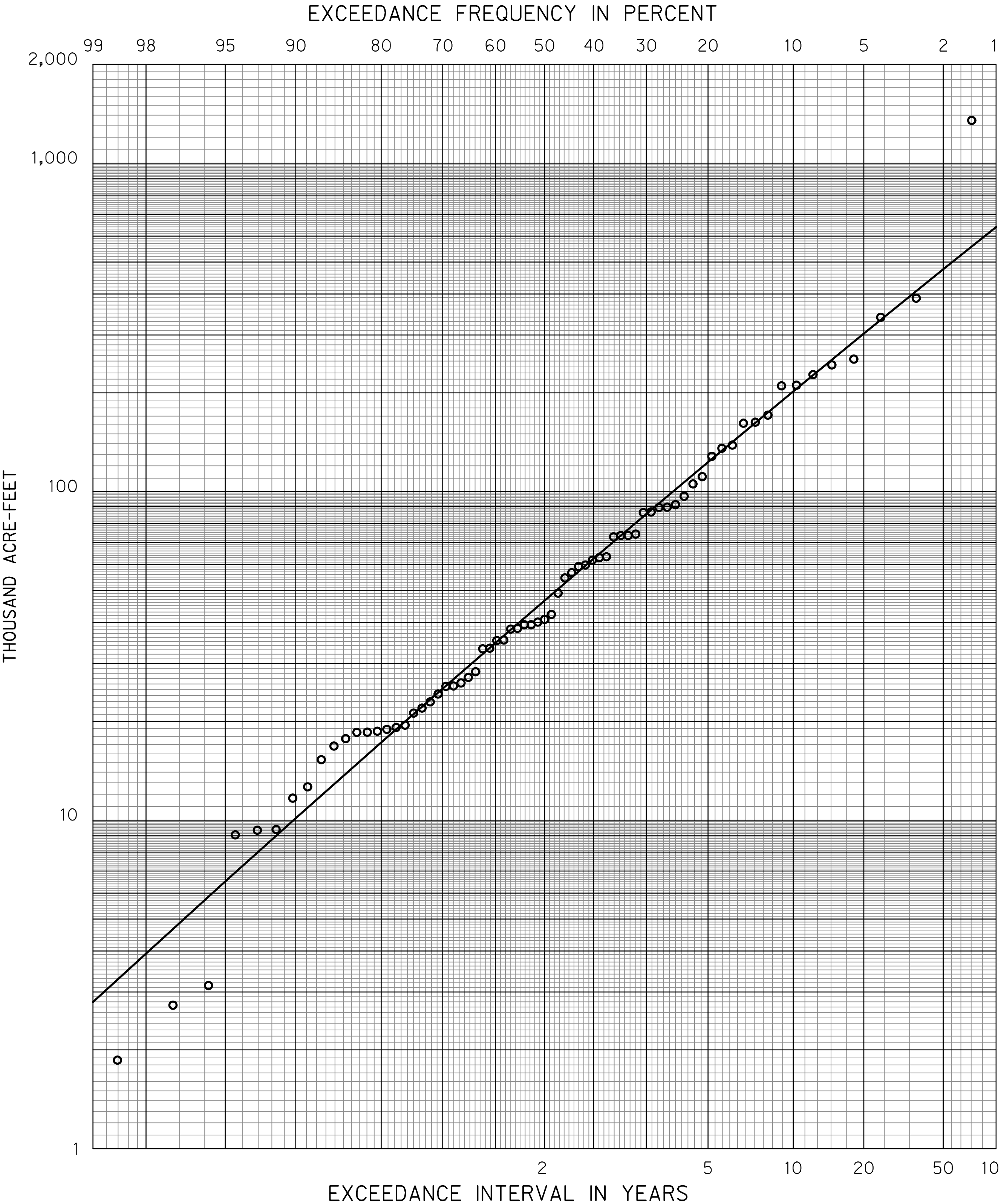

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COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

FEBRUARY INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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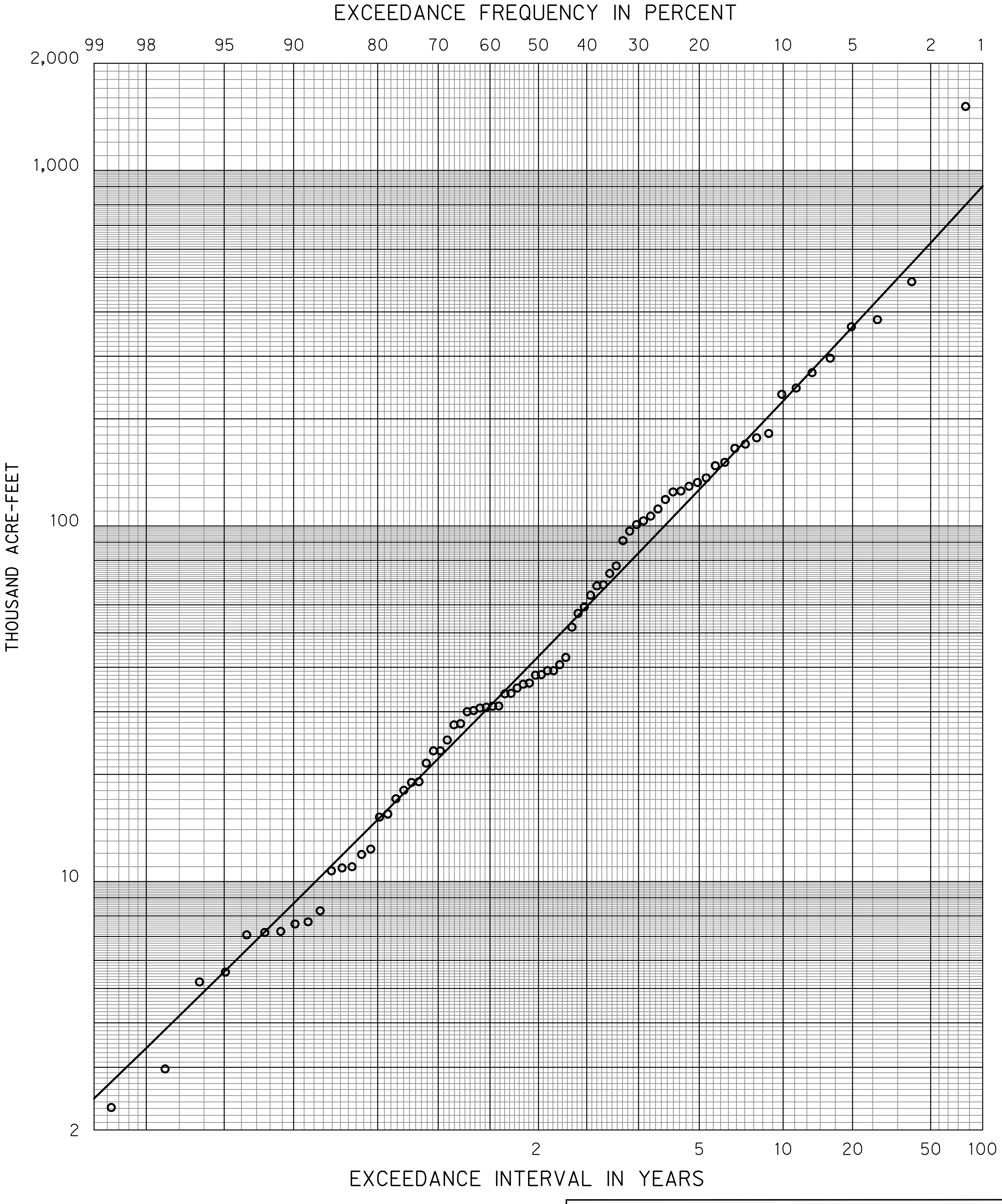

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COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

FEBRUARY INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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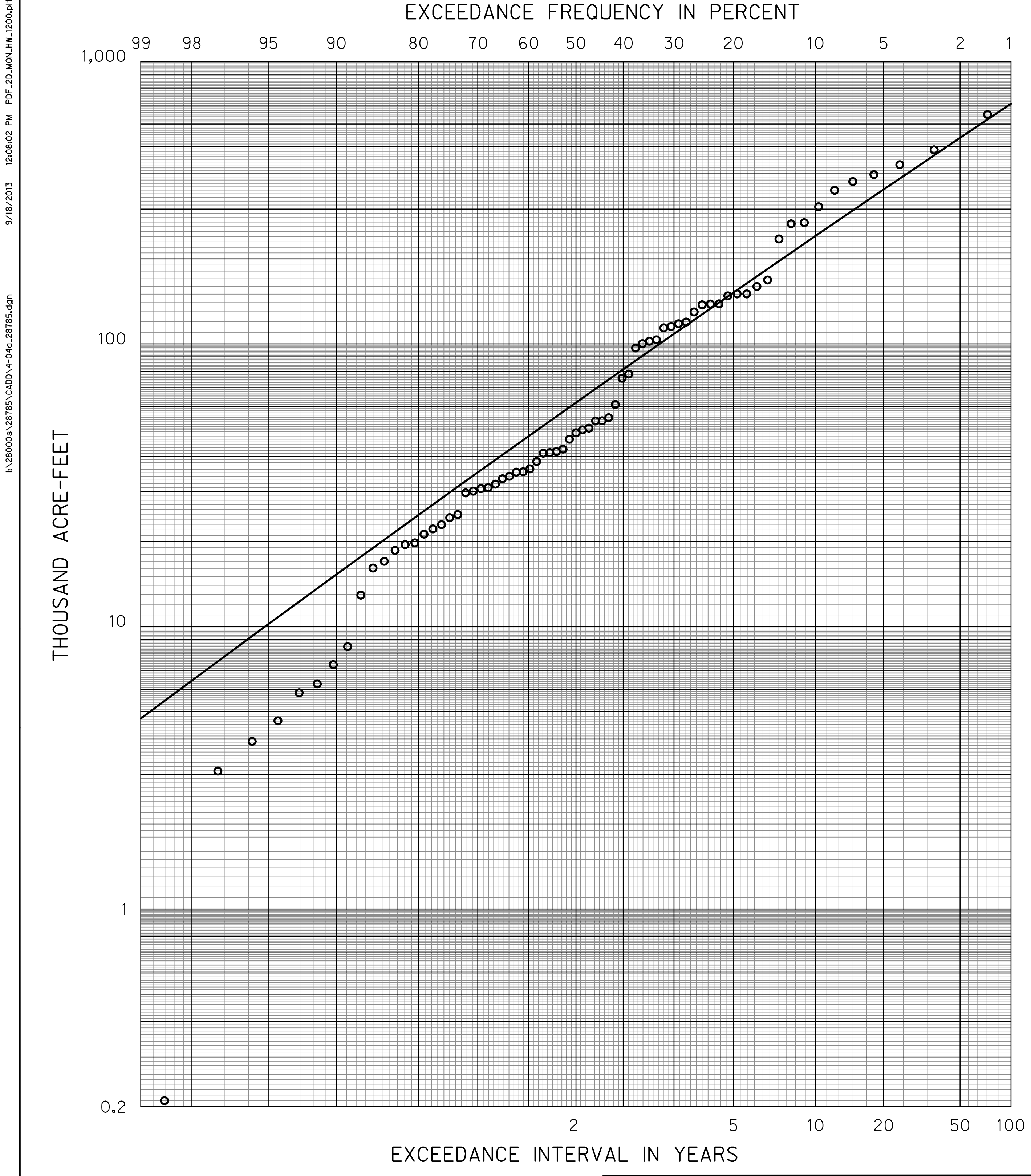

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COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

MARCH INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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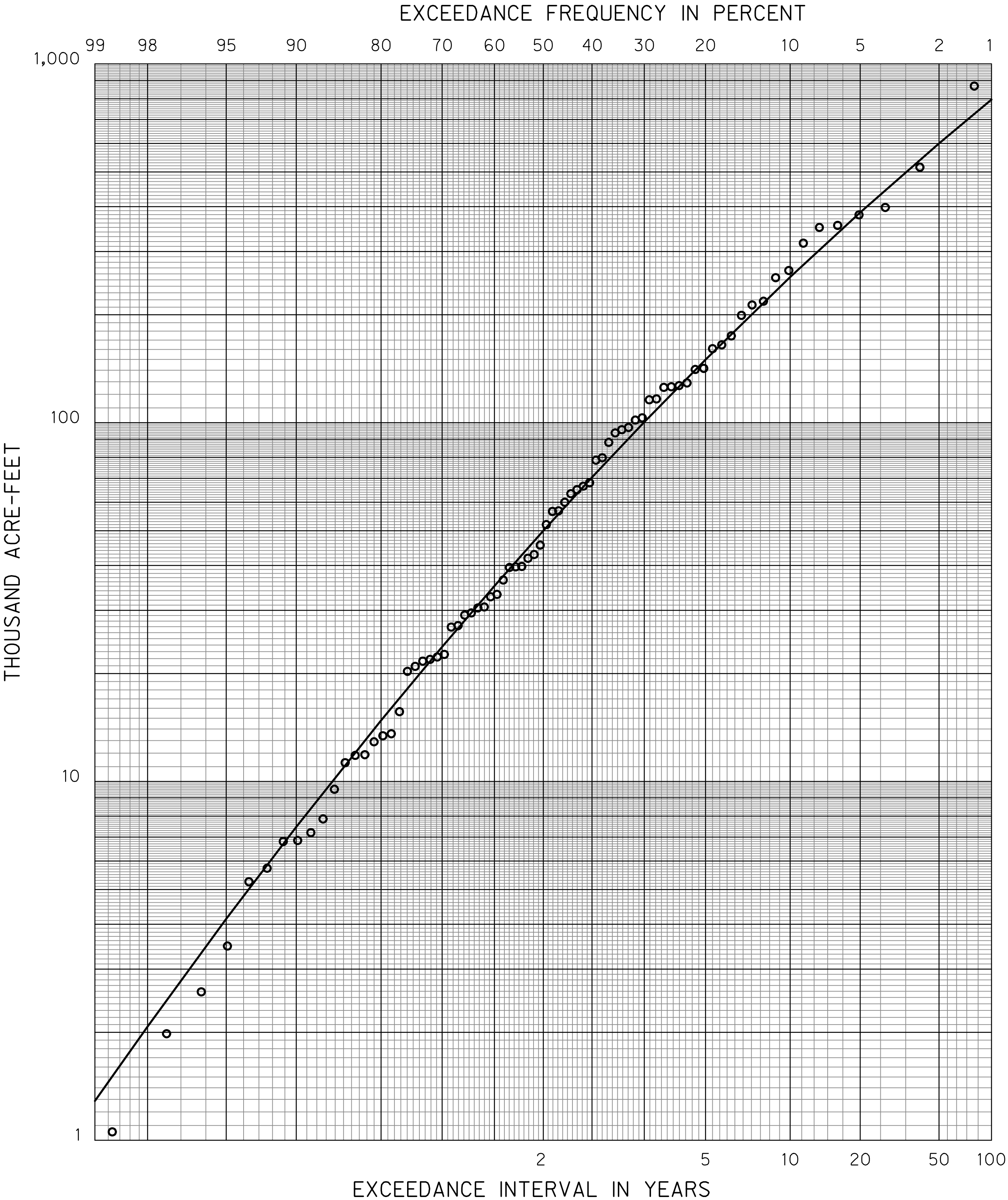

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COLORADO RIVER BASIN — TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

MARCH INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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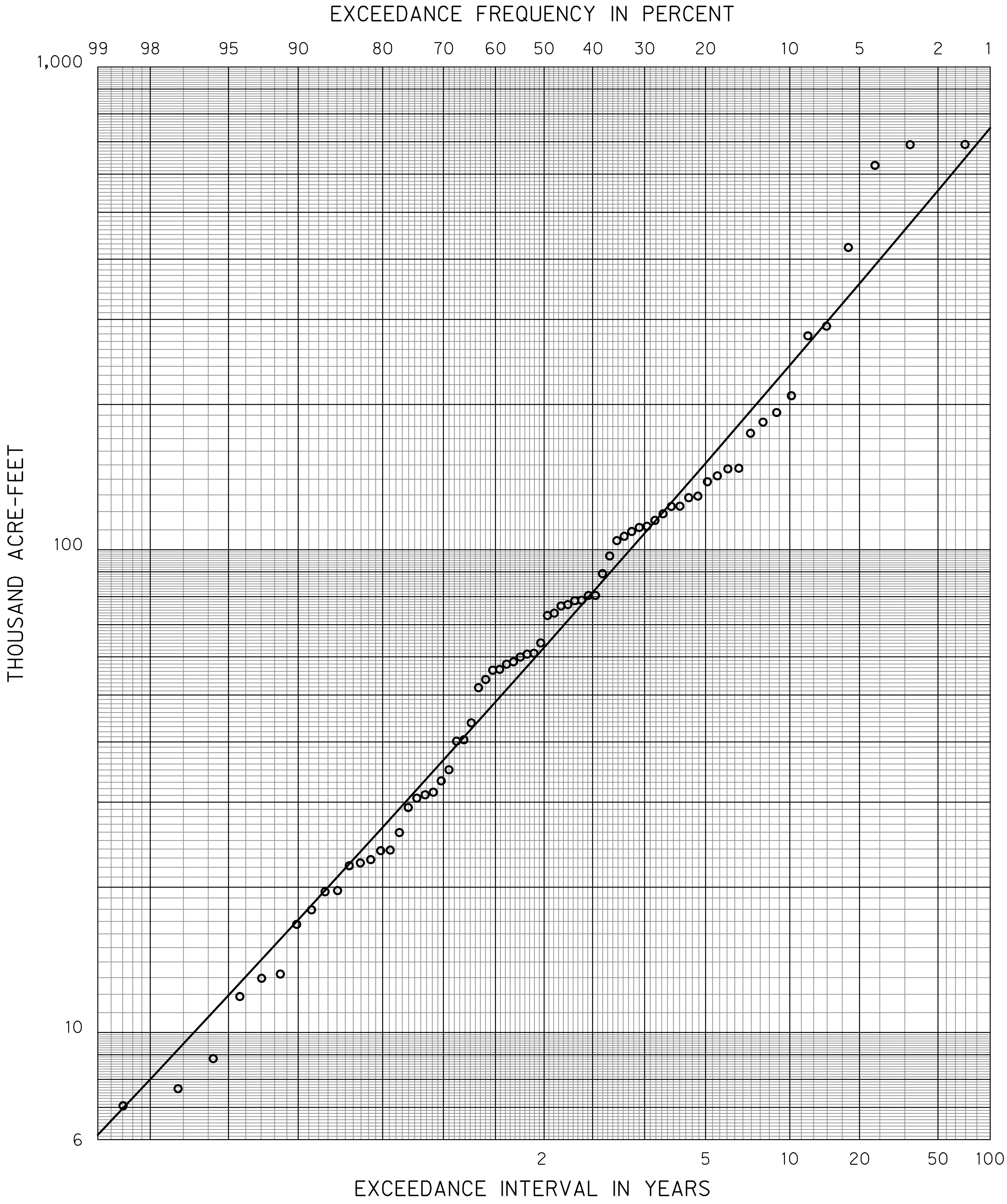

NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

APRIL INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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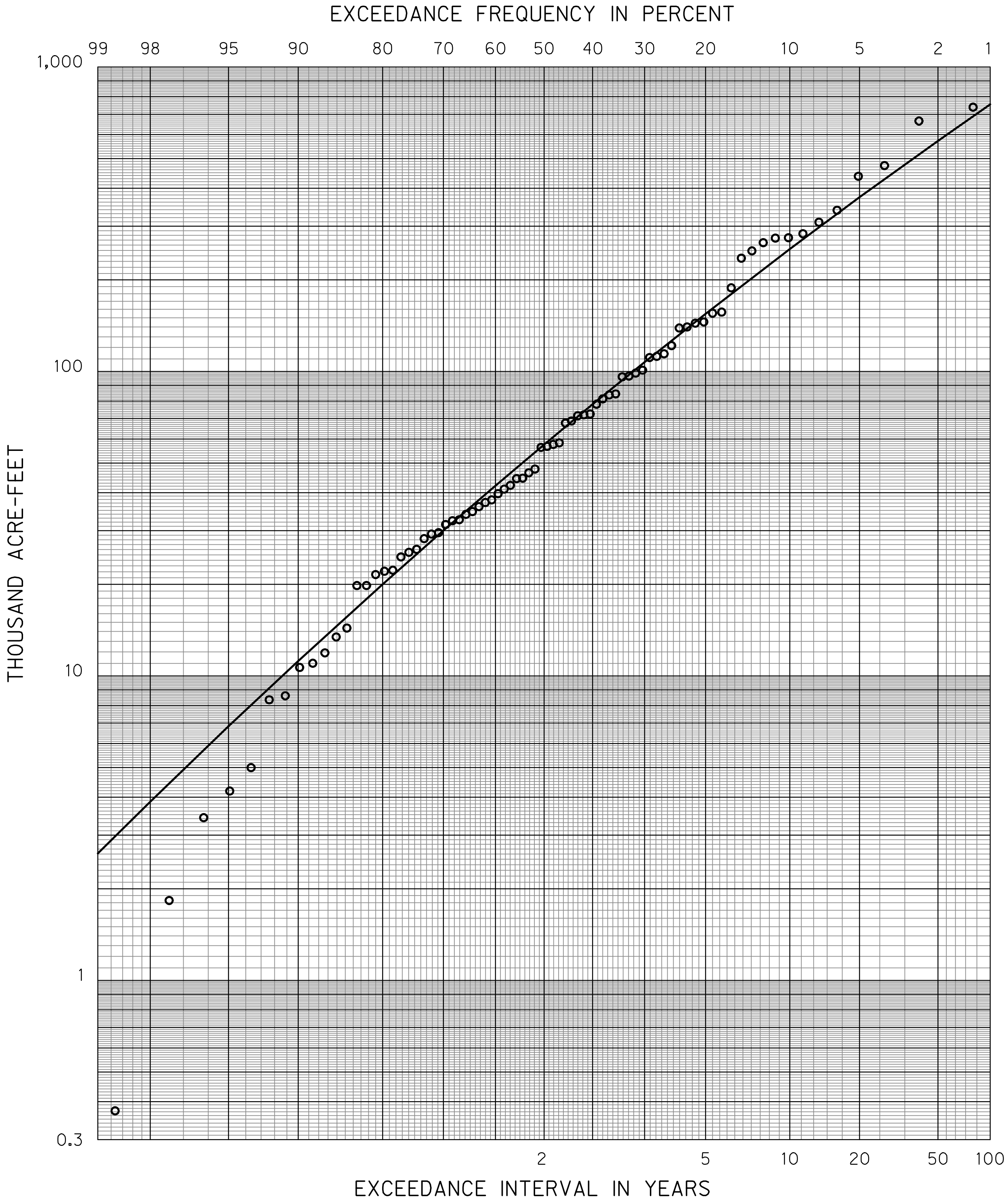

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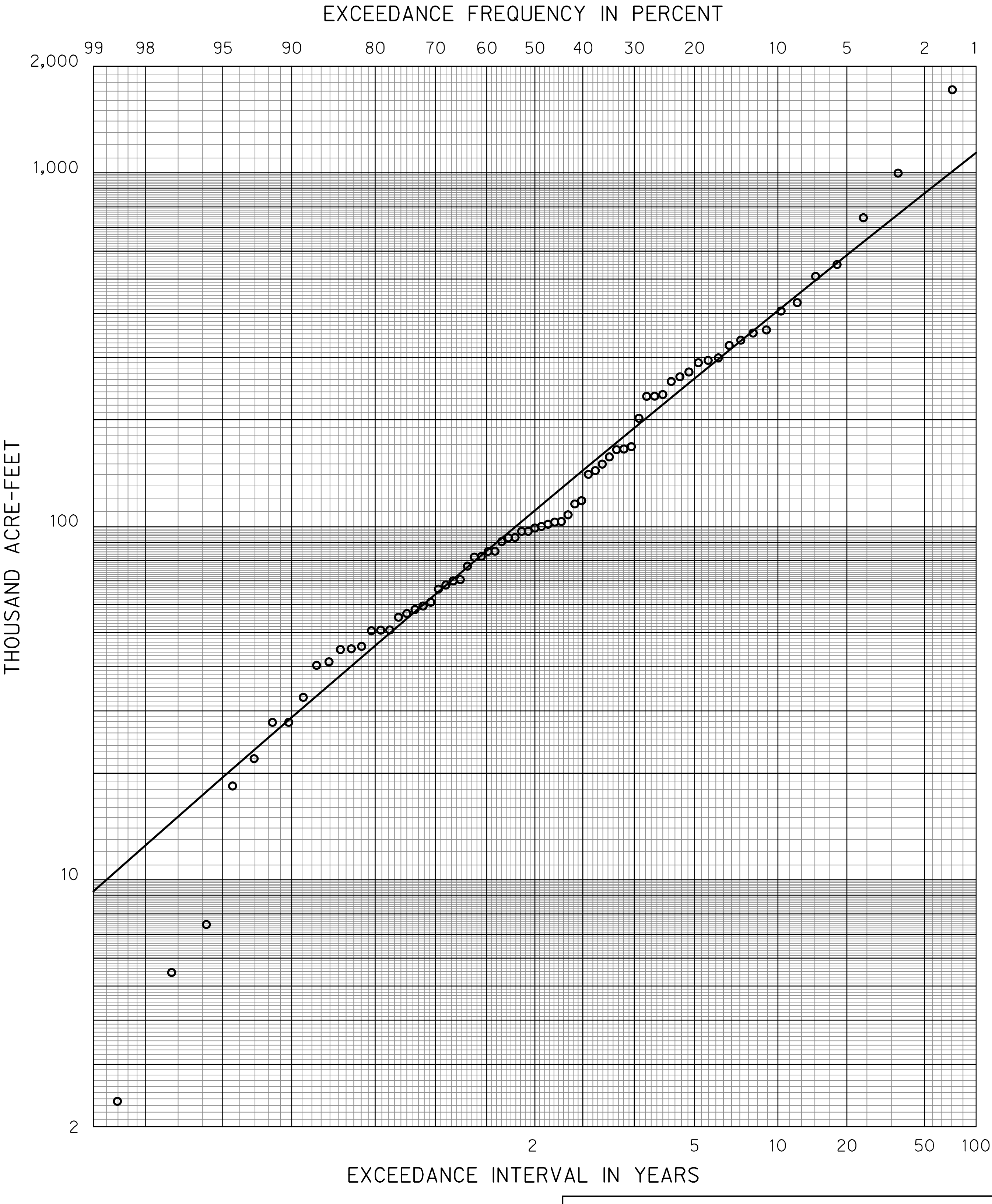
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

APRIL INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

MAY INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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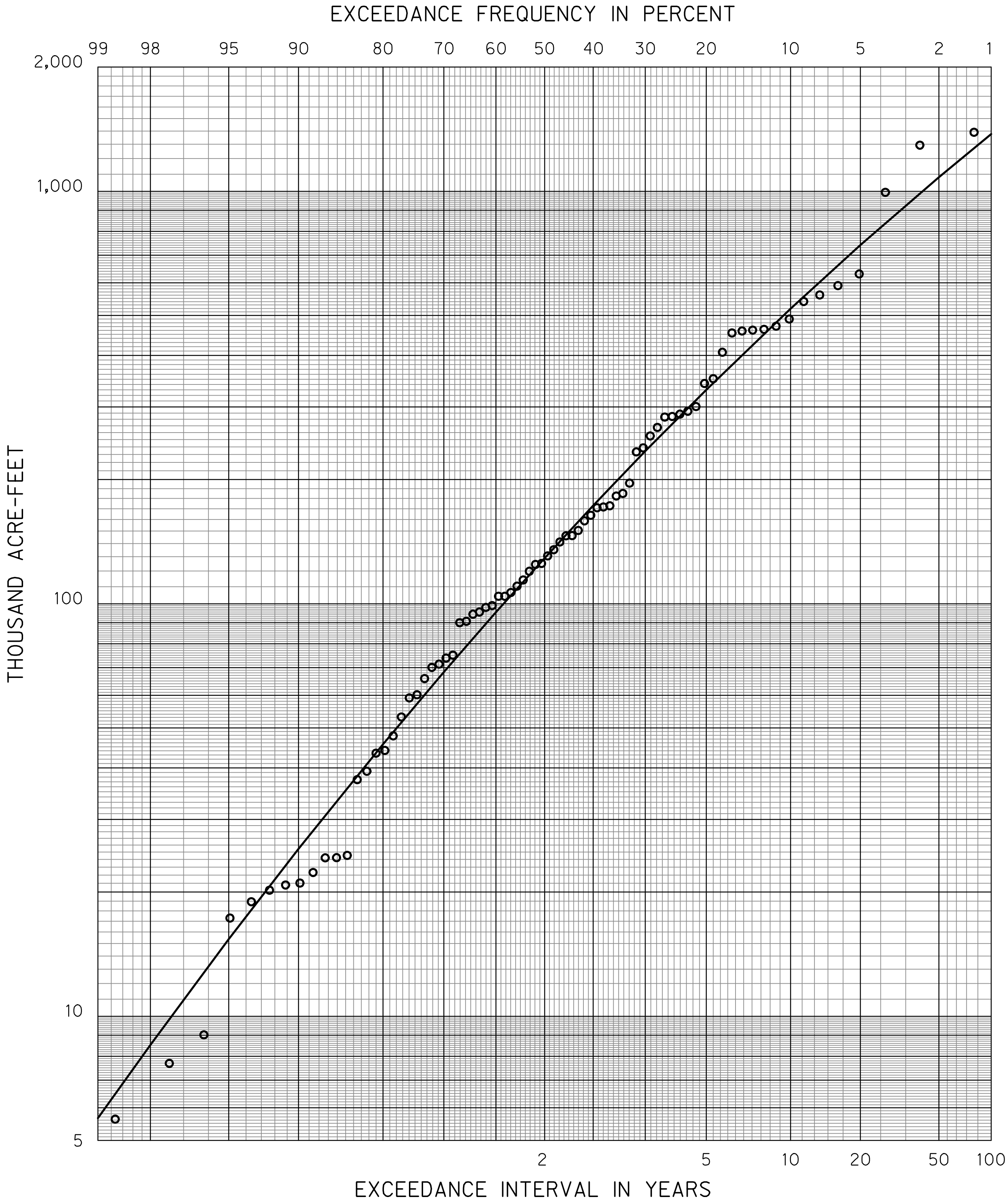


NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

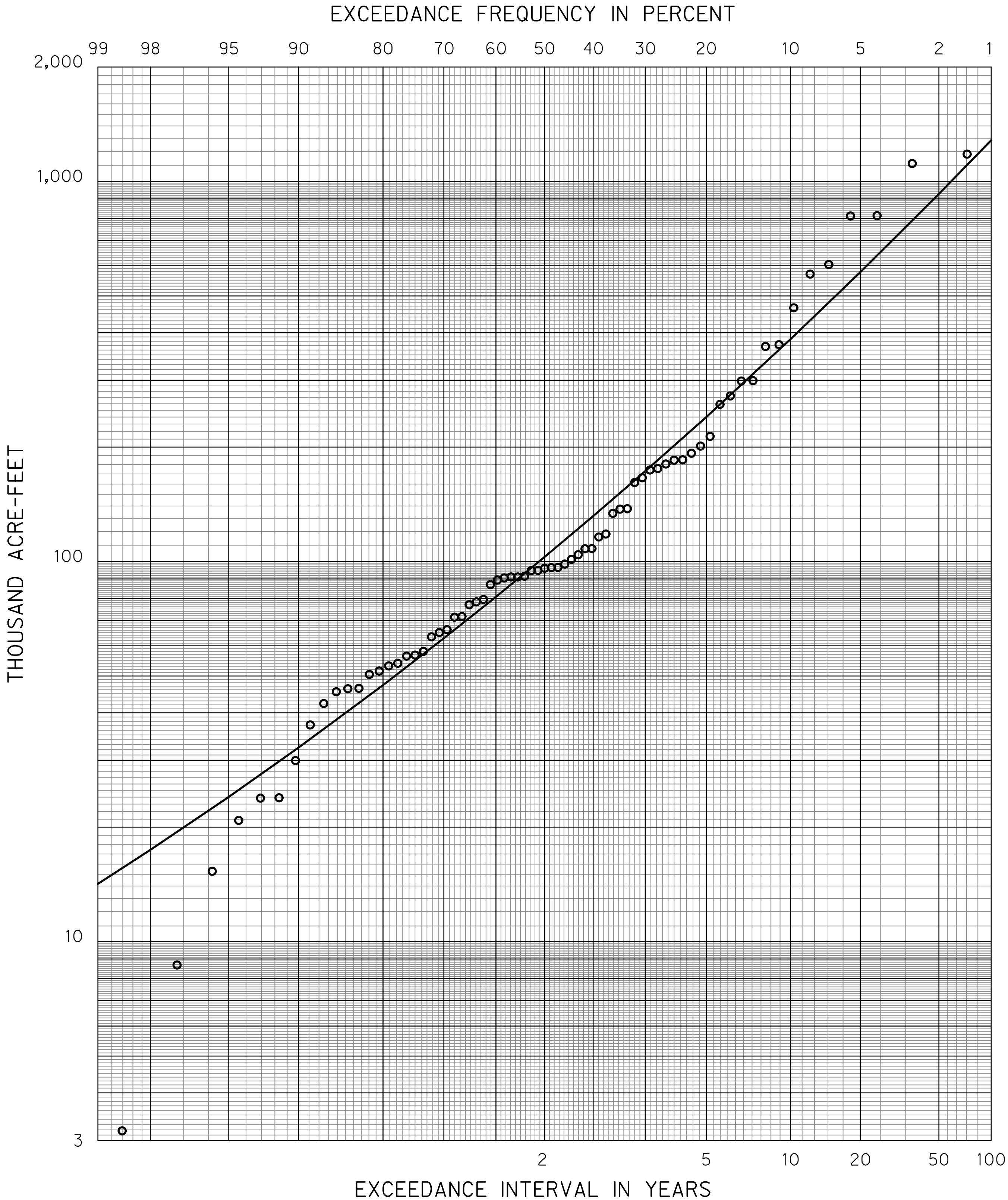
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

MAY INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JUNE INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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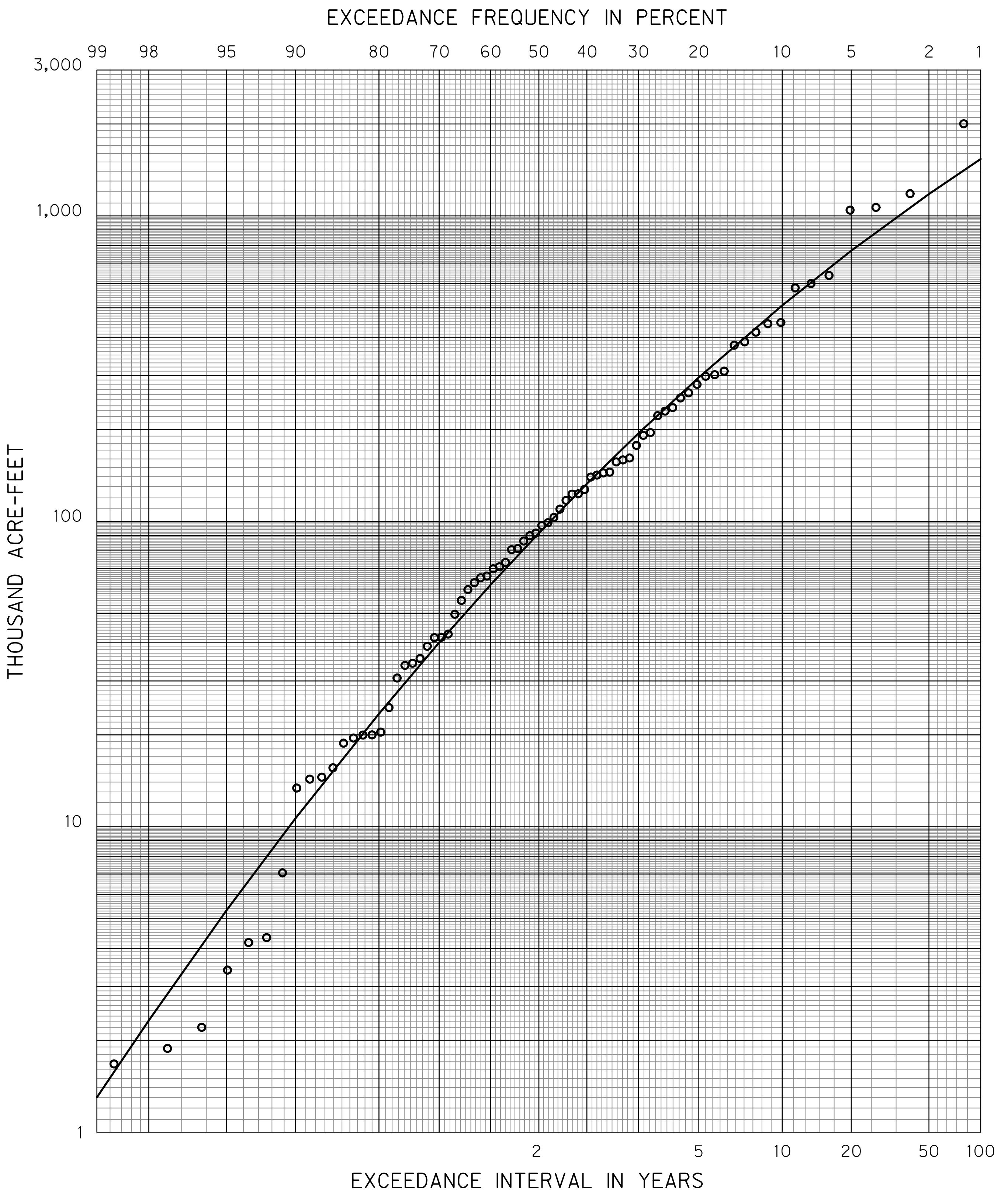


NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

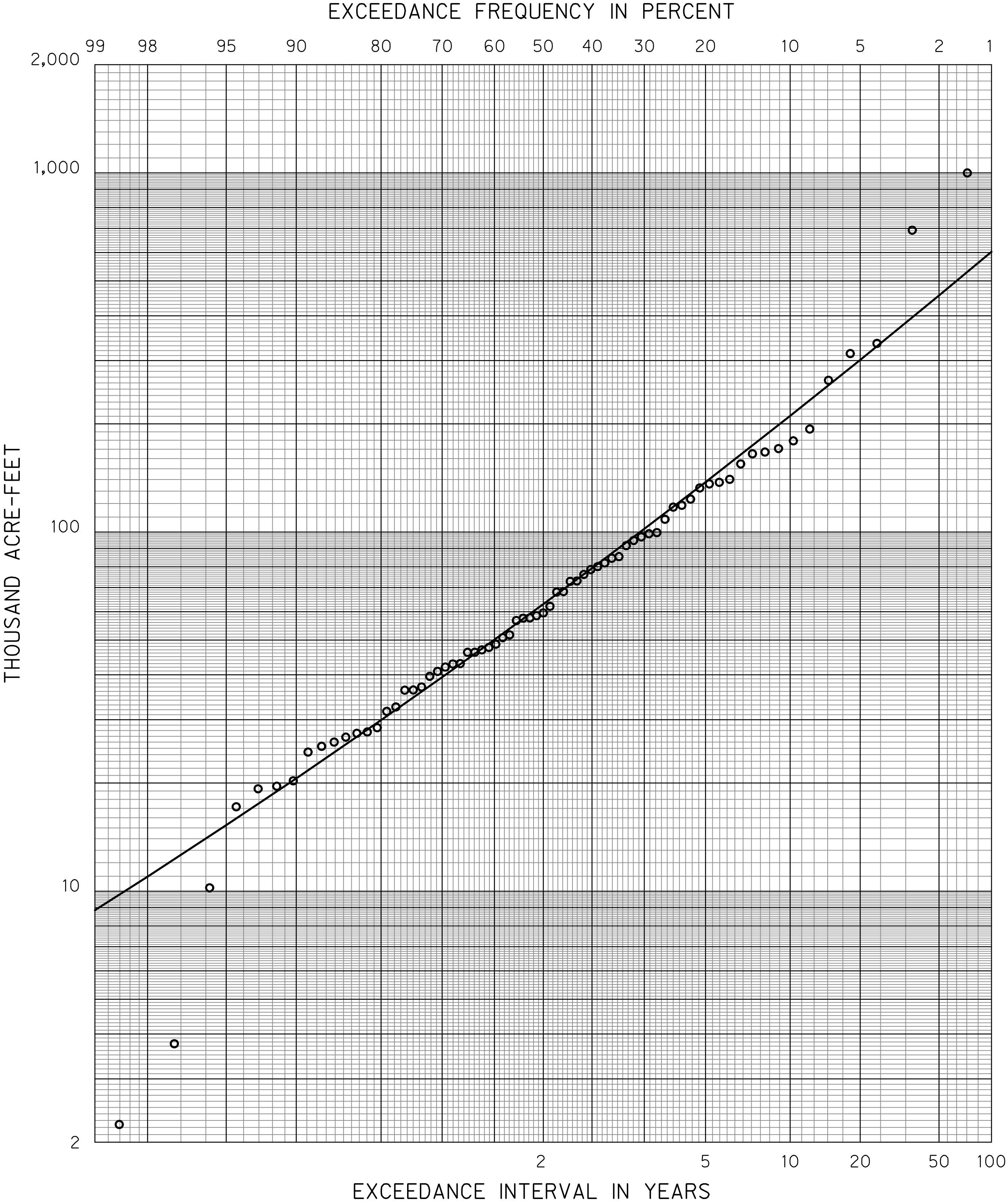
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JUNE INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JULY INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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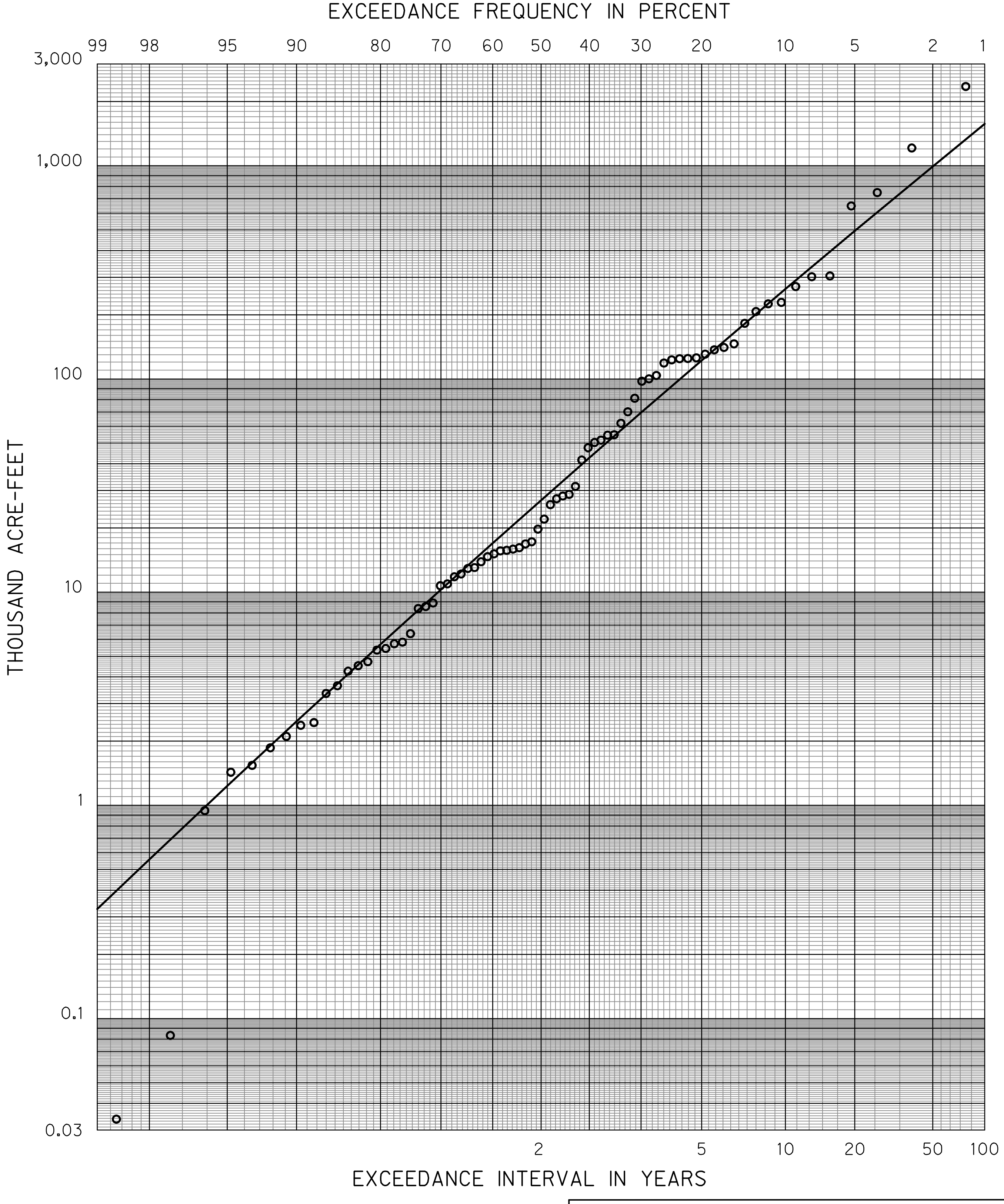

NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

JULY INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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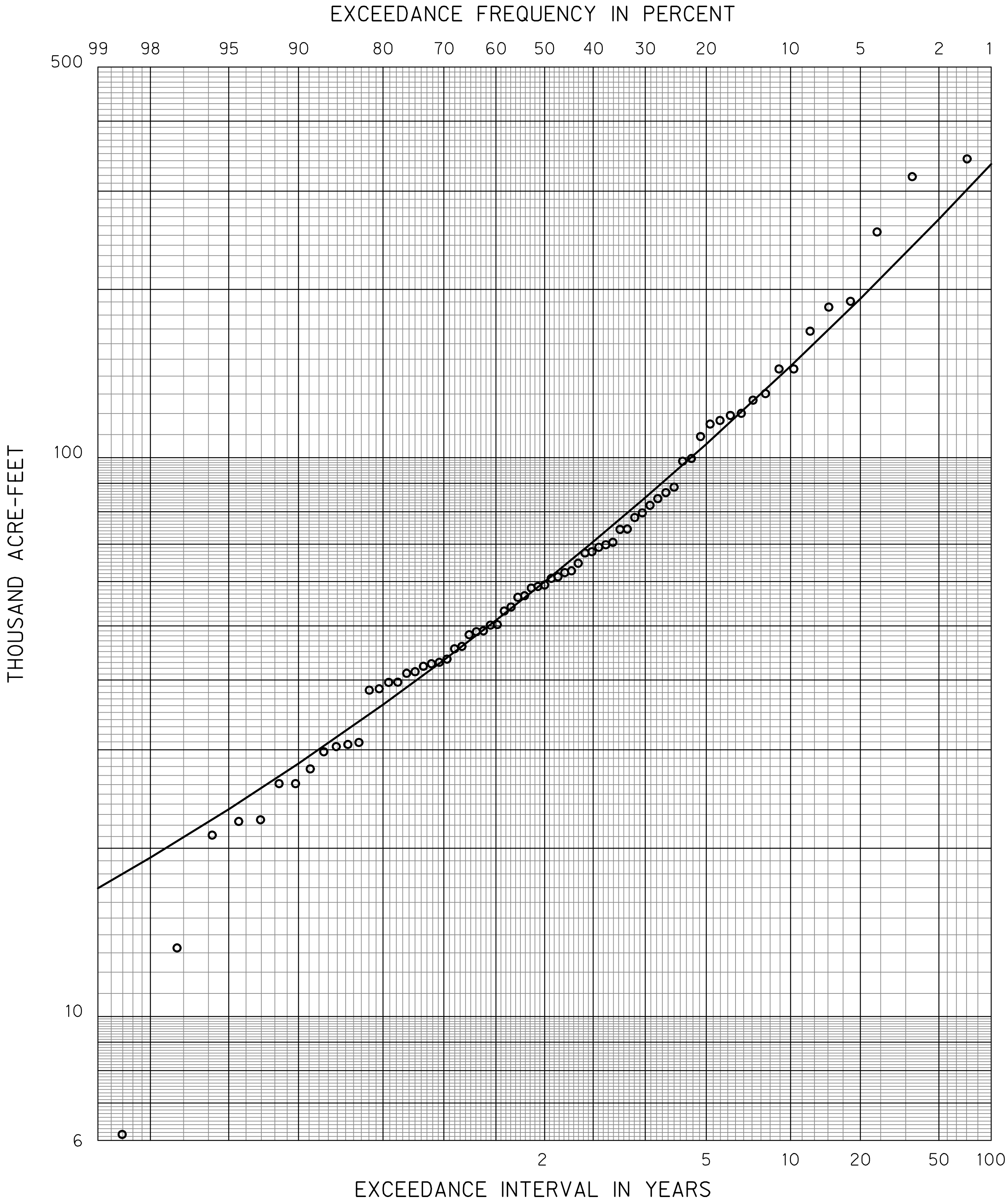

NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN — TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

AUGUST INFLOW FREQUENCY
HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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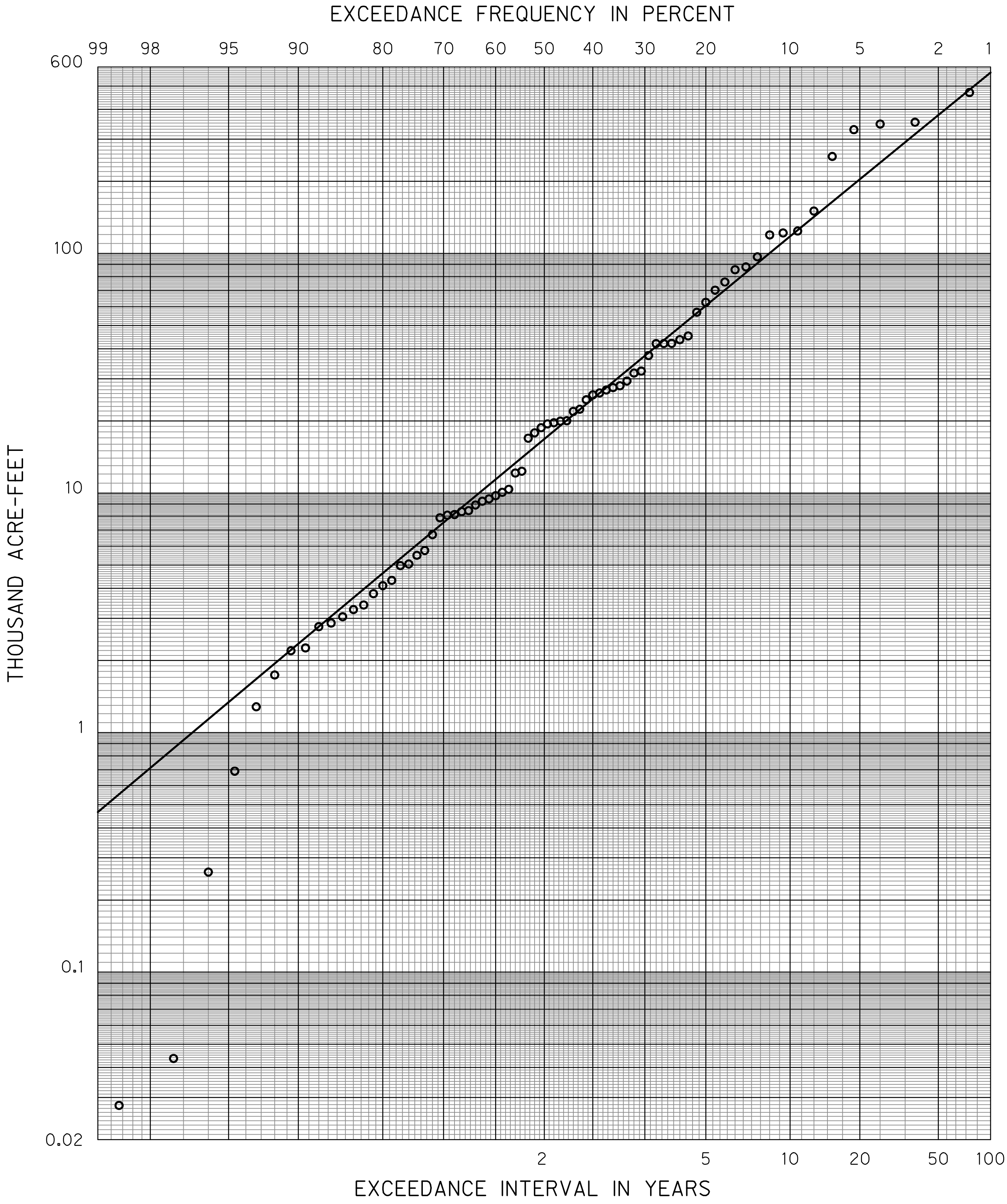

NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

AUGUST INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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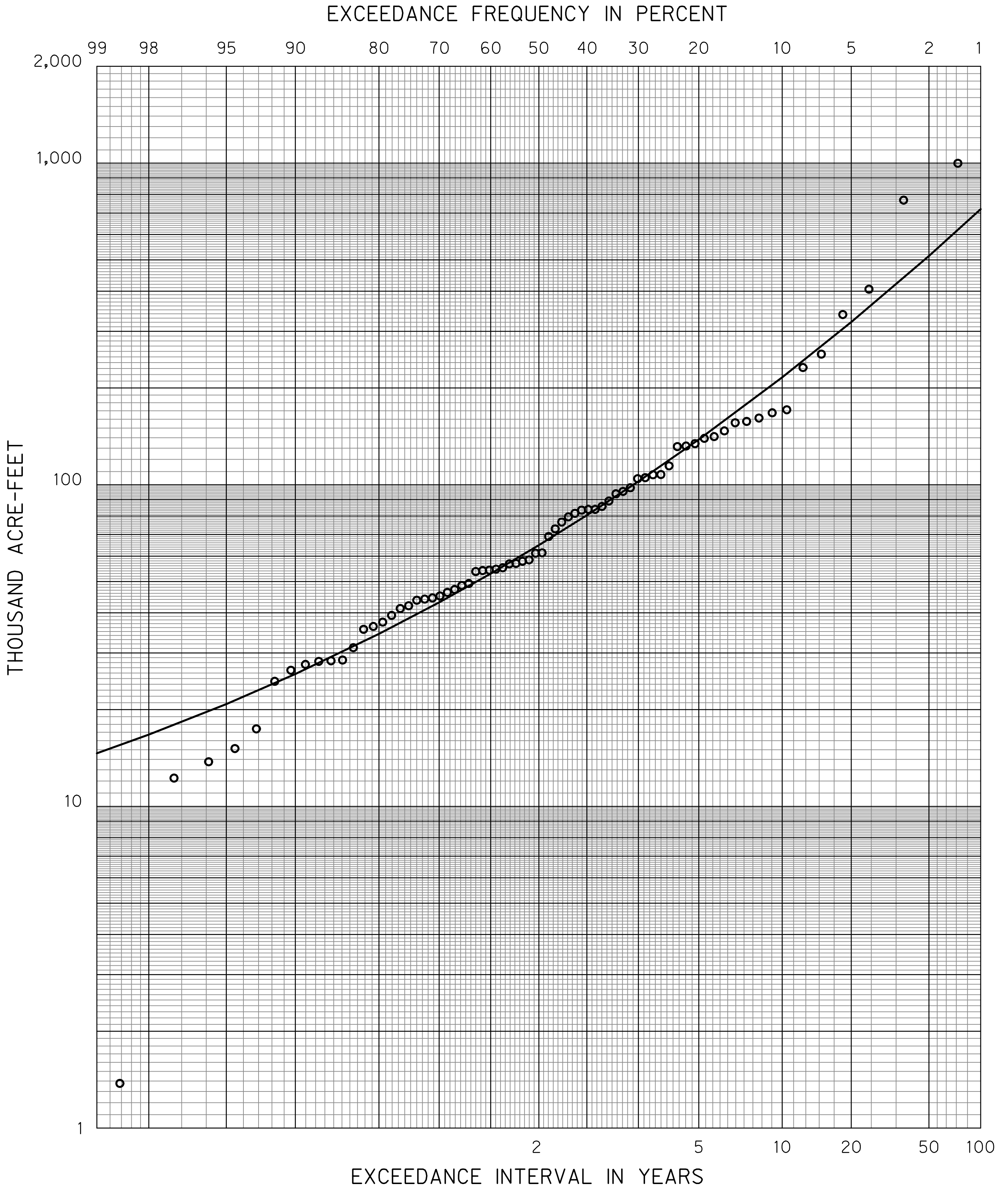

NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

SEPTEMBER INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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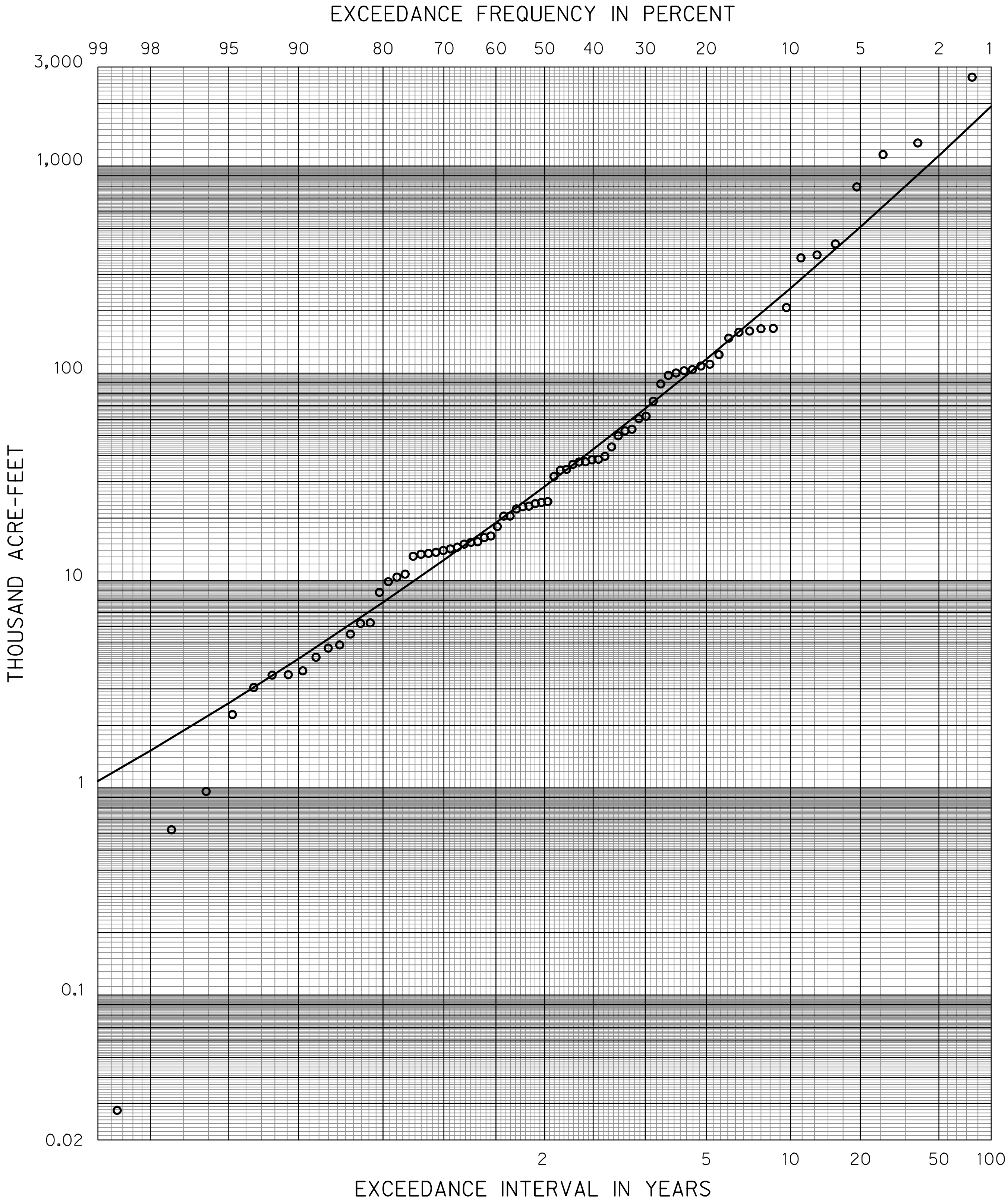

NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

SEPTEMBER INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

PLATE 4-10b

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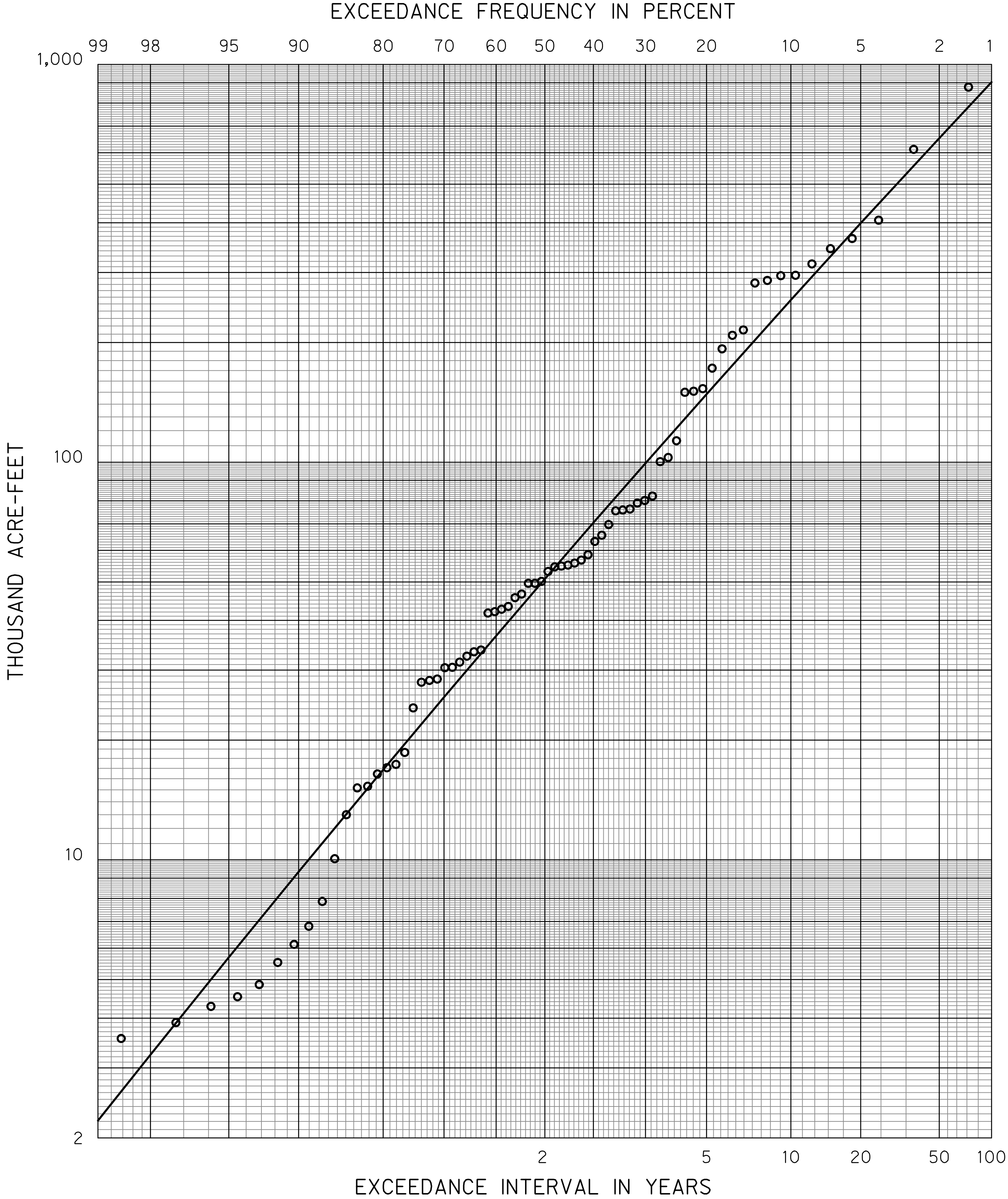


NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

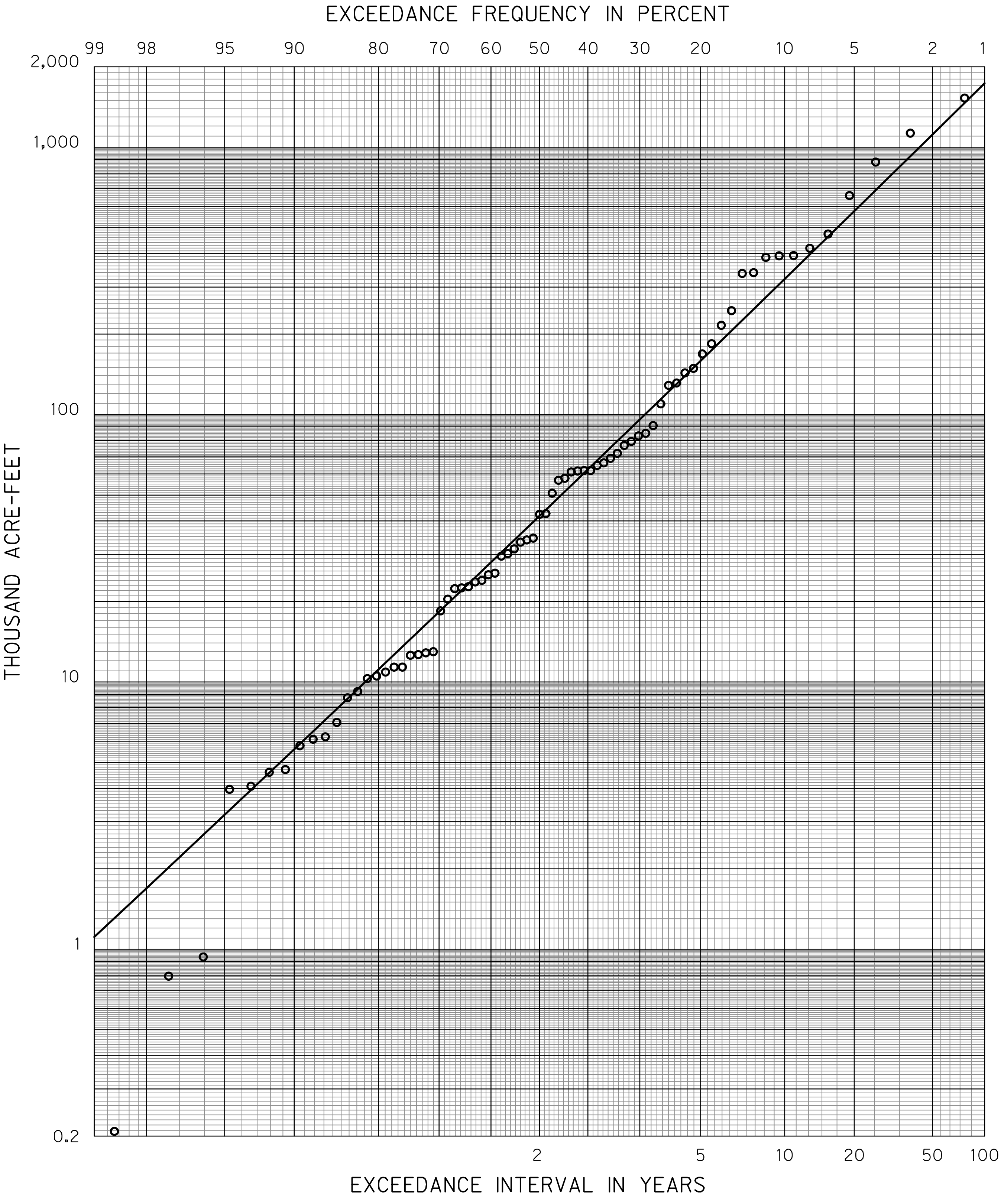
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

OCTOBER INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

OCTOBER INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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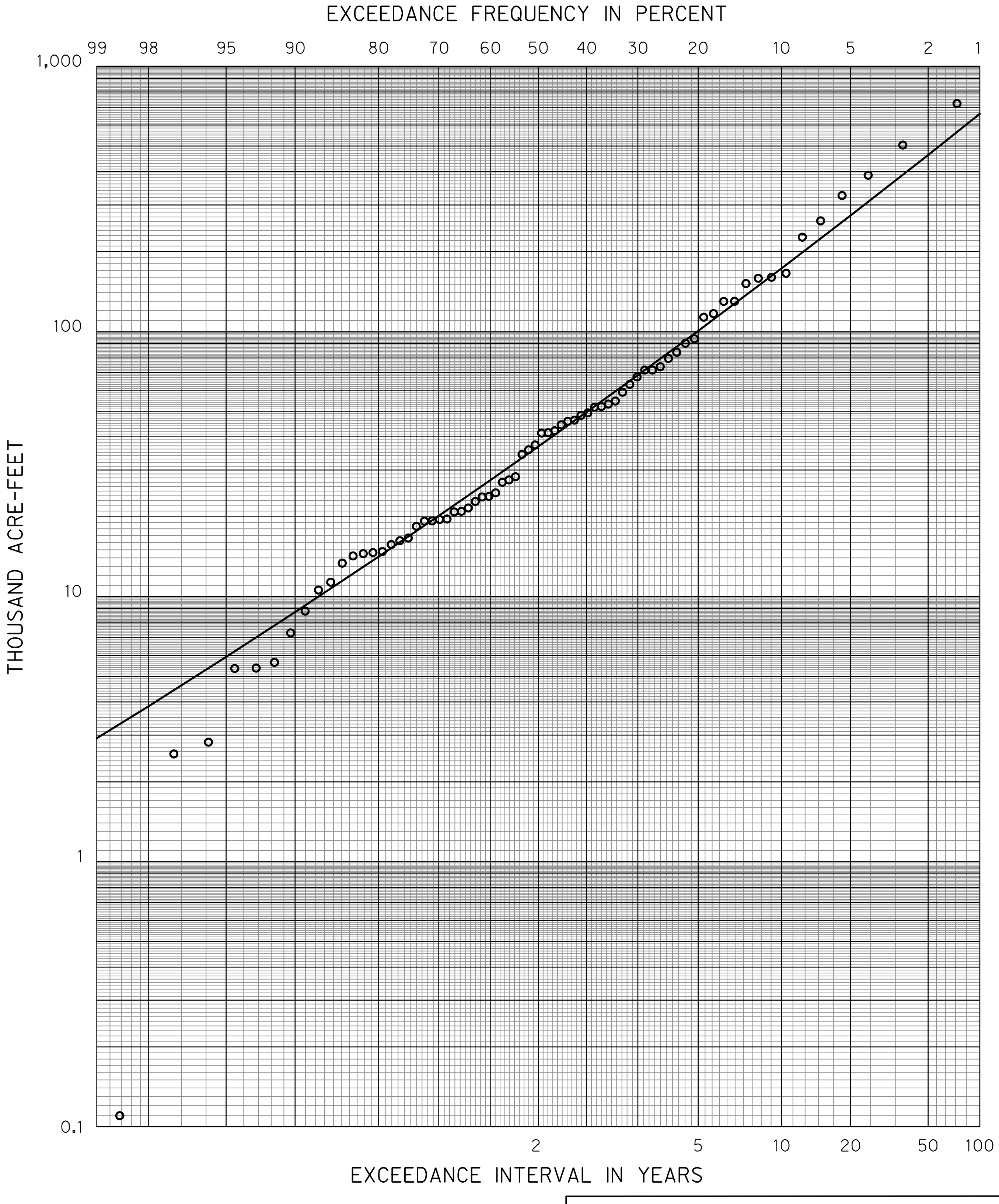


NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

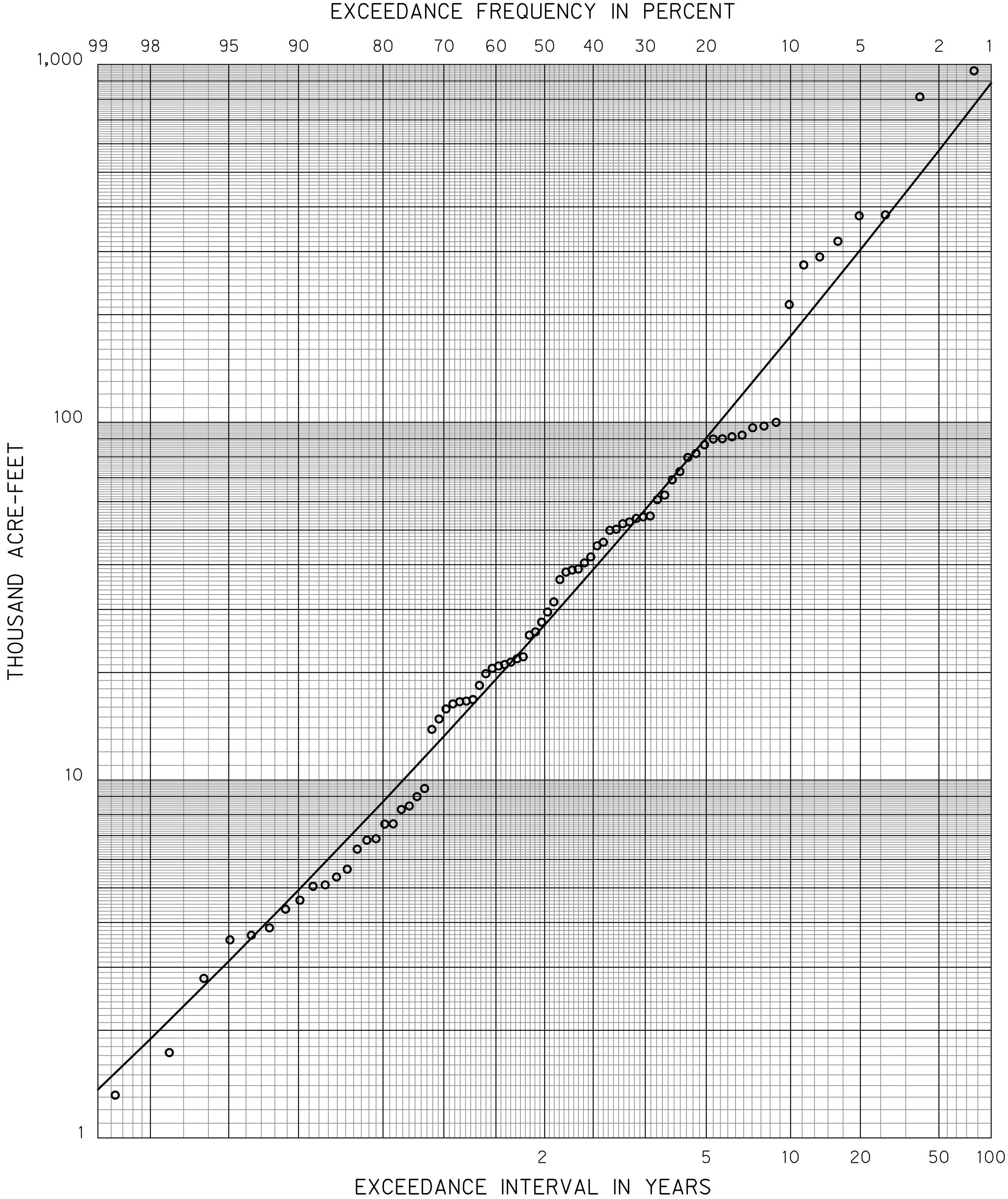
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

NOVEMBER INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

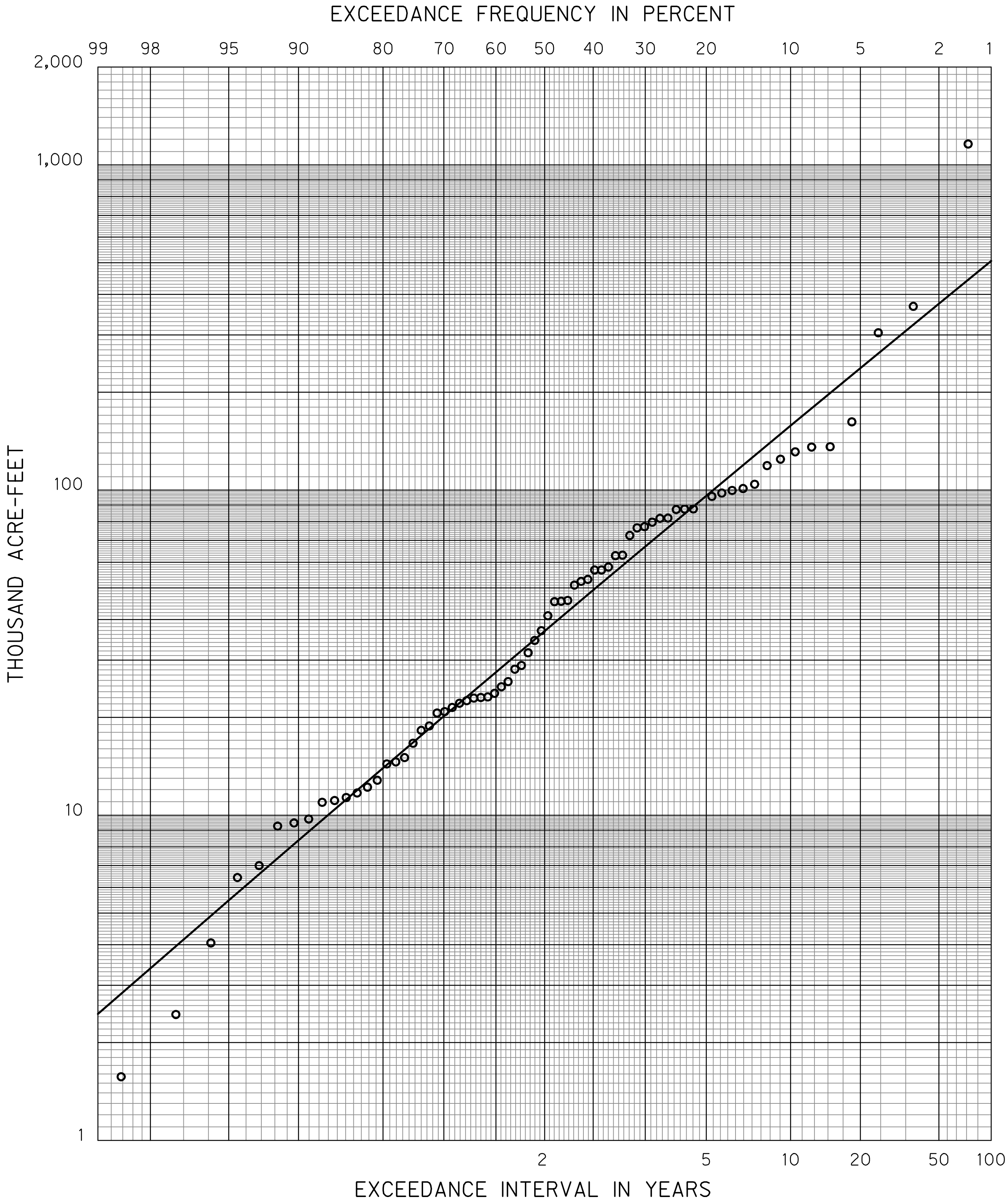
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

NOVEMBER INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON USACE COMPUTED INFLOW 71 YEAR RECORD, 1941-2011. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DECEMBER INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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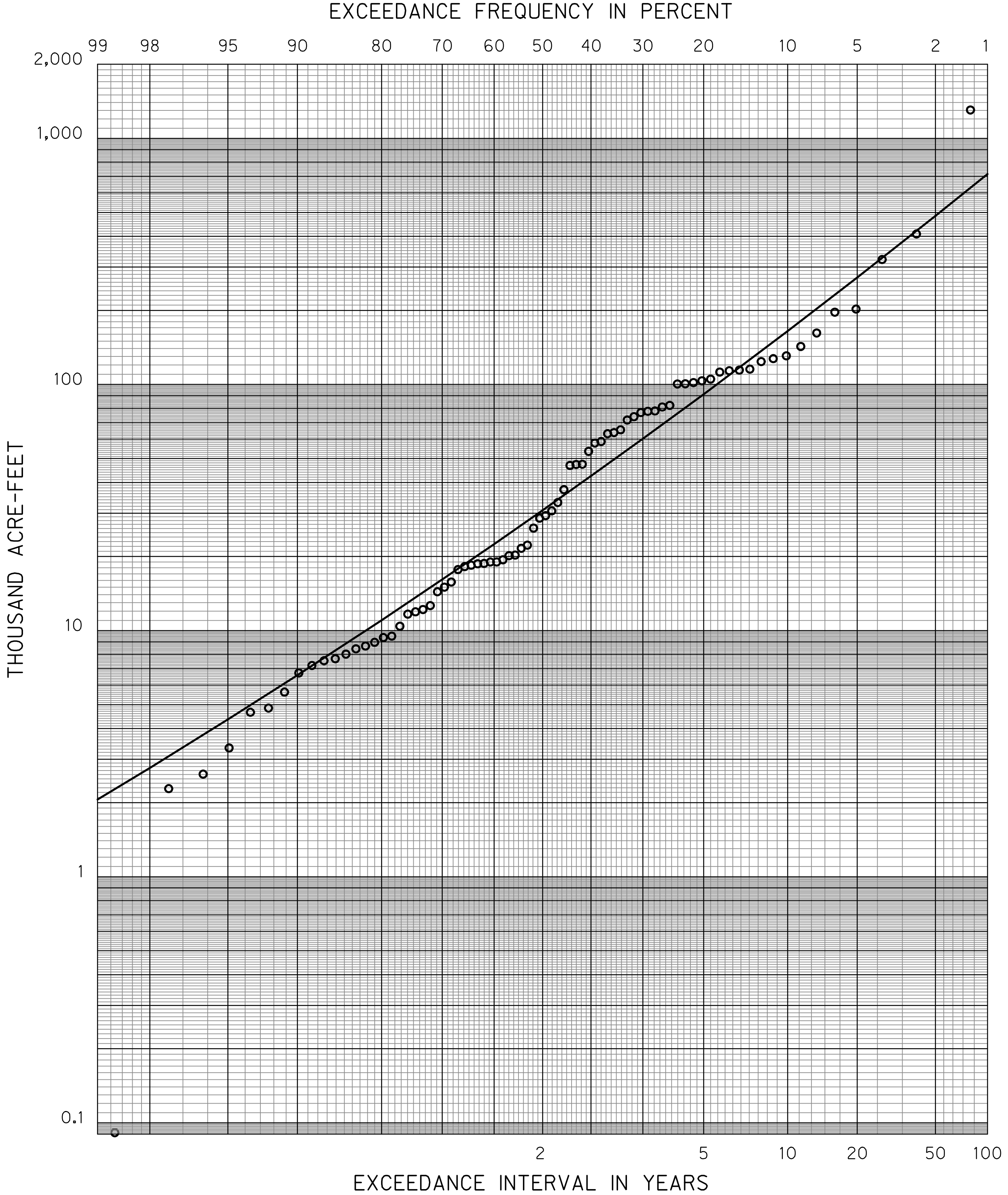

NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DECEMBER INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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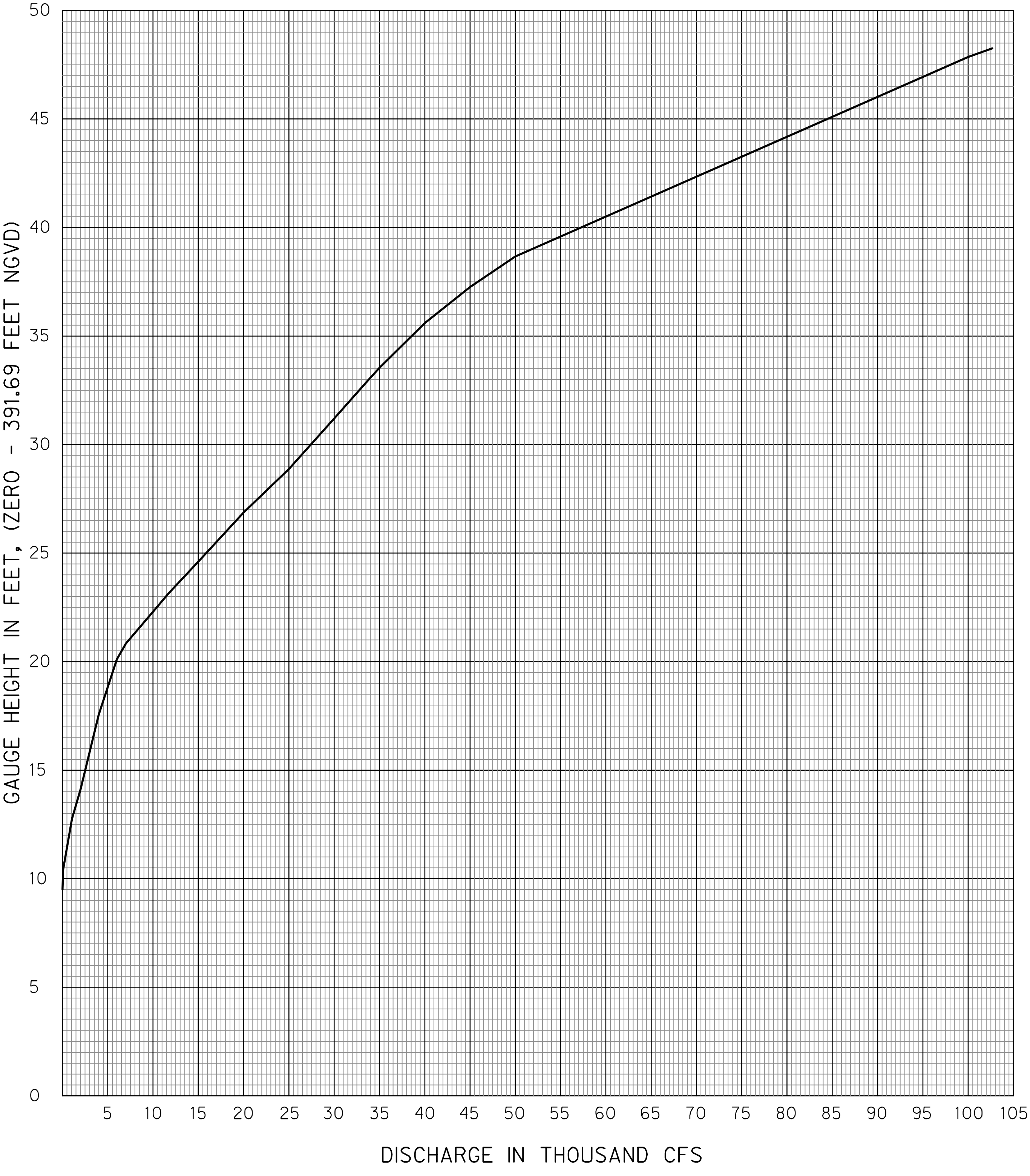

NWS FLOOD STAGE = 33 FEET
USGS DECEMBER 2012 RATING

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DISCHARGE RATING CURVE COLORADO RIVER AT AUSTIN (08158000)

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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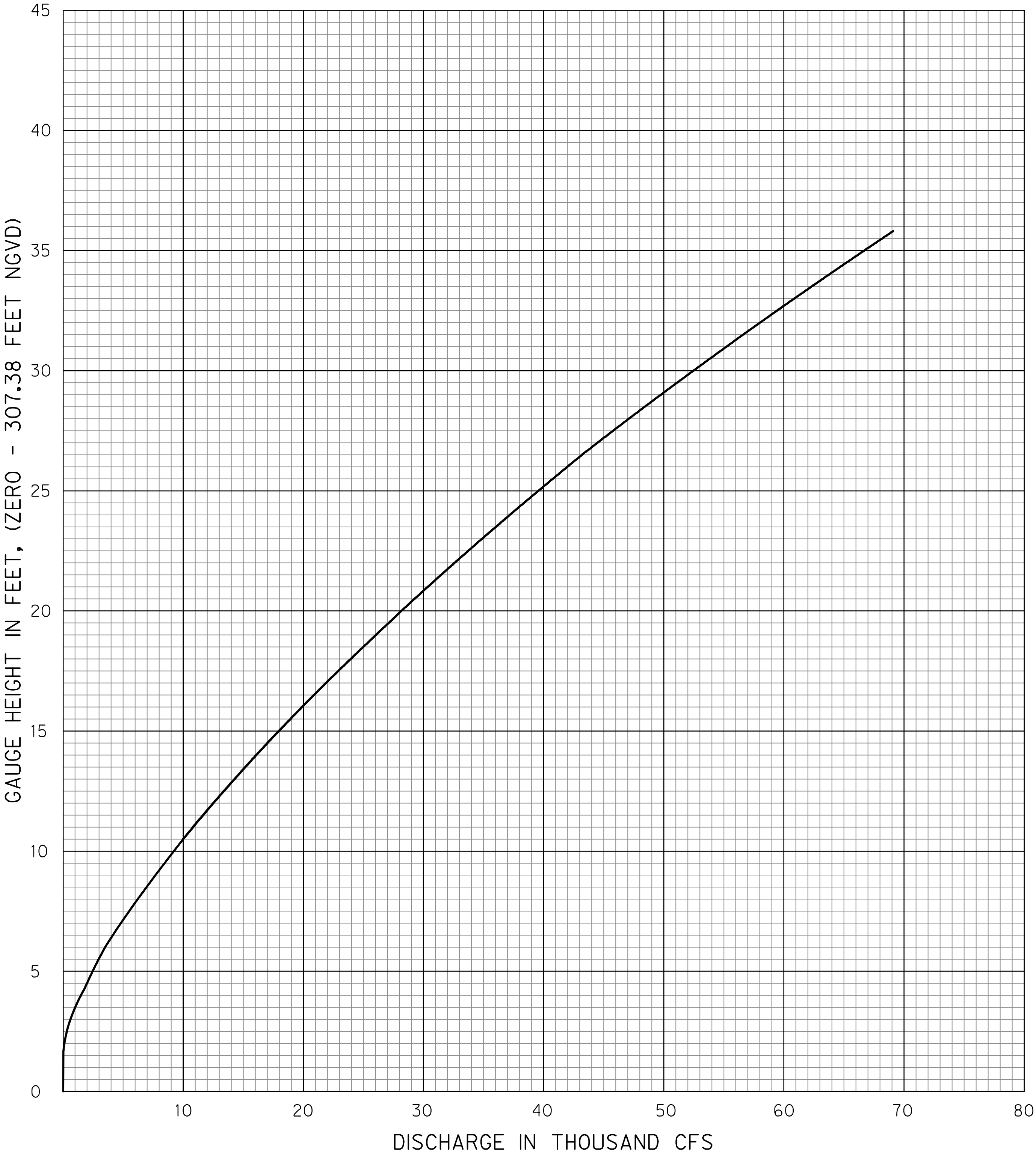


