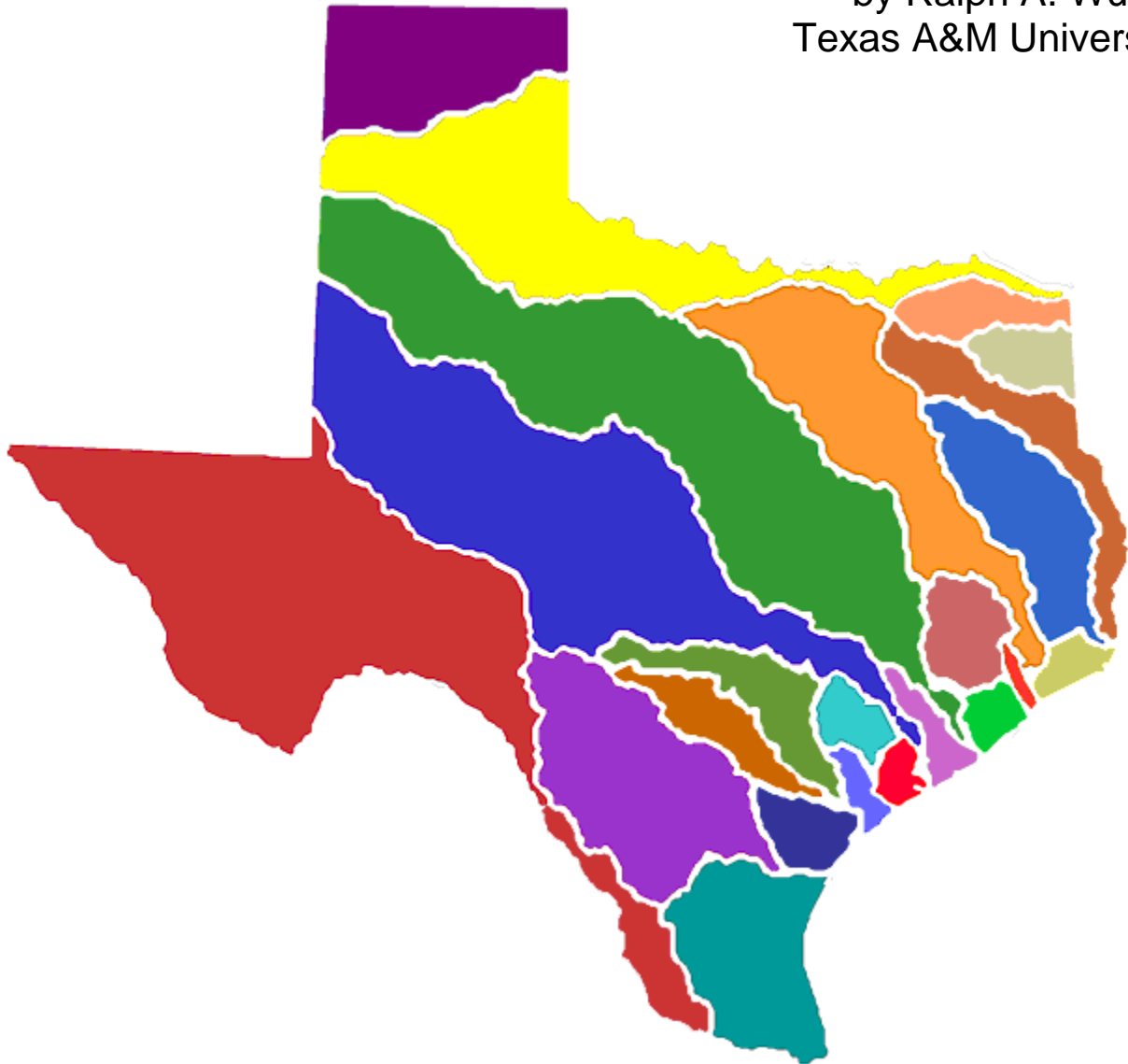


Incorporation of Environmental Flow Standards and Other Water Management Complexities in Water Availability Modeling

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ABSTRACT

The Water Rights Analysis Package (WRAP) modeling system and WRAP simulation input datasets called Water Availability Models (WAMs) are employed by the water management community of Texas to assess surface water availability throughout the state. The 15 major river basins and eight coastal basins of Texas are modeled with 20 WAMs. The WAM datasets and an array of information are accessible at a water availability modeling website maintained by the Texas Commission on Environmental Quality (TCEQ). WRAP software, manuals, online training courses, and publications are available at a WRAP website maintained at Texas A&M University (TAMU). The generalized WRAP modeling system is explained in detail by reference, users, fundamentals, hydrology, daily, and salinity manuals published as Texas Water Resources Institute (TWRI) technical reports. WRAP and the WAMs have been routinely applied in preparing and evaluating water use permit applications; statewide, regional, and operational planning; and other water management endeavors throughout Texas since 2000. The WRAP/WAM modeling system has also been continually improved and expanded over the past 25 years. This "synthesis report" covers recent research and development yet to be fully implemented along with an experience base accumulated over the past more than two decades.

Water availability modeling is essential for effective water resources planning, development, allocation, and management. Complexities and issues in assessing water availability in river and reservoir systems are explored in this report along with synthesizing assessment capabilities. Incorporation of environmental flow standards (EFS) established pursuant to the 2007 Senate Bill 3 (SB3) is a major focus. Routine applications of WRAP and the WAMs are based on a monthly computational time step. The SB3 EFS process motivated development of auxiliary WRAP modeling capabilities employing a daily computational time step. Modeling reservoir flood control operations has also been added to the daily version of the simulation model. Hydrologic variability and stationarity are governing concerns in water management. Updating WAM hydrologic periods-of-analysis with lengthening records of observed stream flow, precipitation, and reservoir evaporation data is another key aspect of water availability modeling.

Daily and modified monthly versions of WAMs for the Brazos, Trinity, Neches, Colorado, Lavaca, and Nueces River Basins developed in TCEQ-sponsored research at TAMU provide case studies for this report. These studies focus on expanding capabilities for incorporating SB3 EFS in water availability modeling but also address other complexities of water management and associated computer modeling. An overview of water availability throughout Texas as well as in the case study river basins is presented.

This synthesis report supplements the WRAP manuals, WAM reports, and other publications with additional practical information and guidance for addressing complexities of river system hydrology, water management, and associated water availability assessments. The report explores statewide water management and water availability as well as computer modeling thereof. The intended audience ranges from engineers and scientists with extensive WRAP and WAM modeling experience to water managers and stakeholders interested in a general overview of surface water availability in Texas and practices and capabilities for performing assessments of surface water availability.

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APPENDIX A
PLOTS OF OBSERVED RESERVOIR STORAGE
DISCUSSED IN CHAPTERS 3 AND 4

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Introduction to Appendix A

The daily reservoir storage volumes plotted in the figures of Appendix A are from the online database of water conditions data maintained by TWDB and accessible through the following TWDB website (<https://www.twdb.texas.gov/surfacewater/conditions/index.asp>). The database is described at the TWDB website and discussed in Chapters 3 and 4 of this report. The database includes historical daily storage contents for 122 large water supply reservoirs from initial impoundment to the present as well as an array of other related information.

The reservoir storage datasets were downloaded by the author as Microsoft Excel CSV (comma-separated values) files. *HEC-DSSVue* was employed to read the downloaded Excel CSV files, store the data in a DSS file, and prepare the plots.

Historical daily reservoir storage time series are discussed in Chapters 3 and 4. Figures 3.3 and 4.13 on pages 73 and 110 and the figures in Appendix A are in the same format with the same legend. Figures 3.3 and 4.13 are plots of the summation of daily storage volumes for 122 reservoirs through July 1, 2025. The daily volumes plotted in Figures A1 through A20 cover the period from initial impoundment of each individual reservoir through February 5, 2024. Figures A21 through A35 time series extend from January 1, 1994 through May 21, 2024. Construction was complete and water was being impounded in most major reservoirs in Texas by 1994.

Reservoir storage is a meaningful metric of water availability that reflects both hydrologic conditions and water resources development and management. The 35 figures in Appendix A provide a graphical articulation of past surface water availability. Figures A1 through A20 illustrate the history of river/reservoir system development throughout the state. Figures A21 through A35 focus on the most recent thirty years comprising the period during which most major reservoirs were in full operation. Figures A1 through A6, A17, A19, and A21 through A35 are comprised of summations of storage quantities for all reservoirs located in each of the 15 major river basins that are included in the TWDB database. The reservoirs included in the TWDB database are listed by river basin at the TWDB website cited above. The Lavaca and San Antonio River Basin each include only one reservoir in the TWDB database. The Canadian, Nueces, and Guadalupe River Basins each have two reservoirs in the database. The ten other major river basins have three or more reservoirs in the database. The Brazos and Trinity River Basins with 28 and 24 reservoirs in the database are the basins with the largest number of major reservoirs included.

The legend below is applicable to all figures in Appendix A as well as the summations of all 122 reservoirs in the TWDB database plotted in Figures 3.3 and 4.13 of Chapters 3 and 4.

| | |
|--------------------------|--|
| blue solid line | Total daily storage contents (acre-feet) |
| red dashed line | Active daily conservation storage contents allocated for use by water users in Texas (acre-feet) |
| black dotted line | Active conservation storage capacity used to store water for use by water users in Texas (acre-feet) |

The difference between total storage and active conservation storage includes: (1) flood control and surcharge storage, (2) active conservation storage used by water users in Mexico and neighboring states, and (3) inactive storage that may be used hydropower head or recreation but does not supply diversions or releases of water from the reservoir.

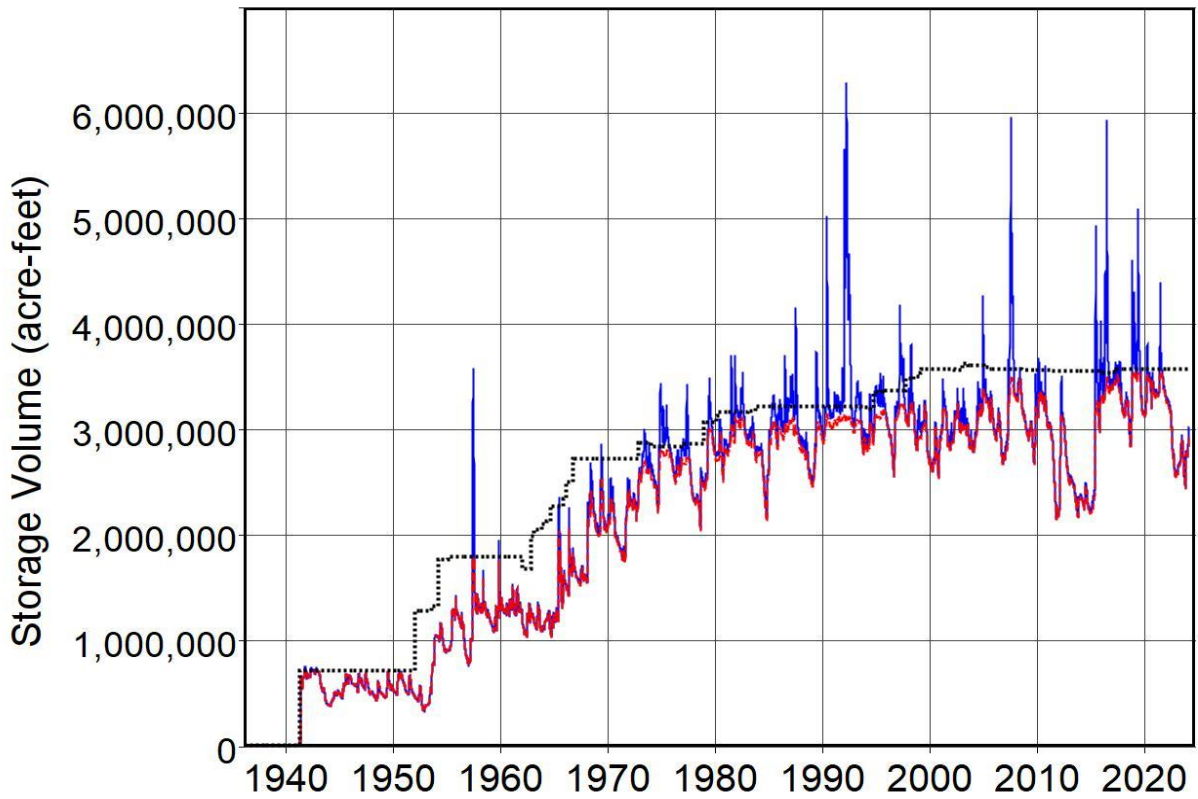


Figure A1 Storage Summations for 28 Reservoirs in the Brazos River Basin

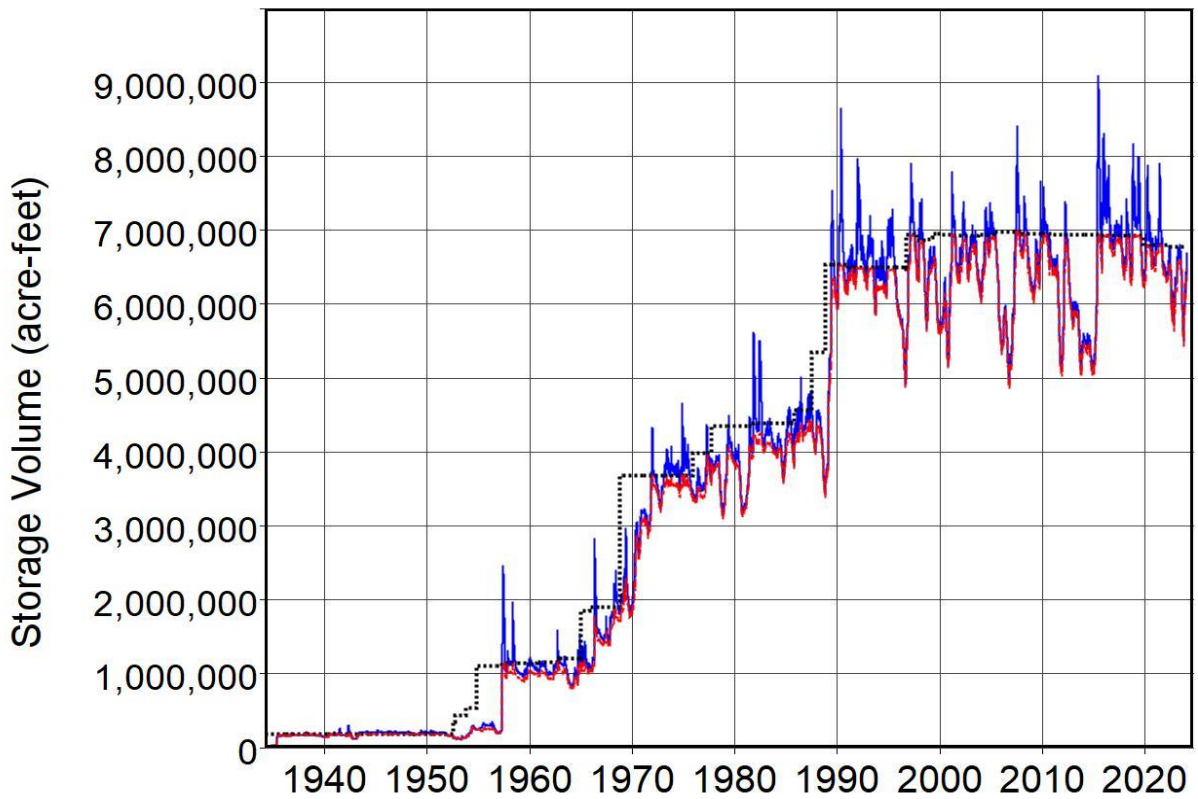


Figure A2 Storage Summations for 24 Reservoirs in the Trinity River Basin

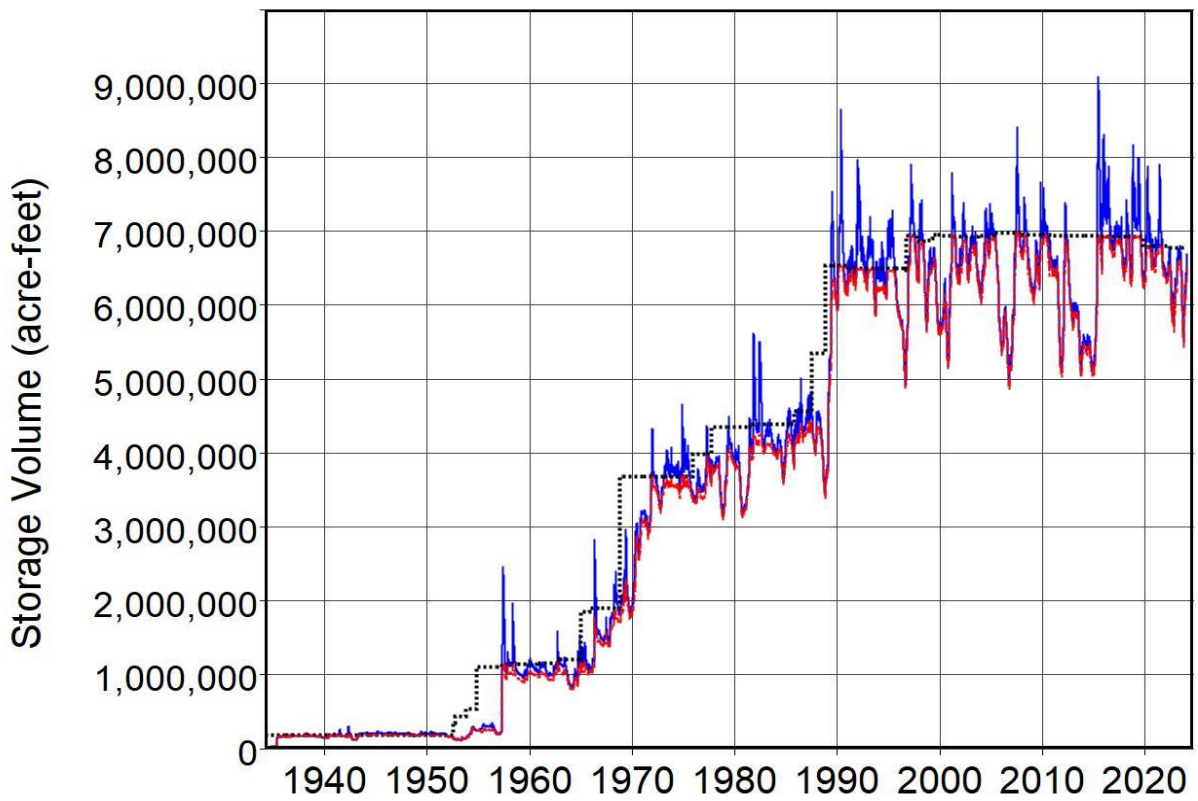


Figure A3 Storage Summations for 8 Reservoirs in the Neches River Basin

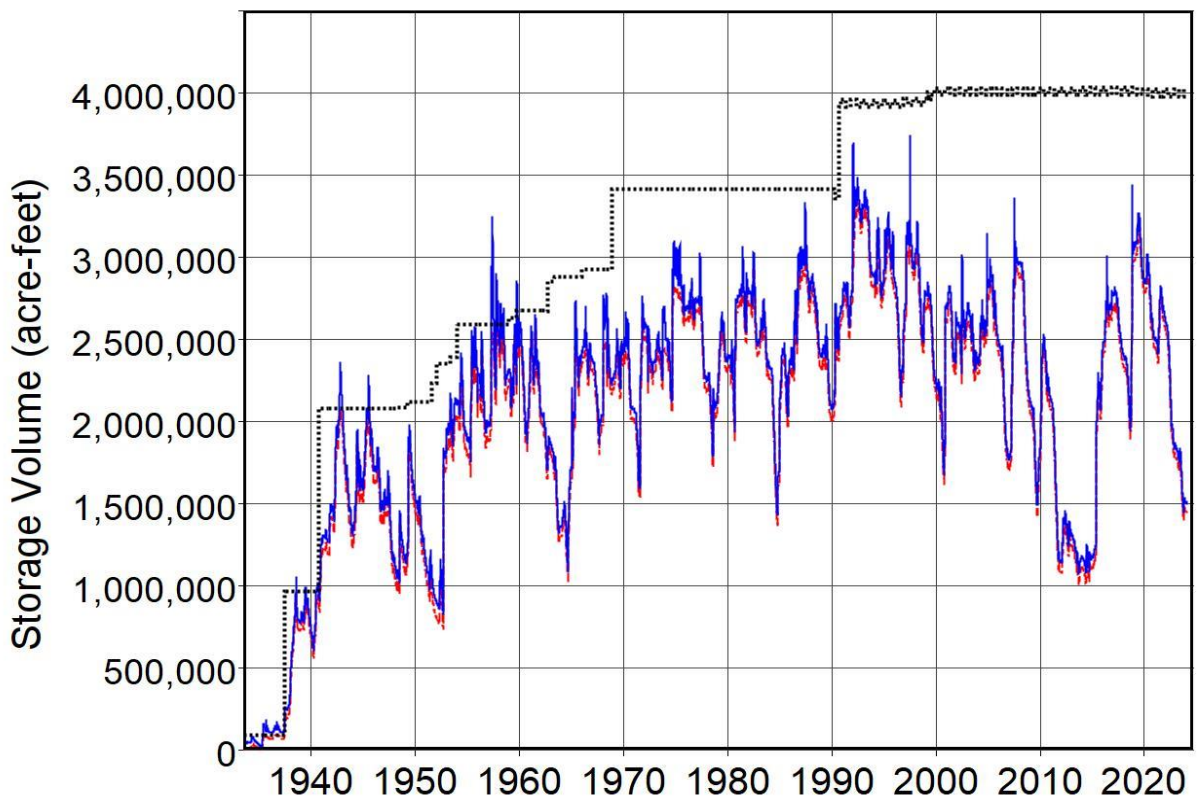


Figure A4 Storage Summations for 19 reservoirs in the Colorado River Basin

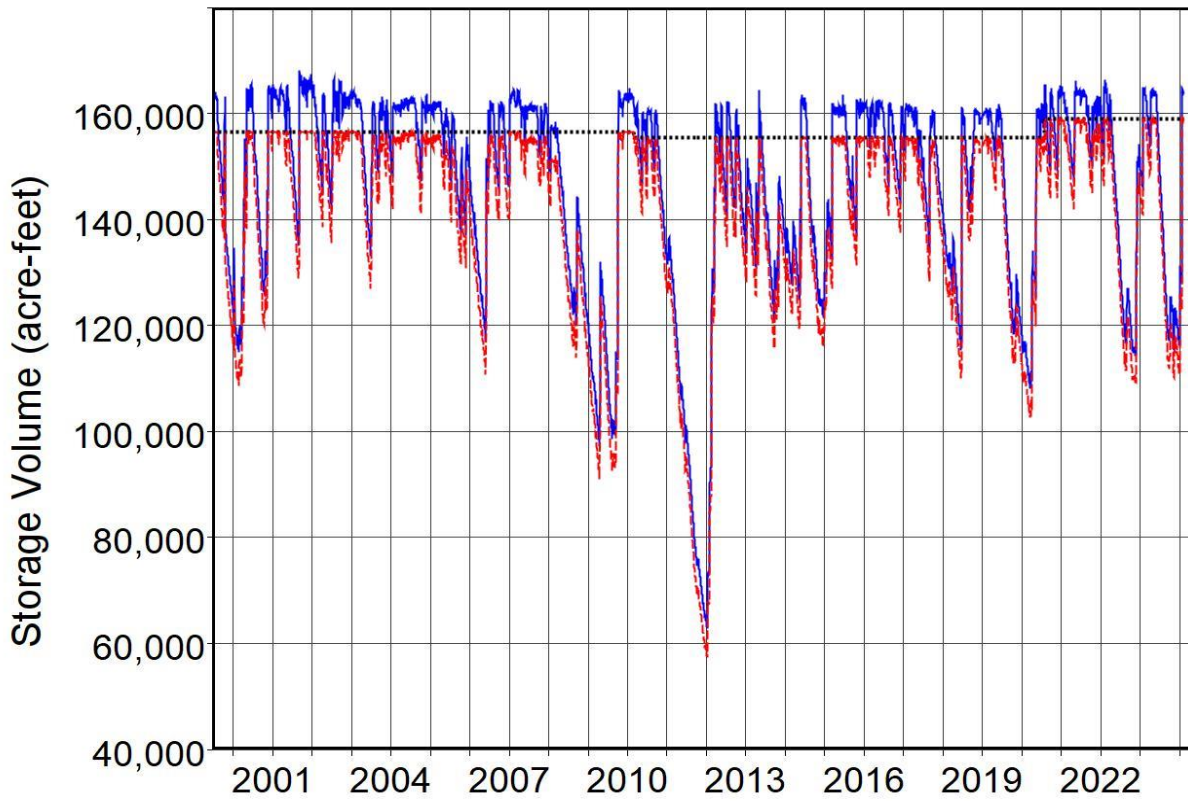


Figure A5 Storage in Lake Texana on the Navidad River in the Lavaca River Basin

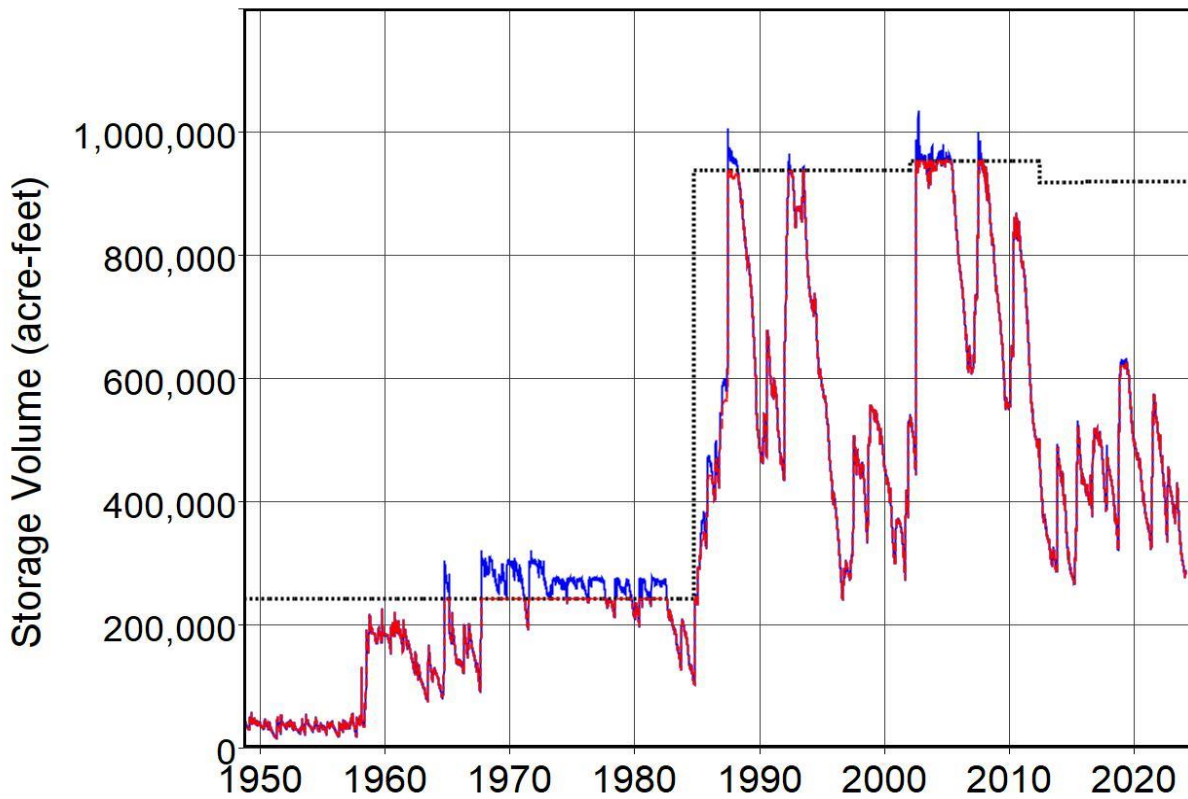


Figure A6 Storage in Lakes Corpus Christi and Choke Canyon in Nueces River Basin

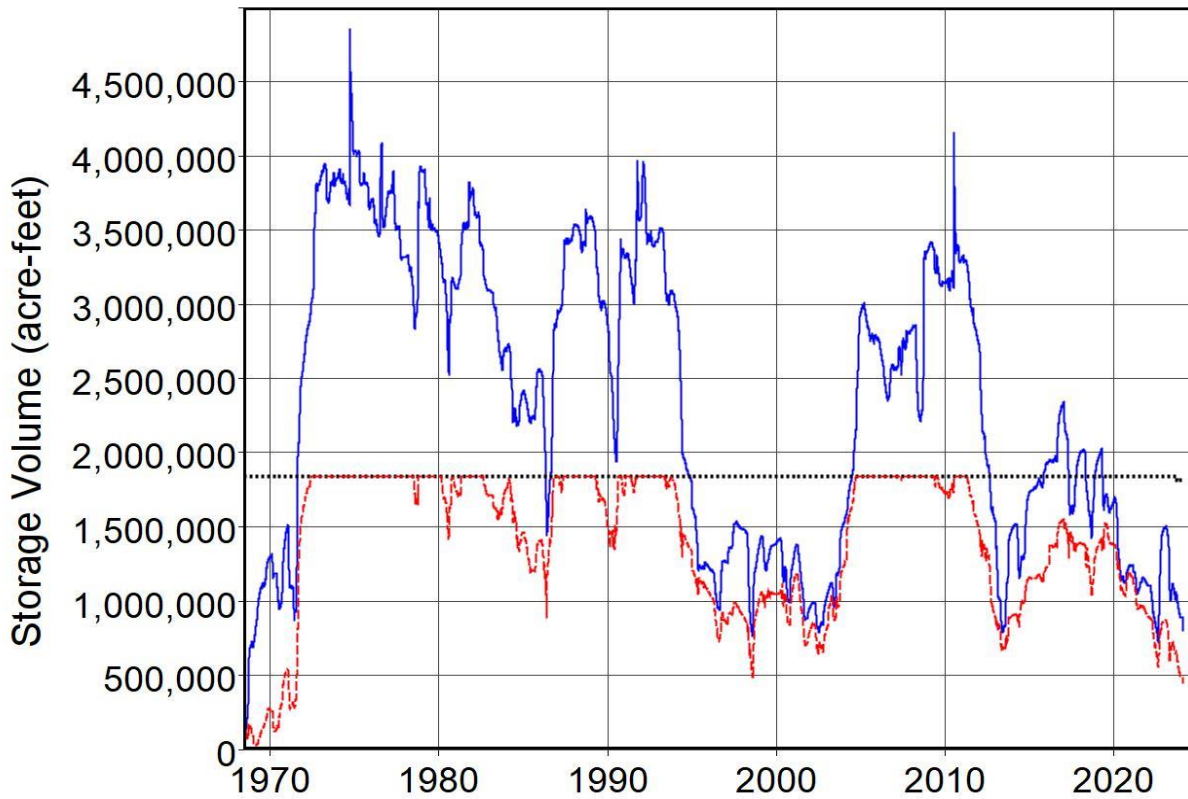


Figure A7 Storage in International Amistad Reservoir on the Rio Grande

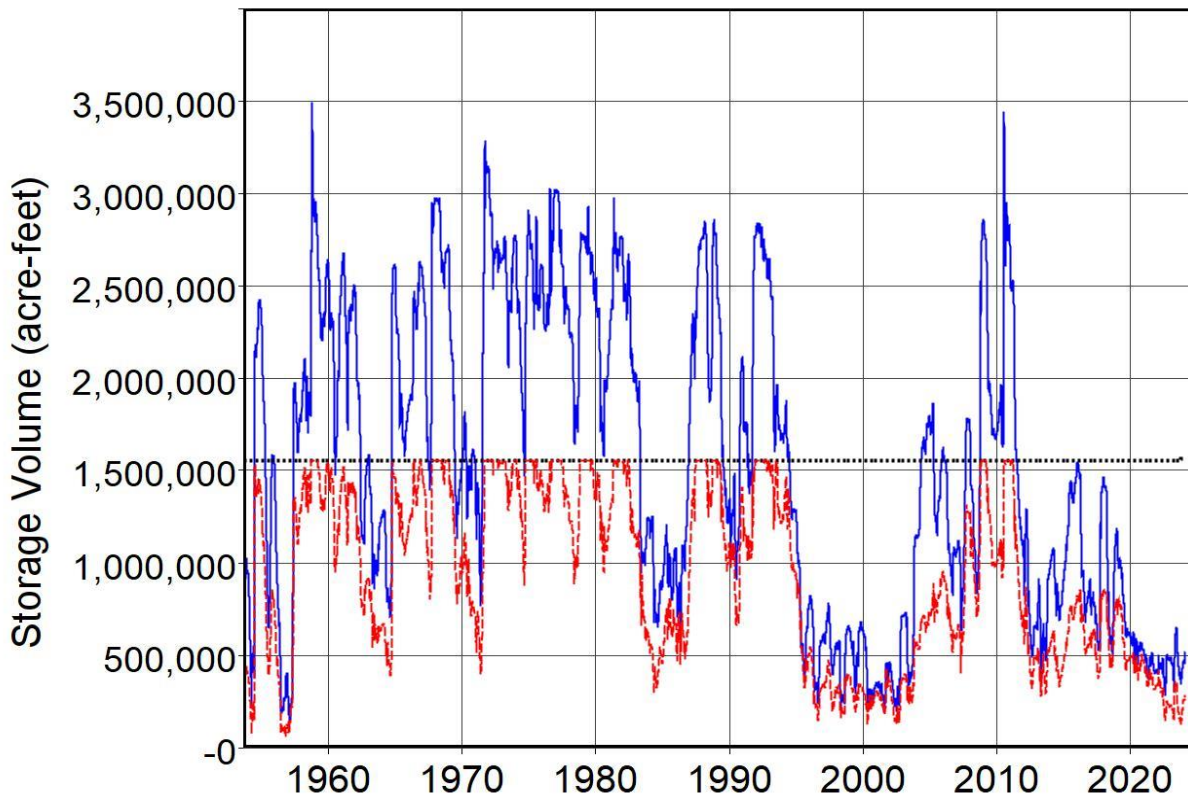


Figure A8 Storage in International Falcon Reservoir on the Rio Grande

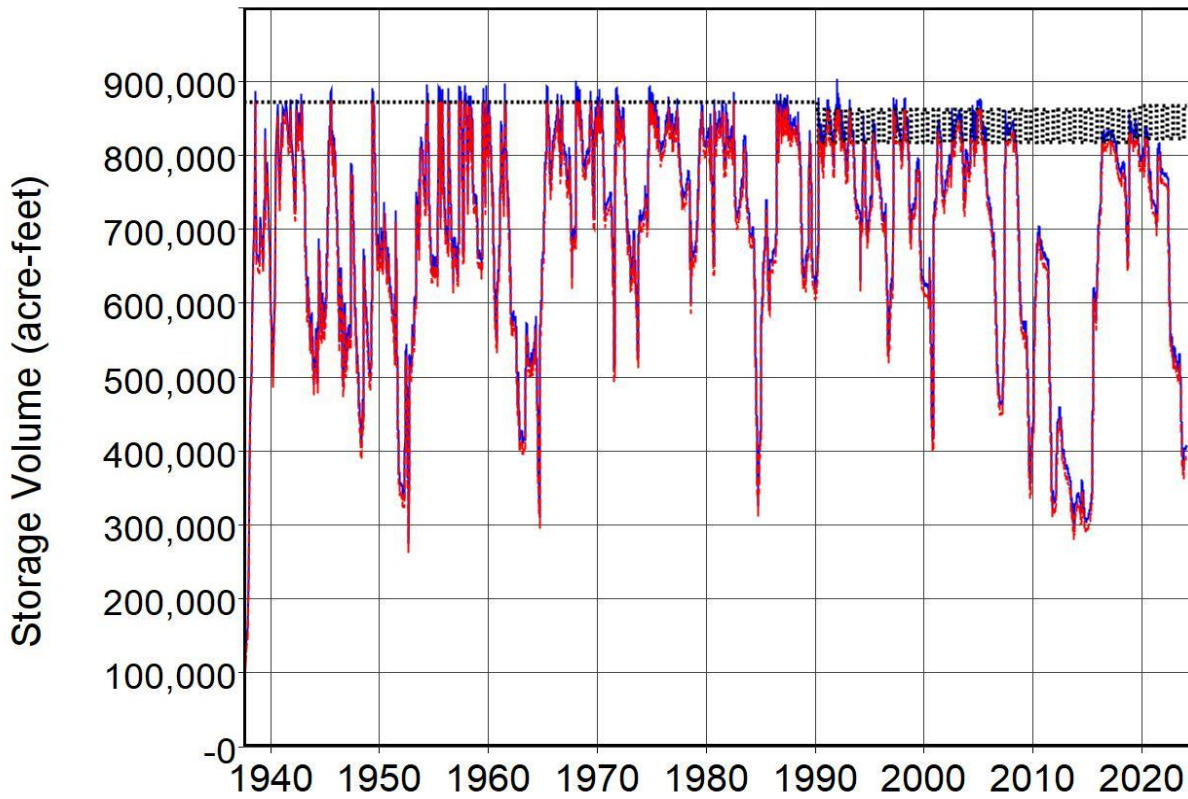


Figure A9 Storage in Lake Buchanan on the Colorado River

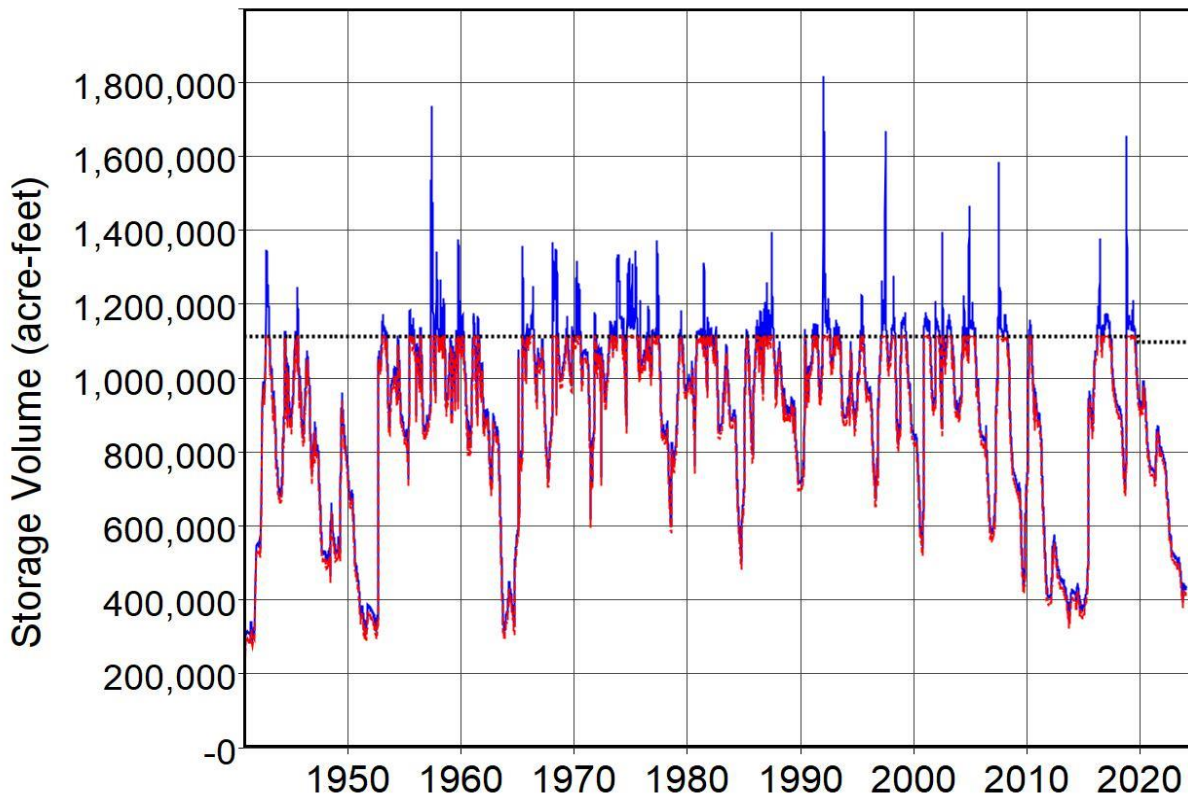


Figure A10 Storage in Lake Travis on the Colorado River

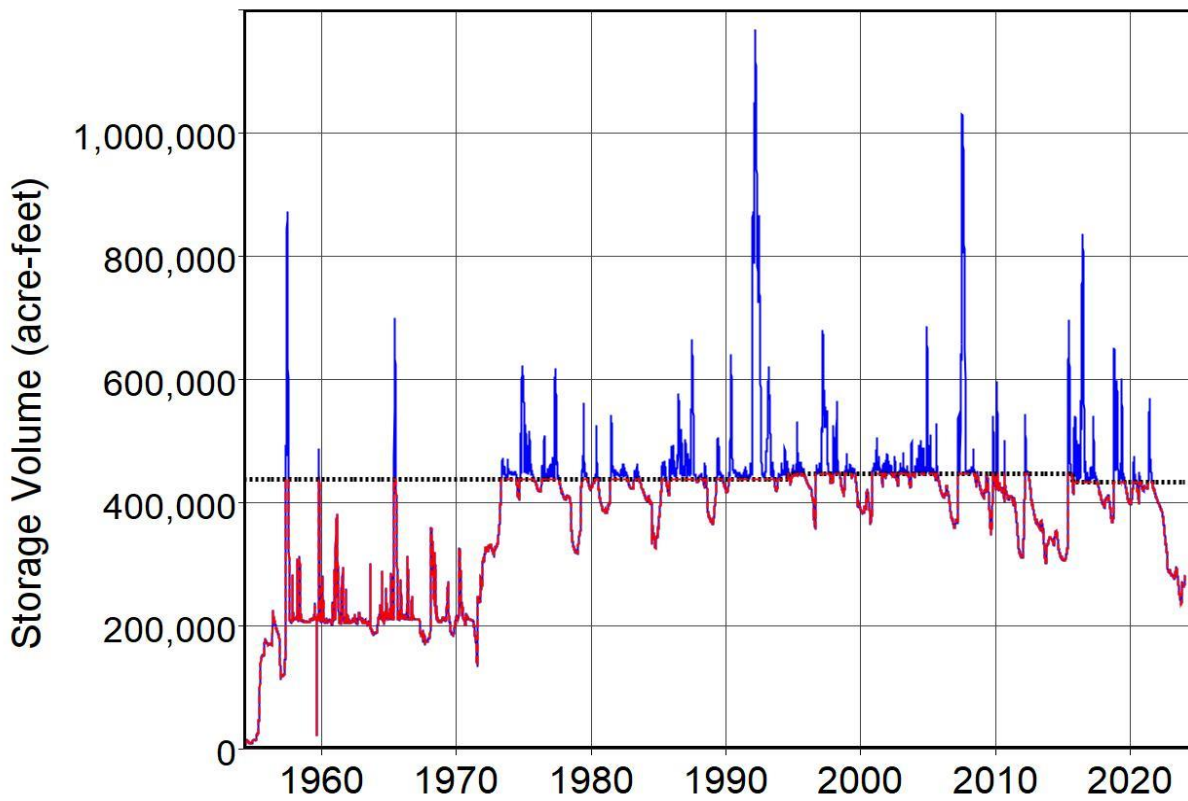


Figure A11 Storage in Belton Reservoir on the Leon River in the Brazos River Basin

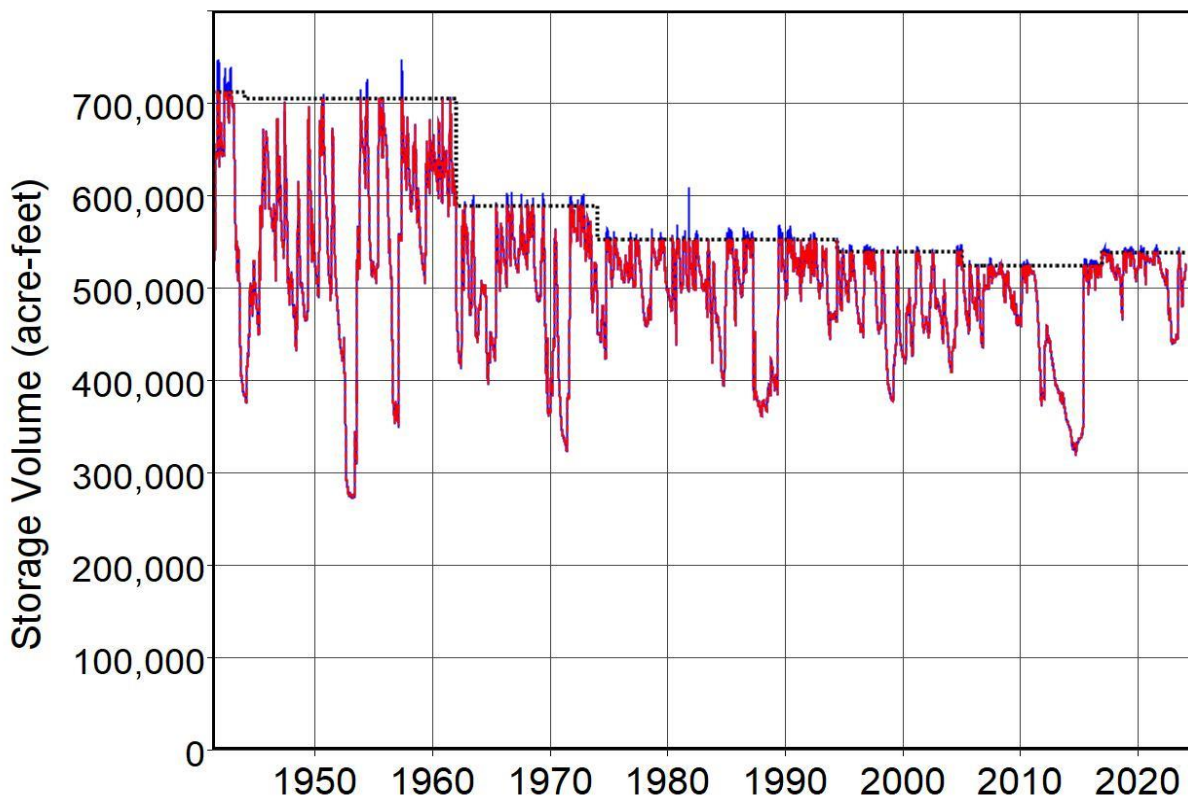


Figure A12 Storage in Possum Kingdom Reservoir on the Brazos River

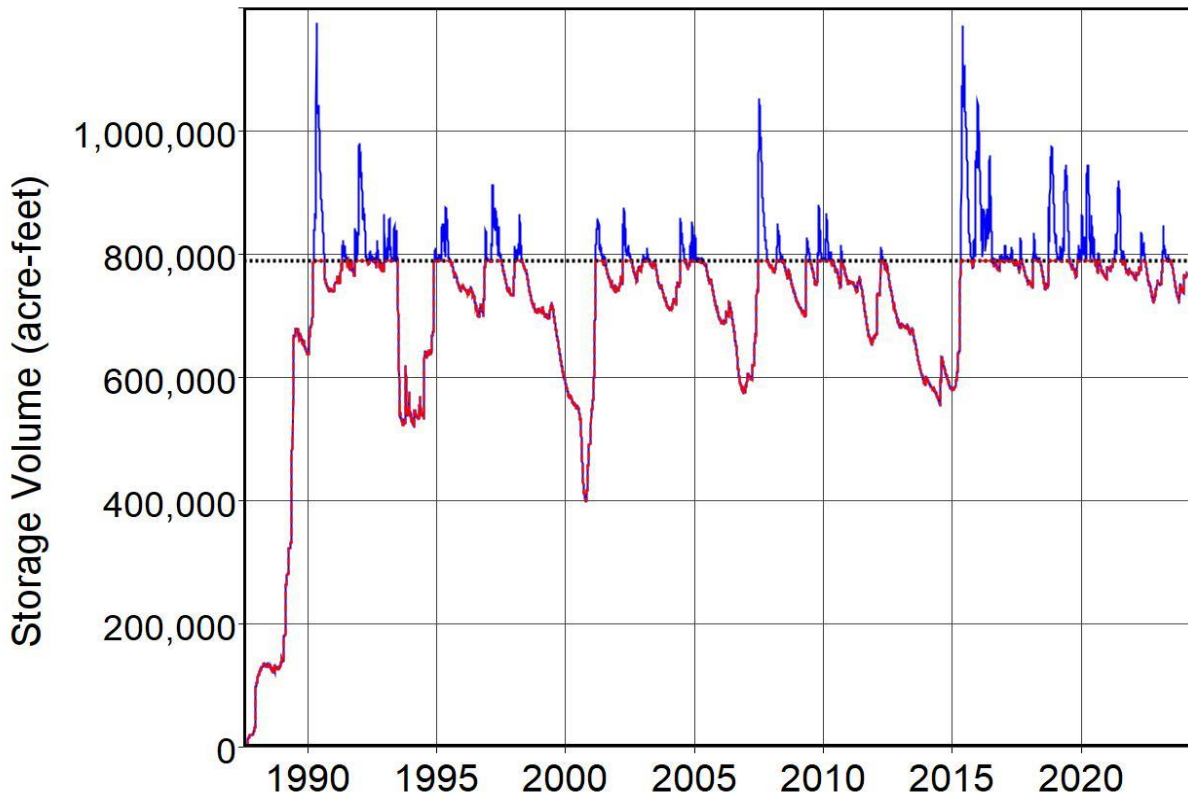


Figure A13 Storage in Ray Roberts Reservoir on the Elm Fork of the Trinity River

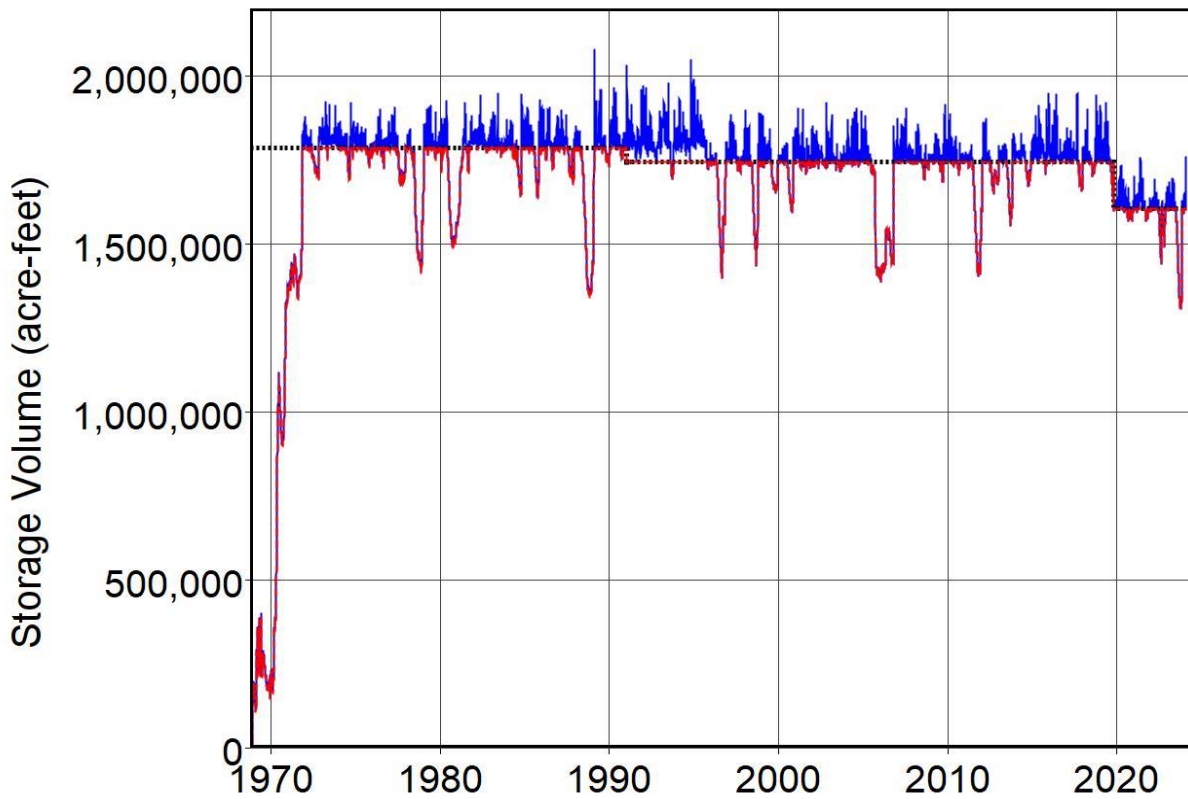


Figure A14 Storage in Lake Livingston on the Trinity River

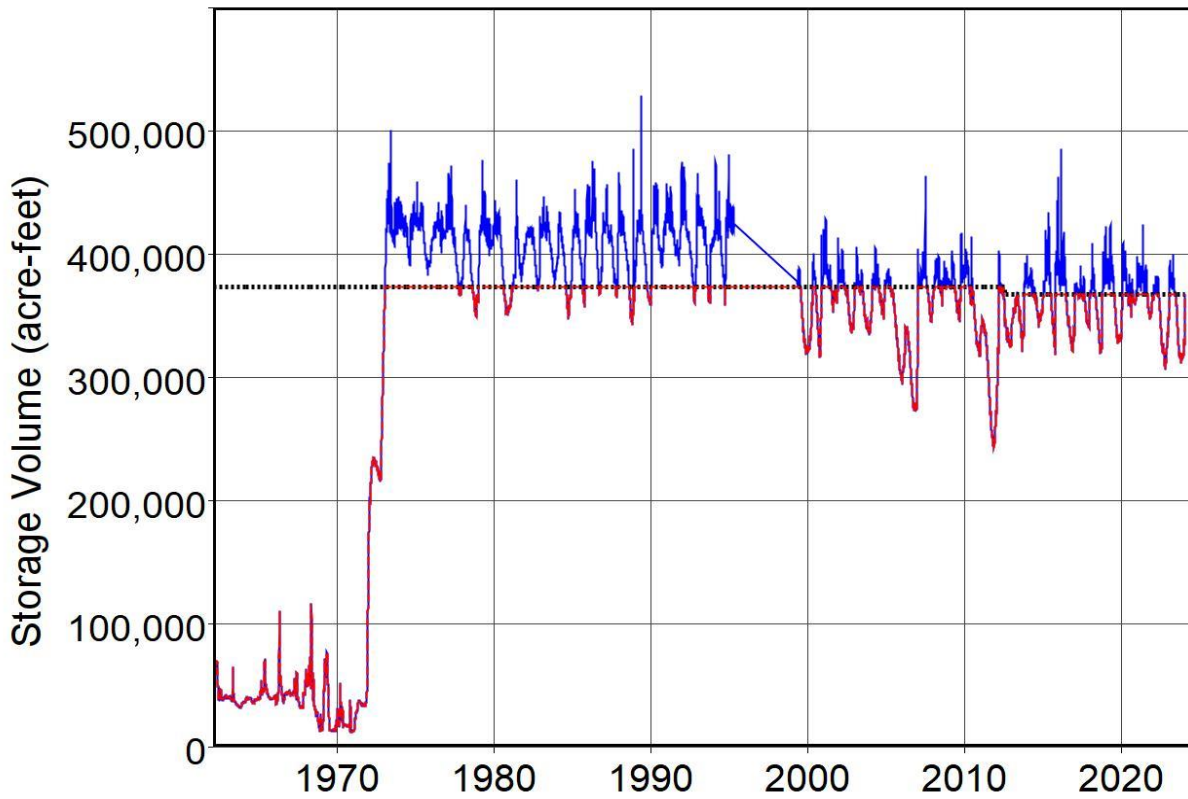


Figure A15 Storage in Lake Palestine on the Neches River

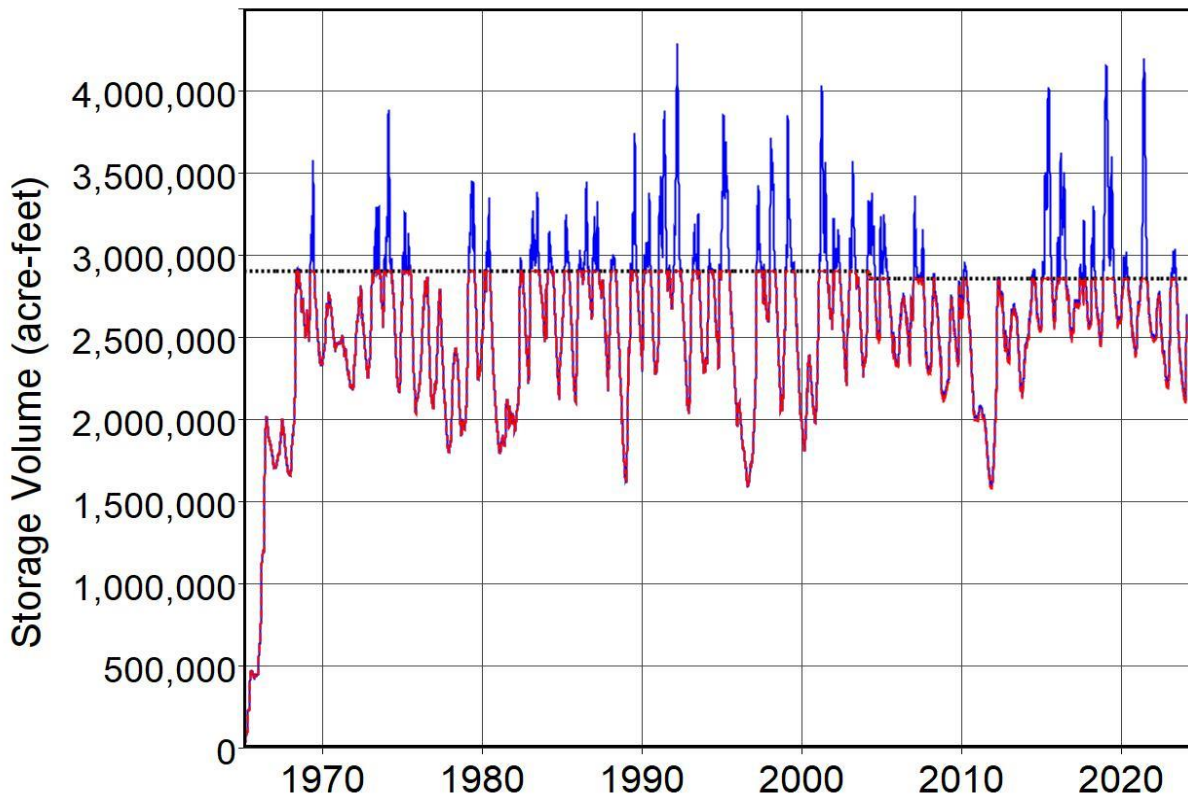


Figure A16 Storage in Sam Rayburn Reservoir on the Angelina River in the Neches Basin

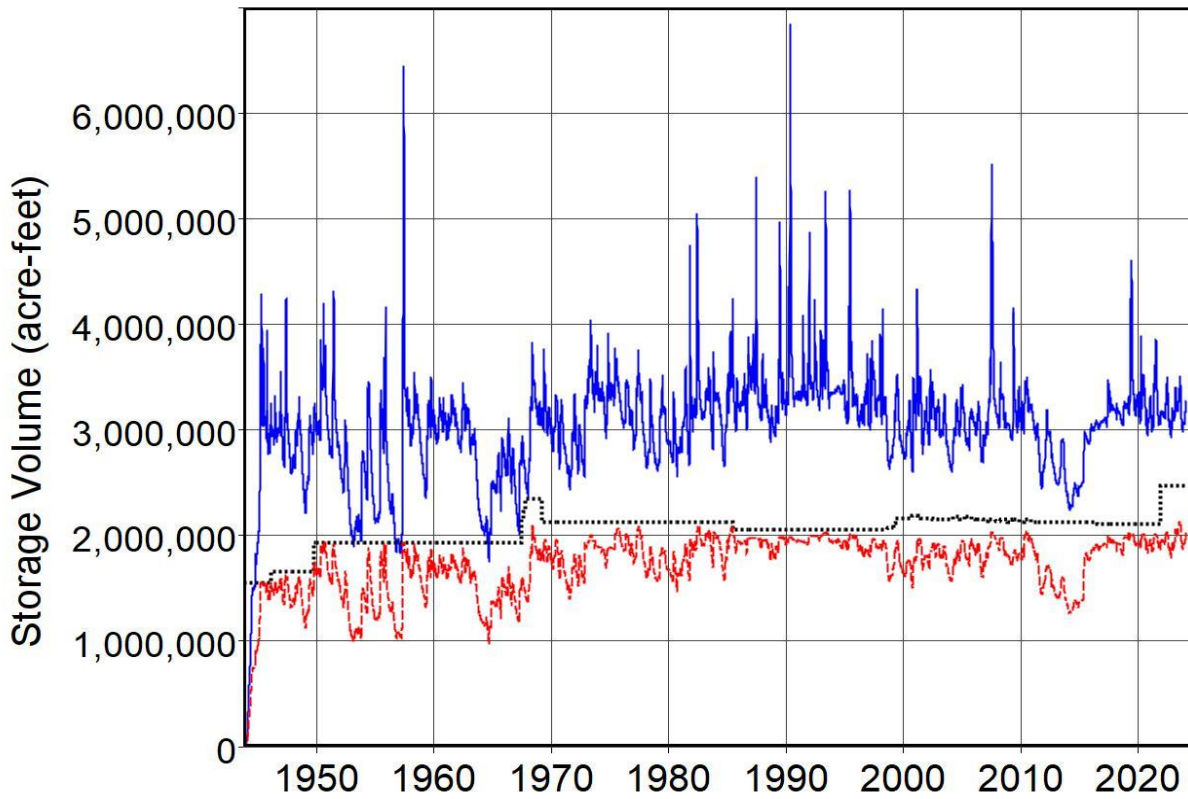


Figure A17 Storage Summations for 13 Reservoirs in the Red River Basin

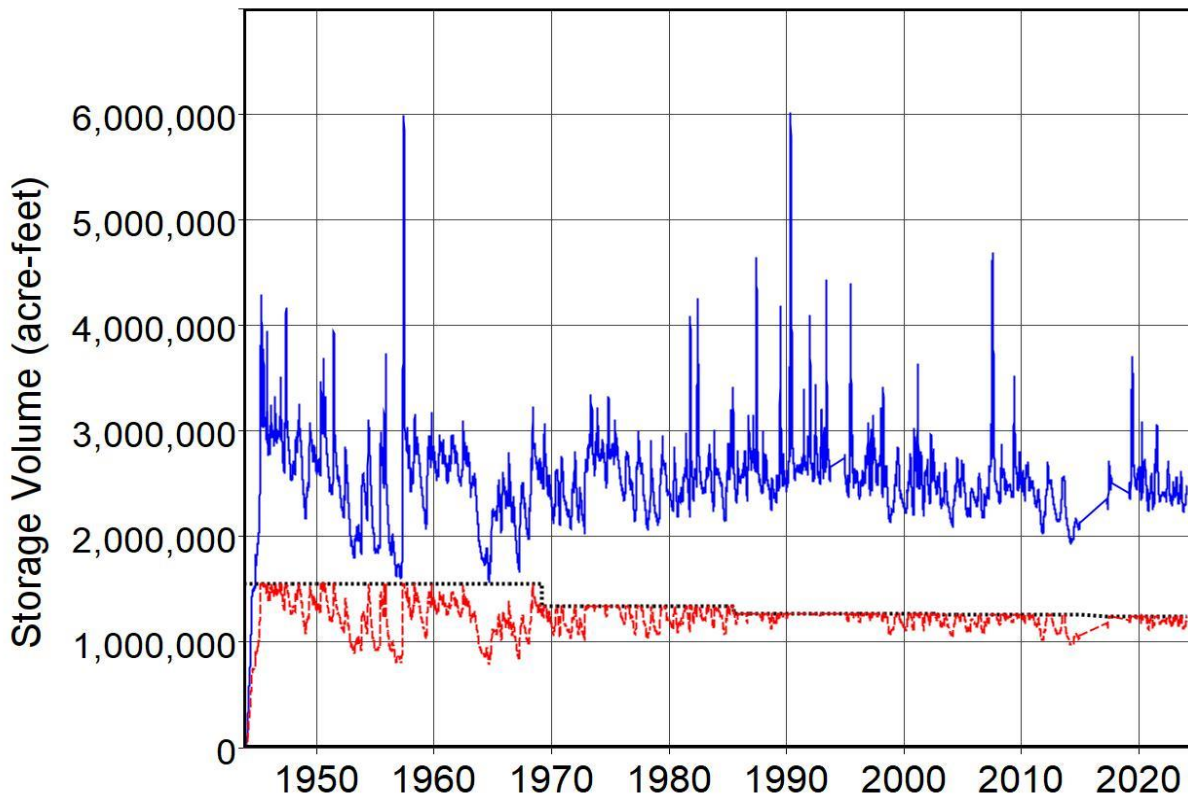


Figure A18 Storage in Lake Texoma on the Red River

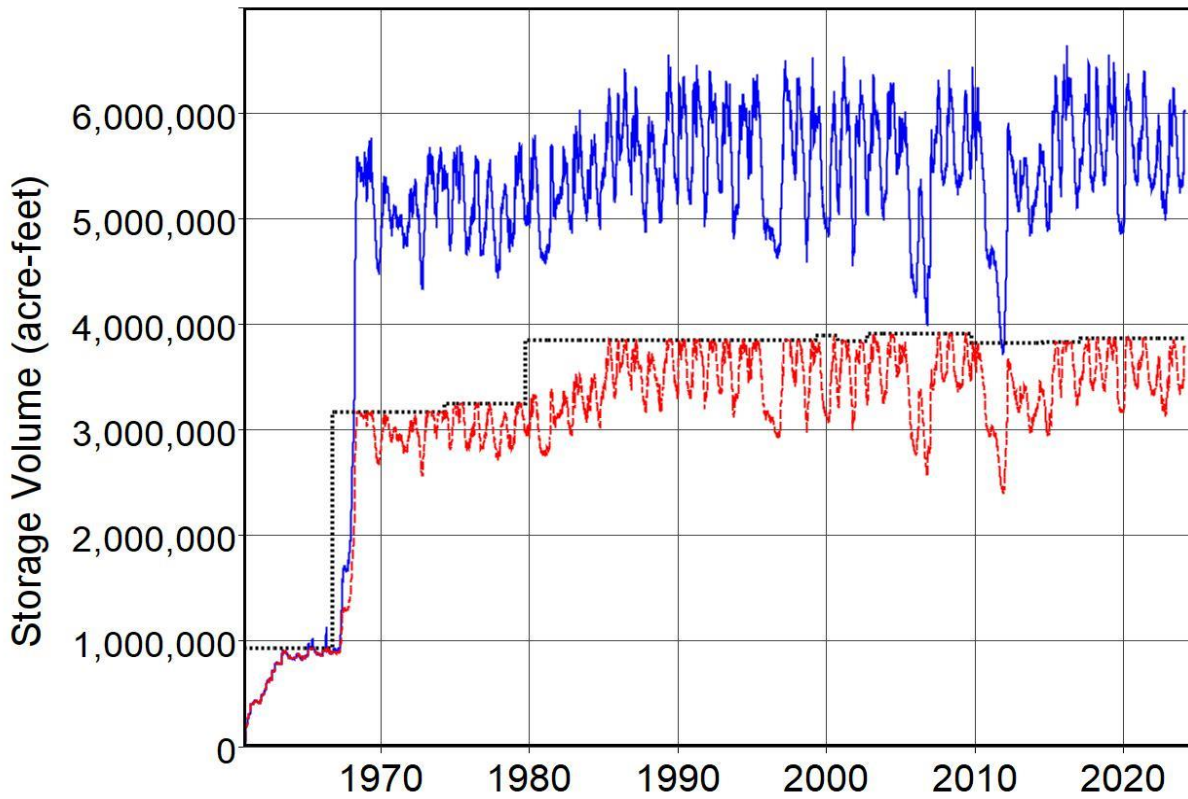


Figure A19 Storage Summations for Six Reservoirs in the Sabine River Basin

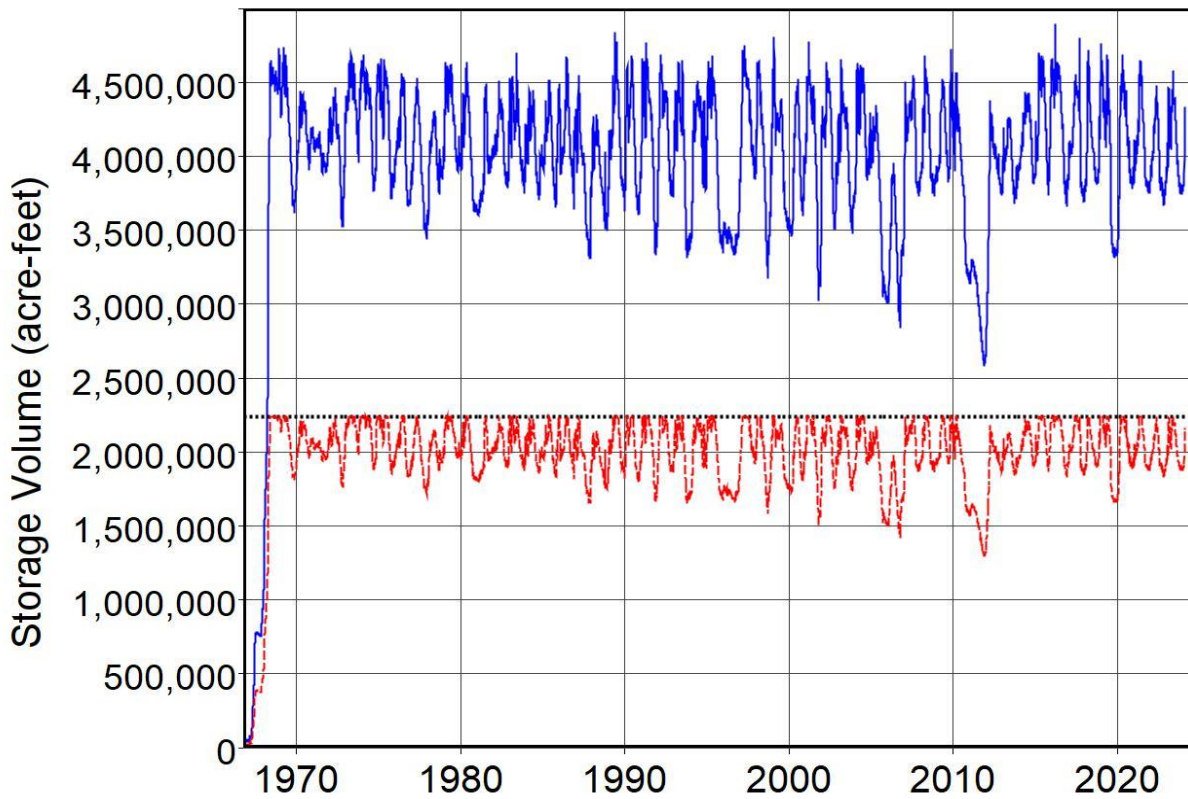


Figure A20 Storage in Toledo Bend Reservoir on the Sabine River

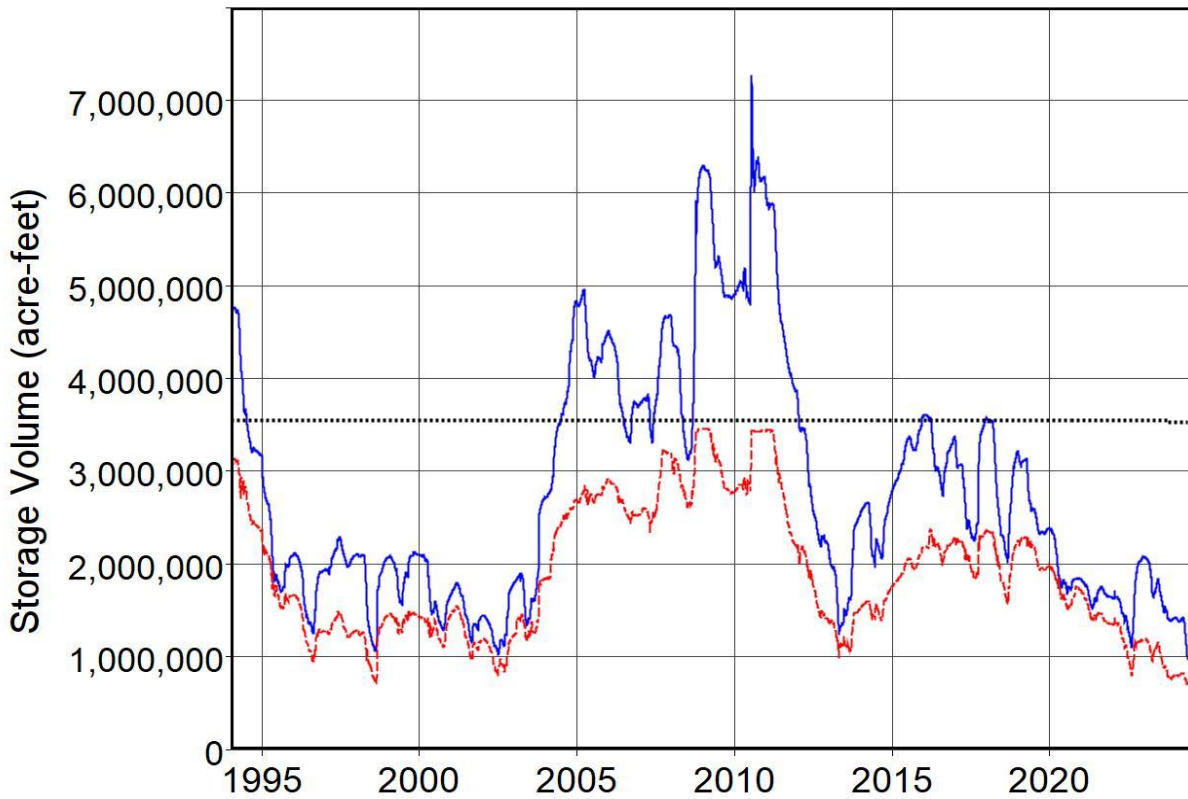


Figure A21 Storage in Amistad, Falcon, and Red Bluff Reservoirs in the Rio Grande Basin

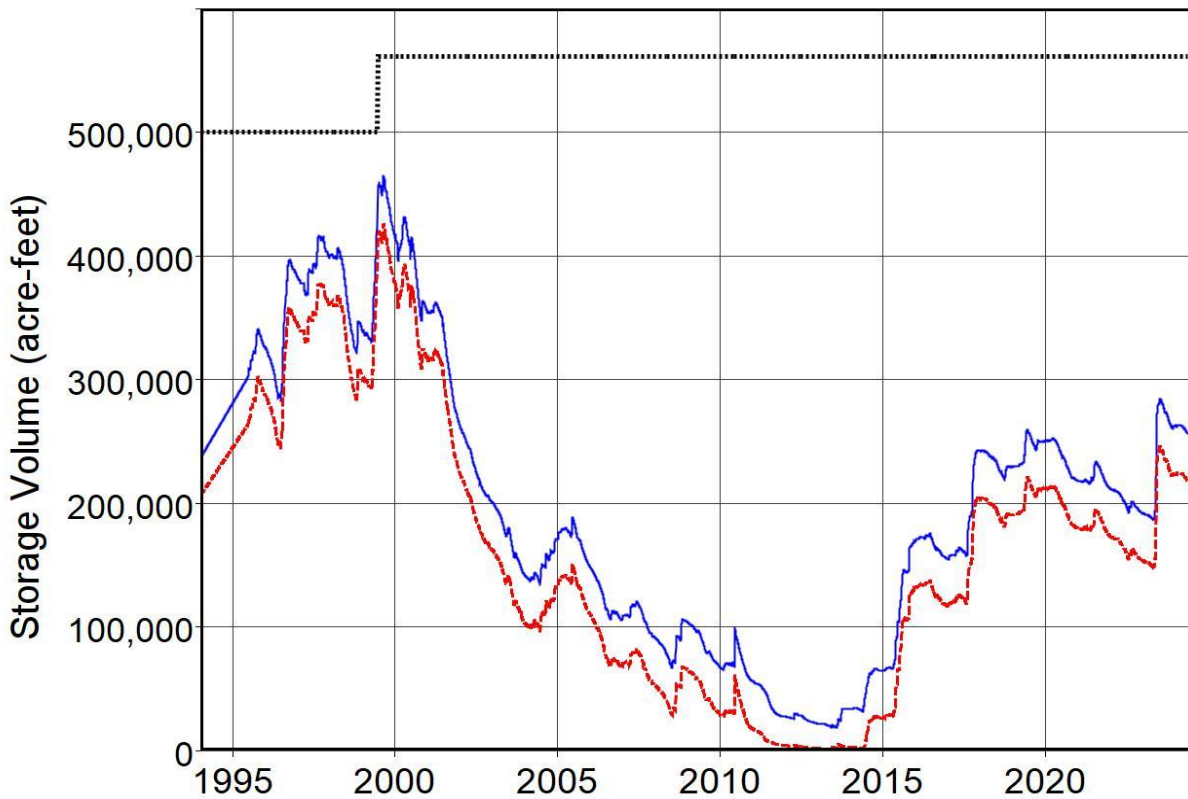


Figure A22 Storage in Meredith and Palo Duro Reservoirs in the Canadian River Basin

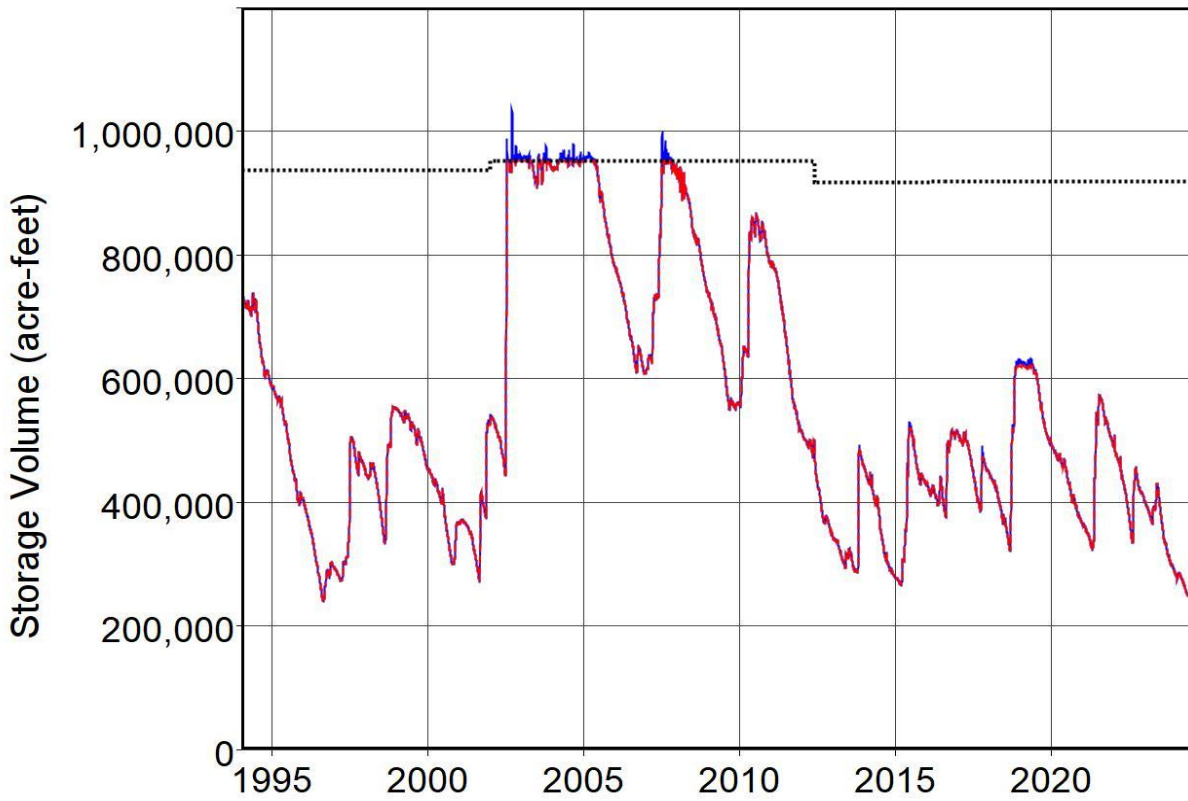


Figure A23 Storage in Corpus Christi and Choke Canyon Reservoirs in the Nueces River Basin

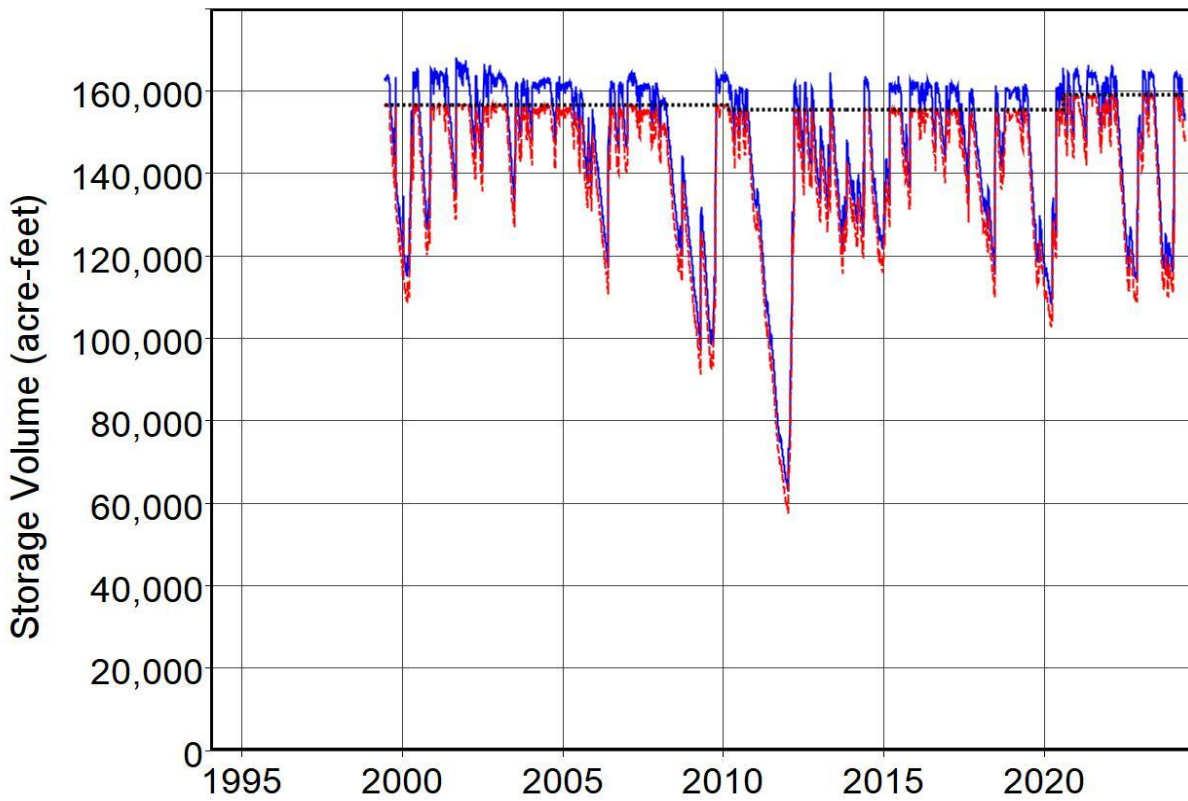


Figure A24 Storage in Lake Texana in the Lavaca River Basin

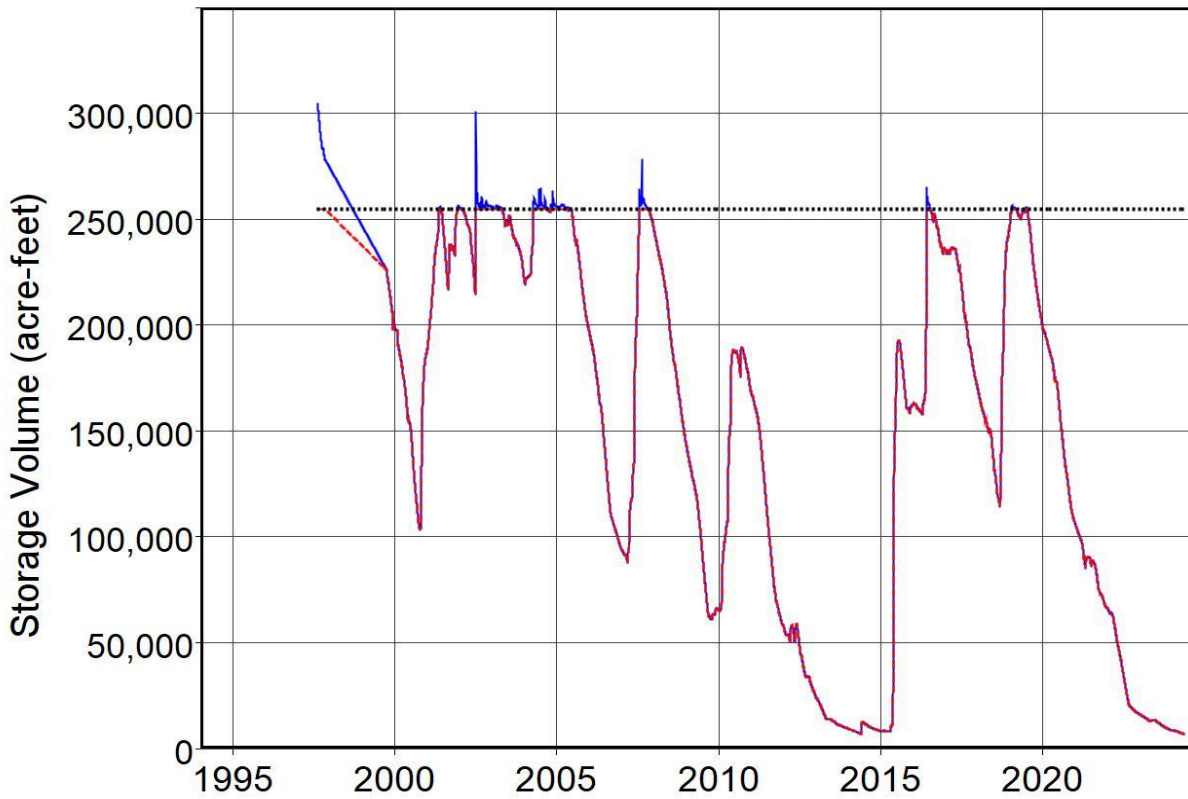


Figure A25 Storage in Lake Medina in the San Antonio River Basin

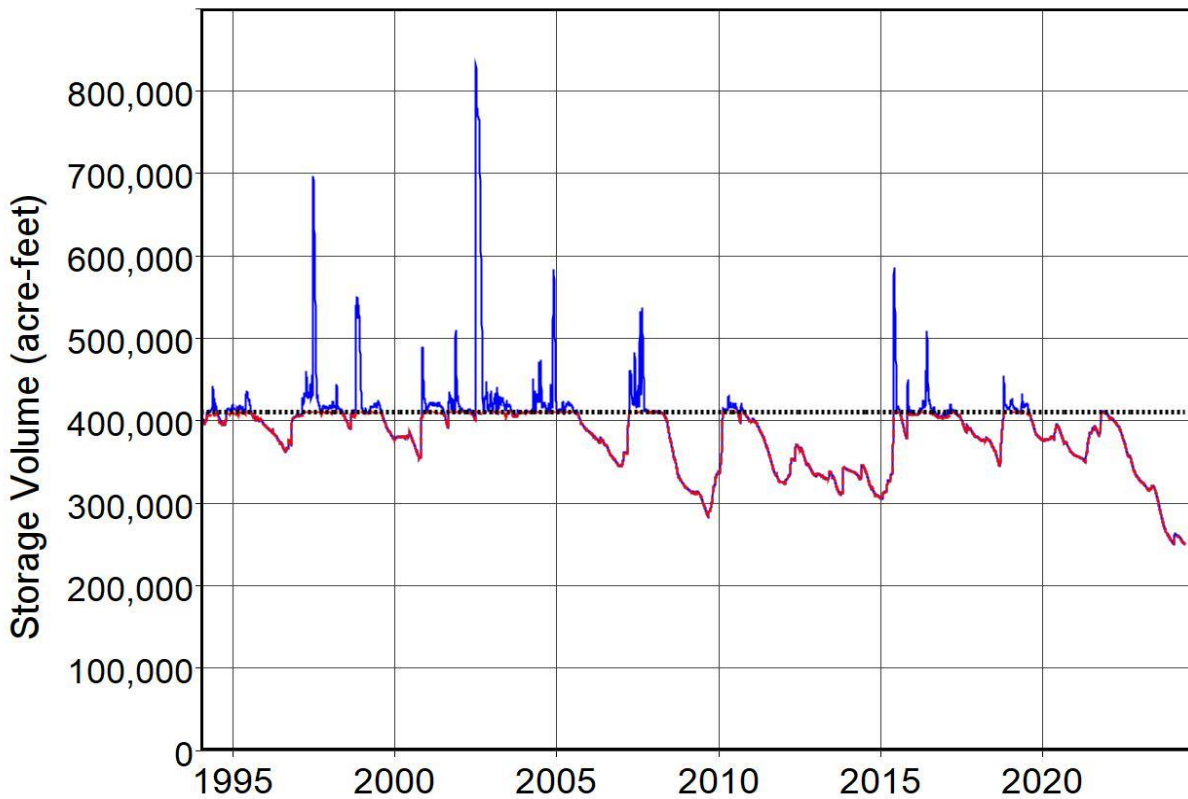


Figure A26 Storage in Canyon and Coleta Creek Reservoirs in the Guadalupe River Basin