NWS FLOOD STAGE = 23 FEET
USGS FEBRUARY 2012 RATING

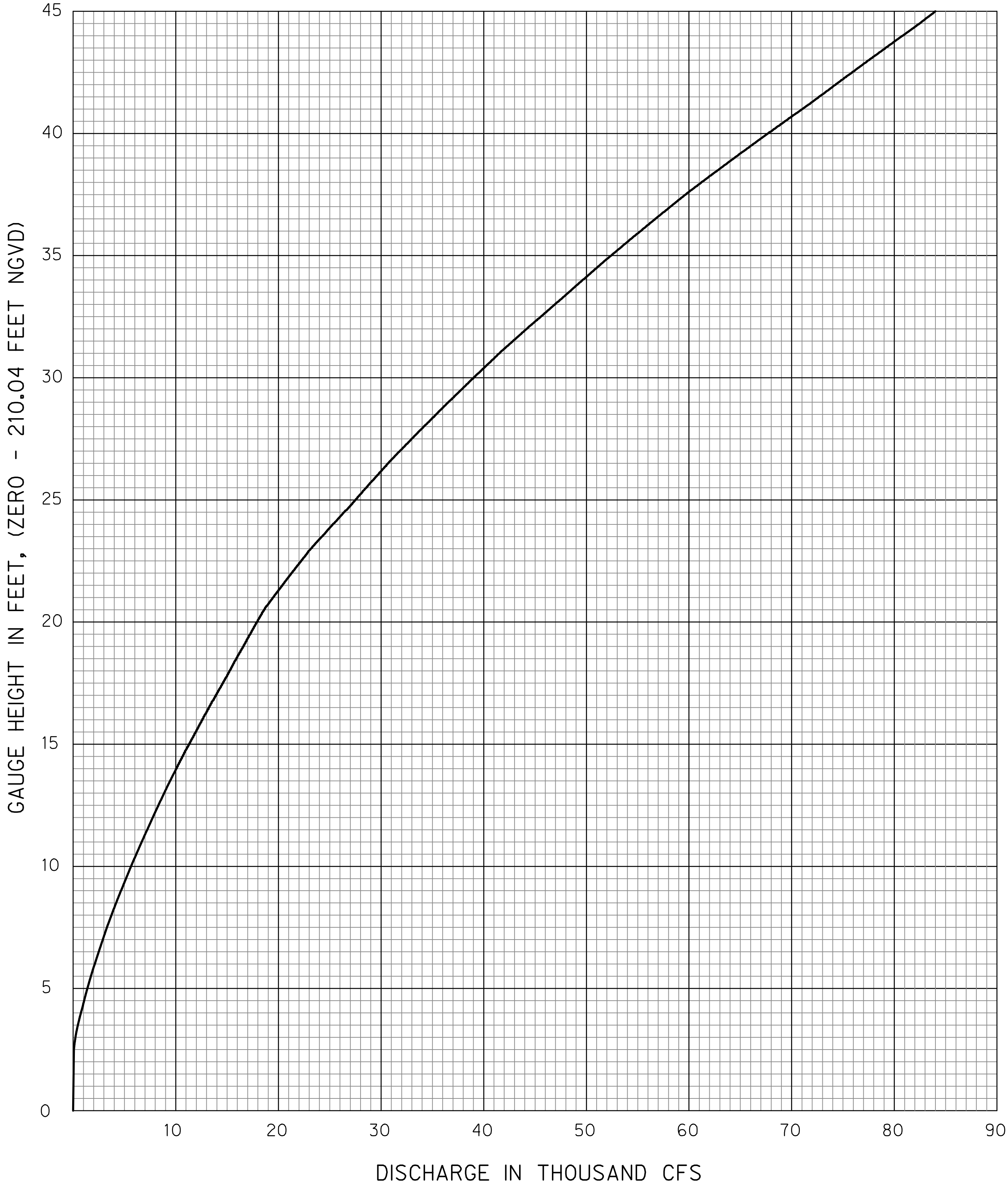
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DISCHARGE RATING CURVE
COLORADO RIVER AT BASTROP
(08159200)

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NWS FLOOD STAGE = 26 FEET
USGS FEBRUARY 2012 RATING

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DISCHARGE RATING CURVE
COLORADO RIVER AT LaGRANGE
(08160400)

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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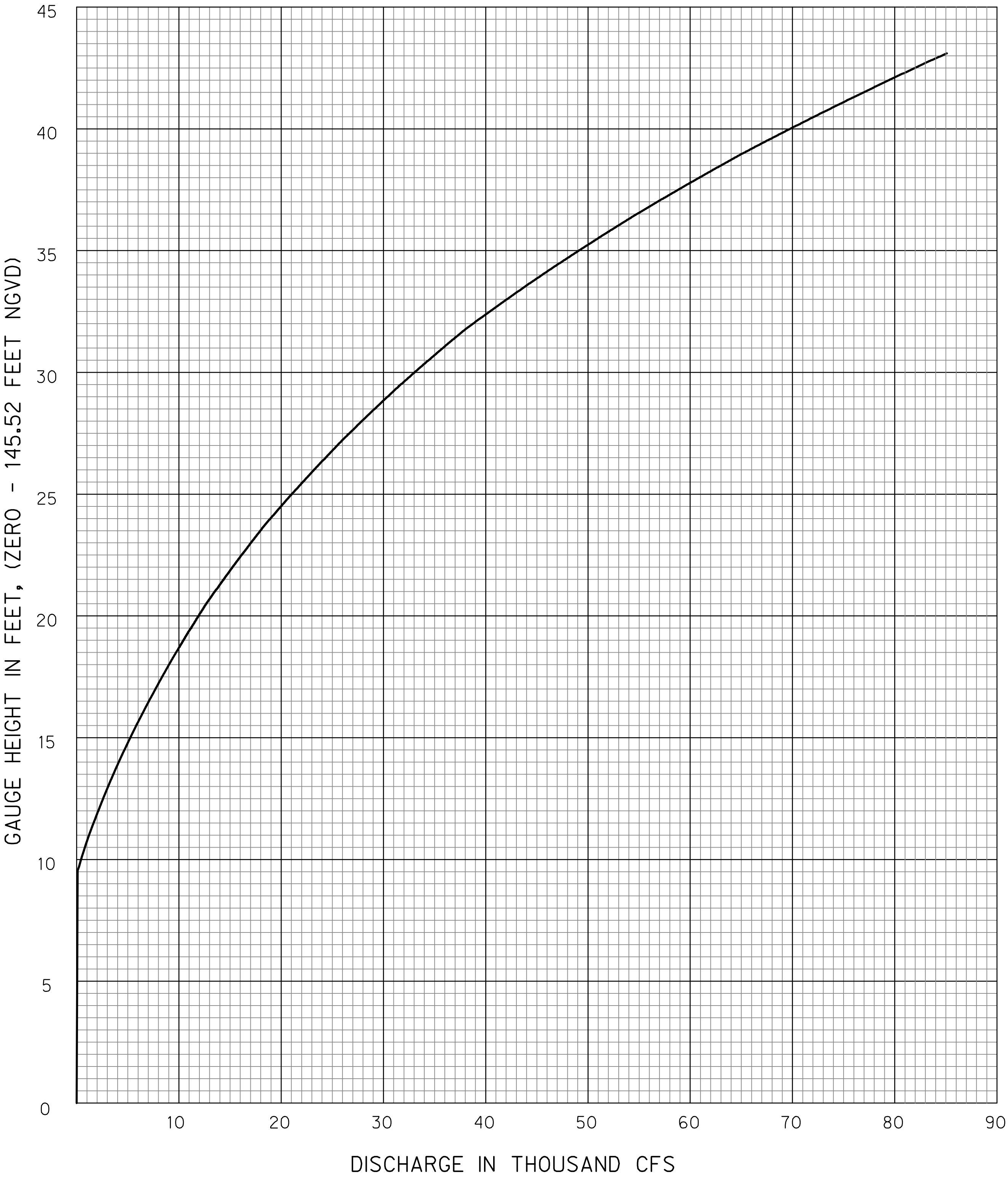

NWS FLOOD STAGE = 34 FEET
USGS MARCH 2012 RATING

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DISCHARGE RATING CURVE
COLORADO RIVER AT COLUMBUS
(08161000)

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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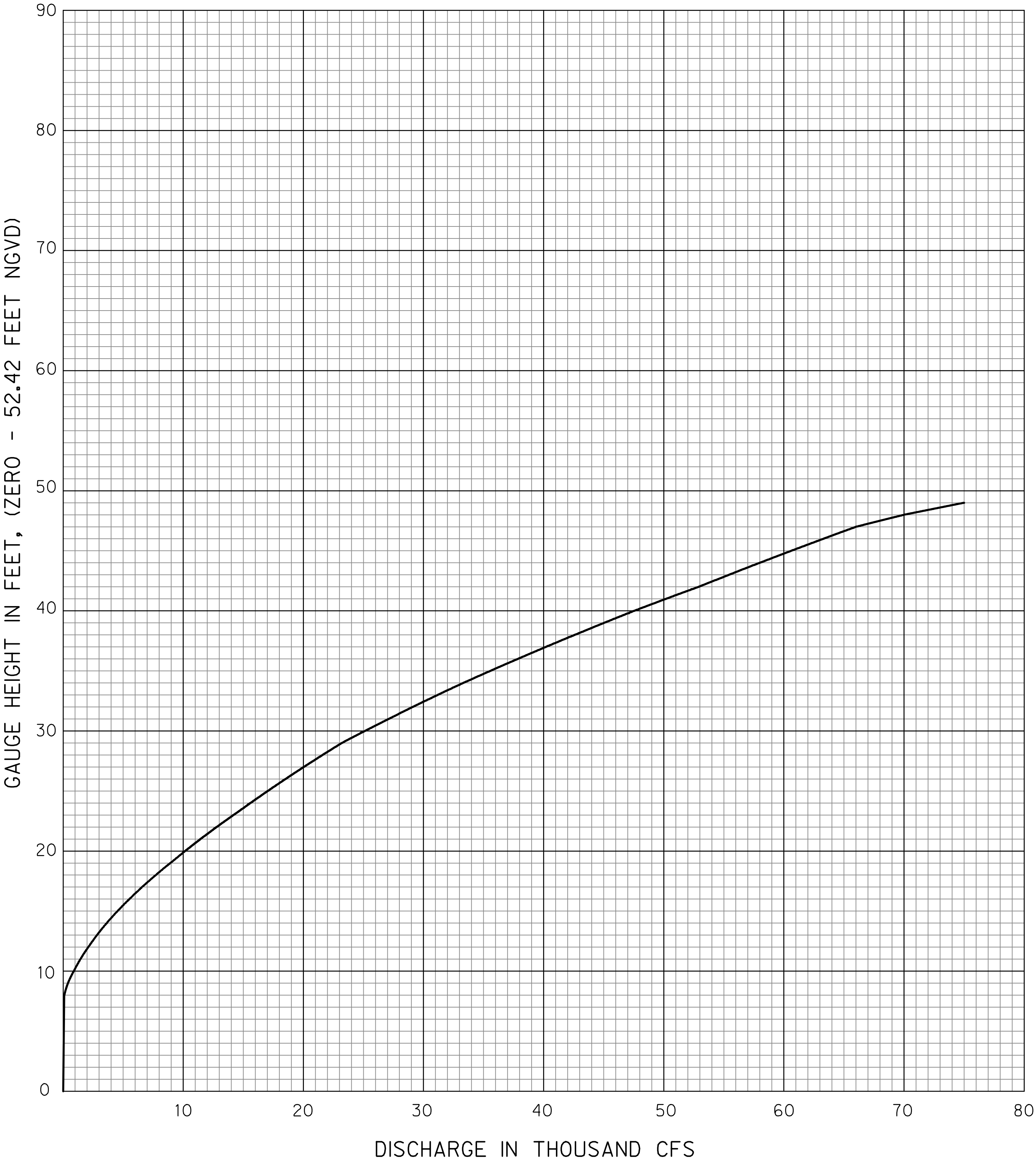

NWS FLOOD STAGE = 39 FEET
USGS MARCH 2012 RATING

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DISCHARGE RATING CURVE COLORADO RIVER AT WHARTON (08162000)

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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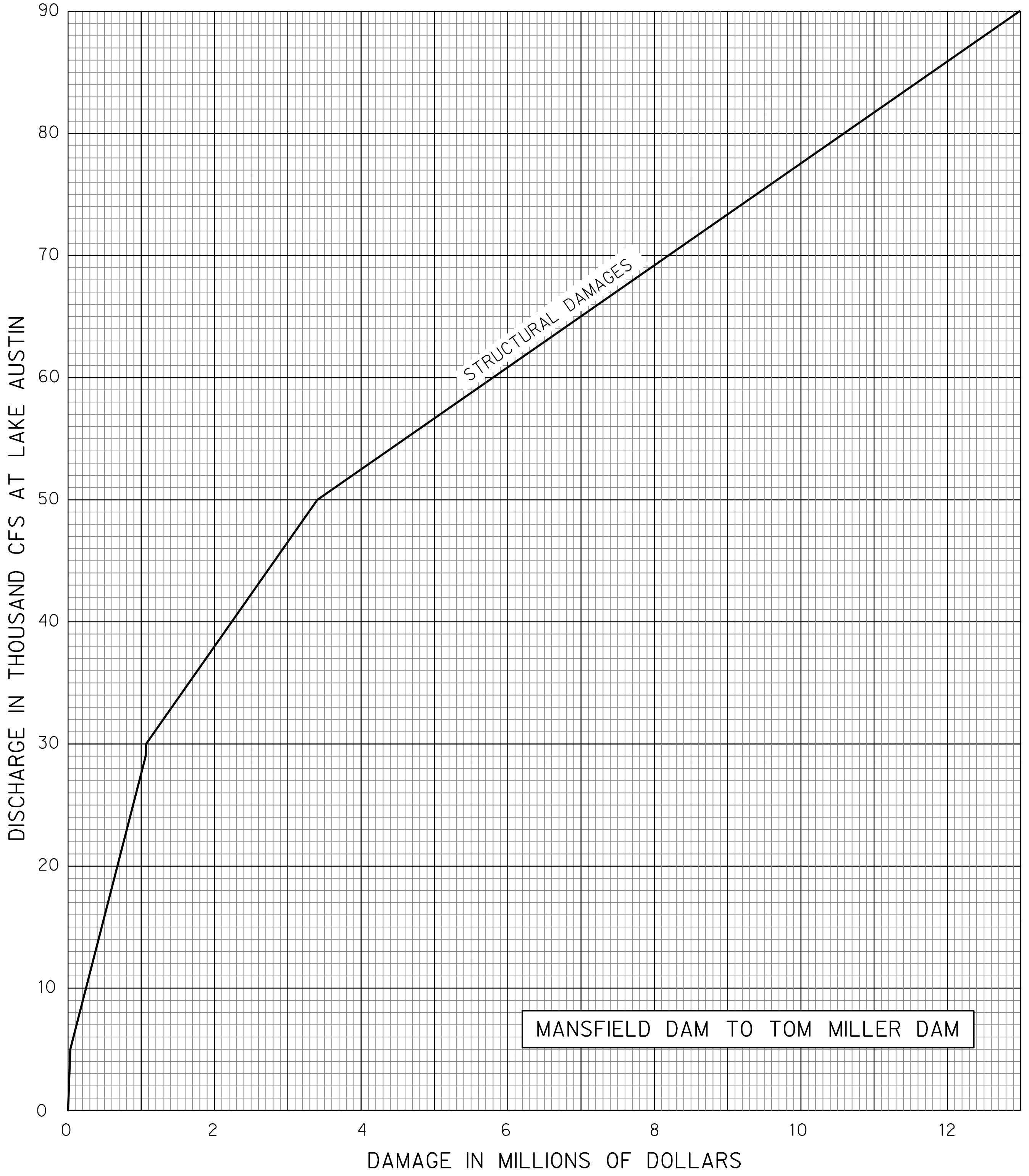


NOTE:
2008 CONDITIONS ADJUSTED TO 2012 DOLLARS.

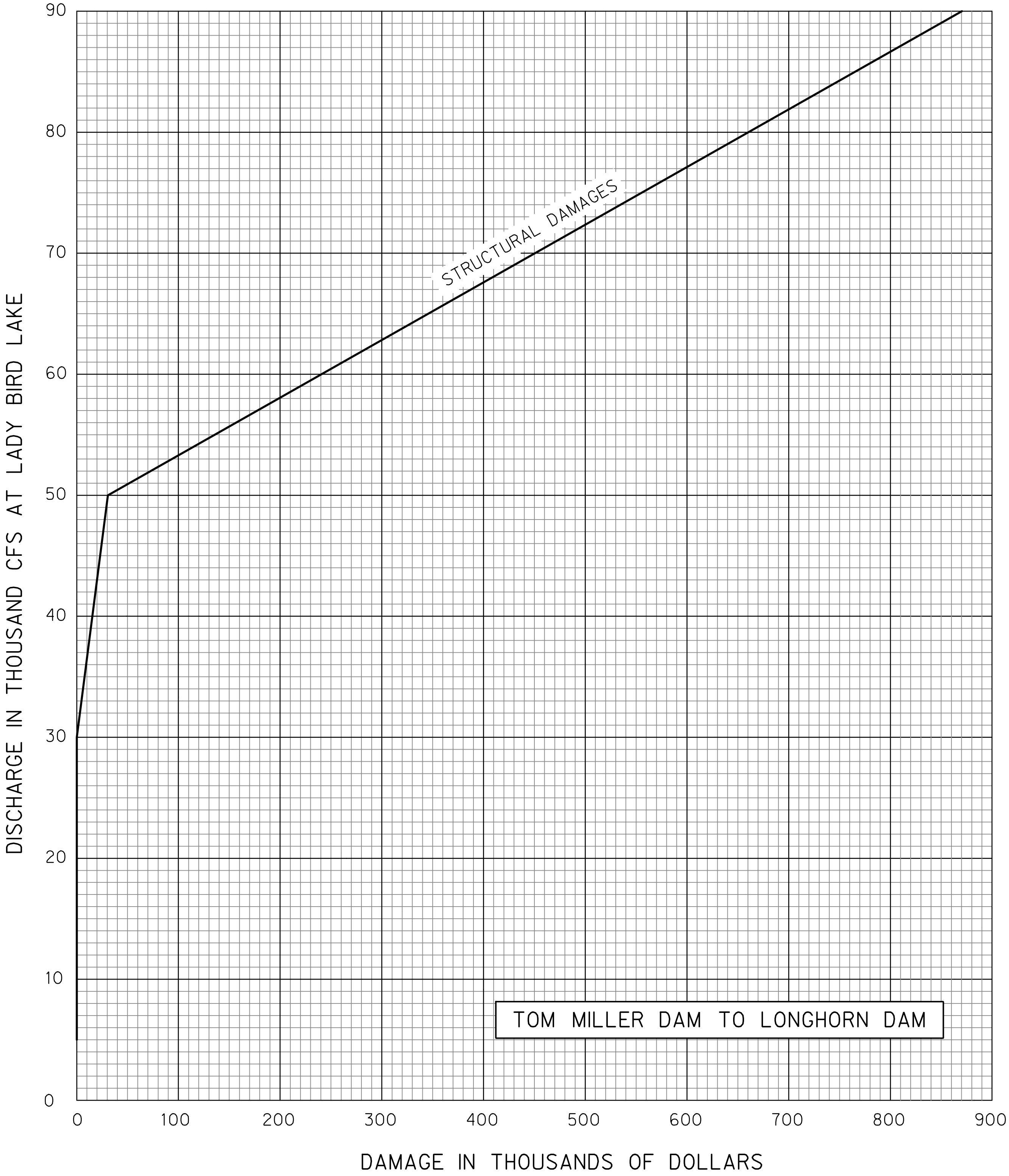
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

**DAMAGE VS. DISCHARGE
MARSHALL FORD DAM (MANSFIELD)
TO TOM MILLER DAM-LAKE AUSTIN**

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE:
2008 CONDITIONS ADJUSTED TO
2012 DOLLARS.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE
TOM MILLER DAM TO
LONGHORN DAM-LADY BIRD LAKE

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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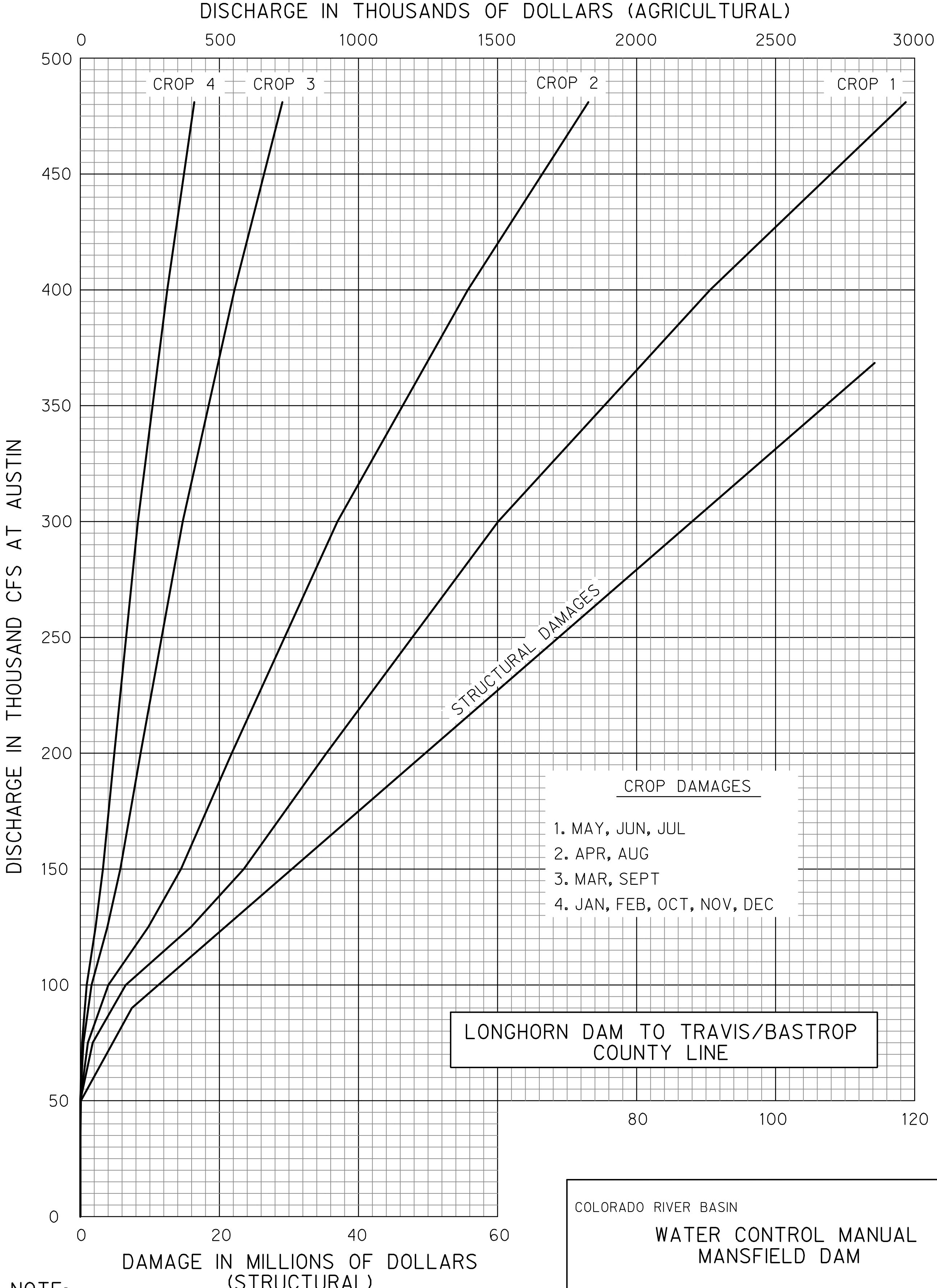

NOTE:

2008 STRUCTURAL CONDITIONS ADJUSTED TO 2012 DOLLARS.

1970s AGRICULTURAL CONDITIONS ADJUSTED TO 2012 DOLLARS.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE
AUSTIN GAUGE REACH

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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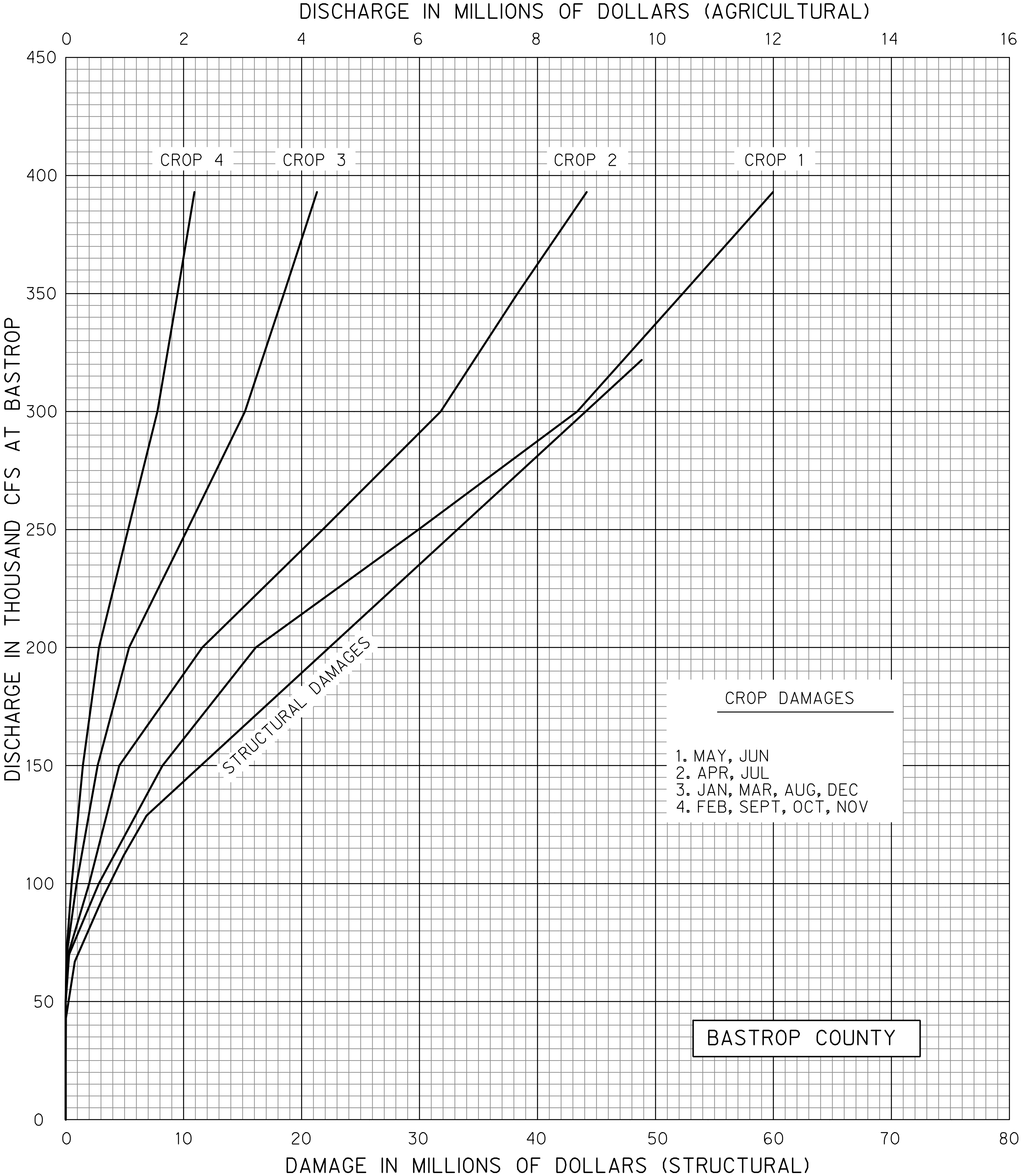

NOTE:

2003 STRUCTURAL CONDITIONS
ADJUSTED TO 2012 DOLLARS.

1970s AGRICULTURAL CONDITIONS
ADJUSTED TO 2012 DOLLARS.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE
BASTROP GAUGE REACH

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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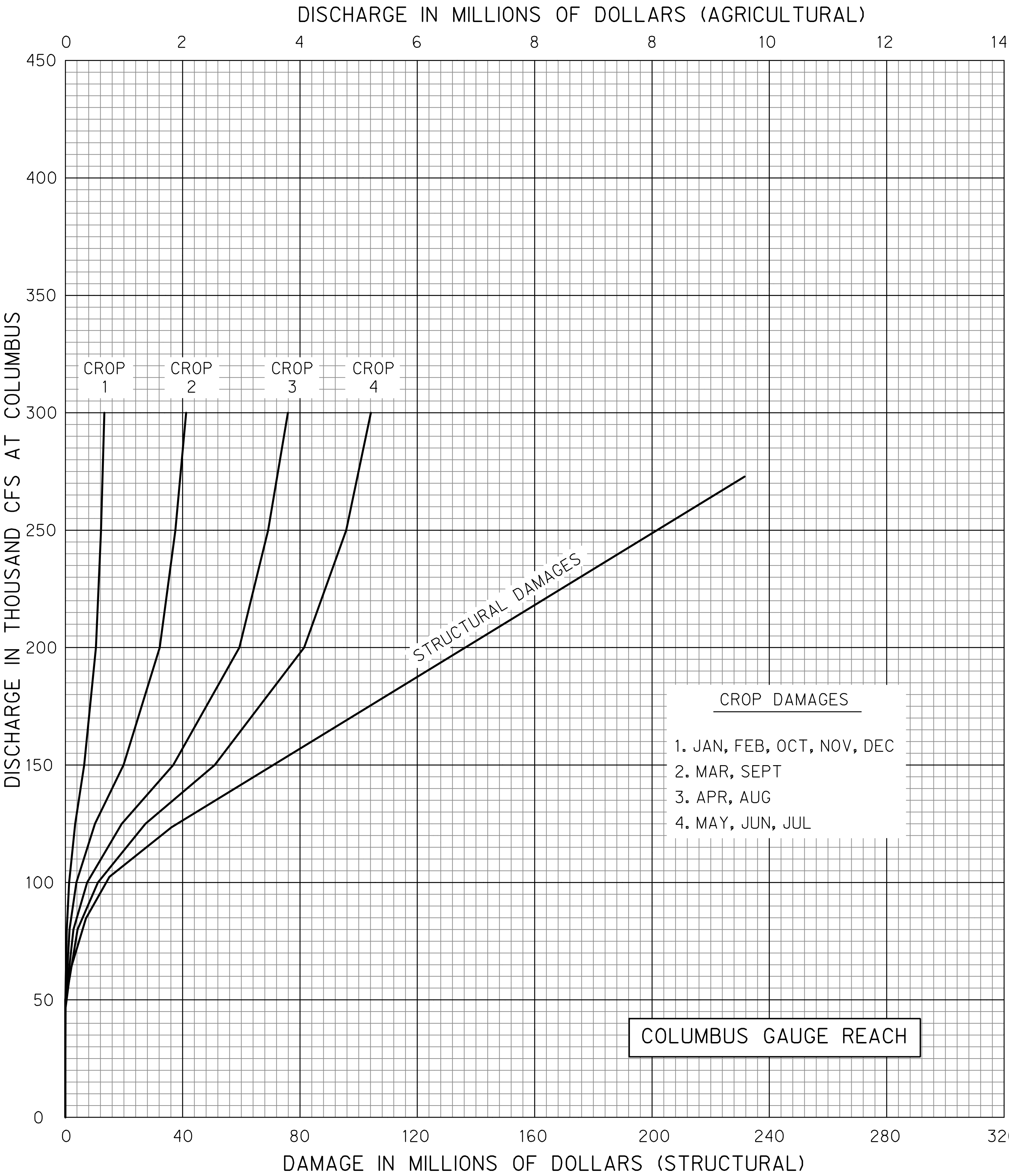

NOTES:

2003 STRUCTURAL CONDITIONS ADJUSTED TO 2012 DOLLARS.

1970s AGRICULTURAL CONDITIONS ADJUSTED TO 2012 DOLLARS.