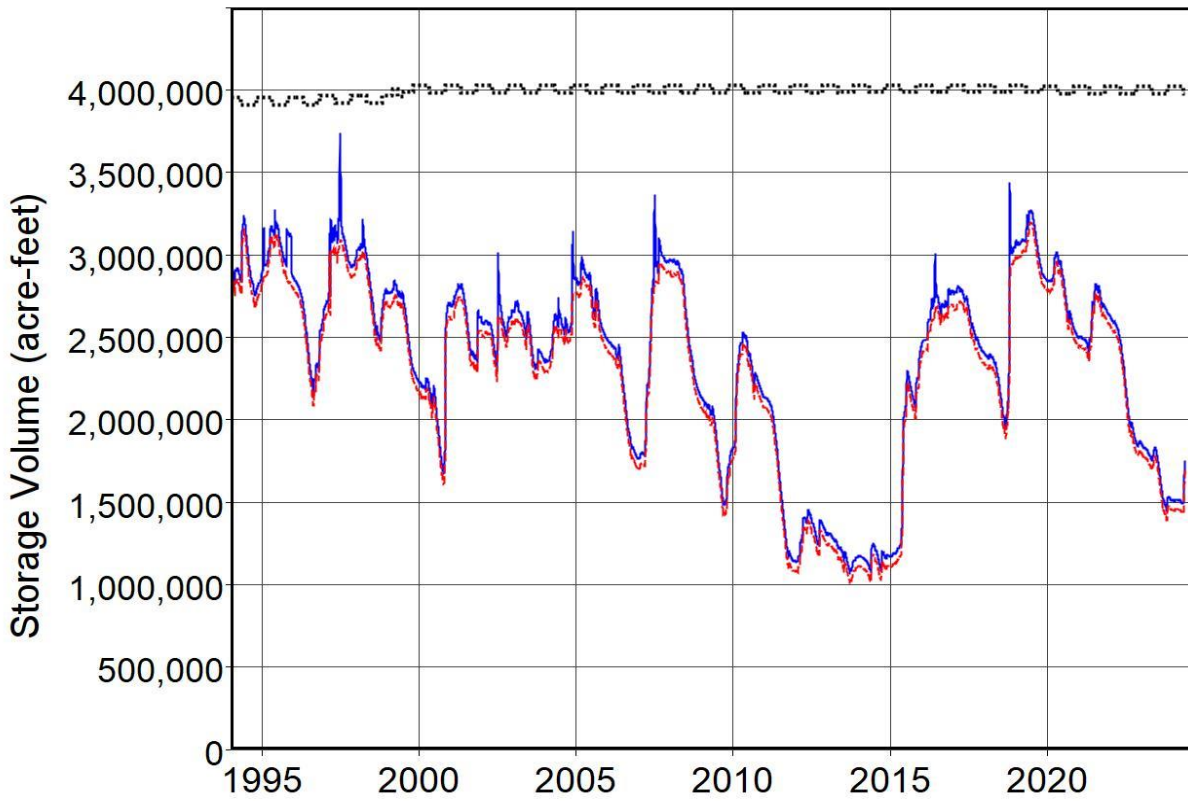


Figure A27 Storage Summations for 19 Reservoirs in the Colorado River Basin

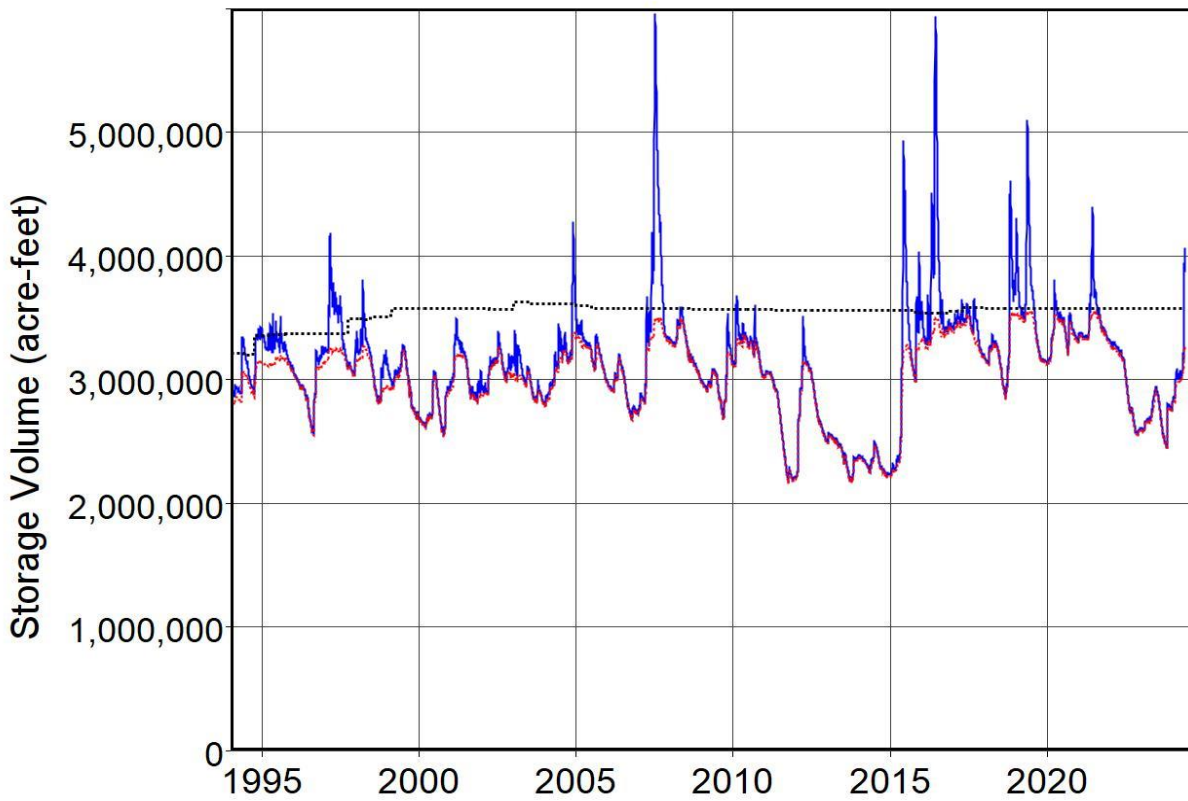


Figure A28 Storage Summations for 28 Reservoirs in the Brazos River Basin

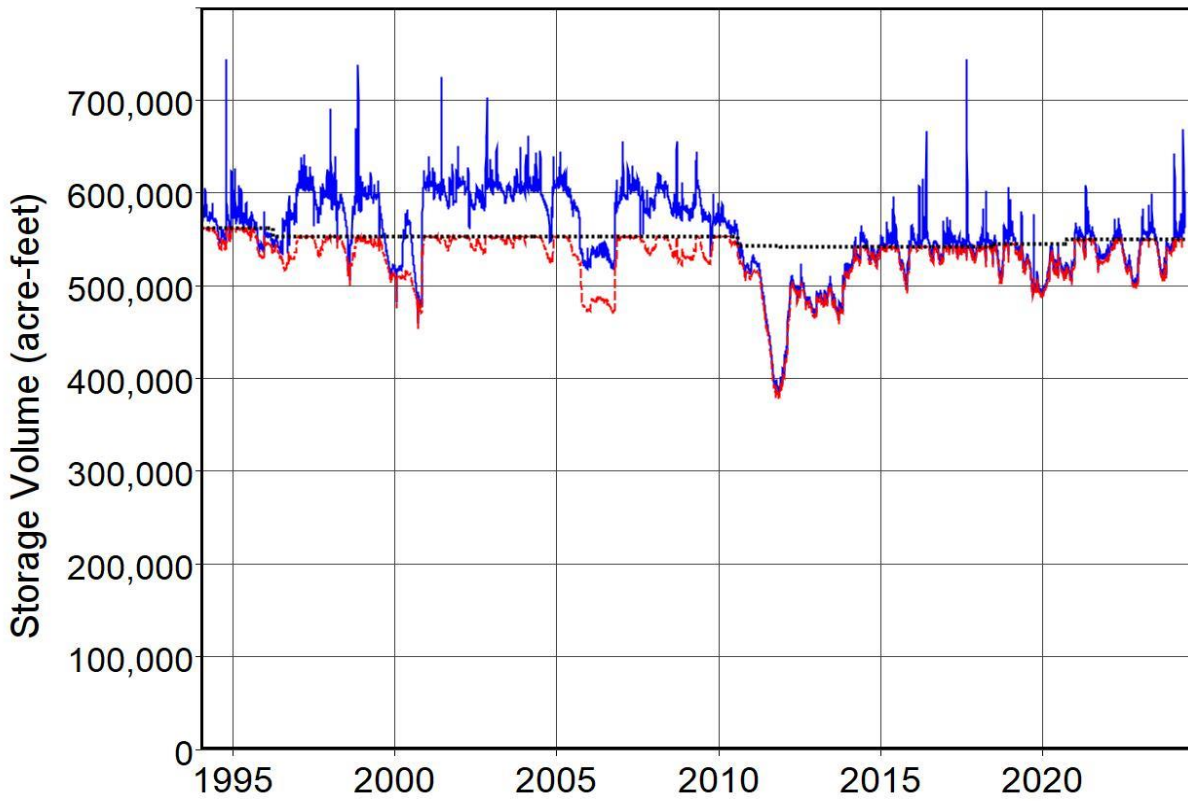


Figure A29 Storage Summations for 4 Reservoirs in the San Jacinto River Basin

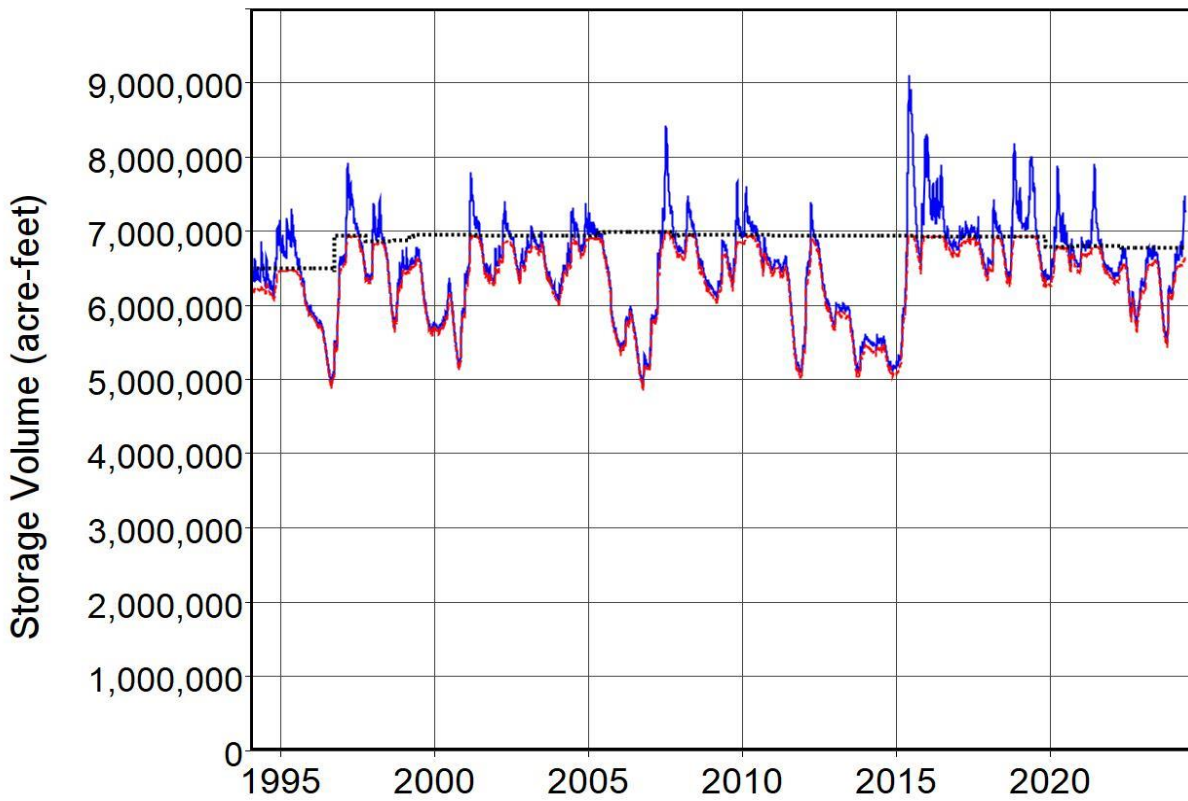


Figure A30 Storage Summations for 24 Reservoirs in the Trinity River Basin

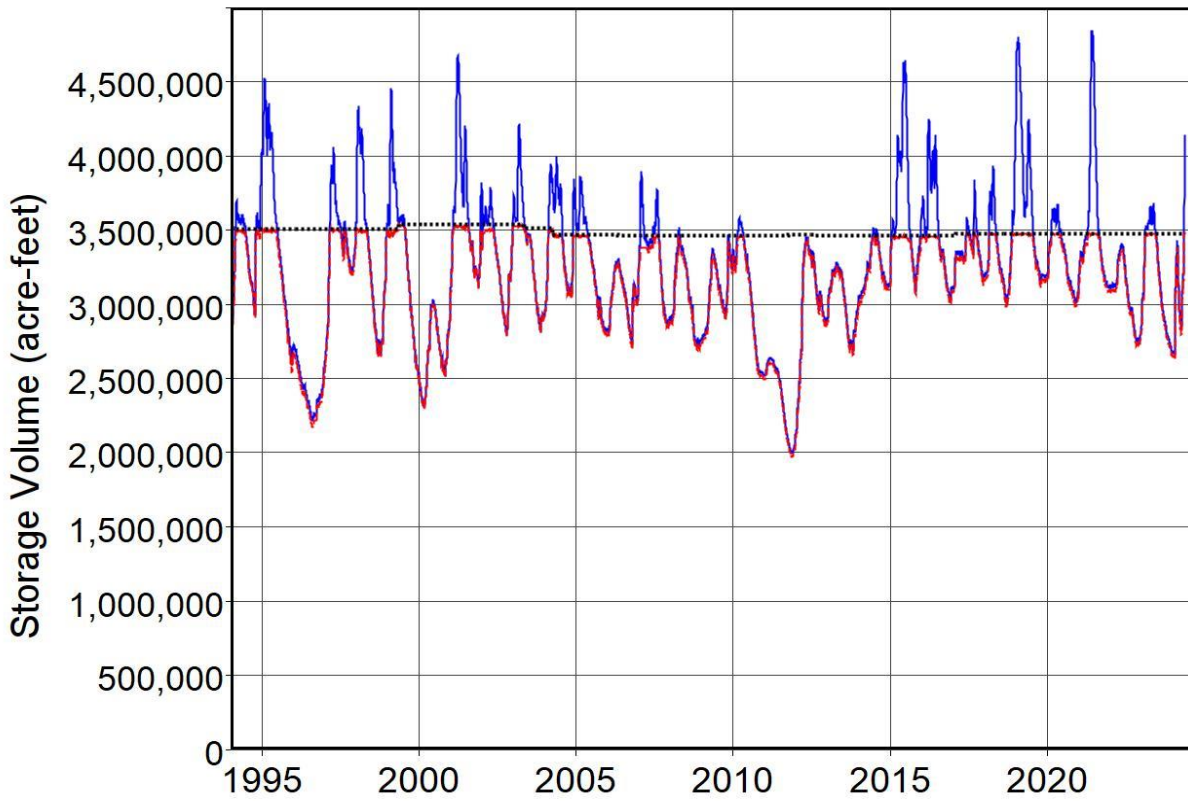


Figure A31 Storage Summations for 7 Reservoirs in the Neches River Basin

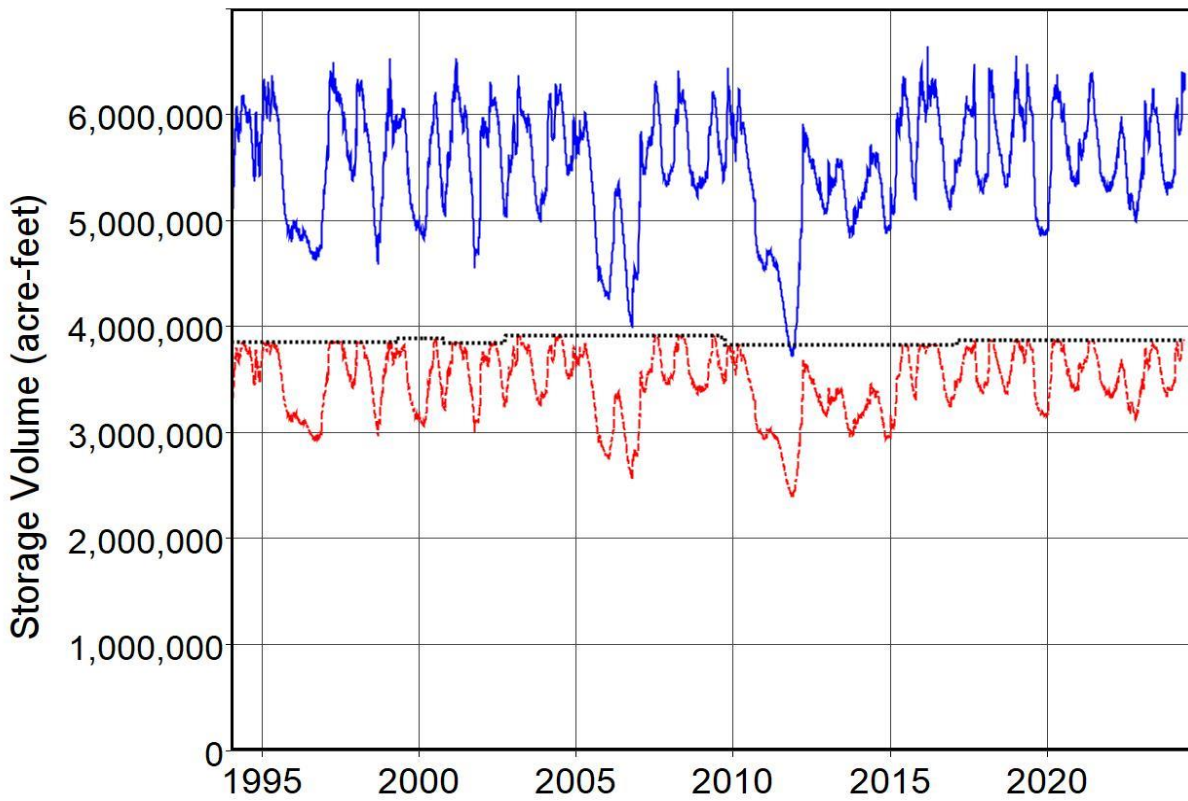


Figure A32 Storage Summations for 6 Reservoirs in the Sabine River Basin

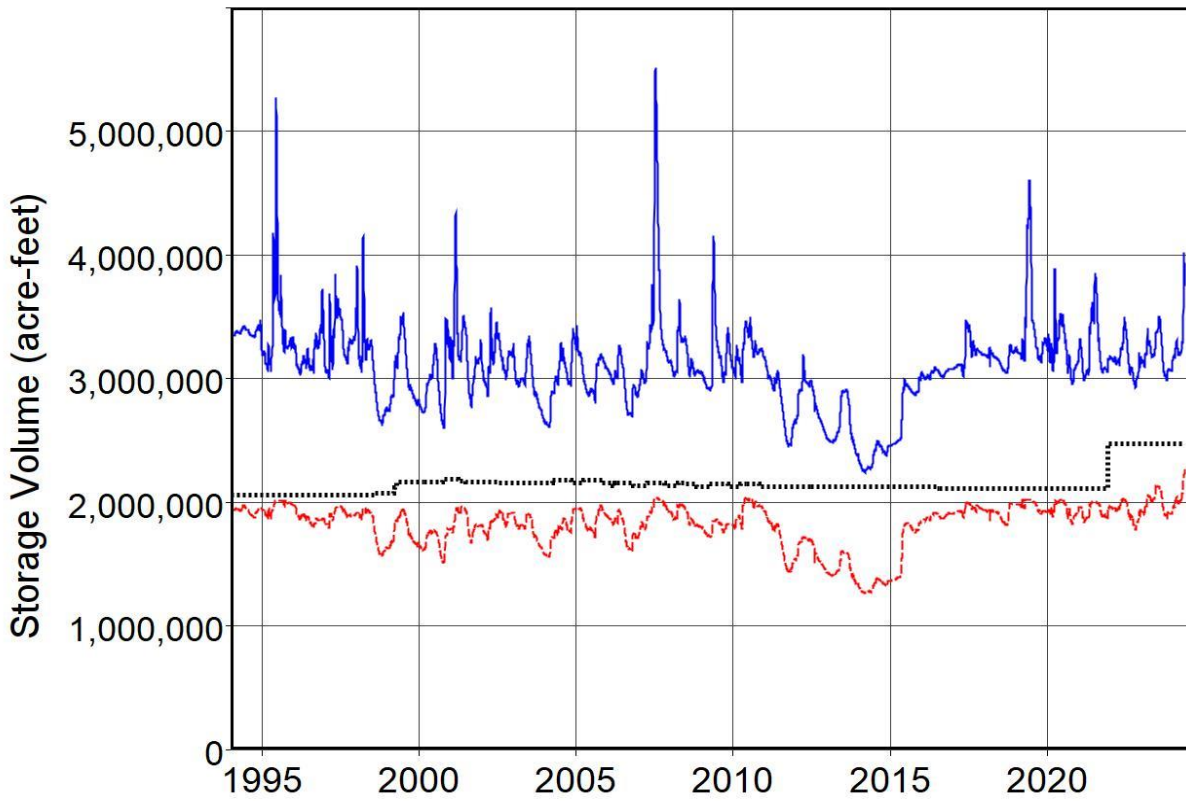


Figure A33 Storage Summations for 13 Reservoirs in the Red River Basin

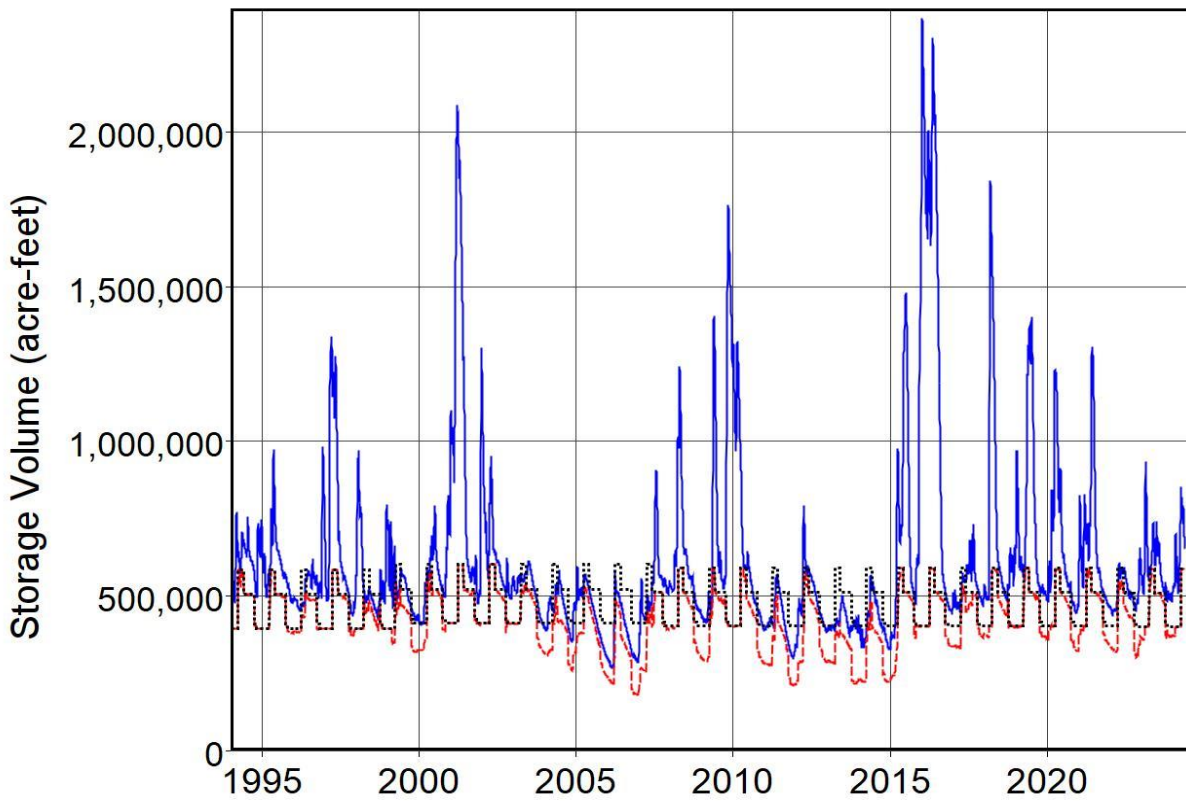


Figure A34 Storage Summations for 3 Reservoirs in the Sulphur River Basin

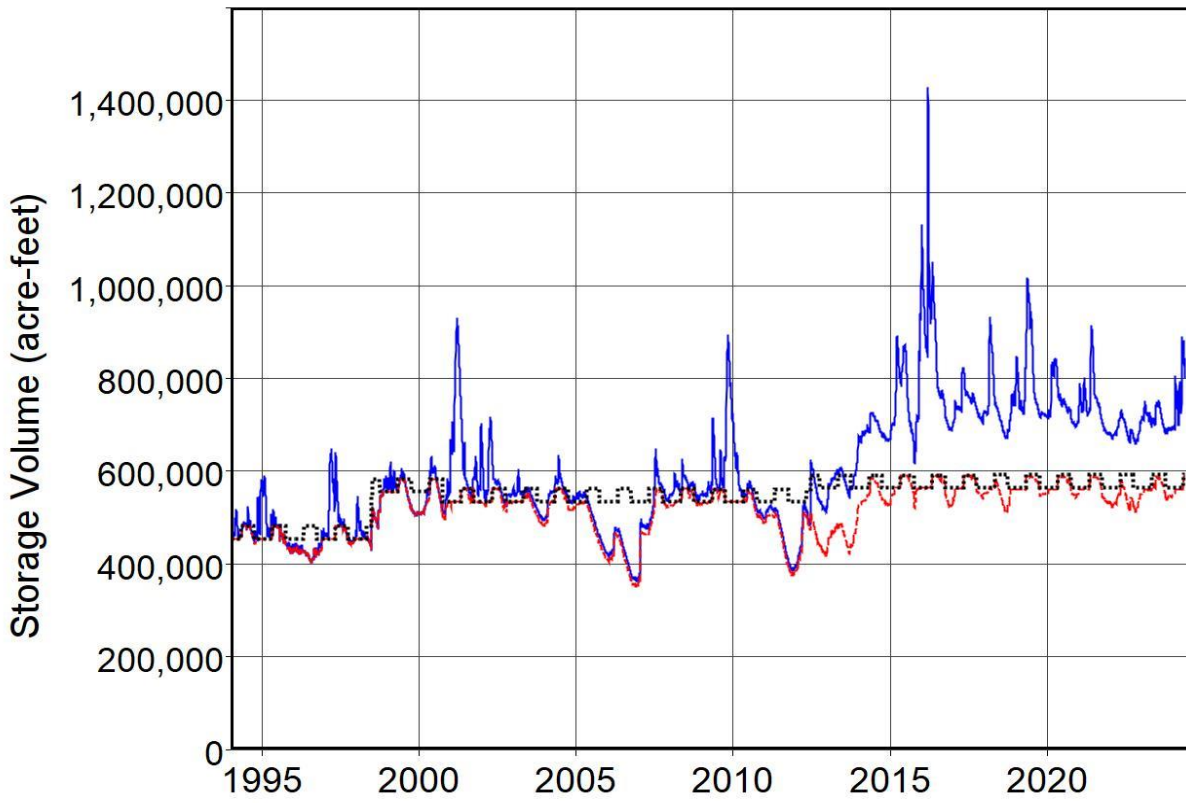


Figure A35 Storage Summations for 5 Reservoirs in the Cypress Creek Basin

APPENDIX B

PLOTS OF OBSERVED STREAM FLOWS DISCUSSED IN CHAPTER 4

The plots of daily, monthly, and annual means of stream flows observed at U.S. Geological Survey (USGS) gage sites presented in this appendix are discussed in Chapter 4. The daily flows were downloaded from the National Water Information System (NWIS) website maintained by the USGS (<https://waterdata.usgs.gov/nwis>) into a DSS file using *HEC-DSSVue*. The daily mean flows in cubic feet per second (cfs) were aggregated to monthly and annual means in cfs and plotted within *HEC-DSSVue*. One cfs is equivalent to 1.9835 acre-feet/day.

The sixteen gage sites with flow plots included in Appendix B are listed below. The beginning of the period-of-record for each gage is shown in the sixth column. The flows in the figures extend through February 8, 2024. Eleven gages have complete records with no gaps. Five gages have gaps with missing daily observed data. Daily flows of the Brazos River at Richmond have a gap of missing data extending from July 1906 through September 1922. The Colorado River at San Saba gage has three gaps of missing data between October 1919 and October 1923 totaling 513 days. The Lavaca River at Hallettsville has no data for October 1992 through September 2015. The Frio River at Derby has no data during October 1987 through September 1989. The gage on the Nueces River at Mathis has 52 days of missing data during May and June 1966.

| Figure Label | Gage Location Stream and Nearest City | USGS Gage ID | Drainage Area (mile ²) | Mean Flow (cfs) | Record Begins | Days Missing | Page |
|--------------|--|-----------------|--|-----------------------|------------------|-----------------|------|
| B1 | Brazos River at Waco | 08096500 | 19,993 | 2,356 | 1/1900 | 0 | 450 |
| B2 | Brazos River at Richmond | 08114000 | 35,541 | 7,535 | 10/1922 | 5,936 | 451 |
| B3 | Navasota River at Easterly | 08110500 | 968 | 428 | 3/1924 | 0 | 452 |
| B4 | Trinity River at Dallas | 08057000 | 6,106 | 1,833 | 10/1903 | 0 | 453 |
| B5 | Trinity River near Oakwood | 08065000 | 12,833 | 5,461 | 10/1923 | 0 | 454 |
| B6 | Trinity River at Romayor | 08066500 | 17,186 | 8,076 | 5/1924 | 4 | 455 |
| B7 | Neches River near Rockland | 08033500 | 3,636 | 2,398 | 7/1904 | 0 | 456 |
| B8 | Neches River near Evadale | 08041000 | 7,951 | 6,266 | 4/1921 | 0 | 457 |
| B9 | Colorado River nr San Saba | 08147000 | 19,819 | 939 | 11/1915 | 513 | 458 |
| B10 | Colorado River at Austin | 08158000 | 27,606 | 2,038 | 3/1898 | 0 | 459 |
| B11 | Colorado River at Columbus | 08161000 | 30,237 | 2,922 | 5/1916 | 0 | 460 |
| B12 | Lavaca River at Hallettsville | 08163500 | 108 | 49.2 | 8/1939 | 8,400 | 461 |
| B13 | Lavaca River near Edna | 08164000 | 817 | 362 | 8/1939 | 0 | 462 |
| B14 | Frio River, Derby | 08205500 | 1,462 | 134 | 8/1915 | 1,462 | 463 |
| B15 | Nueces River, Three Rivers | 08210000 | 15,427 | 708 | 7/1915 | 0 | 464 |
| B16 | Nueces River, Mathis | 08212000 | 16,600 | 634 | 8/1939 | 52 | 465 |

The upper graph in each figure is a plot of daily flows. The lower graph in each figure contains plots of monthly flows (**blue solid line**) and annual flows (**red dotted line**).

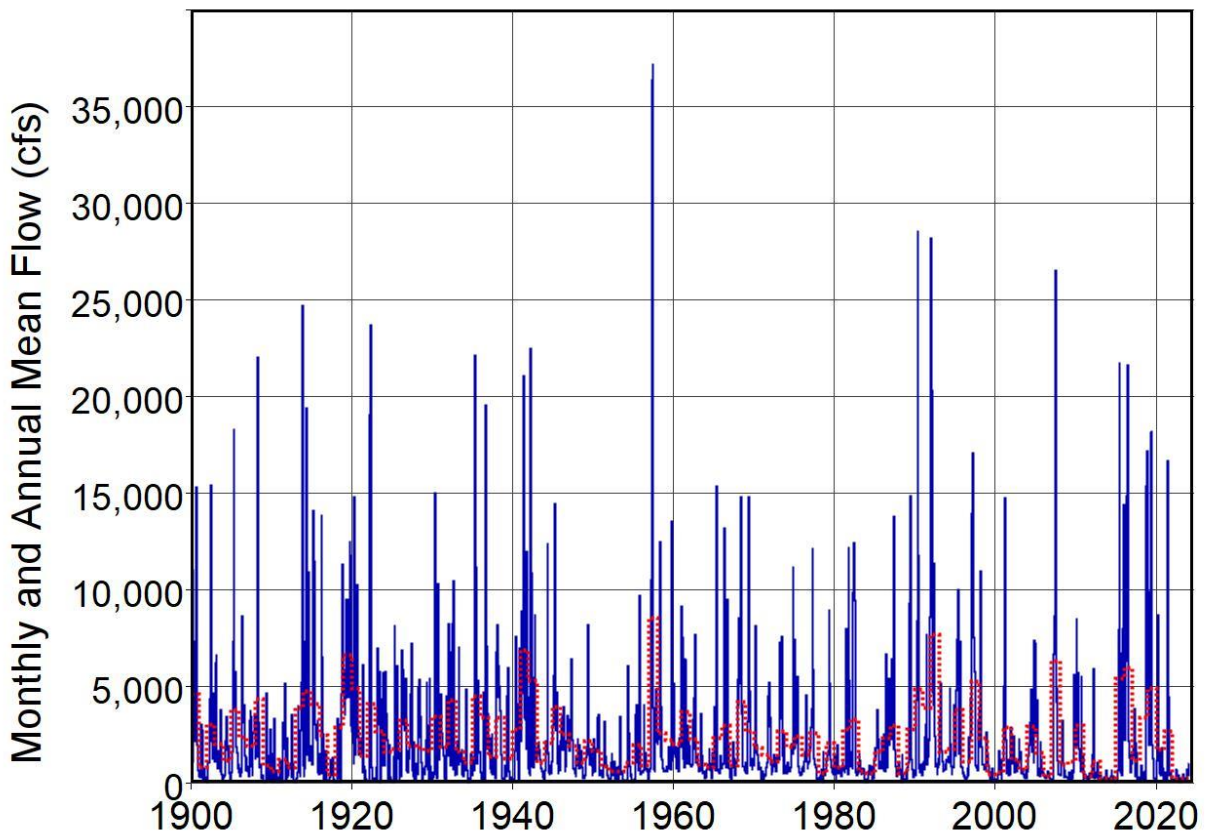
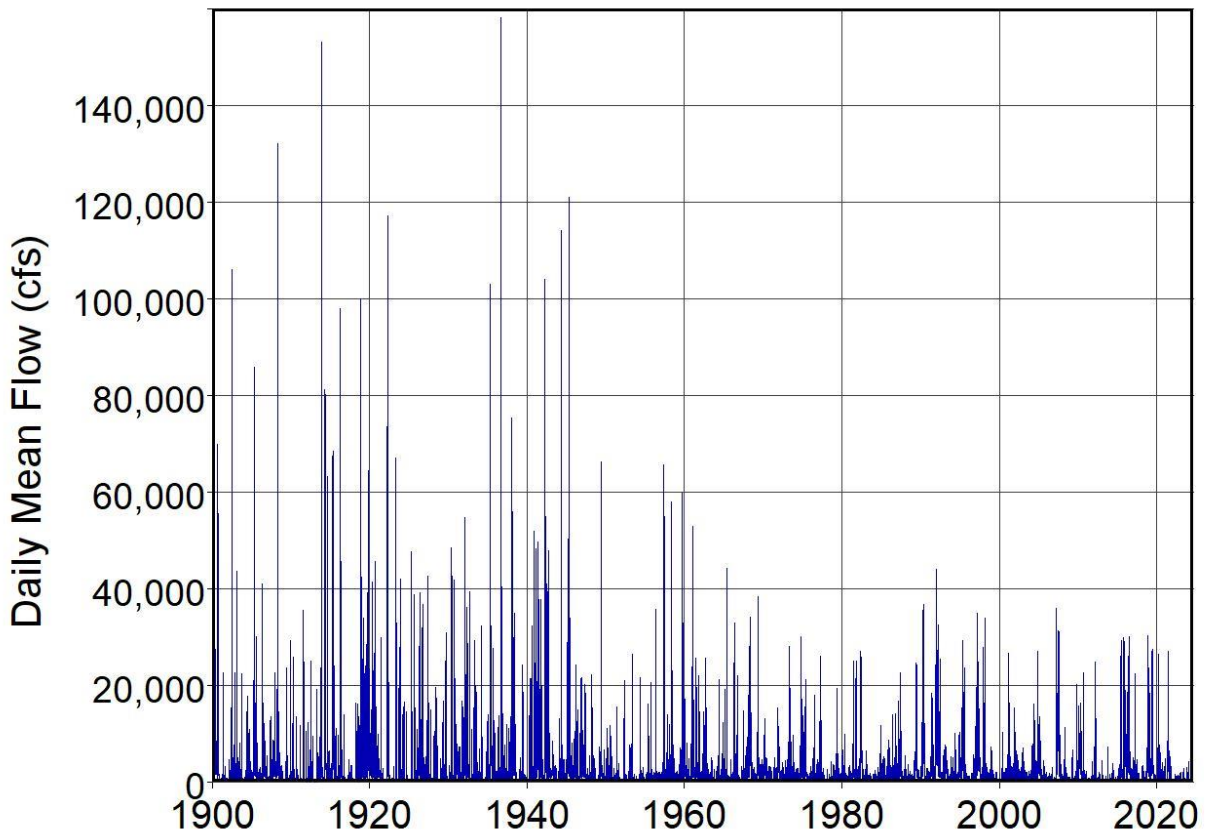


Figure B1 Observed Flows of Brazos River at Waco Gage

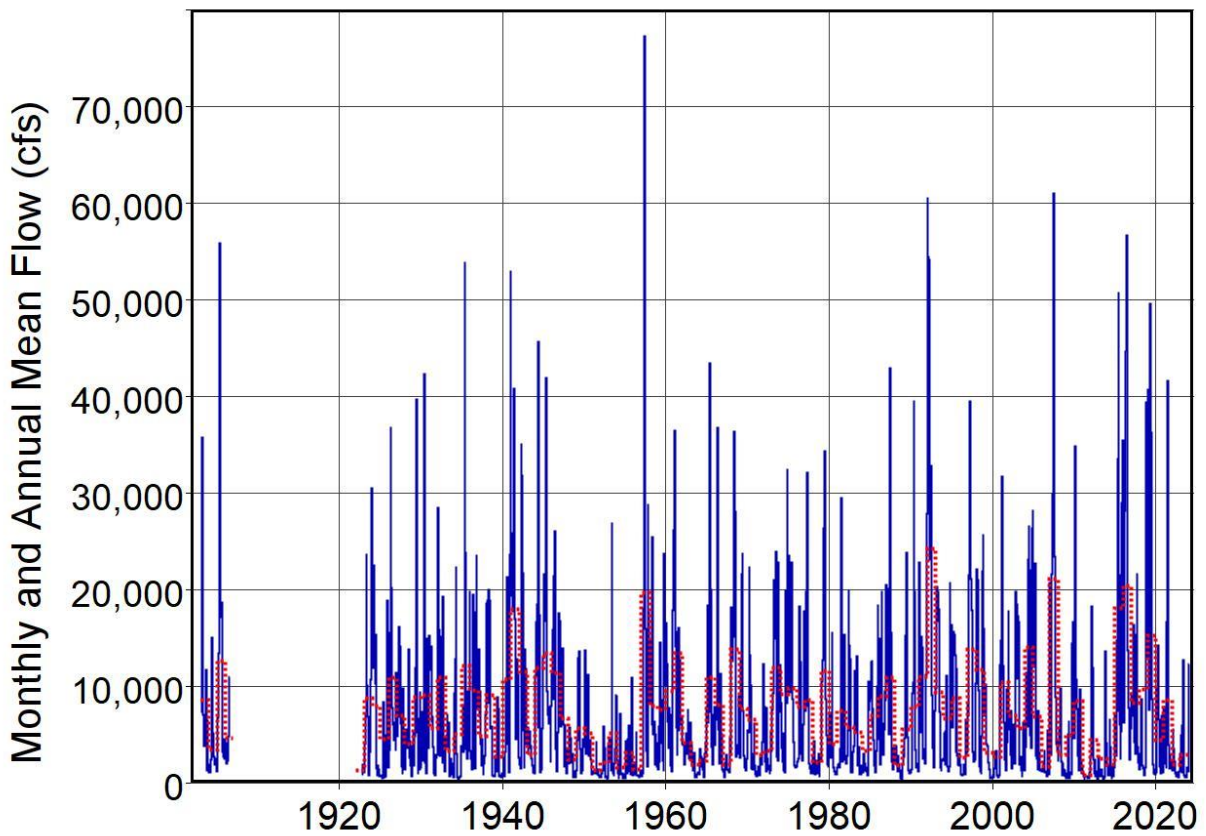
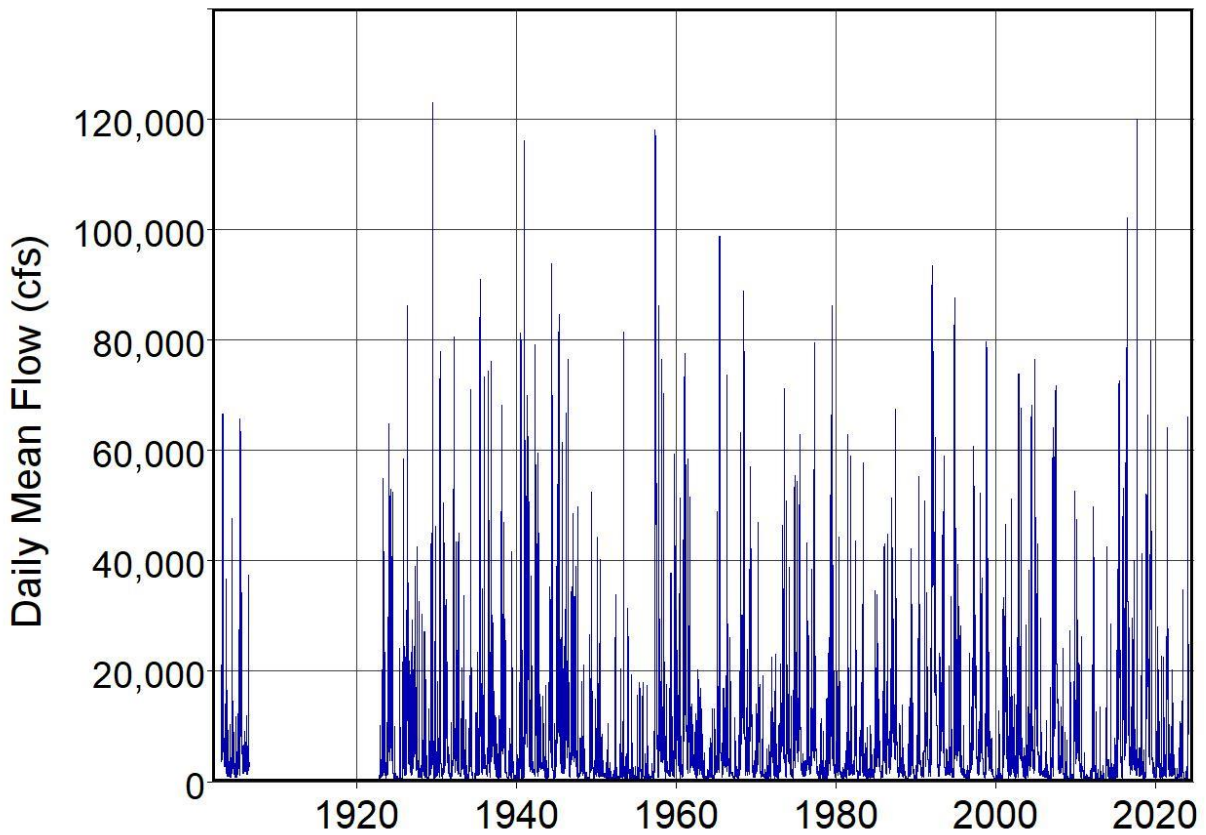


Figure B1 Observed Flows of Brazos River at Richmond Gage

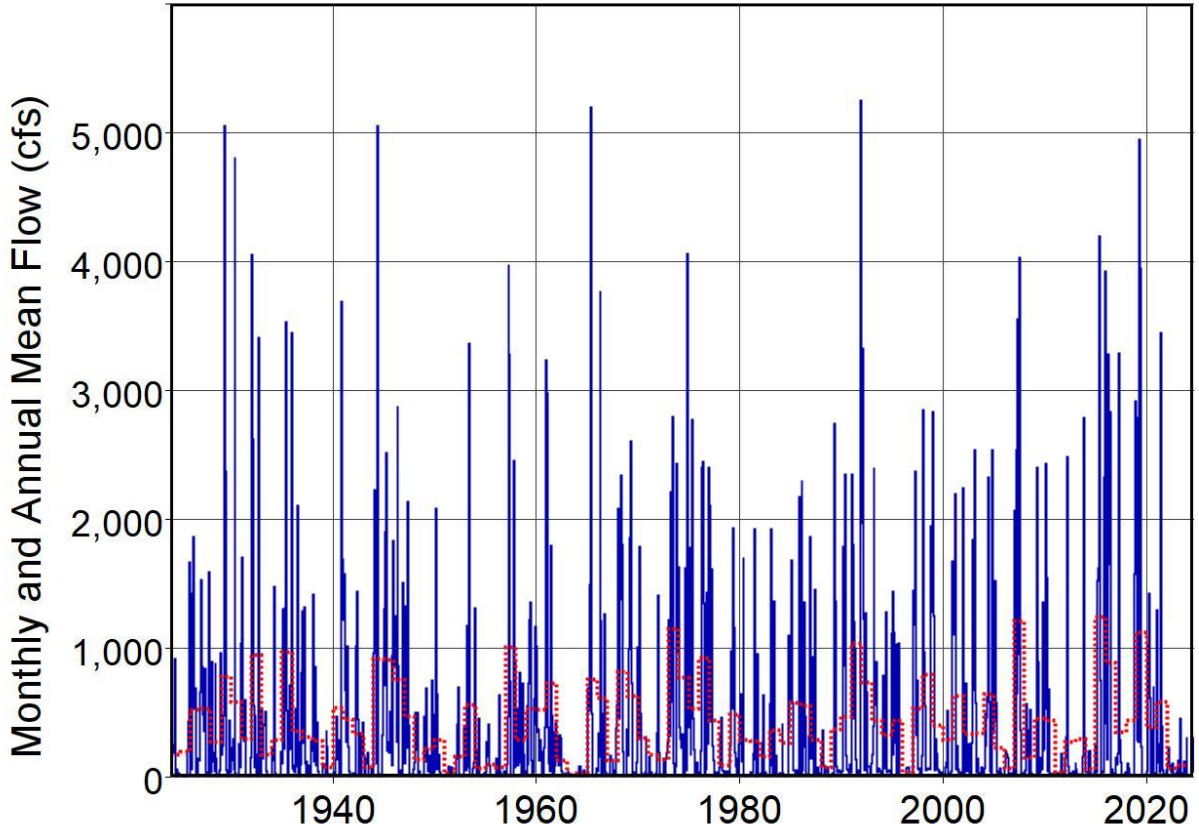
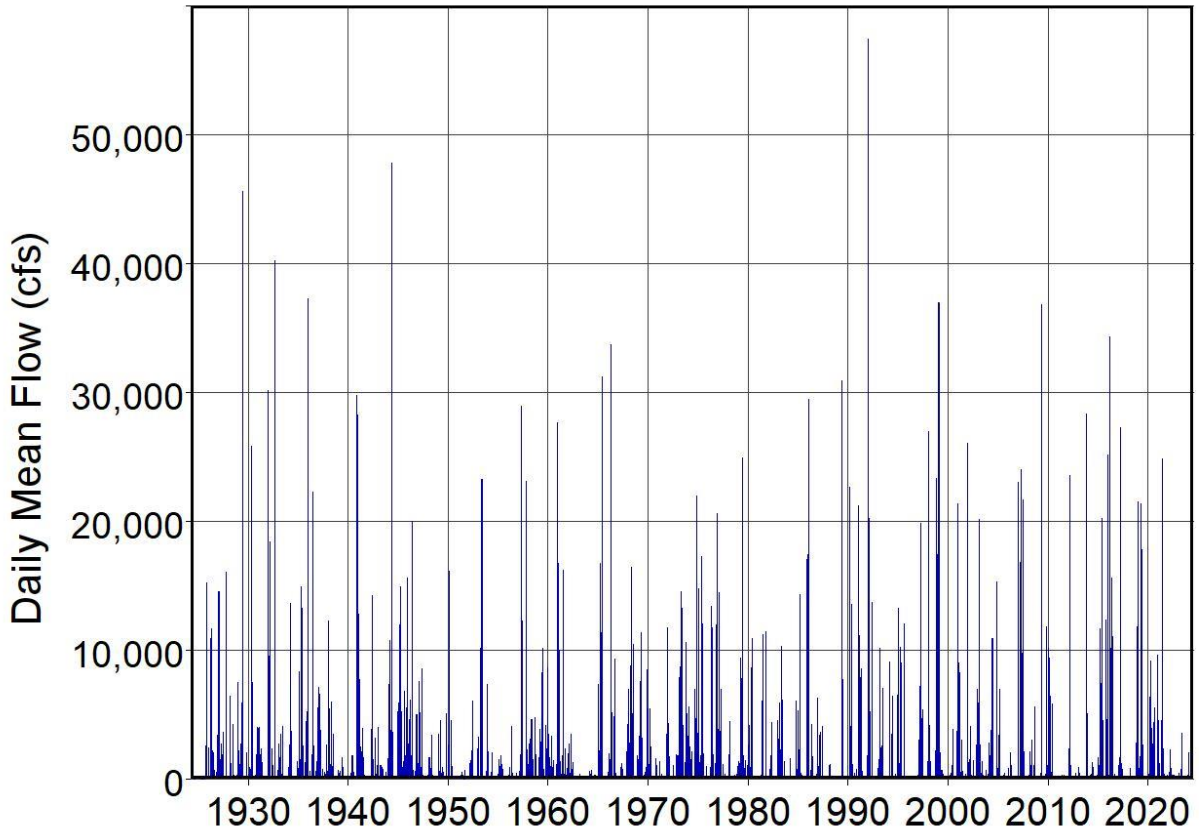


Figure B3 Observed Flows of Navasota River at Easterly Gage

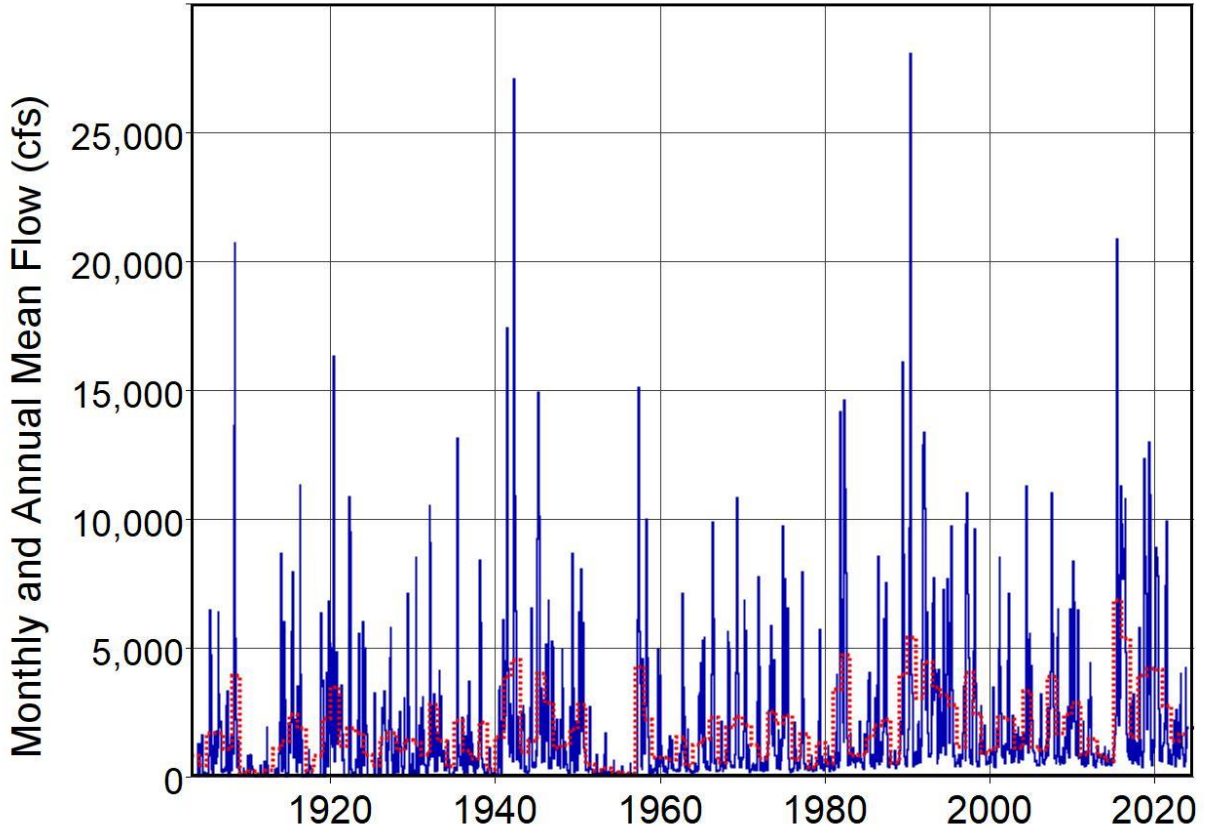
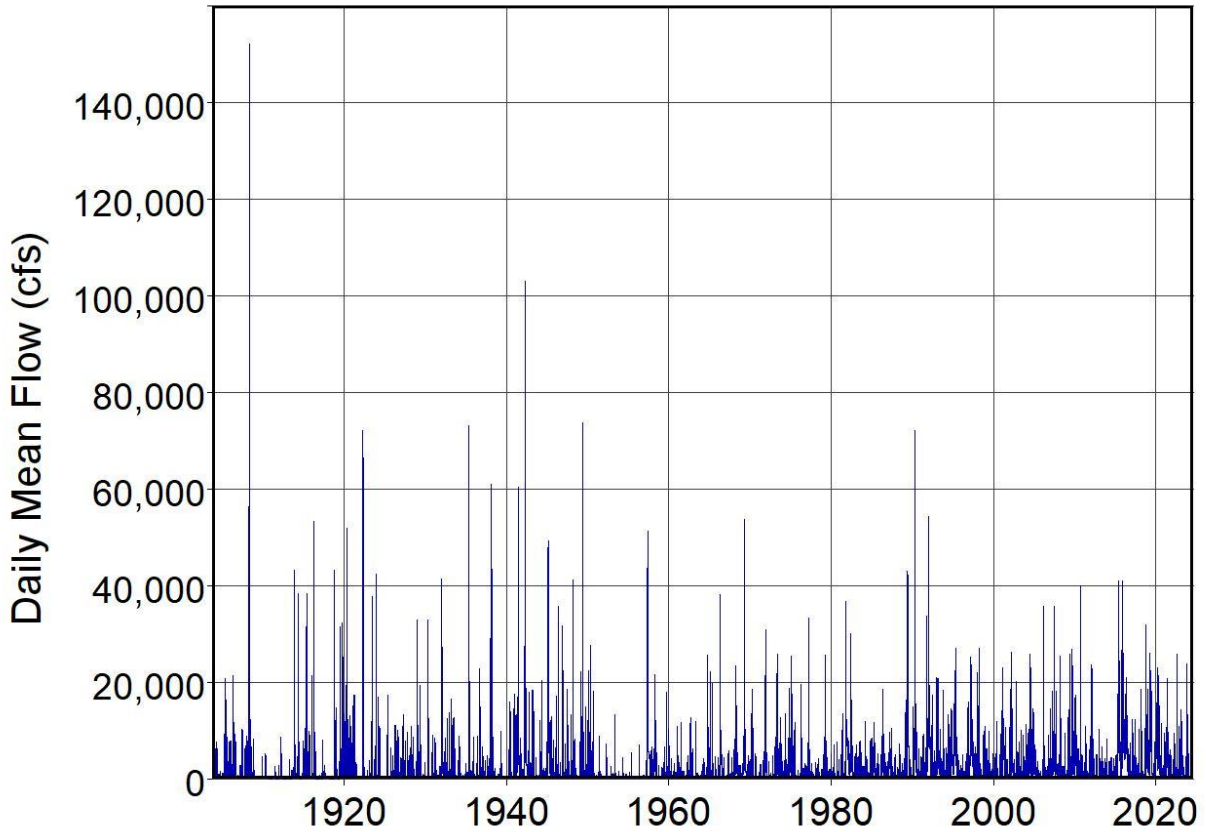


Figure B4 Observed Flows of Trinity River at Dallas Gage

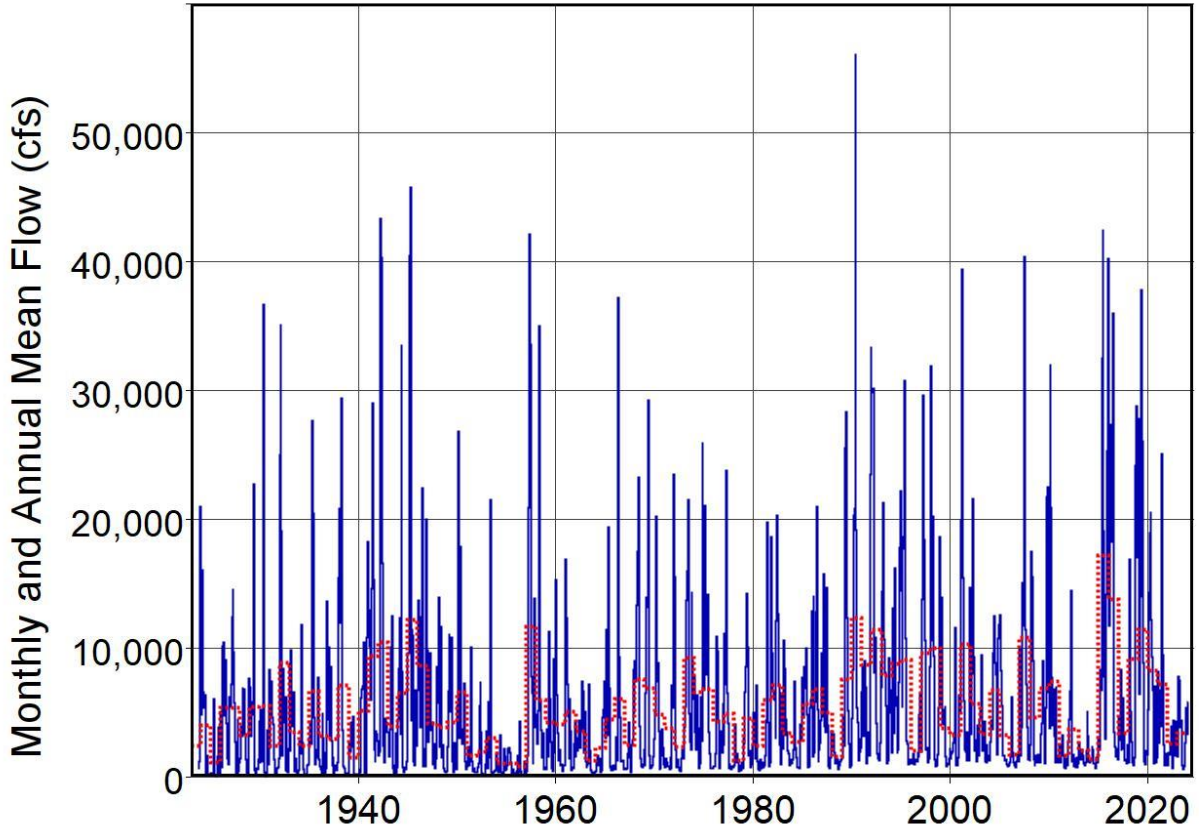
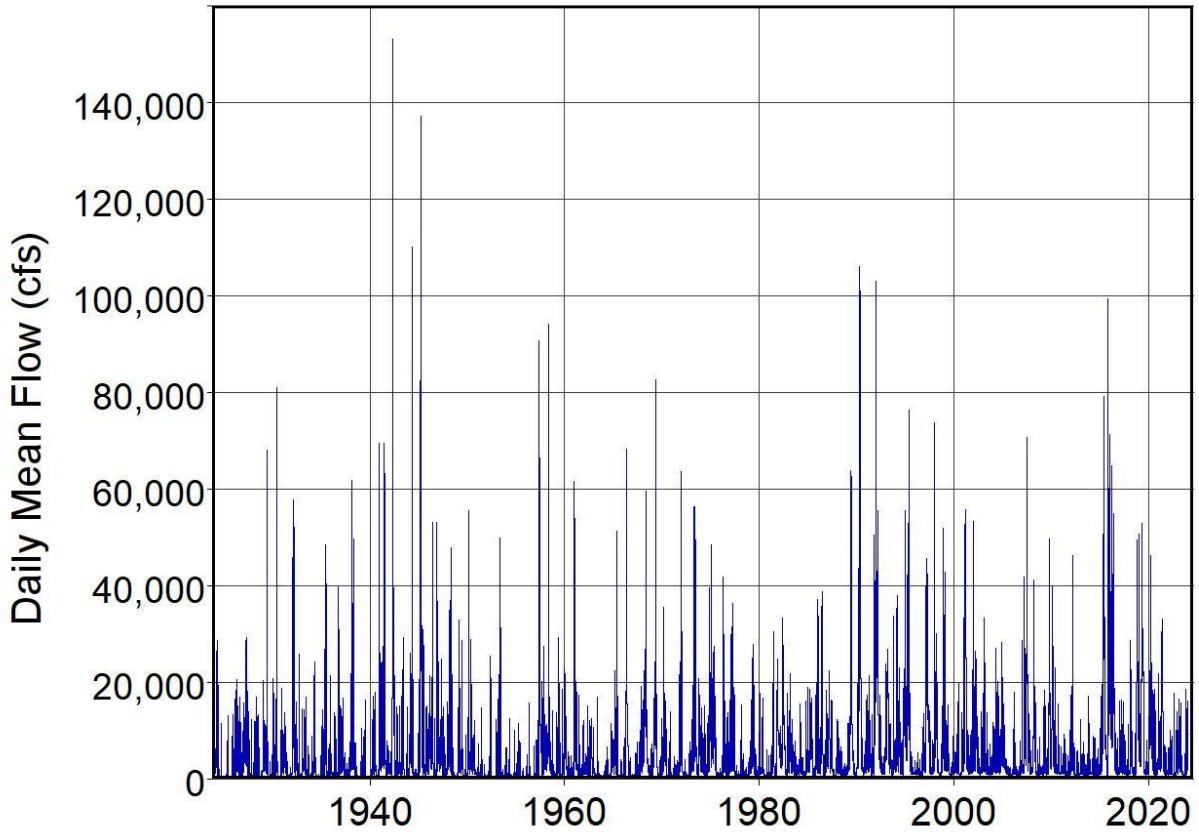


Figure B5 Observed Flows of Trinity River at Oakwood Gage

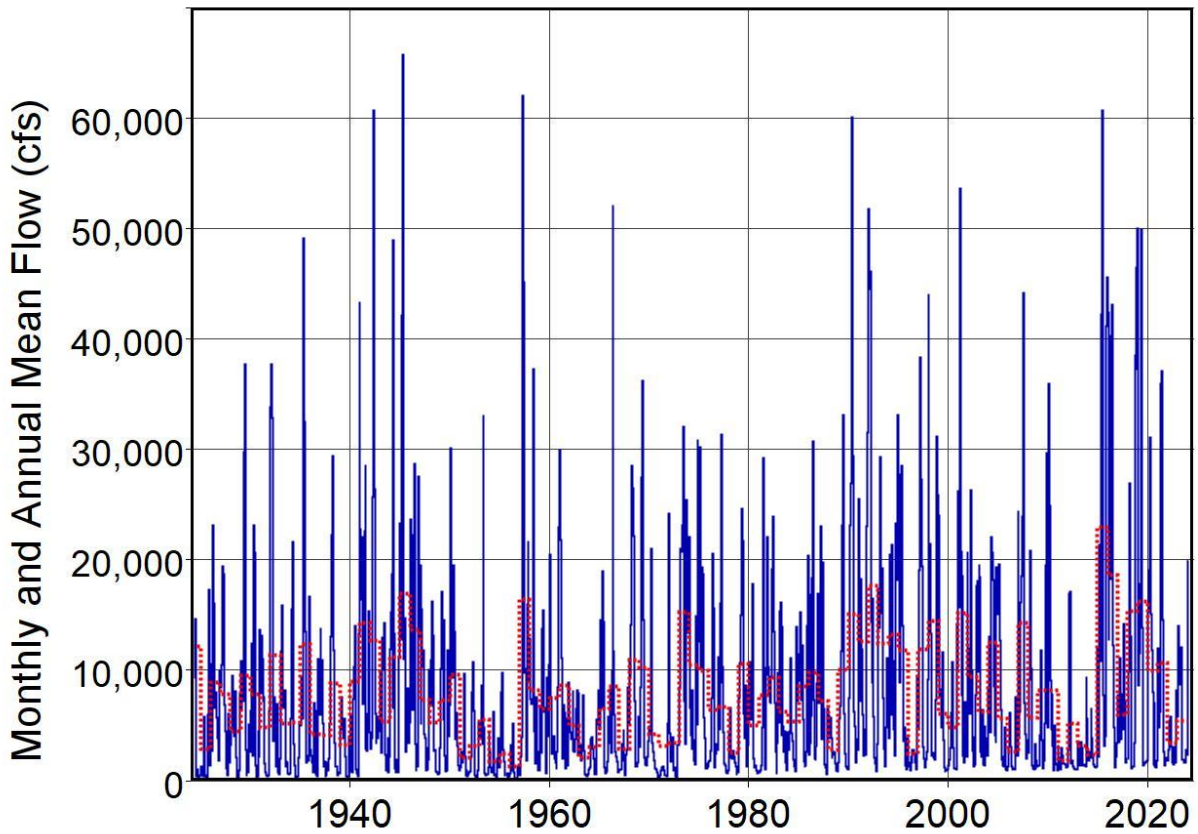
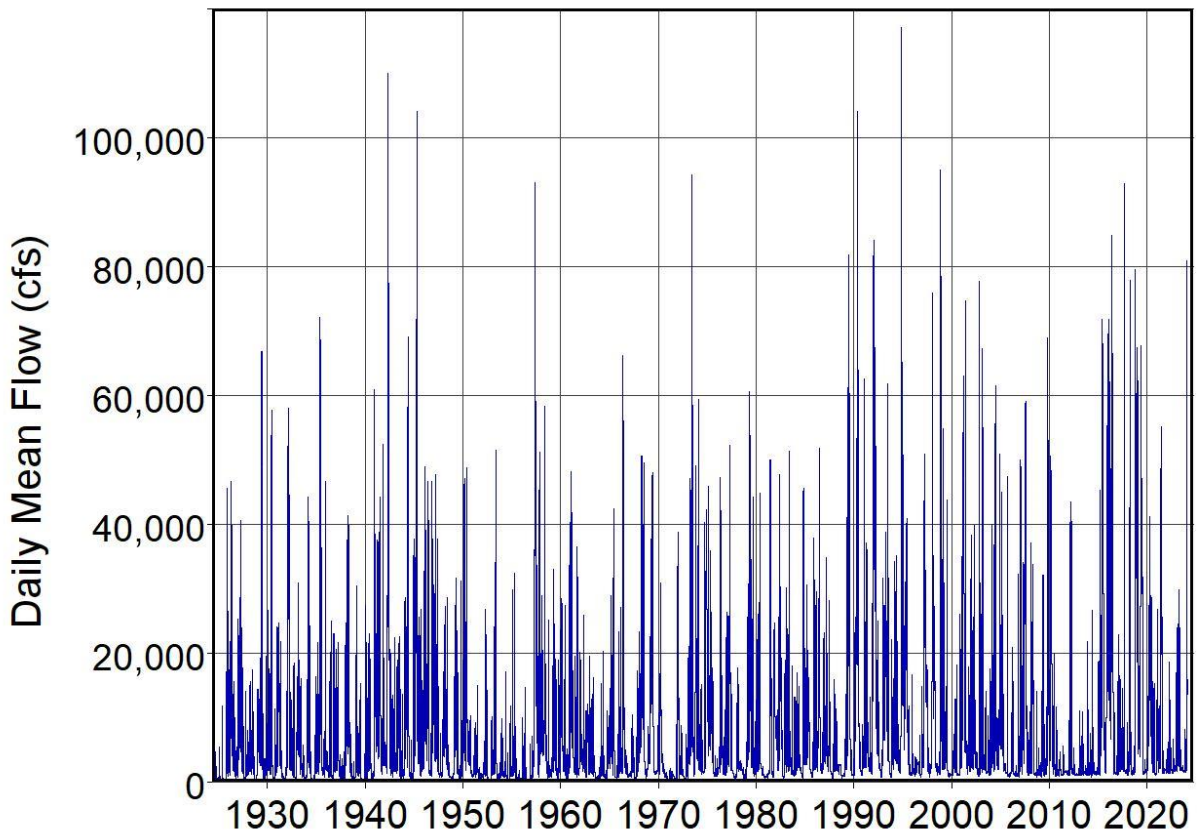


Figure B6 Observed Flows of Trinity River at Romayor Gage

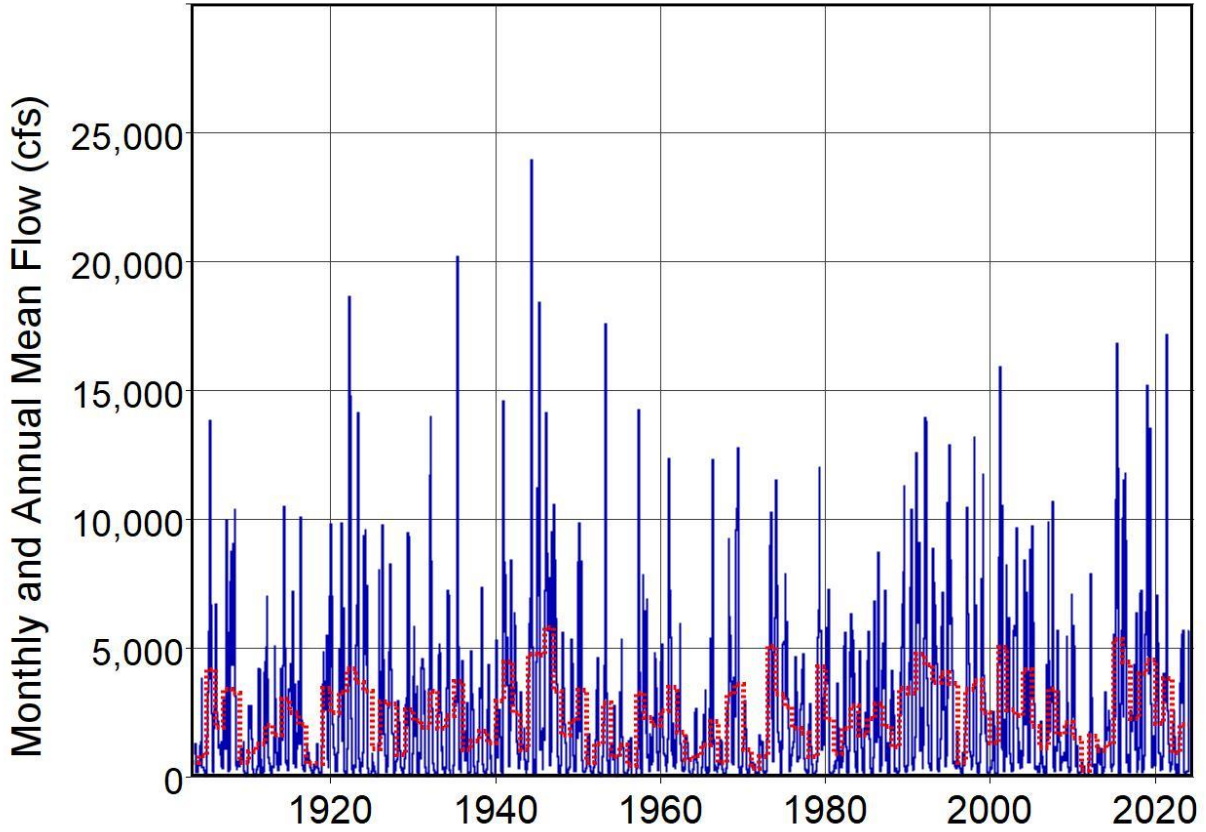
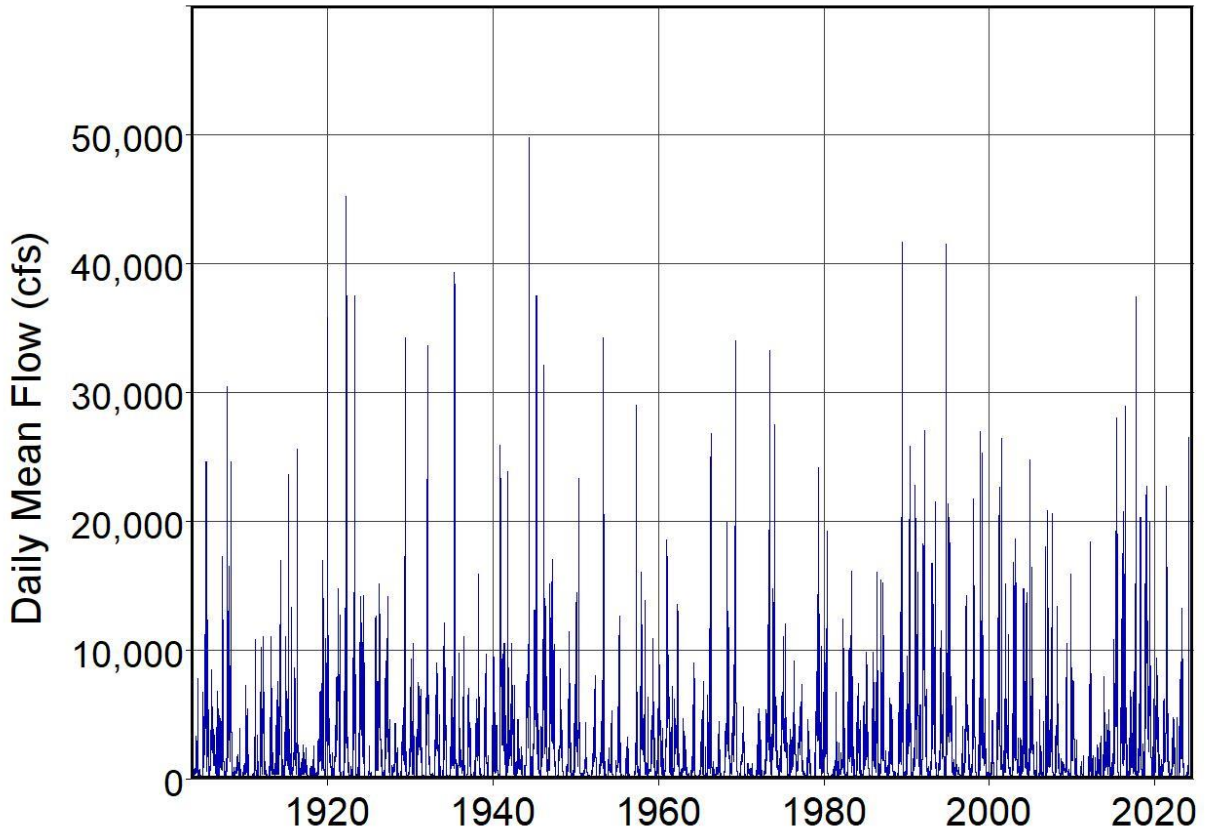


Figure B7 Observed Flows of Neches River at Rockland Gage

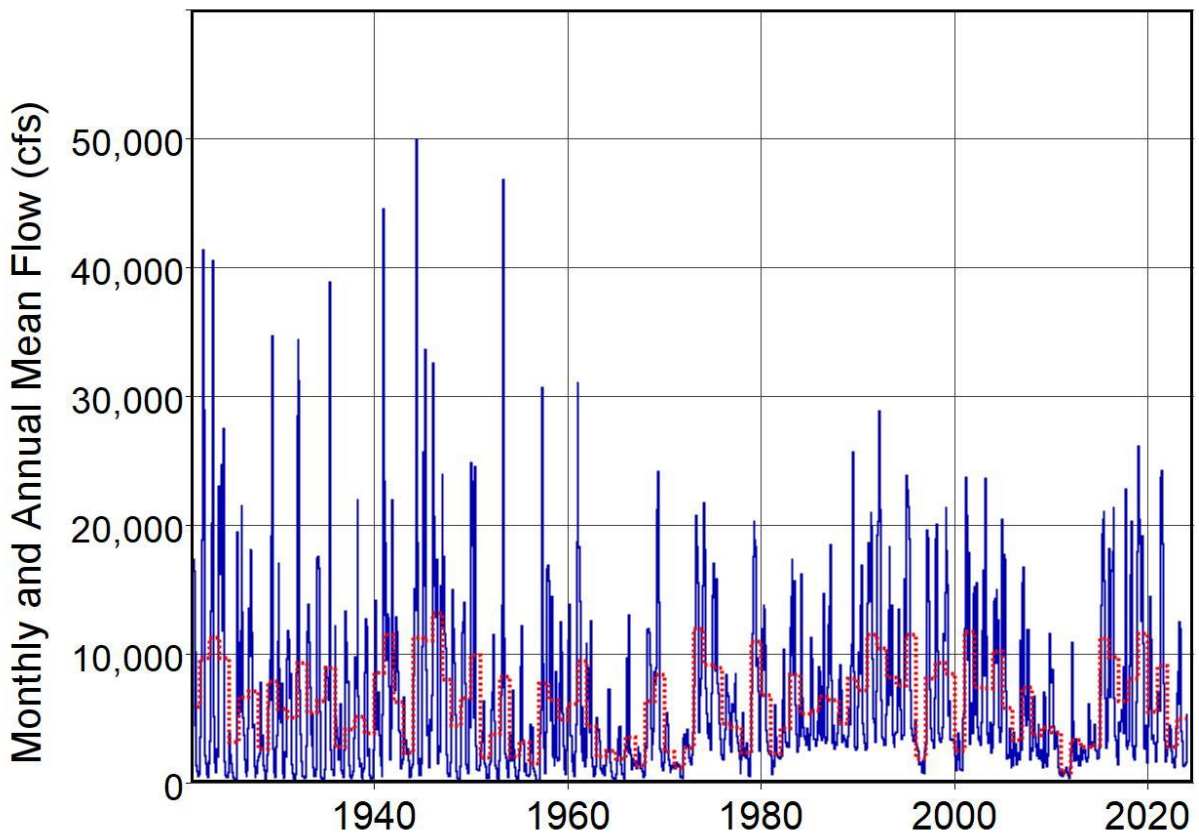
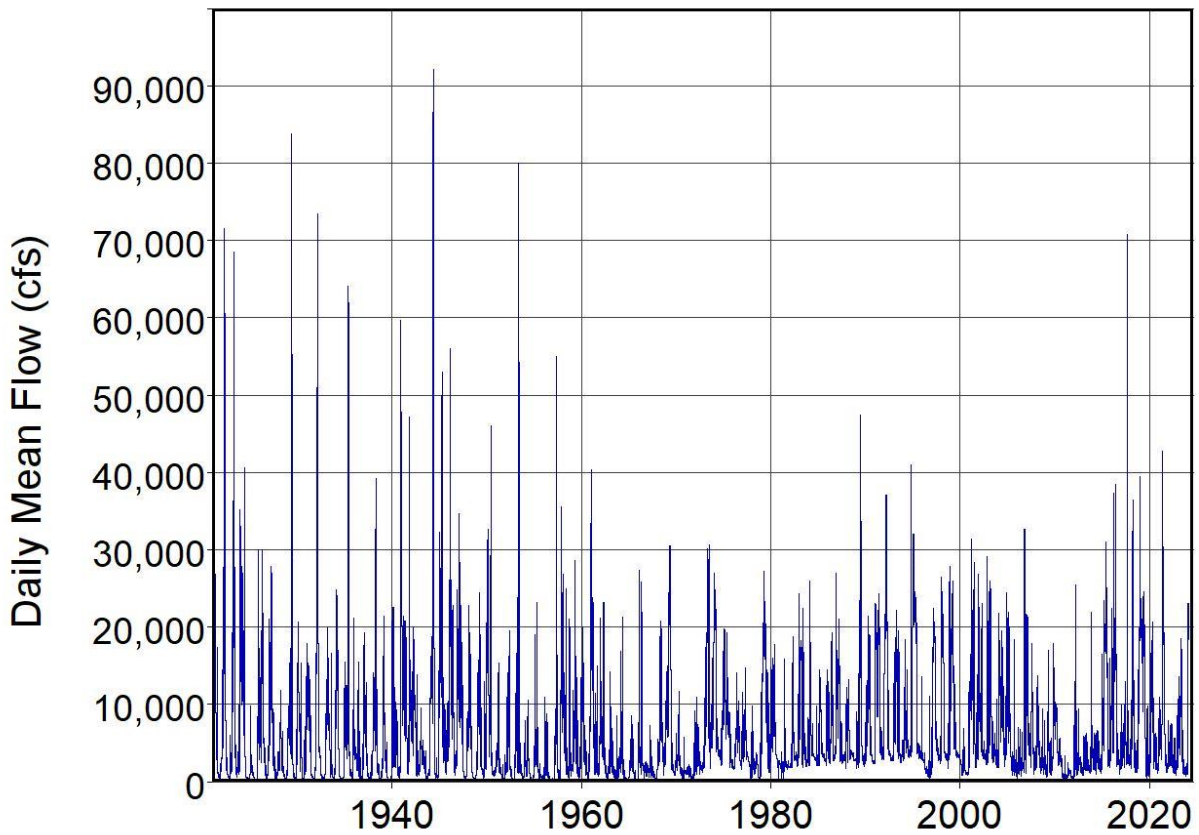


Figure B8 Observed Flows of Neches River at Evadale Gage

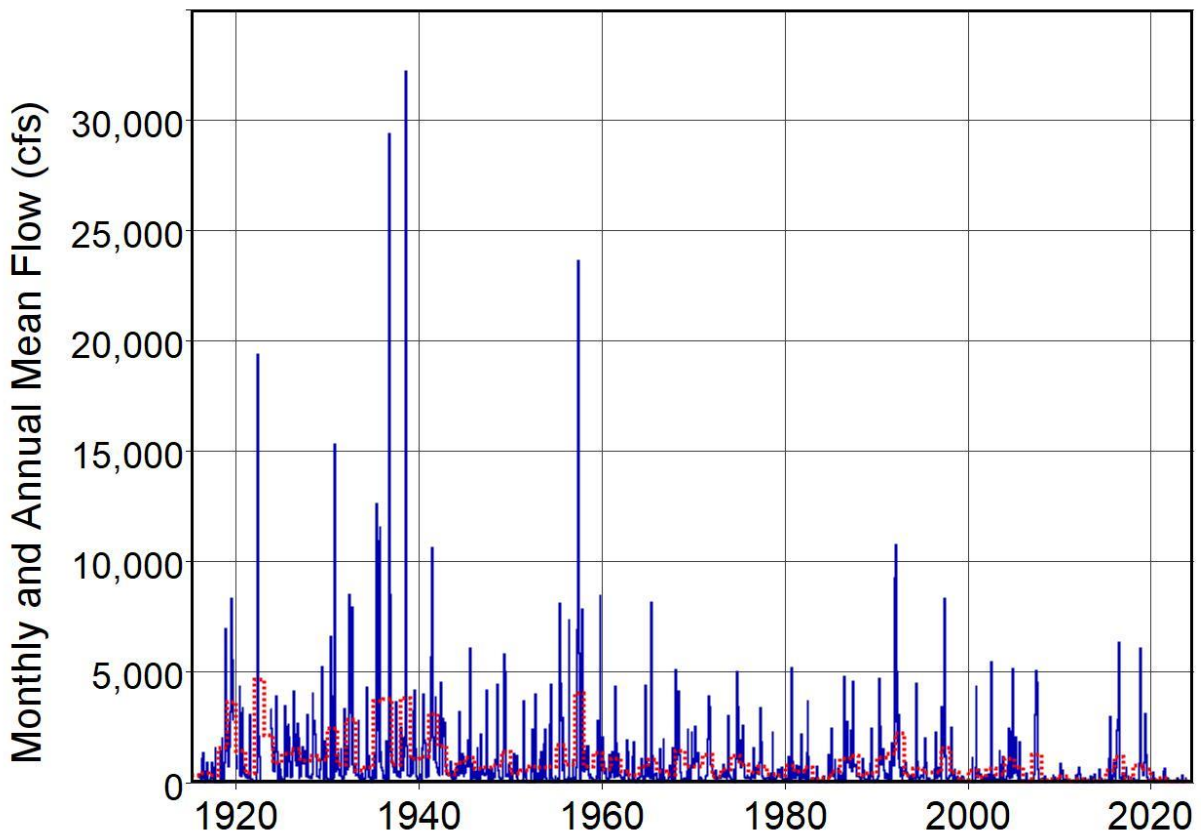
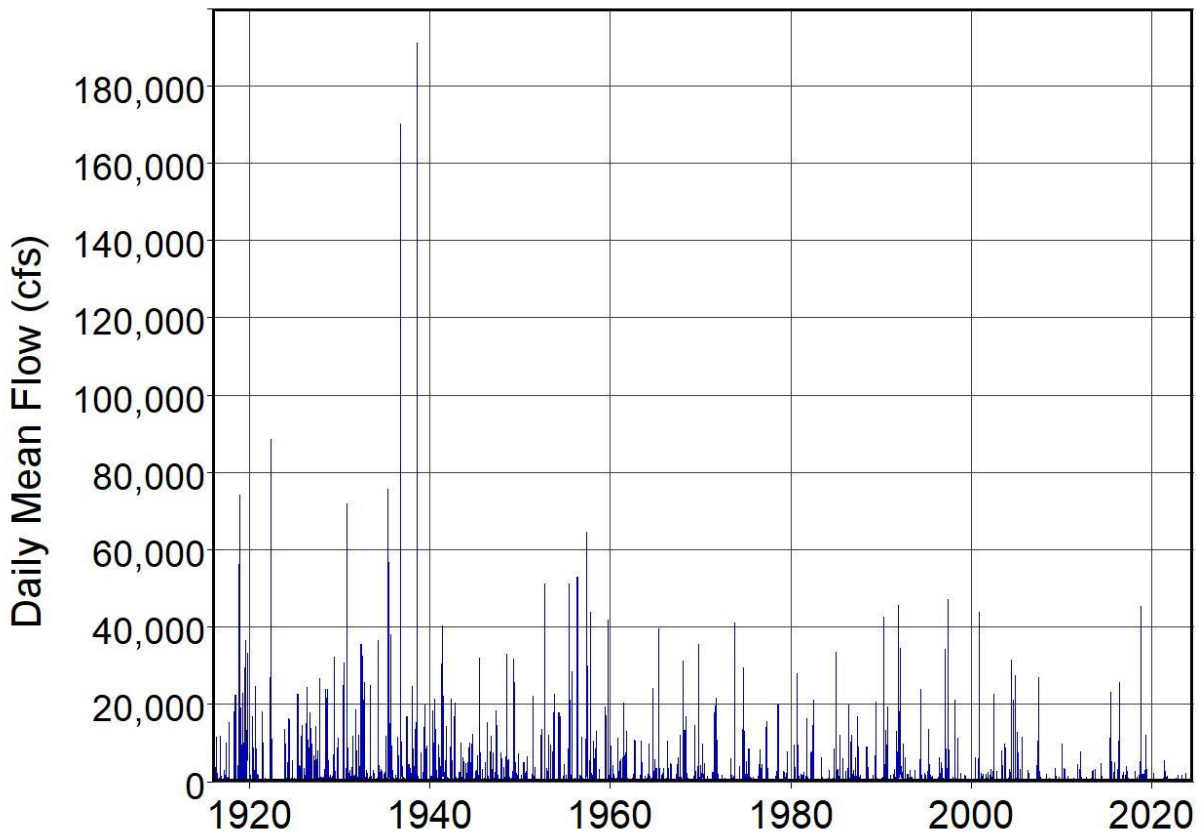


Figure B9 Observed Flows of Colorado River at San Saba Gage

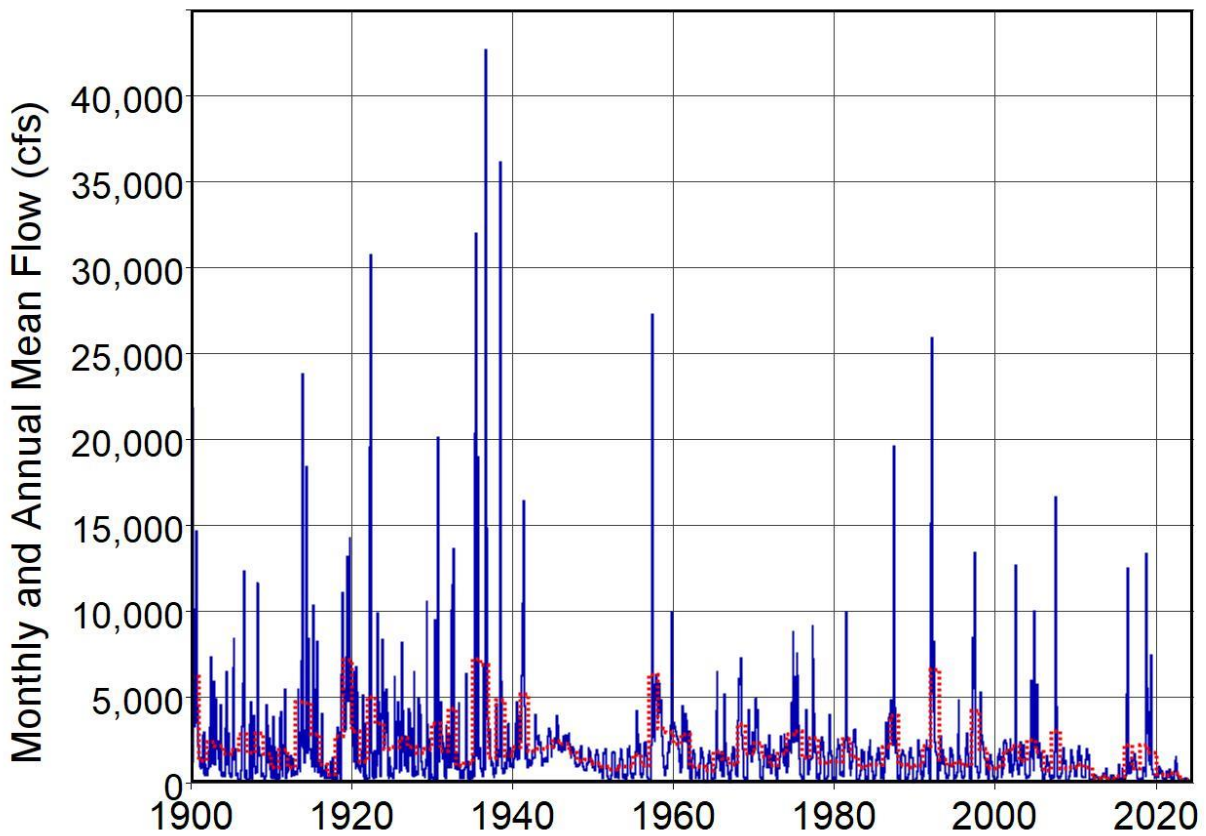
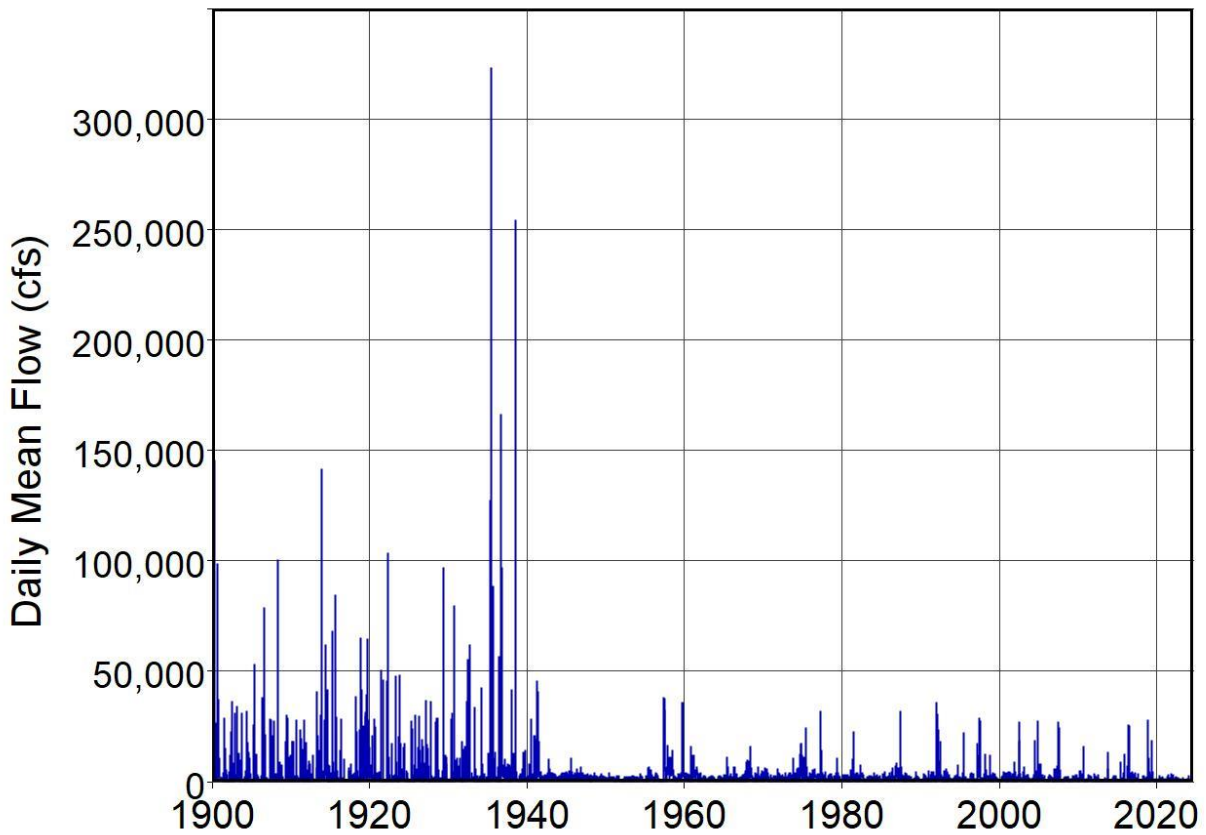


Figure B10 Observed Flows of Colorado River at Austin Gage

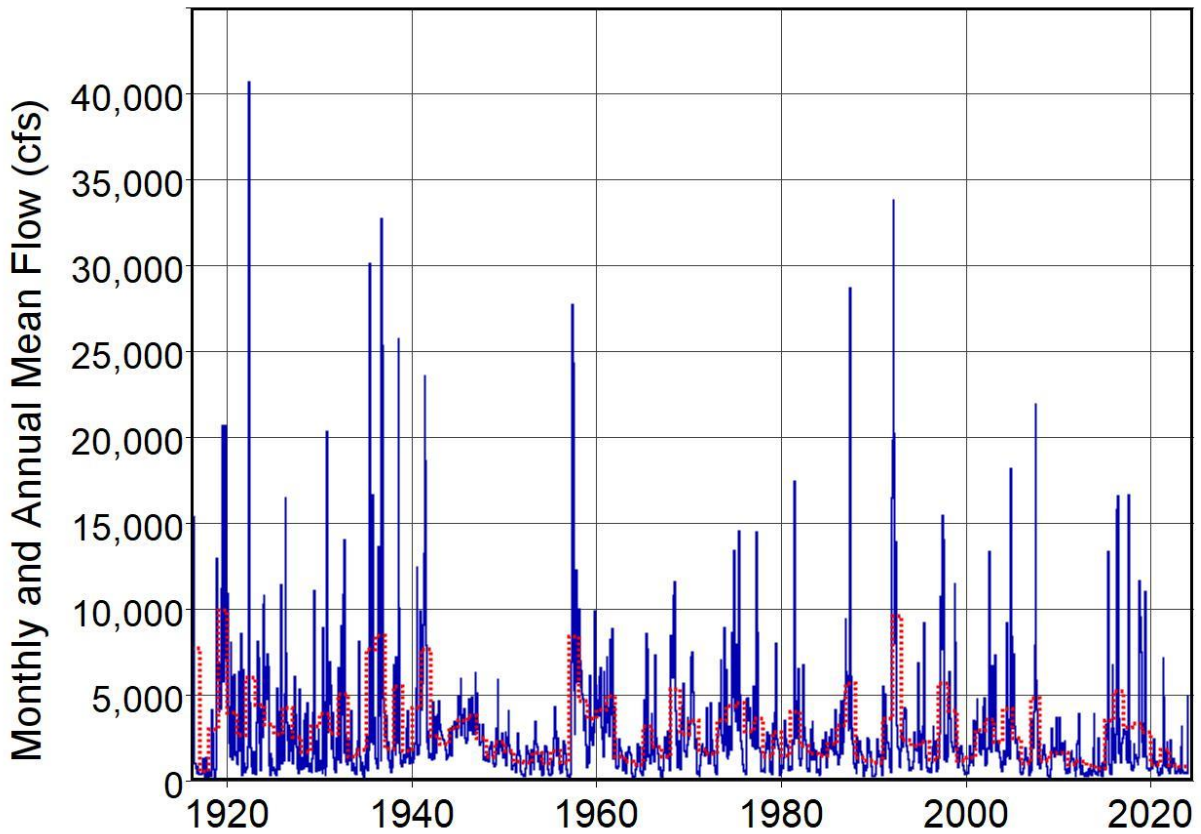
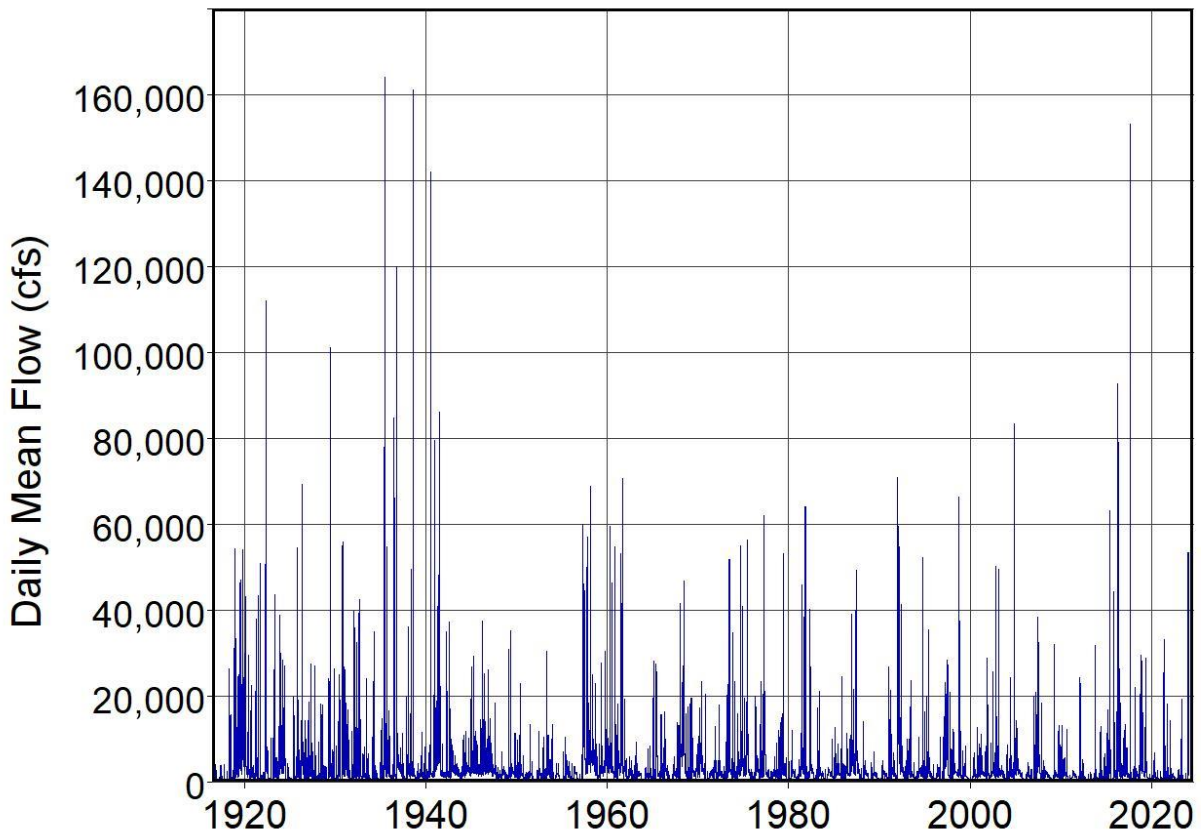


Figure B11 Observed Flows of Colorado River at Columbus Gage

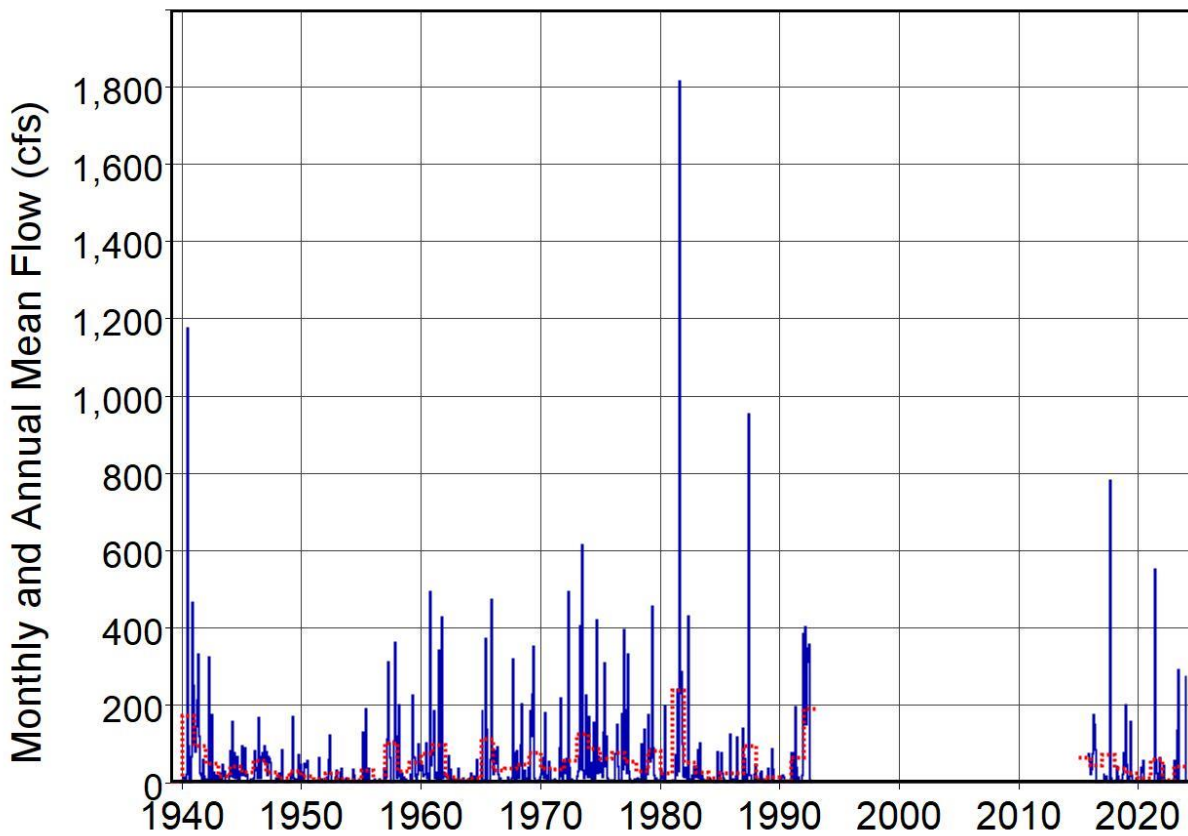
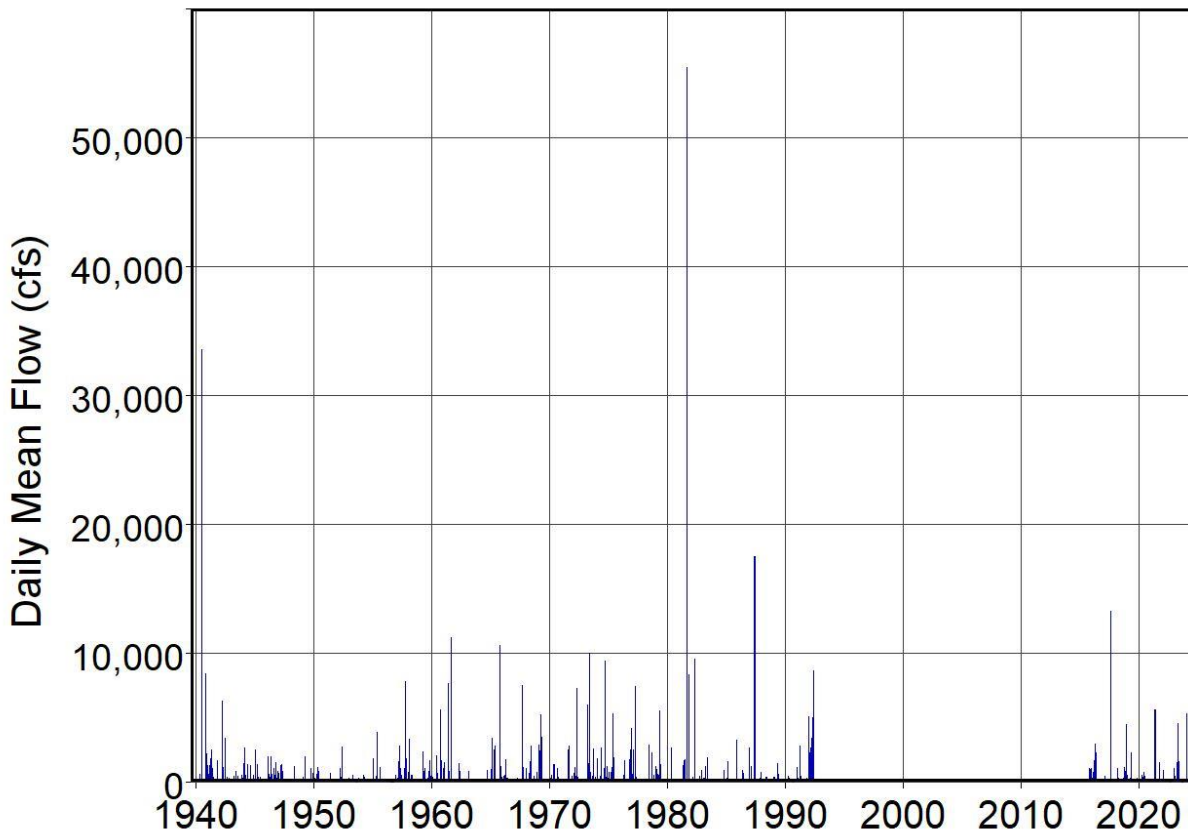


Figure B12 Observed Flows of Lavaca River at Hallettsville Gage

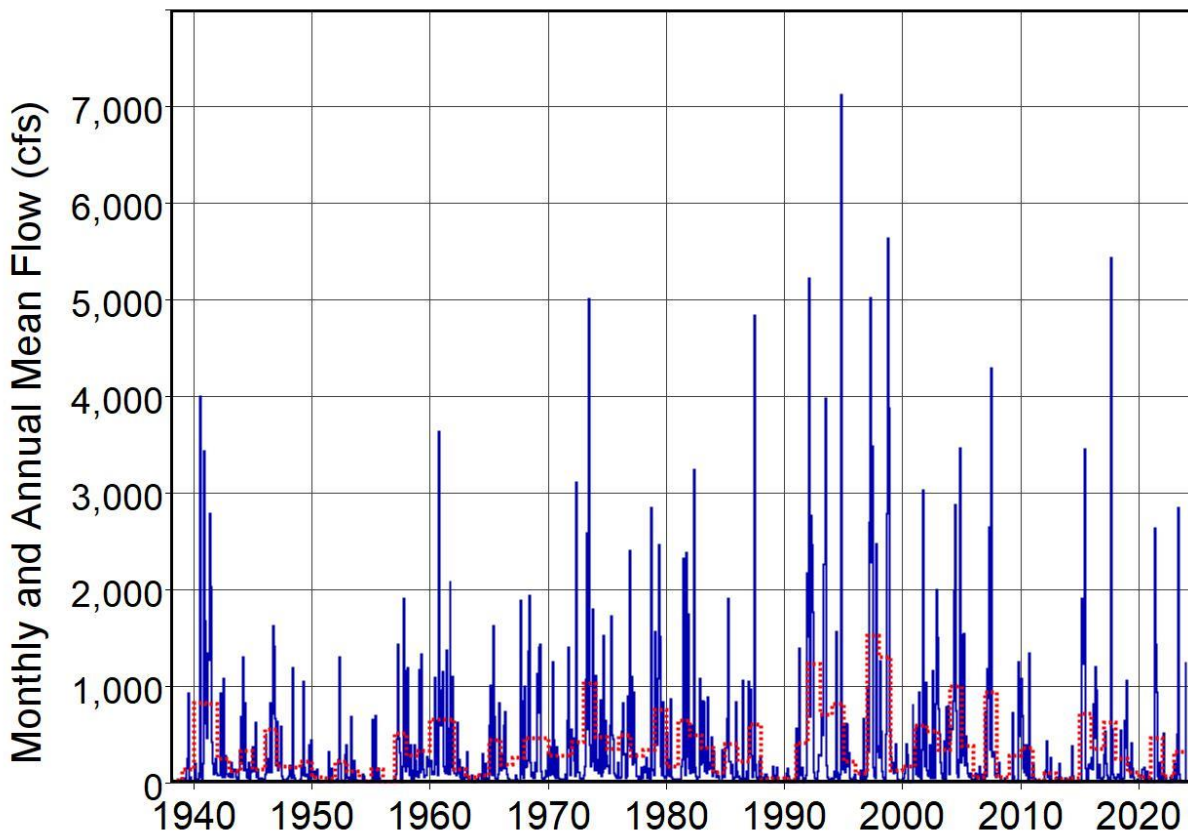
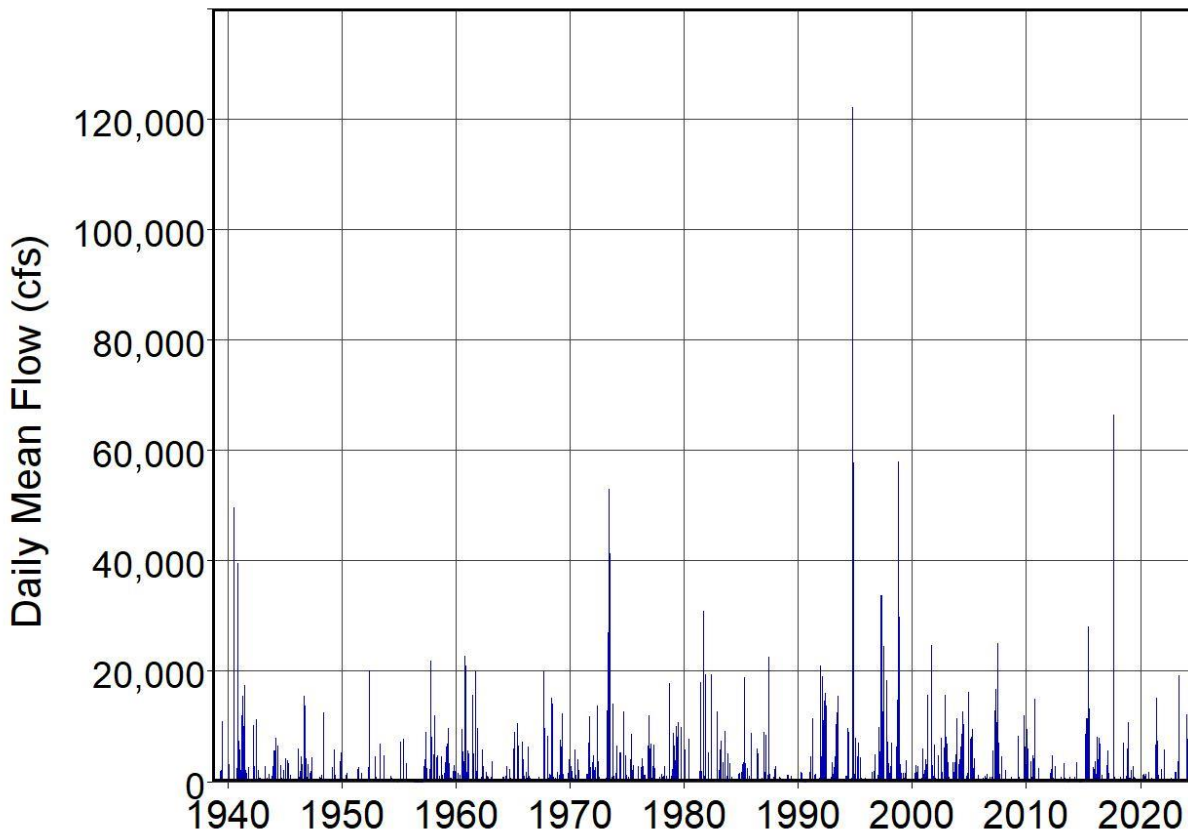


Figure B13 Observed Flows of Lavaca River at Edna Gage

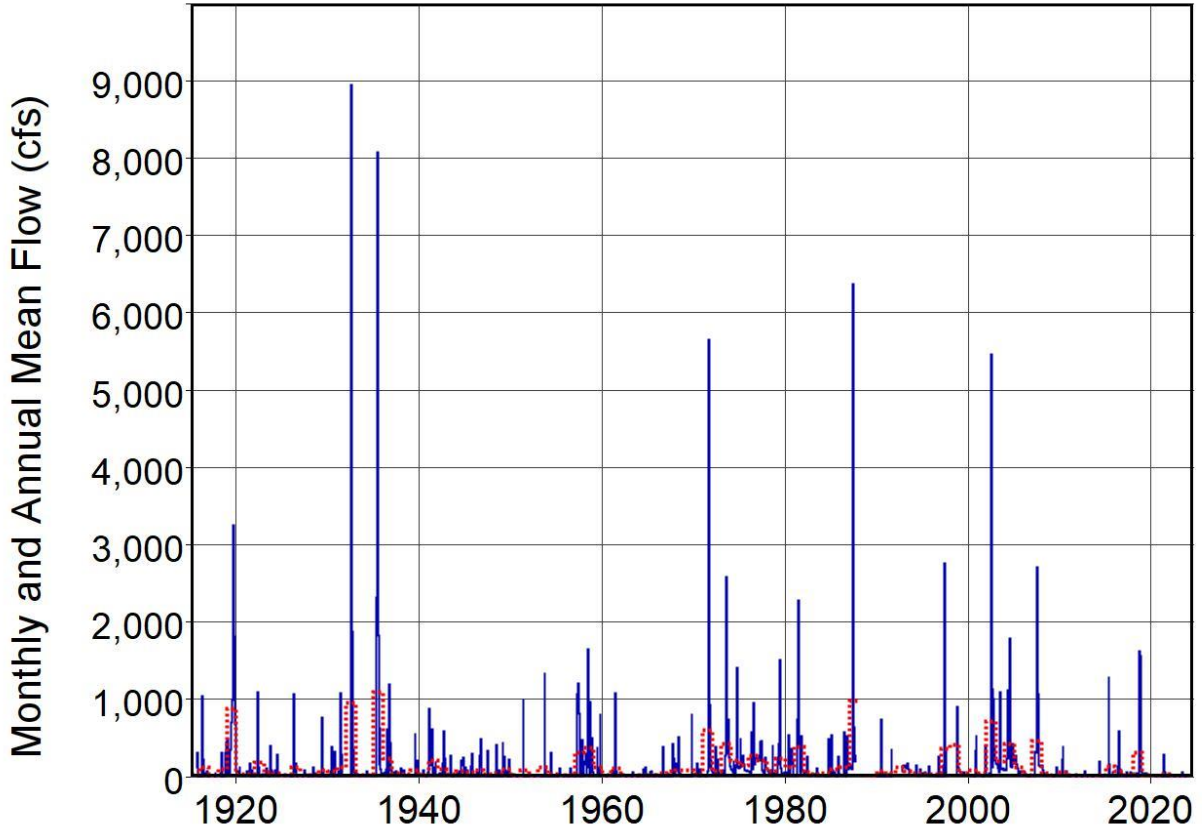
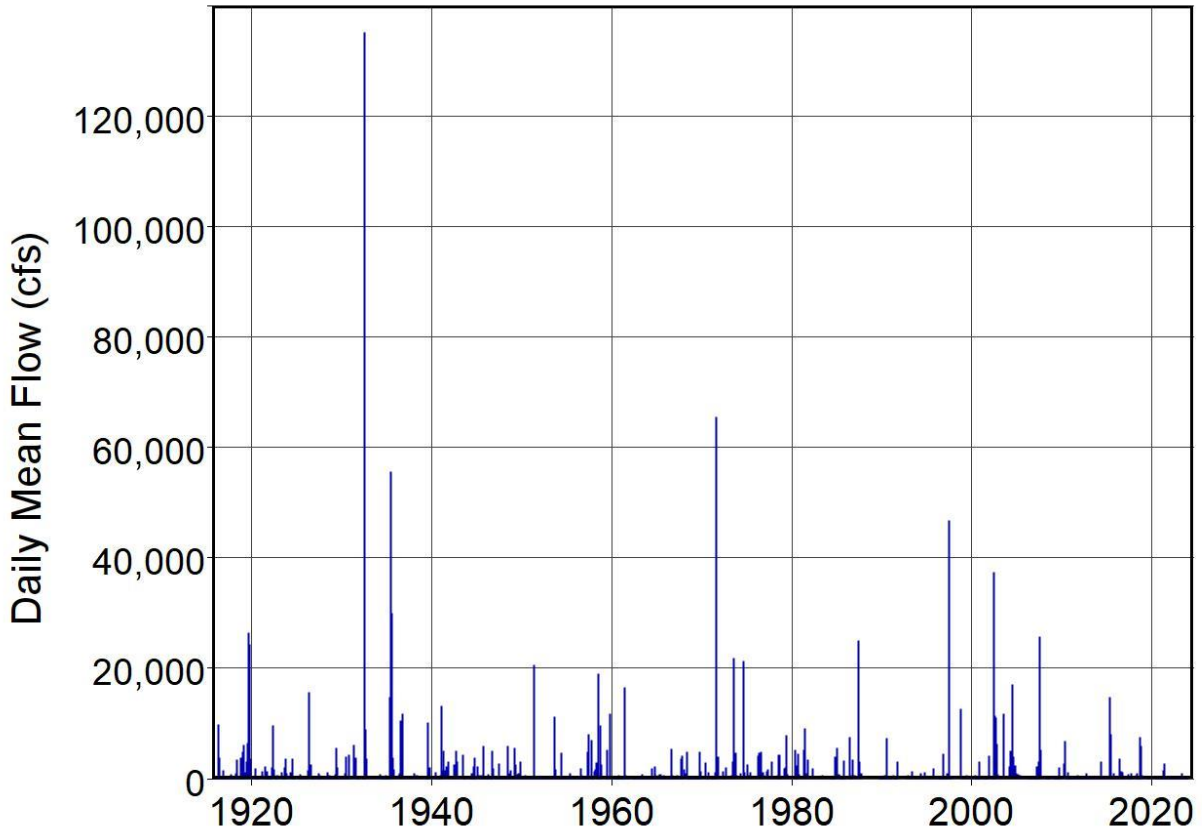


Figure B14 Observed Flows of Frio River at Derby Gage

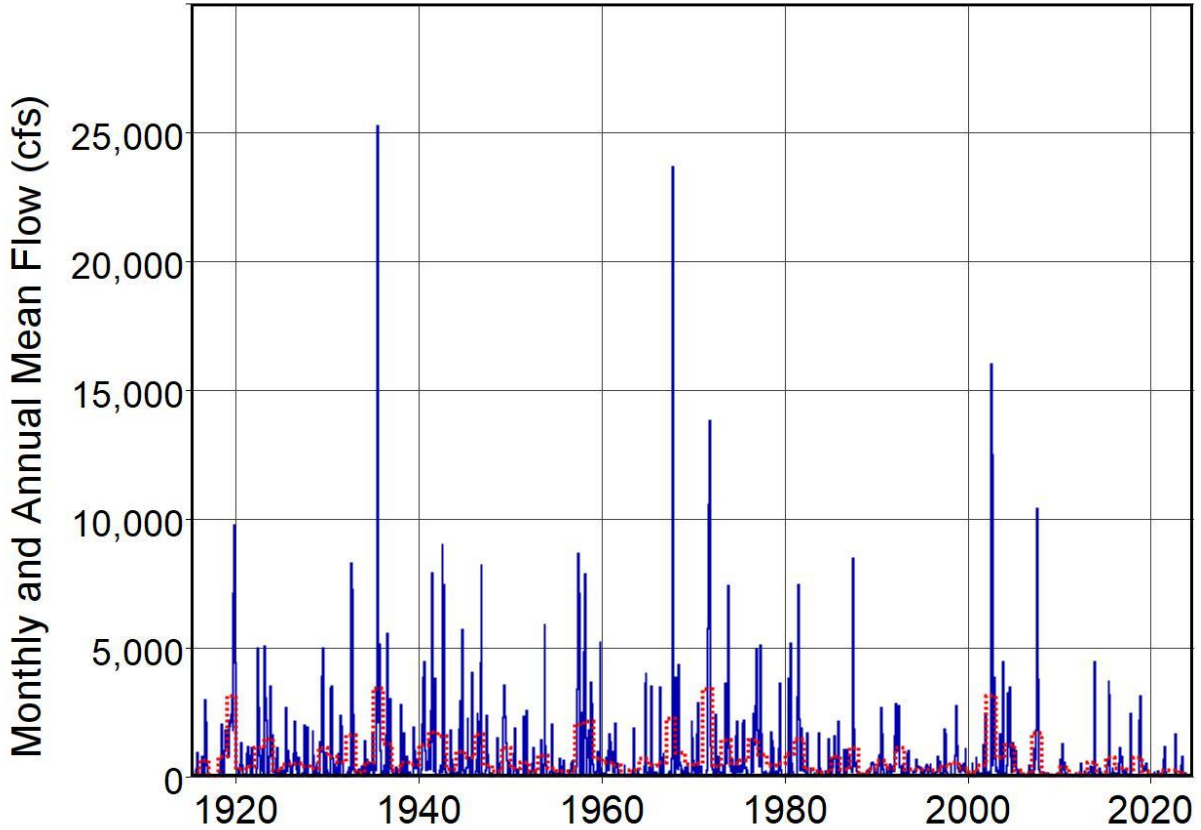
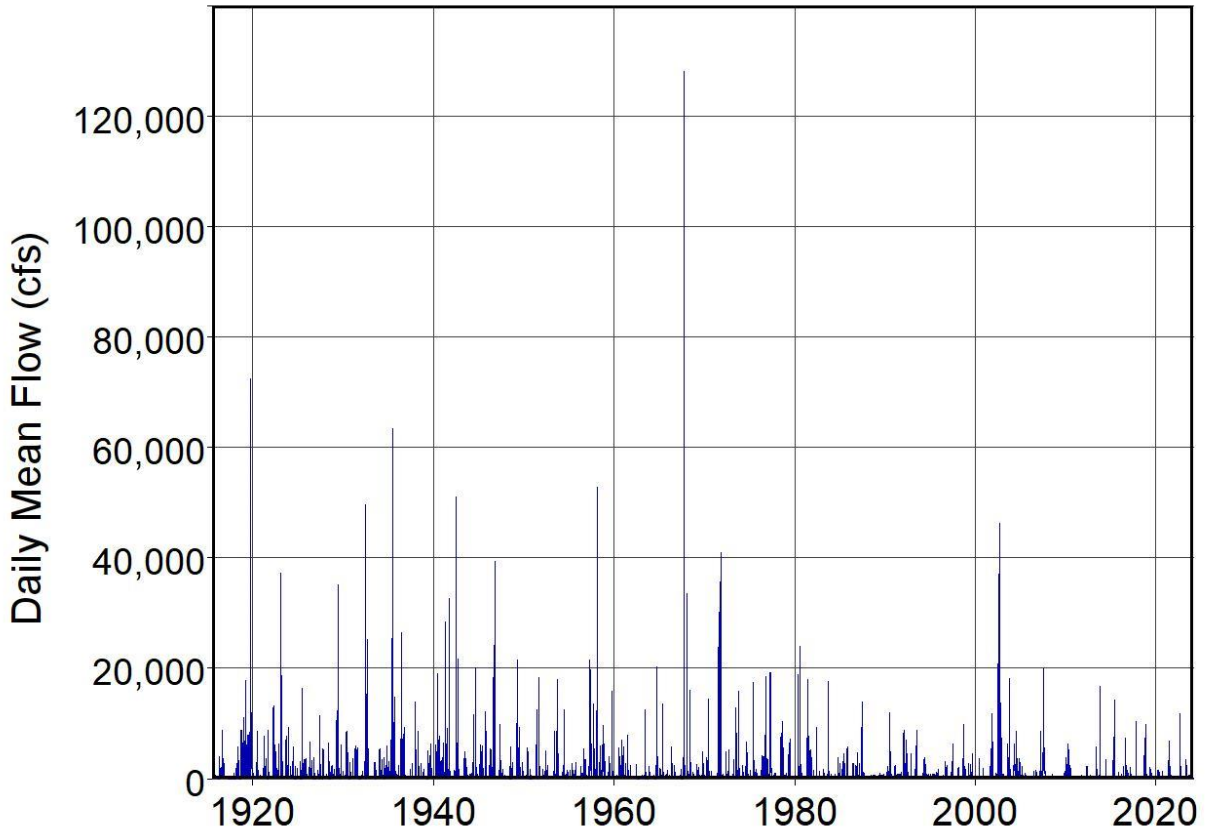