REACH INCLUDES UPPER FAYETTE, LaGRANGE, LOWER FAYETTE, COLUMBUS, EAGLE LAKE, AND GARWOOD.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE COLUMBUS REACH

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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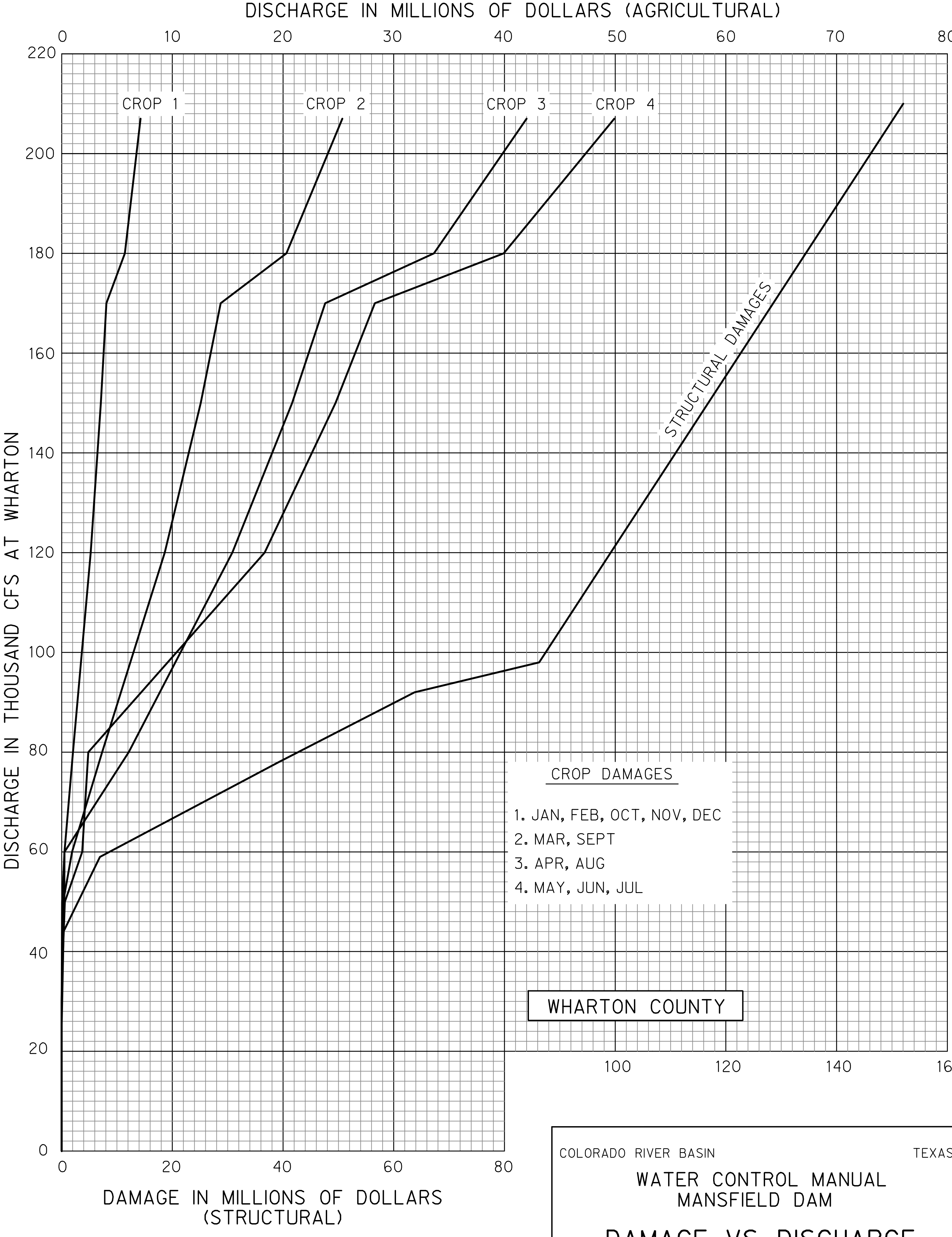


NOTE:

2003 STRUCTURAL CONDITIONS
ADJUSTED TO 2012 DOLLARS.

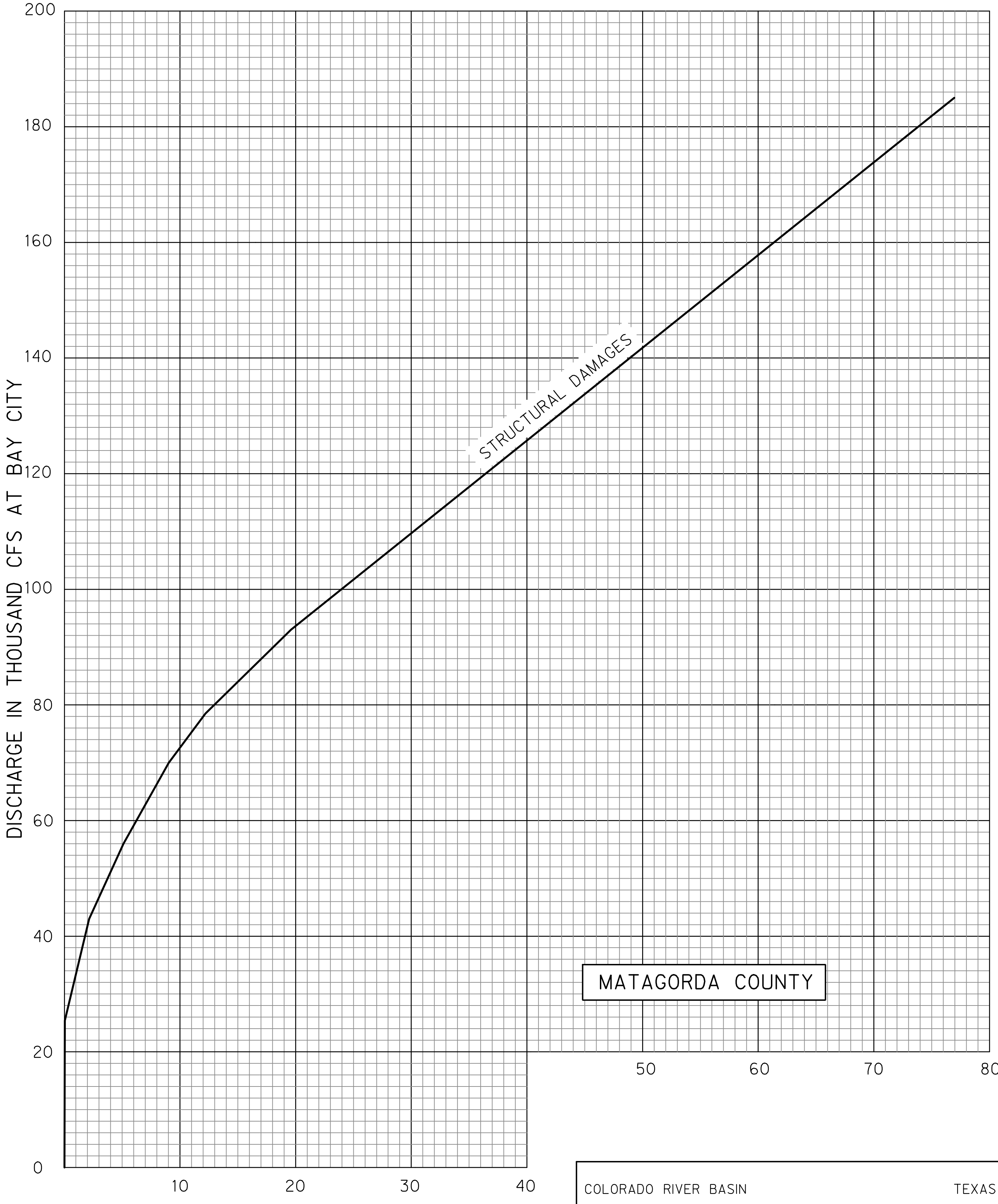
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE
WHARTON COUNTY

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTES:

2003 STRUCTURAL CONDITIONS ADJUSTED TO 2012 DOLLARS.

AGRICULTURAL DAMAGES INCLUDED WITH WHARTON COUNTY (PLATE 4-24).

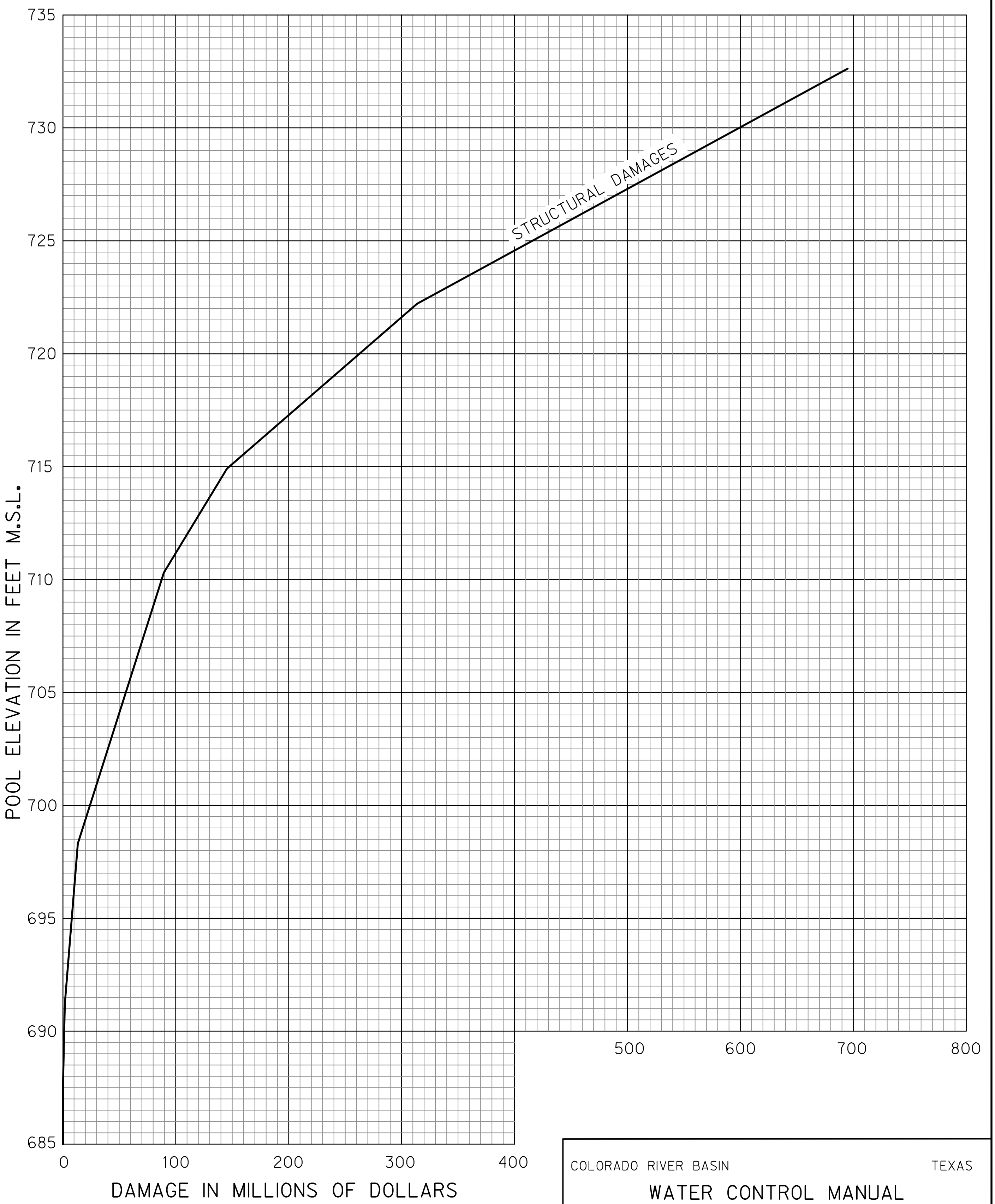
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAMAGE VS. DISCHARGE MATAGORDA COUNTY

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE:

2008 CONDITIONS ADJUSTED TO 2012 DOLLARS.

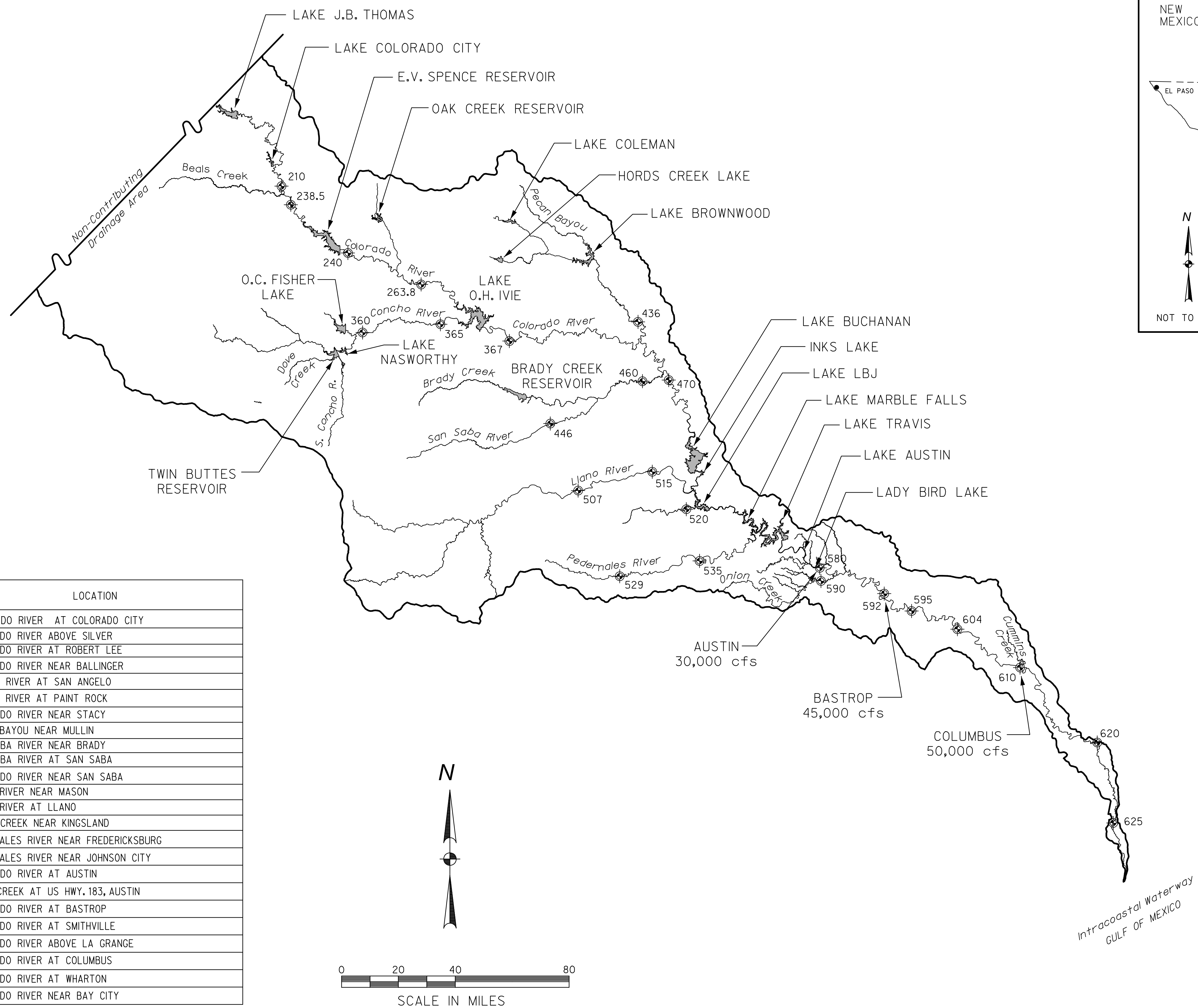
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

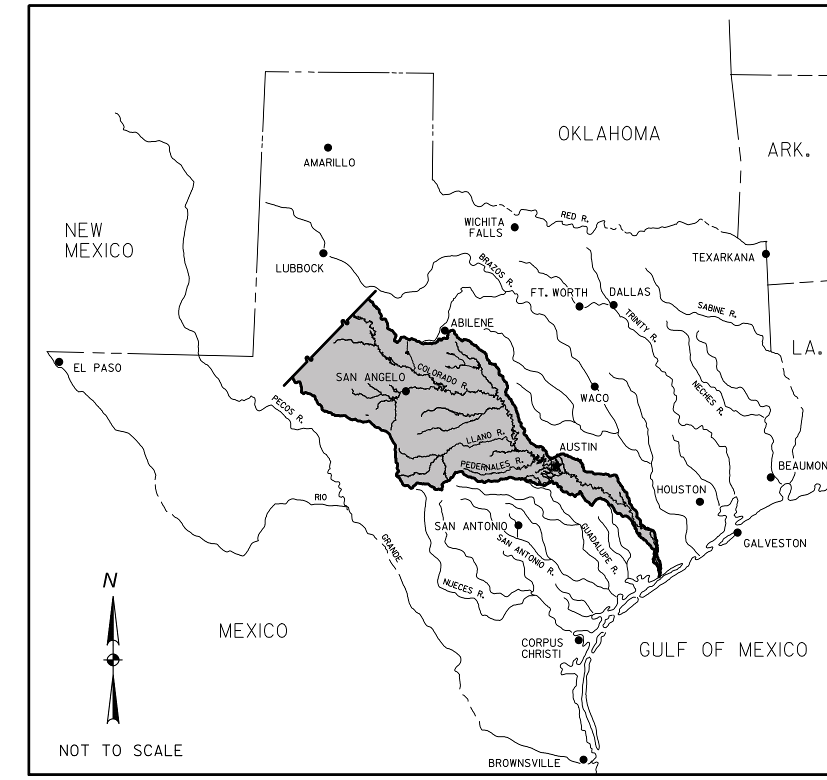
DAMAGE VS. POOL ELEVATION LAKE TRAVIS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



GAGE NO.	LOCATION
210	COLORADO RIVER AT COLORADO CITY
238.5	COLORADO RIVER ABOVE SILVER
240	COLORADO RIVER AT ROBERT LEE
263.8	COLORADO RIVER NEAR BALLINGER
360	CONCHO RIVER AT SAN ANGELO
365	CONCHO RIVER AT PAINT ROCK
367	COLORADO RIVER NEAR STACY
436	PECAN BAYOU NEAR MULLIN
446	SAN SABA RIVER NEAR BRADY
460	SAN SABA RIVER AT SAN SABA
470	COLORADO RIVER NEAR SAN SABA
507	LLANO RIVER NEAR MASON
515	LLANO RIVER AT LLANO
520	SANDY CREEK NEAR KINGSLAND
529	PEDERNALES RIVER NEAR FREDERICKSBURG
535	PEDERNALES RIVER NEAR JOHNSON CITY
580	COLORADO RIVER AT AUSTIN
590	ONION CREEK AT US HWY. 183, AUSTIN
592	COLORADO RIVER AT BASTROP
595	COLORADO RIVER AT SMITHVILLE
604	COLORADO RIVER ABOVE LA GRANGE
610	COLORADO RIVER AT COLUMBUS
620	COLORADO RIVER AT WHARTON
625	COLORADO RIVER NEAR BAY CITY