Figure B15 Observed Flows of Nueces River at Three Rivers Gage

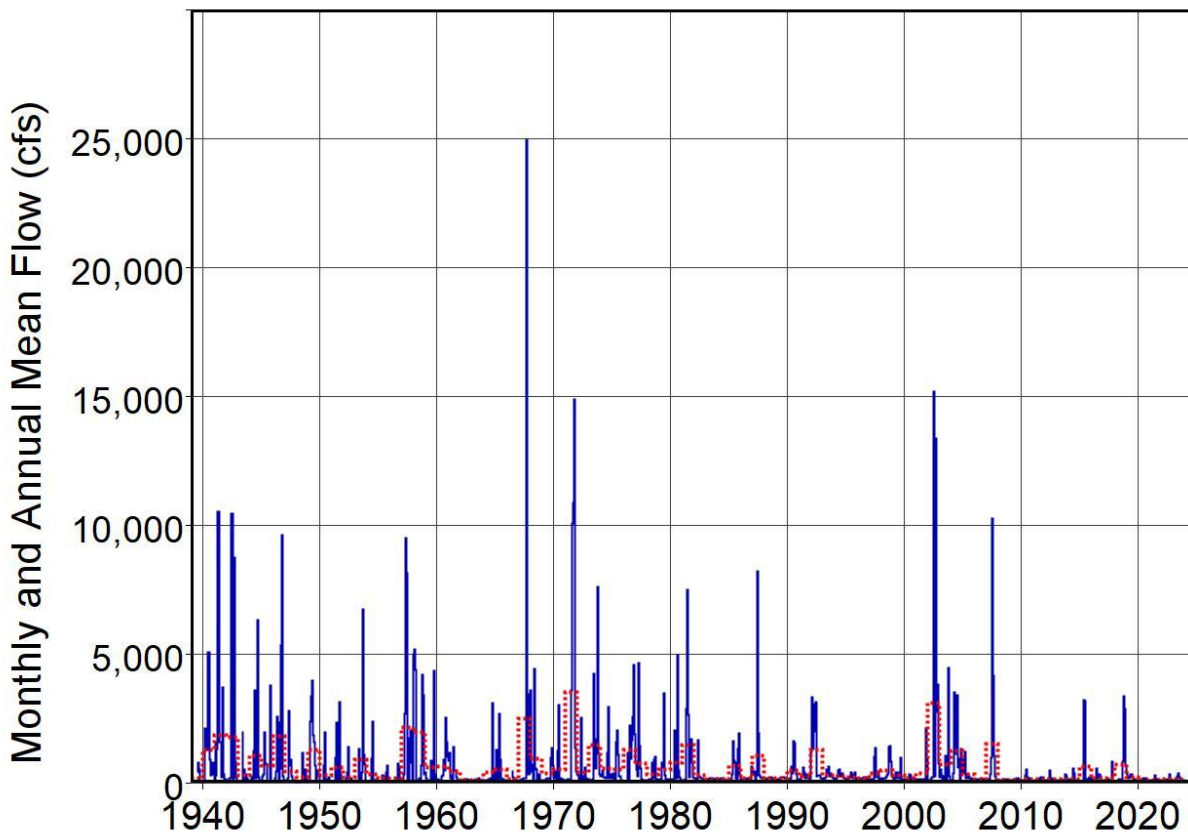
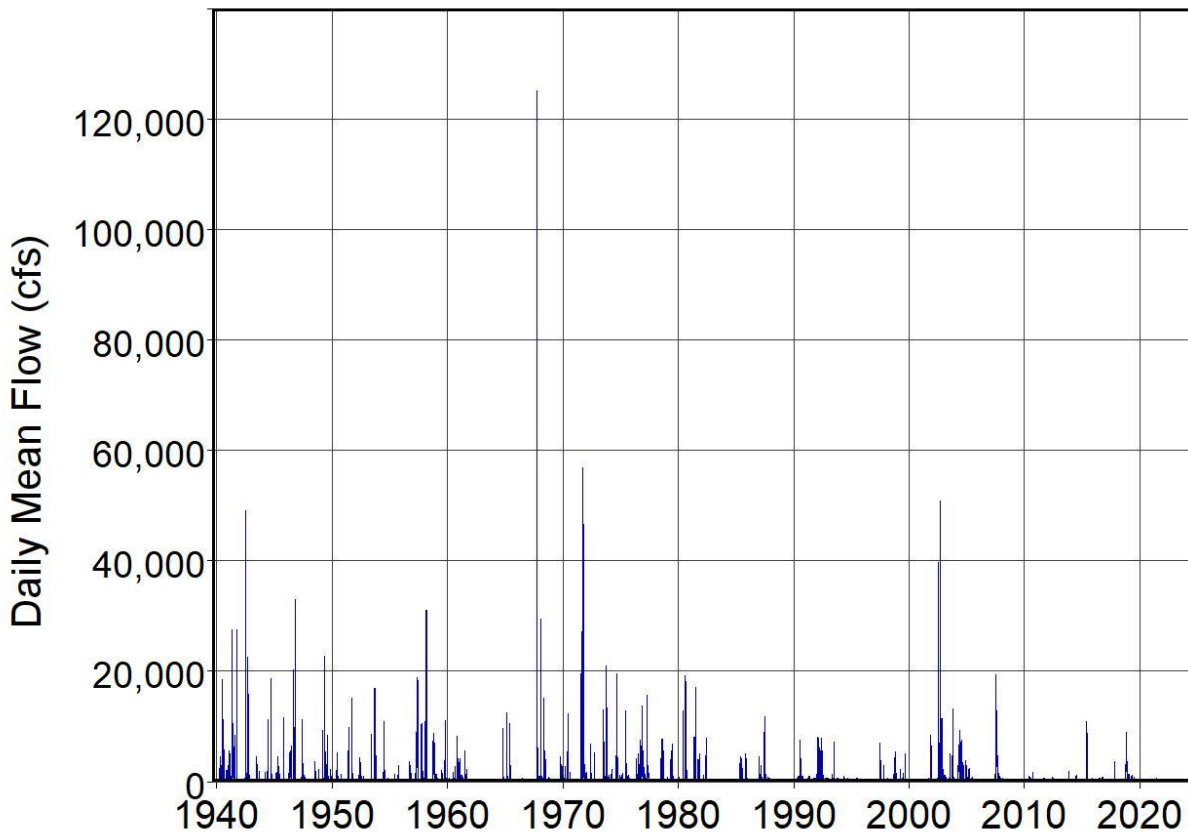


Figure B16 Observed Flows of Nueces River at Mathis Gage

APPENDIX C

PLOTS OF SIMD MONTHLY SB3 EFS TARGETS AND SHORTAGES DISCUSSED IN CHAPTERS 7 THROUGH 12

Appendix C is comprised of plots of 1940-2023 monthly instream flow targets for Senate Bill 3 (SB3) environmental flow standards (EFS) and shortages in meeting the targets. These quantities were computed in daily *SIMD* simulations with each of the six case studies. The USGS gage sites represented by WAM control points for each of the plots are listed in Table C1. The legend for the plots in Appendix C is as follows.

blue solid line - monthly SB3 EFS instream flow targets in acre-feet

red dotted line - monthly shortages in acre-feet in meeting the targets

Daily SB3 EFS instream flow targets computed in a daily *SIMD* simulation are summed to monthly quantities by *SIMD*. The monthly summations of daily targets are transferred to a DSS input file read by *SIM*. Therefore, the monthly instream flow targets plotted in Appendix C represent monthly targets for both daily *SIMD* and monthly *SIM* simulations. The monthly instream flow shortages in Appendix C are likewise *SIMD* summations of daily shortages. However, the *SIMD* simulated shortages are not converted to *SIM* input. Shortages computed in *SIM* simulations typically vary from those plotted in Appendix C even though the monthly targets are the same in both *SIM* and *SIMD* simulations.

Table C1
Locations of SB3 EFS Targets and Shortages

| WAM CP ID | Stream | Nearest City | USGS Gage No. | Watershed Area (square miles) | Figure Label | Page Number |
|---------------------------------------|------------------------|-----------------|------------------|-------------------------------------|-----------------|----------------|
| <u>Brazos River Basin (Chapter 7)</u> | | | | | | |
| SFAS06 | Salt Fork Brazos River | Aspermont | 08082000 | 2,504 | C1 | 470 |
| DMAS09 | Double Mountain Fork | Aspermont | 08080500 | 1,891 | C2 | 470 |
| BRSE11 | Brazos River | Seymour | 08082500 | 5,996 | C3 | 471 |
| CFNU16 | Clear Fork Brazos | Nugent | 08084000 | 2,236 | C4 | 471 |
| CON026 | Clear Fork Brazos | Lueders | 08084200 | 2,542 | C5 | 472 |
| BRSE23 | Brazos River | South Bend | 08088000 | 13,171 | C6 | 472 |
| BRPP27 | Brazos River | Palo Pinto | 08089000 | 14,309 | C7 | 473 |
| BRGR30 | Brazos River | Glen Rose | 08091000 | 16,320 | C8 | 473 |
| NBCL36 | North Bosque River | Clifton | 08095000 | 977 | C9 | 474 |
| BRWA41 | Brazos River | Waco | 08096500 | 20,065 | C10 | 474 |
| LEGT47 | Leon River | Gatesville | 08100500 | 2,379 | C11 | 475 |
| LAKE50 | Lampasas River | Kempner | 08103800 | 817 | C12 | 475 |
| LRLR53 | Little River | Little River | 08104500 | 5,266 | C13 | 476 |
| LRCA58 | Little River | Cameron | 08106500 | 7,100 | C14 | 476 |
| BRBR59 | Brazos River | Bryan | 08109000 | 30,016 | C15 | 477 |
| NAEA66 | Navasota River | Easterly | 08110500 | 936 | C16 | 477 |
| BRHE68 | Brazos River | Hempstead | 08111500 | 34,374 | C17 | 478 |
| BRRI70 | Brazos River | Richmond | 08114000 | 35,454 | C18 | 478 |
| BRRO72 | Brazos River | Rosharon | 08116650 | 35,775 | C19 | 479 |

Table C1 (Continued)
Locations of SB3 EFS Targets and Shortages

| WAM CP ID | Stream | Nearest City | USGS Gage No. | Watershed Area (square miles) | Figure Label | Page Number |
|--|----------------------------|-----------------|------------------|-------------------------------------|-----------------|----------------|
| <u>Trinity River Basin (Chapter 8)</u> | | | | | | |
| 8WTGP | West Fork of Trinity River | Grand Prairie | 08049500 | 3,065 | C20 | 480 |
| 8TRDA | Trinity River | Dallas | 08057000 | 6,106 | C21 | 480 |
| 8TROA | Trinity River | Oakwood | 08065000 | 12,833 | C22 | 481 |
| 8TRRO | Trinity River | Romayor | 08066500 | 17,186 | C23 | 481 |
| <u>Neches River Basin (Chapter 9)</u> | | | | | | |
| NENE | Neches River | Neches | 08032000 | 1,145 | C24 | 482 |
| NERO | Neches River | Rockland | 08033500 | 3,631 | C25 | 482 |
| ANAL | Angelina River | Alto | 08036500 | 1,273 | C26 | 483 |
| NEEV | Neches River | Evadale | 08041000 | 7,885 | C27 | 483 |
| VIKO | Village Creek | Kountze | 08041500 | 861 | C28 | 484 |
| <u>Colorado River Basin (Chapter 10)</u> | | | | | | |
| B20000 | Colorado River | Silver | 08123850 | 4,560 | C29 | 485 |
| C30000 | South Concho River | Christoval | 08128000 | 258 | C30 | 485 |
| C10000 | Concho River | Paint Rock | 08136500 | 5,185 | C31 | 486 |
| D40000 | Colorado River | Ballinger | 08126380 | 6,090 | C32 | 486 |
| D30000 | Elm Creek | Ballinger | 08127000 | 464 | C33 | 487 |
| E10000 | San Saba River | San Saba | 08146000 | 3,048 | C34 | 487 |
| F20000 | Pecan Bayou | Mullin | 08143600 | 2,074 | C35 | 488 |
| F10000 | Colorado River | San Saba | 08147000 | 19,830 | C36 | 488 |
| G10000 | Llano River | Llano | 08151500 | 4,201 | C37 | 489 |
| H10000 | Pedernales River | Johnson City | 08153500 | 901 | C38 | 489 |
| J50000 | Onion Creek | Driftwood | 08158700 | 124 | C39 | 490 |
| J30000 | Colorado River | Bastrop | 08159200 | 28,580 | C40 | 490 |
| J10000 | Colorado River | Columbus | 08161000 | 30,244 | C41 | 491 |
| K20000 | Colorado River | Wharton | 08162000 | 30,601 | C42 | 491 |
| <u>Lavaca River Basin (Chapter 11)</u> | | | | | | |
| GS300 | Lavaca River | Edna | 08164000 | 817 | C43 | 492 |
| DV501 | Navidad River | Edna | 08164390 | 579 | C44 | 492 |
| GS1000 | Sandy Creek | Ganado | 08164450 | 289 | C45 | 493 |
| WGS800 | West Mustang Creek | Ganado | 08164503 | 178 | C46 | 493 |
| ECB720 | East Mustang Creek | Louise | 08164504 | 53.9 | C47 | 494 |
| <u>Nueces River Basin (Chapter 12)</u> | | | | | | |
| CP01 | Nueces River | Laguna | 08190000 | 737 | C48 | 495 |
| CP02 | West Nueces River | Bracketville | 08190500 | 694 | C49 | 495 |
| CP03 | Nueces River | Uvalde | 08192000 | 1,861 | C50 | 496 |
| CP05 | Nueces River | Cotulla | 08194000 | 5,171 | C51 | 496 |
| CP06 | Nueces River | Tilden | 08194500 | 8,093 | C52 | 497 |

| | | | | | | |
|--------|------------------|--------------|----------|--------|-----|-----|
| CP07 | Frio River | Concan | 08195000 | 389 | C53 | 497 |
| CP08 | Dry Frio River | Reagan Wells | 08196000 | 126 | C54 | 498 |
| CP12 | Sabinal River | Sabinal | 08198000 | 206 | C55 | 498 |
| CP13 | Sabinal River | Sabinal | 08198500 | 241 | C56 | 499 |
| CP16 | Seco Creek | Utopia | 08201500 | 45.0 | C57 | 499 |
| CP18 | Hondo Creek | Tarpley | 08200000 | 95.6 | C58 | 500 |
| CP25 | Frio River | Derby | 08205500 | 3,429 | C59 | 500 |
| 320603 | Frio River | Tilden | 08206600 | 4,493 | C60 | 501 |
| CP26 | San Miguel Creek | Tilden | 08206700 | 783 | C61 | 501 |
| CP28 | Atascosa River | Whitsett | 08208000 | 1,171 | C62 | 502 |
| CP29 | Nueces River | Three Rivers | 08210000 | 15,427 | C63 | 502 |
| CP30 | Nueces River | Mathis | 08211000 | 16,660 | C64 | 503 |

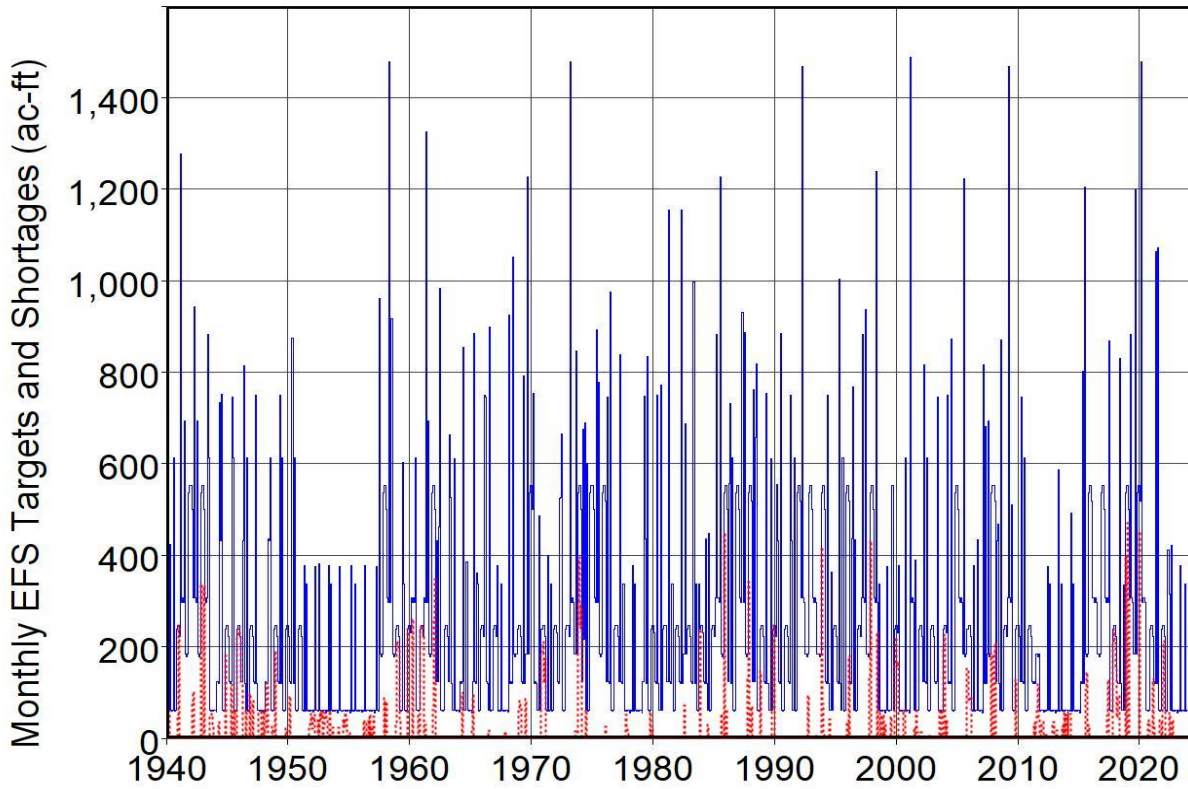


Figure C1 SB3 EFS Targets and Shortages for Salt Fork of Brazos River at Aspermont

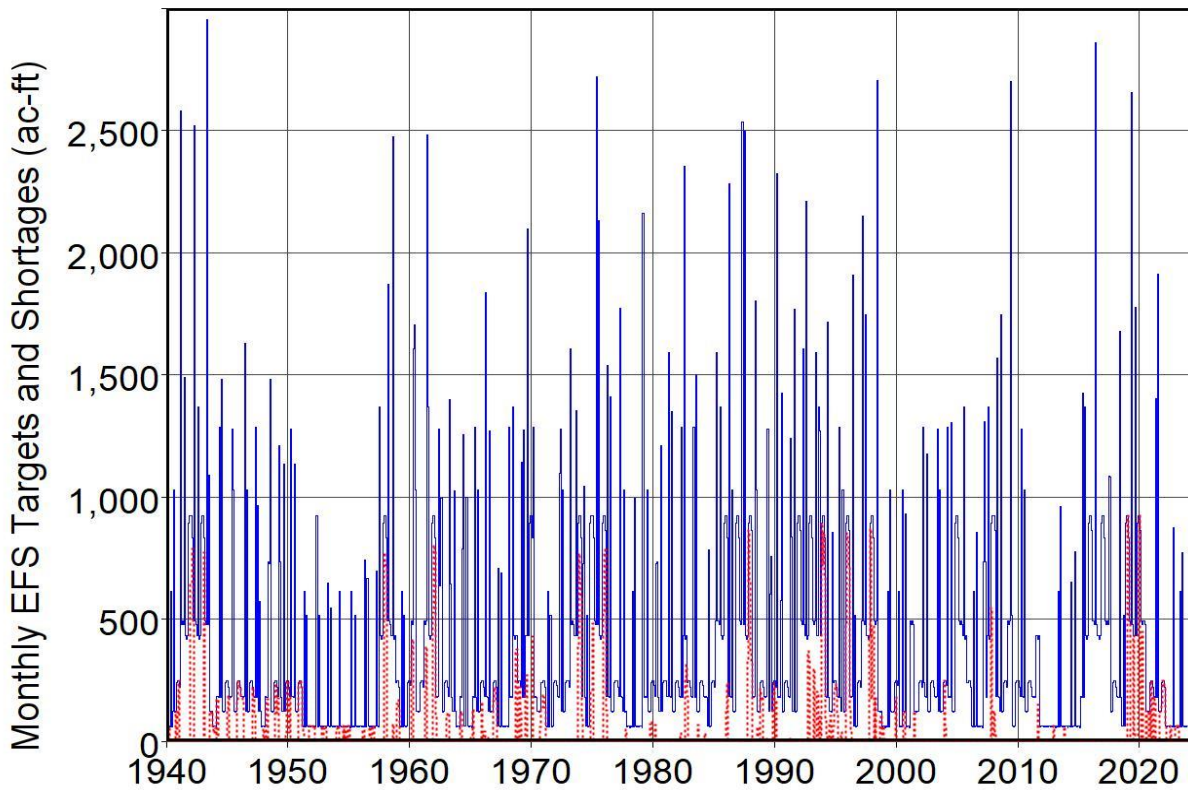


Figure C2 SB3 EFS Targets and Shortages for Double Mountain Fork at Aspermont

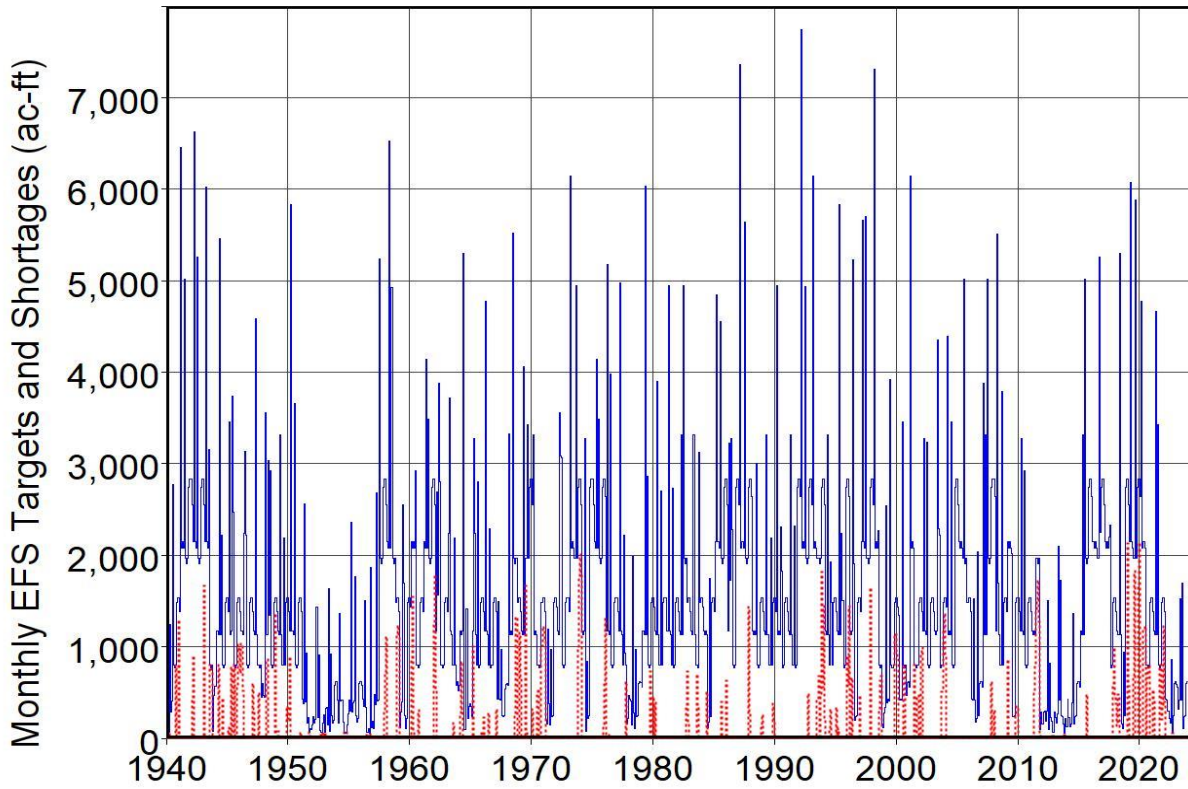


Figure C3 SB3 EFS Targets and Shortages for Brazos River at Seymour

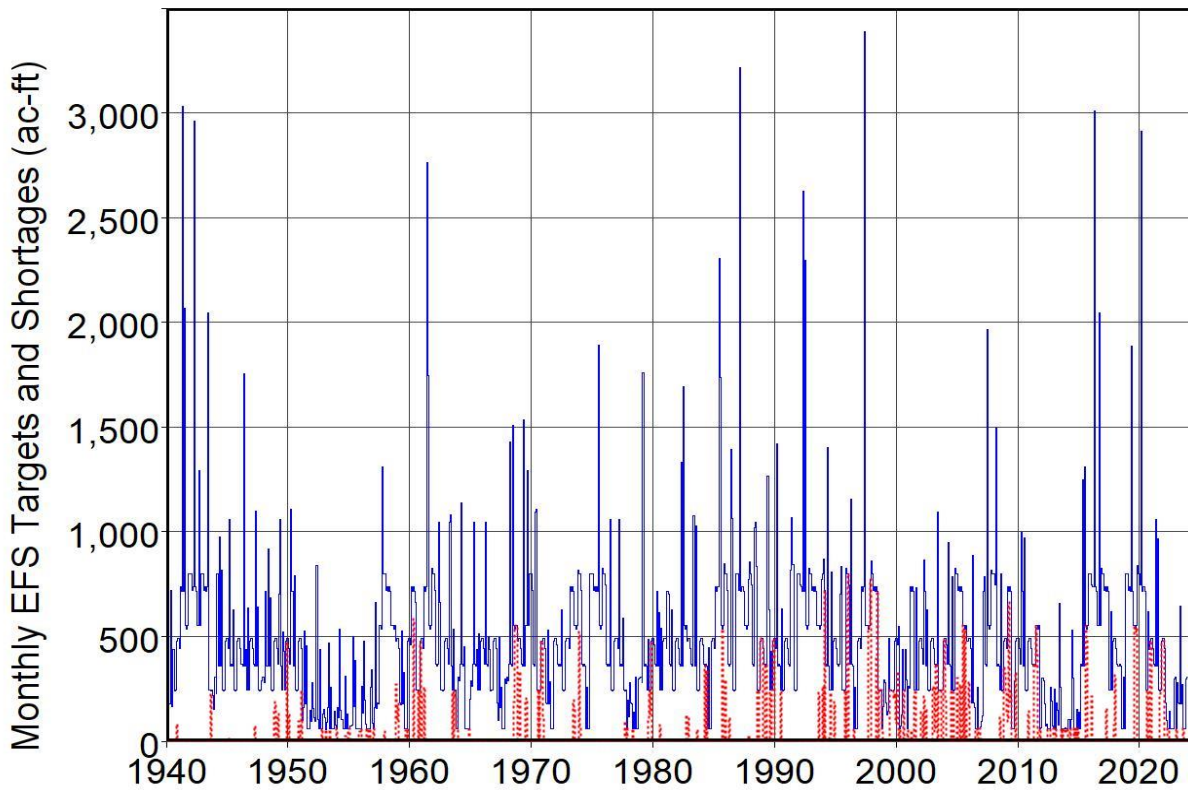


Figure C4 SB3 EFS Targets and Shortages for Clear Fork of Brazos River at Nugent

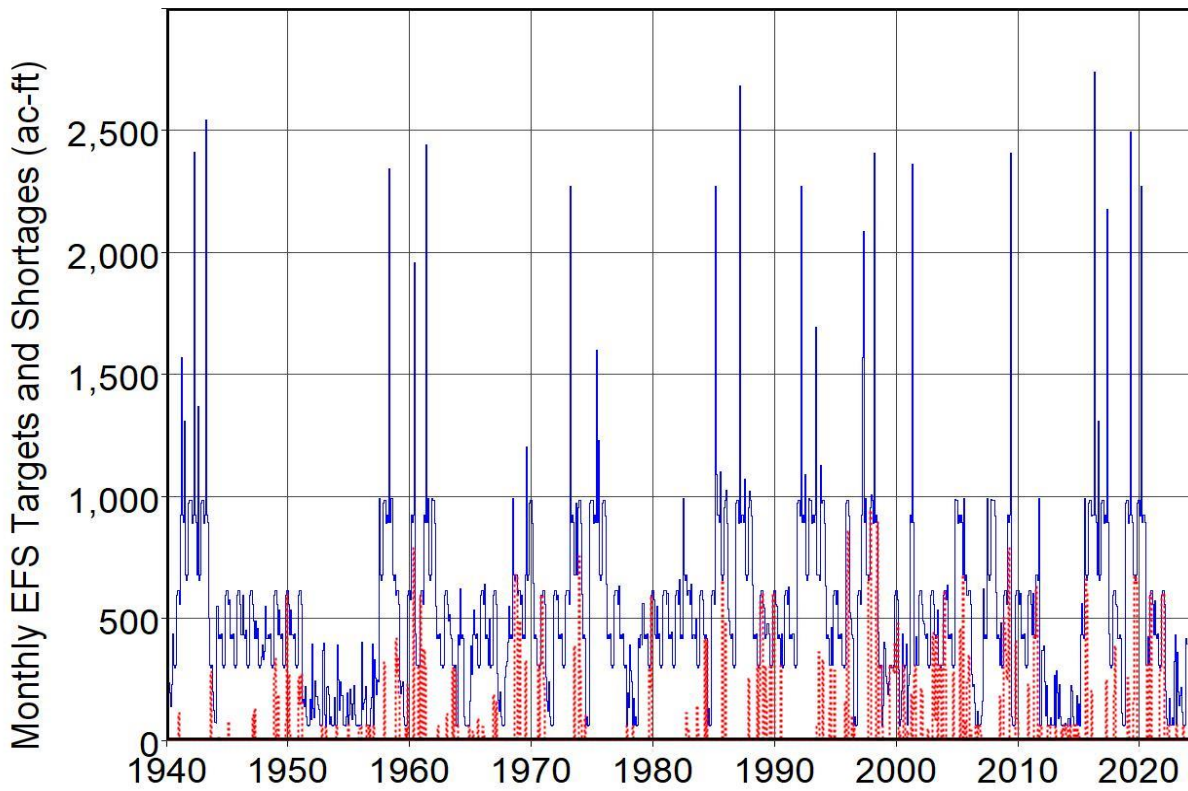


Figure C5 SB3 EFS Targets and Shortages for Clear Fork of Brazos River at Lueders

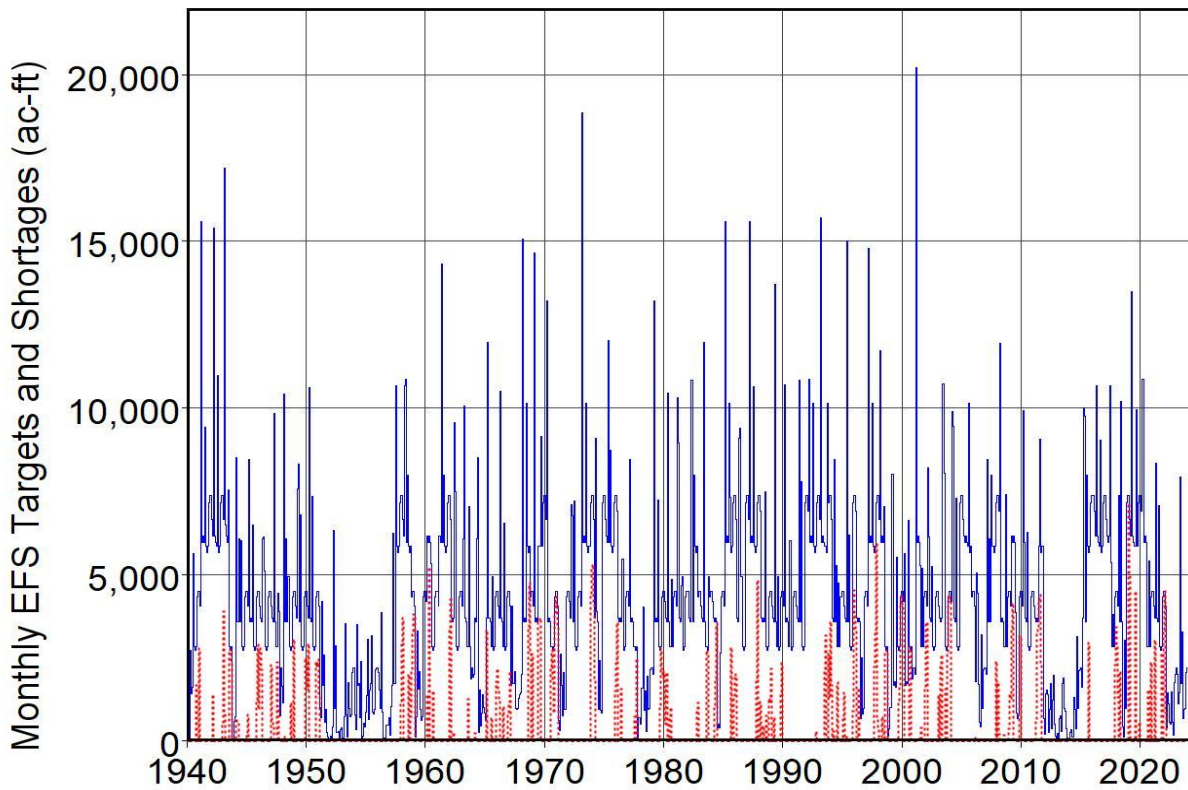


Figure C6 SB3 EFS Targets and Shortages for Brazos River at South Bend

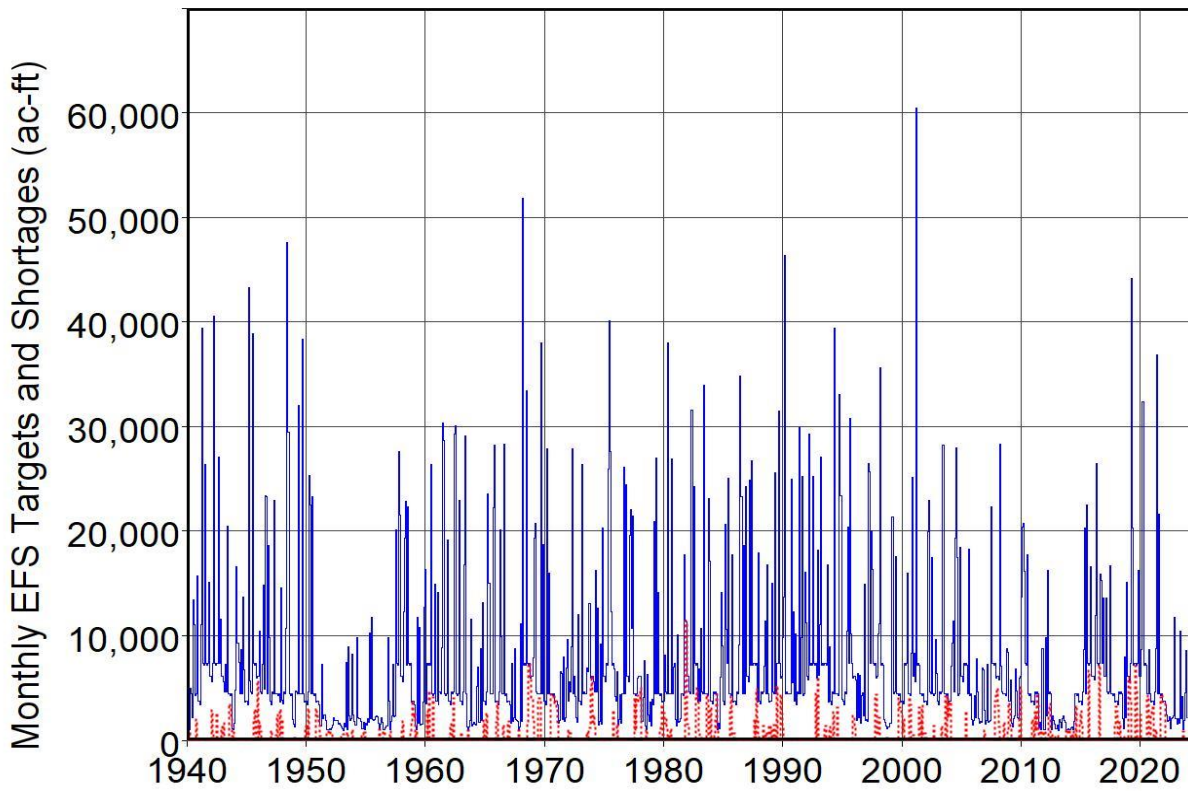


Figure C7 SB3 EFS Targets and Shortages for Brazos River at Palo Pinto

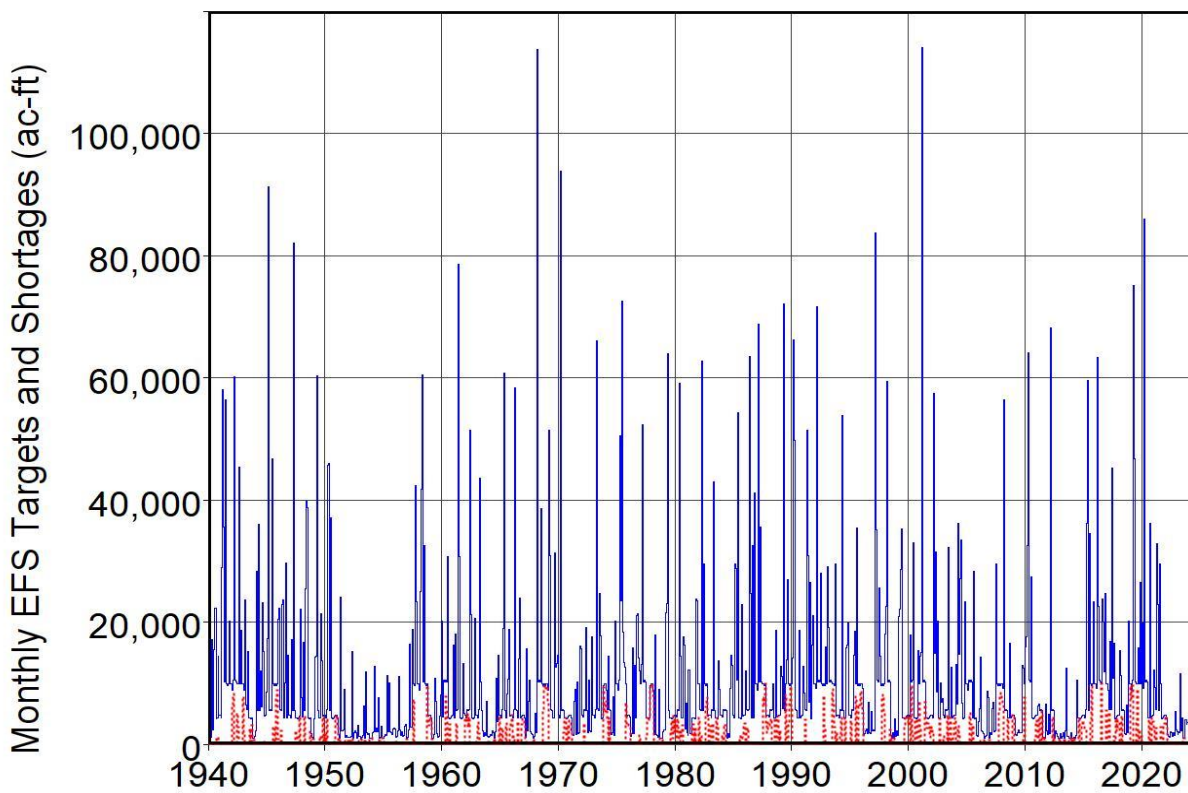


Figure C8 SB3 EFS Targets and Shortages for Brazos River at Glen Rose

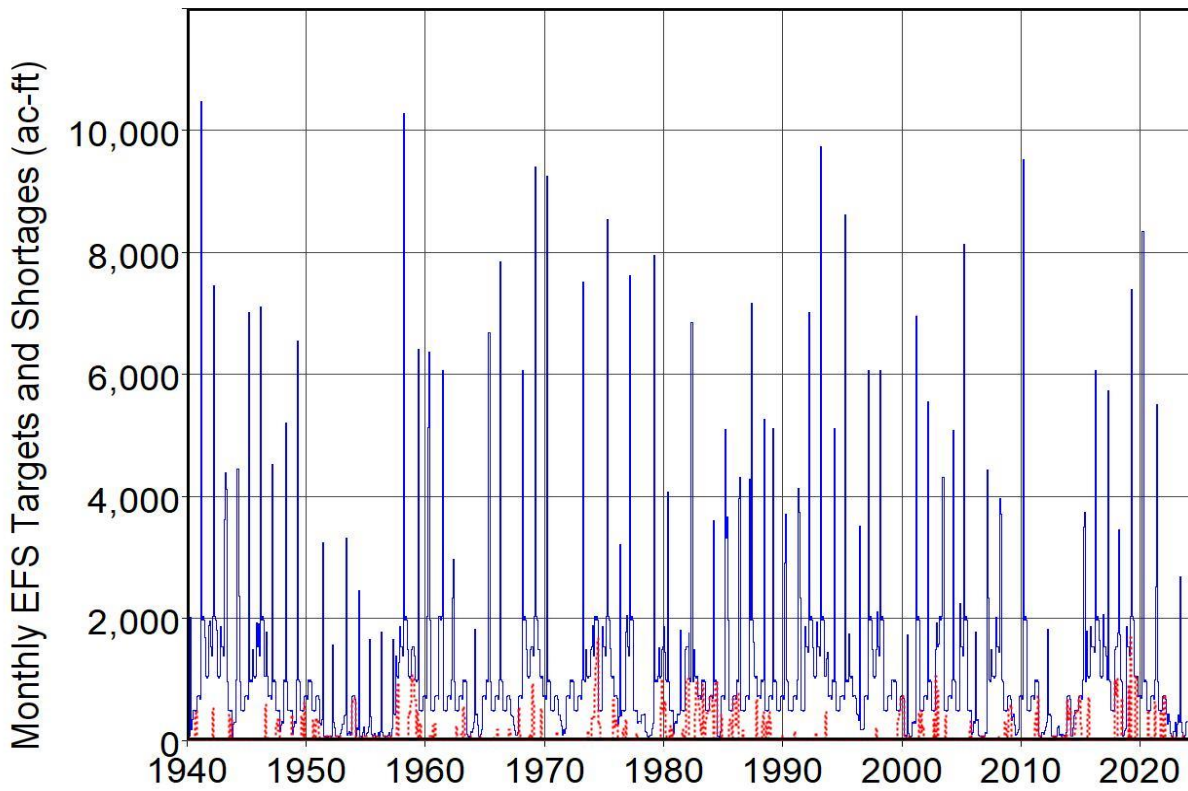


Figure C9 SB3 EFS Targets and Shortages for North Bosque River at Clifton

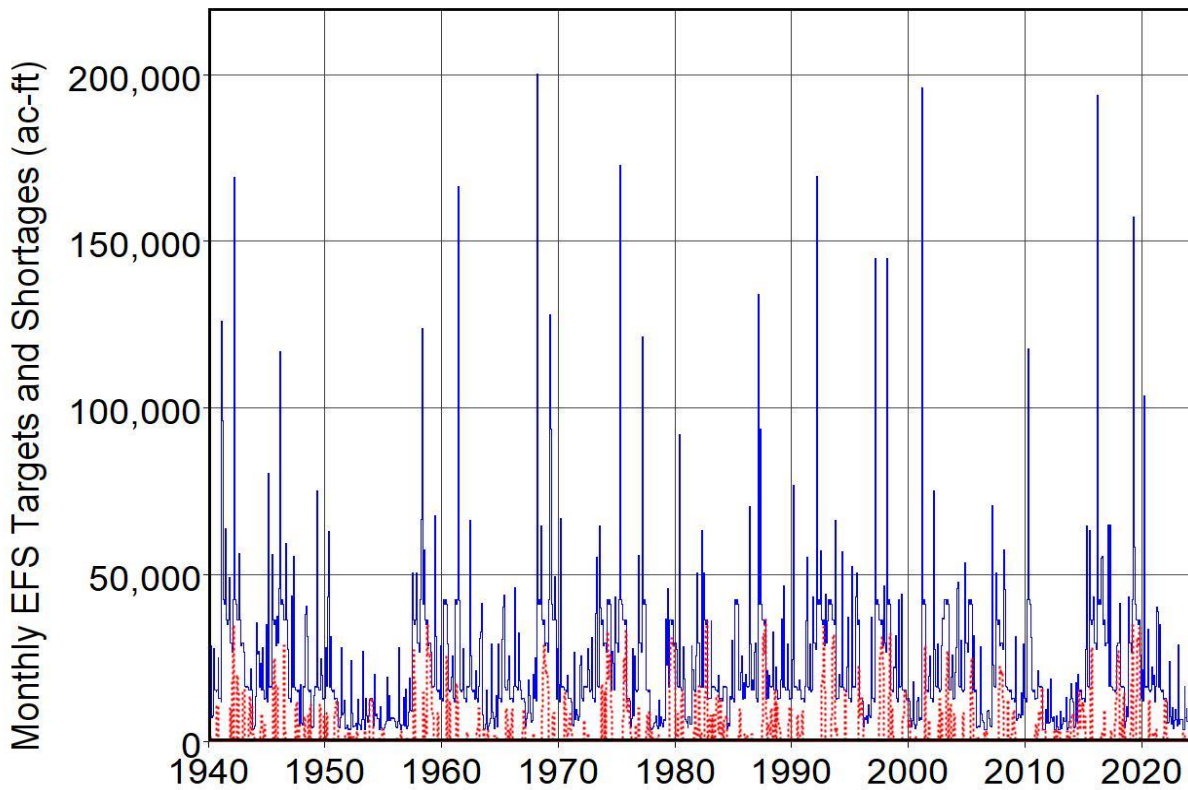


Figure C10 SB3 EFS Targets and Shortages for Brazos River at Waco

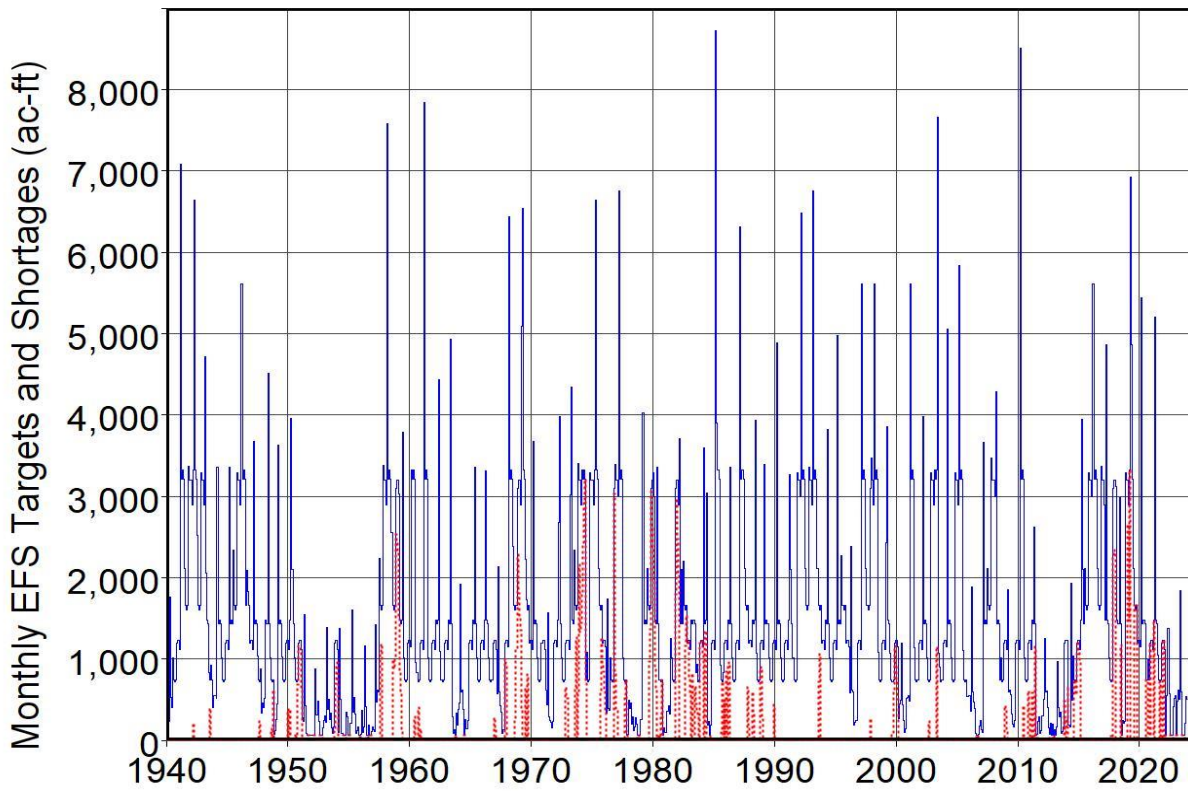


Figure C11 SB3 EFS Targets and Shortages for Leon River at Gatesville

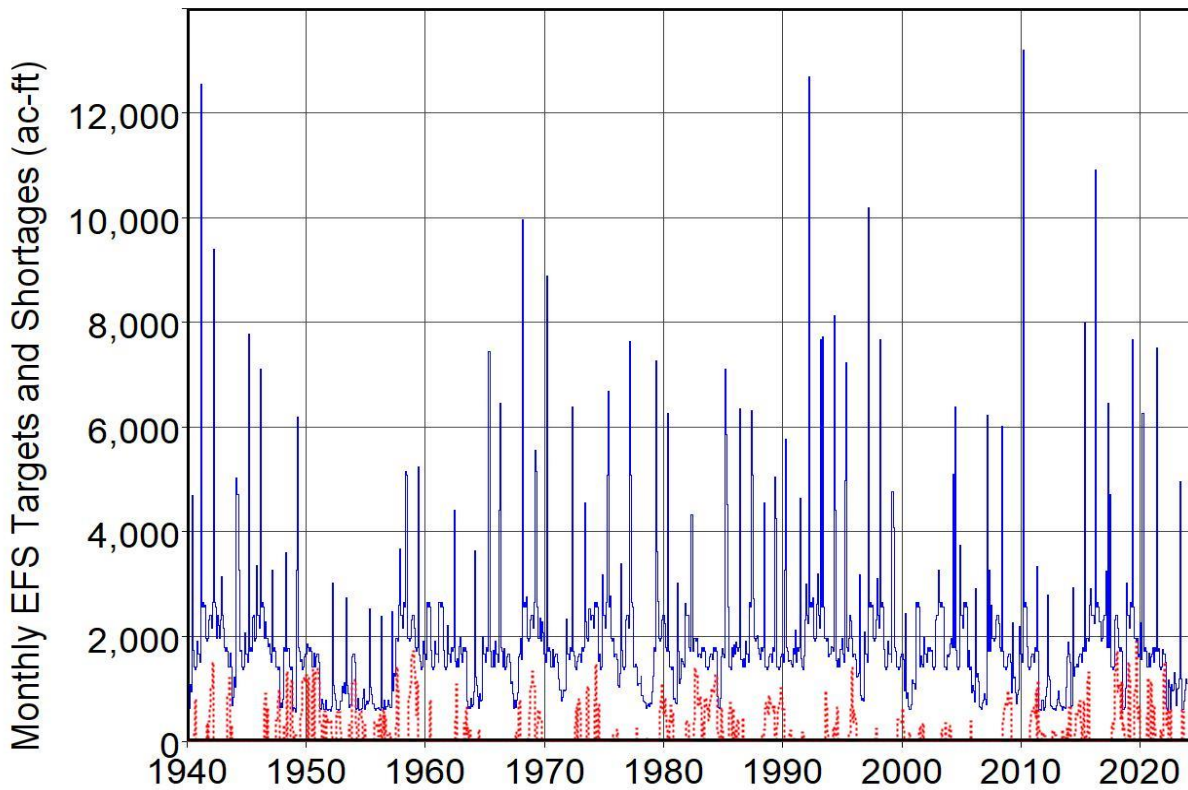


Figure C12 SB3 EFS Targets and Shortages for Lampasas River at Kepner

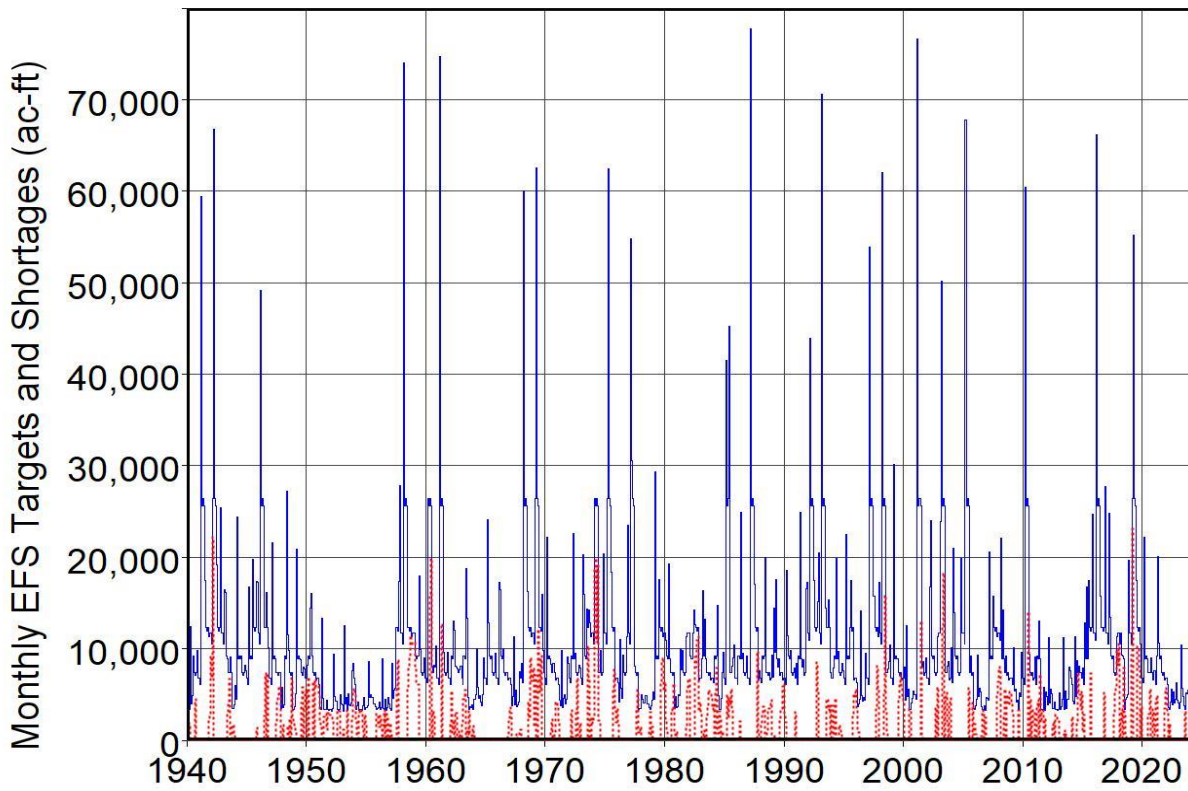


Figure C13 SB3 EFS Targets and Shortages for Little River at Little River

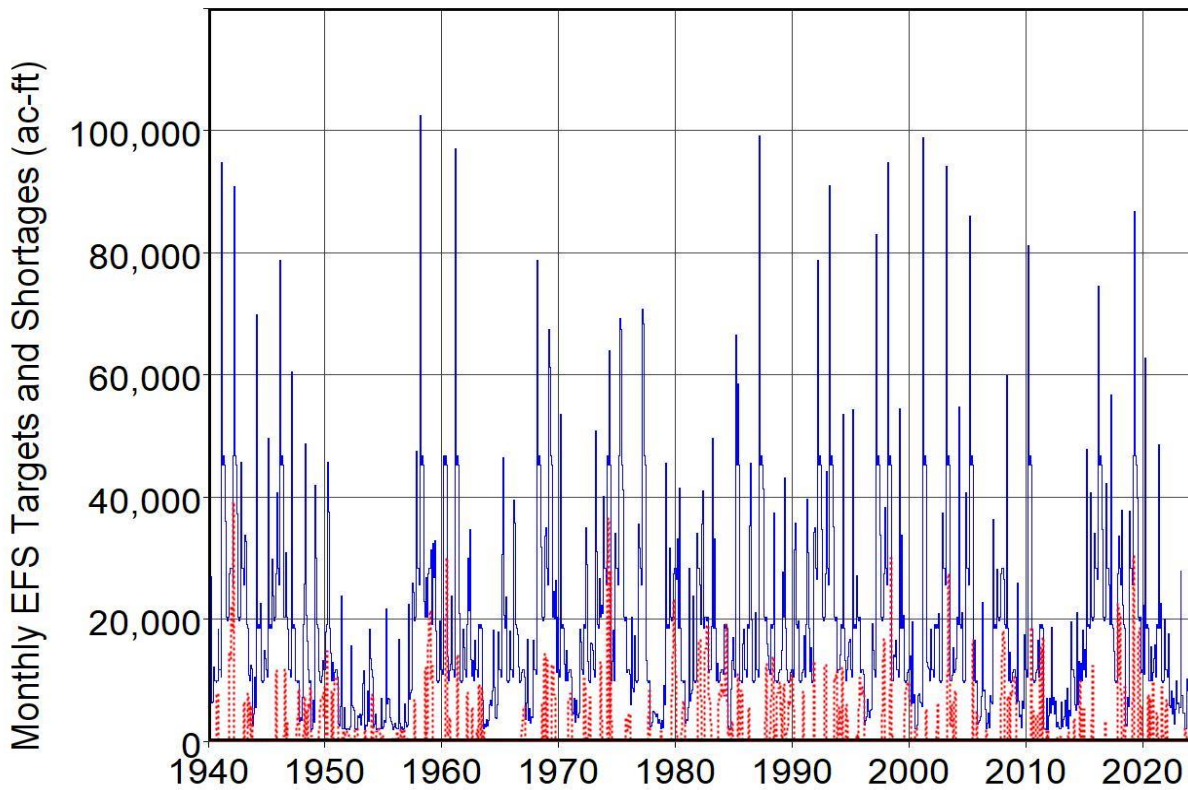


Figure C14 SB3 EFS Targets and Shortages for Little River at Cameron

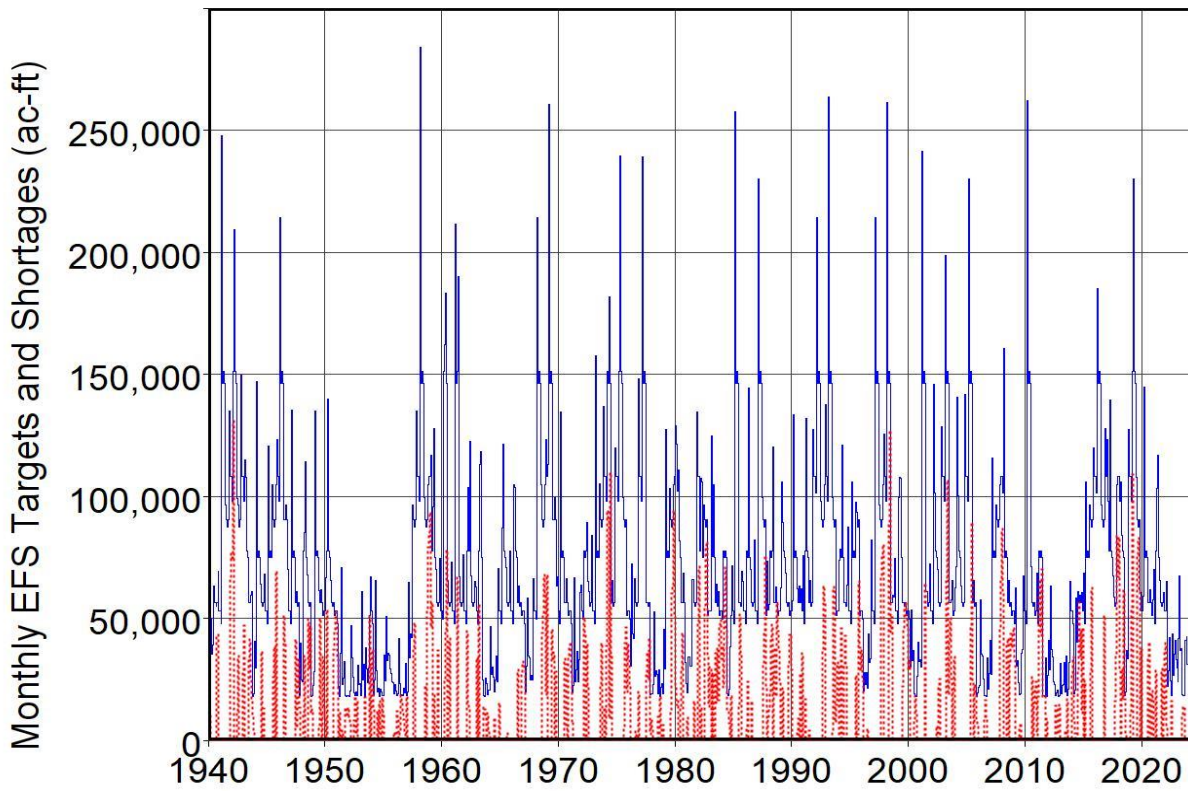


Figure C15 SB3 EFS Targets and Shortages for Brazos River at Bryan

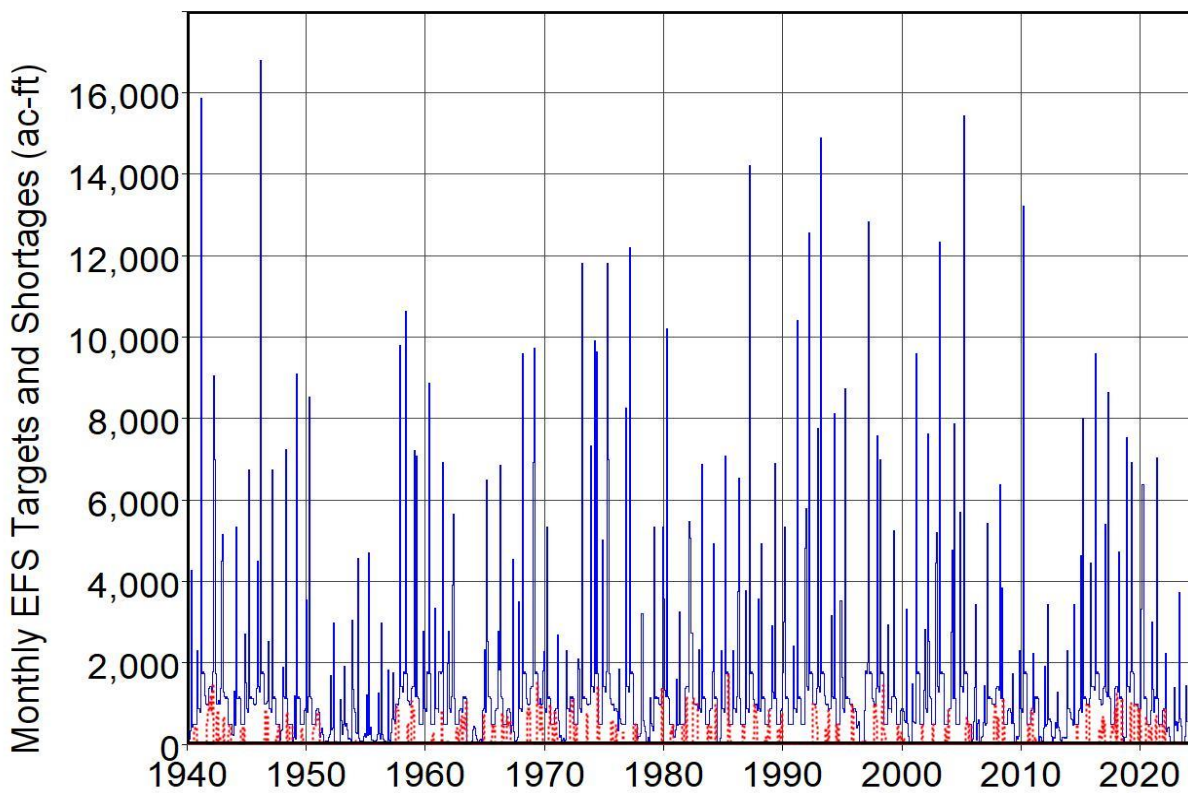


Figure C16 SB3 EFS Targets and Shortages for Navasota River at Easterly

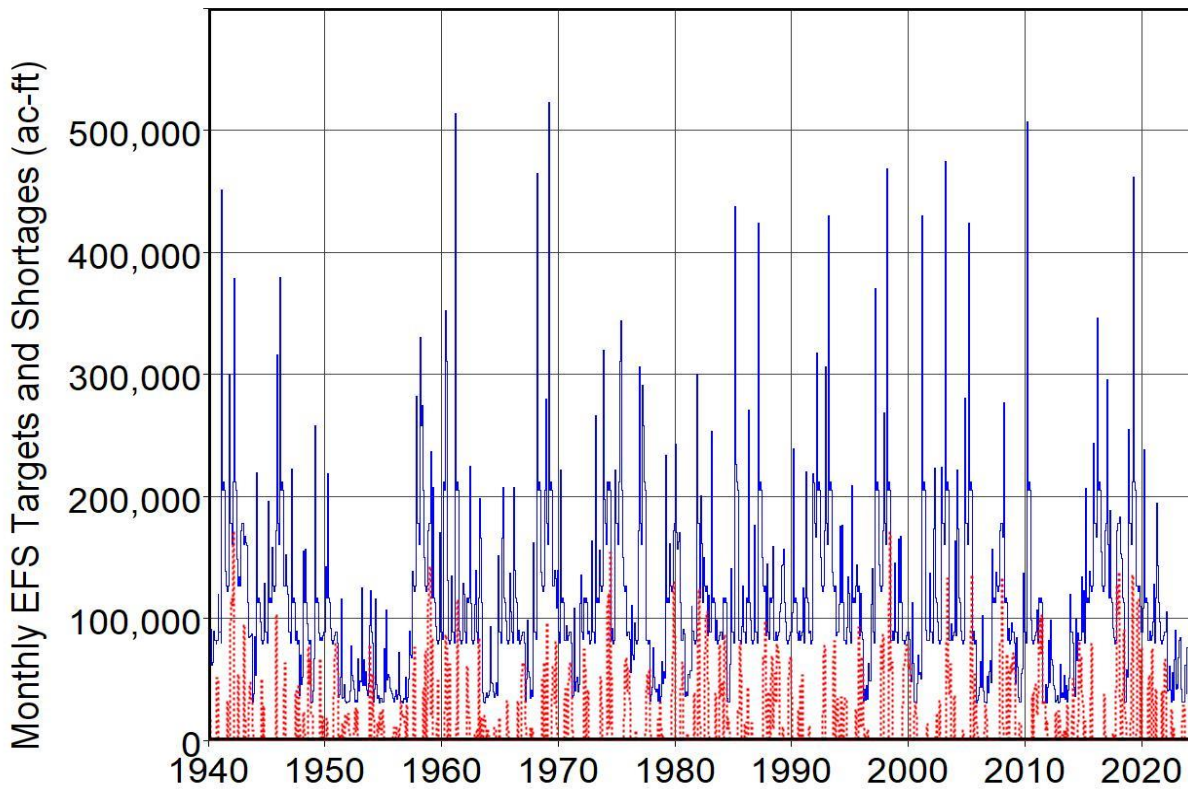


Figure C17 SB3 EFS Targets and Shortages for Brazos River at Hempstead

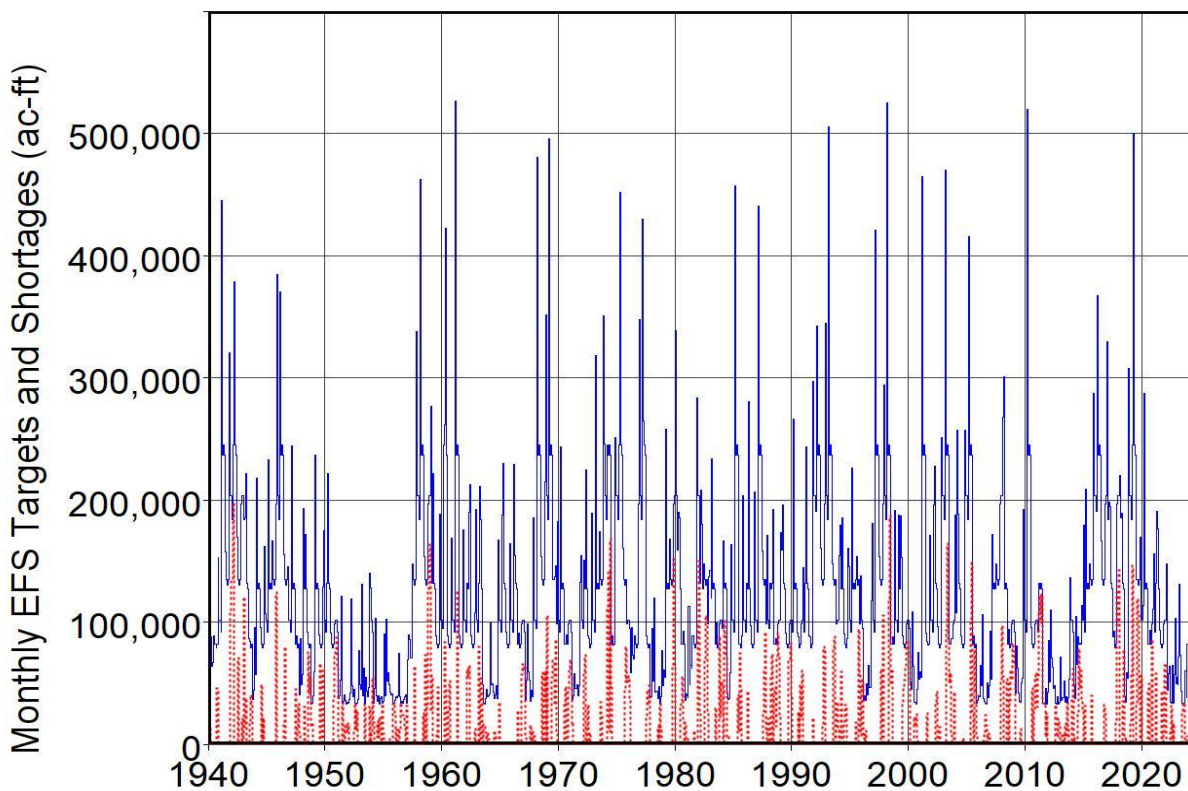


Figure C18 SB3 EFS Targets and Shortages for Brazos River at Richmond

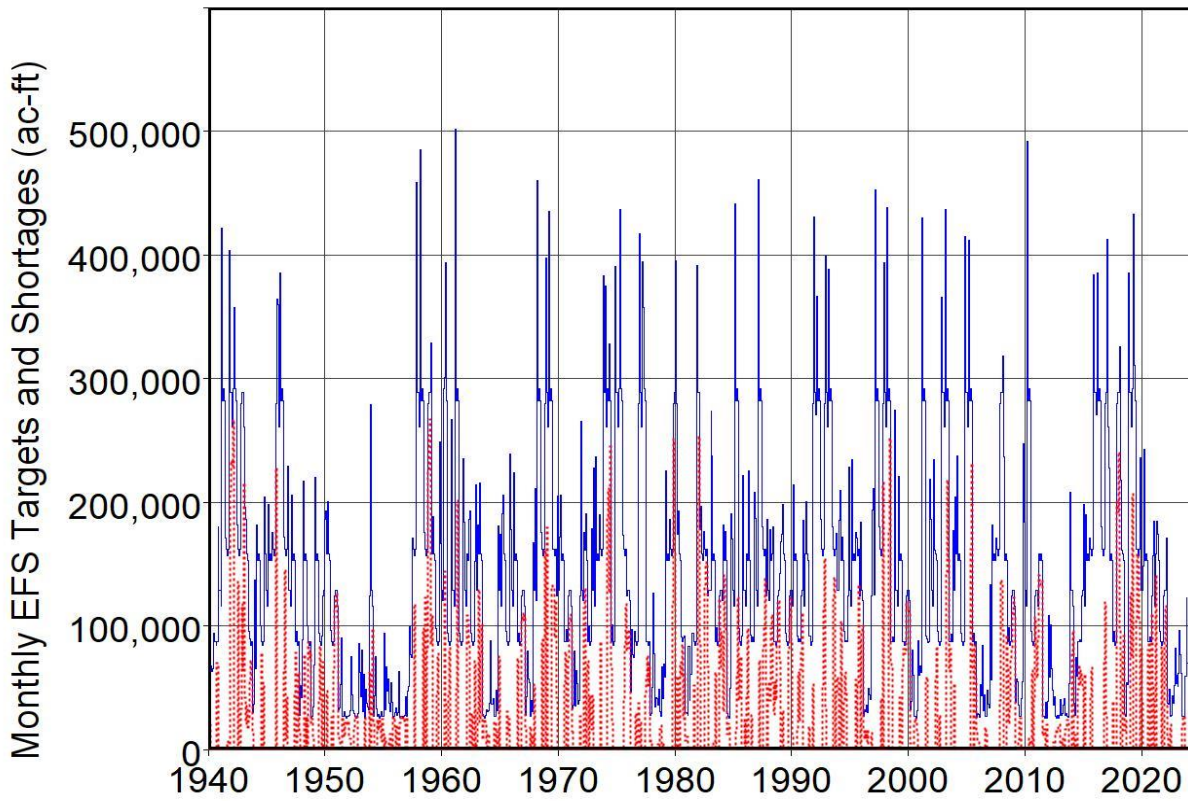


Figure C19 SB3 EFS Targets and Shortages for Brazos River at Rosharon

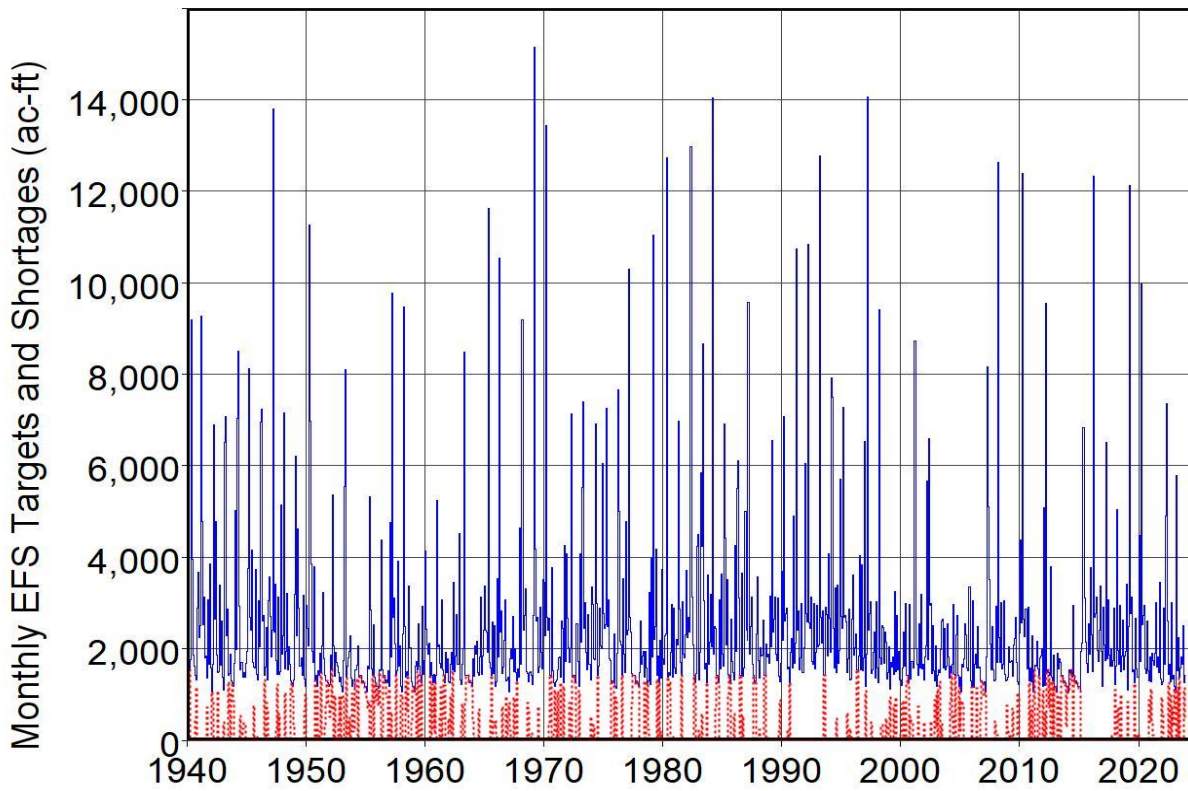


Figure C20 SB3 EFS Targets and Shortages for West Fork the Trinity River at Grand Prairie