VICINITY MAP

COLORADO RIVER BASIN TEXAS

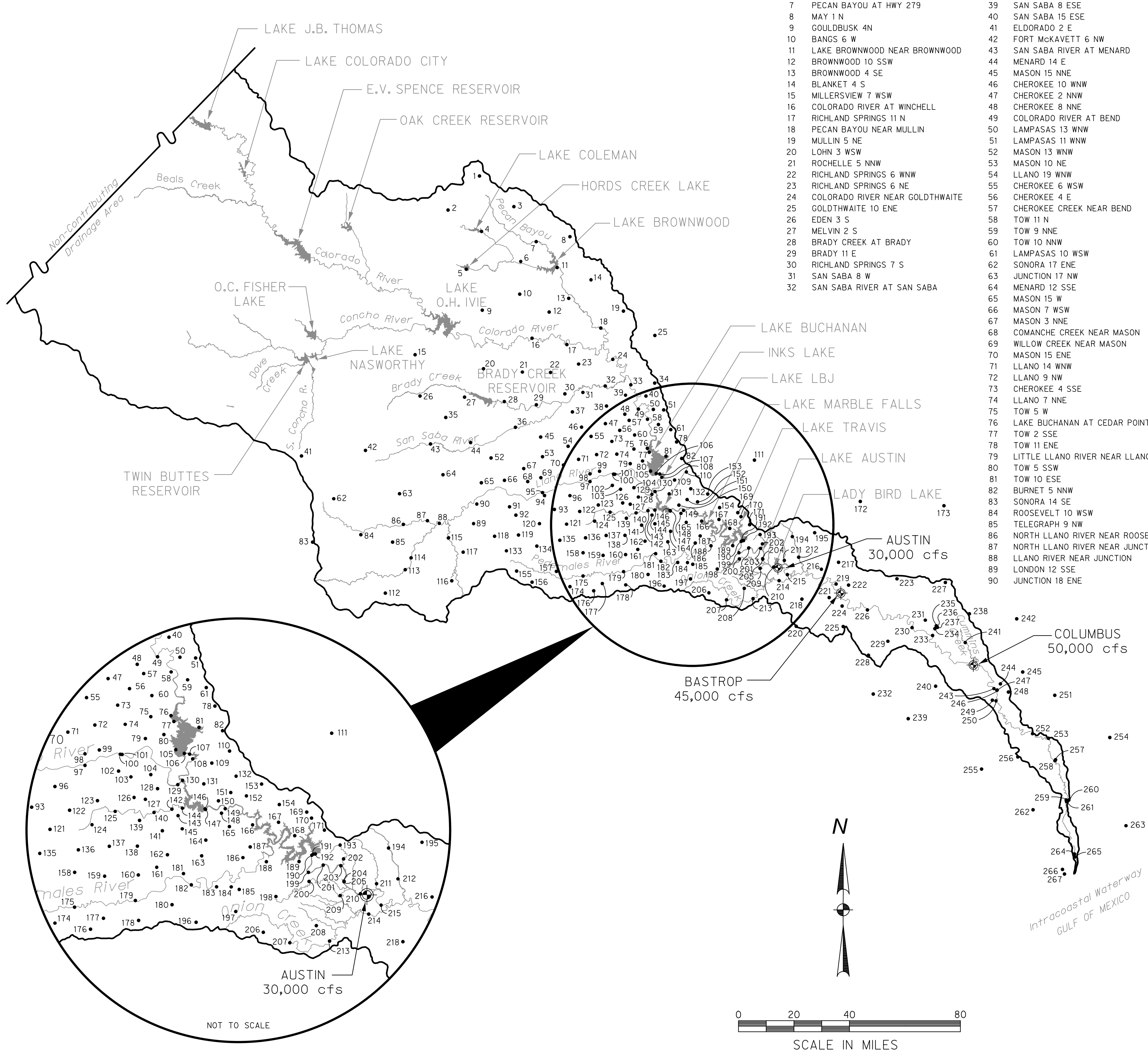
WATER CONTROL MANUAL
MANSFIELD DAM

WATERSHED MAP WITH PERTINENT STREAMFLOW GAUGES

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

PLATE 5-01



1 CLYDE 6 S
2 LAWN 5 E
3 CROSS PLAINS 6 WNW
4 LAKE COLEMAN NEAR NOVICE
5 HORDS CREEK LAKE NEAR VALERA
6 BURKETT 9 S
7 PECAN BAYOU AT HWY 279
8 MAY 1 N
9 GOULDBUSK 4N
10 BANGS 6 W
11 LAKE BROWNWOOD NEAR BROWNWOOD
12 BROWNWOOD 10 SSW
13 BROWNWOOD 4 SE
14 BLANKET 4 S
15 MILLERSVIEW 7 WSW
16 COLORADO RIVER AT WINCHELL
17 RICHLAND SPRINGS 11 N
18 PECAN BAYOU NEAR MULLIN
19 MULLIN 5 NE
20 LOHN 3 WSW
21 ROCHELLE 5 NNW
22 RICHLAND SPRINGS 6 WNW
23 RICHLAND SPRINGS 6 NE
24 COLORADO RIVER NEAR GOLDTHWAITE
25 GOLDTHWAITE 10 ENE
26 EDEN 3 S
27 MELVIN 2 S
28 BRADY CREEK AT BRADY
29 BRADY 11 E
30 RICHLAND SPRINGS 7 S
31 SAN SABA 8 W
32 SAN SABA RIVER AT SAN SABA
33 COLORADO RIVER NEAR SAN SABA
34 LOMETA 2 WNW
35 MENARD 11 NE
36 SAN SABA RIVER NEAR BRADY
37 SAN SABA 15 SW
38 SAN SABA 6 S
39 SAN SABA 8 ESE
40 SAN SABA 15 ESE
41 ELDORADO 2 E
42 FORT McKAVETT 6 NW
43 SAN SABA RIVER AT MENARD
44 MENARD 14 E
45 MASON 15 NNE
46 CHEROKEE 10 WNW
47 CHEROKEE 2 NNW
48 CHEROKEE 8 NNE
49 COLORADO RIVER AT BEND
50 LAMPASAS 13 WNW
51 LAMPASAS 11 WNW
52 MASON 13 WNW
53 MASON 10 NE
54 LLANO 19 WNW
55 CHEROKEE 6 WSW
56 CHEROKEE 4 E
57 CHEROKEE CREEK NEAR BEND
58 TOW 11 N
59 TOW 9 NNE
60 TOW 10 NNW
61 LAMPASAS 10 WSW
62 SONORA 17 ENE
63 JUNCTION 17 NW
64 MENARD 12 SSE
65 MASON 15 W
66 MASON 7 WSW
67 MASON 3 NNE
68 COMANCHE CREEK NEAR MASON
69 WILLOW CREEK NEAR MASON
70 MASON 15 ENE
71 LLANO 14 WNW
72 LLANO 9 NW
73 CHEROKEE 4 SSE
74 LLANO 7 NNE
75 TOW 5 W
76 LAKE BUCHANAN AT CEDAR POINT
77 TOW 2 SSE
78 TOW 11 ENE
79 LITTLE LLANO RIVER NEAR LLANO
80 TOW 5 SSW
81 TOW 10 ESE
82 BURNET 5 NNW
83 SONORA 14 SE
84 ROOSEVELT 10 WSW
85 TELEGRAPH 9 NW
86 NORTH LLANO RIVER NEAR ROOSEVELT
87 NORTH LLANO RIVER NEAR JUNCTION
88 LLANO RIVER NEAR JUNCTION
89 LONDON 12 SSE
90 JUNCTION 18 ENE
91 JAMES RIVER NEAR MASON
92 MASON 14 SSW
93 MASON 17 SE
94 BEAVER CREEK NEAR MASON
95 LLANO RIVER NEAR MASON
96 CASTELL 4 SSE
97 HICKORY CREEK NEAR CASTELL
98 SAN FERNANDO CREEK NEAR LLANO
99 JOHNSON CREEK NEAR LLANO
100 LLANO RIVER AT LLANO CITY DAM
101 LLANO RIVER AT LLANO
102 LLANO 5 SSW
103 LLANO 6 SSE
104 KINGSLAND 7 WNW
105 BUCHANAN DAM 2 NNW
106 BUCHANAN DAM
107 INKS LAKE AT HWY 29 BRIDGE
108 INKS DAM
109 BURNET 6 WSW
110 BURNET 1 WSW
111 FLORENCE 3 SW
112 ROCKSPRINGS 12 NE
113 TELEGRAPH 5 SW
114 SOUTH LLANO RIVER AT TELEGRAPH
115 JOHNSON FORK NEAR JUNCTION
116 MOUNTAIN HOME 17 WNW
117 JUNCTION 14 SE
118 HARPER 13 NW
119 DOSS 8 W
120 DOSS 4N
121 CHERRY SPRING 3 ENE
122 LLANO 19 SW
123 LLANO 13 SSW
124 WILLOW CITY 9 NW
125 SANDY CREEK NEAR WILLOW CITY
126 LLANO 11 SSE
127 KINGSLAND 9 WSW
128 HONEY CREEK NEAR KINGSLAND
129 LAKE LBJ AT 2900 BRIDGE
130 LAKE LBJ AT 1431 BRIDGE
131 KINGSLAND 6 ESE
132 BURNET 6 SSE
133 HARPER 6 NW
134 HARPER 8 NE
135 FREDERICKSBURG 12 NW
136 FREDERICKSBURG 10 NNE
137 WILLOW CITY 3 NNW
138 WILLOW CITY 6 ENE
139 WILLOW CITY 10 NNE
140 SANDY CREEK NEAR CLICK
141 ROUND MOUNTAIN 11 WNW
142 SANDY CREEK NEAR KINGSLAND
143 WALNUT CREEK NEAR KINGSLAND
144 LAKE LBJ AT SANDY HARBOR
145 ROUND MOUNTAIN 6 WNW
146 WIRTZ DAM
147 MARBLE FALLS 4 WSW
148 FLAT ROCK CREEK NEAR MARBLE FALLS
149 STARCKE DAM
150 BACKBONE CREEK AT MARBLE FALLS
151 HAMILTON CREEK NEAR MARBLE FALLS
152 MARBLE FALLS 6 ENE
153 BERTRAM 8 SSW
154 MARBLE FALLS 14 ESE
155 HARPER 4 SSW
156 HARPER 8 SSE
157 FREDERICKSBURG 10 WSW
158 FREDERICKSBURG 5 N
159 WILLOW CITY 6 SSW
160 STONEWALL 7 NNE
161 NORTH GRAPE CREEK NEAR JOHNSON CITY
162 JOHNSON CITY 10 NNW
163 JOHNSON CITY 9 NNE
164 MARBLE FALLS 10 SSW
165 SPICEWOOD 5 WNW
166 SPICEWOOD 2 NNE
167 COW CREEK NEAR LAGO VISTA
168 LAGO VISTA 1 ESE
169 LEANDER 5 SW
170 BIG SANDY CREEK NEAR JONESTOWN
171 CEDAR PARK 3 SSW
172 THORNDALE 3 SSE
173 CALDWELL 1 NNE
174 FREDERICKSBURG 9 SW
175 PEDERNALES RIVER NEAR FREDERICKSBURG
176 FREDERICKSBURG 10 SSE
177 SOUTH GRAPE CREEK NEAR LUCKENBACH
178 BLANCO 13 WNW
179 PEDERNALES RIVER AT LBJ RANCH NEAR STONEWALL
180 JOHNSON CITY 5 SSW
181 JOHNSON CITY 4 NNW
182 PEDERNALES RIVER NEAR JOHNSON CITY
183 MILLER CREEK NEAR JOHNSON CITY
184 JOHNSON CITY 10 E
185 FLAT CREEK NEAR PEDERNALES FALLS STATE PARK
186 CYPRESS CREEK NEAR CYPRESS MILL
187 SPICEWOOD 4 S
188 LAKEWAY 6 W
189 LAKEWAY 2 E
190 LAKE AUSTIN BELOW MANSFIELD DAM
191 MANSFIELD DAM
192 MANSFIELD DAM 1 ENE
193 JOLLYVILLE 2 SW
194 PFLUGERVILLE 3 SSE
195 ELGIN 8 NW
196 BLANCO 5 NNE
197 DRIPPING SPRINGS 8 W
198 DRIPPING SPRINGS 4 NNE
199 LAKE AUSTIN AT QUINLAN PARK
200 BARTON CREEK AT SH 71 NEAR OAK HILL
201 LAKE AUSTIN AT CORTANA SHORES
202 BULL CREEK AT LOOP 360, AUSTIN
203 LAKE AUSTIN AT BUNNY RUN FARM
204 TOM MILLER DAM
205 LCRA REDBUD CENTER
206 DRIPPING SPRINGS 5 SSW
207 DRIFTWOOD 4 SSE
208 MANCHACA 4 W
209 BARTON CREEK AT LOOP 360, AUSTIN
210 LADY BIRD LAKE NEAR LONGHORN DAM
211 WALNUT CREEK AT WEBBERVILLE ROAD, AUSTIN
212 GILLELAND CREEK NEAR MANOR
213 ONION CREEK AT BUDA
214 ONION CREEK AT HWY. 183, AUSTIN
215 COLORADO RIVER AT DEL VALLE
216 WILBARGER CREEK NEAR ELGIN
217 BIG SANDY CREEK NEAR ELGIN
218 CEDAR CREEK 3 WSW
219 COLORADO RIVER AT SIM GIDEON RIVER PLANT
220 LOCKHART 6 NE
221 CEDAR CREEK NEAR BASTROP
222 LAKE BASTROP AT SIM GIDEON POWER PLANT
223 GIDDINGS 3 WSW
224 CEDAR CREEK BELOW BASTROP
225 ROSANKY 1 W
226 COLORADO RIVER AT SMITHVILLE
227 CARMINE 1 SSW
228 MULDOON 6 WSW
229 BUCKNERS CREEK NEAR MULDOON
230 COLORADO RIVER ABOVE LaGRANGE
231 LaGRANGE 5 NE
232 MOULTON 1 SSE
233 COLORADO RIVER AT FPP RIVER PLANT
234 UNAVAILABLE
235 LAKE FAYETTE AT FAYETTE POWER PLANT
236 UNAVAILABLE
237 UNAVAILABLE
238 INDUSTRY 3 W
239 HALLETTSVILLE 1 SSE
240 WEIMAR 7 S
241 CUMMINS CREEK NEAR FRELSBURG
242 BELLVILLE 1 SW
243 COLORADO RIVER NEAR ALTAIR
244 EAGLE LAKE 3 WNW (PRAIRIE PLANT)
245 EAGLE LAKE 7 NE
246 EAGLE LAKE 4 WSW (RIVER TO PRAIRIE)
247 EAGLE LAKE 4 WSW (RIVER TO LAKE)
248 EAGLE LAKE 2 S (LAKE PLANT)
249 GARWOOD 5 NNW (RIVER PLANT)
250 COLORADO RIVER NEAR GARWOOD
251 SAN BERNARD RIVER AT EAST BERNARD
252 COLORADO RIVER NEAR GLEN FLORA
253 COLORADO RIVER AT WHARTON
254 DAMON 1 NNW
255 EL CAMPO 15 WSW
256 EL CAMPO 2 NW
257 LANE CITY 3 WSW (PLANT 2)
258 COLORADO RIVER NEAR LANE CITY
259 BAY CITY 3 W (PLANT)
260 BAY CITY 2 W (PLANT 1)
261 COLORADO RIVER AT BAY CITY
262 MIDFIELD
263 SARGENT 1 ENE
264 COLORADO RIVER AT MATAGORDA
265 MATAGORDA 1 S
266 MATAGORDA 7 SW
267 MATAGORDA 8 SSW

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

HYDROLOGIC GAUGE NETWORK

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

PLATE 5-02

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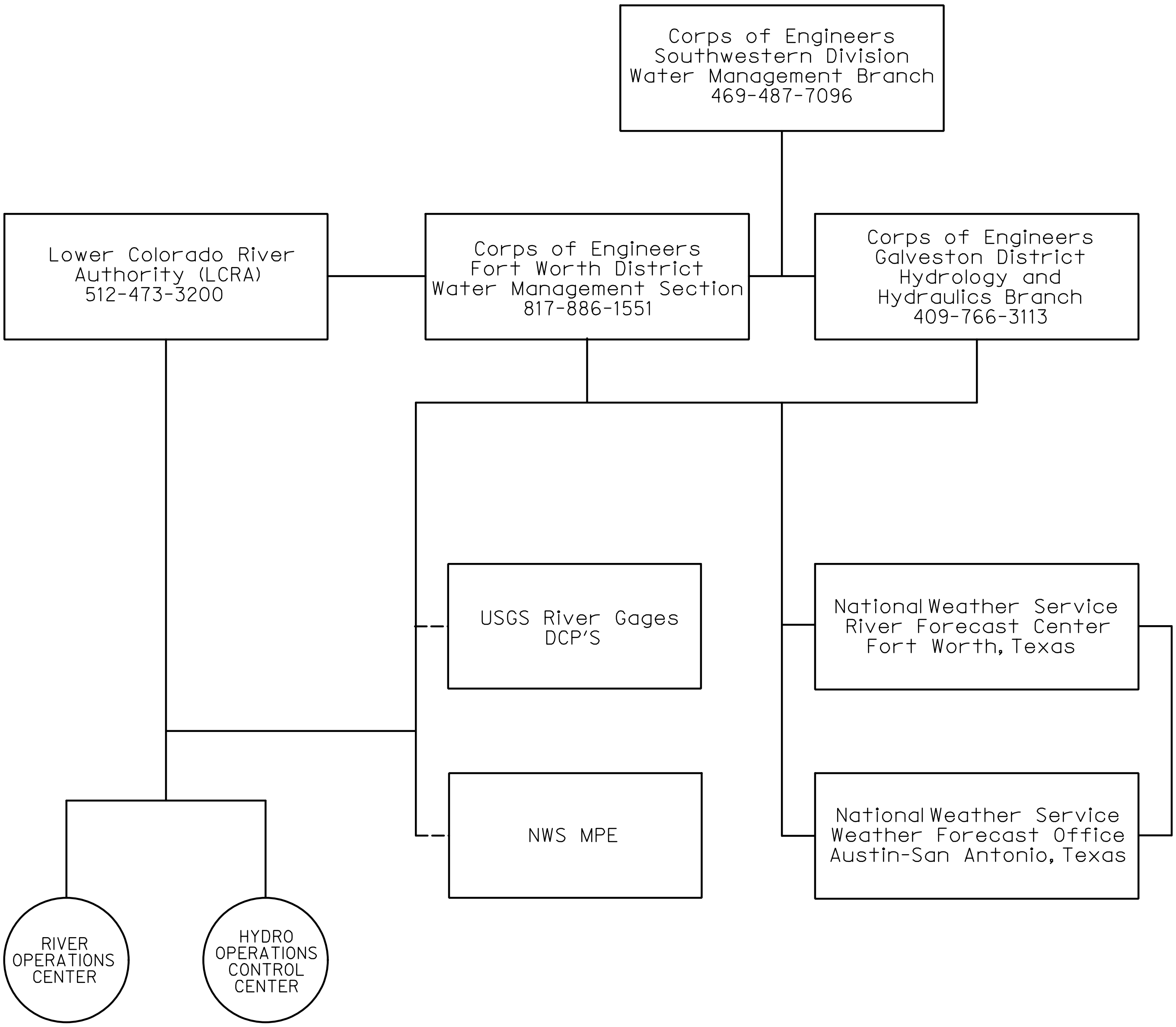
LINES OF COMMUNICATION



COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

LINES OF COMMUNICATION

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

PLATE 5-03

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FLOOD RELEASE CRITERIA

1. IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO AN ELEVATION BETWEEN 681.0 AND 683.0, RELEASE A MINIMUM VOLUME OF 3,000 DSF IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE A.** THE MAXIMUM DAILY AVERAGE RATE OF RELEASE SHALL NOT EXCEED 7,500 CFS.

2. IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO BETWEEN ELEVATION 683.0 AND 685.0, RELEASE A MINIMUM OF 5,000 CFS AND A MAXIMUM OF 30,000 CFS IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE A.**

3. SEASONAL POOL OPERATION:
   IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO BETWEEN ELEVATION 685.0 AND 691.0;

   a. DURING JAN. - APR., JUL. - AUG., NOV. - DEC., RELEASE A MINIMUM OF 5,000 CFS AND A MAXIMUM OF 30,000 CFS IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE A.**

   b. DURING MAY-JUN., SEPT. - OCT., RELEASE UP TO 30,000 CFS IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE B.**

4. IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO BETWEEN ELEVATION 691.0 AND 710.0, RELEASE UP TO 30,000 CFS IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE B.**

5. IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO BETWEEN ELEVATION 710.0 AND 714.0, RELEASE 50,000 CFS IN ACCORDANCE WITH **CHANNEL CAPACITY SCHEDULE C.**

6. IF THE RESERVOIR LEVEL IS FORECAST TO RISE TO AN ELEVATION BETWEEN 714.0 AND 722.0, THE RELEASE SHALL EQUAL THE ASSOCIATED PEAK FLOOD INFLOW, BUT NOT TO EXCEED 90,000 CFS. AT THIS LEVEL THERE ARE <u>NO DOWNSTREAM CONTROL STAGES.</u>

7. IF THE RESERVOIR LEVEL IS FORECAST TO RISE ABOVE ELEVATION 722.0, THE OPENING OF THE REMAINING CLOSED CONDUIT GATES WILL PROCEED UNTIL:

   a. A REVISED FORECAST INDICATES THE POOL WILL PEAK AT OR BELOW ELEVATION 722.0, AT WHICH TIME OPENING OF ADDITIONAL CONDUIT GATES WILL CEASE.

   OR

   b. LCRA DIRECTS AN ALTERNATIVE COURSE OF ACTION FOR PROTECTING THE SAFETY OF THE STRUCTURE.

<u>CHANNEL CAPACITY SCHEDULE A.</u> MINIMUM RELEASES MAY ONLY BE REDUCED TO PREVENT THE FLOWS FROM EXCEEDING THE DOWNSTREAM CONTROL STAGES OF:

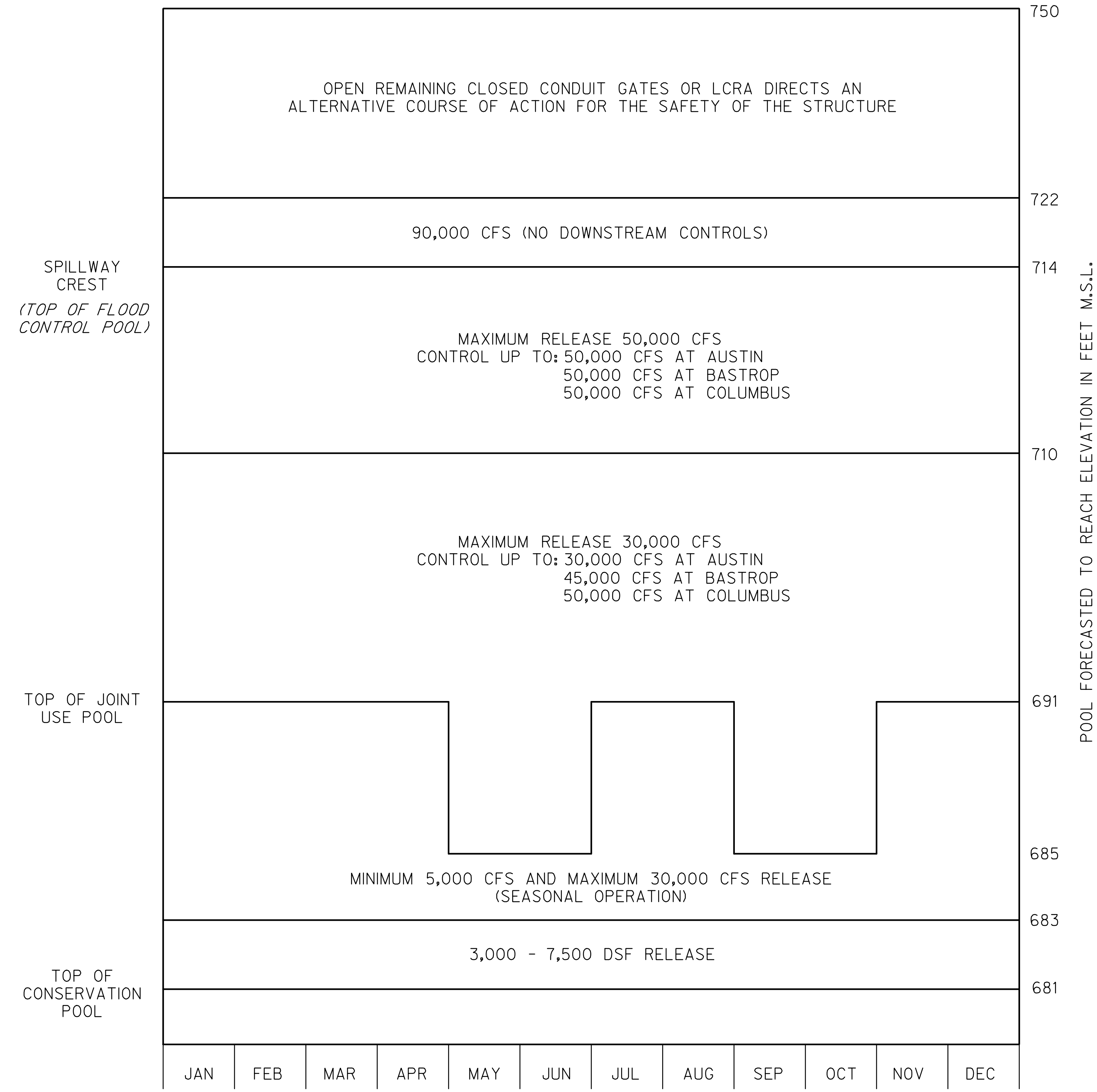
33.0 FEET (30,000 CFS) AT AUSTIN
27.2 FEET (45,000 CFS) AT BASTROP
35.5 FEET (50,000 CFS) AT COLUMBUS

<u>CHANNEL CAPACITY SCHEDULE B.</u> RELEASES, WHEN COMBINED WITH LOCAL FLOWS BELOW THE DAM, SHALL EQUAL BUT NOT EXCEED THE DOWNSTREAM CONTROL STAGES OF:

33.0 FEET (30,000 CFS) AT AUSTIN
27.2 FEET (45,000 CFS) AT BASTROP
35.5 FEET (50,000 CFS) AT COLUMBUS

<u>CHANNEL CAPACITY SCHEDULE C.</u> RELEASES, WHEN COMBINED WITH LOCAL FLOWS BELOW THE DAM, SHALL EQUAL BUT NOT EXCEED THE DOWNSTREAM CONTROL FLOWS OF:

50,000 CFS AT AUSTIN
50,000 CFS AT BASTROP
50,000 CFS AT COLUMBUS



NOTE:

REFER TO CHAPTER 7-05. FLOOD CONTROL REGULATION OF THIS MANUAL FOR MORE DETAILED RELEASE CRITERIA.

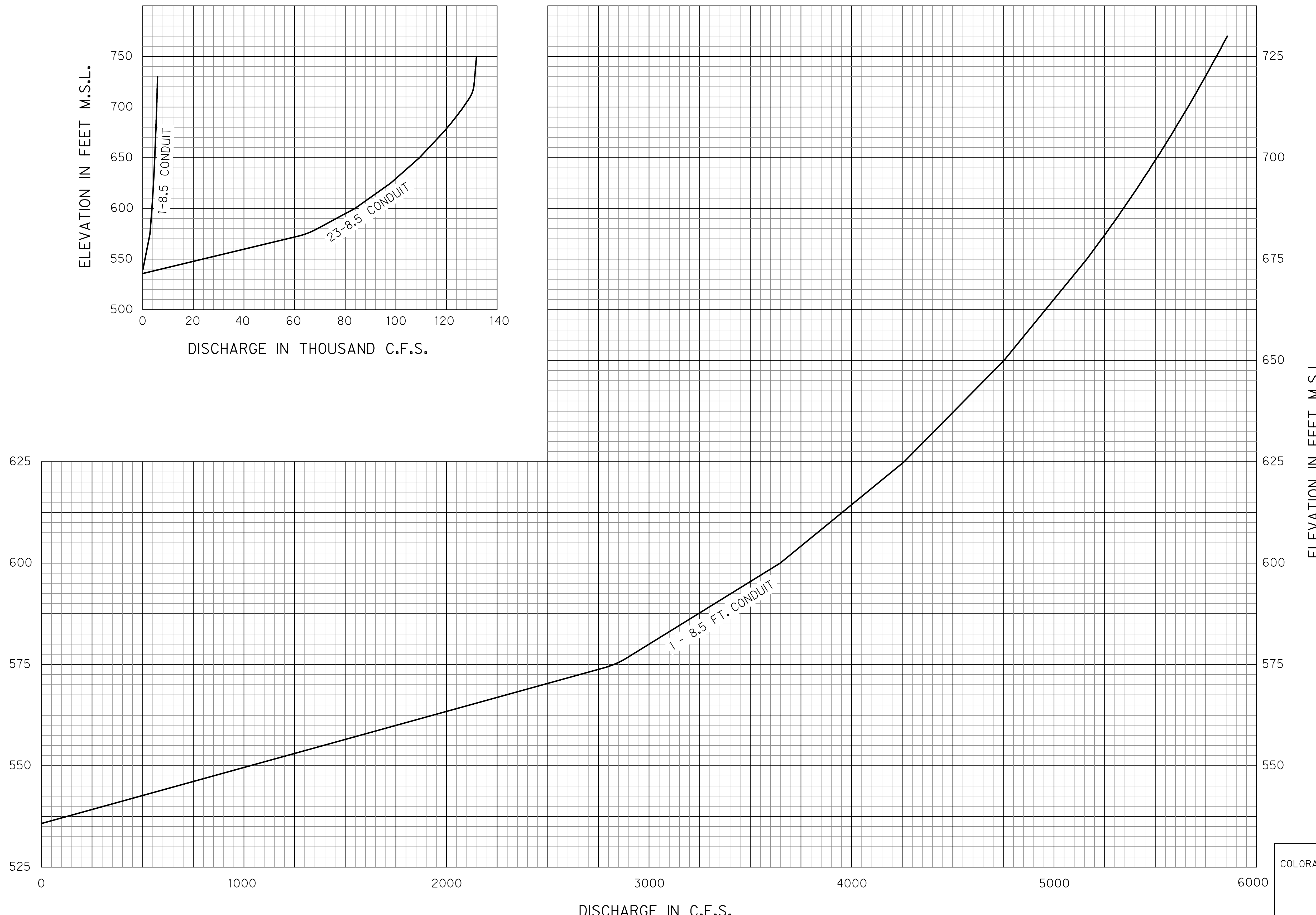
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

FLOOD CONTROL REGULATION

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



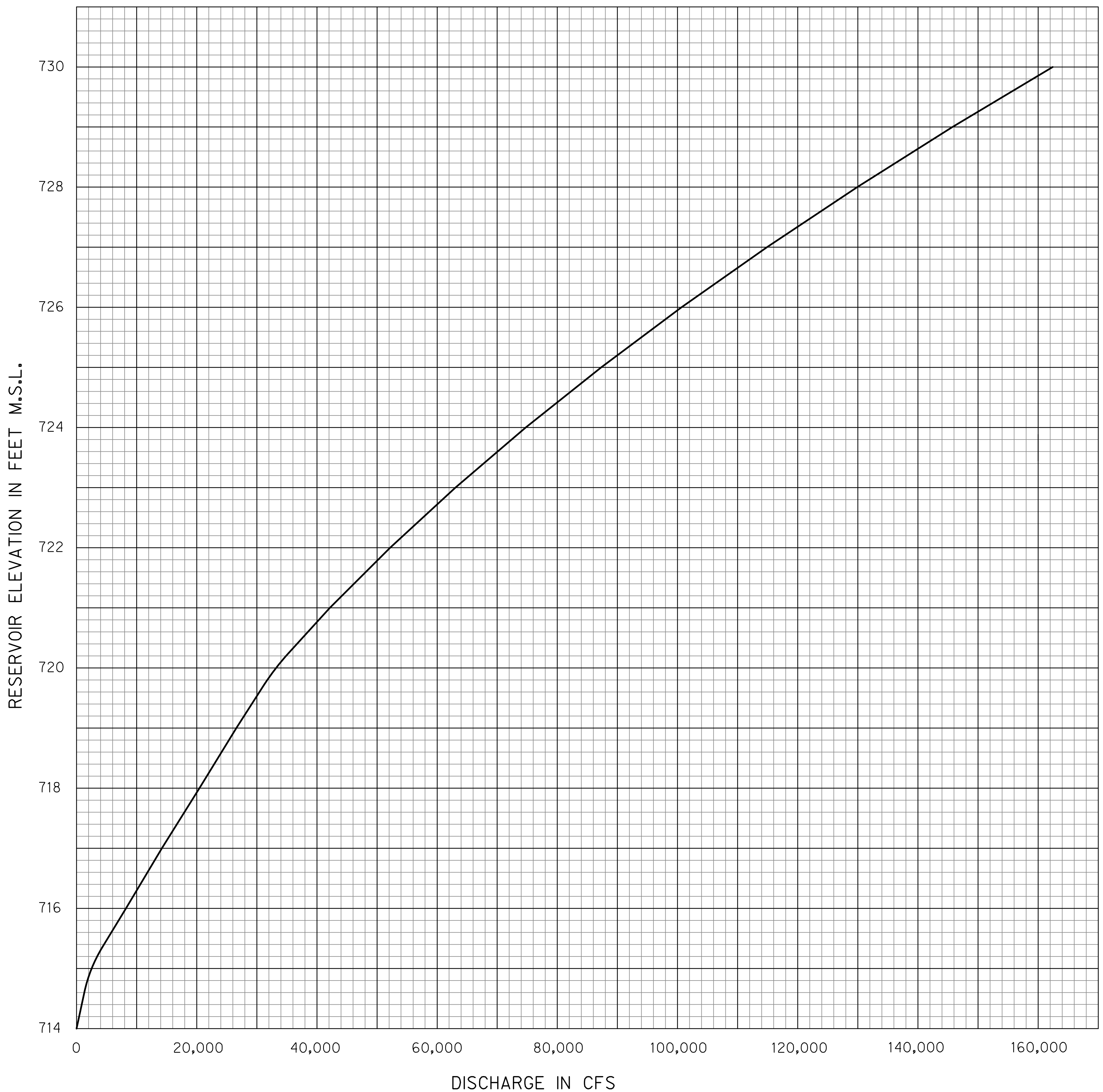
COLORADO RIVER BASIN TEXAS

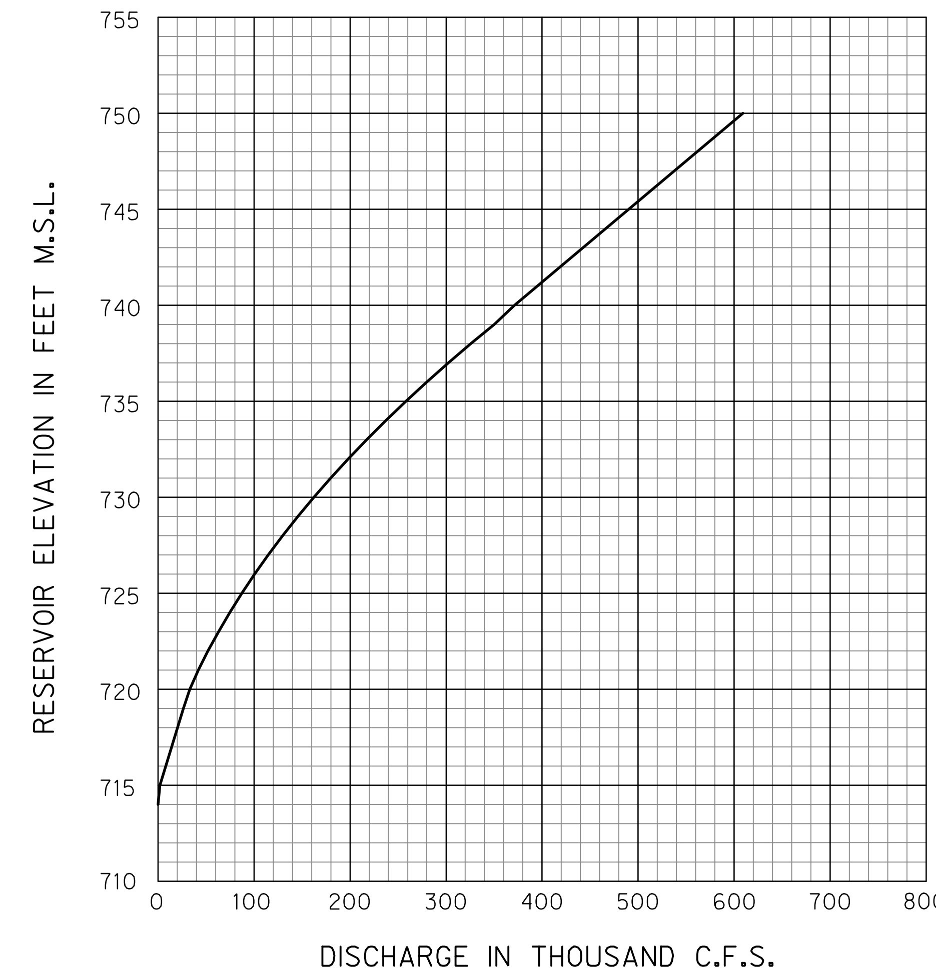
WATER CONTROL MANUAL
MANSFIELD DAM

CONDUIT DISCHARGE RATING CURVE

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013





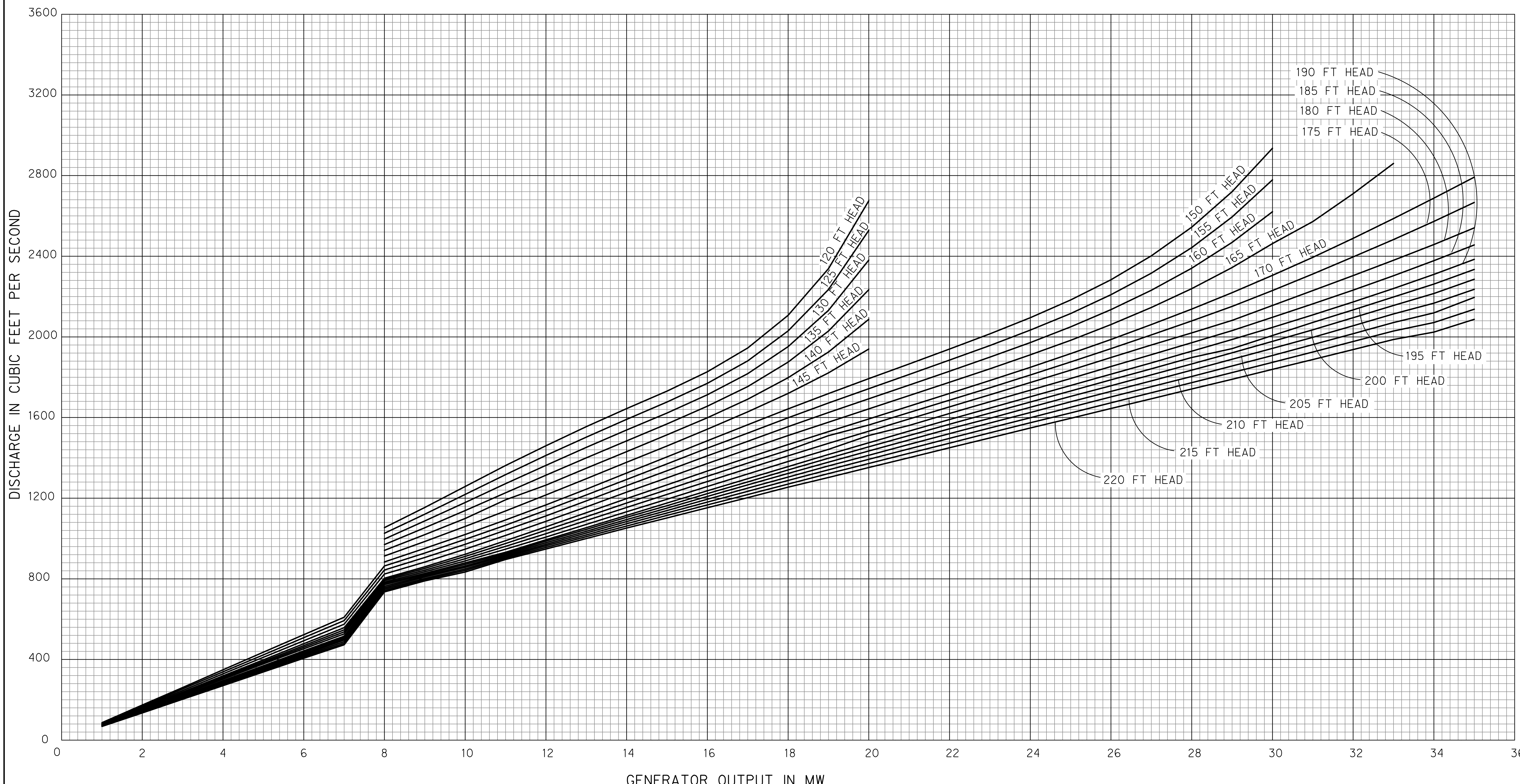
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