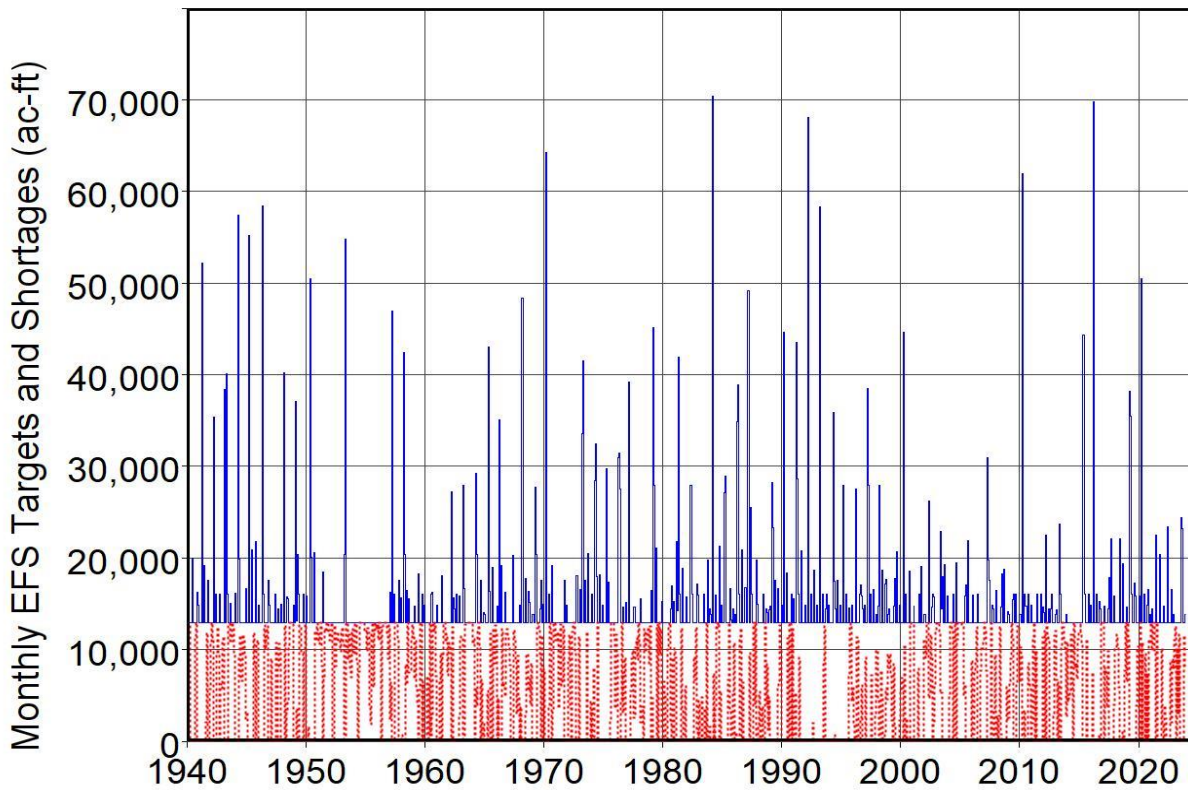


Figure C21 SB3 EFS Targets and Shortages for the Trinity River at Dallas

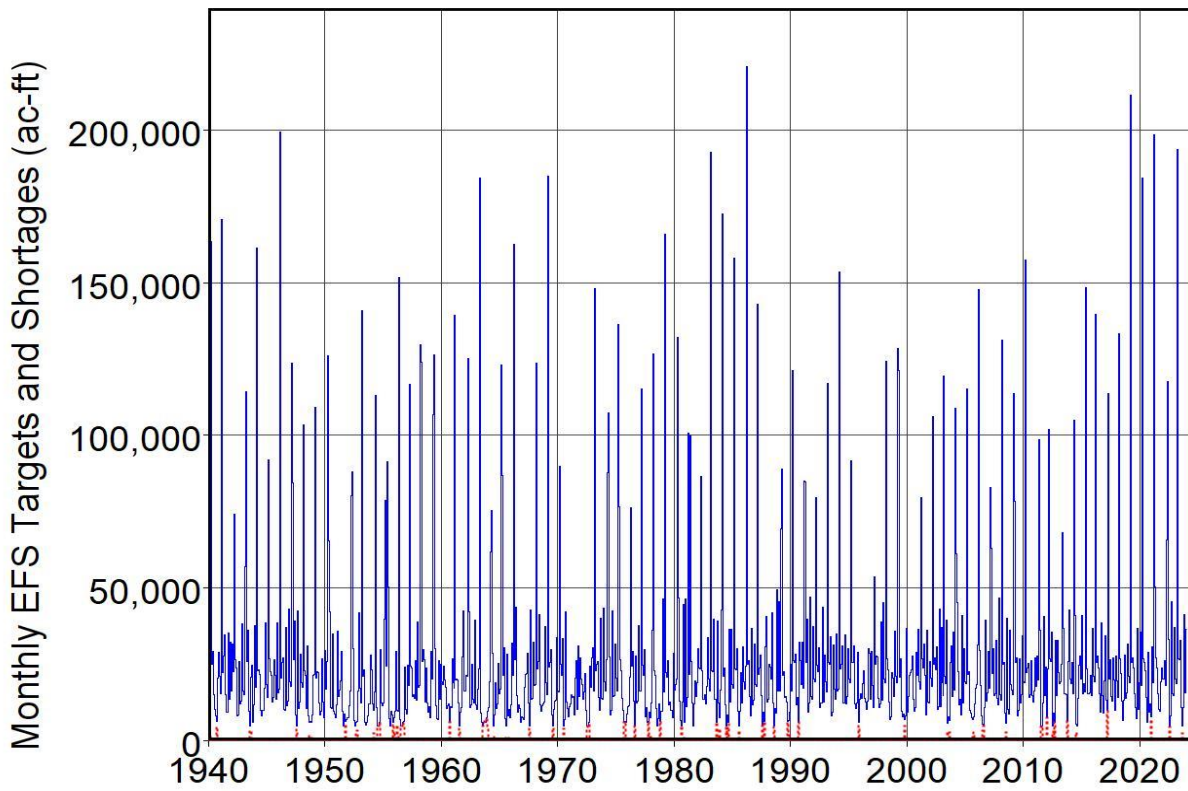


Figure C22 SB3 EFS Targets and Shortages for the Trinity River at Oakwood

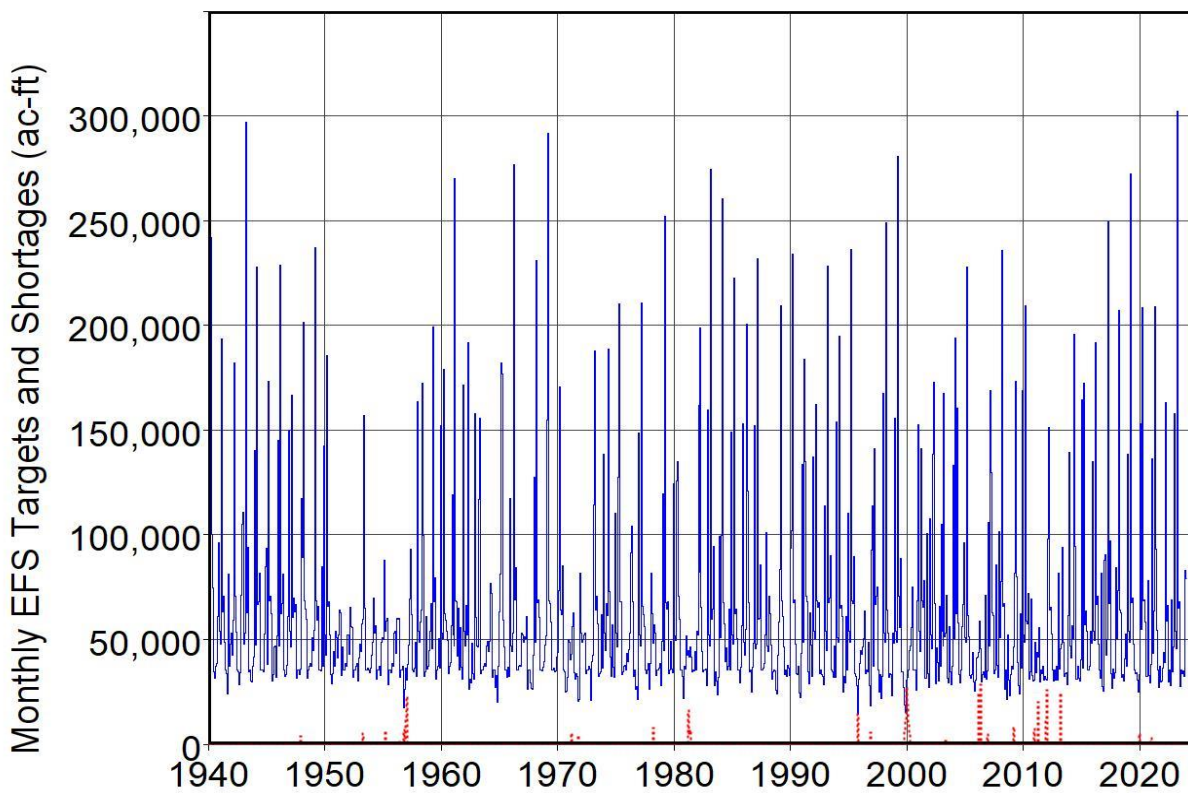


Figure C23 SB3 EFS Targets and Shortages for the Trinity River at Romayor

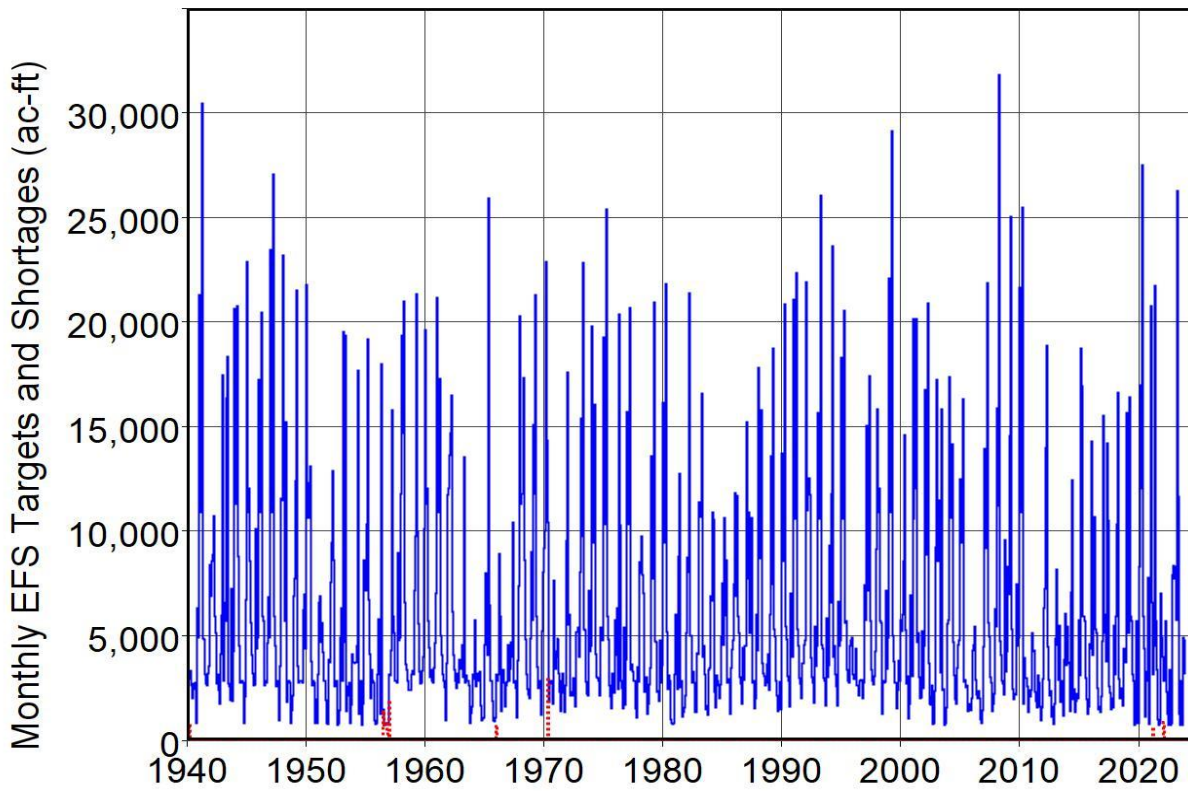


Figure C24 SB3 EFS Targets and Shortages for the Neches River at Neches

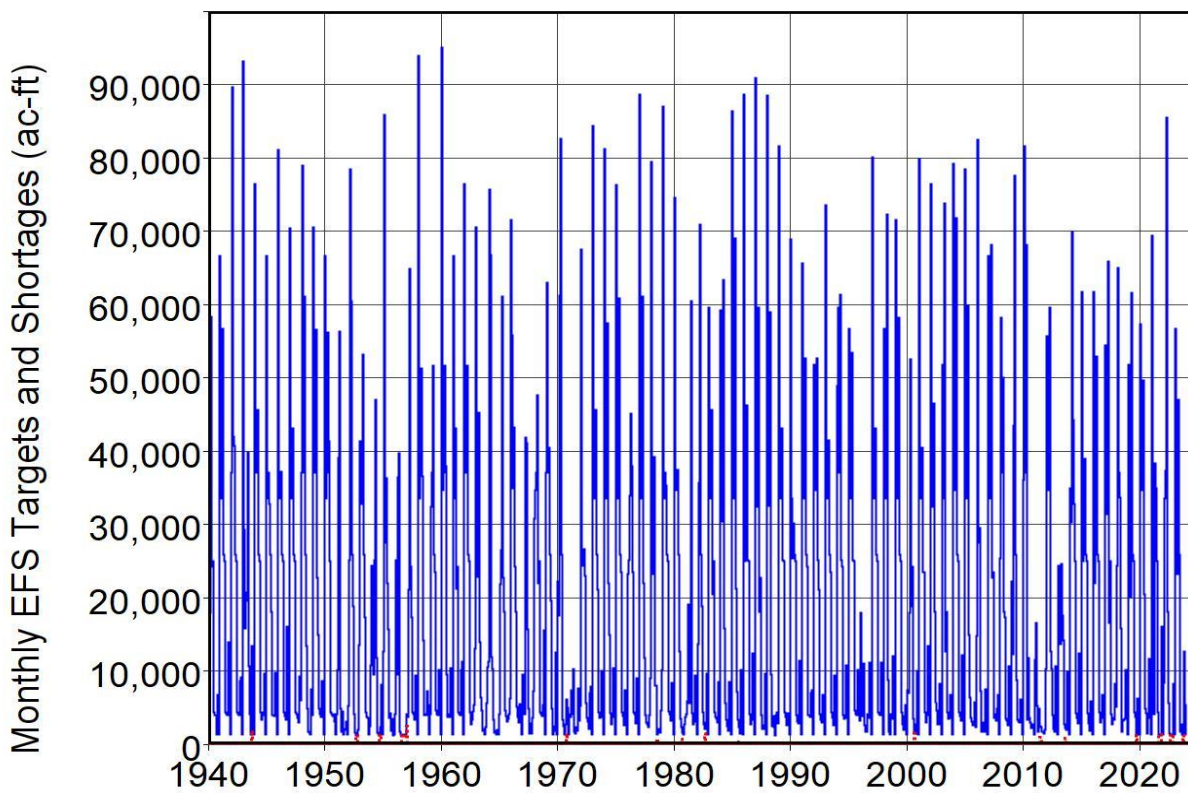


Figure C25 SB3 EFS Targets and Shortages for the Neches River near Rockland

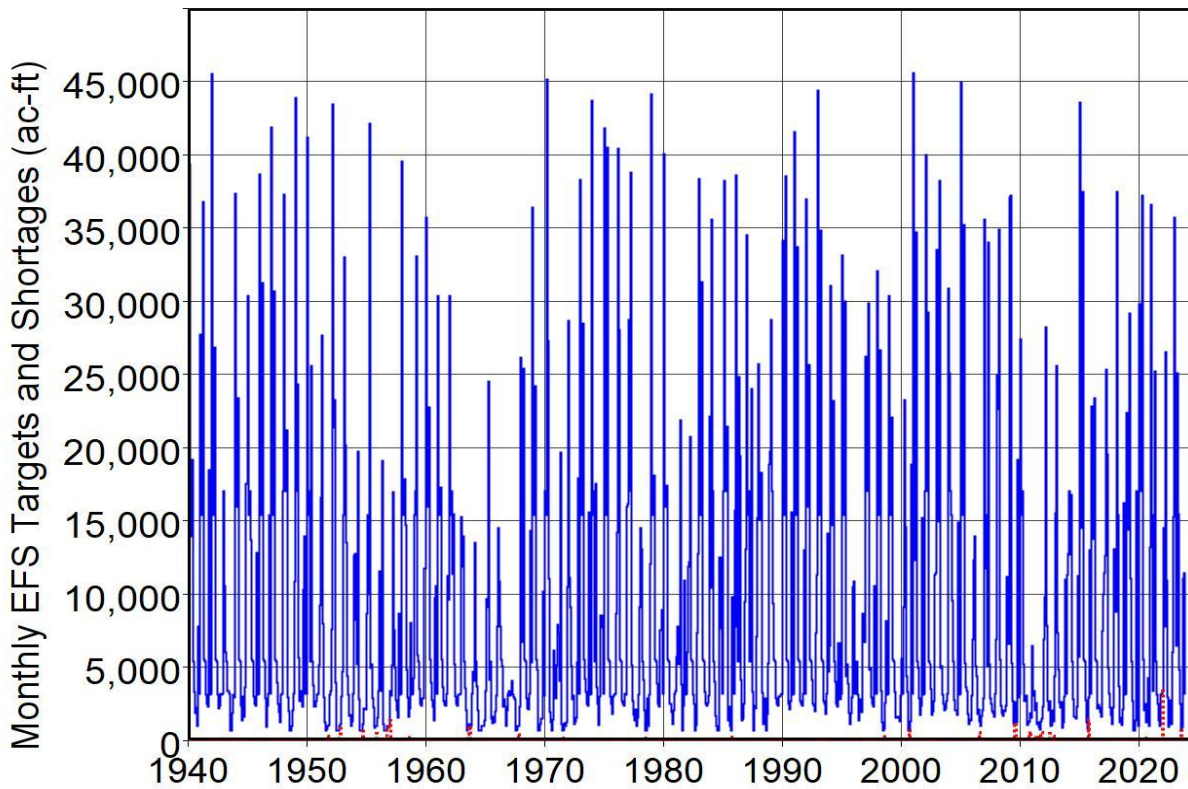


Figure C26 SB3 EFS Targets and Shortages for the Angelina River near Alto

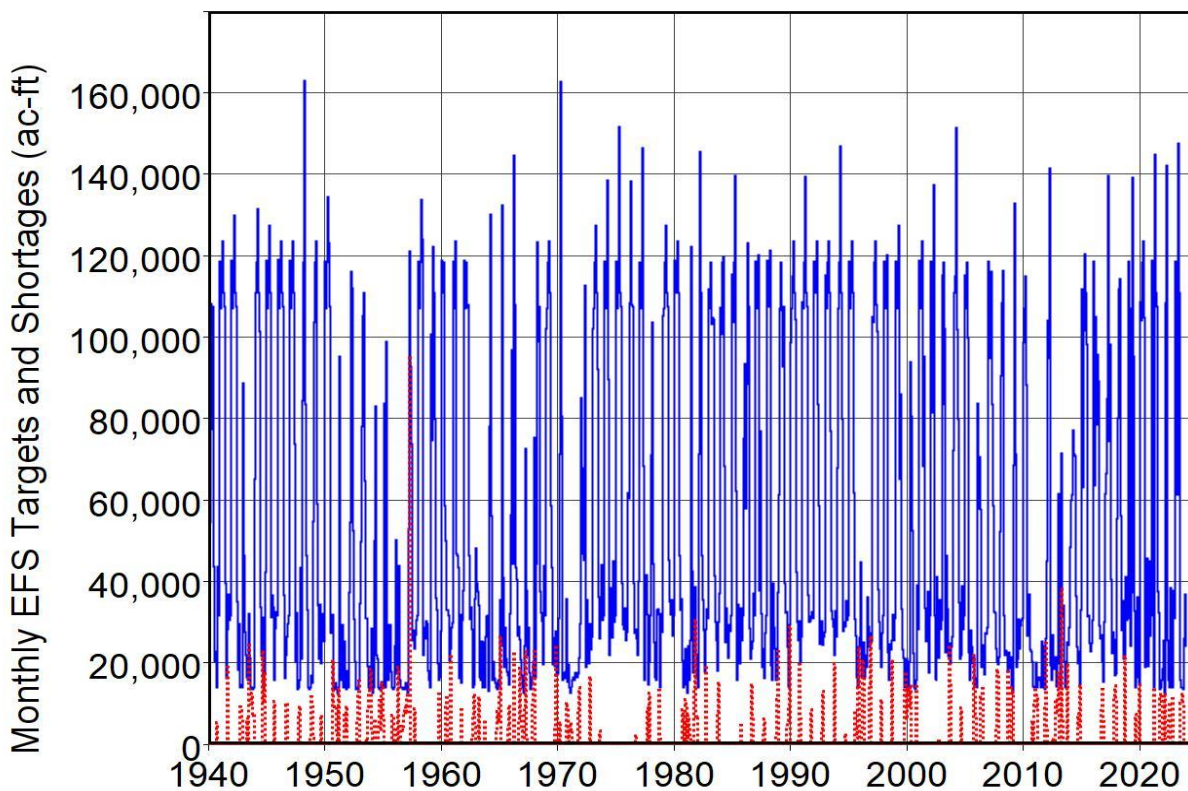


Figure C27 SB3 EFS Targets and Shortages for the Neches River at Evadale

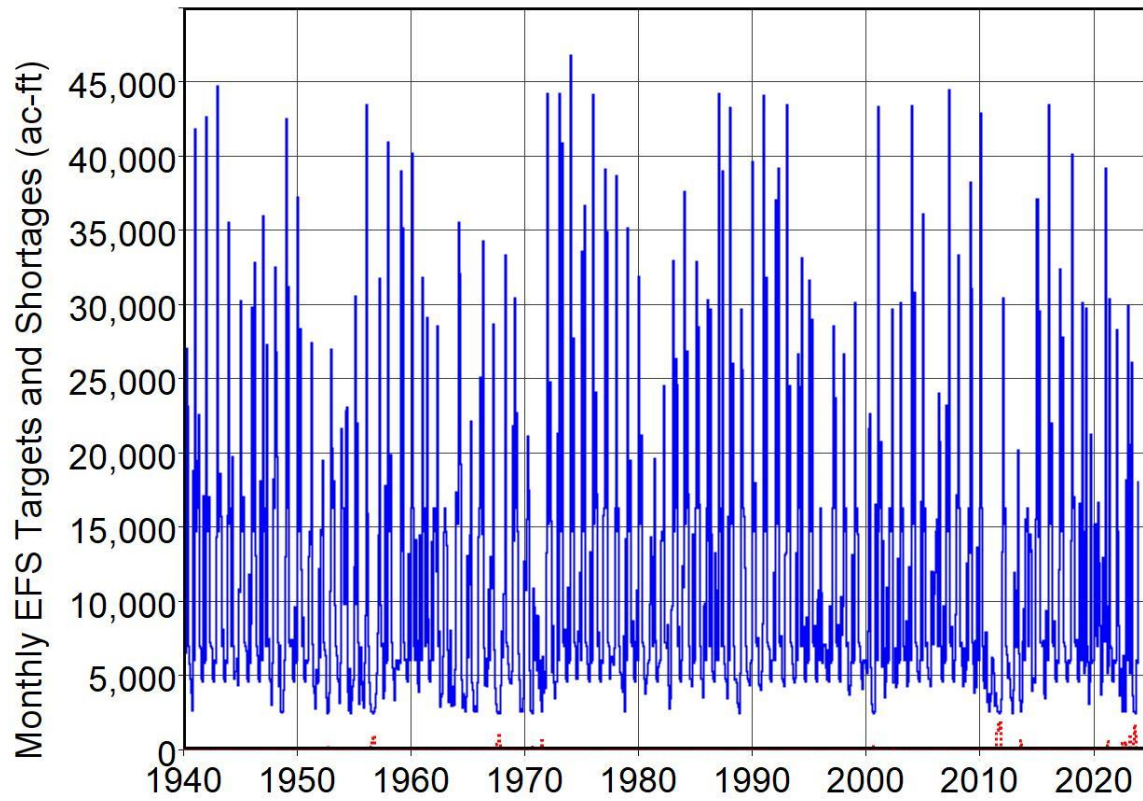


Figure C28 SB3 EFS Targets and Shortages for Village Creek near Kountze

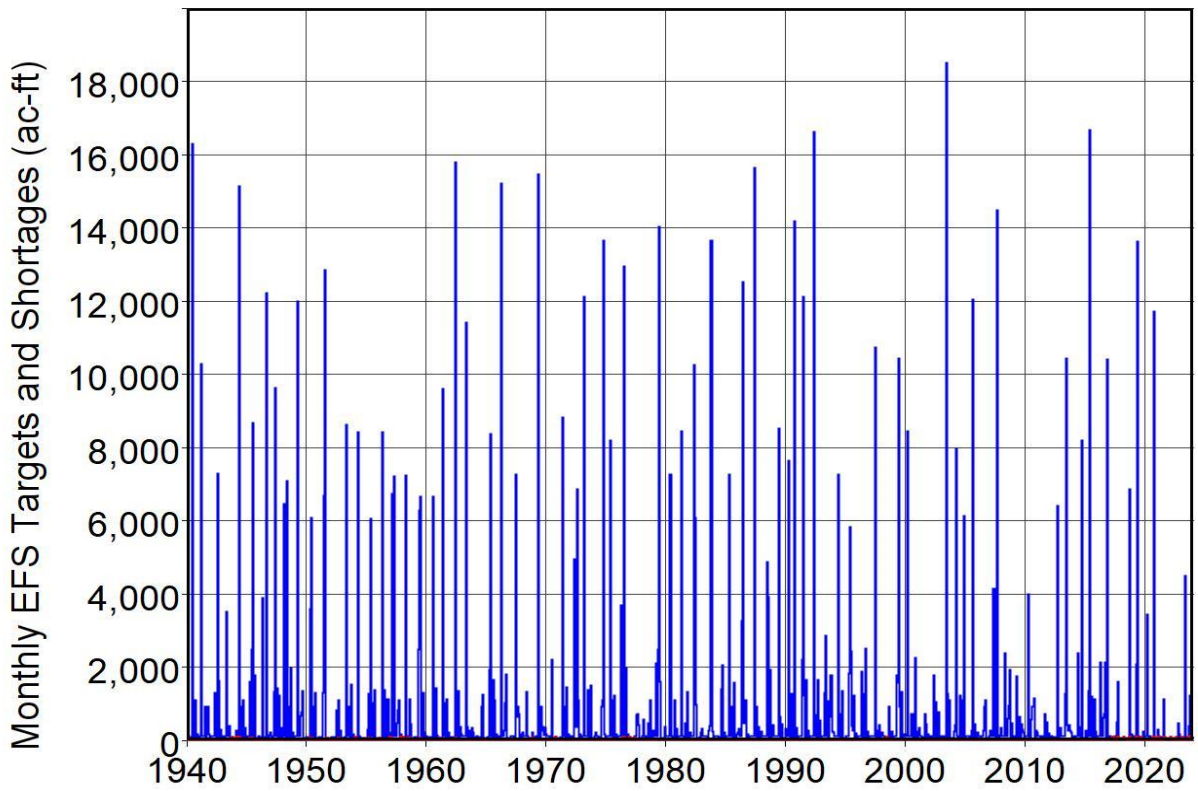


Figure C29 SB3 EFS Targets and Shortages for Colorado River above Silver

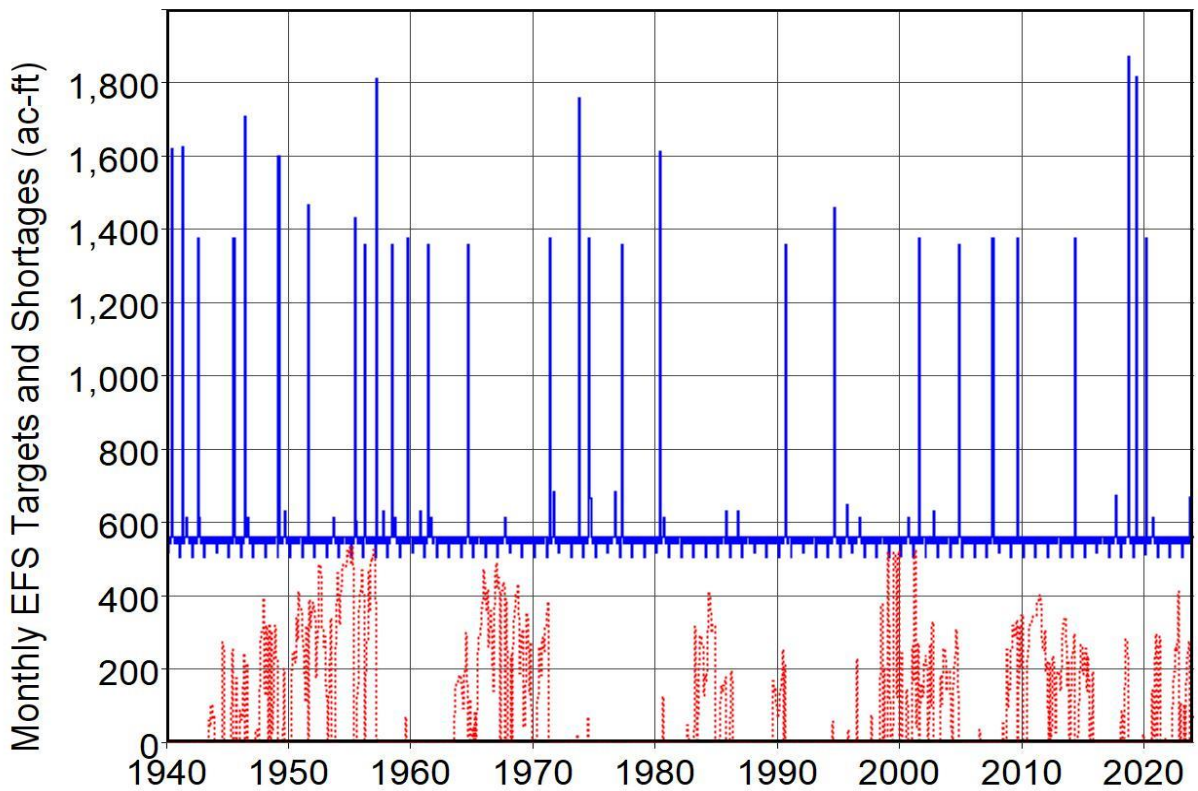


Figure C30 SB3 EFS Targets and Shortages for South Concho River at Christoval

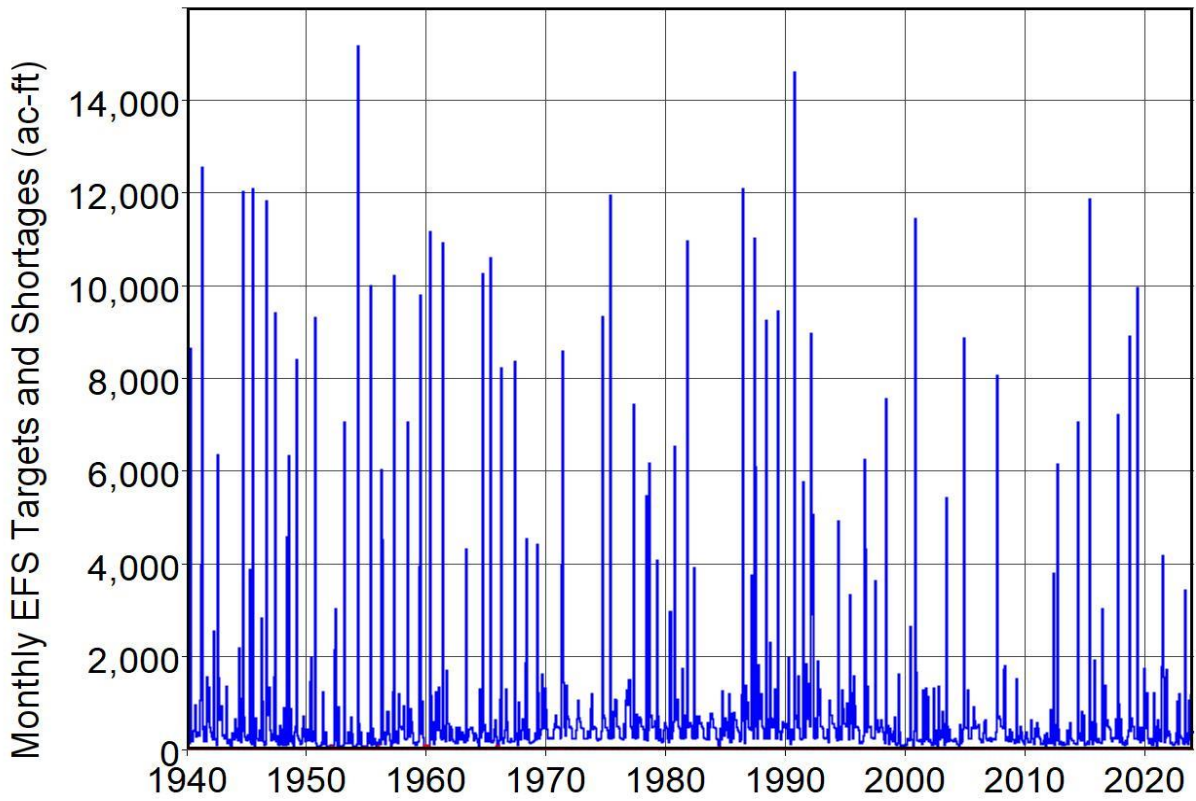


Figure C31 SB3 EFS Targets and Shortages for Concho River at Paint Rock

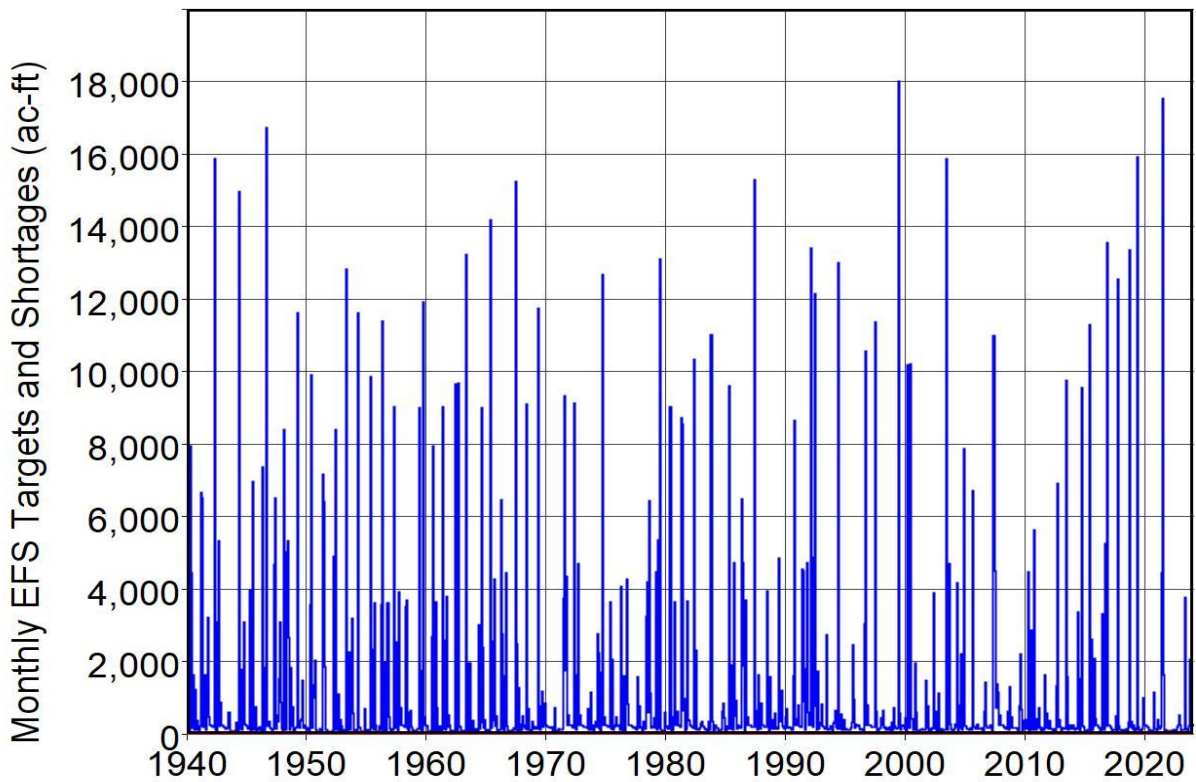


Figure C32 SB3 EFS Targets and Shortages for Colorado River near Ballinger

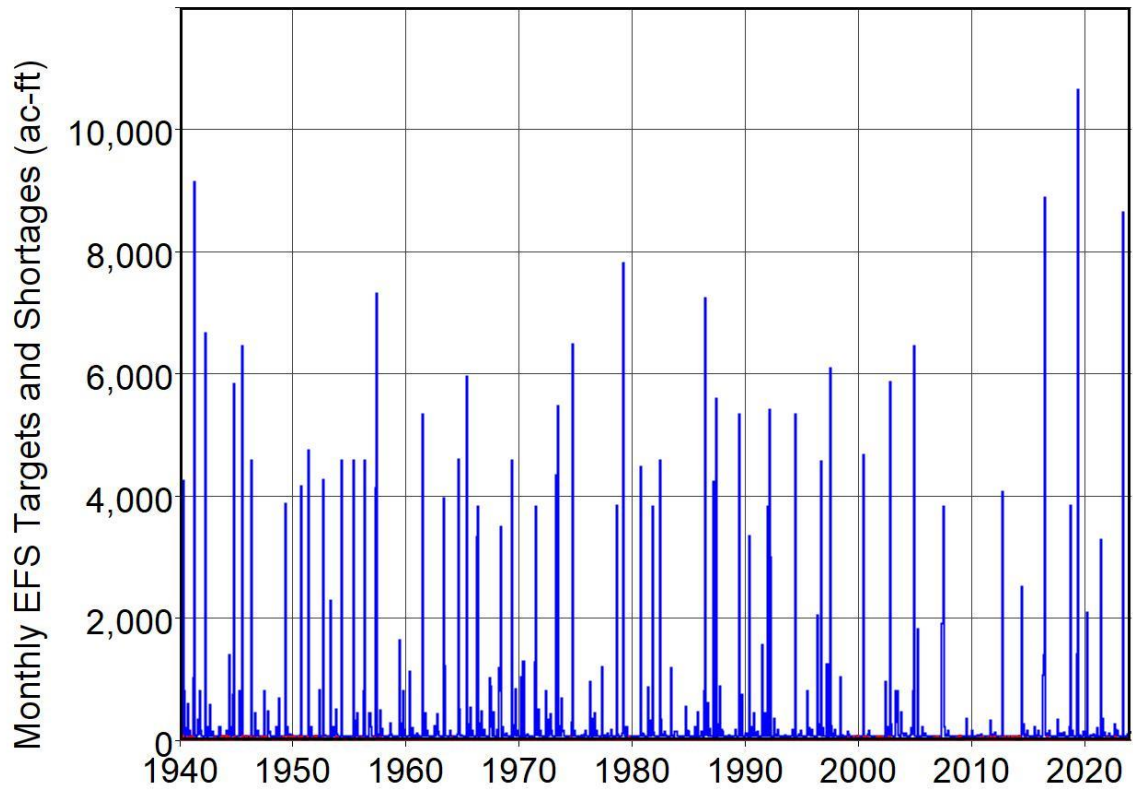


Figure C33 SB3 EFS Targets and Shortages for Elm Creek at Ballinger

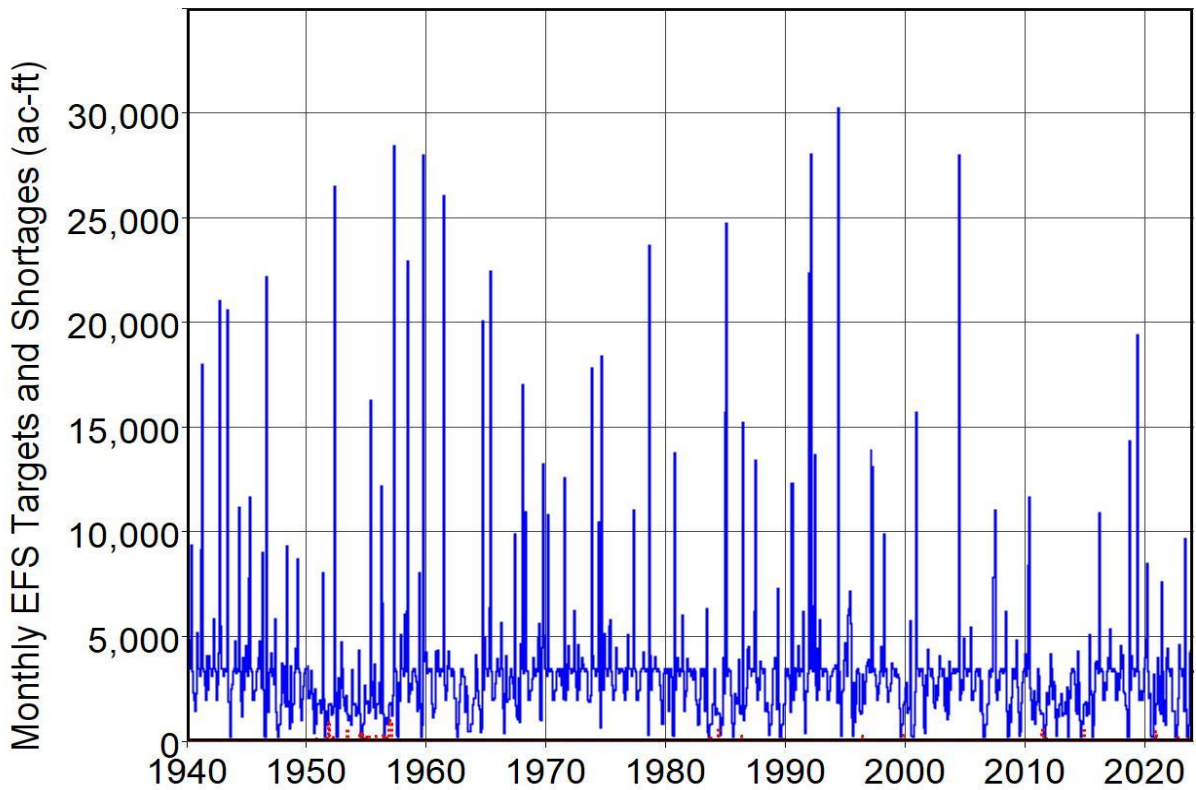


Figure C34 SB3 EFS Targets and Shortages for San Saba River at San Saba

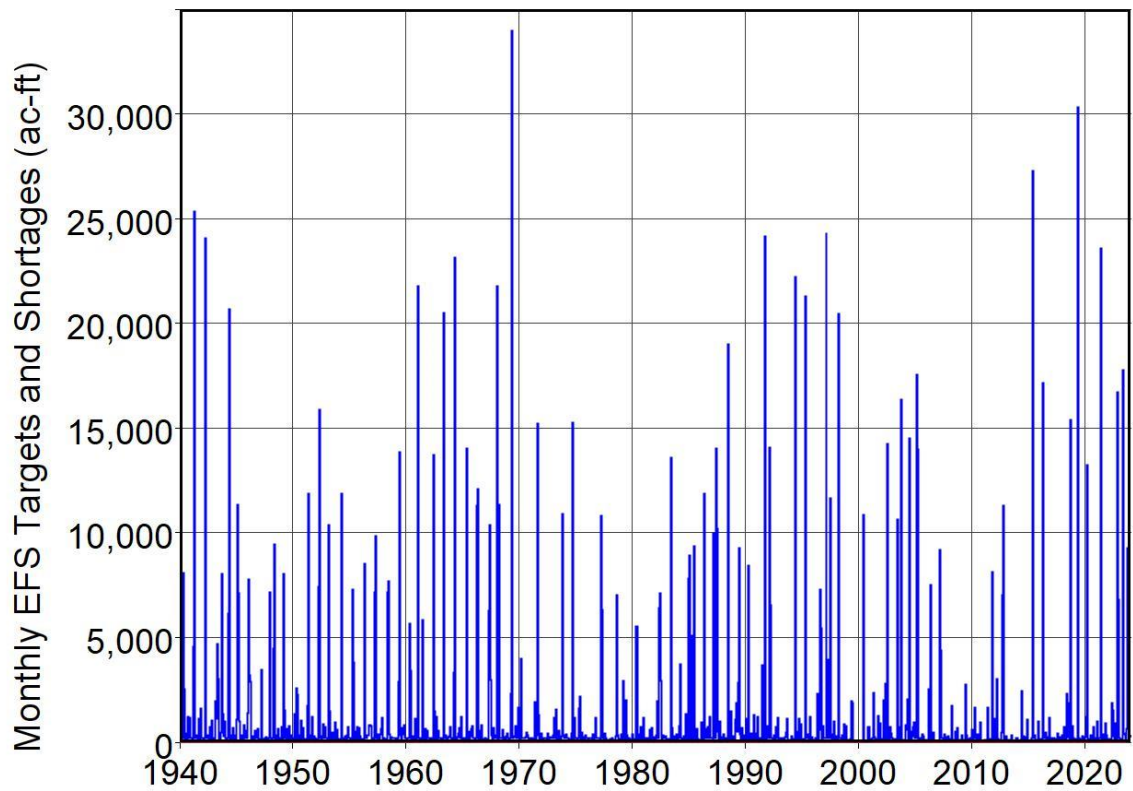


Figure C35 SB3 EFS Targets and Shortages for Pecan Bayou near Mullin

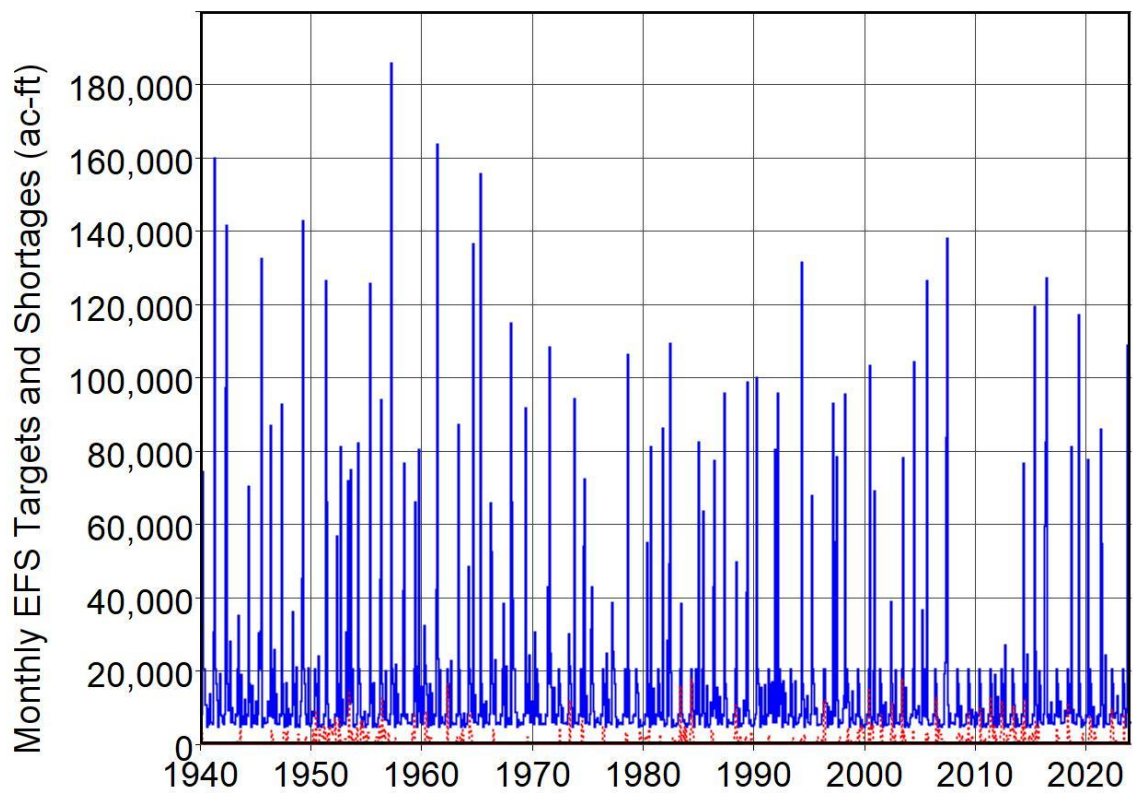


Figure C36 SB3 EFS Targets and Shortages for Colorado River near San Saba

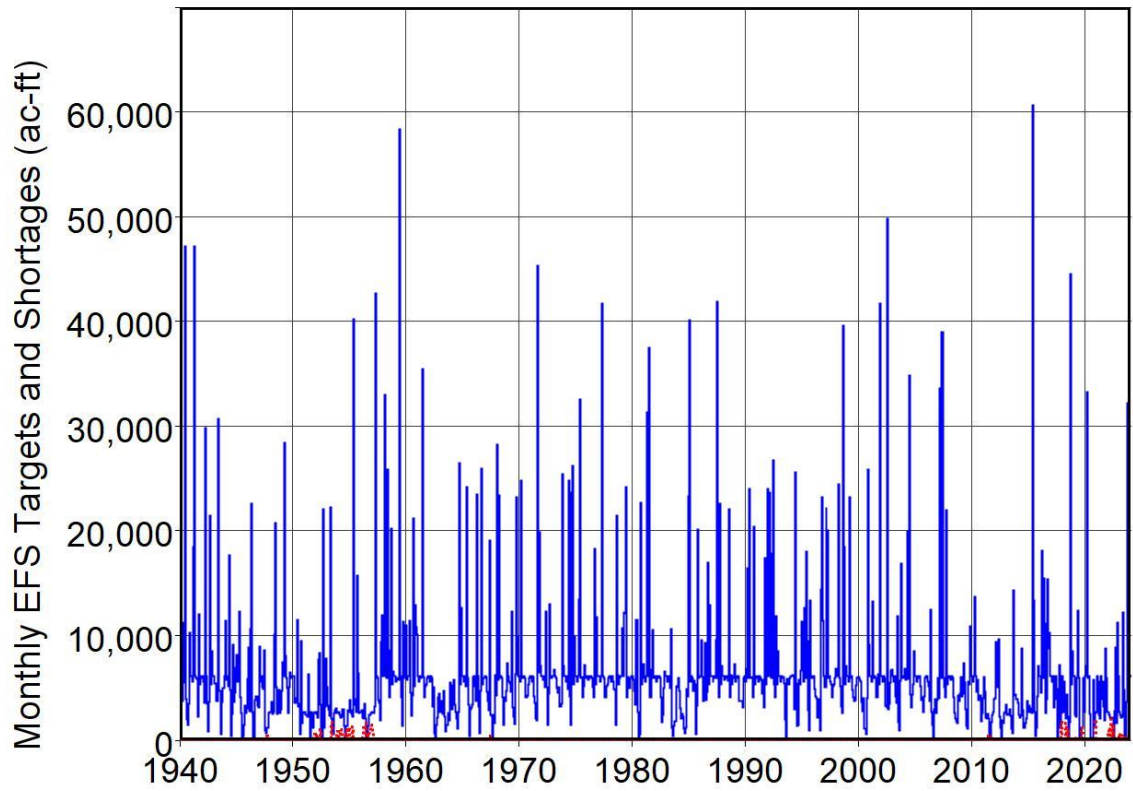


Figure C37 SB3 EFS Targets and Shortages for Llano River at Llano

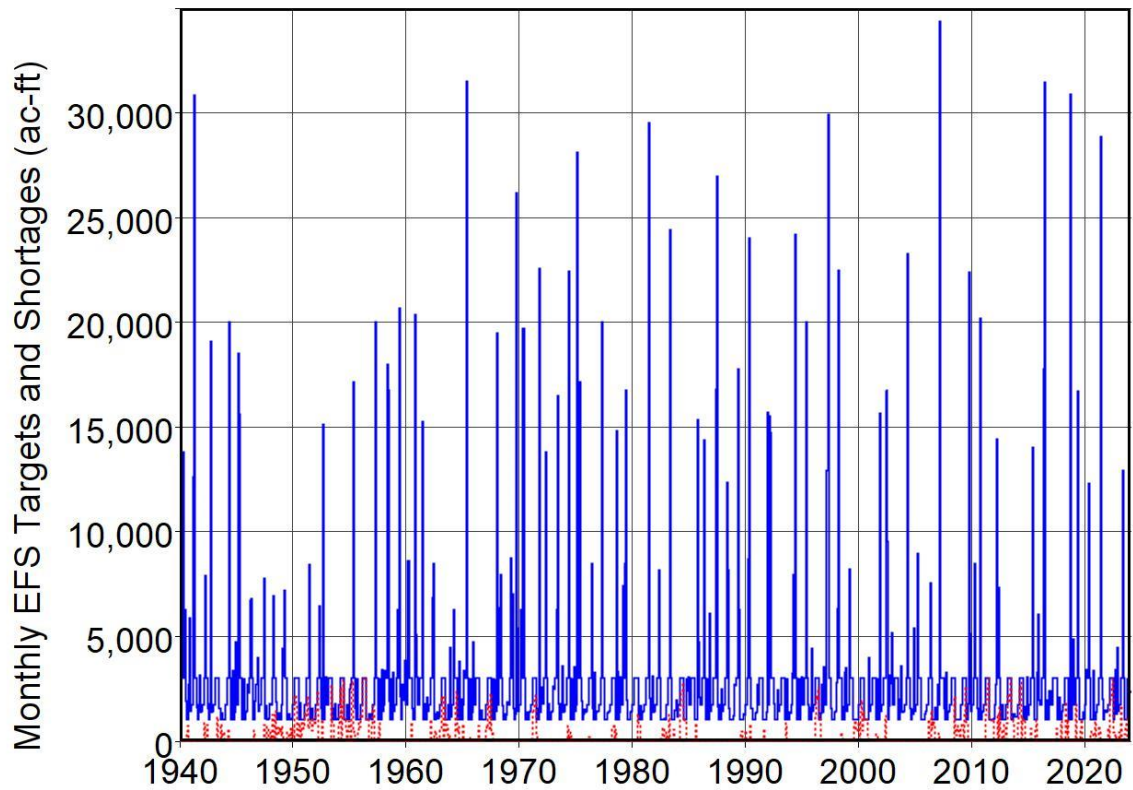


Figure C38 SB3 EFS Targets and Shortages for Pedernales River near Johnson City

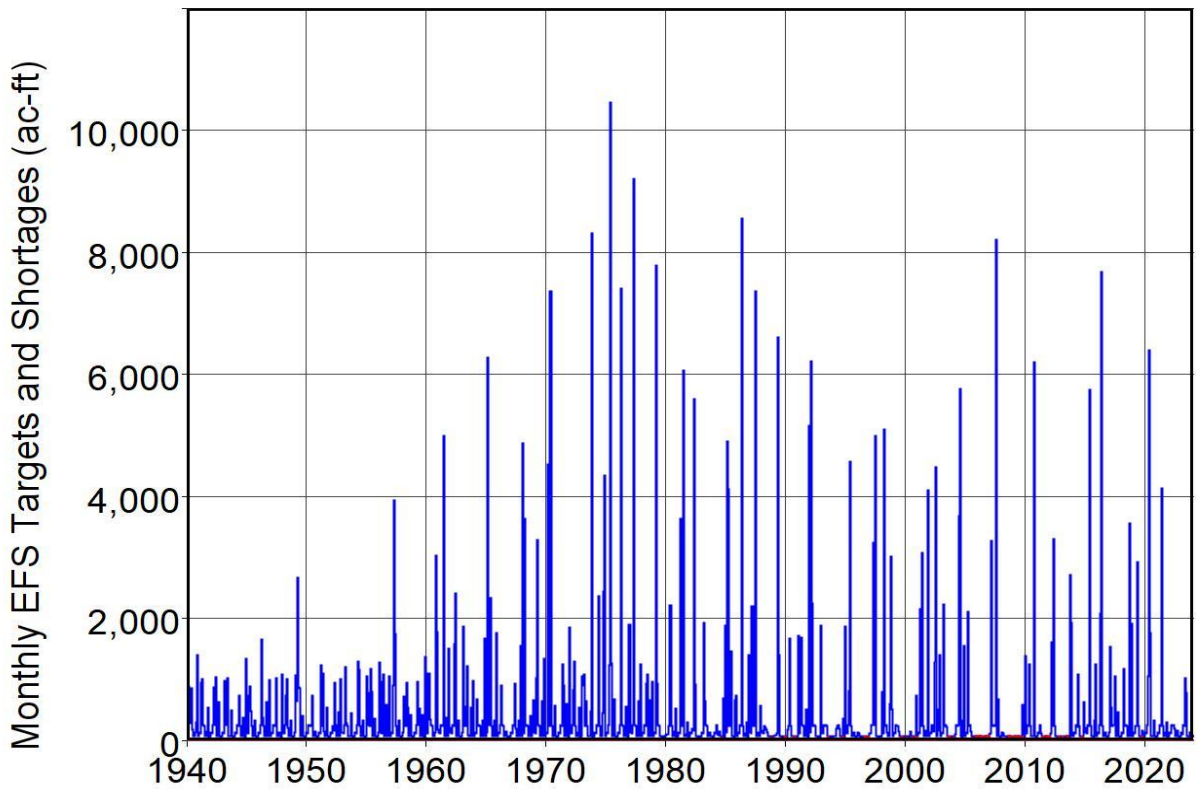


Figure C39 SB3 EFS Targets and Shortages for Onion Creek near Driftwood

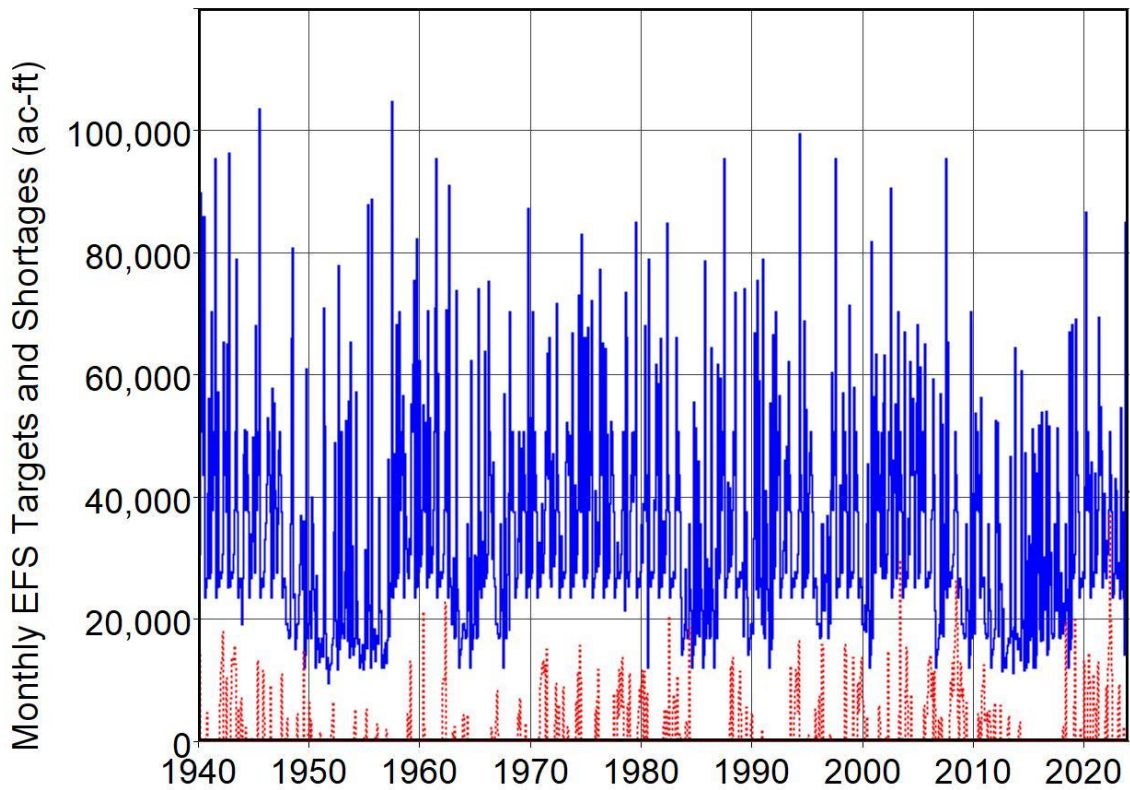


Figure C40 SB3 EFS Targets and Shortages for Colorado River at Bastrop

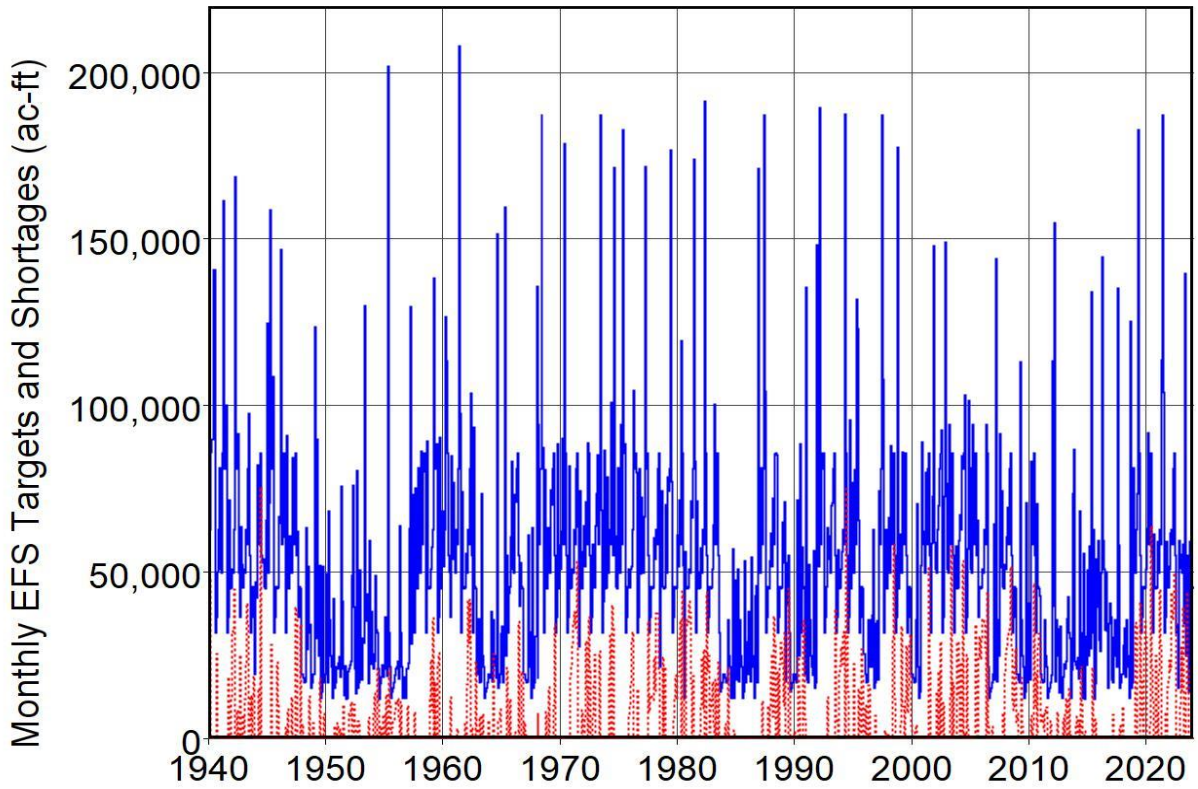


Figure C41 SB3 EFS Targets and Shortages for Colorado River at Columbus

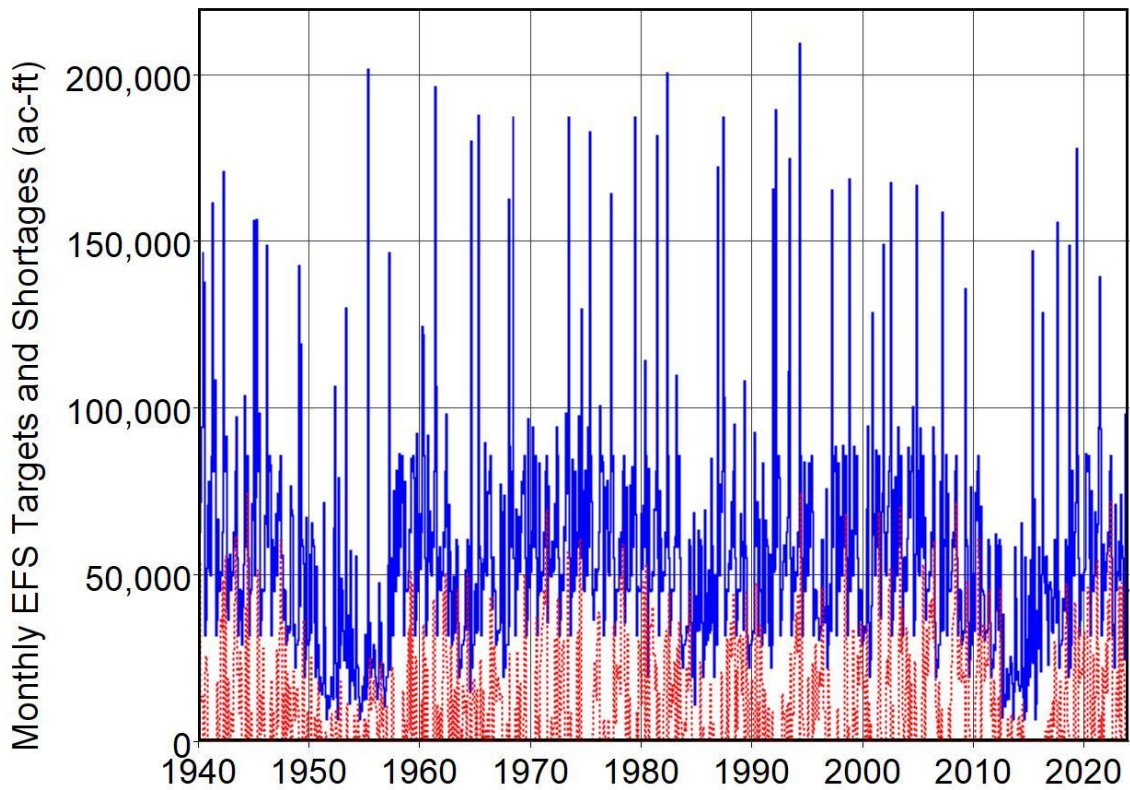


Figure C42 SB3 EFS Targets and Shortages for Colorado River at Wharton

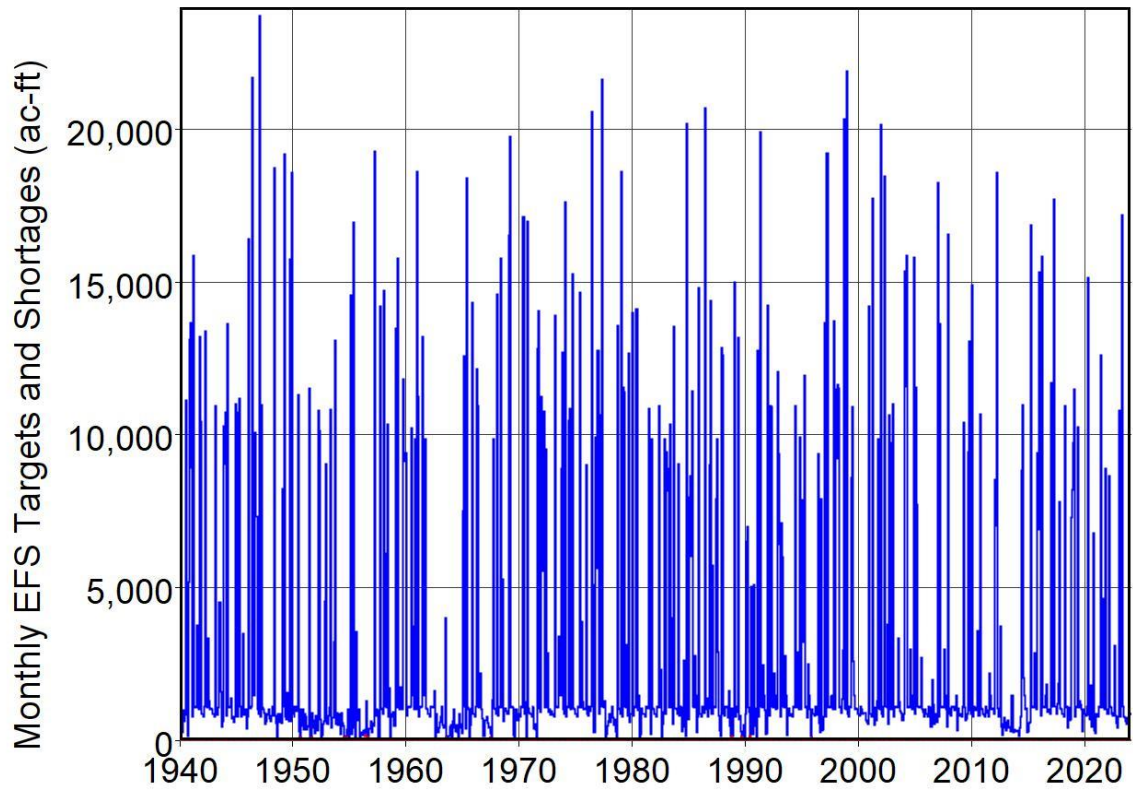


Figure C43 SB3 EFS Targets and Shortages for Lavaca River near Edna

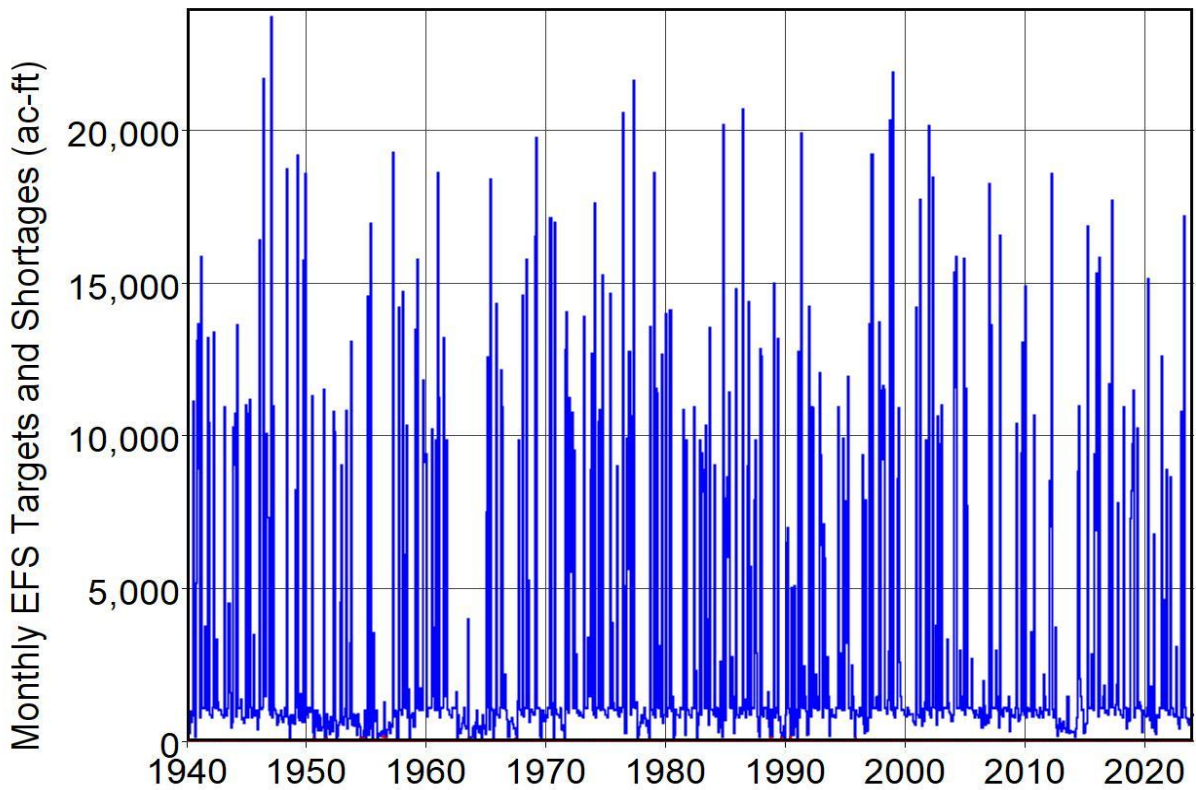


Figure C44 SB3 EFS Targets and Shortages for Navidad River at Strane Park near Edna

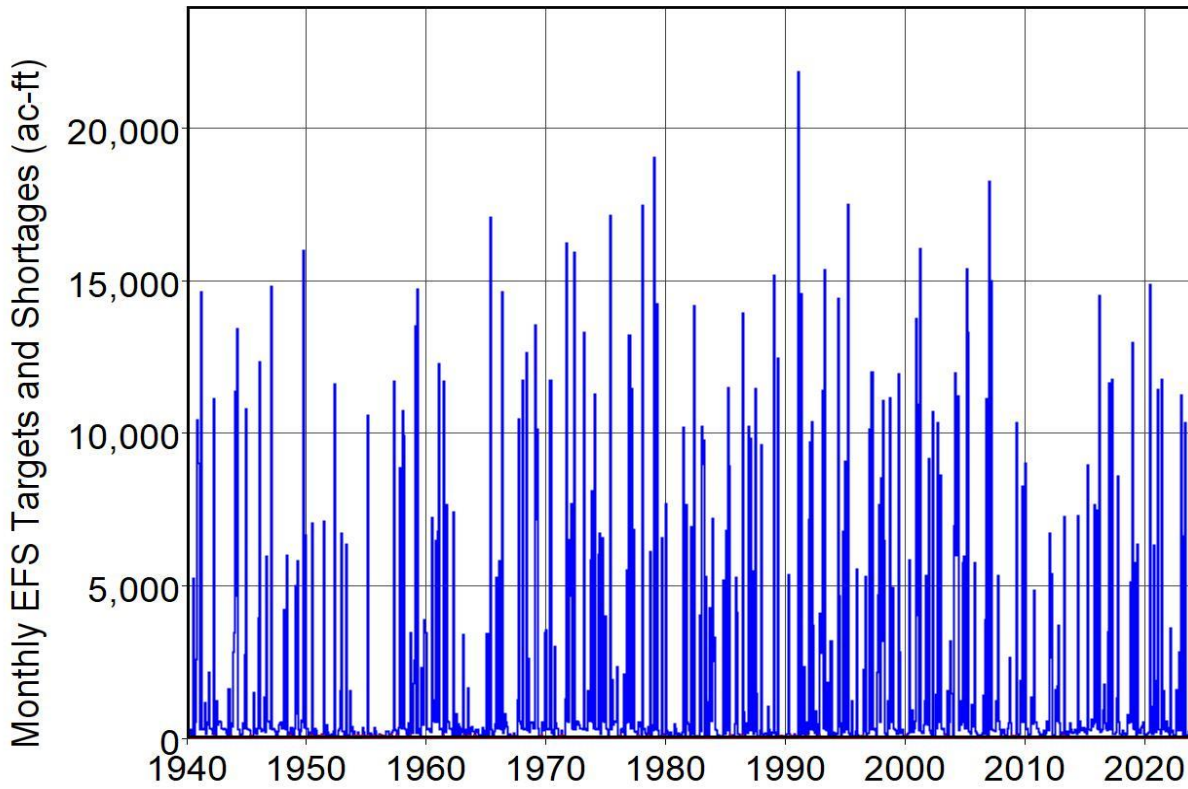


Figure C45 SB3 EFS Targets and Shortages for Sandy Creek near Canada

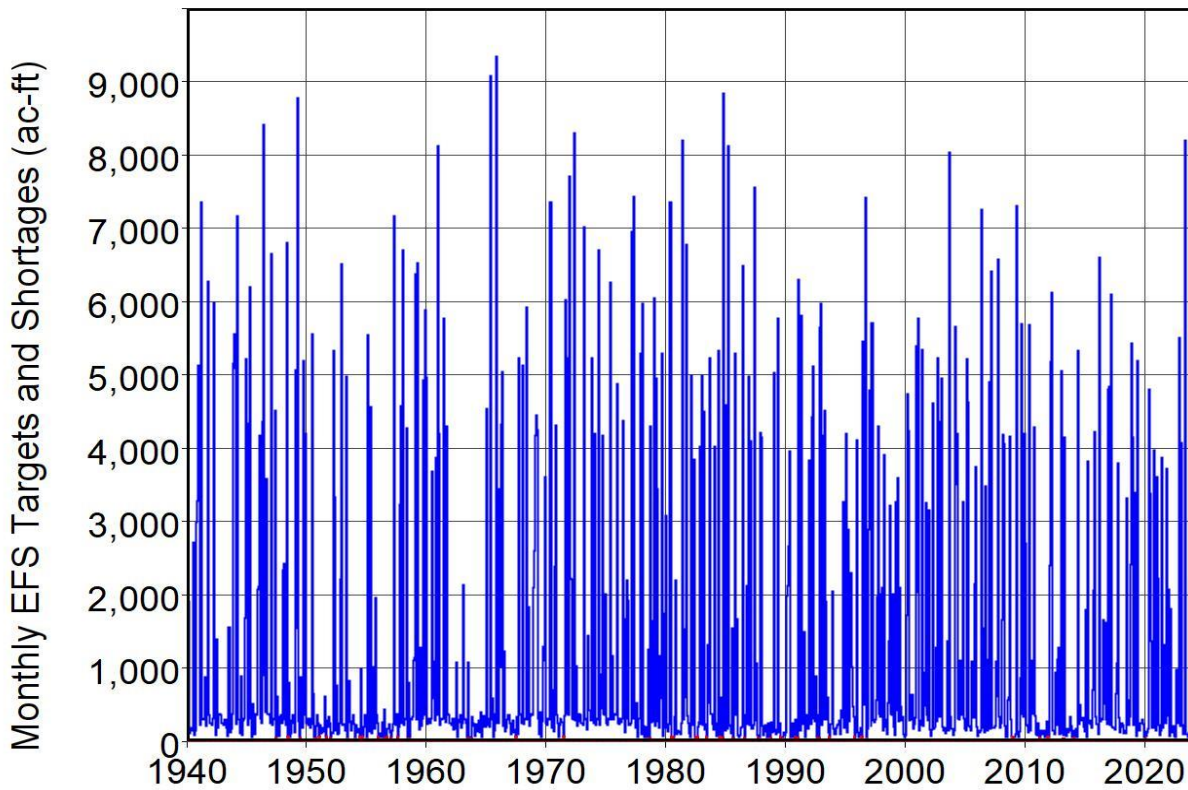


Figure C46 SB3 EFS Targets and Shortages for West Mustang Creek near Canada

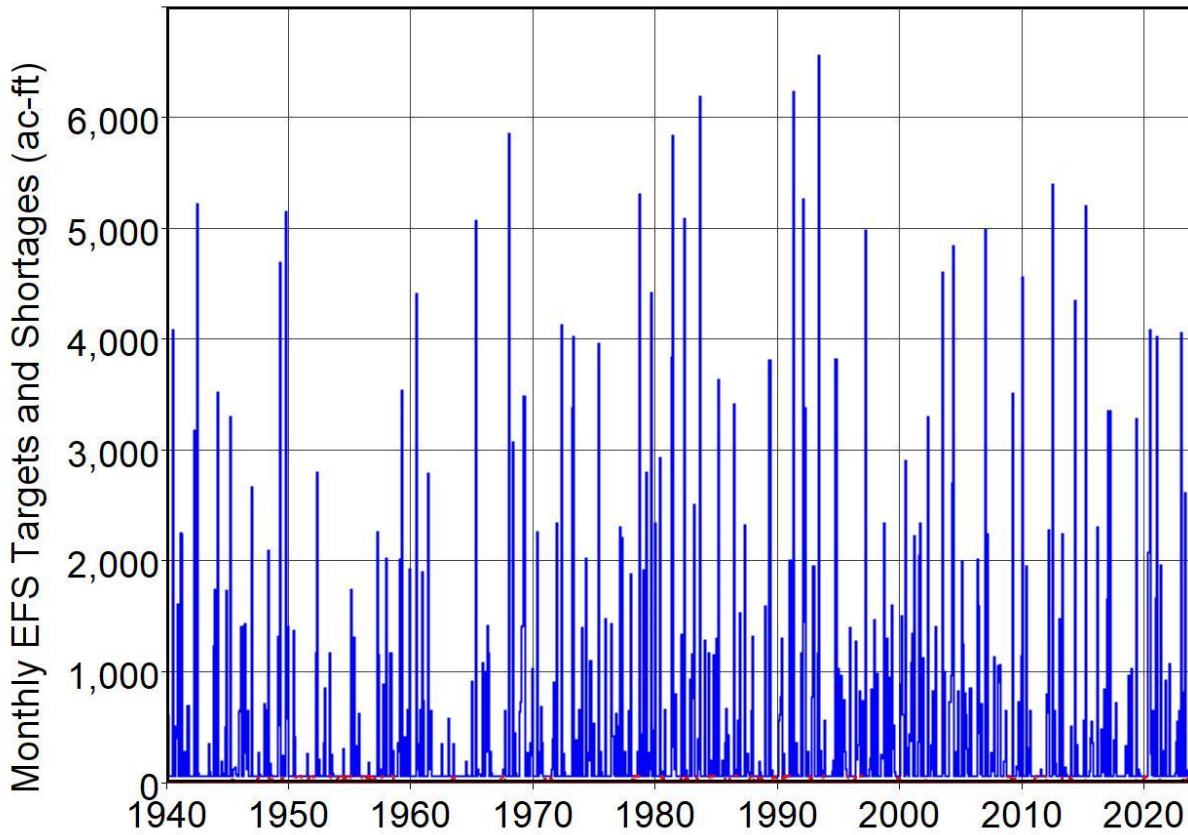


Figure C47 SB3 EFS Targets and Shortages for East Mustang Creek near Louise

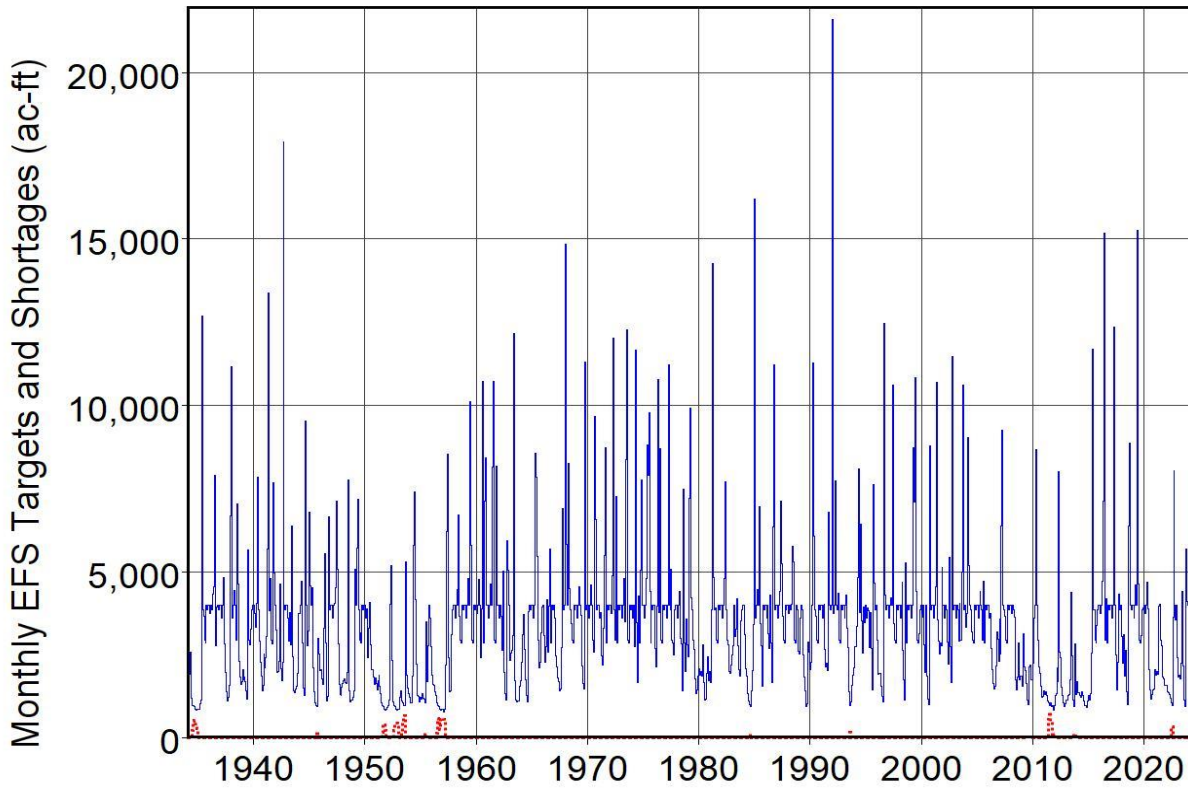


Figure C48 SB3 EFS Targets and Shortages for Nueces River at Laguna

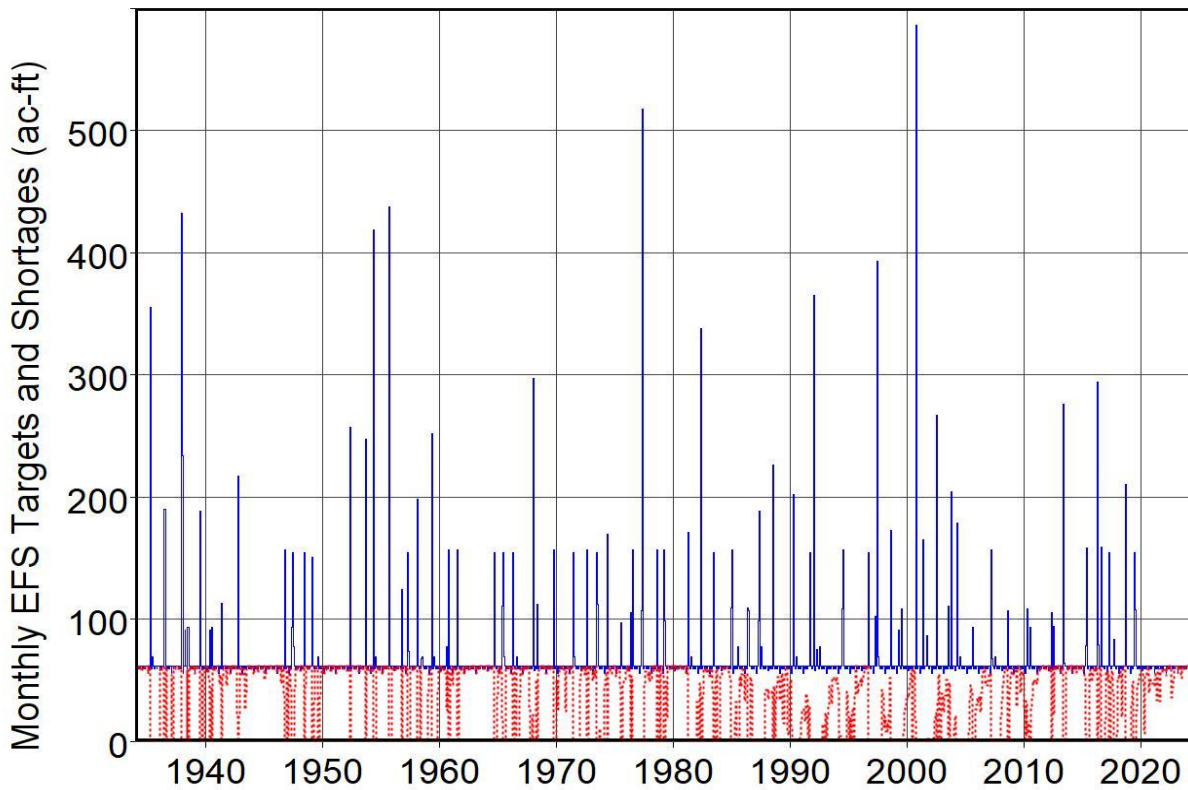


Figure C49 SB3 EFS Targets and Shortages for West Nueces River near Brackettville

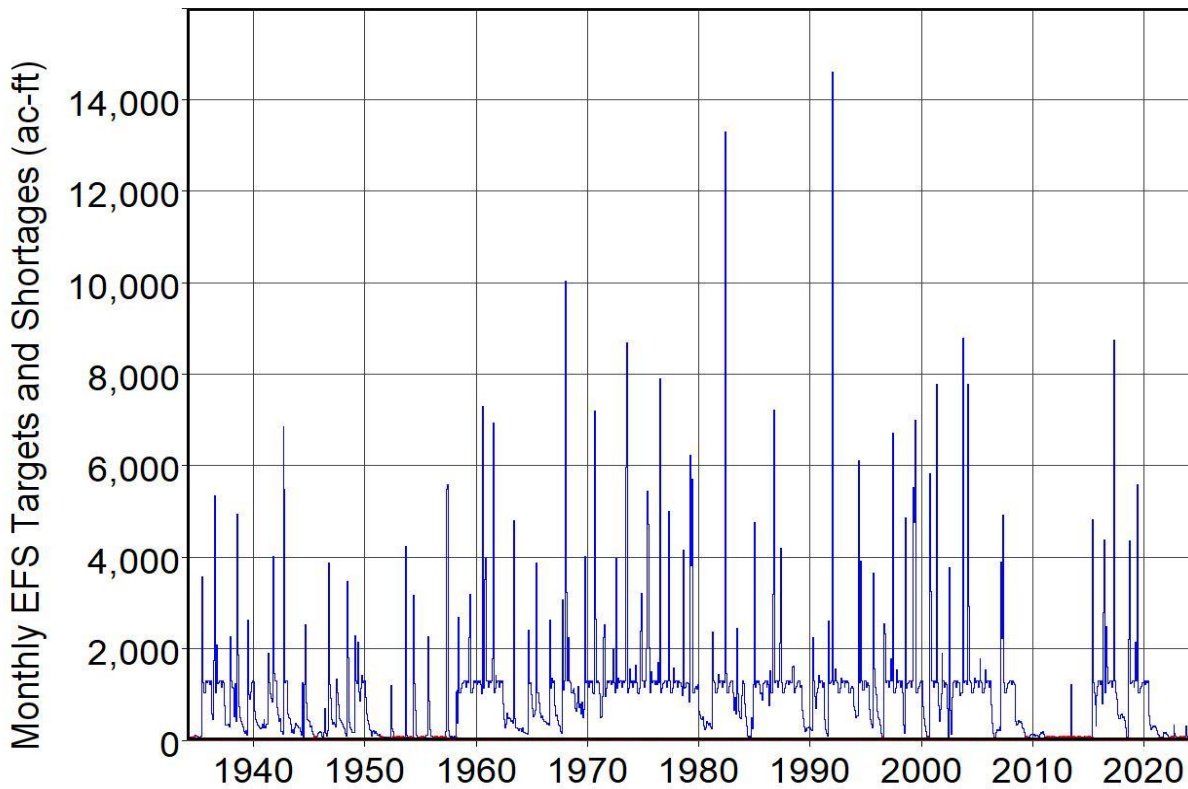


Figure C50 SB3 EFS Targets and Shortages for Nueces River below Uvalde

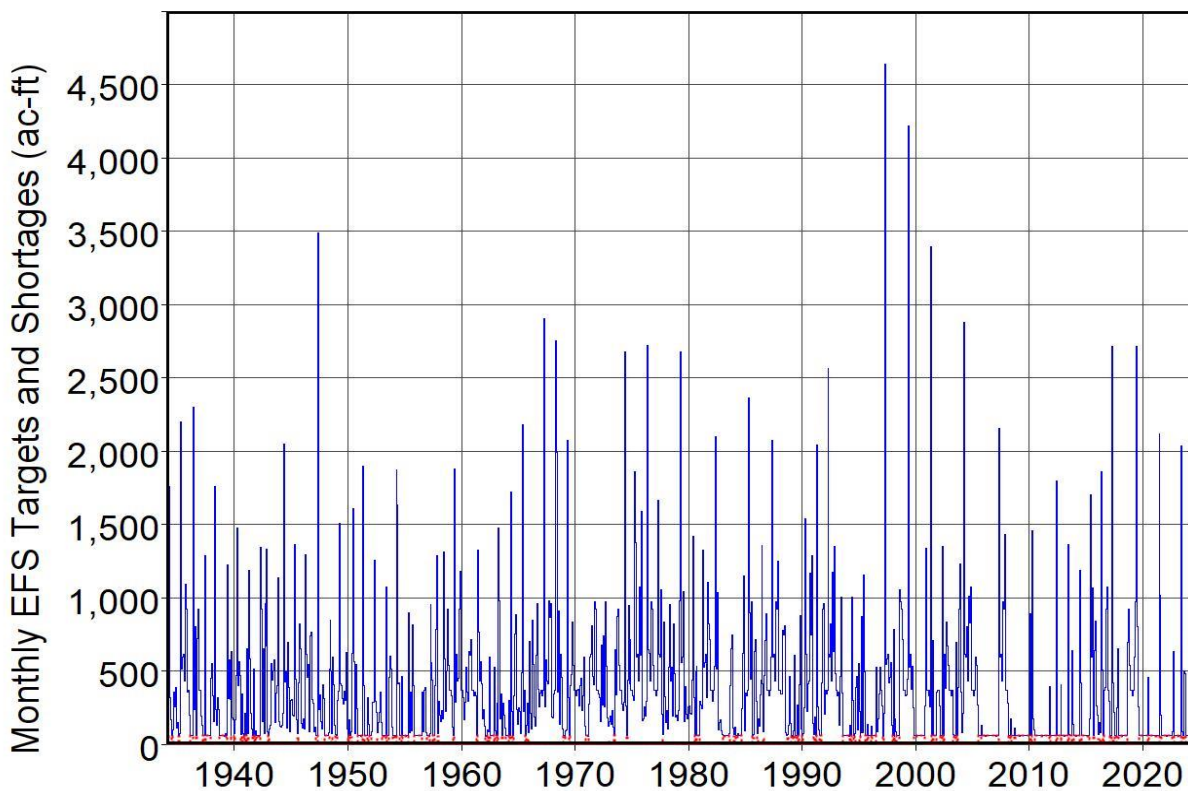


Figure C51 SB3 EFS Targets and Shortages for Nueces River at Cotulla

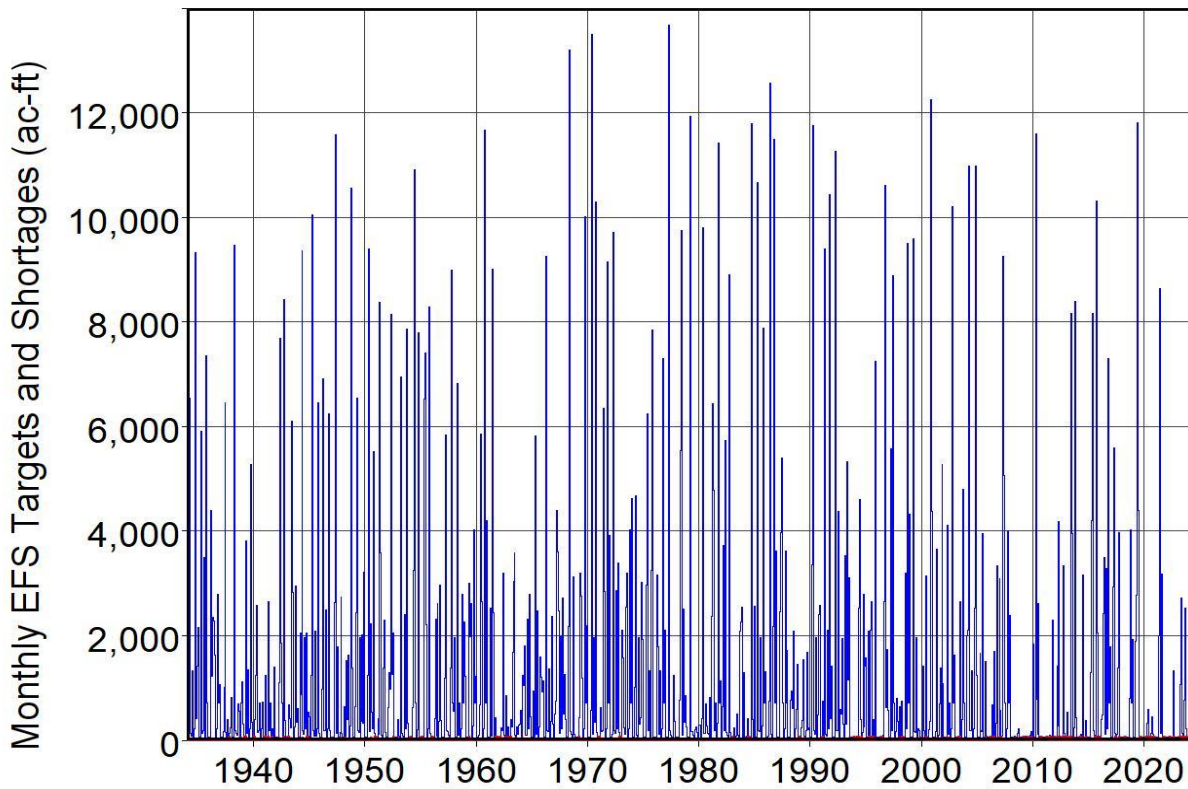


Figure C52 SB3 EFS Targets and Shortages for Nueces River near Tilden

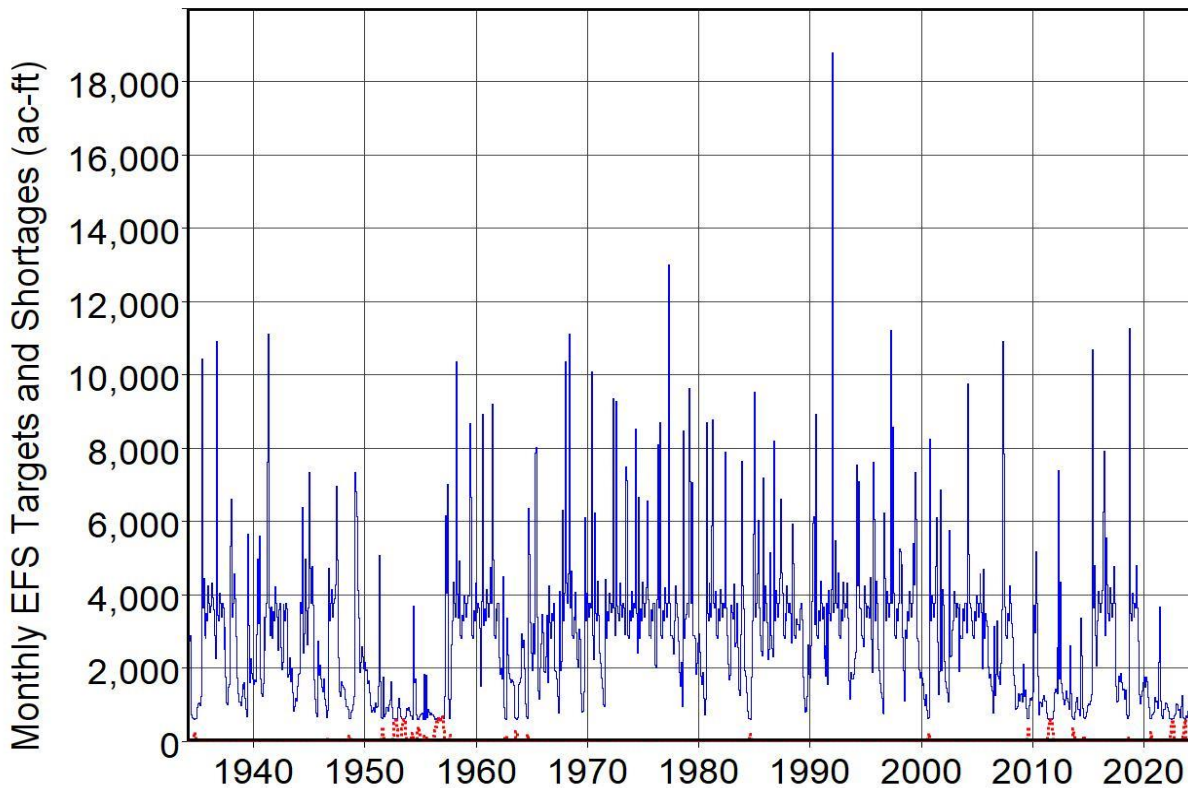


Figure C53 SB3 EFS Targets and Shortages for Frio River at Concan

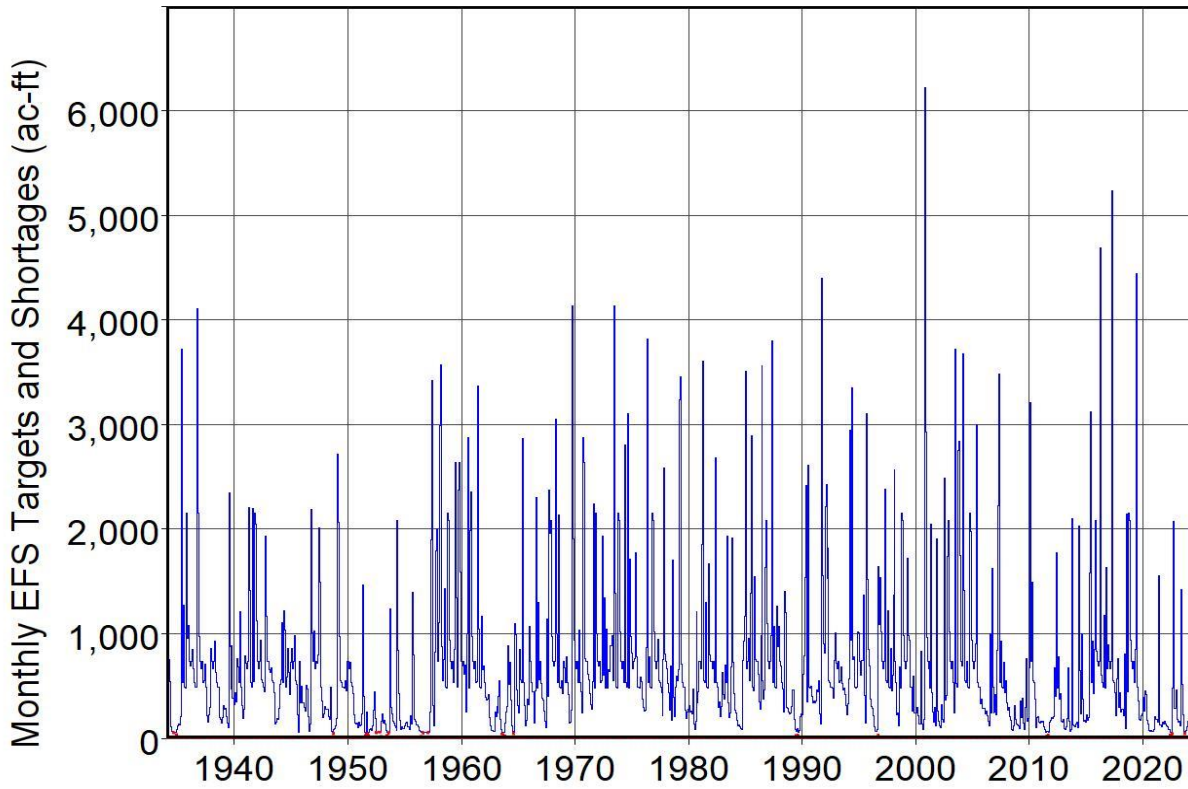


Figure C54 SB3 EFS Targets and Shortages for Dry Frio River near Reagan Wells

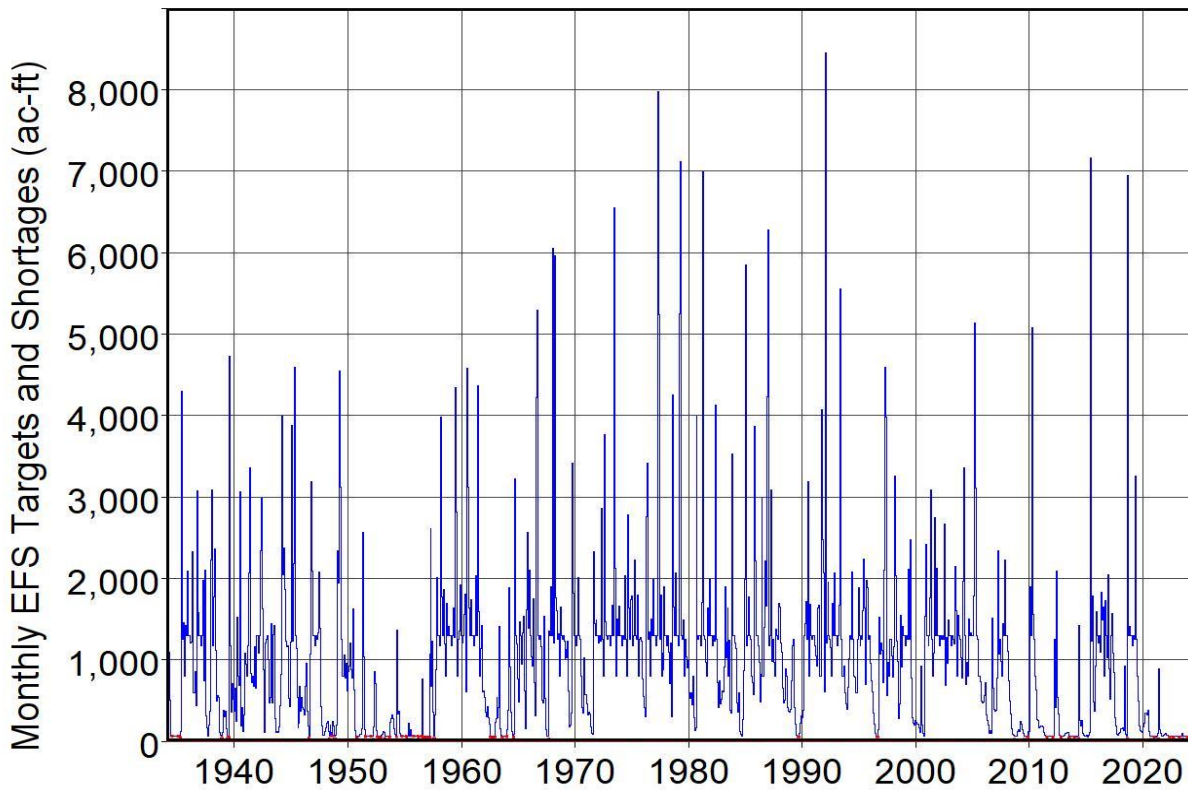


Figure C55 SB3 EFS Targets and Shortages for Sabinal River near Sabinal

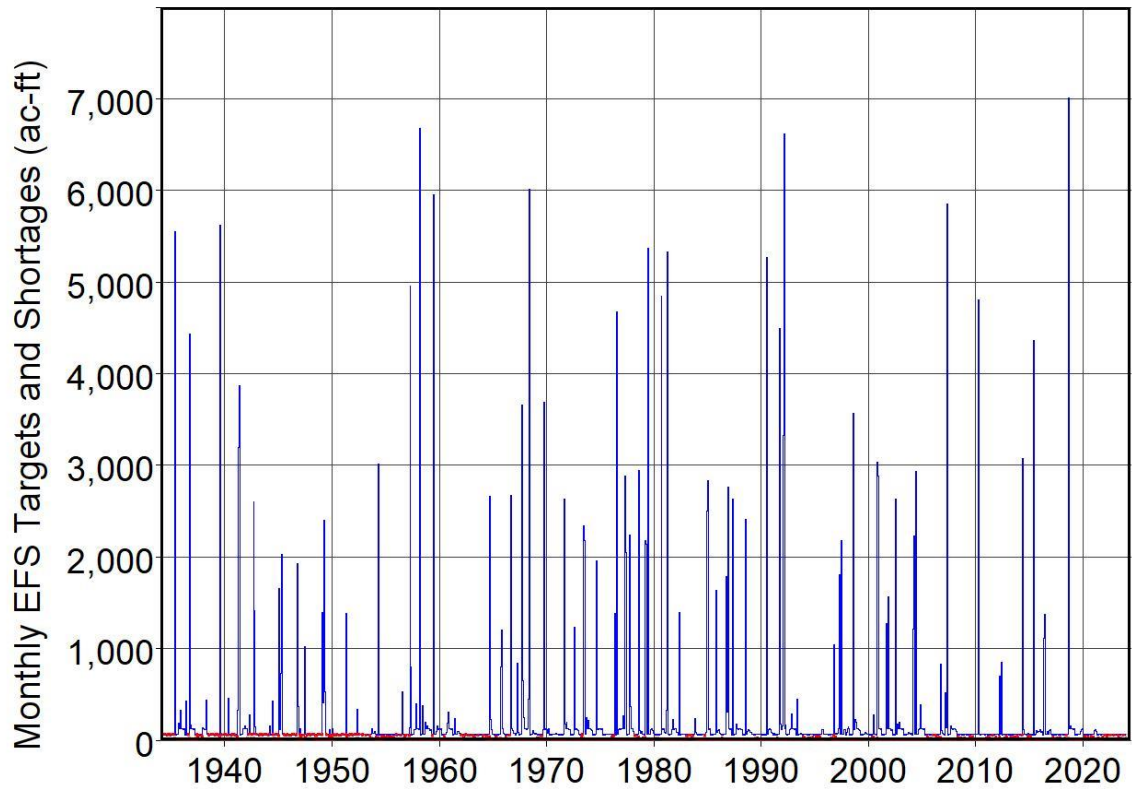


Figure C56 SB3 EFS Targets and Shortages for Sabinal River at Sabinal

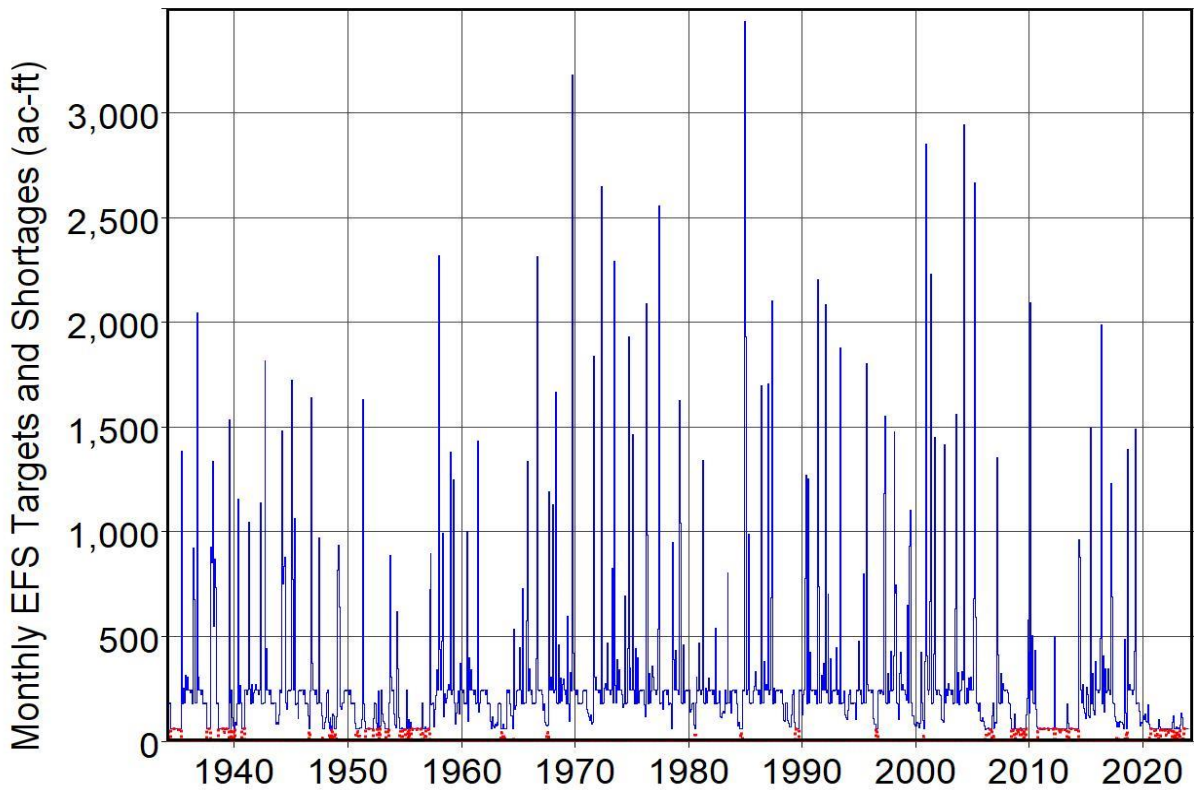


Figure C57 SB3 EFS Targets and Shortages for Seco Creek at Miller Ranch near Utopia

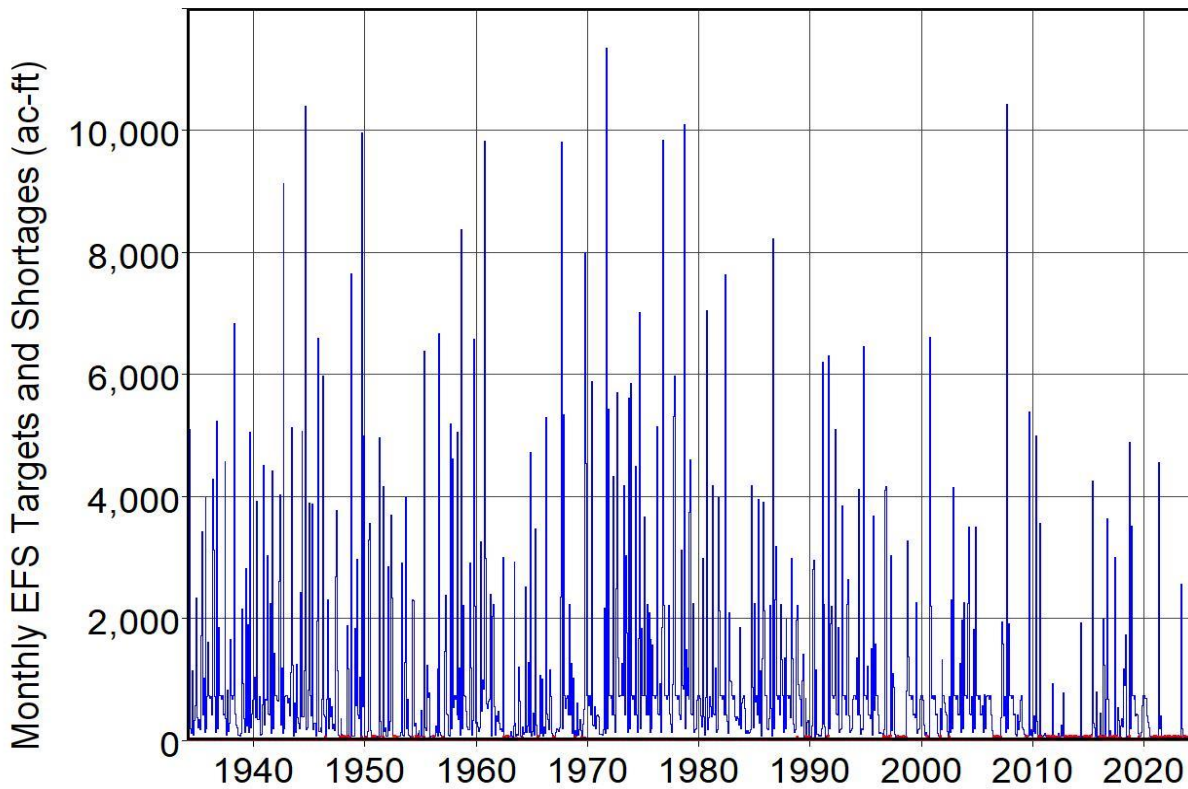


Figure C58 SB3 EFS Targets and Shortages for Hondo Creek near Tarpley

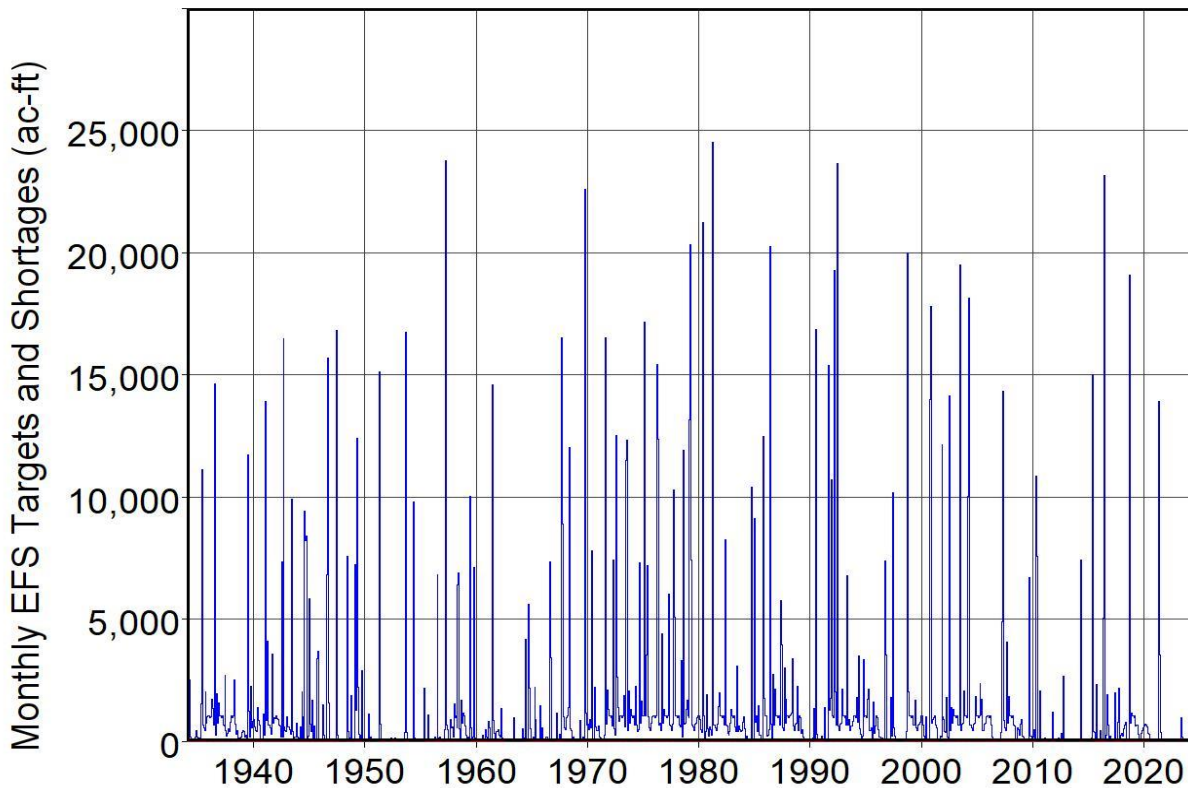


Figure C59 SB3 EFS Targets and Shortages for Frio River near Derby

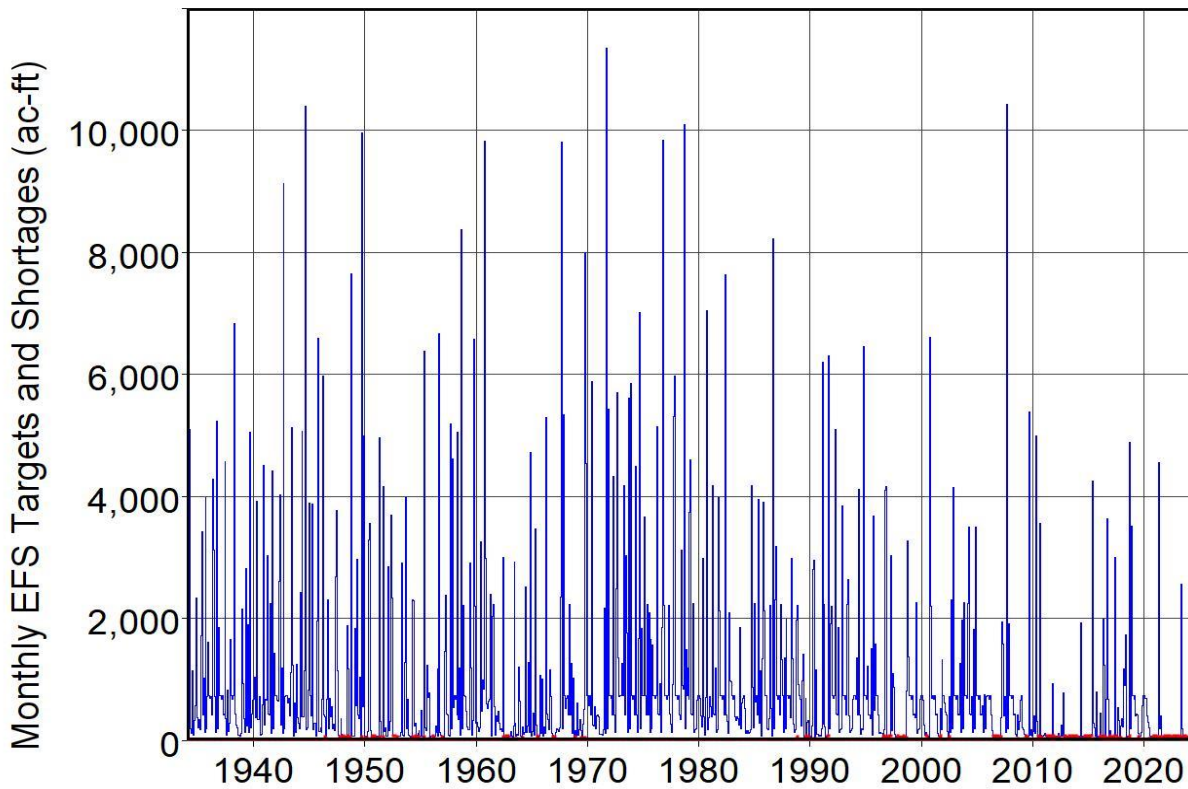


Figure C60 SB3 EFS Targets and Shortages for Frio River at Tilden

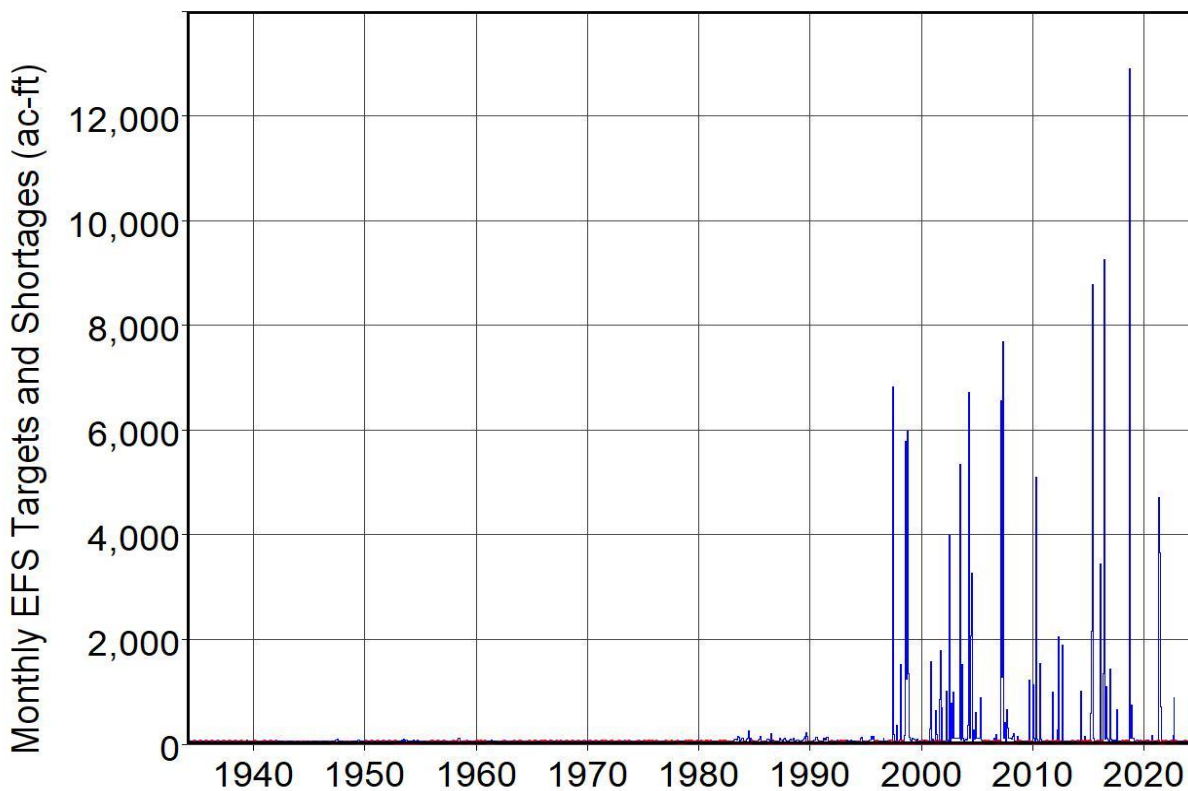


Figure C61 SB3 EFS Targets and Shortages for San Miguel Creek near Tilden

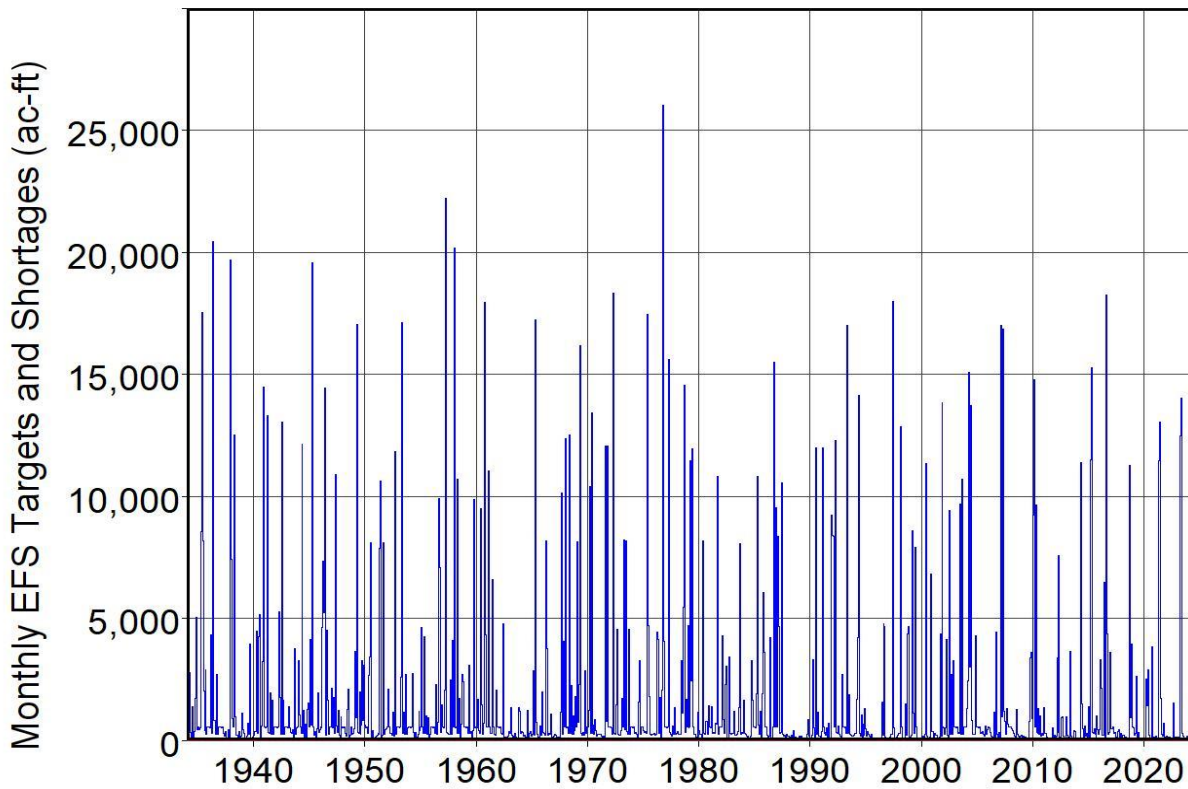


Figure C62 SB3 EFS Targets and Shortages for Atascosa River at Whitsett

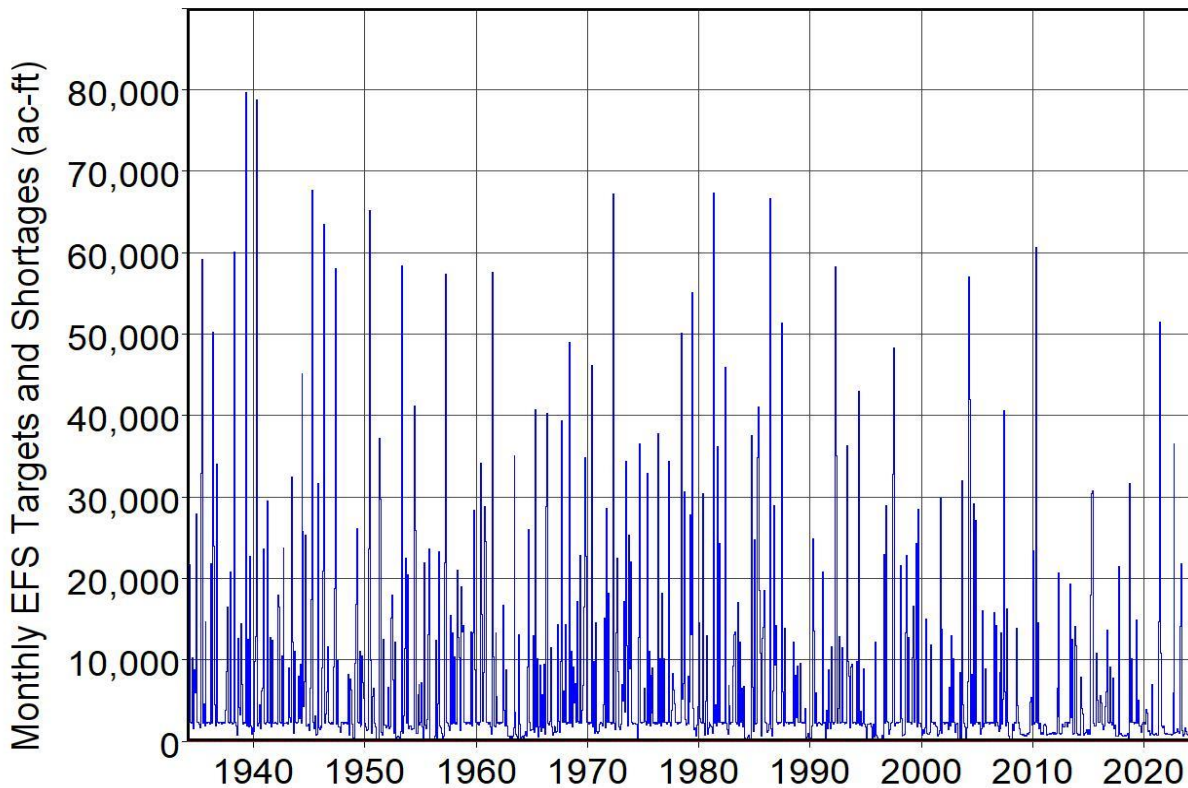


Figure C63 SB3 EFS Targets and Shortages for Nueces River at Three Rivers

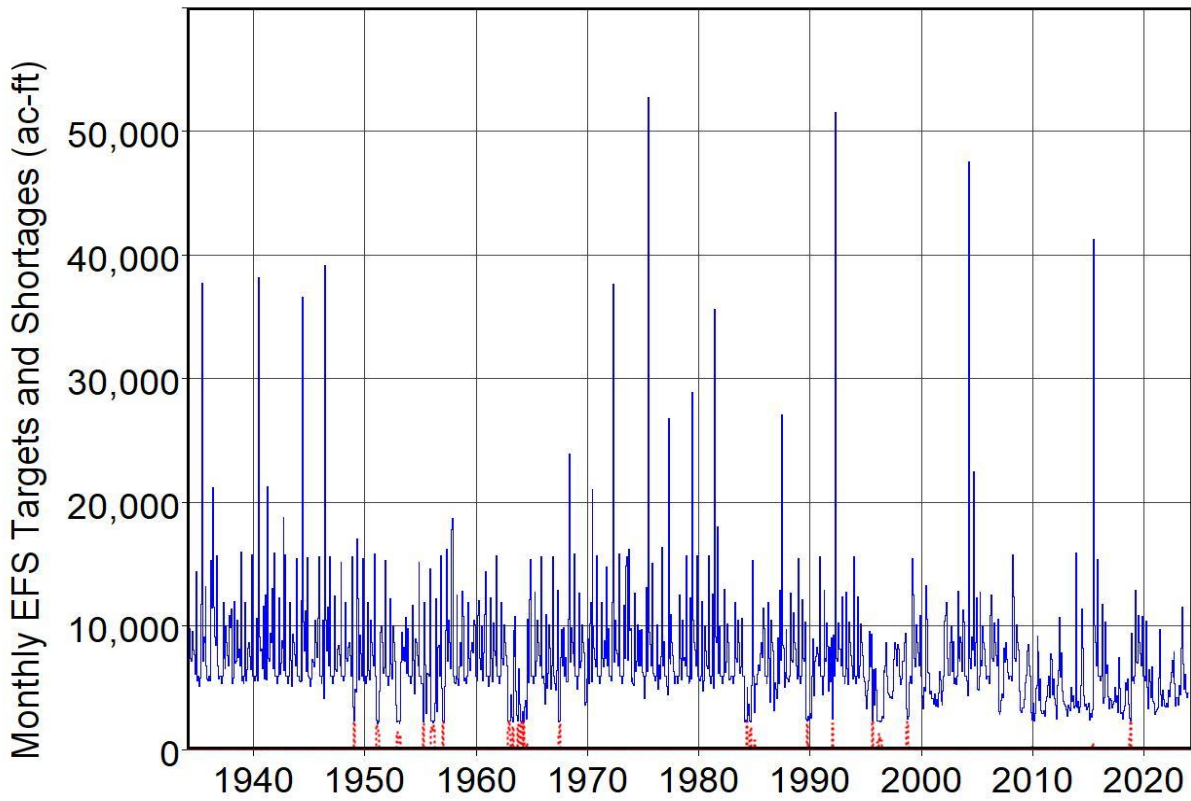


Figure C64 SB3 EFS Targets and Shortages for Nueces River near Mathis