SPILLWAY DISCHARGE RATING CURVE

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



DATA FROM ALLIS CHALMERS PERFORMANCE CURVES (PROVIDED BY LCRA IN 2012)

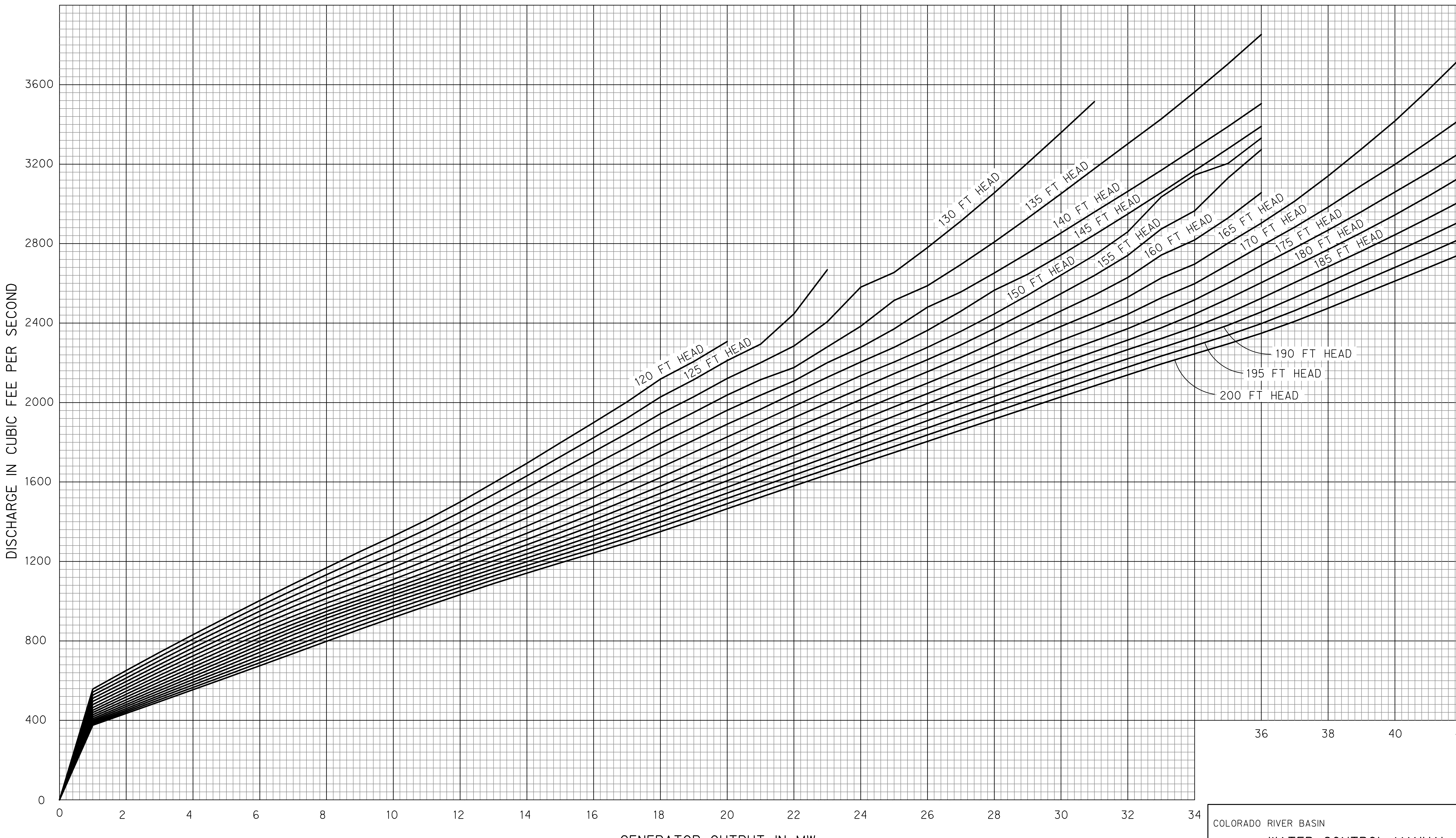
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

TURBINE PERFORMANCE CURVES FOR UNITS 1 & 3

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



DATA FROM VOITH HYDRO (PROVIDED BY LCRA IN 2012)

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

TURBINE PERFORMANCE CURVES FOR UNIT 2

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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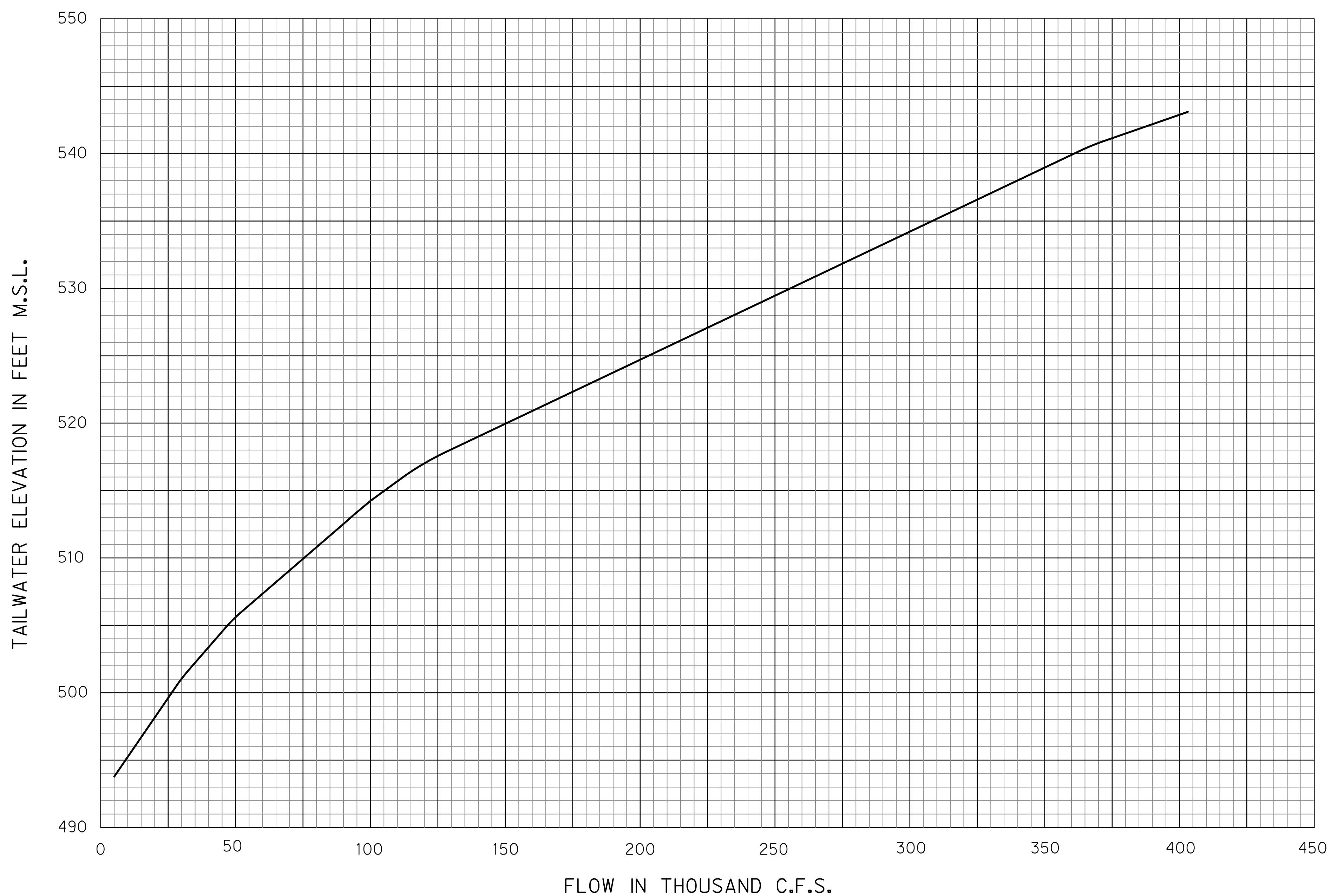

TAILWATER CURVE DEVELOPED FROM FDEP PHASE 1 (2000) HEC-RAS MODELS FOR LAKE AUSTIN

COLORADO RIVER BASIN	TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

TAILWATER RATING CURVE

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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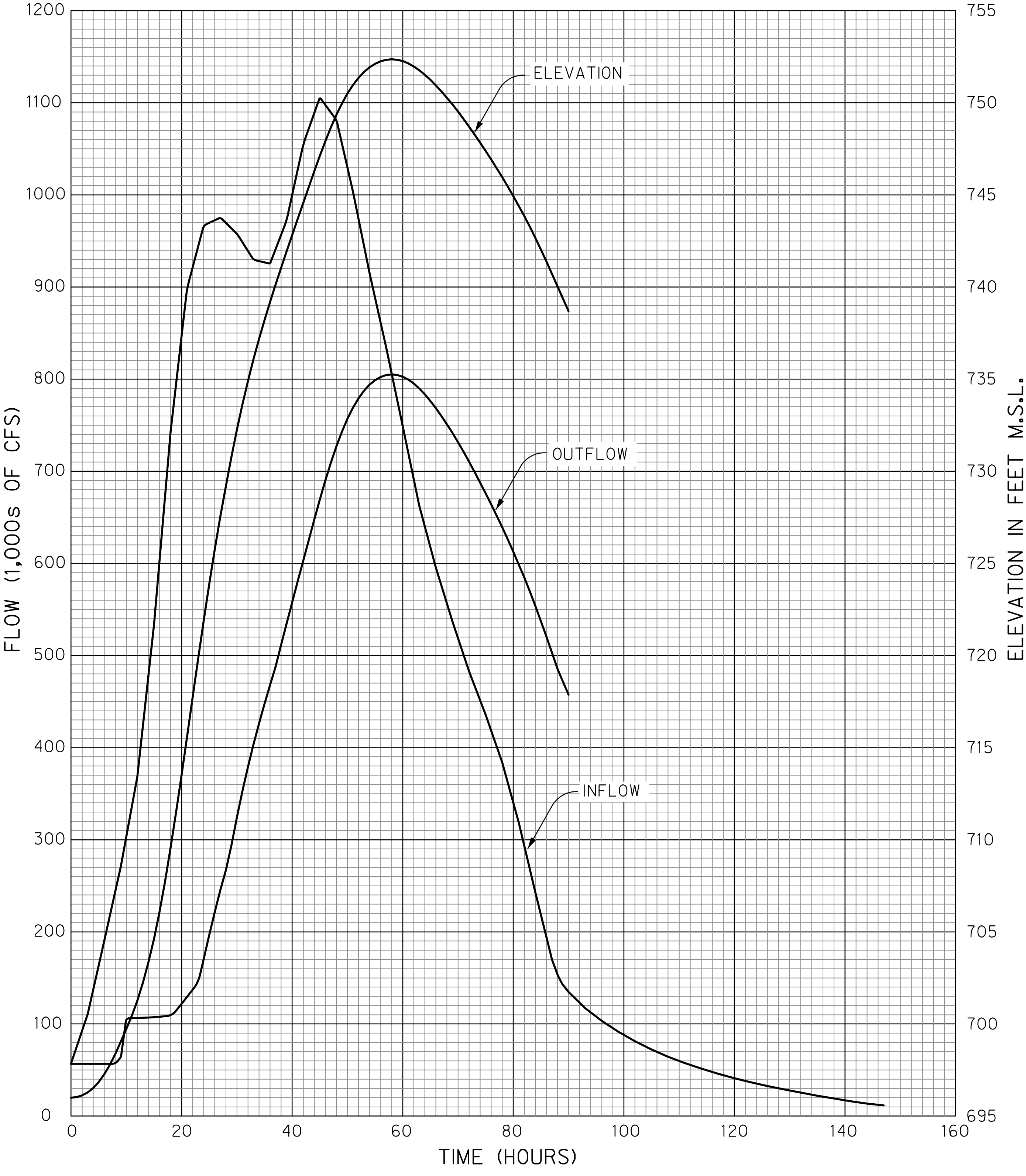


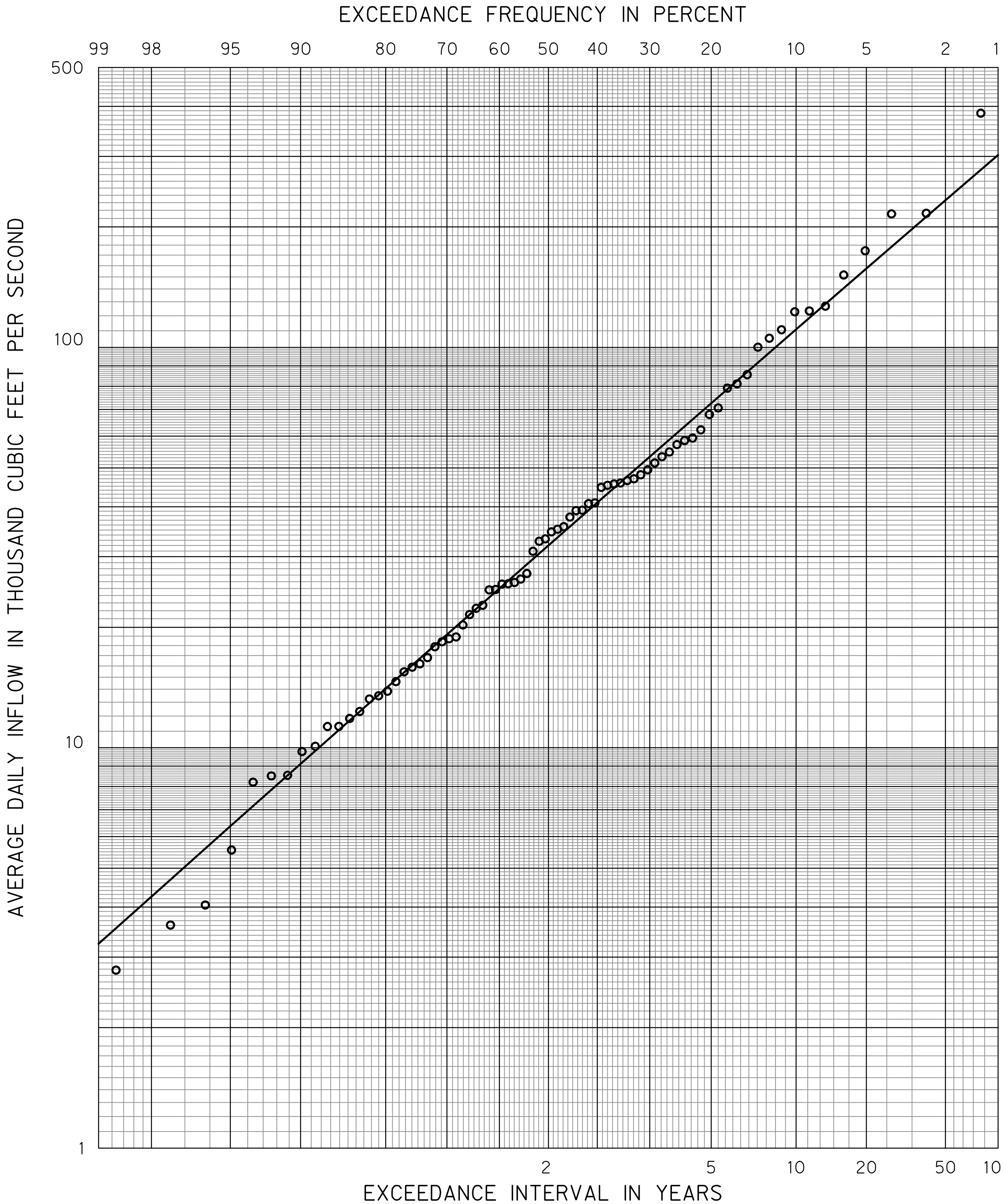
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

1991 MANSFIELD DAM PMF ROUTINGS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

ANNUAL MAXIMUM DAILY INFLOW FREQUENCY

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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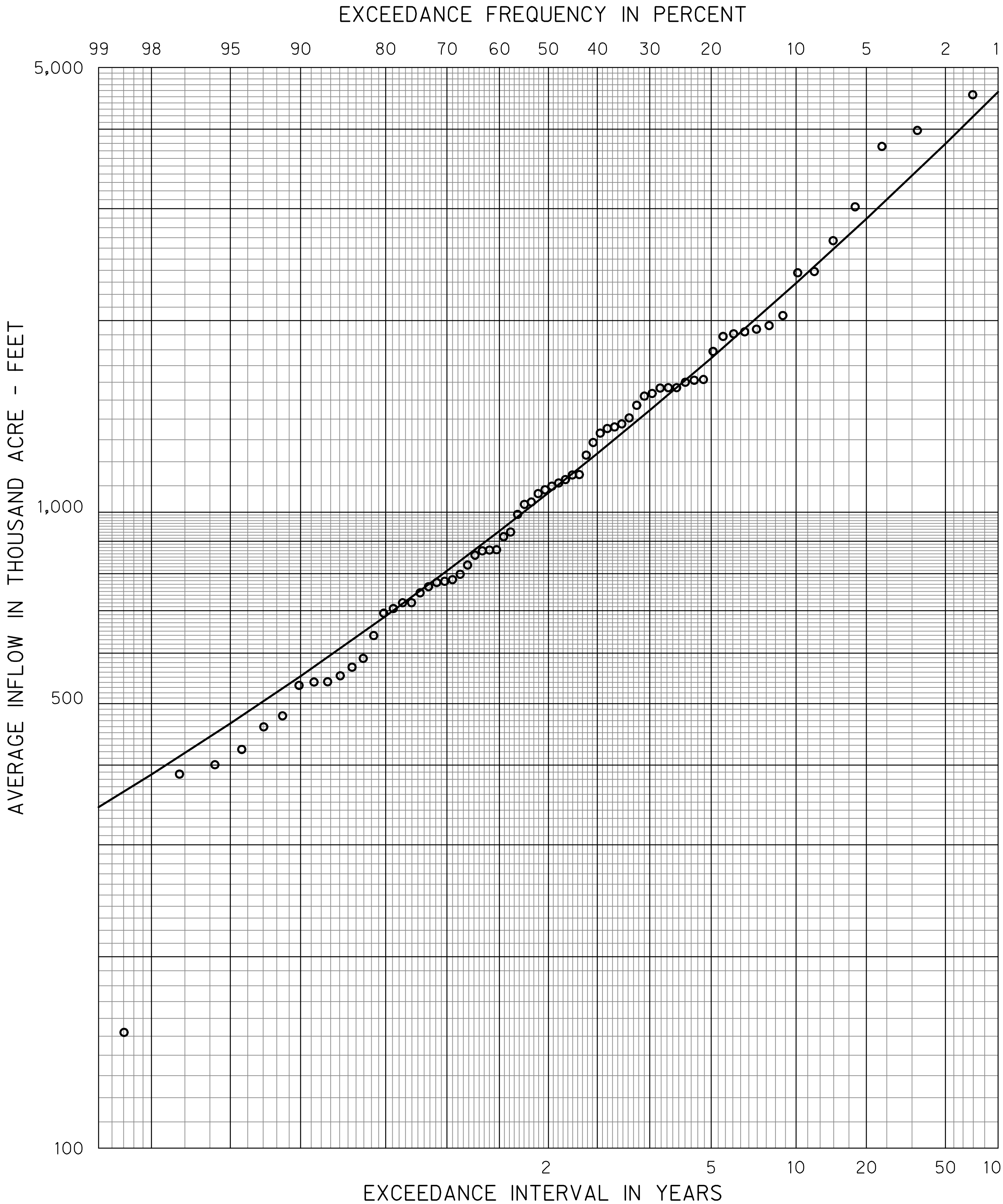

NOTE: BASED ON USACE COMPUTED INFLOW 70 YEAR RECORD, 1941-2010. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

COLORADO RIVER BASIN — TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

ANNUAL INFLOW FREQUENCY HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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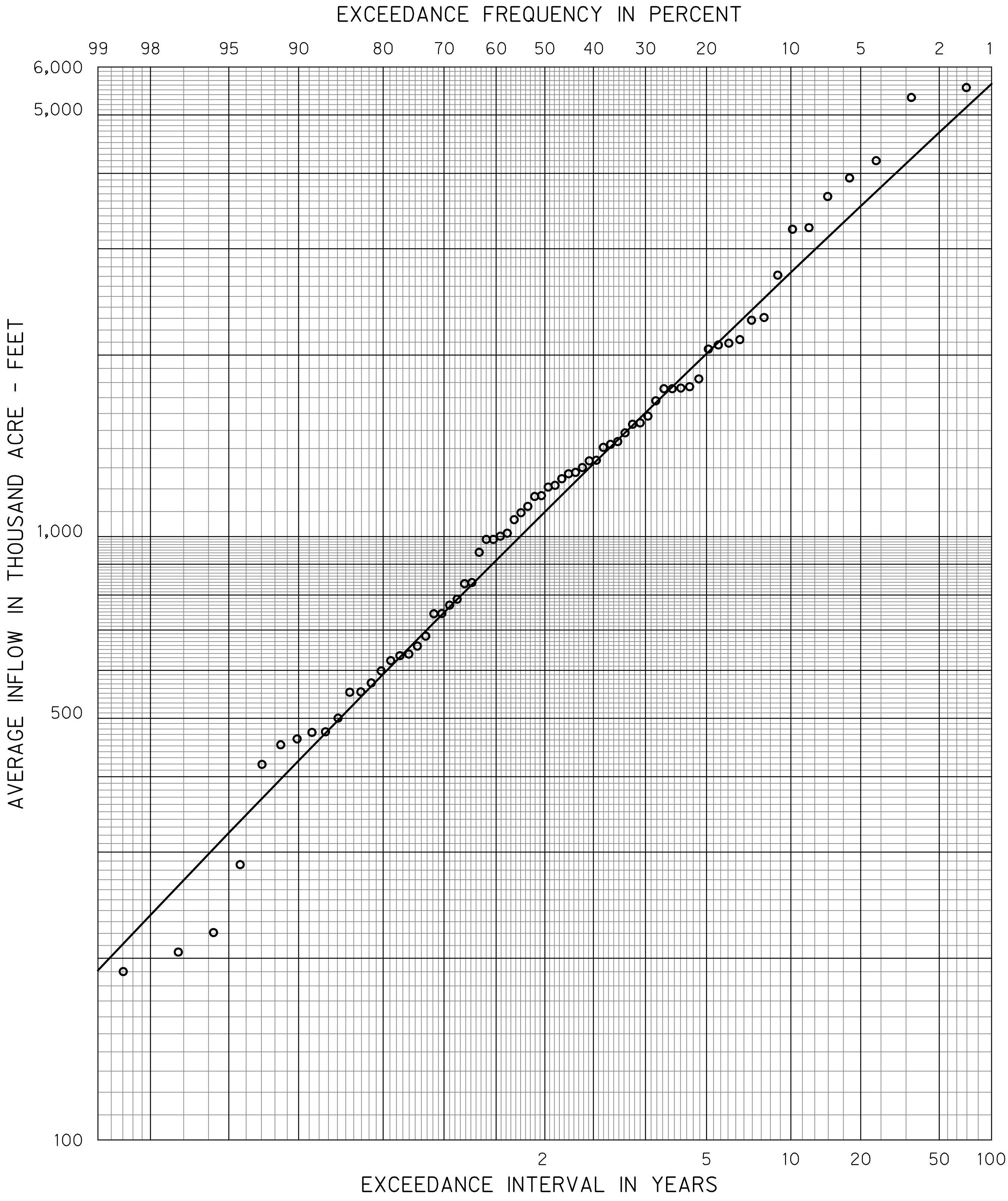


NOTE: BASED ON SIMULATED 78 YEAR RECORD, 1930-2007. ANALYTICAL CURVES ARE IN ACCORDANCE WITH BULLETIN #17B OF THE U.S. WATER RESOURCES COUNCIL, MARCH 1982.

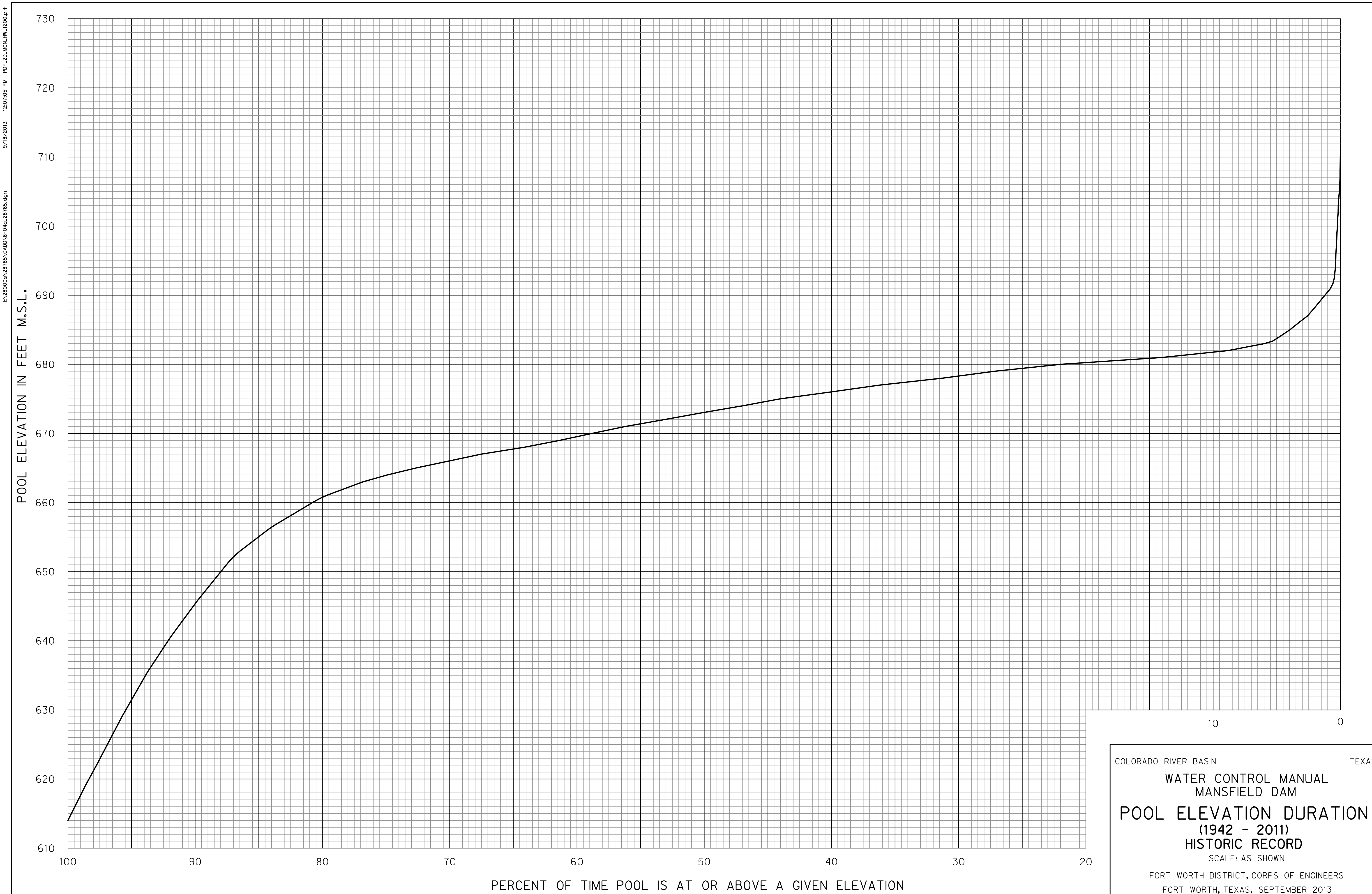
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

ANNUAL INFLOW FREQUENCY SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

POOL ELEVATION DURATION
(1942 - 2011)
HISTORIC RECORD

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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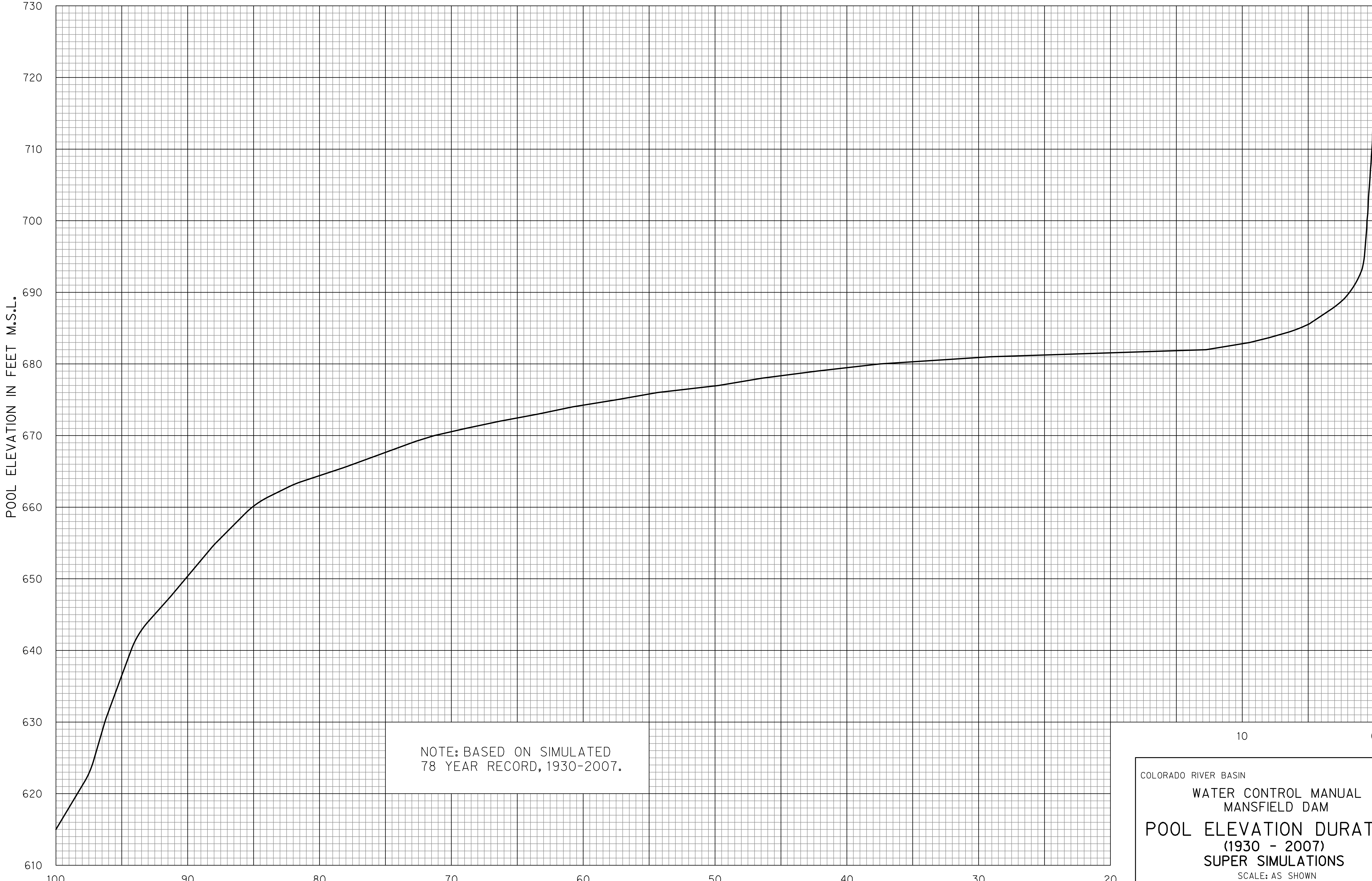

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

POOL ELEVATION DURATION
(1930 - 2007)
SUPER SIMULATIONS

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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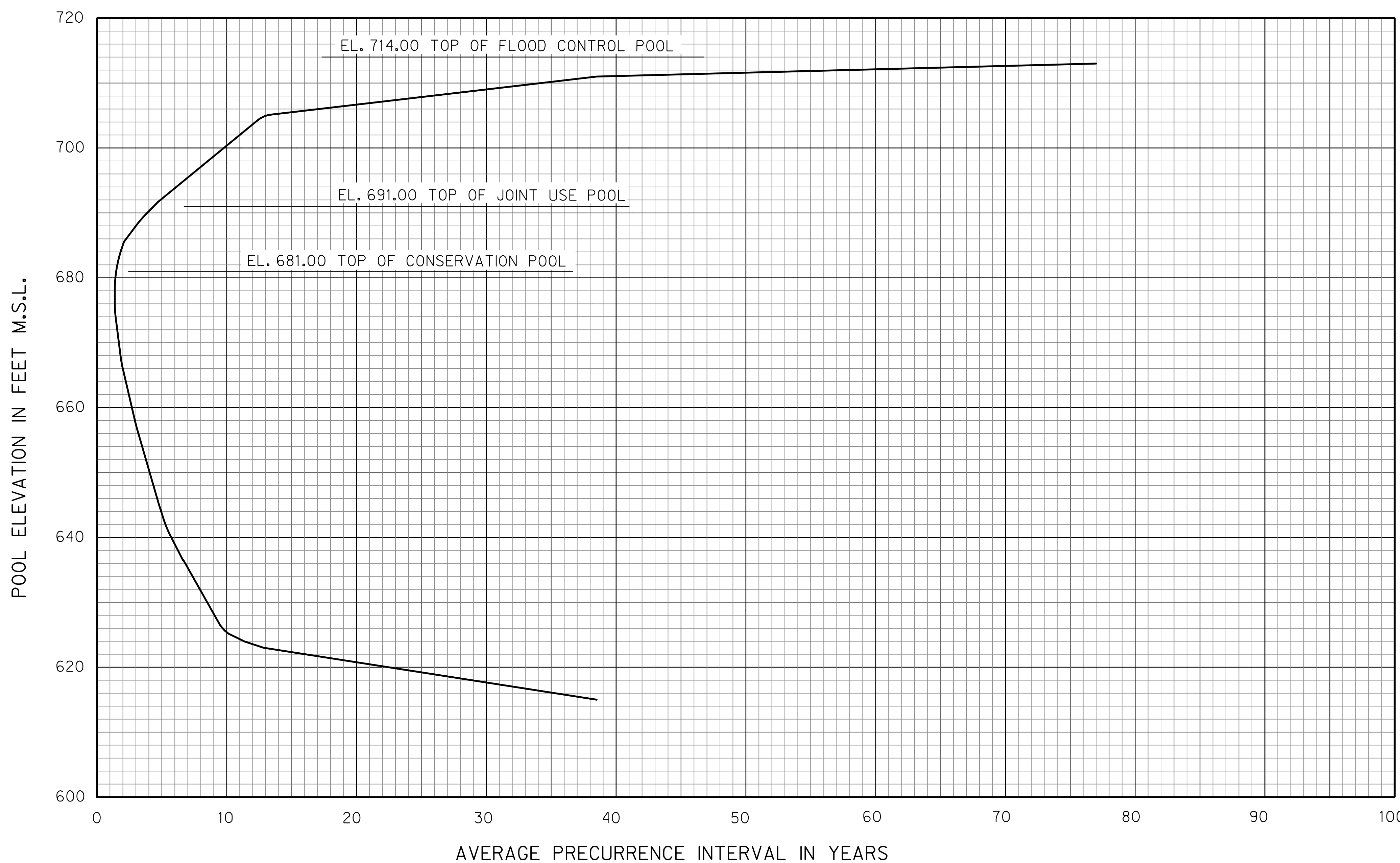


* BASED ON 1930-2007 SUPER PERIOD-OF-RECORD SIMULATION

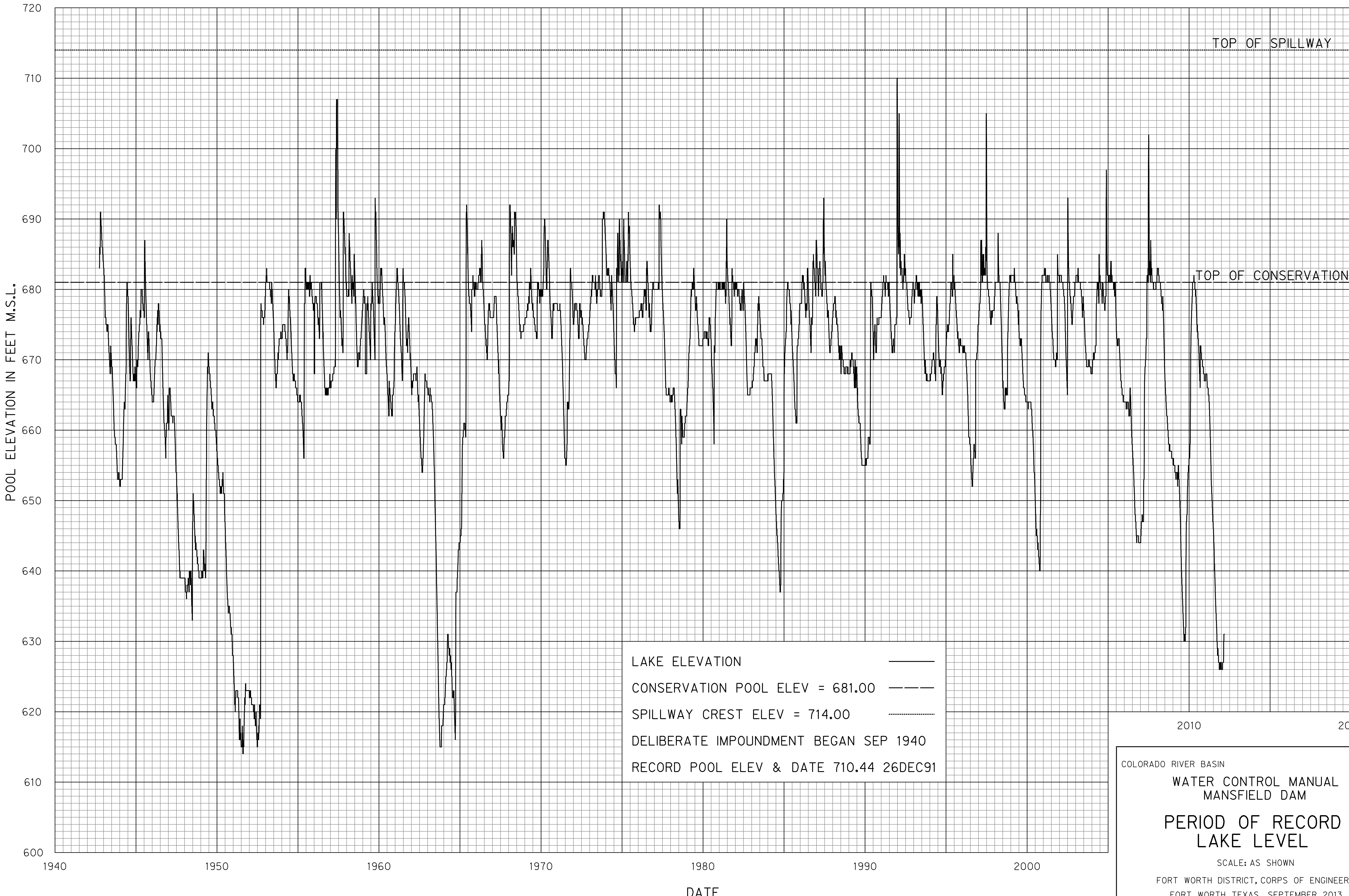
COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

POOL ELEVATION PROBABILITY CURVE

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013



COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

PERIOD OF RECORD LAKE LEVEL

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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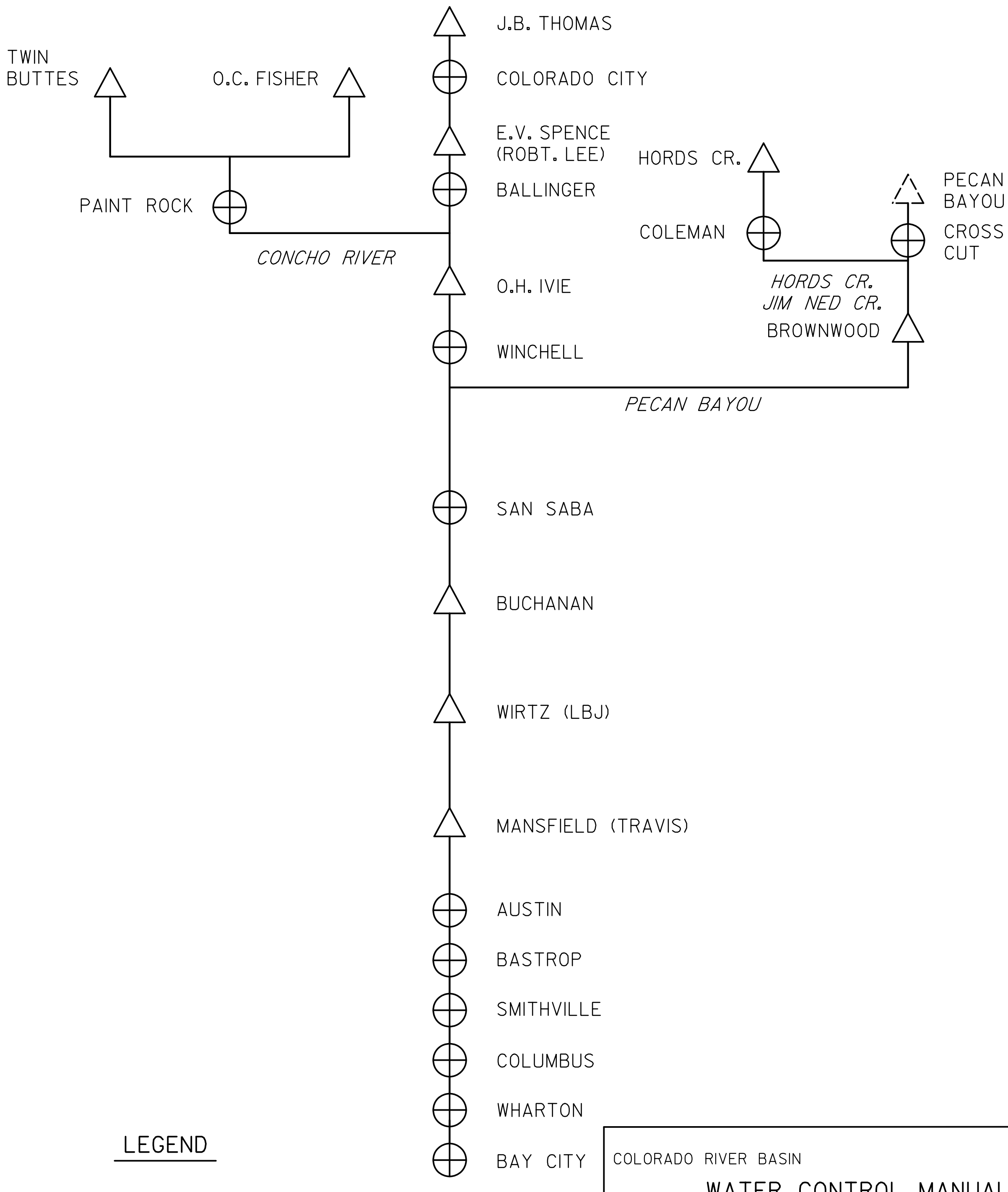
COLORADO RIVER BASIN COMPUTER MODEL

SWD SUPER



LEGEND

⊕ USGS RIVER GAGE LOCATIONS FOR WHICH THE LAKE RELEASES WILL BE CONTROLLED

△ EXISTING LAKES AND RESERVOIRS

RECOMMENDED LAKES AND RESERVOIRS TO BE ADDED FOR SUBSEQUENT STUDIES

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

COLORADO RIVER
BASIN MODEL

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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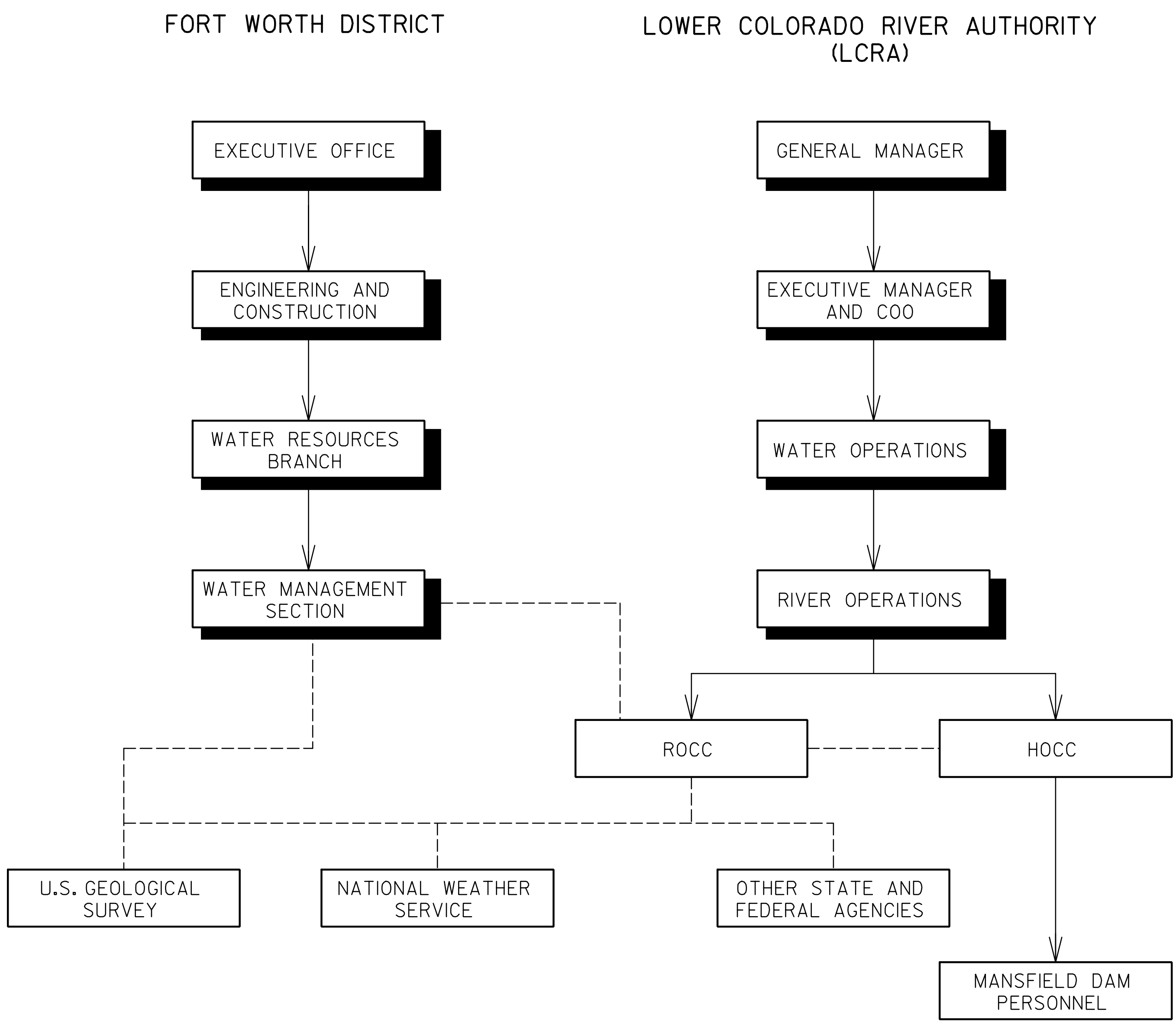
ORGANIZATION CHART FOR FLOOD CONTROL REGULATION



LEGEND

LINES OF COMMAND AUTHORTIY

LINES OF DIRECT COMMUNICATION

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

ORGANIZATION FOR FLOOD CONTROL REGULATION

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

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FORT WORTH DISTRICT CORPS OF ENGINEERS
RESERVOIR REPORT FOR THURSDAY 28JUN2012

RESERVOIR	ELEVATION 0800 FT-NGVD	TOP CONS POOL	MEAN INFLOW DSF	MEAN TURBINE DSF	DAILY PUMP MGD	RELEASES OTHER DSF	RAIN INCHES	EVAP INCHES	0800 RELEASE CFS	POOL OCCUPIED %		POOL OCCUPIED A-F
RED RIVER BASIN												
Cooper	438.53	440.0	-131	--	68.806	5	0.00	.35	5	90	C	234950
Wright Patm	226.29	226.9	381	--	44.150	114	0.00	.38	114	93	C	268544
Bob Sandlin	334.55	337.5	14	--	--	0	--	--	0	87	C	175194
Lake O Pine	226.64	230.0	-63	--	--	71	0.00	--	71	78	C	209695
Caddo	168.56	168.5	-448	--	--	462	0.00	--	224	1	S	1606
NECHES RIVER BASIN												
Sam Rayburn	163.19	164.4	-1333	900	--	0	0.00	.30	0	91	C	1273319
B.A. Steinh	82.75	81.0	2697	1300	--	0	0.00	.10	1220	96	C	64055
TRINITY RIVER BASIN												
Bridgeport	830.01	836.0	-9	--	--	93	0.00	--	110	80	C	297858
Eagle Mount	646.07	649.0	58	--	67.000	187	0.00	--	187	87	C	157349
Lake Worth	592.05	594.0	169	--	96.800	0	0.00	--	0	83	C	30331
Benbrook	691.99	694.0	-75	--	64.942	13	0.00	.53	13	90	C	64152
Joe Pool	521.51	522.0	10	--	9.618	5	0.00	.45	5	97	C	139236
Mountain Ck	457.36	457.0	-18	--	--	0	--	--	0	--	S	998
Ray Roberts	632.07	632.5	30	--	15.271	44	--	--	44	98	C	776054
Lewisville	520.93	522.0	-157	0	62.472	400	0.00	--	400	95	C	534790
Grapevine	533.15	535.0	9	--	--	85	0.00	.45	85	92	C	134945
Lavon	490.50	492.0	-16	--	390.507	0	0.00	.41	0	93	C	412585
Ray Hubbard	435.11	435.5	-137	--	148.900	31	0.00	--	31	98	C	481102
Cedar Creek	321.08	322.0	-300	--	65.350	0	0.00	--	0	95	C	638771
Navarro Mil	424.65	424.5	15	--	9.330	11	0.00	.59	11	1	F	761
Bardwell	420.67	421.0	-12	--	6.706	0	0.00	.43	0	98	C	45110
Richland Cr	314.31	315.0	766	--	145.810	5	0.00	--	5	97	C	1075412
BRAZOS RIVER BASIN												
Possum King	993.93	1000.0	28	--	--	51	0.00	.44	51	78	C	345270
Granbury	692.06	693.0	-2	--	64.330	31	0.00	.41	463	94	C	120942
Whitney	532.10	533.0	184	700	--	25	0.00	.52	25	91	C	213340
Aquilla	537.01	537.5	5	--	--	2	--	--	2	95	C	29776
Waco	462.05	462.0	40	--	40.066	10	0.00	.37	10	0	F	422
Proctor	1160.85	1162.0	-27	--	3.037	41	0.00	.44	41	90	C	44809
Belton	593.67	594.0	87	--	62.198	60	--	--	60	99	C	378613
Stillhouse	620.30	622.0	28	--	0.000	1	0.00	.47	1	95	C	213487
Georgetown	786.67	791.0	18	--	49.872	0	0.00	.50	0	85	C	31486
Granger	503.63	504.0	-3	--	4.497	1	0.00	.40	1	96	C	33733
Somerville	237.75	238.0	-50	--	4.708	1	0.00	.49	1	98	C	145024
Limestone	361.57	363.0	-263	--	--	6	0.00	.25	6	91	C	171160
COLORADO RIVER BASIN												
Twin Buttes	1888.15	1940.2	67	--	--	60	0.00	--	60	1	C	2318
O.C. Fisher	1849.94	1908.0	9	--	0.000	7	0.00	.46	7	1	D	214
O.H. Ivie	1509.19	1551.5	--	--	--	--	--	--	--	15	C	84695
Hords Creek	1881.51	1900.0	1	--	0.000	1	0.00	.40	1	12	C	830
Buchanan	997.46	1020.5	--	--	--	--	--	--	--	51	C	474480
Marshall Fo	640.57	681.0	-140	760	--	0	0.00	.34	0	29	C	246790
GUADALUPE RIVER BASIN												
Canyon	903.99	909.0	60	0	--	61	0.00	.49	61	89	C	336128

Pumpage below dam (MGD): Grapevine 7.825, and Belton 24.038.
Total outflow includes this and pumpage tabulated.
Preliminary data--Inflow not adjusted for wind effect, etc.

D = Sediment Pool
C = Conservation Pool
F = Flood Pool
S = Surcharge Pool
nr = Not reported today

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

DAILY REPORT

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013

Marshall Ford
Monthly Report
OCT1997

DAY	ELEVATIONS 0800	ELEVATIONS 2400	STORAGE 2400	EVAP	PUMP	RELEASES TURBINE	RELEASES OTHER	ADJ. INFLOW	RAIN
	FEET-NGVD	FEET-NGVD	A-F	DSF	DSF	DSF	DSF	DSF	INCH
1	675.56	675.46	1070335	168	0.0	880	0	160	0.00
2	675.47	675.37	1068576	148	0.0	880	0	141	0.00
3	675.37	675.26	1066642	167	0.0	958	0	151	0.00
4	675.25	675.14	1064712	167	0.0	830	0	25	0.00
5	675.15	675.04	1062960	174	0.0	885	0	176	0.00
6	675.04	675.06	1063310	87	0.0	640	0	903	0.20
7	675.11	675.12	1064186	227	0.0	1040	0	1709	1.36
8	675.19	675.19	1065414	127	0.0	820	0	1566	0.04
9	675.25	675.24	1066467	33	0.0	400	0	964	0.25
10	675.27	675.19	1065589	67	0.0	990	0	614	0.50
11	675.19	675.20	1065765	67	0.0	900	0	1056	0.50
12	675.26	675.20	1065589	67	0.0	750	0	728	0.50
13	675.19	675.15	1064888	107	0.0	750	0	504	0.00
14	675.15	675.06	1063135	120	0.0	800	0	37	0.00
15	675.05	675.02	1062610	113	0.0	360	0	209	0.00
16	675.23	675.46	1070159	100	0.0	380	0	4287	0.00
17	675.83	675.93	1078462	114	0.0	370	0	4671	0.00
18	676.16	676.30	1085035	115	0.0	360	0	3789	0.00
19	676.34	676.39	1086817	122	0.0	310	0	1331	0.00
20	676.41	676.52	1089137	109	0.0	380	0	1659	0.00
21	676.53	676.50	1088601	95	0.0	420	0	195	0.00
22	676.53	676.44	1087709	47	0.0	380	0	123	0.02
23	676.42	676.43	1087530	95	0.0	420	0	330	0.07
24	676.51	676.49	1088601	116	0.0	320	0	976	0.00
25	676.61	676.51	1088959	116	0.0	220	0	517	0.00
26	676.46	676.49	1088423	116	0.0	230	0	76	0.00
27	676.48	676.48	1088244	88	0.0	320	0	228	0.00
28	676.43	676.43	1087352	6	0.0	380	0	47	0.02
29	676.40	676.37	1086460	75	0.0	370	0	25	0.00
30	676.35	676.33	1085747	74	0.0	250	0	15	0.00
31	676.33	676.38	1086460	0	0.0	160	0	419	0.00
MONTHLY TOTAL (DSF)				3240	0	17153	0	27631	3.46
(A-F)			14362	6426	0	34022	0	54805	

COLORADO RIVER BASIN TEXAS

WATER CONTROL MANUAL
MANSFIELD DAM

MONTHLY RESERVOIR REPORT

SCALE: AS SHOWN

FORT WORTH DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS, SEPTEMBER 2013